73 AMATEUR RADIO

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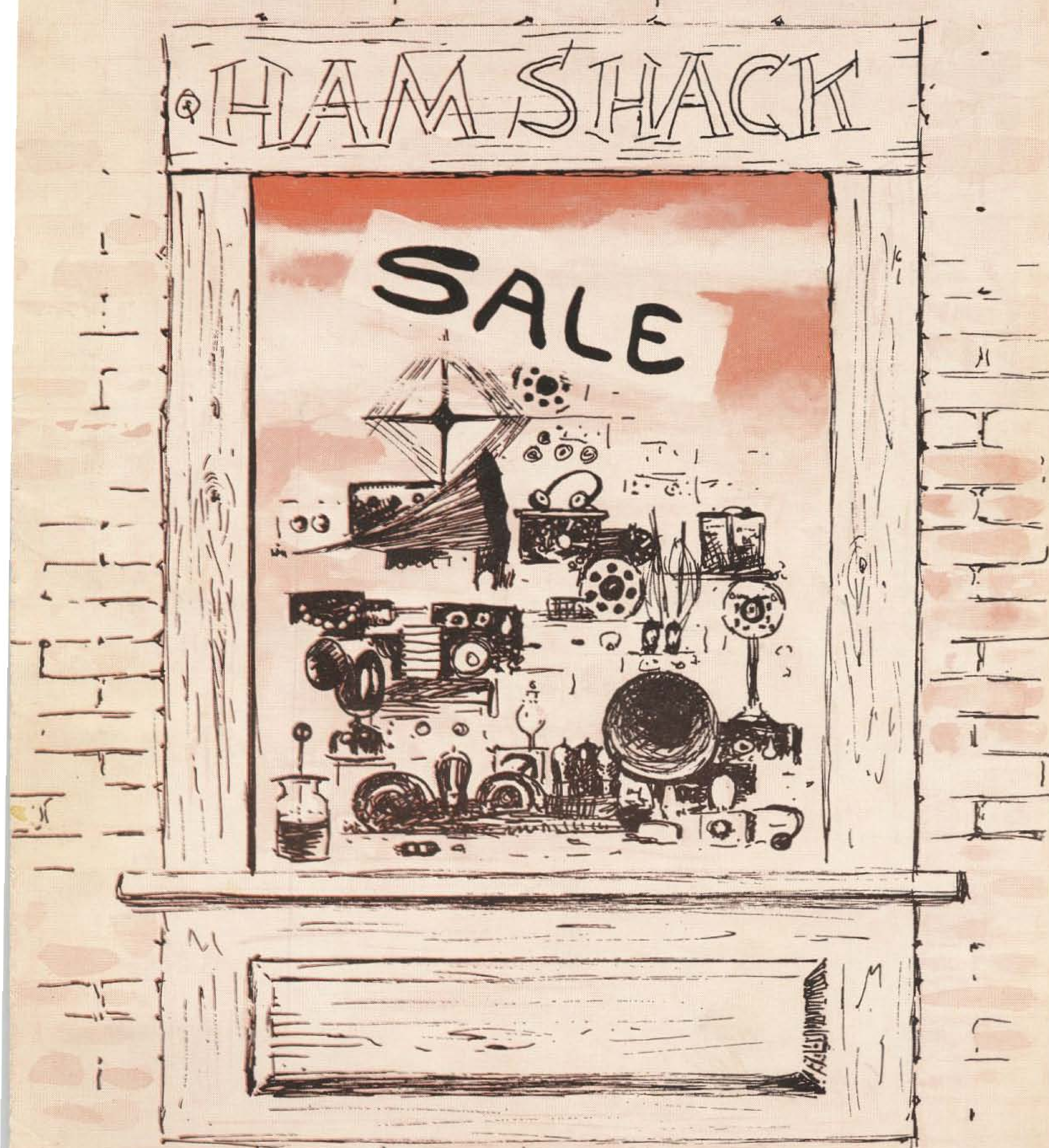

73 Magazine

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never say die

Stanford Report

I tried to get a copy of this from Huntoon, but was refused, arousing my suspicions about it a bit. I still remember that lovely report they bought with your money from a public relations firm a couple years back which showed that QST was the only place to advertise and that virtually no ham had ever heard of 73. Fortunately this was so far out that few people paid it any heed.

Well you've spent $21,000 on another report fellows. The first leak on the report says that they have found that 0.4% of ham operations are on TV and 3% on RTTY. Now you know that I am gung ho on these two modes, but I would never try to fool even the most gullible that there are 400 ham TV stations going or 3000 RTTYers batting it out at any time. Their 36% AM vs 19% SSB will take a lot of explaining to anyone who has operated on the ham bands within the last five years . . . make that ten.

The DXers Magazine

Gus, despite all warnings from friends, has decided to put out a DX magazine. The first issue came out back in September and the magazine has now settled down to an interesting, usually weekly, publication, running about 20 pages. I would say this, if you like to work DX now and then you are missing a lot of the fun if you don't have this little magazine coming in. It costs only $8.50 a year by first class mail to US, Canada and Mexico. You'll know just what is going on all the time and all the latest scuttle.

Note for authors

Reputable magazines, almost without exception, pay for articles when they accept them for publication. I've been getting more and more complaints from ham authors about not getting payment for articles published in other ham magazines. What can we do, they ask. Well, first of all, if I may be sarcastic, be a little more careful where you send your articles in the first place. If, however. you have submitted your article to us and we have, through sheer stupidity, rejected you, then, to get even with us for our denseness, you have forwarded your gem to another magazine and these clouts, after holding it for a year and a half, which, whether you like it or not, is par for the course, you find that you still have not been "paid on publication" and you don't seem to get answers to your letters asking what is and where is my money then, I suggest, you write an explanatory letter to the post office department of mail fraud explaining the details of this attempt to mulct you through the U. S. mails.

Magazines exist only because they have second class mailing privileges and the appearance of a postal inspector in the publication office is reason enough for several cases of diarrhea, ague, ulcer, and housemaid's knee. I think you'll get the dough pronto. You get it two years or so earlier if you deal with 73 . . . unless we reject you.

Around the world with Wayne

Having worked Rasheed, YK1AA, a couple of times on twenty I was particularly anxious to visit Damascus and say hello to him. Jim (W5PYI) and I drove from Beirut to Damascus in a rented car, detouring for a few hours on the way to see the most remarkable ancient ruins at Baalbek, way out in the hinterlands of Lebanon.

Border crossings in the near east are an adventure. Jim worked the car patiently through the jam of cars while I used every New York subway trick I knew to work my way through the mob of people waving passports, exit forms, entry forms, automobile forms, and money at the nonchalant

(*Continued on page* 118)

Editor's Ramblings

Paul Franson WAICCH

You probably noticed a few changes when you received this issue of 73. In the first place, we've addressed the magazine on our new IBM data processing system rather than the mimeograph-type stencils we have been using. The IBM system is faster and more legible, and reduces the amount of manual labor involved in processing subscriptions and renewals considerably. We've been growing at an average rate of about 1000 per month for the past year and some, and we were outgrowing the old system. After all the bugs are straightened out, we expect a worthwhile improvement in the speed and ease with which we handle your correspondance.

However, in a change such as this one involving about 50,000 individual addresses, some mistakes are bound to occur. We regret these mistakes and want to get them straightened out quickly. You can help us in this. Please check the address label on your wrapper very carefully. If it contains any errors that might affect your receiving your monthly 73, please send us both the improper label and the correction. It is particularly important that your zip code be correct. If it isn't the Post Office may not deliver your magazines.

If your address label contains a minor mistake such as a mispelled name or wrong call, we'd appreciate your not asking us to correct it now. The next time you renew or change your address it will be easy to correct, but we'd rather not have to correct these minor things until we've had a chance to cure the more important mistakes.

Another change is that we've switched to a perfect binding. In my editorial in the November 73, I discussed the types of bindings for magazines and their advantages and disadvantages. I made a mistake in one term I used. CQ and QST are side stitched rather than perfect bound. Perfect binding doesn't use staples, so a perfect-bound magazine can be opened fully and it will stay that way. We feel that this binding overcomes the major disadvantages of both side stitching and saddle stitching, and hope you like it.

The third change this month is that we've switched printers. Since the September 1965

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Here's a typical address label. The name comes first. It includes one or two initials, and a last name of up to thirteen letters. Those of you with longer last names are perfectly justified in complaining about machines that don't have human feelings and so forth, but I'm afraid that we won't be able to use your full name. It won't affect delivery anyway. Next is the call. You'll notice that there's something suspicious about this particular one. It's irritating to have your call wrong, but we'd appreciate it if you would wait until you renew to ask us to correct it. It's also won't affect delivery of your magazines. The next line contains the street or box address and the expiration date. The first number indicates the month your subscription expires: 1 is January, 2 February and so forth up to 9, which is September. O is October, N is November and D is December. The second number gives the year your subscription expires: 7 is 1967, 8 is 1968, 9 is 1969 and so forth. If this space is blank, you have a life or advertiser's subscription, or something else special. The last line of the label gives the town, state and zip code. The zip is very important and must be right. If it's not, please send us both the incorrect label and the correct zip code. Incidentally, if you have an address that requires more than three lines, we can use it but it's not as convenient as the regular three-line address.

(*Continued on page* 120)

Getting Acquainted with Integrated Circuits

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Scottsdale, Arizona

Been looking for some practical general data on using integrated circuits? Here's a short introduction complete with circuits for inexpensive IC's.

If you are going to keep abreast of the most modern solid state circuitry, it's time to start thinking about using linear integrated circuits. Motorola and RCA have recently made available, off distributor shelves, monolithic integrated circuits suitable for operation up to about 100 MHz. And, the best news is that these latest solid state innovations are well within the pocketbook of the average ham. The introductory single piece price of these high frequency devices is in the $4-5 dollar range. (RCA has just announced a 40% price reduction so the price will be less than listed in the catalog.) RCA is also offering an FM *if* amplifier limiter integrated circuit containing ten transistors and a voltage regulator for only $2.00 and an integrated circuit amplifier-discriminator with twelve transistors and regulator for $2.65.

However, the two circuits that look the most promising for ham use from the price and versatility viewpoint, are the Motorola MC 1550 and the RCA CA 3005. Both of these devices are broadly classified as rf-*if* amplifiers, and either one is useful at frequencies from dc to beyond 100 MHz. They can be used with an external tuned circuit, transformer, or resistive load in applications such as:

A—Mixers
B—Wide and narrow band amplifiers (r-f, i-f and video)
C—Oscillators
D—product detectors
E—low-power modulators,

and probably many more with the application of a little ham ingenuity.

I don't wish to leave the impression that the devices mentioned are the only ones available. Similar devices are made by other manufacturers, for example, Westinghouse and Philco, to mention a couple, and also there are a host of other linear integrated circuits broadly classified as dc amplifiers, audio amplifiers and video amplifiers. Fairchild has just announced the availability of the μA 703 rf amplifier with specification and price in the same range with the Motorola and RCA devices discussed in this article. Moreover, as I will get around to later, some of the low-cost digital integrated circuits can be extremely useful for rf purposes.

Circuit Operation

Now, let's get down to details, first as to what is inside these integrated circuits, how they function, and then, some typical hook-ups.

The MC 1550 and the CA 3005 are quite similar in construction and operation, in that both use a balanced differential amplifier. A simplified schematic that can be used to get familiar with the operation of both integrated circuits are comprised of three devices is shown in **Fig. 1.** Essentially, these integrated circuits are comprised of three transistors. The current to the emitter-coupled differential transistor pair is supplied from a constant current sink transistor.

The voltage V_2 and resistor R_5 establish

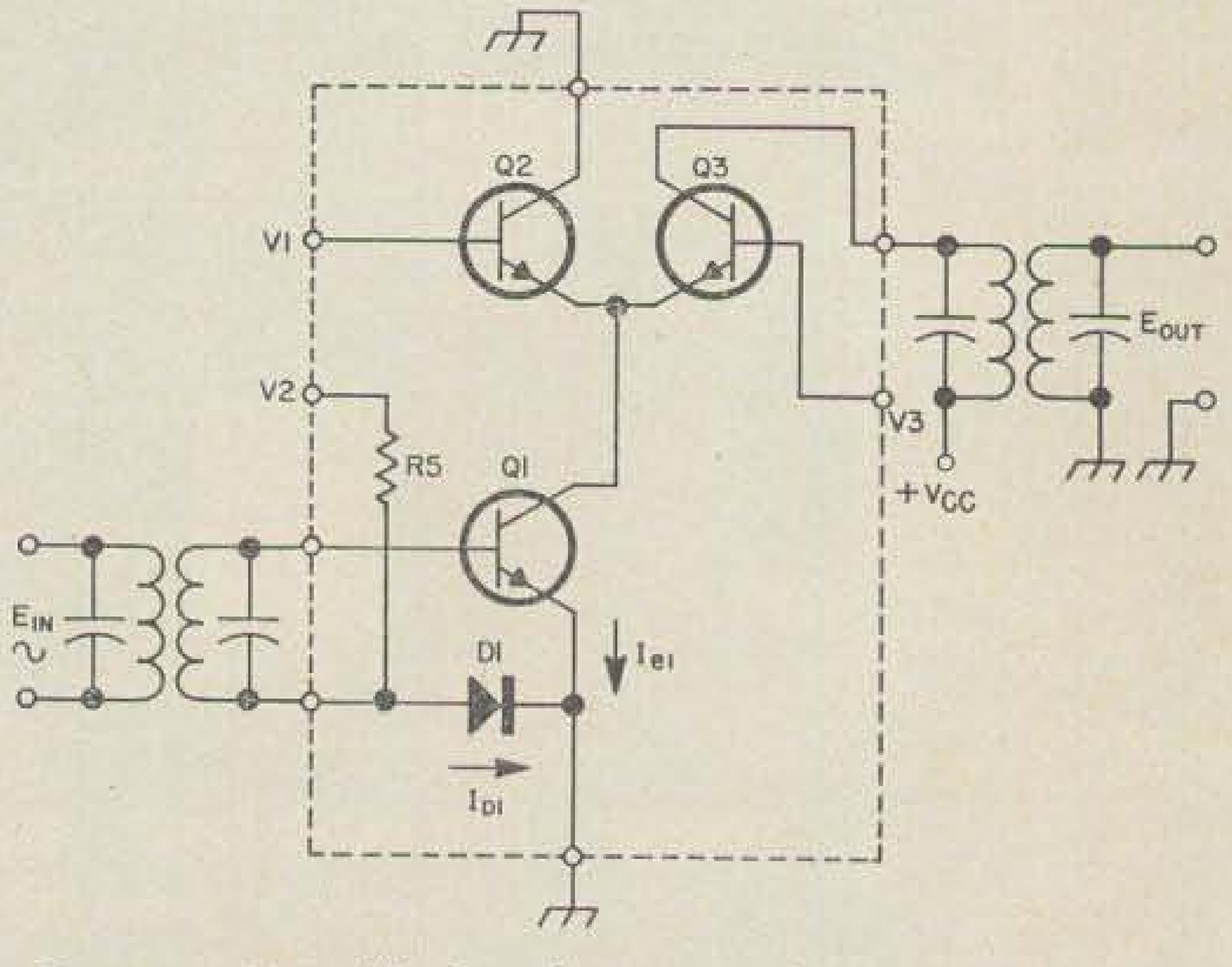


Fig. 1. Simplified schematic diagram of integrated circuit rf-*if* amplifier.

the current I_{D1} in diode D1. Since D1 and Q1 are built on a tiny monolithic silicon chip their base-emitter voltage characteristics will be quite similar. Therefore, the emitter current of Q1 will, for all practical purposes, be equal to the diode current. This current established in Q1 will be shared in some manner by Q2 and Q3 depending upon the voltages at V_1 and V_3. If V_1 is at least 114 mV greater than V_3, Q_3 will not conduct and all the current will flow through Q2 and Q1. Under this condition, the gain of the entire module is at a minimum. However, if V_1 is less than V_3 by 114 mV or more, all the current will flow through Q3 providing maximum circuit gain. This characteristic should give a hint as to one of the several possible applications of a voltage applied to the base of Q_2, i.e., it's a very good point to apply AGC voltage.

Now, let's consider signal operating conditions, the incoming signal is applied to the base of Q1 and the output signal is taken from the collector of Q3. Thus, Q1 and Q3 are functioning as a common-emitter common-base pair which is better known as a cascode configuration. This configuration has a very distinct advantage because it considerably reduces the internal feedback as compared to a single transistor. The fact that the internal feedback is extremely low means that these circuits (the MC 1550 and CA 3005) are very stable, and you won't have to concern yourself with neutralizing.

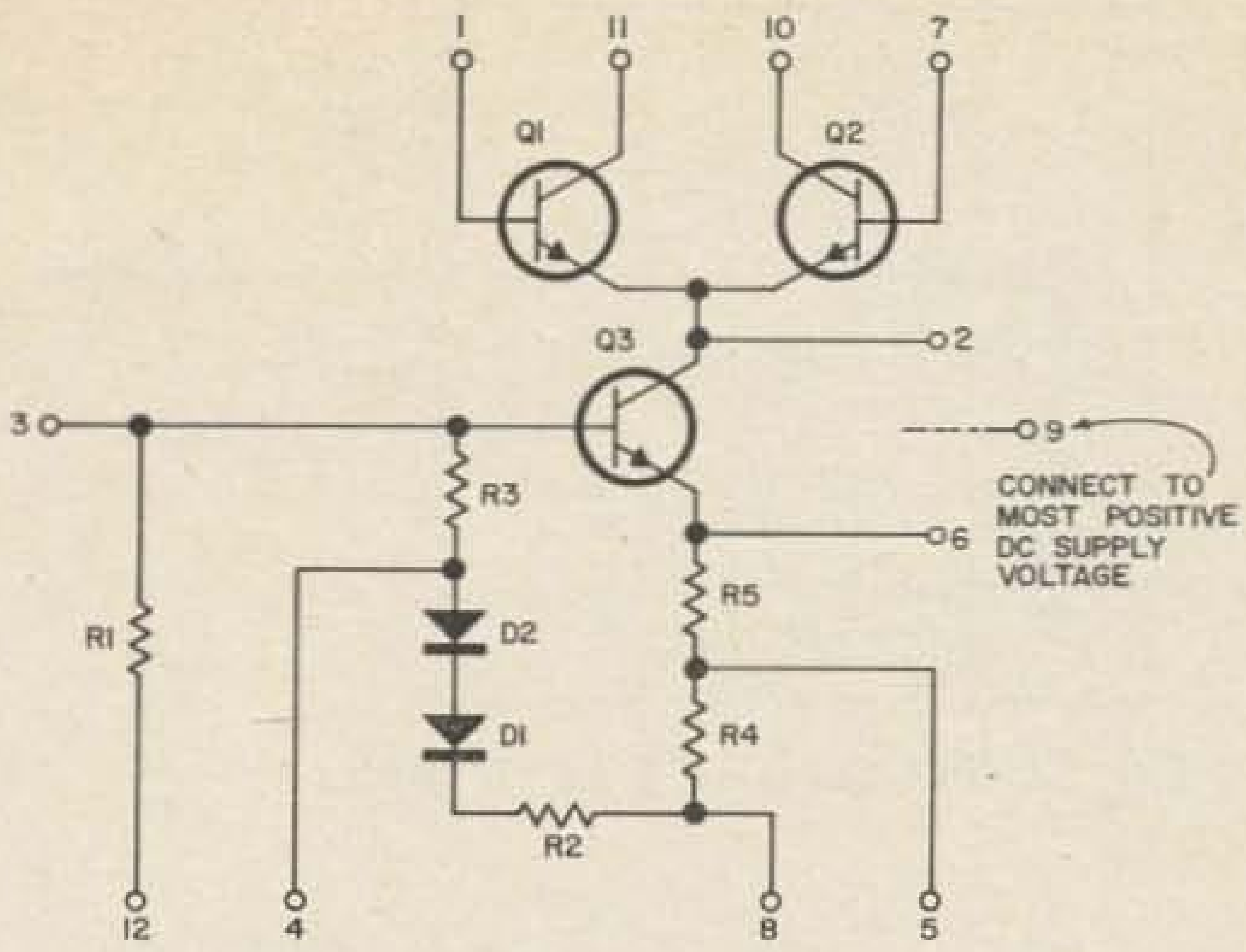


Fig. 3. Schematic diagram of the RCA CA 3005 integrated circuit rf amplifier.

Another performance advantage is the AGC capability of these integrated circuit devices as compared to a single transistor. The application of an AGC voltage to Q2 has negligible effect on the operation of Q1, hence, the input characteristics of Q1 remain constant. Thus, there is no detuning of the tuned input circuit with changes in the AGC voltage.

Both the RCA and Motorola circuits can be operated as a differential amplifier with minor external modifications in the wiring. Some of the options of using the cascode configuration or the differential configuration will be covered later.

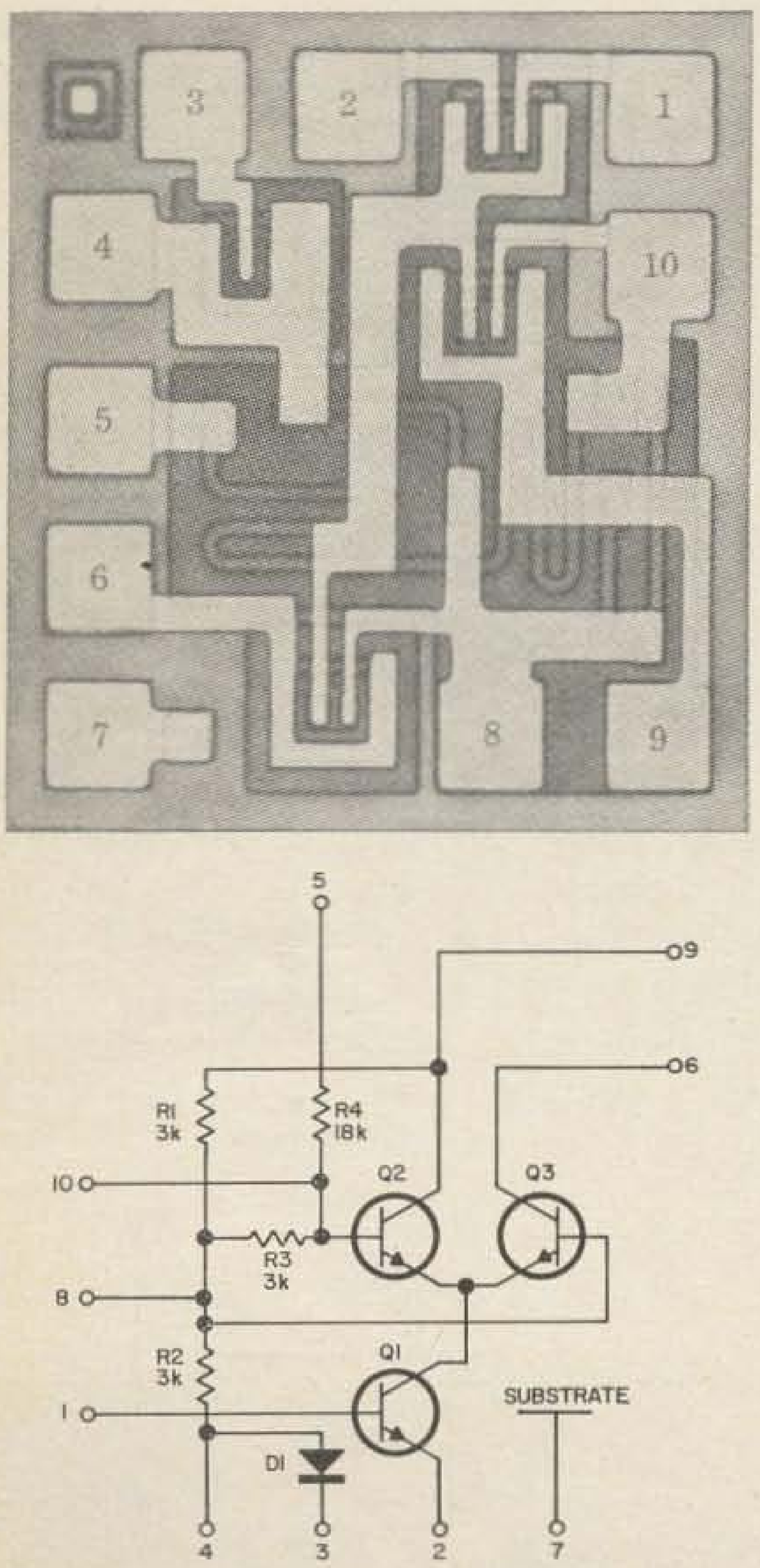


Fig. 2. Schematic diagram and photograph of the Motorola MC 1550. Terminal numbers refer to leads on TO-5 type package.

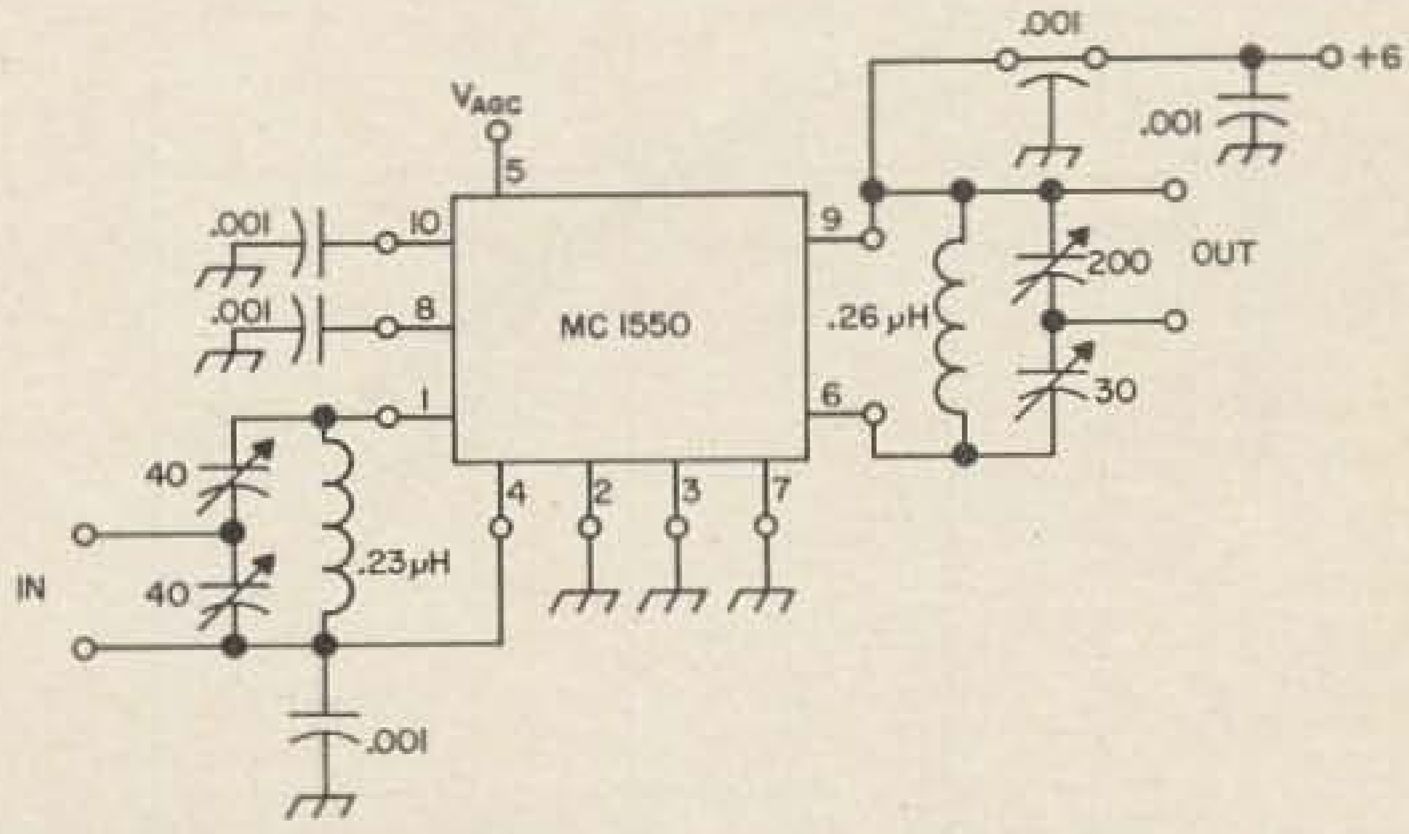


Fig. 4. Typical 50-60 MHz tuned amplifier. Gain is 30 dB with 0 volts AGC and bandwidth is 5 MHz.

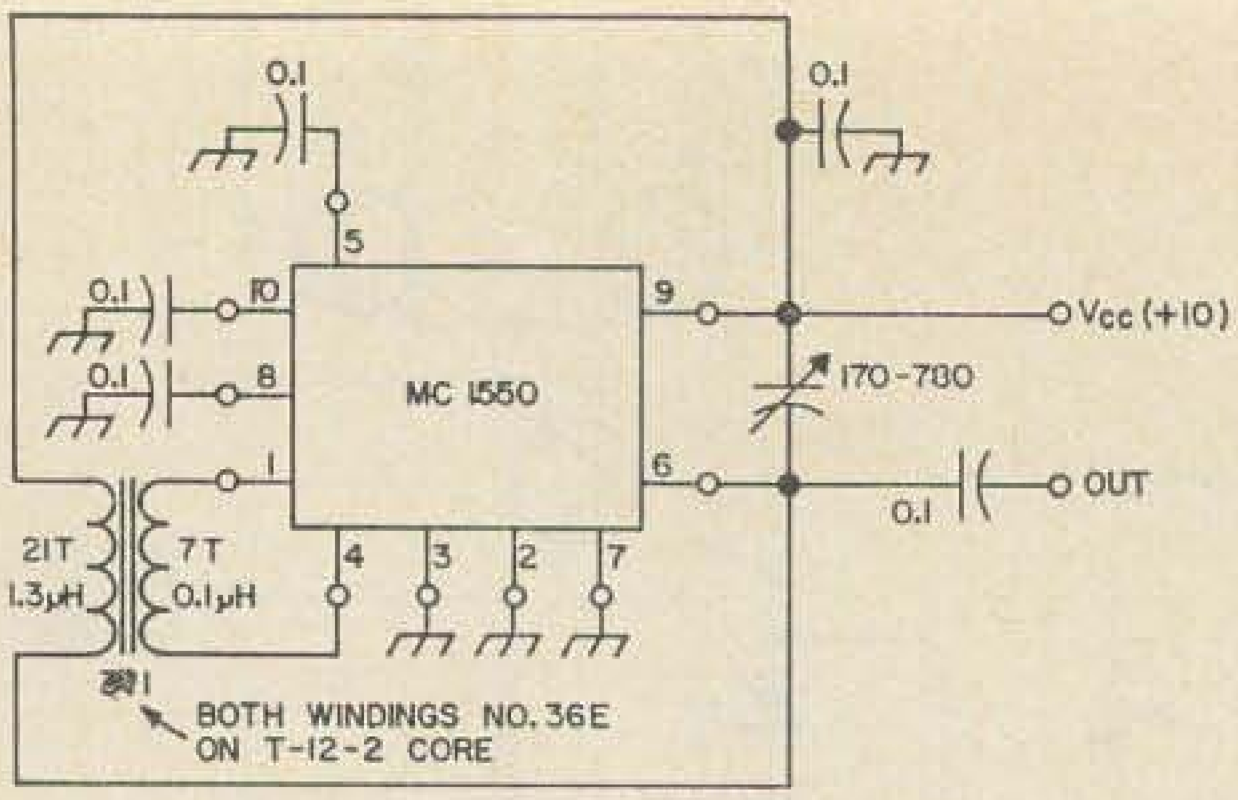


Fig. 5. VFO covering 5 to 10 MHz.

A diagram of the die for the Motorola MC 1550 is shown in **Fig. 2.** The tiny silicon chip contains the three transistors, four resistors and the diode. Resistors R_1 and R 2 bias D_1, and also provide a base voltage for Q3. The other resistors R_3 and R_4 broaden the AGC voltage range from the previously mentioned 114 mV to about 0.86 volts to reduce susceptibility to noise interference.

The schematic diagram for the RCA CA 3005 circuit is shown in **Fig.** 3. While the basic transistor configuration is the same, the biasing arrangement is different and the CA 3005 does not contain the AGC improvement resistors. However, RCA recommends other methods for applying AGC.

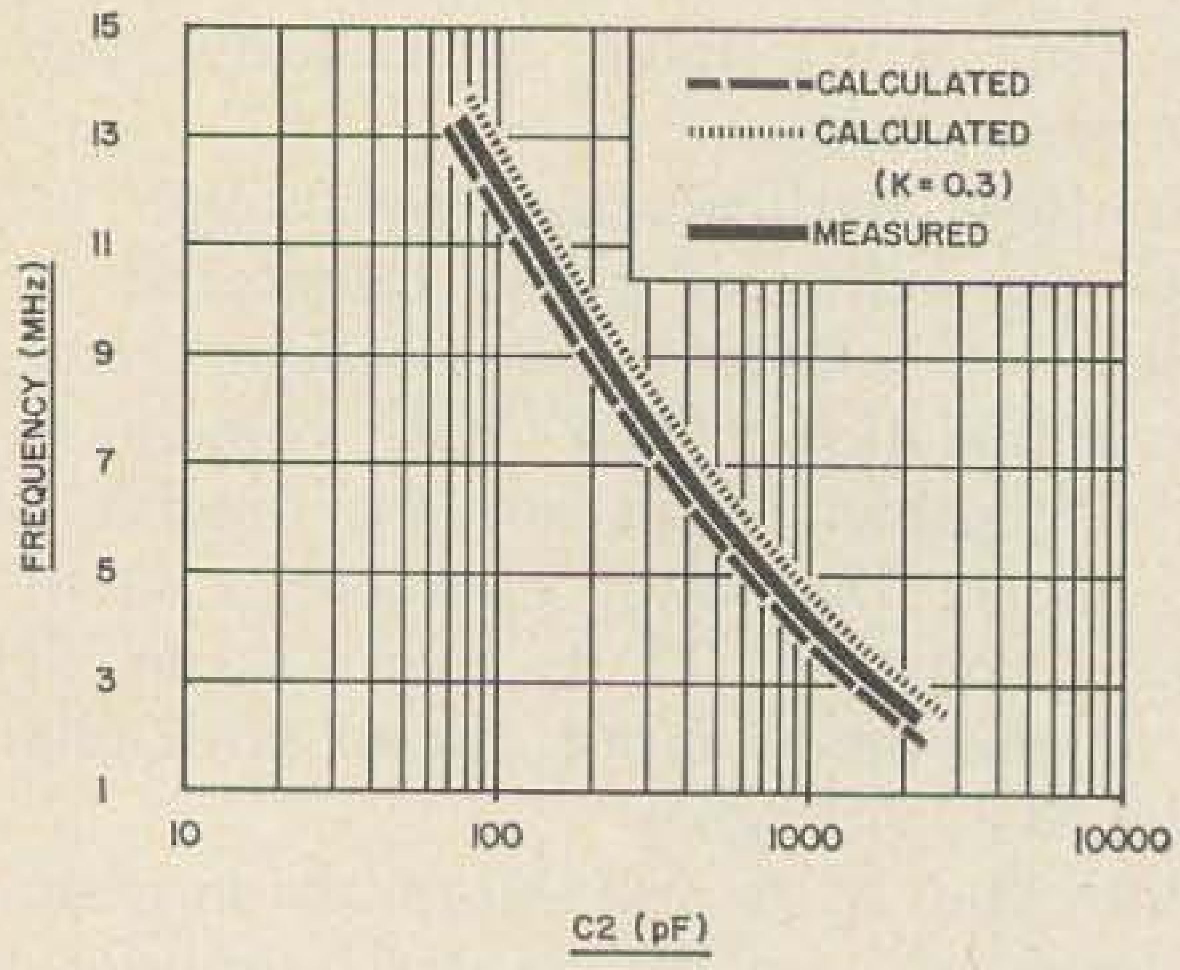


Fig. 6. Frequency vs. C_T.

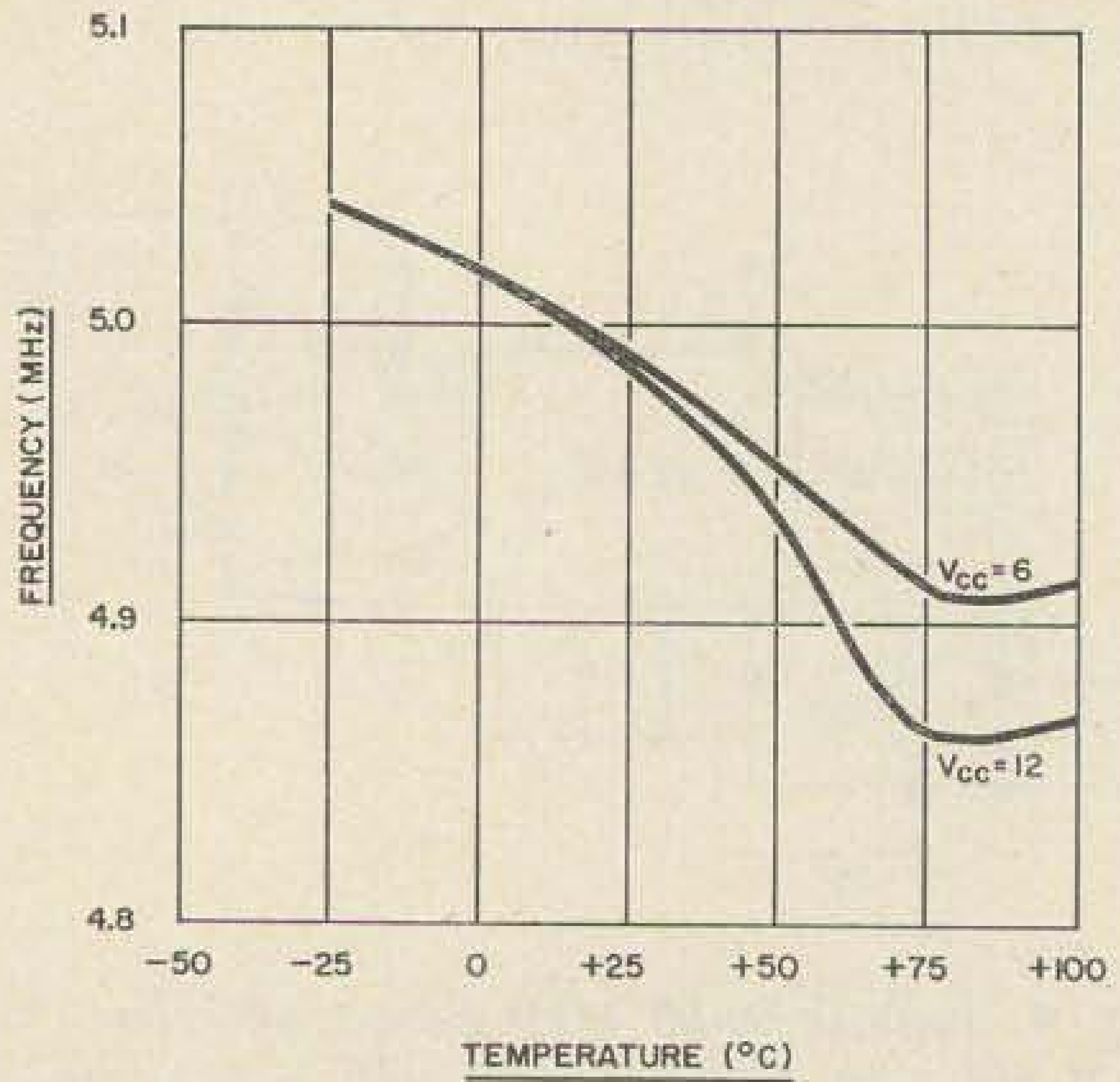


Fig. 7. Frequency vs. temperature.

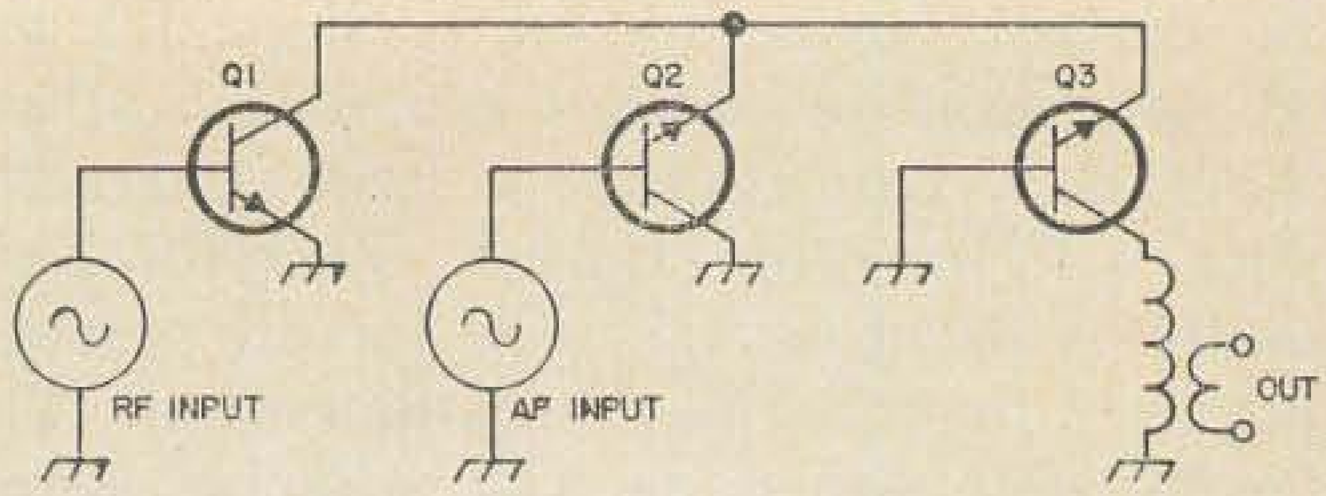


Fig. 8. Simplified model of the MC 1550 used as an rf modulator.

Applications

Rf amplifier

Now let's see how these two devices can be applied by the home experimenter. Motorola has built a 60 MHz amplifier using the MC 1550 as shown in **Fig. 4.** According to Motorola data this amplifier has a gain of 30 dB and a bandwidth of 0.5 MHz. For initial experimentation, adjustment of the input and output trimmers (C_1, C_2, C_3 and C_4) should easily move this amplifier to six meters.

Another Motorola circuit employing the MC 1550 is a VFO covering 5 to 10 MHz. This circuit is shown in Figure 5. Data illustrating the performance of this oscillator is given in **Fig. 6** and **7.**

The excellent AGC characteristics discussed earlier, makes the MC 1550 very useful as an amplitude modulator. A simplified diagram of a typical low power modulator is shown in **Fig. 8.** By injecting an audio signal to the base of Q2 and an RF signal at the base of Q1, the rf will be amplified by Q3 as a function of the audio input. Remember earlier when it was discussed how the gain of Q3 varied from

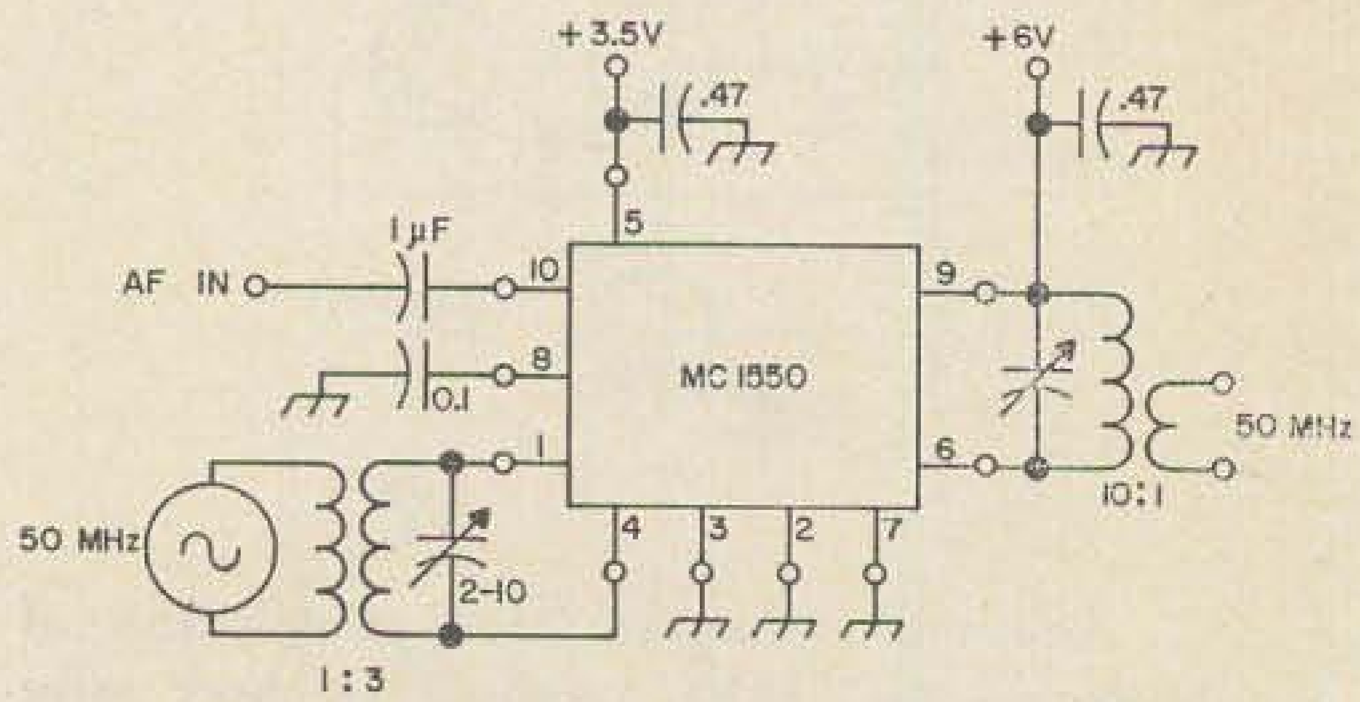


Fig. 9. Low power modulator circuit for 50 MHz.

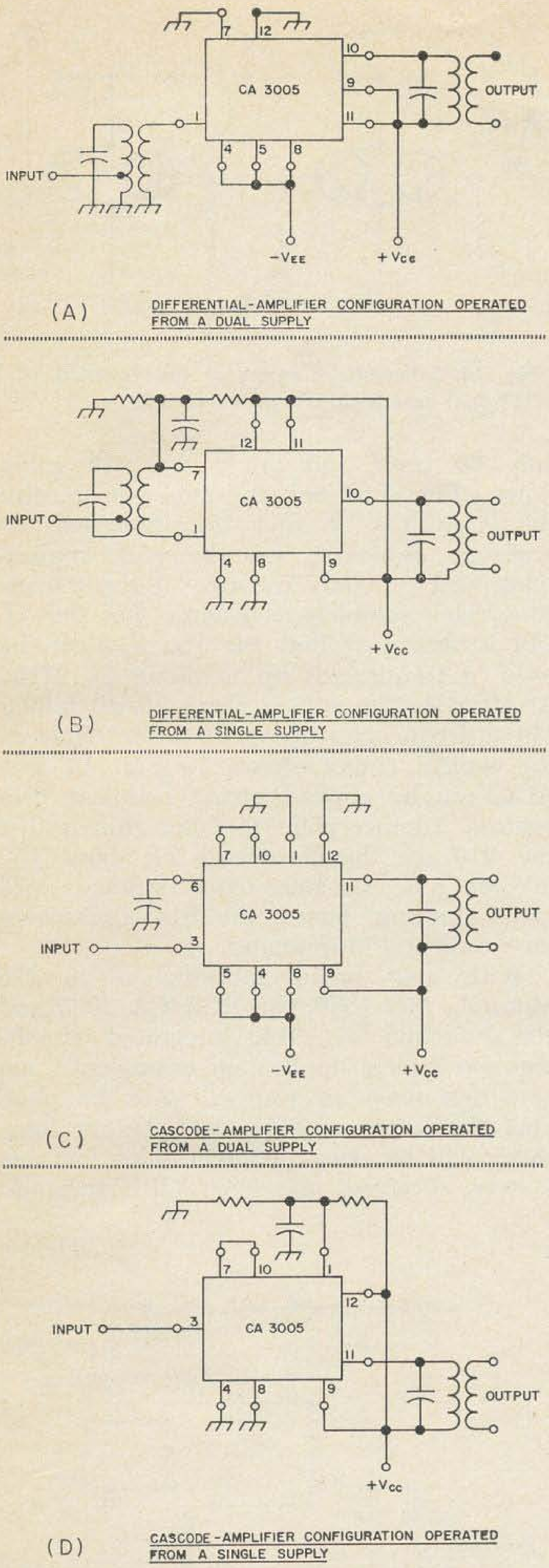
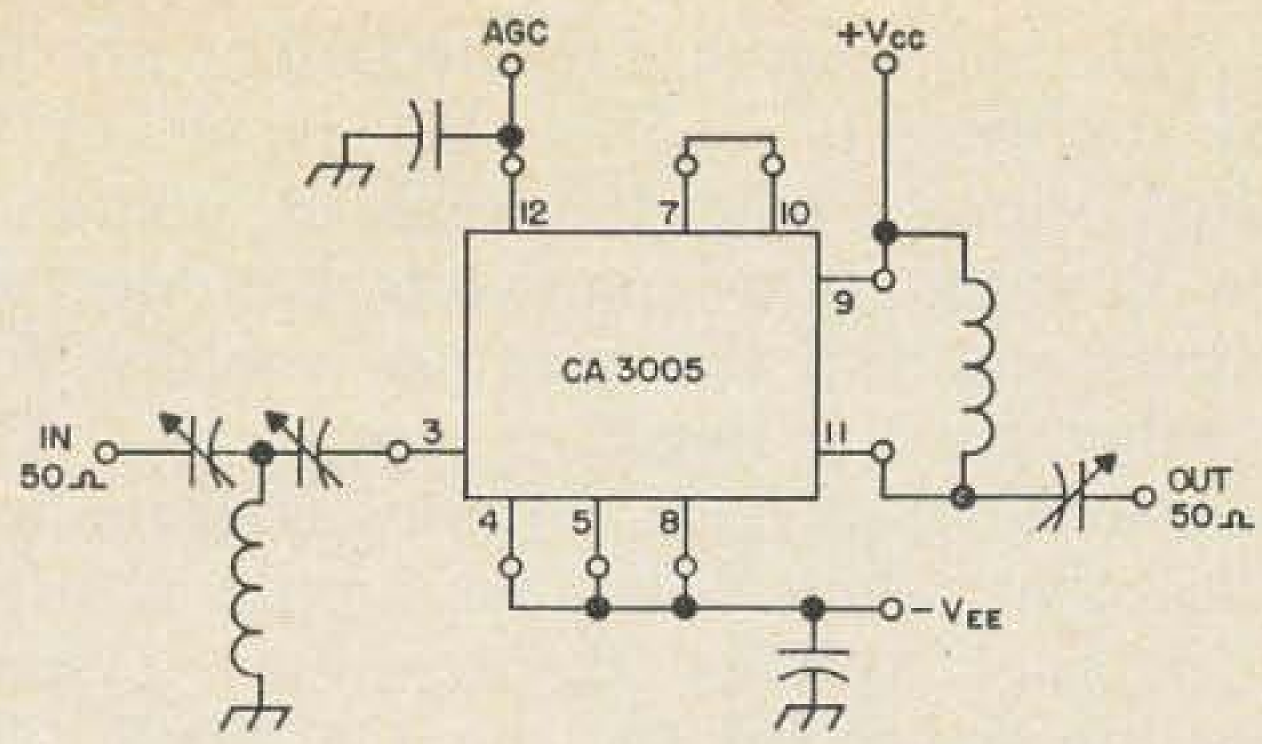


Fig. 10. Supply connections for the CA 3005 integrated circuit amplifier. A. Differential amplifier configuration operated from a dual supply. B. Differential amplifier configuration operated from a single supply. C. Cascade amplifier configuration operated from a dual supply. D. Cascade amplifier configuration operated from a single supply.



DC SUPPLIES V_{EE} & V_{CC}	POWER GAIN (dB) 30 MHz	100 MHz
±6V	36.0	20.0
±4.5V	33.0	18.5
±3V	22.0	15.0

Fig. 11. Typical power gain performance of a cascade configuration at various supply voltages.

minimum to maximum with the bias voltage applied to Q2? This circuit yields excellent modulation characteristics with about 90% modulation, both up and down, easily achieved with very low distortion.

A 50 MHz modulator is shown in **Fig. 9.** This typical circuit should spark ideas for other modulation applications, for example, the previously described oscillator or oscillators at other frequencies could easily be modulated to provide a signal generator or even a low-low power transmitter.

The CA 3005

Now let's take a look at some of the circuits RCA proposes for their versatile CA 3005 integrated circuit.

The CA 3005 can be operated at various levels of supply voltage from 3 to 9 volts and from single or dual dc power sources. **Fig. 10** shows the various methods of connecting supply voltages for both the differential and cascode amplifier configuration and for single and dual supplies. Fewer

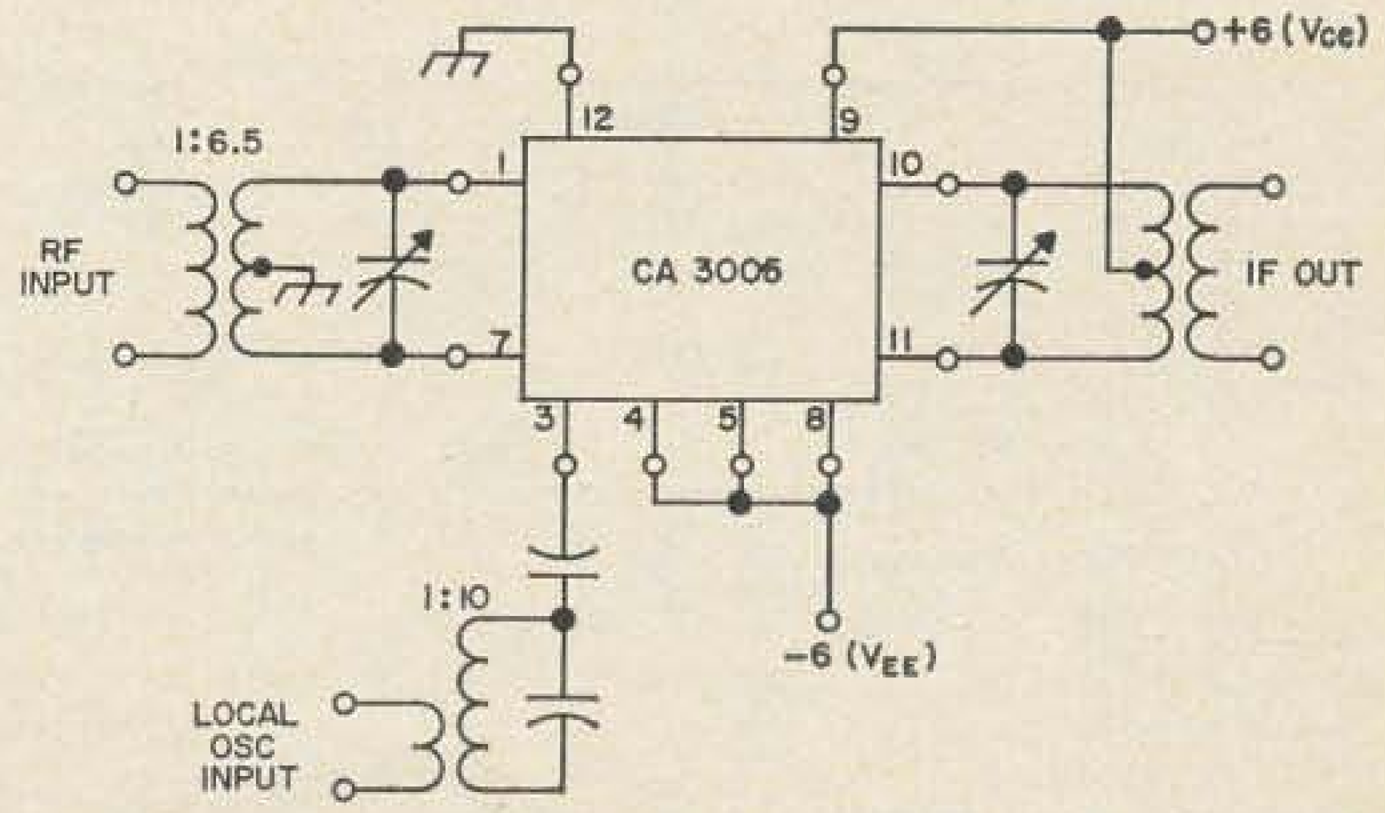


Fig. 12. Typical circuit diagram using the CA 3005 as a mixer.

external components are needed with the dual supply. To clarify what is meant by a dual supply, take the case of operation from 9 volts. Two nine volts batteries are needed, one for the positive supply Vcc, the other for the negative supply Vee. The other terminal of both batteries is grounded. Notice that when only one supply is used, an external voltage divider and by-pass capacitor is needed for the CA 3005. The MC 1550 has this voltage divider built in the circuit.

The circuits in **Fig. 11** illustrate what you can expect from the CA 3005 operating as an *rf* or *if* amplifier at 30 MHz and 100 MHz from several supply voltages. Of course, several of these integrated amplifiers can be cascaded to provide additional gain. However, the CA 3004 which has emitter resistors that provide increased signal handling capabilities is recommended in place of the CA 3005 when several stages of *if* amplification are needed.

Mixer applications

The CA 3005 integrated circuit can also be used as a mixer converter, low power modulator and as a product detector. A typical example of a mixer application is shown in **Fig. 12**. The local oscillator signal is applied to the base of Q3 and the rf signal is applied either single-ended or double ended to the bases of transistors Q1 and Q2. A mixer-oscillator combination, which could be considered as a complete front-end on a single chip, is shown in **Fig. 13**.

Using digital circuits in rf applications

The Fairchild µL 914, which is a dual gate logic circuit, is of particular interest for *rf-if* circuitry. This epoxy device costs only 80 cents and prices are still going down. For this meager sum, you receive the equivalent of four transistor and six resistors. However, for the *rf-if* applications, you can only use two of the transistors. The complete schematic for the µL 914 is shown in **Fig. 14**. The 914 can be used at frequencies up to about 20 MHz. At 10 MHz the gain is about 30 dB falling off at frequencies above 10 MHz. Note in the typical circuit shown in **Fig. 14** that AGC can be applied giving excellent gain control. Another point to note, also, is that the 914 can handle inputs of about 150 mV or less. Greater signal voltages will cause limiting, hence, the 914 also makes an excellent FM-*if* limiter.

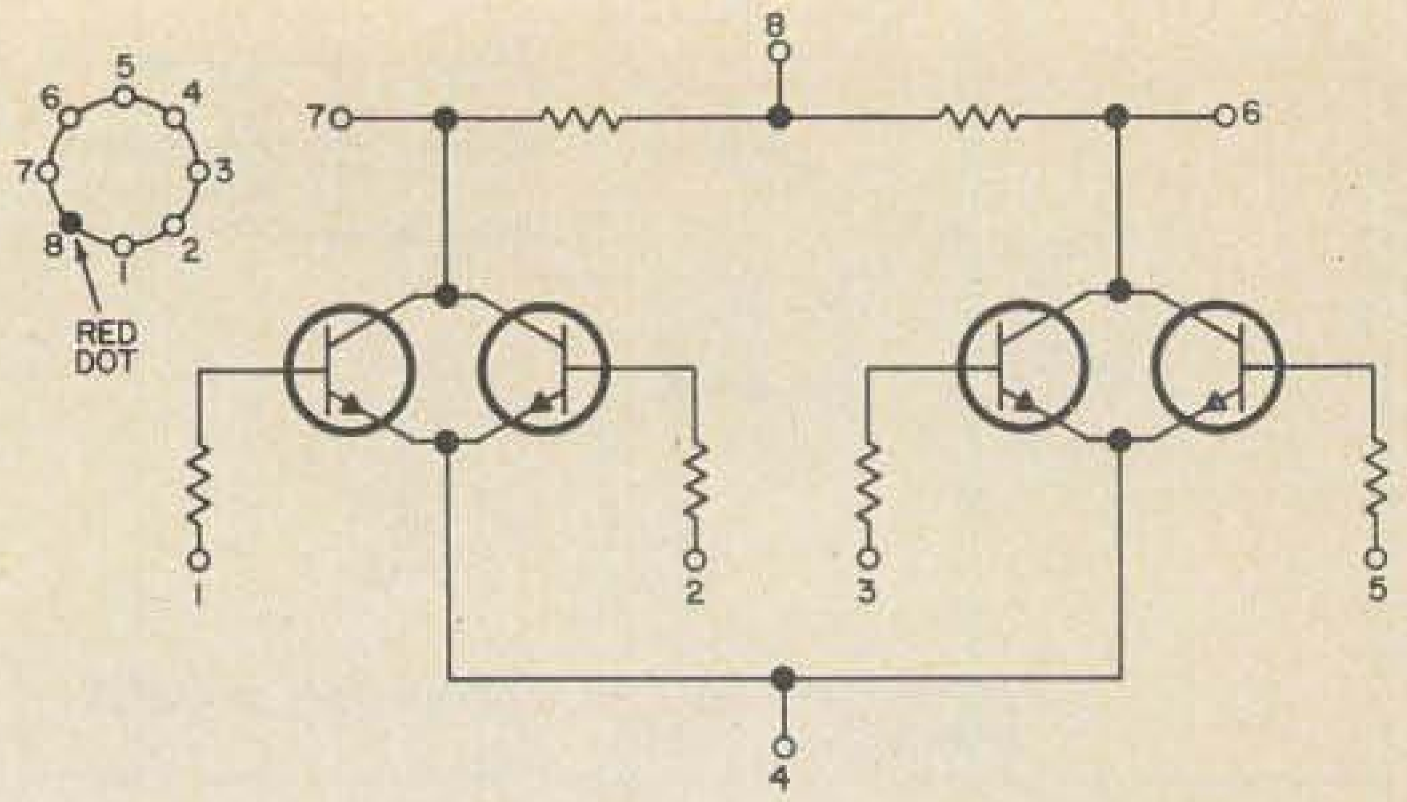


Fig. 14. Schematic diagram of the Fairchild µL 914 dual gate logic integrated circuit.

With this broad introduction to the Motorola MC 1550, the RCA CA 3005 and the Fairchild µL 914, integrated circuits and the typical application examples, I am sure that many of you will soon be plugging them into sockets. And, before long, there will be construction articles for converters, receivers and even QRP transmitters.

. . .Thorpe

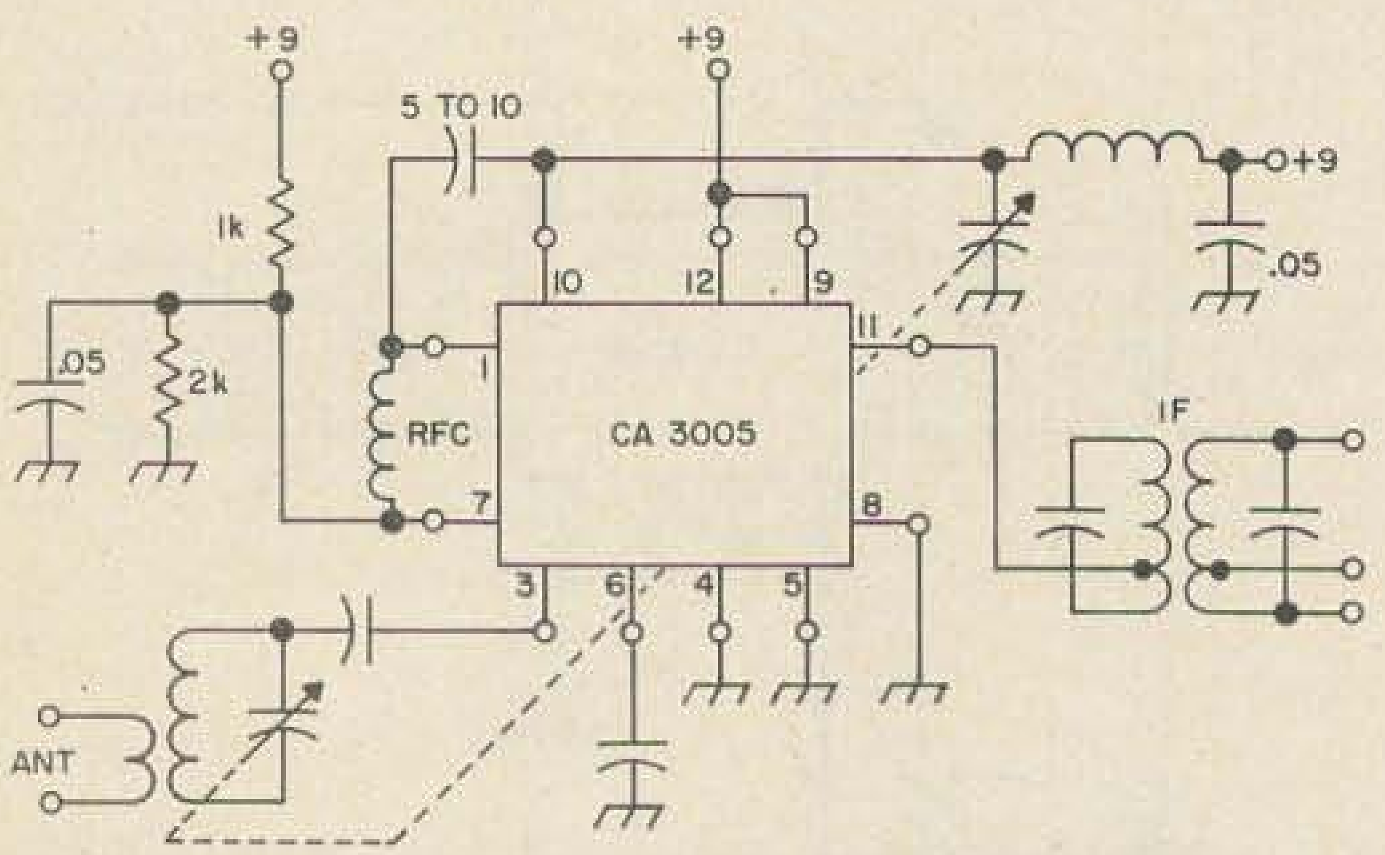


Fig. 13. CA 3005 can function as a complete front end. Part of the circuit acts as a mixer and the other parts as a local oscillator.

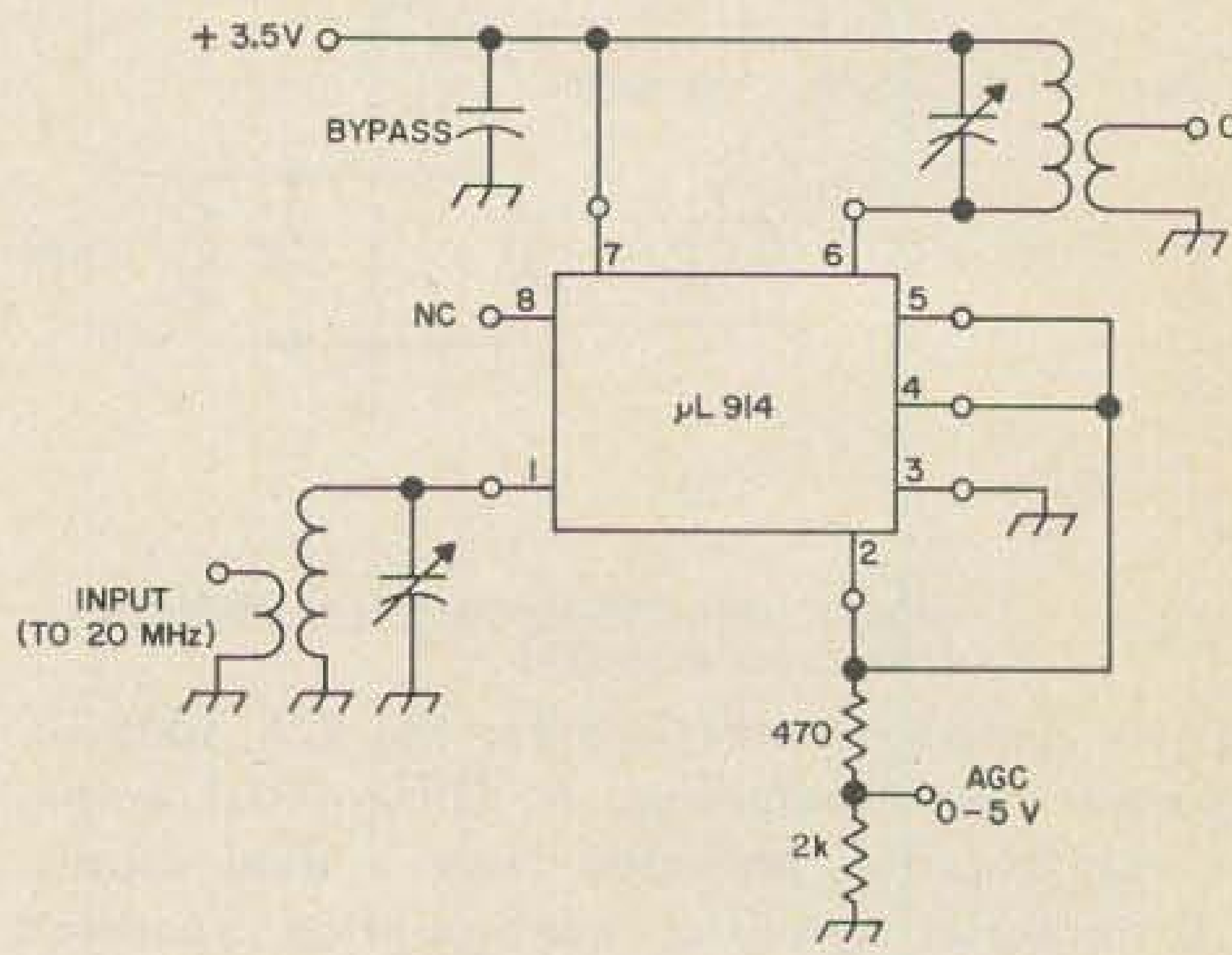


Fig. 15. Fairchild µL 914 shown in a typical rf-*if* circuit. Input signals up to 20 MHz and levels up to 150 mV can be handled by this device.

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Sonoma, California

Using Low Cost FET's on Six

The new Texas Instruments TIM12 field effect transistor is excellent for 50 MHz use, yet costs only $1 in small quantity.

Field effect transistors (FET) seem to be the answer to converter design for the 50 MHz amateur band. The cross-modulation problems common with ordinary transistors and even with tubes are no longer a real headache when using these new transistors. Ordinary transistors are subject to overload and cross-modulation with more than about 20 millivolts input which means that local stations can ride in on weaker signals anywhere in the amateur band. An rf stage ahead of the mixer even with tubes (less overload characteristics) will usually amplify a local station 100 KHz or so away from the desired signal enough to cross-modulate it in the mixer stage. FET types of transistors as mixers have extremely good characteristics for reducing cross-modulation and will even permit the use of an rf amplifier in most locations. Ordinary transistors and even some tube mixer types will often overload enough with an rf stage circuit to make them useless in some locations.

The FET units have been expensive for use in the vhf region and often have exhibited poor noise figure values. The writer recently obtained some new FET plastic-cased transistors for approximately one dollar apiece from a Texas Instrument distributor. These were TIM12 units which have very low NF and good gain values at 50 MHz. A circuit of a good 50-MHz converter is shown in **Fig. 1** and illustrated in the photographs. The converter was built on a scrap piece of copper-plated board

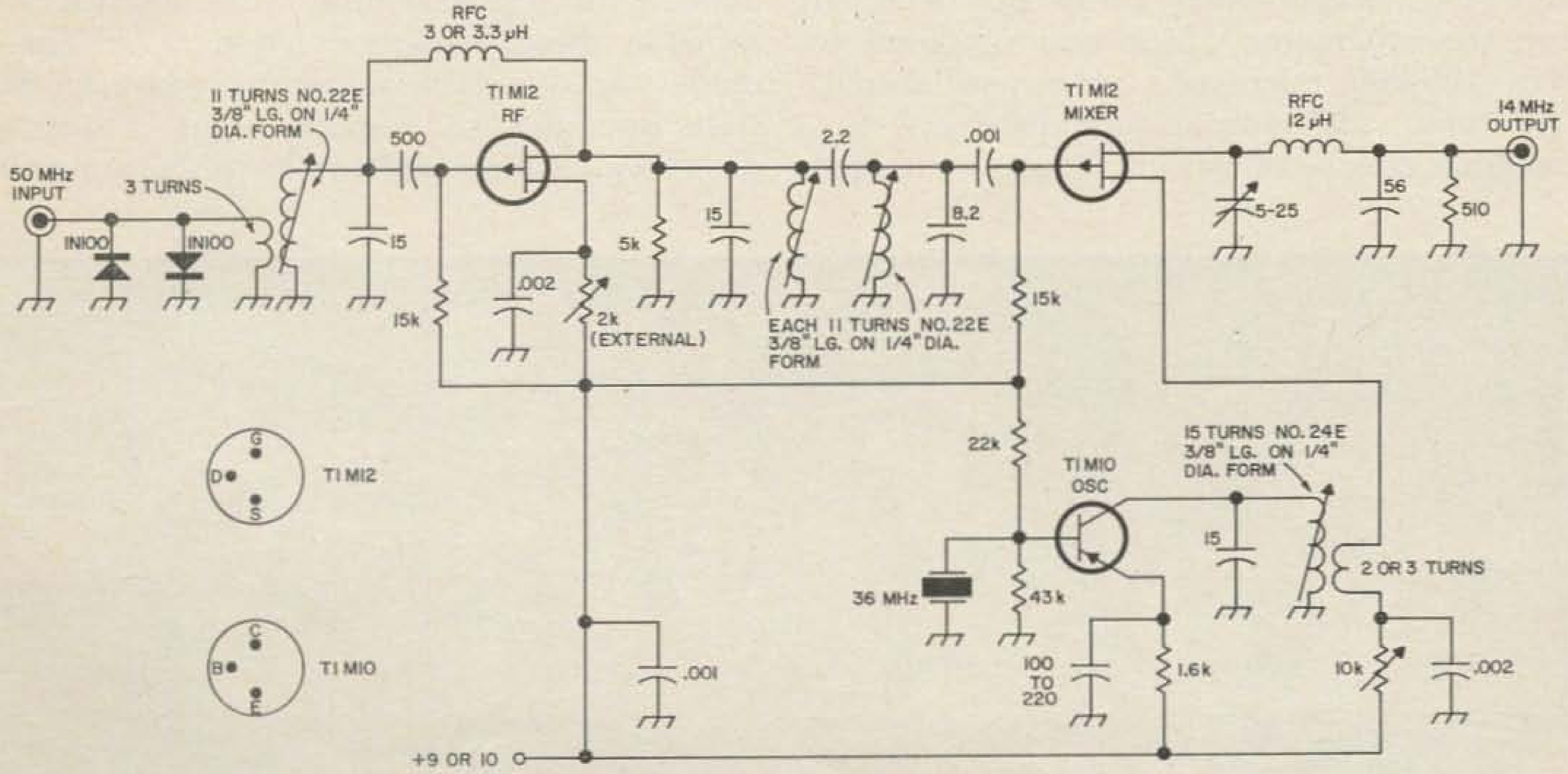
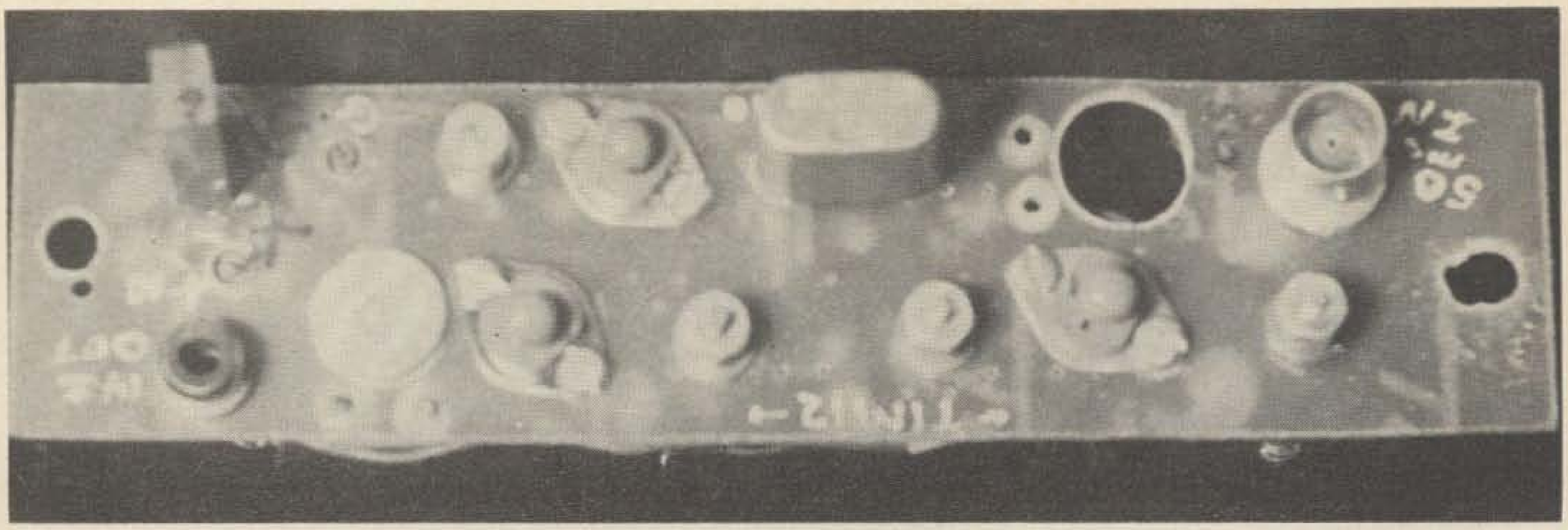


Fig. 1. 50 MHz converter using field effect transistor rf amplifier and mixer. The FET's cost about $1 each. This converter has a noise figure of around 2 dB and great resistance to cross-modulation.

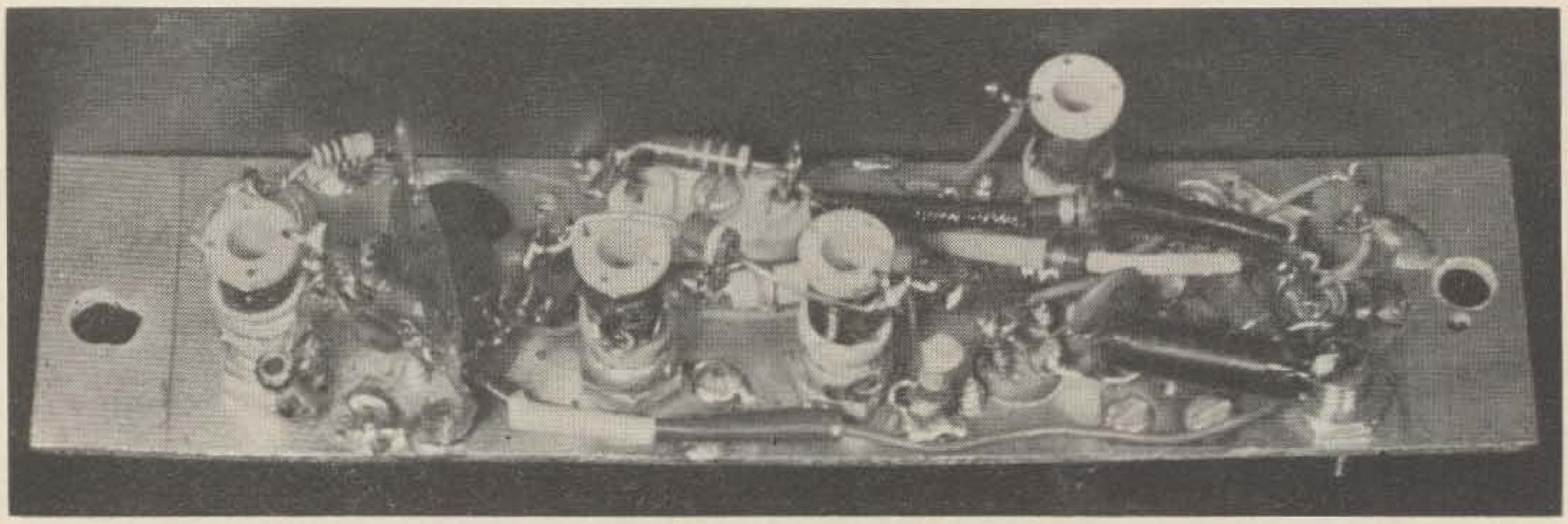


Top view of W6AJF's six meter FET converter. The extra hole by the BNC input jack was used for neutralizing trimmer that proved unnecessary.

1½ x 6 inches for mounting into a 6 inch wide aluminum chassis. The noise figure measurement between 50 and 52 MHz was from 1.5 to 2.5 dB. This is very low and means that in nearly all locations, antenna noise pick-up will completely override the receiver noise.

The cross-modulation capability was checked by connecting two signal generators to the input jack. One signal generator was connected to the converter input thru a 10 dB pad and, with no modulation, was set to give an S5 or S6 signal reading in the *if* receiver when the whole system was tuned to this signal frequency. Then another tone modulated signal generator was turned on at about 1 MHz off frequency (connected directly to the converter) and its output attenuator adjusted until some over-riding tone modulation was heard on the cw signal generator. It took more tone signal than could be obtained thru the attenuator which was supposed to have 100,000 microvolts maximum output. The "one volt" output jack produced appreciable cross modulation. It was estimated that it took about ¼ volt to produce objectionable cross-modulation. It was necessary to have a large resistor pad between the converter and the *if* receiver, and to have the two test signals separated far enough apart so the cross modulation problems in the *if* receiver were negligible. It is surprising how poor some homemade and some commercial radio receivers are for cross modulation in the 14 MHz region. It would seem that FET transistors should be used in all 14 to 18 MHz and 5 or 2 MHz if and mixer stages right up to the main sharp mechanical or crystal filter in the *if* section. A 20 dB pad on the *if* receiver input helped to reduce these effects while trying to check the converter only. The added pad or attenuator was only a stopgap cure since the real cure is to use a better designed *if* receiver.

Surprisingly, the IN100 back-to-back diodes in the receiver input were not troublesome in these cross-modulation tests. These diodes are standard on all my converter inputs in order to provide some transistor protection from moderately high powered



Bottom view of the low noise, low cross-modulation FET converter. The copper shield is across the rf amplifier socket. The solenoid rf choke at the other end is part of the pi network output circuit.

transmitters at this station. The 1N100 diodes have a low capacitance, reasonably high back resistance and quite low forward resistance and are low cost types. Connected across the coax input jack, the diode loss is very low and it does provide some added protection against destructive surge voltages from the antenna system or switching relay.

The converter rf stage required some neutralization by means of a 3 or 3.3 microhenry rf choke connected between the input and output tuned circuits. This resonates roughly at 50 MHz with the gate to drain capacitance of a TIM12 which is typically about 3 pF. Even with this amount of inductive neutralization it was necessary to load the tuned input circuit down to quite a bit less than 1000 ohms by means of the antenna link of three turns. The FET has high input and output impedance and a 5000 ohm resistor across the output tuned circuit was also needed. A variable source resistor of 2000 ohms was mounted external to the converter to permit easy rf gain adjustment.

The FET mixer stage in this unit has gate signal input and source oscillator injection. A small Trimpot, 0 to 10,000 ohms, provides bias for the mixer stage. This pot and the oscillator pick-up link of 2 to 3 turns were adjusted to provide minimum cross-modulation effects. Actually a 2-kΩ or 3-kΩ fixed resistor would be quite satisfactory for this type of transistor and oscillator injection voltage. The latter is greater than with ordinary transistor mixers, but should be a little less than that which gives maximum mixer gain. At the maximum gain value, the cross-modulation effects are worse. The mixer output circuit is a pi coupling network tuned to about 15 MHz. The dc path resistor across the output jack can be made much lower in value if a wider *if* frequency response is needed. The value will be somewhere between 50 and 500 ohms for most *if* receivers. If the latter actually looks like 50 to 70 ohms, the dc shunt resistor can be of a higher value.

The 36 MHz crystal oscillator uses a TIM10 or any other VHF transistor which will produce strong 36 MHz output with one or two milliamperes of collector current. The emitter bypass capacitor produces regeneration and its value will usually range between 100 pF and 220 or even more for most types of PNP transistors. The FET TIM12 units are P-channel which is similar to PNP transistors for battery supply polarity. Some FET units are N-channel which require the same supply voltage polarity as NPN transistors. The TIM12 has an odd base arrangement of leads (see Fig.1) as compared to ordinary transistors. This can cause some confusion in wiring up the transistor sockets and requires a little care in checking over the circuit wiring before fixing up the converter.

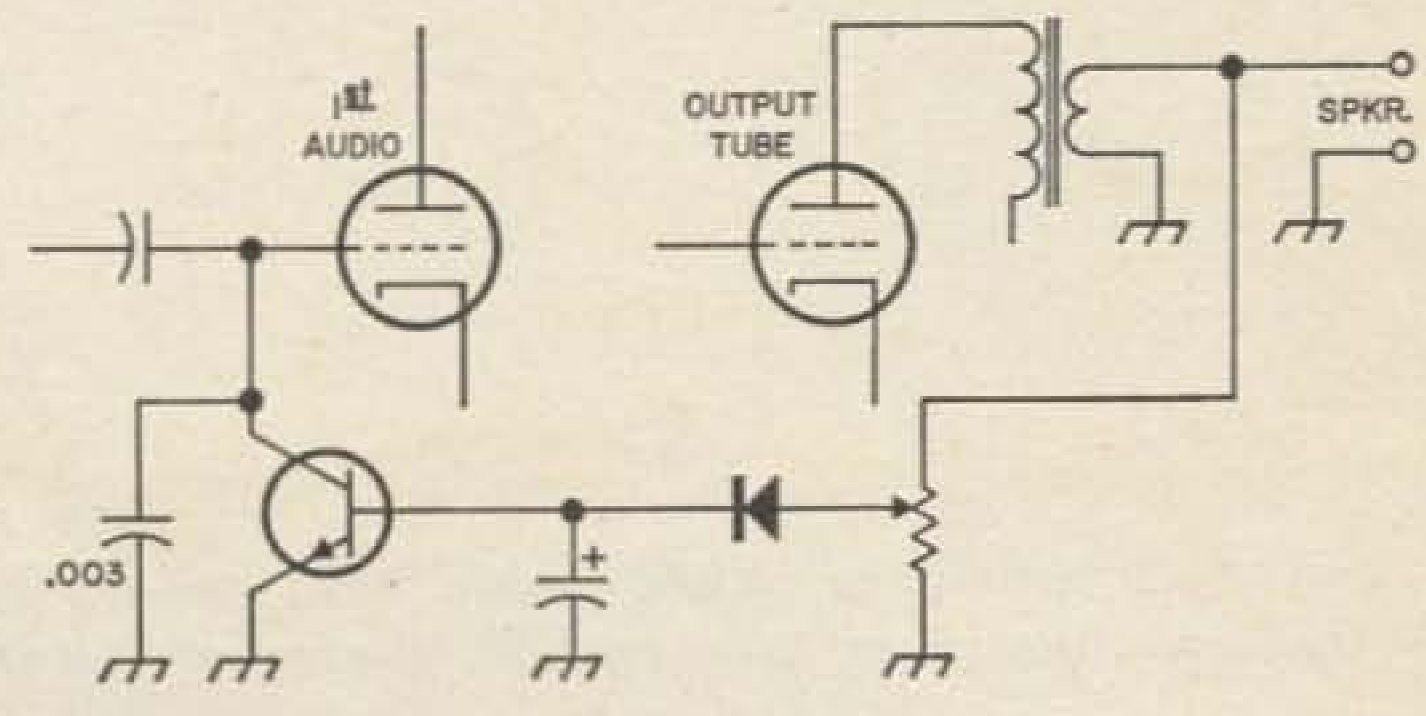
As a final comment, this converter showed a 25 to 30 dB improvement in cross-modulation as compared to several other 50 MHz converters using ordinary vhf transistors of several types. It also had a better NF than the other converters. The spurious signal responses were less due to the FET mixer.

. . . W6AJF

Simple Audio-Derived AGC

I don't claim originality for the basic idea here. Obtaining AGC voltage from the audio output is as old as audio output. The schematic tells most of the story; it will help others equip their receivers with effective AGC from junk box parts with only one internal connection. The transistor is not critical, although it must be NPN silicon (high collector to emitter resistance with no signal or small signal). I've tried about fifteen, from 2N33, 497, 2195 to 2N????, and they all work. The variable resistor can be anything over 50 ohms; I used 10 kilohms, and an audio taper is better than linear. Diode—any germanium: 1N34, 1N277, etc. Base capacitor will depend on each operator's taste on delay time. 40 μF works fine. The circuit provides fast attack and on three receivers has given an average of 30 dB compression with the pot at maximum. Receiver volume control should be set for loudness with minimum signal and maximum is set with the AGC pot.

. . . N. H. Chamion W6BGQ



Frank Jones W6AJF/AF6AJF
850 Donner Avenue
Sonoma, California

Low Cross-Modulation at 144 MHz

The biggest culprit in most cases of cross-modulation is the mixer. In the converter described in this article, W6AJF uses a low cost FET for the mixer, which gives low cross-modulation, and a low cost VHF transistor for the rf stage, for low noise figure.

The 144 MHz band sometimes has enough nearby stations to cause trouble in receiving on this band. Very strong local or line-of sight transmitters can overload the usual transistor converter and ride in on top of the desired signals even though far enough removed in frequency so the selectivity of the main if system should eliminate this effect. Usually the trouble can be traced to the converter transistor mixer stage since perhaps 20 millivolts of signal will produce cross-modulation on top of the desired signal. The answer in most cases is to use an FET type as the mixer since it takes ten to twenty times as much input to show cross modulation. FET devices are usually better than nearly any type of tube mixer at vhf.

FET (field effect transistors) have been very expensive in the past but now some are in the one dollar class such as the TIM12, a plastic-cased transistor. It works very well as a mixer at 144 MHz but is not too good as an rf stage. The converter shown in the photographs and in the circuit diagram was originally built with two FET TIM12's in it, one as the rf stage and the other as the mixer. The noise figure measured about 5 dB which isn't bad for average local station reception but isn't good enough for 144 MHz dx signal reception. The TIM12 is a p-channel germanium FET unit sold by Texas Instrument distributors for $1.07 at the time the writer

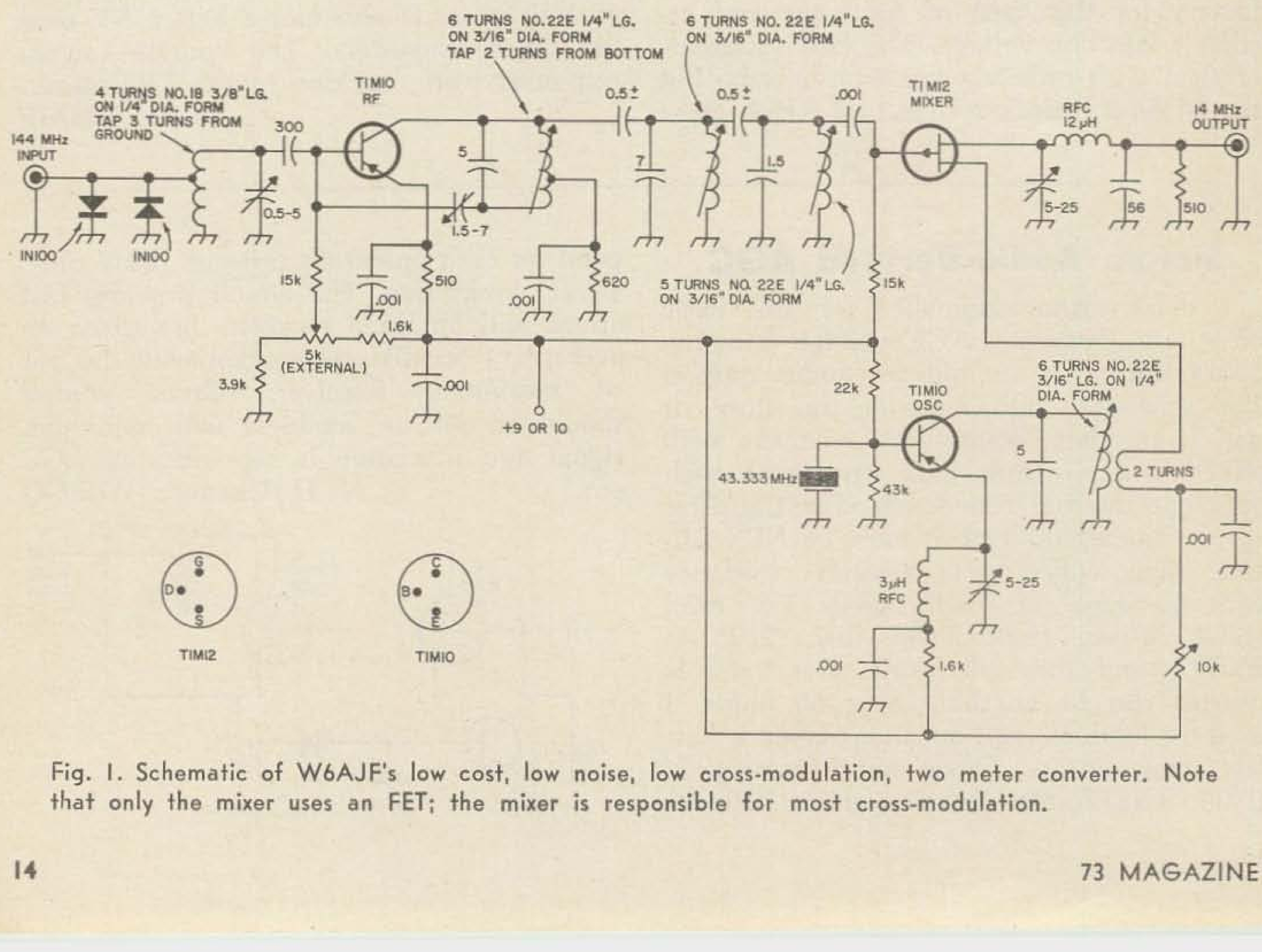
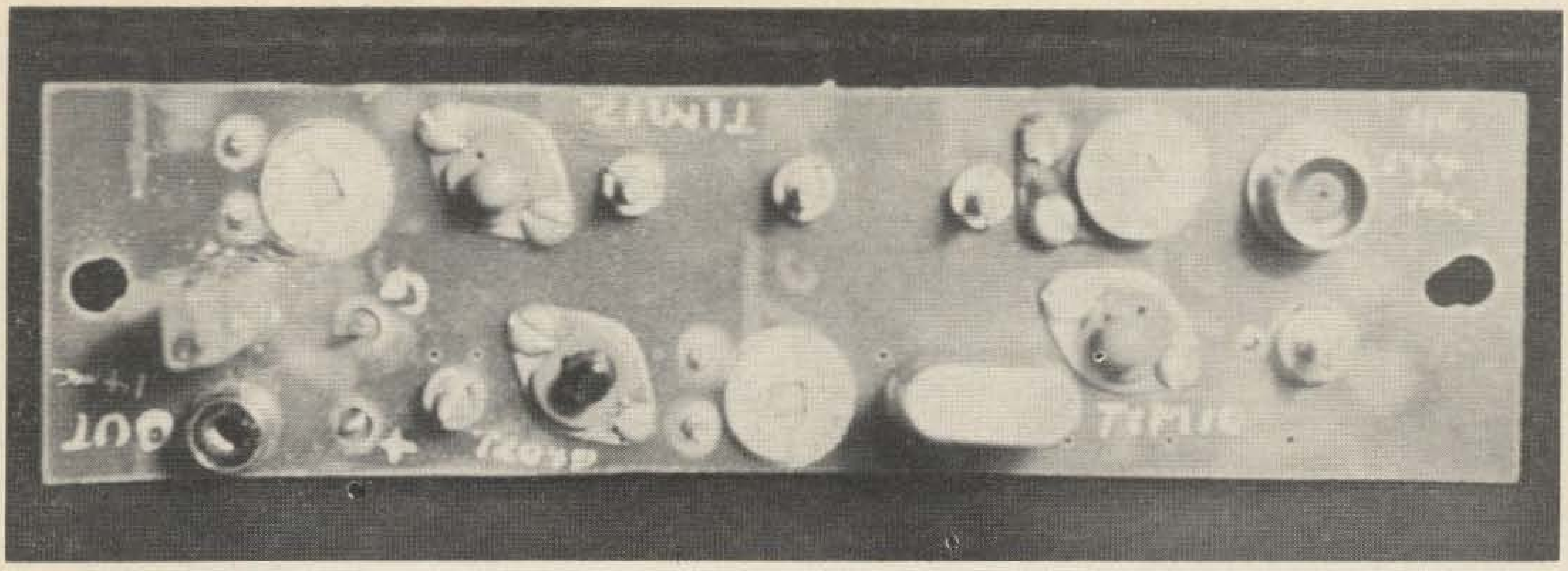


Fig. 1. Schematic of W6AJF's low cost, low noise, low cross-modulation, two meter converter. Note that only the mixer uses an FET; the mixer is responsible for most cross-modulation.

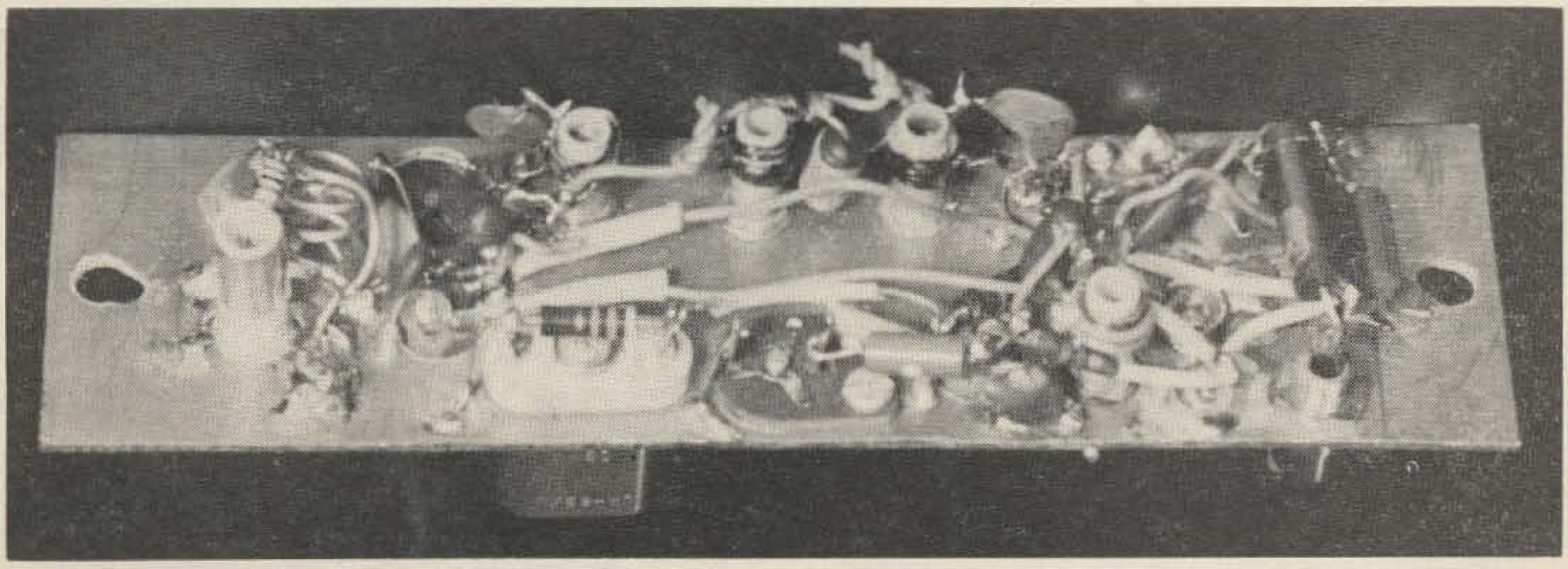


Top view of the converter described in this article. It's built on a 1½" x 6" piece of copper-clad board. The copper is on the underside.

obtained a few. The rf gain and NF varied greatly at 144 MHz though these same units gave excellent results at 50 MHz in an rf stage. Apparently at 144 MHz the TIS34 FET (at 4 times the price) would be needed and it is an N-channel silicon transistor requiring a change in battery supply polarity.

It was decided to use a neutralized TIM10 vhf transistor (approximately 50 cents) in the rf stage, and oscillator, and the low-prived FET as the mixer. The resulting circuit is shown in **Fig. 1.** The NF measured at 2 to 3 dB which is fine for dx reception. Two 144 MHz signal generators were connected together thru a 10 dB pad (50 ohms) and the tone modulated generator also tied into the converter directly. The unmodulated signal generator was adjusted to 145 MHz and its output attenuator set to give an S-6 signal into the converter and if system. The tone modulated signal generator was then set to 144 or 146 MHz and its output increased until some tone could be heard riding in on top of the "cw" signal at 145 MHz. With maximum rf stage gain and maximum mixer gain, it took about 25,000 microvolts to cross modulate the S-6 desired "cw" signal. By increasing the mixer source variable resistor to 2-kΩ ro 3-kΩ the "tone" signal had to be increased to 50,000 μV or 50 millivolts. If a local signal is greater than that, some benefit can be obtained by using forward gain control on the rf stage. For extreme cases of cross modulation, a TIS34 N-channel FET stage (neutralized) would be desirable in place of the PNP ordinary TIM10 transistor.

Just changing the mixer stage from a TIM10 or other types of vhf transistors, to a FET mixer such as a TIM12, improves the cross modulation characteristic by at least 20 dB. The 50 MHz converter shown in the May '66 issue of 73 Magazine and the 144 MHz converter in the June '66 issue were modified to use the FET mixers only. Type TIM12 FET units look like the TIM10 ordinary units but have a different basing



Bottom view of the converter. The "gimmick" capacitors between the three tuned circuits are about 1/2 pF apiece. They should be adjusted for best coverage of 144 to 148 MHz.

arrangement as shown in the new circuit diagram. The 10-KΩ variable source resistor was not used in these modifications. Only the fixed 3.3 kΩ former emitter resistor was used in the source lead with an .001 μF bypass and two turn pick-up link to the oscillator coil. The gate is a fairly high impedance even at 144 MHz, so should be connected to the top of the tuned circuit instead of thru a one turn link as with an ordinary transistor mixer. Note that the FET unit only requires one resistor to the plus supply voltage rather than the voltage divider normally used with ordinary transistors.

The overtone crystal oscillator uses a low-Q emitter circuit tuned above the fundamental frequency of the crystal (about 14½ MHz). This emitter circuit has to be tuned below the overtone frequency of 43⅓ MHz. Too low a LC ratio, at perhaps 25 or 30 MHz, may not give enough regeneration at the 130 MHz collector frequency with some transistors to give good output power at 130 MHz. The TIXM05 crystal oscillator functions very well with a 5-25 pF adjustable ceramic capacitor and a 3 μH rfc. The TIM10 is a little marginal with these values and perhaps a 4 μH rfc and smaller capacitor might be better. The proper values are those which provide a very weak 43⅓ MHz oscillation at the overtone crystal frequency and doubling or tripling power to the desired output frequency in the collector to emitter system. Low rf power oscillation at 43⅓ MHz should mean low rf crystal current with attendant high frequency stability. However, the transistor has to oscillate at 43⅓ MHz and efficiently triple to 130 MHz. Regeneration at 130 MHz helps increase the 130 MHz power output without running much rf at 43⅓. These oscillators, where one does the work of two, can be made more stable in frequency but do require some experimenting to get them to work with each change in transistor type. The writer has never had any difficulty with their use over long periods of time, but does sometimes have to work on a particular converter to get it into reliable oscillation the first time it is tested. The 3 microhenry coil can be wound from coil table or calculator data, or it can be a commercially made small encapsuled rf choke. If one doesn't work, don't be afraid to try another one as the tolerance on some rf chokes is awfully wide. Actually, a ferrite-cored rf choke of 3 or 4 micorhenrys will have a higher Q than "air wound" varieties and produce oscillation more easily. The unloaded Q of this coil should be at least 15, with higher values being desirable. The transistor should be a type with good vhf gain and a cut-off frequency of at least six times the overtone crystal frequency, and a few times the harmonic frequency desired. Like most harmonic generators, the second harmonic is upwards of twice the value as for the third harmonic. The fourth harmonic is usually too low in amplitude to be used in vhf converters.

. . . W6AJF

Eloy Marez W1DBN
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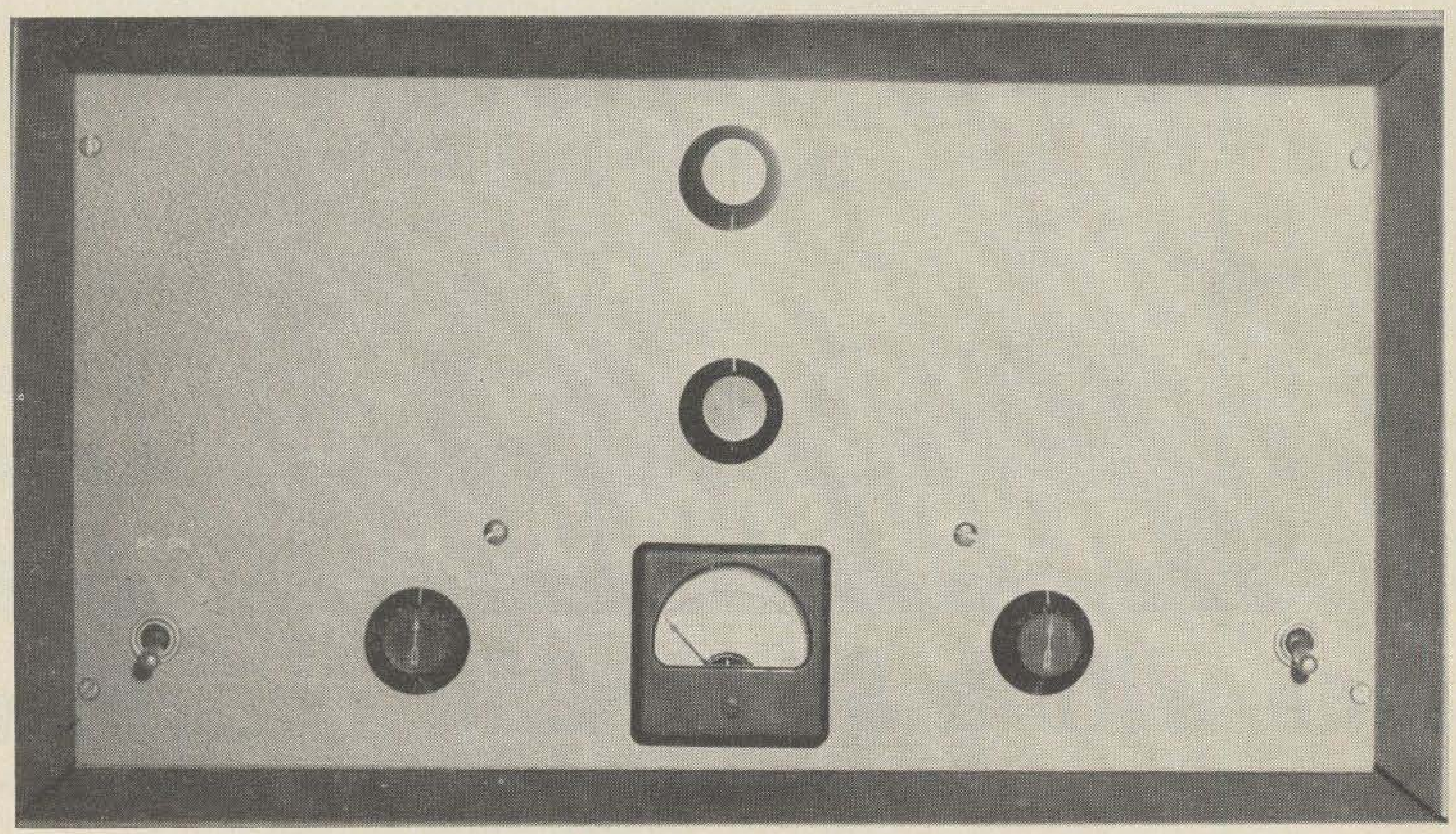


The 30P1 Linear Amplifier -A Peasant's 30L1

The commercial trend toward smaller and lighter equipment has been only slightly followed by the home builder. The reasons are many. The newer smaller components are expensive, difficult to obtain in some cases, and of course one has to make use of all the goodies present in the junk box, and of the surplus bargains.

The amplifier described here was planned to be as small as possible, yet provide kW, or near kW power. It offers nothing new in circuitry, being the standard 811A rig already described many times in all the amateur publicatiions[1]. The only thing different is the packaging. It proves that the proper selection of components, layout planning, and the use of the BIG parts press will result in a smaller piece of equipment of comparable power than usually comes out of the home workshop. All without requiring an elaborate machine shop and using all readily available parts.

The whole thing is squinched into a Bud SB-2142 Shadow Box cabinet, measuring 17 x 11 x 9½ inches, and weighs 57 pounds. Squinched—Lowenbrau inspired contraction of squeeze and pinch). While few of the components are of the junk box variety, all of them are readily available and will present no problem. The total investment on my part was $80, but this was greatly reduced since the pwwer transformer was on hand. If a similar transformer is available, the amplifier can be duplicated for roughly the same amount.

An explanation of the name is in order. Other than being a take-off on the well known amplifiers, it goes back to my Greenville, S. C. days. When I graduated to a 4-1000A, I proclaimed loud and often to my 811A operating friends that 'any ole peasant can run 811's. Hence the '30 Peasant 1'.

1. For instance, March 1962, page 33.

The circuit: As already stated, nothing new or unusual is claimed for the circuit, and space will not be wasted to show a schematic that can be found in back issues. It is a standard grounded grid, cathode driven pi-net output configuration. The power supply shown provides 1520 Vdc, while 4.5 volts negative bias is furnished by a filament transformer supply. The Barker and Williamson 851 pi-net tank is used in the output circuit, with added contacts being used to switch in added capacitance for loading on 75/80 meters only. Metering is provided in the grid and cathode circuits, as well as an rf voltmeter which provides relative power output indication.

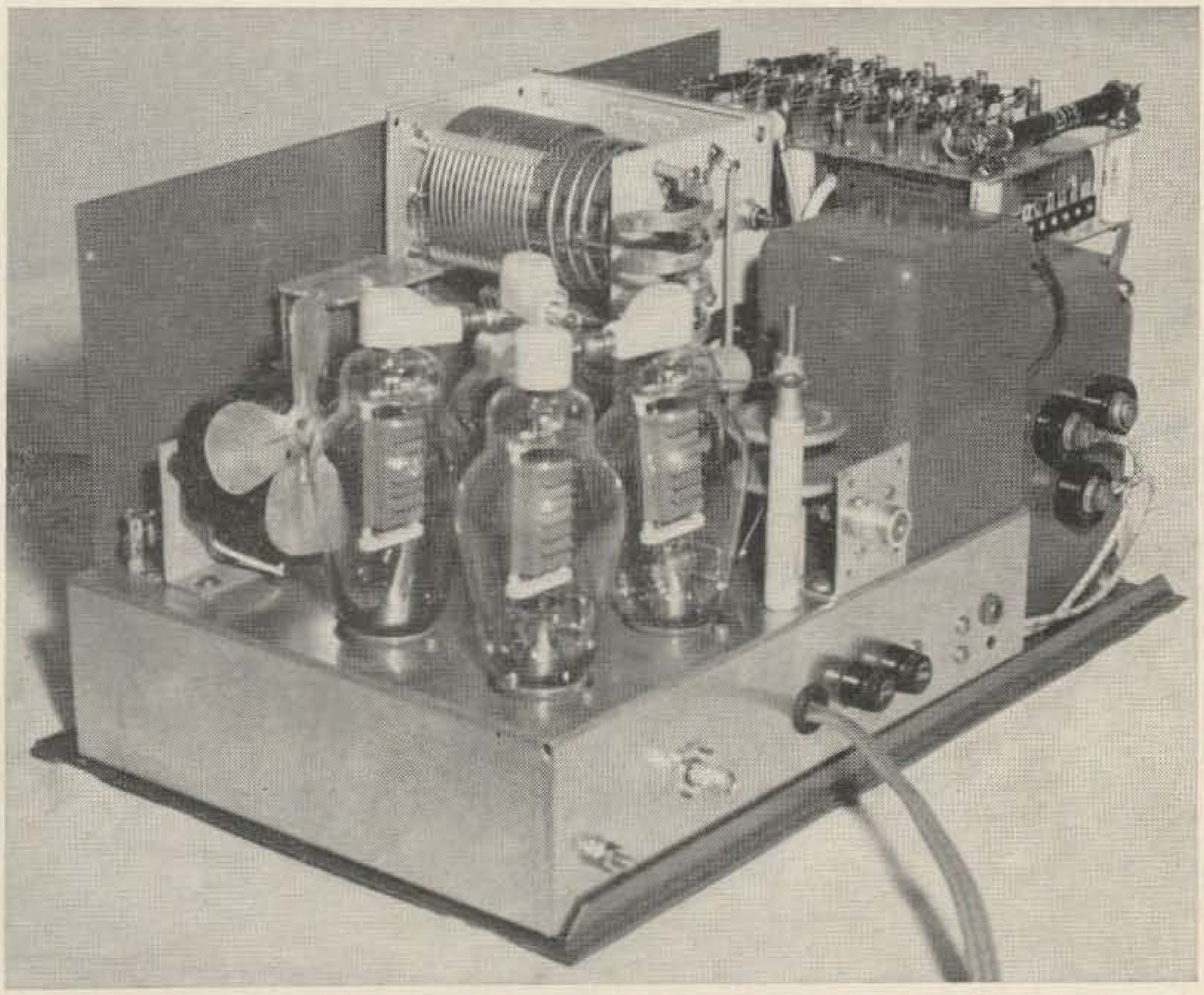
The power supply: As already mentioned, the power supply delivers 1520 volts with the transformer used. It is a full wave circuit, using nine 750 mA 600 piv silicon rectifiers in each leg. The particular rectifiers used here were obtained from Barry Radio in New York, and sold for 36c. There are many bargain counter type rectifiers on the market today, though many turn out to be the bargains they appear. These silicons from Barry have been used in a number of my projects and I recommend them unconditionally. Negative lead filtering is used, mainly to reduce the required voltage, insulation and physical size of the choke. Four 100 μF/525 volt paper filter capacitors are used in series. The resulting 25 μF at 2100 working volts maintain a fairly constant output voltage. These capacitors are shunted with 100 KΩ 2 watt resistors to equalize the voltage drop across each individual unit.

Fuses are used in the primary of the high voltage transformer as well as in the B+ line itself. The latter is a Buss High Voltage HVB type, rated at ½ amp. These particular fuses are manufacturer rated to carry up to 135 per cent load. The ½ amp size used here seems the best choice to protect the particular rectifiers used.

The rectifier and filter assembly is made up of two similar pieces of lucite, supported and separated by 1¼ inch steatite spacers. Right angle brackets hold the entire assembly on top of the power transformer. One-half inch screw-type standoff insulators are mounted on the top piece to support the rectifiers, paralleling resistors, and also the current limiting resistors. The high-voltage fuse holding clips are also mounted on the top piece, toward the back so it can be accessible by removing the back cover of the cabinet.

Construction: A few words now concerning the sheet metal work involved. The Bud cabinet used comes apart in four pieces: top and sides together, front, back, and bottom. This is an ideal setup since components can be mounted directly to the bottom and the rest of the cabinet built up around it. One drawback is the fact that the cabinet is made of steel, and is difficult to work, but the small number of holes required makes this a minor problem. The

Back view of the linear with the power supply in place.



meter hole was cut with a Sears and Roebuck adjustable hole cutter which, with plenty of oil went through with no trouble without burning up the cutter blade.

A hint of the use of such cutters: Remove the ¼ inch pilot drill and replace with a short piece of ¼ inch shaft material. Drill a ⅜ inch hole in the panel and install a ¼ inch inside diameter panel bushing for the shaft to ride in. After centering the work carefully, clamp securely to the drill press table and feed slowly. In the case of steel panels, oil should be applied steadily as the cut deepens. Oil is not required while cutting aluminum, although it should be used in the panel bushing at all times. In the latter case. cutting should be stopped periodically to remove the buildup of material that accumulates on the cutter blade, insuring a clean cut.

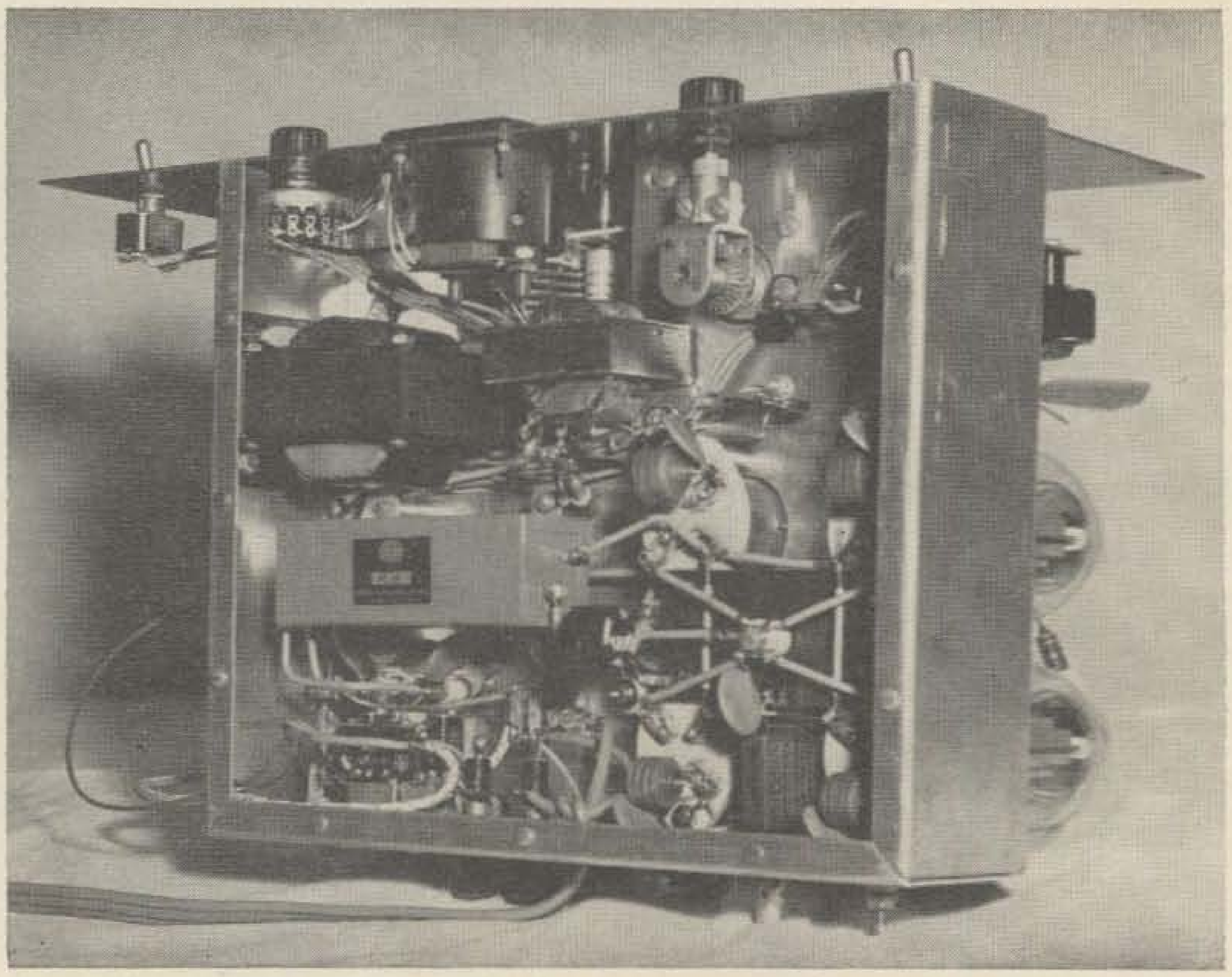
The power transformer is mounted directly to the cabinet bottom using rubber feet on the outside. This provides firm support for the transformer. Rubber feet are also installed on the opposite end of the bottom in the opposite locations used to mount the transformer. The chassis is a Bud AC-418 17 x 12 x 3 inches, cut down to 10 x 12 x 3 inches. The resulting open end is placed against the front panel and secured with threaded right angle brackets.

To provide ventilation, the solid back provided with the cabinet was discarded and replaced with a like-size piece of Reynolds perforated aluminum. Also, three 1-inch holes were punched in the forward edge of the sides, and 'C & G' 1-inch perforated ventilating hole plugs were installed.

Tank coil and plate tuning capacitor are mounted on a bracket made from 3/32 inch aluminum and really serves two purposes. Primarily it supports the coil and capacitor, but it also provides a mount for the bleeder resistors and a heat sink of sorts to help dissipate the heat generated by them.

The B & W coil was modified by the addition of an extra set of contacts to the switch on the back, to switch in a 1000 pF/-1250 volt mica capacitor for loading in the 75/80 meter band. The contacts are installed in the normally blank position, and further modification is required to the detent plate on the front of the coil assembly. This modification consists of drilling a hole for the spring-loaded ball bearing to drop in and hold the shaft in the proper position. A quick look at the coil, switch, and detent plate will readily clear up any vague points. Extra switch contacts can be obtained from Barker & Williamson, Inc, for $1.00. Don't forget to mention the type of coil.

The plate loading variable capacitor is a broadcast type triple 420 pF unit, also from Barry Radio. It is mounted vertically against the chassis and driven through a National 'RAD' right angle drive. This method of mounting was used to permit a short RF ground path, a short connection to the output side of the pi-net coil, and also because the darn thing was too long to mount any other way. Actually, it is efficient for the



Bottom view of the 811A linear described in the text. This is the rf section; the power supply fits in the space at the left.

reasons mentioned, and helps to maintain a symmetrical front panel.

The ten meter portion of the coil is removed from its original mounting, the ends rebent, and placed as seen in the accompanying photographs. Two Centralab 858S 1000 pF 5 kV capacitors are used for plate coupling and mounted directly on the ten meter coil. Copper strap ½ inch wide is used for all plate circuit connections.

Due to the height of the tubes, the sockets have to be submounted. A 1½ inch socket punch is used to cut clearance holes for the tube bases, and also for the Millen R-175A plate choke. The Johnson 122-224 sockets used for the 811's are mounted on 1¼ inch spacers. The base provided with the choke is removed and the choke is mounted directly to a ⅛ inch thick phenolic rectangle mounted on the inner tube socket mounting screws. This can be seen in the accompanying bottom view photographs. The B & W FC-15 filament choke is mounted under the chassis on 1 inch standoff insulators to clear the high-voltage line running from a feedthrough insulator close to the edge of the chassis, to the rf choke, and to the choke by-pass capacitor. Also, mounting the filament choke at this height puts its terminals at the same level as the tube connections, resulting in shorter leads.

Suggested changes: Bias. As originally built, the 811's are not cut off during standby periods, and the resulting plate dissipation makes the whole thing run a wee bit on the warm side. I recommend a higher voltage bias supply, with external switching thru the vox circuits, to apply cutoff bias during standby periods, applying operating bias as drive is applied.

Fan: The fan used does an adequate job, though since building this I have discovered the Rotron muffin fans, and their newer Skipper fans. I used the former, and recommend them for this or any similar applications. They are small, death quiet, and the amount of air they move has to be felt to be believed. They are almost as windy as some 75 meter operators.

The filter/rectifier sandwich should be changed to a triple-decker. The top, or added section, would be a similar size piece of lucite mounted on proper height spacers to clear the components already mounted. This is for safety reasons only as the exposed high-voltage could result in a shocking situation during the initial cover-off smoke test.

. . . W1DBN

Many UHF converters suffer from lack of local injection. W6OSA seems to have solved this problem in his converter. Maybe you could use his arrangement.

An Improved Multiplier for UHF

Les Maurer W6OSA
209 Nob Hill Way
Los Gatos, Calif.

It seems to the writer that every UHF converter he builds up with the same basic deficiency—marginal crystal current through the mixer diode. This deficiency in turn has always been traced to the same cause—low output from the last tube in the multiplier string.

Maybe this is because I operate my multiplier tubes at their rated input while other builders follow the good old California custom of doubling the manufacturer's recommended plate voltage. Or maybe I am just a careless builder.

After putting up with this nonsense for a couple of years it was decided to grip the bull by the horns and construct a souped up multiplier string. The next question was how to soup it up without turning it into a transmitter. Remembering K1CLL's article on neutralizing receiving type tubes in the August 1965 73, it was decided to try a 6AK5 straight through amplifier at the 3F point in the chain (141 MHz in this case).

The old multiplier string was modified to look like **Fig. 1.** Following K1CLL's advice, the 6AK5 amplifier was first tried without neutralization, and as usual, no luck. Next, we added the neutralizing loop and two twists of hook-up wire for Cn. Got the loop backwards the first time as predicted. Reversed the loop and "Voila" about ½ watt of stable rf energy at 141 MHz. How do I know it is watt? Well, it lights an NE 52 neon bulb if you touch the tip on the tank coil. Also, be it noted, the light goes out when you pull the crystal out of its socket, which it did not do prior to neutralization.

The writer uses the unit in Fig. 1 to drive a Raytheon 5656 dual tetrode operating as a push-pull tripler to 423 MHz. The 5656 has recently turned up in surplus houses at about $2.50 and is indeed a nifty UHF low power multiplier or amplifier. It appears to put out about ½ watt at 423 when used as a tripler. The writer used the plate lines out of an old APS 13 oscillator, ¼ wave at 423 MHz and a 4 turn grid coil resonant at 141 MHz and link coupled to the preceding unit (**Fig. 1**). The output of the 5656 is link coupled through the original APS 13 link to a varactor multiplier in my K6AXN/W6AJF mixer box which is tuned to 1296 MHz. This produces 350 μA of crystal current in the 1296 MHz mixer diode (1N21C) even when very loosely coupled and with the 5656 running cool (140 volts on plate).

In addition to now having all the mixer current I can use, there is an added bonus, (where did all the birdies go?). Apparently, as a result of inserting the straight through amplifier and the addition of three more tuned circuits followed by a push-pull tripler in place of the old single ended stage; all the birdies which normally wend their way

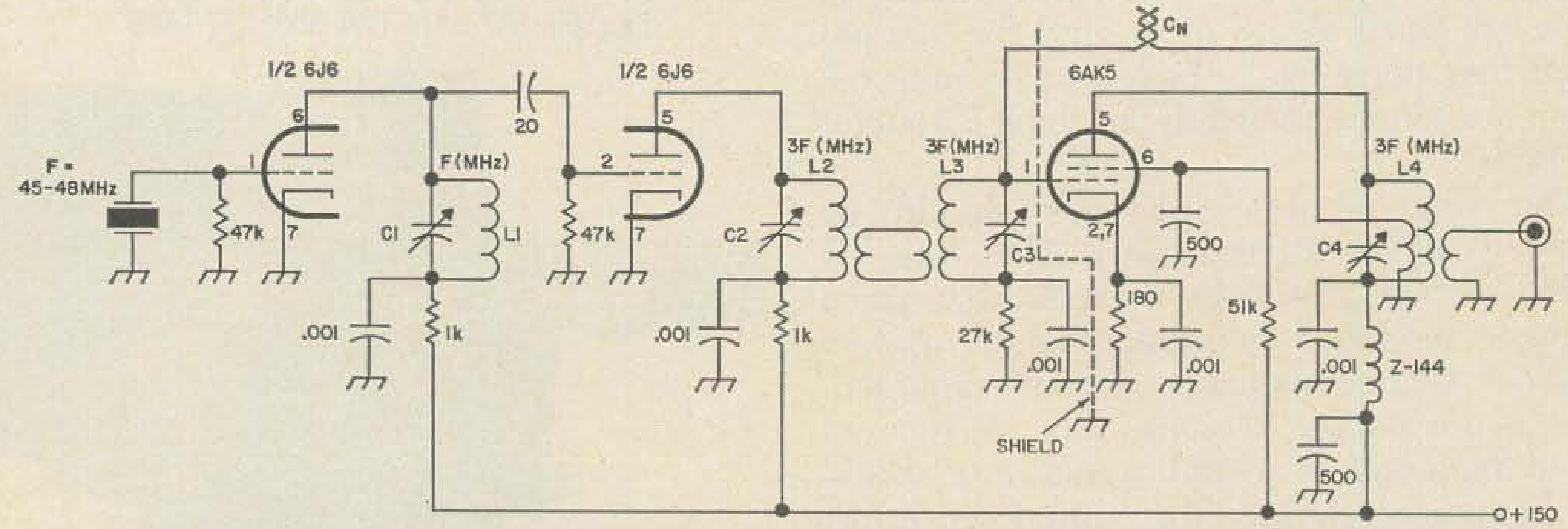


Fig. 1. Low power exciter-local oscillator. Output is in the 140 MHz range for use as local injection in a 1296 MHz converter.

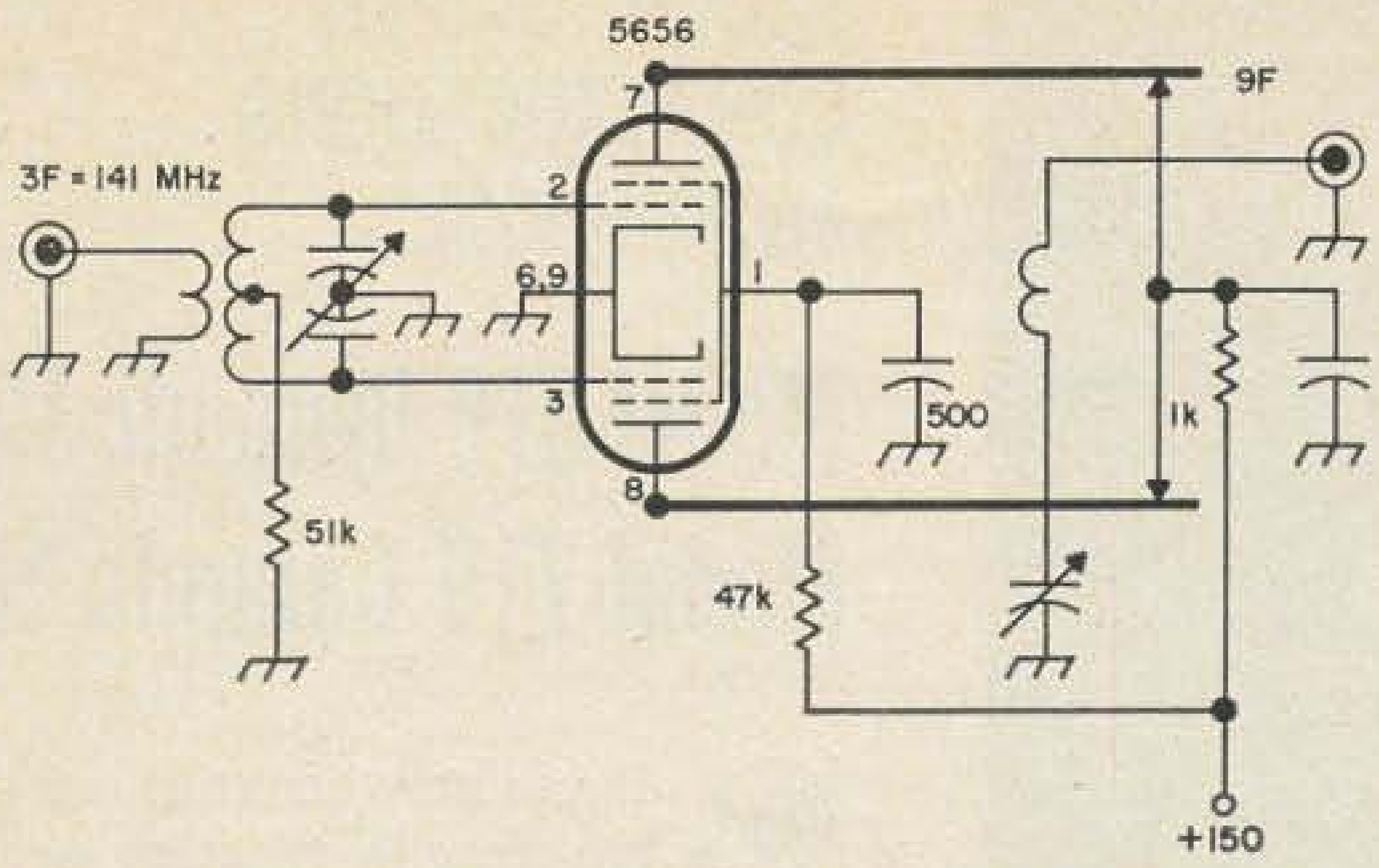


Fig. 2. Tripler from 141 to 423 MHz. This circuit uses the plate lines from the old APS 13.

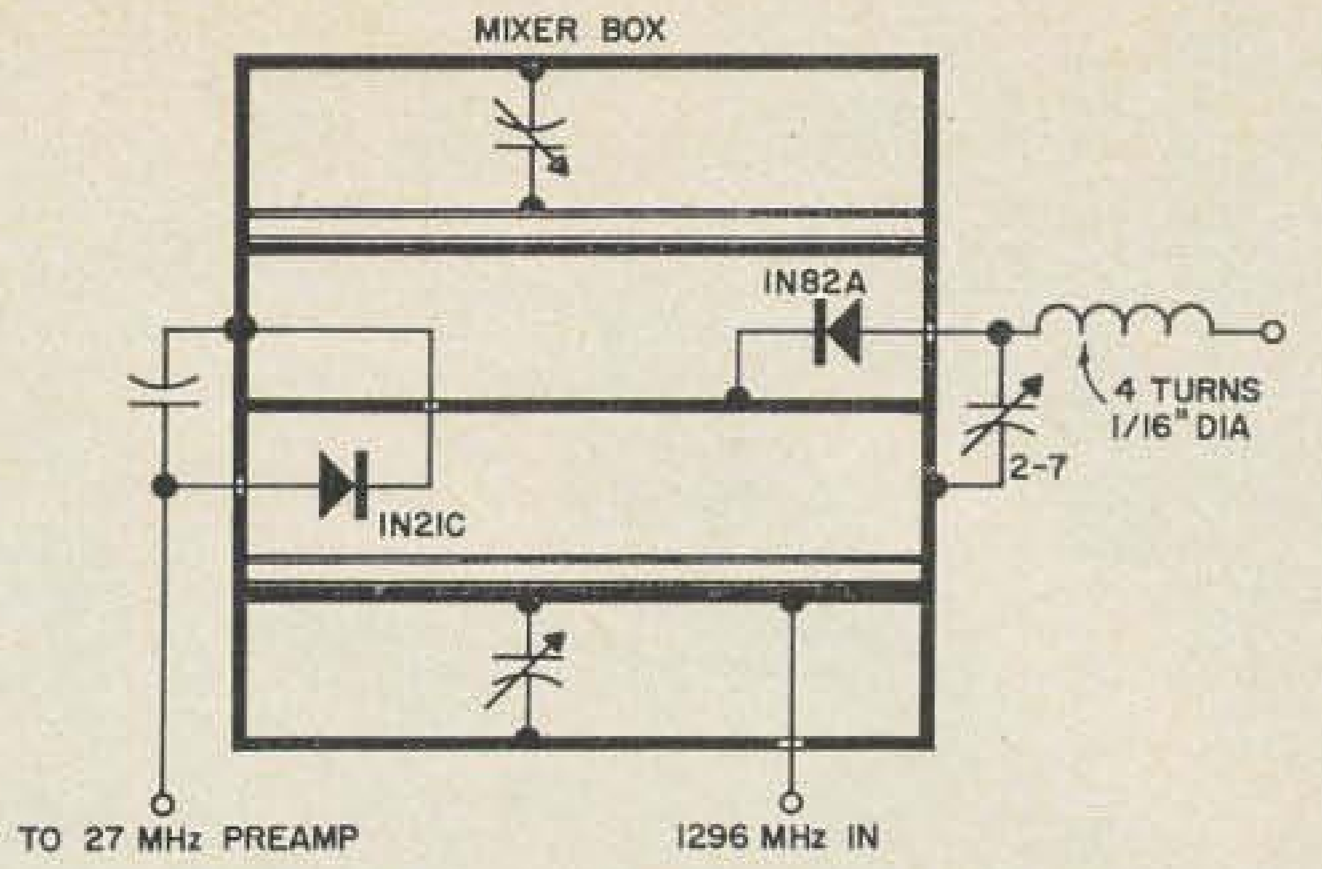


Fig. 3. 1296 MHz converter front end. Input at right is 423 MHz from the tripler in Fig. 2.

up the multiplier string were knocked out. This in itself would probably justify the effort.

It appears that commercial designers of military equipment (not ham equipment) feel that the use of push-pull triplers and link coupled straight amplifiers in a local oscillator chain is good practice. I have since discovered that the LO chain in the AN/FRC-34 1800 to 2000 MHz receiver, built by GE, has almost the same arrangement. They went a little overboard on power. The FRC-34 has an 832A where I have the 6AK5* and a 2C39 where I use the 5656. Who needs a transmitter? Just modulate your LO, provided it's in the band.

As a matter of fact, the 6J6-6AK5 unit would make a neat flea power two meter rig. All that is needed is a suitable crystal, like 48.4 MHz for instance, and a 6AK6 modulator driven by a carbon mike.

With regard to tube substitutions, the 12AT7 could be used in place of the 6J6 if desired. I can't think of a substitute for the 6AK5 off hand, but show me the UHF experimenter who doesn't have a few in his junk box and I'll send him a couple. The 5656 is a little more of a problem. A pair of 6J4's would also work. These little tubes have turned up in the surplus around here for as little as fifty cents a piece. They are outmoded as receiver amplifiers but still look mighty good as low power frequency multipliers up to at least 450 MHz. Check the Gm in your tube manual. There is the added advantage that if the APS-13 transmitter box is used, the 6J4's would plug into the 7 pin miniature sockets already there with only minor changes in the pin connections.

One final piece of advice with regard to the 1N82A varactor multiplier, I had all kinds of trouble driving these things until I tried the "L" network out of the ARRL *VHF Handbook* (see **Fig. 3**). Since that time, no more trouble has been experienced in getting the drive out of the 423 MHz tank and over to the place where it is needed on the ungrounded end of the varactor.

. . . W6OSA

Measure Relative Power and Plate Current

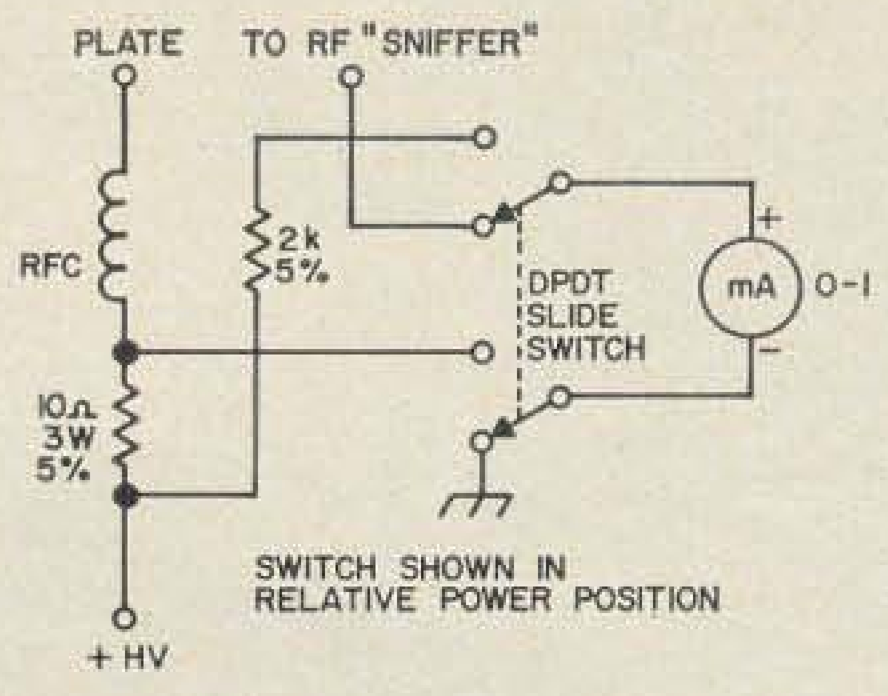
A relative power meter on a sideband transmitter or transceiver is quite useful in tuning for maximum output, but at times it is helpful to know the final plate current.

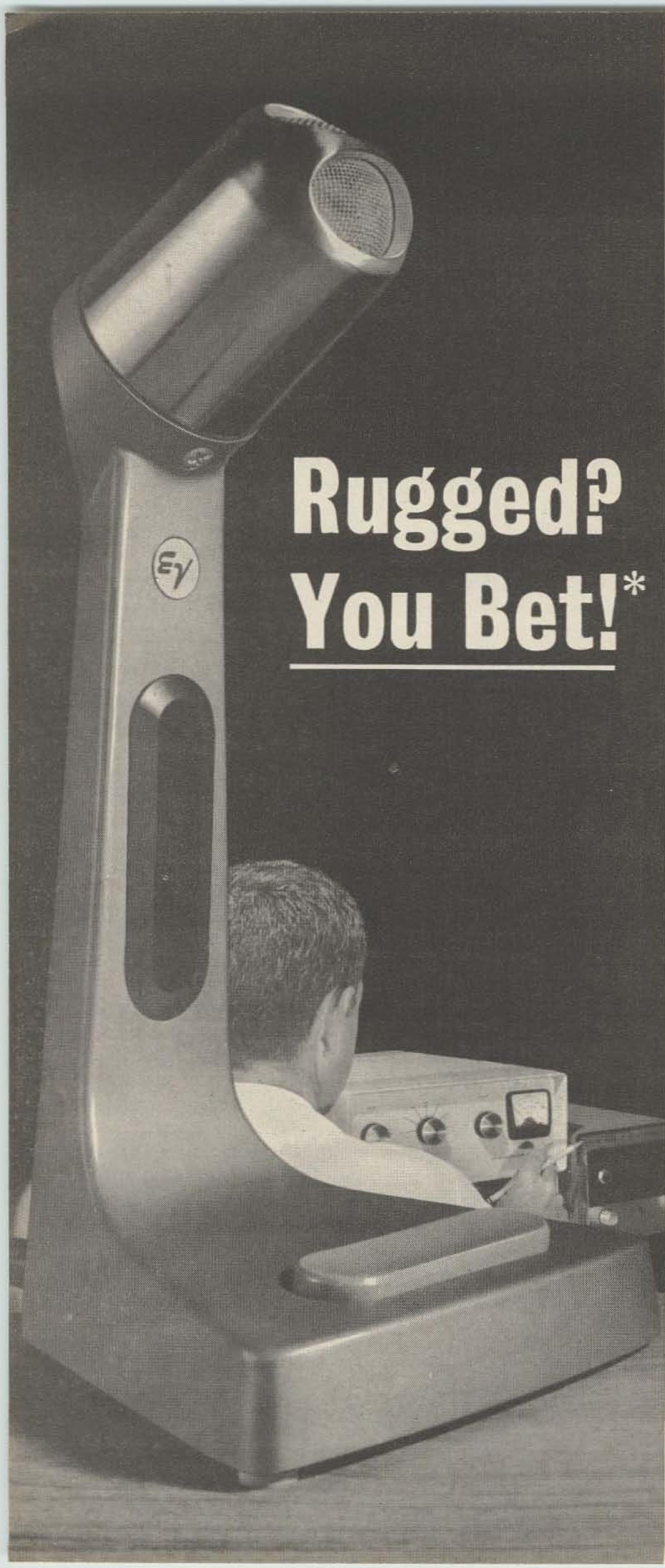
The circuit shown has been used on an HX-20 and has proved quite useful as a check on operating conditions, as well as an indication of power input. With the resistors used and the 0-1 mA meter switched, full scale deflection is approximately 200 mA. Be sure to insulate the meter and switch for full plate voltage.

The desire for a plate current meter arose upon changing the final tube to a 6146-B and increasing the plate voltage to 750 volts in an effort to obtain maximum drive for a linear amplifier.

Only a minimum of time and parts are required to install the above circuit and it is well worth the effort if it saves a final tube from going bad.

. . . Carl Pleasant W5MPX





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George Cousins VEITG
Box 18, RR 2
Lower Sackville, Nova Scotia

A Broad Band 80 Meter Vertical

Tired of narrow band antennas that have to be retuned when you change from CW to SSB? Here's an antenna that covers the whole 3.5 to 4.0 MHz band without any adjustments.

Being an advocate of DX and contests, most of my operating time is spent on 20, 15 or 10 meters, but there is the odd time that the urge hits me to try 80 and 40, especially during an all-band type of contest. Unfortunately the usual type of array which one finds on 20 meters and higher is in most cases impractical on the low bands because of size and cost. In order to get the necessary low angle of radiation so necessary for DX, the most logical type of antenna to choose is the vertical, but even this becomes a bit formidable when one gets down to 3.5 megahertz.

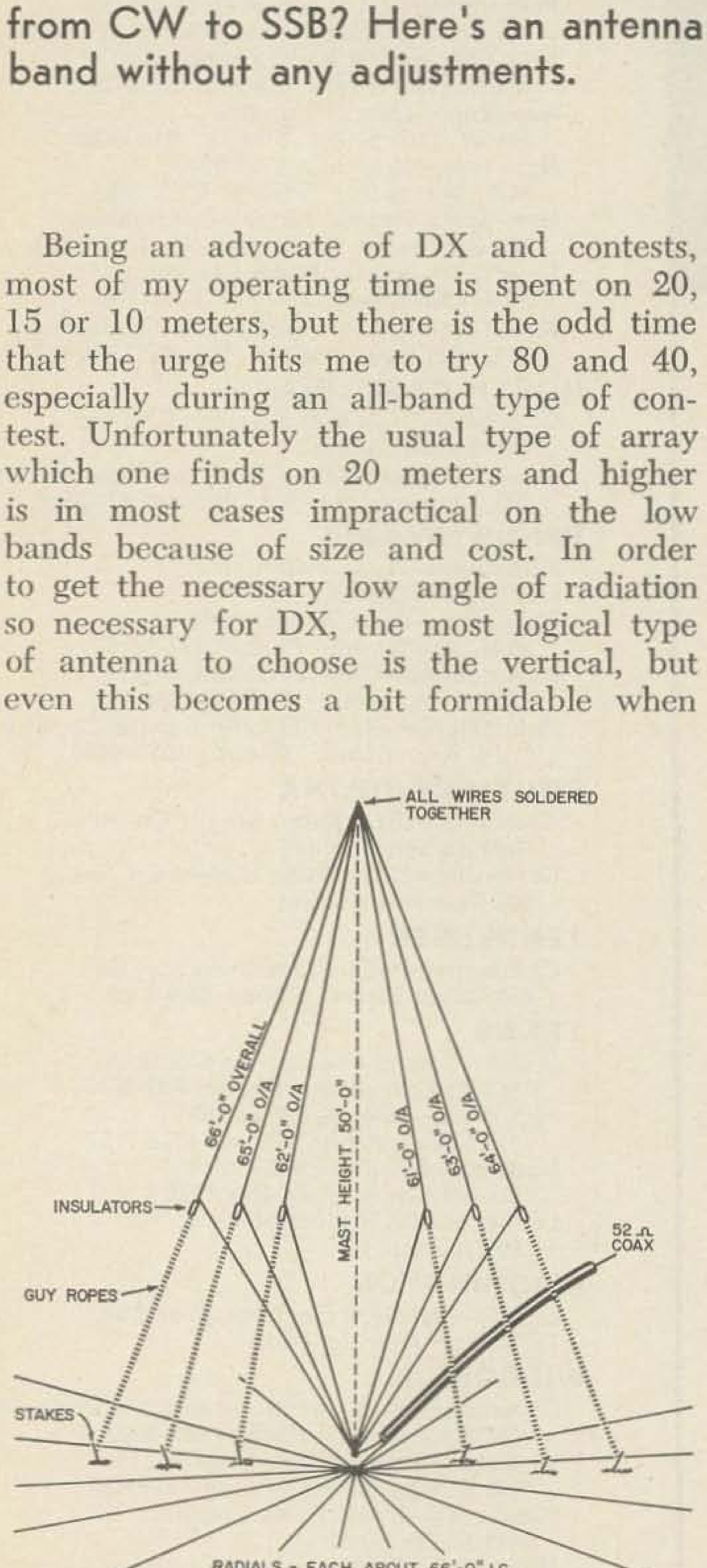


Fig. 1. Basic configuration of VEITG's broadband 80 meter vertical. The idea is old, but it works well.

My old reliable antenna for 80 was the familiar inverted V, or drooping dipole, which has served me well in many different places. The same goes for 40, but having finally landed in a fairly permanent QTH it seemed the time had arrived for a more serious effort.

As far as 80 was concerned, the major requirements of the antenna were:

1. Simplicity and ease of construction.
2. Low cost.
3. Low angle of radiation for DX work.
4. Broad band of operation to cover both 3.5 CW and 3.7 to 3.8 SSB.
5. Coax feed.

Considerable thought was given to the usual ground plane type of array, but considering the heights involved, this was discarded in favour of the vertical quarter wave with radials on the ground. As will be seen, the actual result was quite a departure from the usual single vertical radiator. **Fig. 1** shows the complete design of the antenna in its final form. The main support of the antenna is a 50 foot wooden A frame. Six lengths of wire are cut. The longest is 66 feet, and each other wire is one foot less, with the shortest being 61 feet. The upper ends of the wires are well soldered in parallel, and are mounted to the top of the A frame by whatever means is convenient. In my case I used a stainless steel strap which encircled the top of the mast, and to which a large cable clamp was bolted. The wires were then soldered to the clamp.

At a point about two-thirds down the length of the wires, an insulator is fastened, and by using ropes or other suitable strong lines, the six wires not only act as radiators but also as guy wires. Note from **Fig. 2**, that the wires are merely looped through the holes in one end of the insulators and then carry on down to the base of the A frame. At this point, all six wires are again soldered together and fastened to the mast by the use of a stand-off insulator. Now when the guy ropes are pulled tight, the antenna becomes a conical shaped multi-element vertical. Because each wire is a different length, and each length is resonant at some point in the 80 meter band (¼ wave) the antenna as a whole is broadly resonant over most of the band. In my own case, I was only interested in operating up to about 3.8, but the antenna performs very well right up to 4.0 MHz.

The vertical structure is really very simple to build, as the wires are actually nothing more than insulated guy wires for the A frame. The construction of the frame will be covered in a moment, but first let's finish the antenna. The only way to really get the most out of the array is to have as good a ground radial system as possible. There is probably only one rule-of-thumb on radials: the more, the better. Being very cost-conscious, I found the cheapest source of copper wire for the radials was the nearest motor-repair shop. There is undoubtedly such a shop somewhere near every small town in the country, and of course in a city there will be quite a few. You'll find that in most cases you can get old motor coils either free or for a nominal charge-usually based on the junk value of copper per pound. Another excellent source of such wire is an old line transformer or distribution transformer which your local utility may have removed from service. In a farming area, electric fence wire is fine.

The method of laying the wire must be

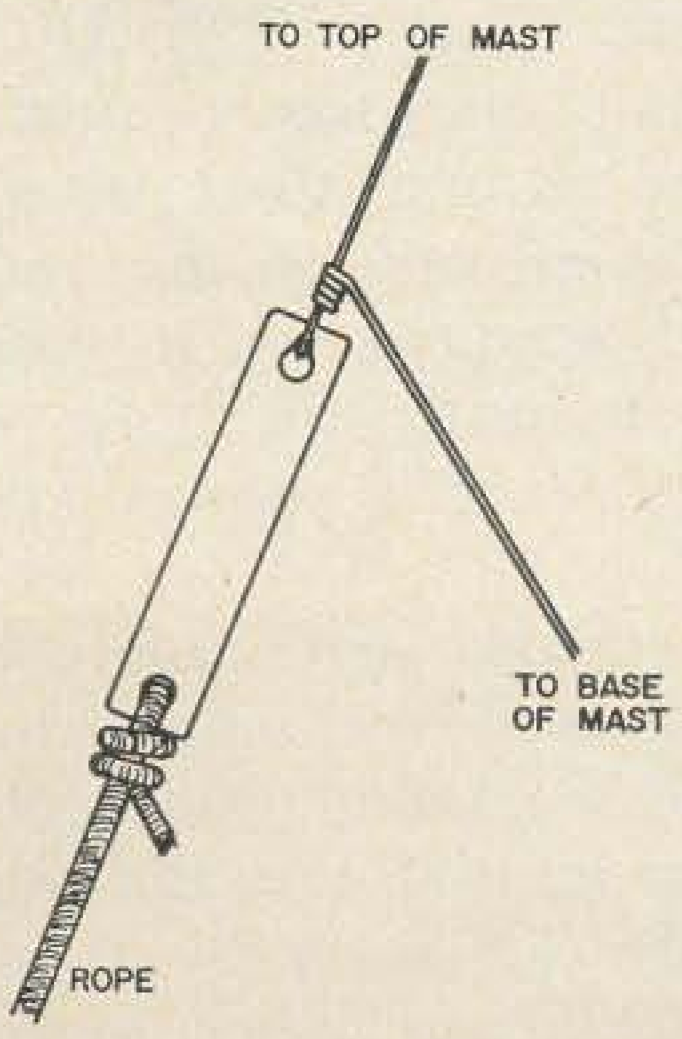


Fig. 2. Details of the insulators in the antenna.

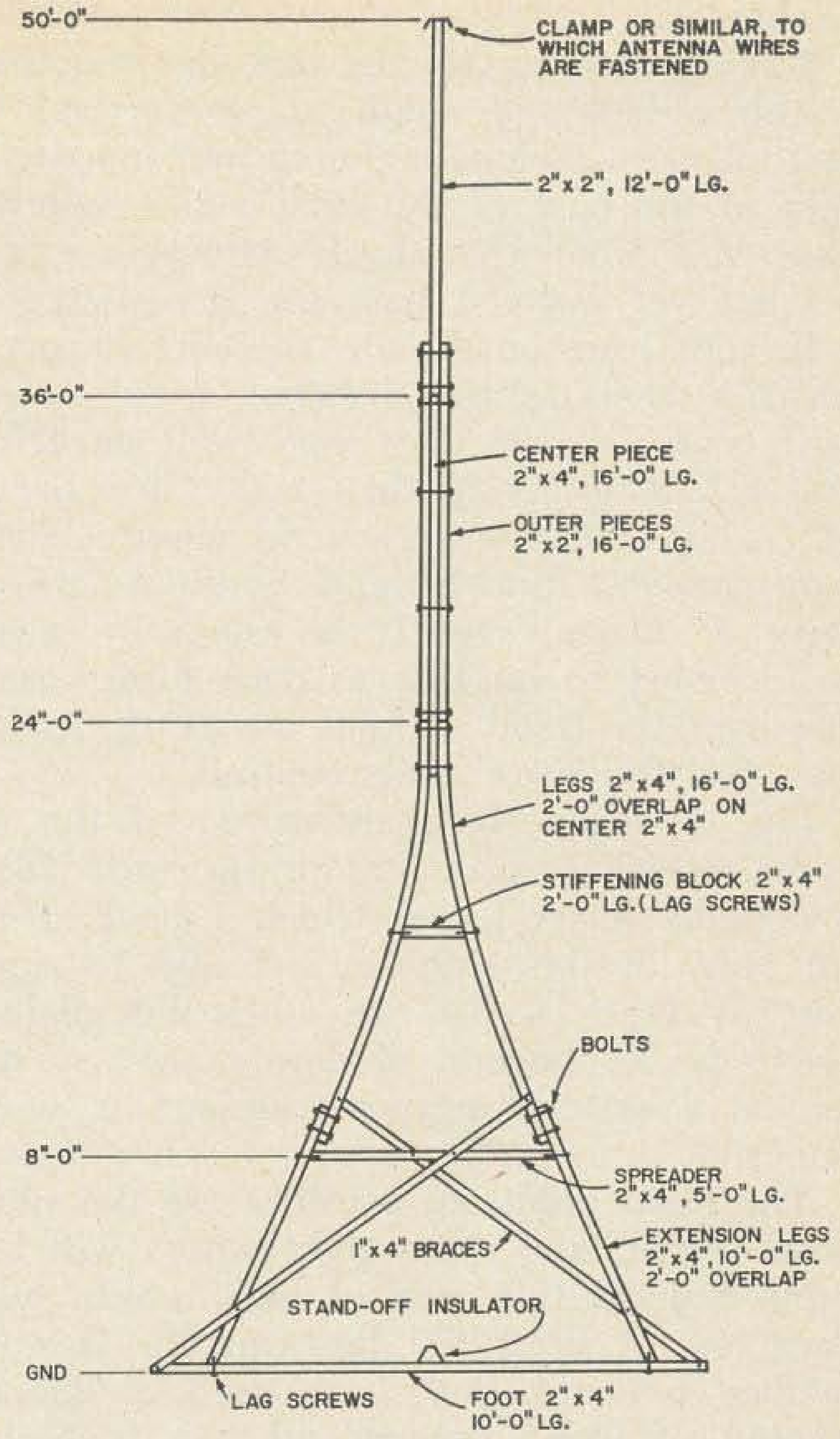


Fig. 3. Construction of the 50 ft. wooden mast for the vertical. Don't use a metal mast.

determined by your own geography. In grassland or sod, it's easy to cut a slit in the sod and tamp the wire down out of sight. In rocky terrain, it may be necessary to either dig out a path or merely lay the wire on the ground and cover it with some loose dirt or sand. The wires need not be in a straight line; almost any configuration will work.

You will find that laying the radials is the biggest and hardest part of the array, but doing a good job here will really pay off on the air.

In the case of my own antenna, I used RG-8 coax, 52 ohm, which matched the thing very well without the use of any other devices. The SWR over the band was about 1.3 to 1.8, which is certainly good enough. Undoubtedly the match could be made more perfect at some frequencies, or a tuning unit could be used to adjust the antenna as one moved across the band. However, the best feature of the antenna as it stands is one's ability to move around the band at will, and without any extra tuning encumbrance.

Making note of the fact that the antenna is also a half-wave high at 40 meters, I have plans to include a tuning unit mounted right at the base of the mast and remotely controlled from the shack. However, this has not yet evolved past the paper stage.

In actual use on the air, the antenna performs as well as the inverted V on short haul contacts, and does very well on DX. Best DX (considering their rarity) has been ZD7 and VS9, but very good reports have been received from Europe, South America, parts of Africa, etc. It is especially nice in a contest to be able to dash hither and yon over the band without constantly grabbing for the plate tank controls!

Fig. 3 shows the construction of the A frame, which is very straight-forward. This is actually an A frame which I have used not only for this antenna, but also to support at times a 40 meter ground plane, inverted v's, one end of dipoles, etc. so its use as a general purpose support is very extensive.

The main points to consider are the ultimate height, and the weight which will be supported. In this area of high winds, ice, sleet, etc. I used the best quality 2 x 4 lumber I could find, and used a liberal coating of wood primer and two coats of exterior house paint. Since the longest lumber I could find was 16 feet, I used extension pieces on the bottom. At the top, I used two lengths of 2 x 2 to both steady the upper piece of 2 x 4 and also to act as a bracket into which the top section of 2 x 2 was inserted. Since the radiators are acting as guys fastened right at the top, the 2 x 2 is plenty strong enough. Depending upon your local weather conditions, you may or may not require the use of a second set of guys about half way up the tower.

When the A frame is laid out for raising, the wide base will make it an easy task for three people. In fact, if you can secure your guys at right angles and have the use of a small block and tackle, with a tree or similar anchor, you can raise the mast all by yourself.

Because of slight flexing and "working" that takes place in a high wind, I would suggest using only bolts in the mast; nails have a habit of working out at the most unlikely and least desirable times. The guy ropes need not be expensive; I use synthetic cord used to make deep-sea fishing nets, and it works very well.

As a last comment, I hung a 40 meter inverted V right at the top of the mast, and found that this upset the SWR considerably on the vertical, pushing it up to about 2.5 all over the band. This can be taken out by a little tuning at the base, but is probably best avoided by simply not hanging anything else on top. After all you have gone to the trouble of making a pretty good antenna so why spoil it?

. . . VE1TC

Temporary Knobs and Tuning Tools

When working with gear have you ever come across a control you couldn't adjust? It may be inaccessible (as inside an *if* can), or odd shaped, or both. Tools fitting some of these shafts aren't even in the catalogue let alone on your workbench. Fortunately there is a quick, cheap, easy solution to the problem—the ubiquitous ballpoint pen.

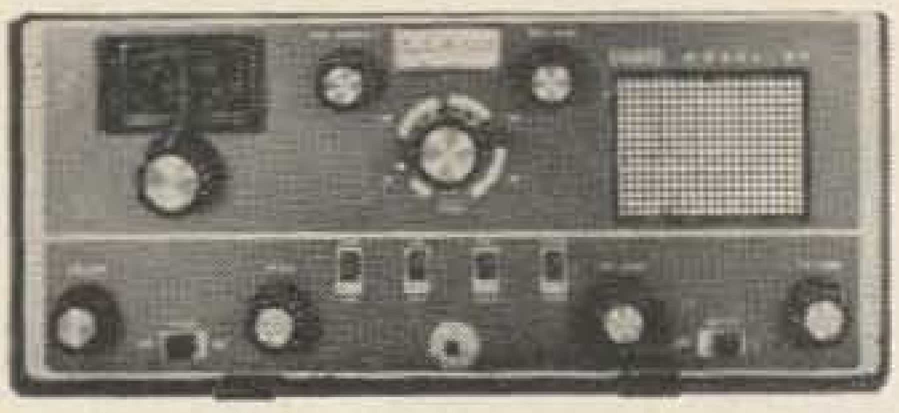
Here's the trick. Take the plastic outer barrel of the (presumably) empty ballpoint and remove any metal molded to it. This can be done with a match or a cigarette lighter used as a cutting torch. In the same way melt the barrel till the end is almost the same size as the shaft to be turned. Do this so the barrel will still fit into the space available. Now *slowly* heat the end until the plastic is just softened. Quickly push over the shaft and let it cool. You will have no trouble removing the pen in a few seconds after it has hardened completely. If done carefully, this process can be repeated several times until a good fit is obtained.

You now have an insulated tool of surprising durability. I have used the same pen barrel to tune a T23/ARC5 for five years. Another one has turned the moth-eaten splined tuning shaft of a Q-5'er all around the passband of my receiver since Christmas. I suppose as it wears out I'll just reheat it until the cost of matches approaches that of a surplus knob, or vice versa.

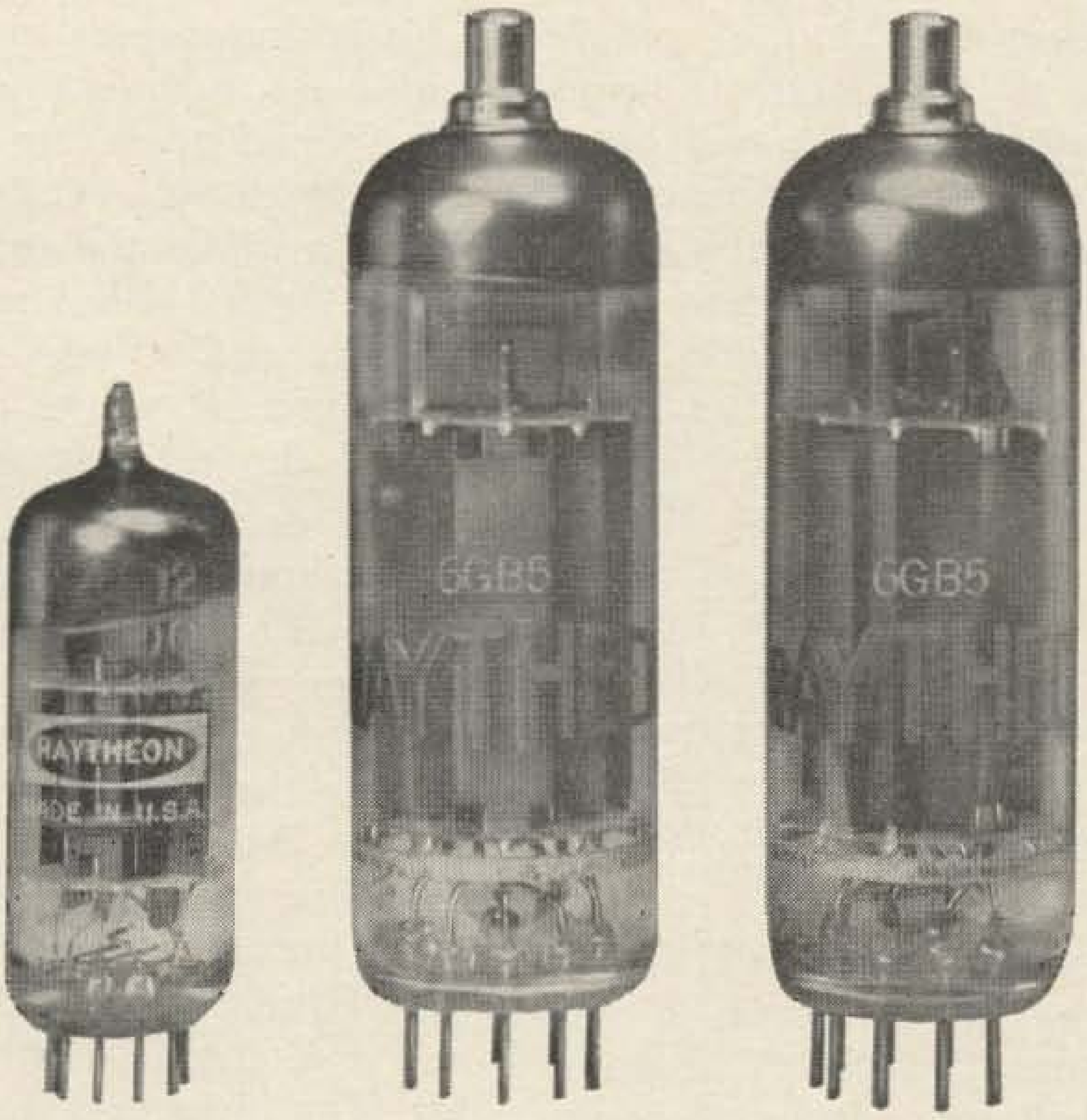
You can squeeze even more out of this. A tapered barrel can be treated on each end to make a combination tool. Other applications are limited only by ballpoint sizes, and probably not even by that, using the amateur's last resort . . . ingenuity.

. . . Thomas Kuffel K0YPB

SBE



three tube transceiver



In the advanced **SB-34** design, 23 silicon transistors, 18 silicon diodes, a zener and a varactor replace tubes everywhere except in RF driver and parallel-connected output amplifiers. And the only reason transistors are not used in these applications is that high power units are still far too expensive for a complete-with-dual power supply, 4-band SSB transceiver that is in a price bracket all by itself.

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Bob Kolb WA6SXC
1300 W. Oak
Fullerton, California

A Reliable Directional Coupler and VSWR Bridge for VHF-UHF Use

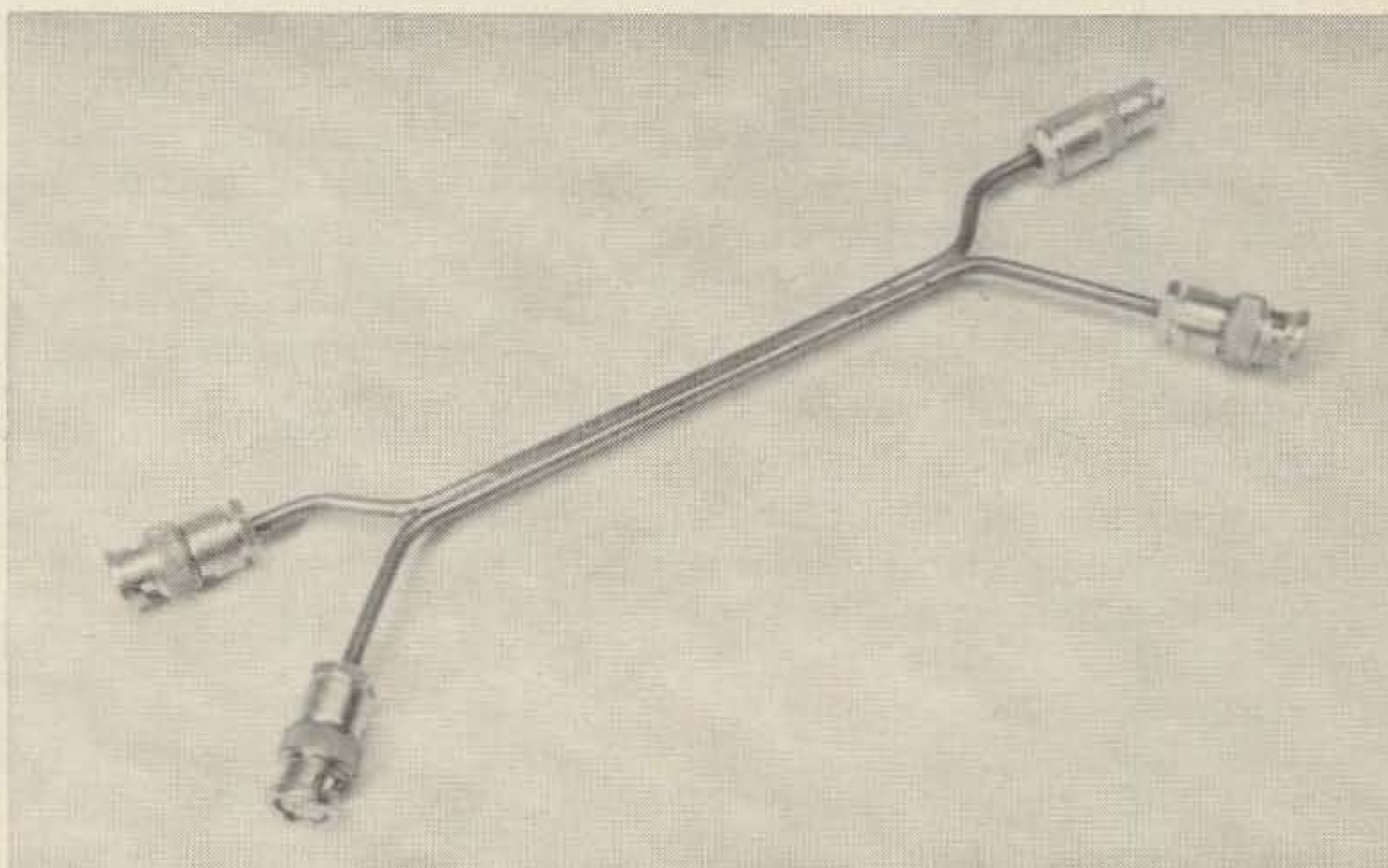
The average VSWR bridge isn't very satisfactory in the VHF or UHF range. This article describes an easily reproducible directional coupler that can be trusted even at 1300 MHz.

The aerospace industry has fostered the development of many new components and materials. Hams, being the kind of people they are, are quick to see practical applications for these materials that never occur to design engineers. I have often heard the criticism that it is impractical to publish articles or design ham gear with these new or expensive materials, because most OM's don't have access to them. Yet I've often been dismayed when I learn of an application for a piece of surplus equipment after it is no longer available. For this reason I feel that we should publish any application that is practical regardless of how immediately it can be used. Sooner or later, the material will show up on the surplus market and then we'll know what use can be made of it.

Reliable test equipment for the VHF-UHF bands is difficult to come by on a low budget. The literature is full of "relative" measuring devices but few pieces of homebrew gear are engineered for repeatable performance. Several directional couplers have been built according to the description in this article and each has measured to within ±.5 dB of the designed value. This is due in part to the mechanical rigidity and close tolerance of RG-141 "coaxitube." No special tools are required outside of a cheap pair of vernier calipers. The tools used to make the original coupler were an Xacto knife, file, soldering gun, vernier calipers and a vise. Don't let the calipers scare you. If you're not after a closely calibrated device they may be omitted.

The design goal was a directional coupler with about 30 dB directivity in the passband with a low insertion loss. Each milliwatt measured at the coupling arm equals one watt through the main line. Such a device is the heart of a good quality VSWR Bridge. The measured values were 30.3 dB coupling and 38 dB directivity at 432 MHz. Data presented in the graph was taken using HP608C and 614A signal generators and a General Microwave R. F. Power Meter. The measured insertion loss was 0.2 dB.

Resolution of the smallest possible VSWR is limited by directivity. Few of the handbook VSWR bridges or the low cost type



This UHF directional coupler is very simple to make, yet offers excellent performance on the 70 and 23 cm bands.

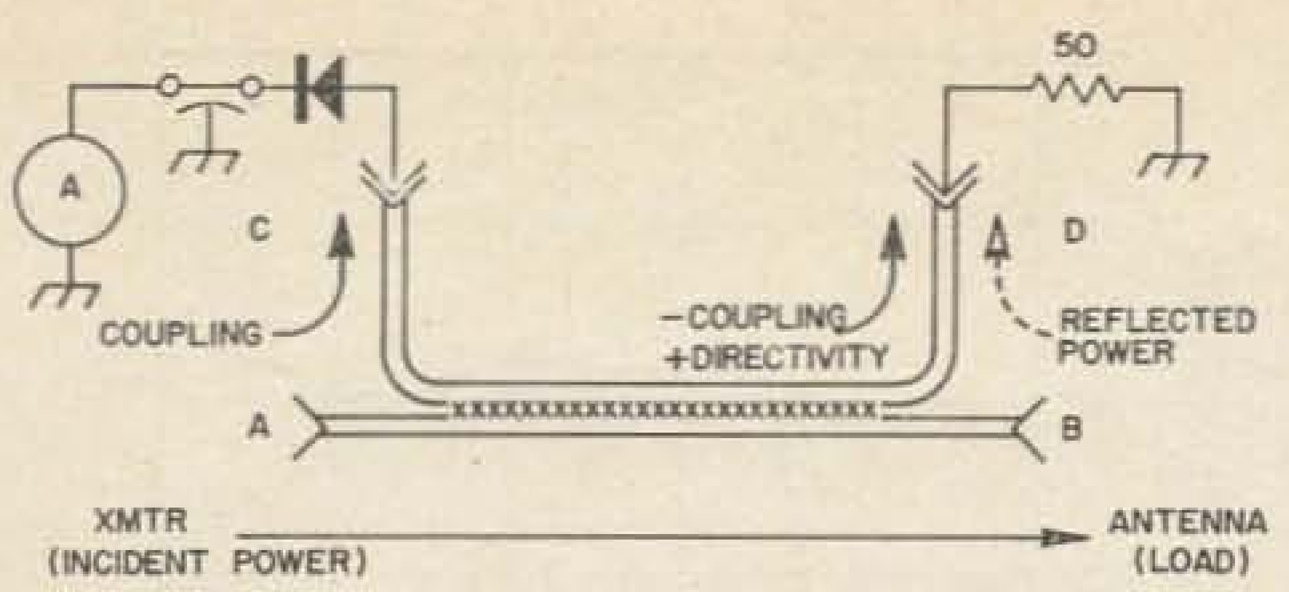


Fig. 1. A typical directional coupler. This device is the heart of a VSWR bridge, and can also be used for many other applications.

attractive to the CB trade achieve as much as 20 dB directivity. Thus the minimum discernable VSWR is approximately 1.7:1. With 38 dB directivity, 1.02:1 VSWR's can be accurately measured.

Directivity may be defined as the isolation of arm D from arm A, over and above the coupling as shown in the **Fig. 1.** Coupling is achieved by removing part of the jacket between adjacent coax conductors. If the input is at arm A, incident power can be sampled 30 dB down at arm C but appears −68 dB at arm D. Reflected power entering arm B is sampled −30 dB at arm D while at arm C it is −68 dB. It stands to reason if the directivity is low, one cannot tell with certainty if he is measuring incident or reflected power. Port D may be used as the dc return for a detector at port C and vice versa.

This device will have its fundamental passband where the length exposed between the two lines is $\lambda/4\sqrt{\epsilon_r}$. It will also have a passboard at $(2n - 1)\ \lambda/4\sqrt{\epsilon_r}$ or at three, five, seven, etc., times the frequency for which it is a quarter wave. Hence a coupler designed at 432 MHz is usable at 1296 MHz.

This coupler has also been used to measure relative power and modulation at 2 meters where its coupling factor for incident power is approximately −40 dB but the directivity is poor, hence arm D must be terminated in 50 ohms. It's a real aid for tune up and will give a good indication of increased power with AM modulation right in the r.f. line. RG141 will handle 500 watts of rf up to 2000 MHz.

The formula for determining coupling length is

$$\frac{c}{4f_0\sqrt{\epsilon_r}} = \frac{\lambda c}{4\sqrt{\epsilon_r}} \quad \text{or} \quad \frac{300 \times 10^8\ \text{cm}}{4 \times f_0 \times \sqrt{2.1} \times 2.54\ \ ^{\text{cm}}/_{\text{in}}}$$

$$= \frac{\lambda\ c\ \text{inches}}{4\sqrt{\epsilon_r}}$$

$\sqrt{\epsilon_r}$ for Teflon $= \sqrt{2.1} = 1.449$

From these calculations $\frac{\lambda \text{coupling}}{4}$ at 432 MHz is 4.73 inches. With an Xacto knife cut two pieces of line 8.73 inches long and carefully bend them so that they form the shape shown in **Fig. 2A.**

Clamp the bent coax into the vise and file away the copper jacket taking care that the filed surface is smooth and flat. A belt or stationery disc sander works well too. A cross section of the filed piece should look like **Fig.** 2B. Next fit the two pieces together so that a cross section would look like a figure 8 and secure in a vise. Heat with a soldering gun only. Do not use a torch. Avoid excessive heating. Flow solder between the two lines as shown in **Fig. 2C.** The "arms" can now be bent into any convenient configuration provided enough allowance is made at the ends for connector assembly. A good rule to follow is a minimum bend radius of half an inch although a quarter inch radius is permissible. The arms should be approximately two inches long.

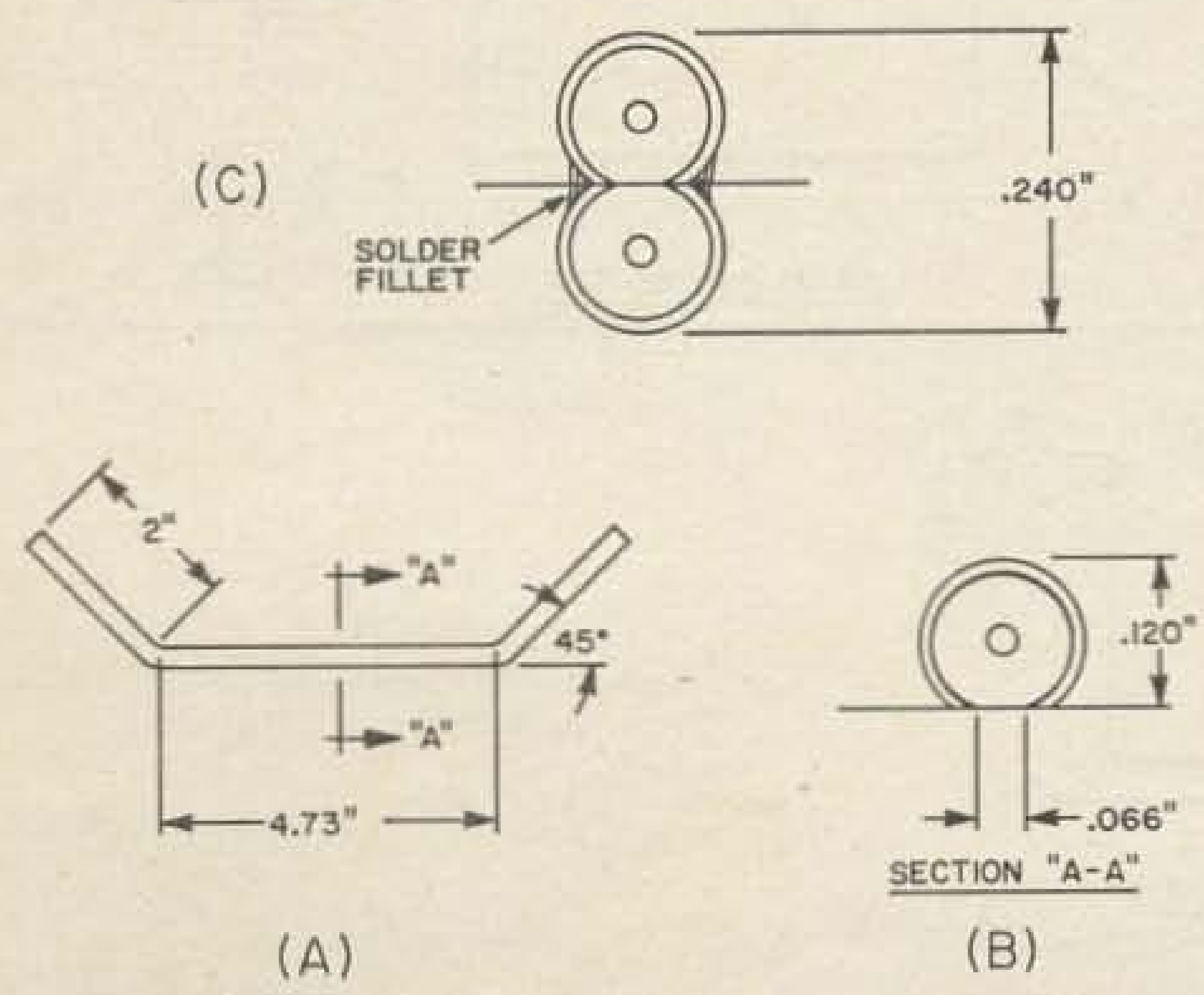


Fig. 2. Details of the construction of the UHF directional coupler.

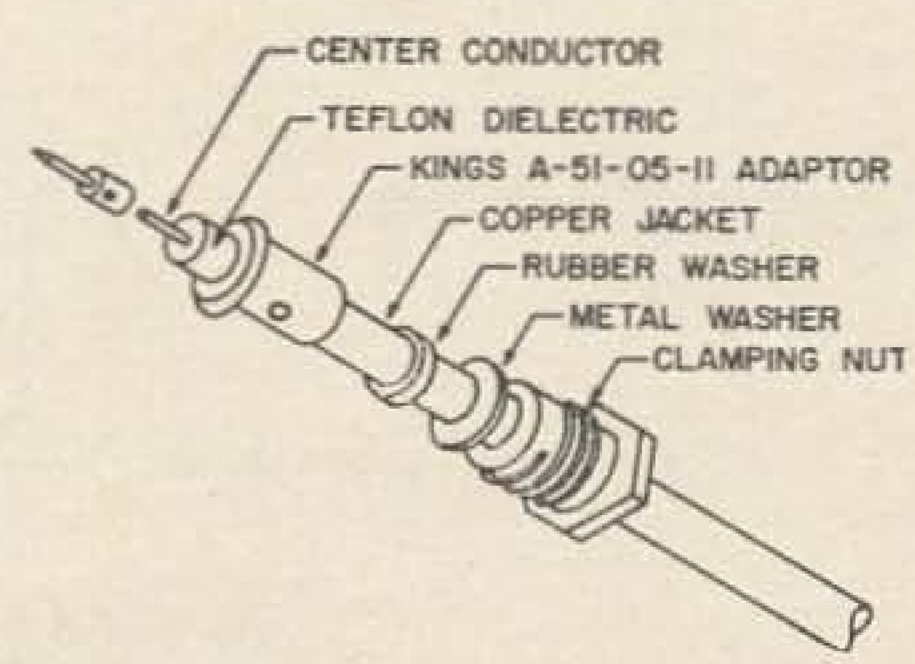


Fig. 3. Use of Kings A-51-05-11 adapter for using GR-141 with standard BNC connectors.

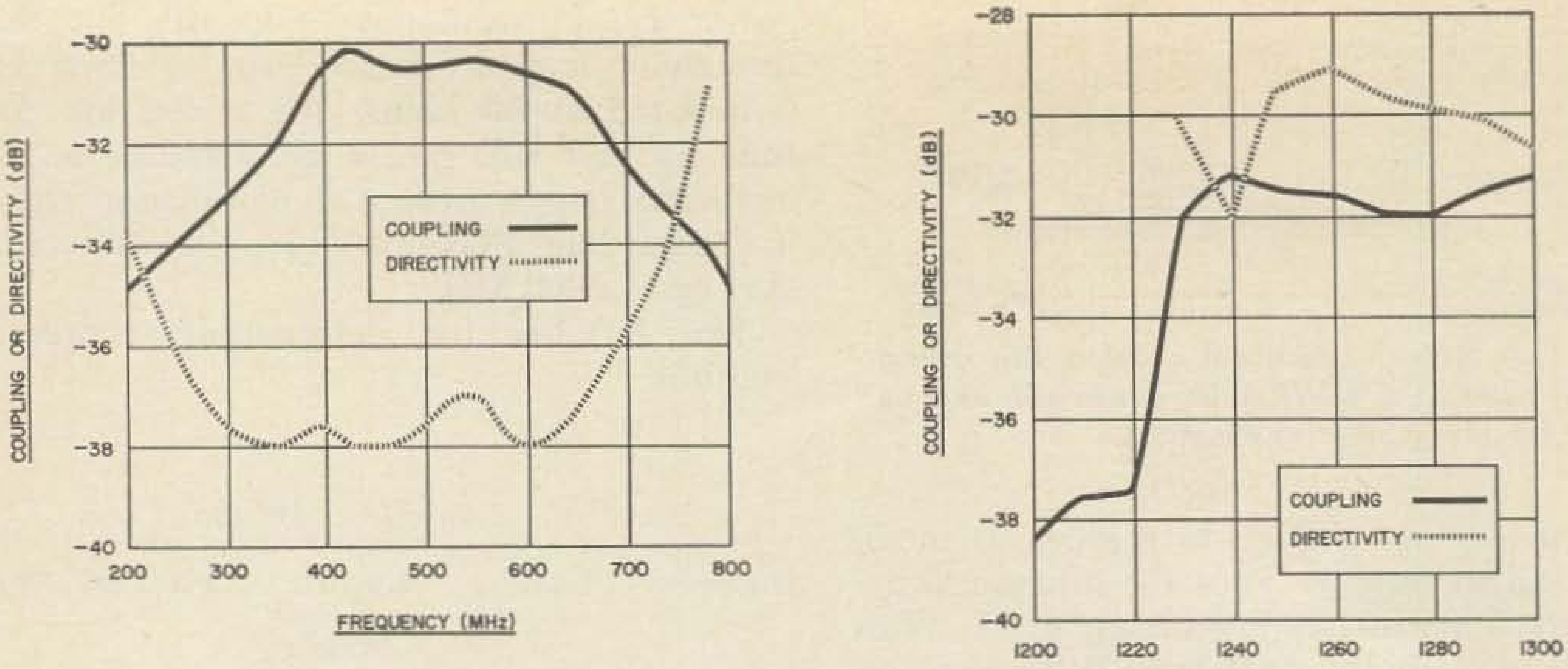


Fig. 4. Coupling and directivity for a directional coupler similar to the one discussed in the text. This device used a coupling wavelength of 4.635 inches rather than the 4.73 inches specified in the text. The only effect of the longer wavelength is to center the curves on 432MHz instead of about 500 MHz.

RG 141 has the same cross section as RG 58/U *without* the vinyl jacket therefore any connector that will accept RG 58/U can be used on RG 141 provided a sleeve is made up to make a snug fit in the clamping nut. A special adaptor is made by Kings for this purpose and sells for 45 cents. The connector assembly is shown in **Fig. 3.** Three RG 88E/U and one RG 89C/U connectors were used on the coupler shown in the photo.

Fig. 4 gives the measured directivity and coupling for this type of directional coupler at both 70 and 23 cm. You can see that performance is quite satisfactory.

Fig. 5 lists a number of applications for a directional coupler. The detectors in the measuring instruments should be suitable for use at 500 or 1300 MHz.

. . . WA6SXC

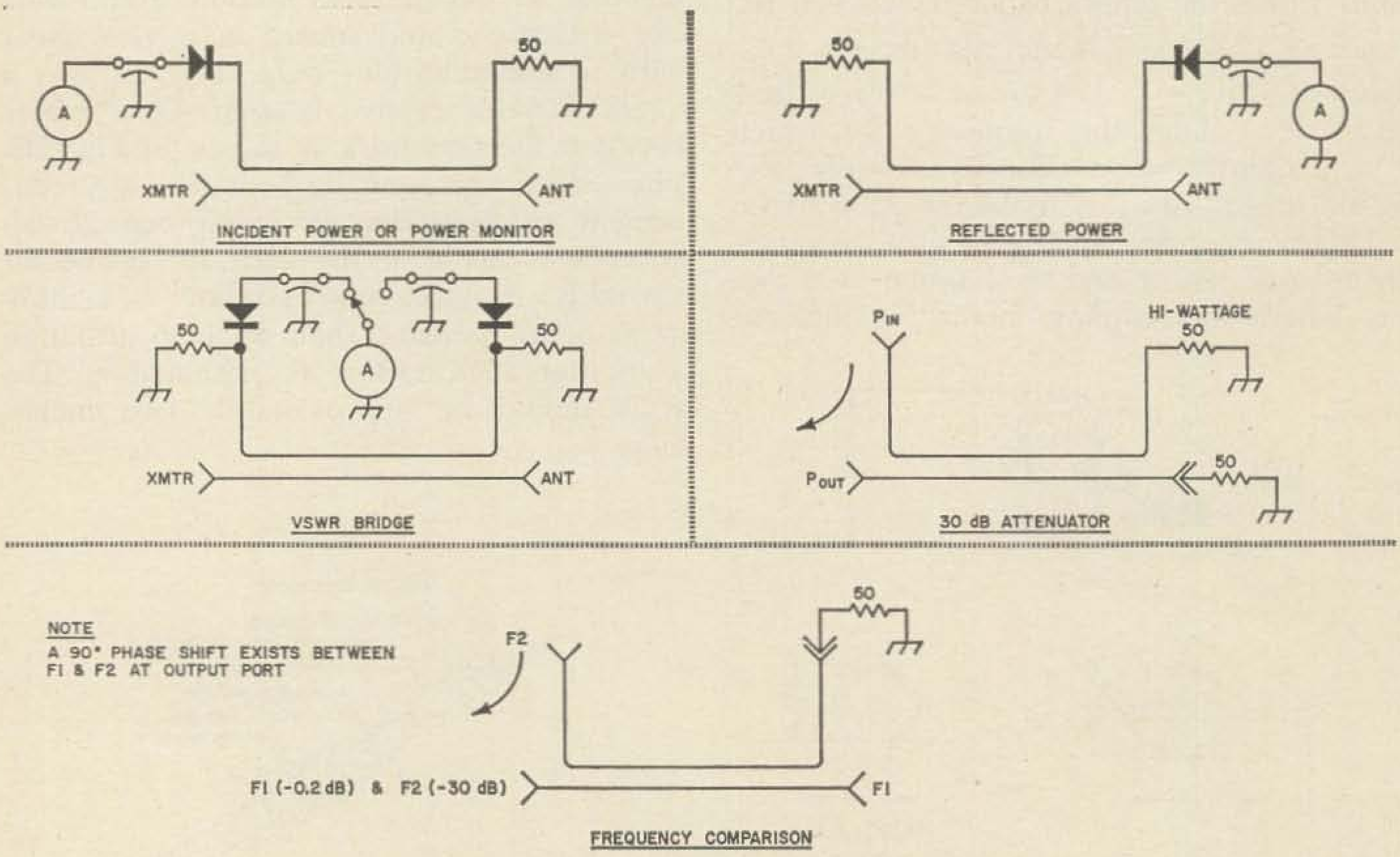


Fig. 5. Applications of the directional coupler described in the text. Unlike most pieces of ham-made test equipment, this one is good at 450 and even 1300 MHz.

Common Base Mixer

The transistor common-base configuration offers good frequency response, isolation between input and output, very high output impedance, and lots of gain.

Generally used only as an amplifier, it also makes a fine mixer. The parts required are one transistor, an output arrangement, and perhaps a resistor and capacitor. **Fig. 1** shows the complete circuit.

L1 and L2 are low impedance links bringing the rf and local oscillator signals. They are in series as shown, not in parallel. No base biasing network is required.

L1, the oscillator input, is wound for about 1 mA of mixer current. R and C are there only so you can measure this current without breaking into the circuit. Then L2 is set up for good signal performance, starting with about one-tenth as many turns as there are in the rf or antenna coil.

Z is the output load. It may be the tuned circuit of an if transformer, or a unity-coupled input to a regenerative detector. What . . . don't you know what a unity coupling is?

Fig. 2 shows a unity-coupled coil. The two equal windings are wound together. Since the mixer generates lots of noise, including a fine audio hiss, it cannot be coupled directly to some regenerative detectors. The unity coupled winding has practically the same rf characteristics as a direct coupling, but doesn't transfer the audio and dc. Simple!

. . . Jim Ashe W2DXH

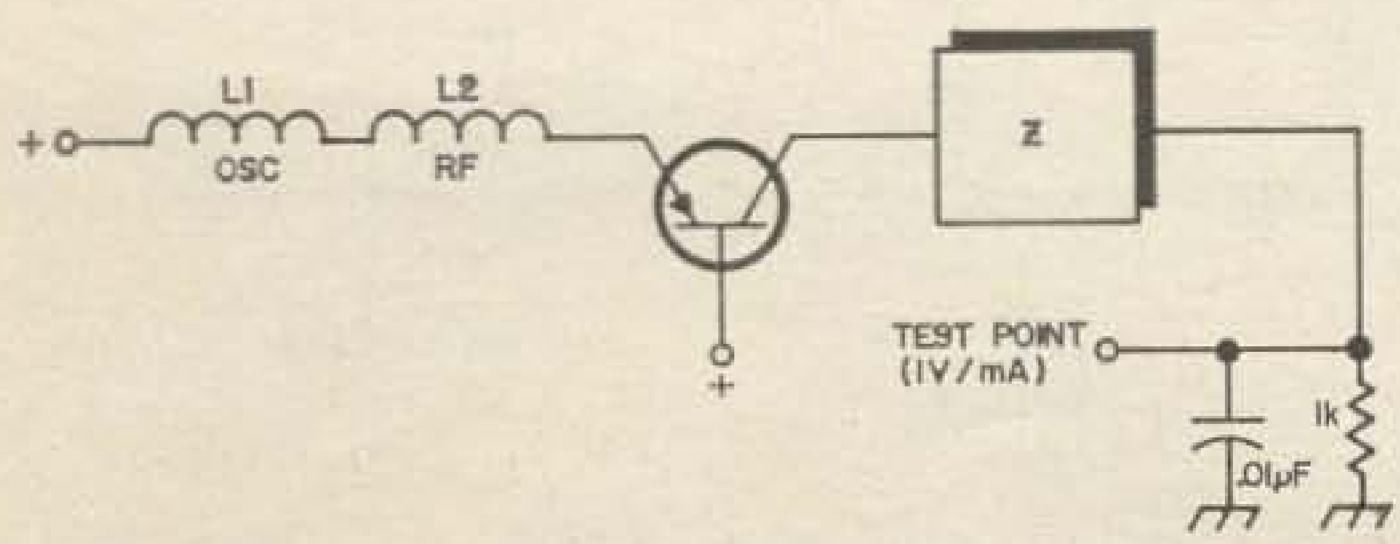


Fig. 1. A PNP common base transistor mixer.

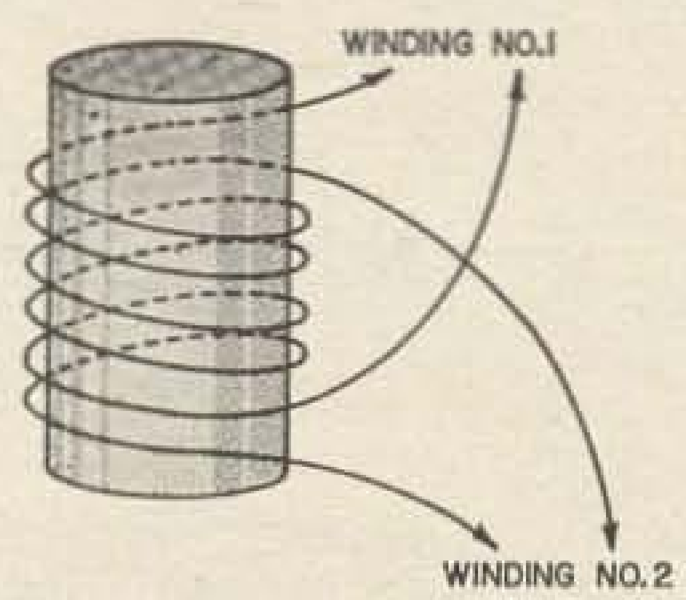


Fig. 2. A unity coupled coil as used for Z in Fig. 1.

Jackson S. Wright K2IYC
86 Brook Road
Red Bank, N. J. 07701

A Solid State Antenna Relay

Mechanical relays and conventional TR switches are unsatisfactory for the ham who wants to enjoy the ultimate in operating. This silicon diode switch offers excellent performance and overcomes the faults of other methods of switching.

A TR switch is basically a single pole single throw switch in series with the receiver, which is controlled by transmitted rf. An antenna relay is a single pole double throw switch controlled by a dc signal. A TR switch has several disadvantages, notably suckout and TVI. A mechanical antenna relay is slow and noisy. A solid state antenna relay has all the good features of both.

The device described here is a diode double throw switch with a dc control lead. It causes no suckout or TVI and does not require tuning. It is fast and silent in operation. It introduces negligible loss on receive.

Theory

The basic switch element in this relay is an ordinary silicon rectifier. **Fig. 1** shows how dc bias and an rf signal may be combined on a diode. If the dc bias is in the reverse direction, the series rf impedance is high (open switch), and if the dc bias is in the forward direction, the rf impedance is low (closed switch). Both of these conditions hold only if certain constraints are met. In the reverse case, the peak rf voltage must not exceed the dc bias or rectification will occur (hence TVI). In the forward case, the rf current must not exceed a value relative to the dc bias which would remove all stored charge in the diode in less than ½ cycle; with typical rectifiers this means rf peak = 10 times dc average at 3.5 MHz. Thus a circuit like **Fig. 1** is an rf switch which can be controlled by a dc bias.

Fig. 2 shows how four such switches can

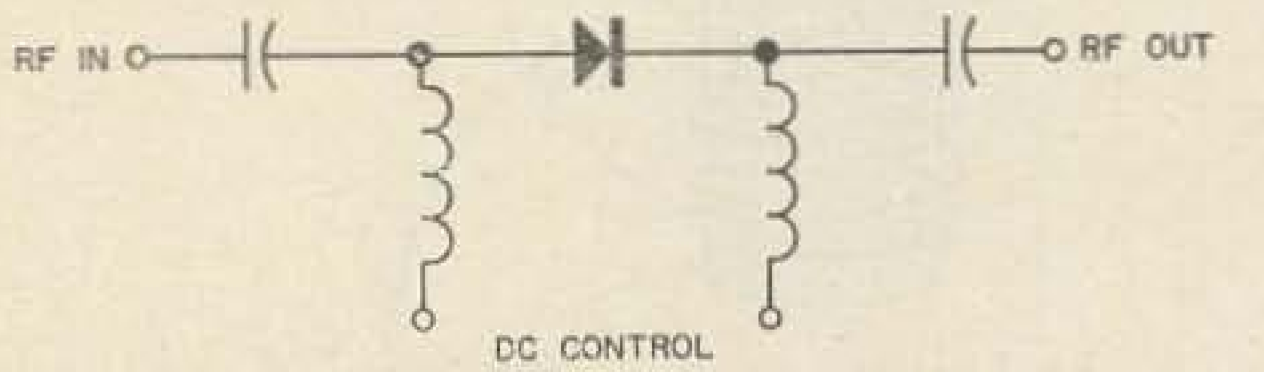


Fig. 1. Basic diode switch element. The diode is silicon. The dc control bias is switched in polarity to open or close the switch.

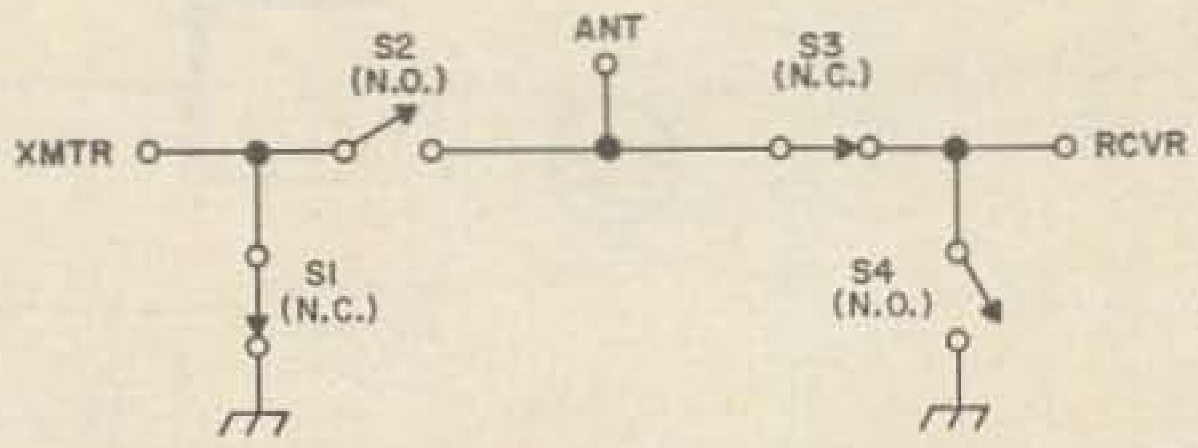


Fig. 2. Four simple diode switches can be combined into an antenna relay.

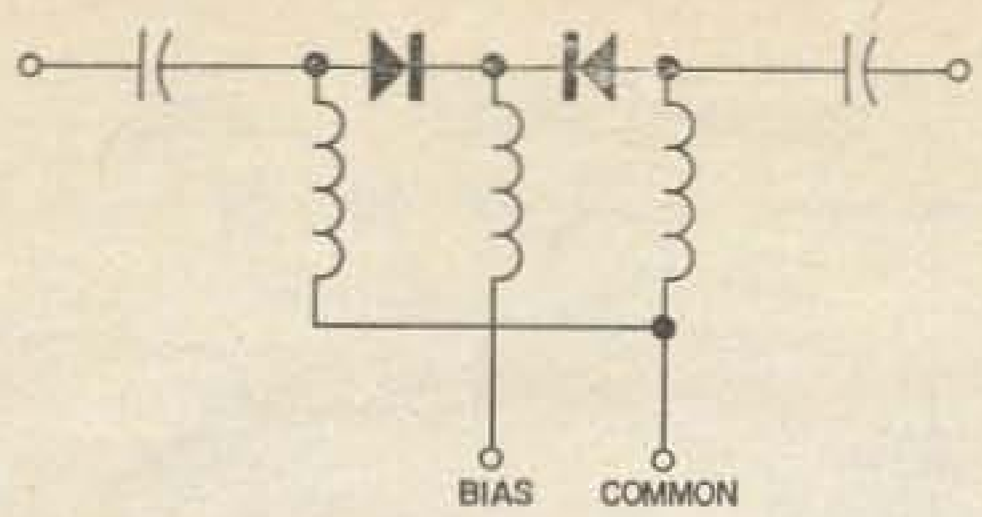


Fig. 3. A simple variation of Fig. 1 avoids charging up a large capacitance when changing from closed to open.

be combined into an antenna relay.

The type of diode used and required bias voltage depend on the open rf voltage and closed rf current in the switch. S1 and S3 are subject to high voltages and low currents. 2000 volt 1 watt rectifiers are used with 900 volts of reverse bias and 5 mA of forward bias. S2 must handle high current so five 1 watt diodes in parallel are used, with 1 amp forward bias and 60 volts reverse bias. S4 operates at a low level; a ¼ watt diode is used with 5 mA/60 volts bias.

Fig. 3 shows a variant of **Fig. 1** where the bias circuit does not have to charge up a big capacitance when changing from closed to open; this is used for S1, S3 and S4. The leakage from the transmitter during reverse periods may be reduced by use of a toroidal neutralizing transformer.

Band	Leakage to Rx on Xmtg	Leakage from Tx on Rcvg*	Loss on Receive
80	−67 db	−17 dB	2.0 dB
40	−63	−15	0.2
20	−46	−50	2.0
15	−47	−33	—
10	−47	−19	1.0

Suck out is less than 0.1 dB on all bands.

*Balanced at 14 MHz.

Switching times:

Receive to transmit 0.3 ms

Transmit to receive 0.7 ms

Power capability greater than 1 KW at 80 and 15 meters (tested). Rated 2 KW 3-30 MHz.

Impedance: 50-70 ohm unbalanced

Table I. Performance of the antenna relay.

Operation

Fig. 4 shows the complete rf unit of the relay. As can be seen, it has two dc control inputs A and B. A requires −60 volts at 30 mA on RCV. and +1000 volts on XMIT. B requires −60 volts on RCV. and +5 volt/1 amp on XMIT. **Fig. 5** gives a control circuit which supplies these signals.

The operation of this circuit is as follows. On recieve, the control input is grounded, cutting off Q1, whose collector rises toward +20 volts. This cuts off Q2, which goes to

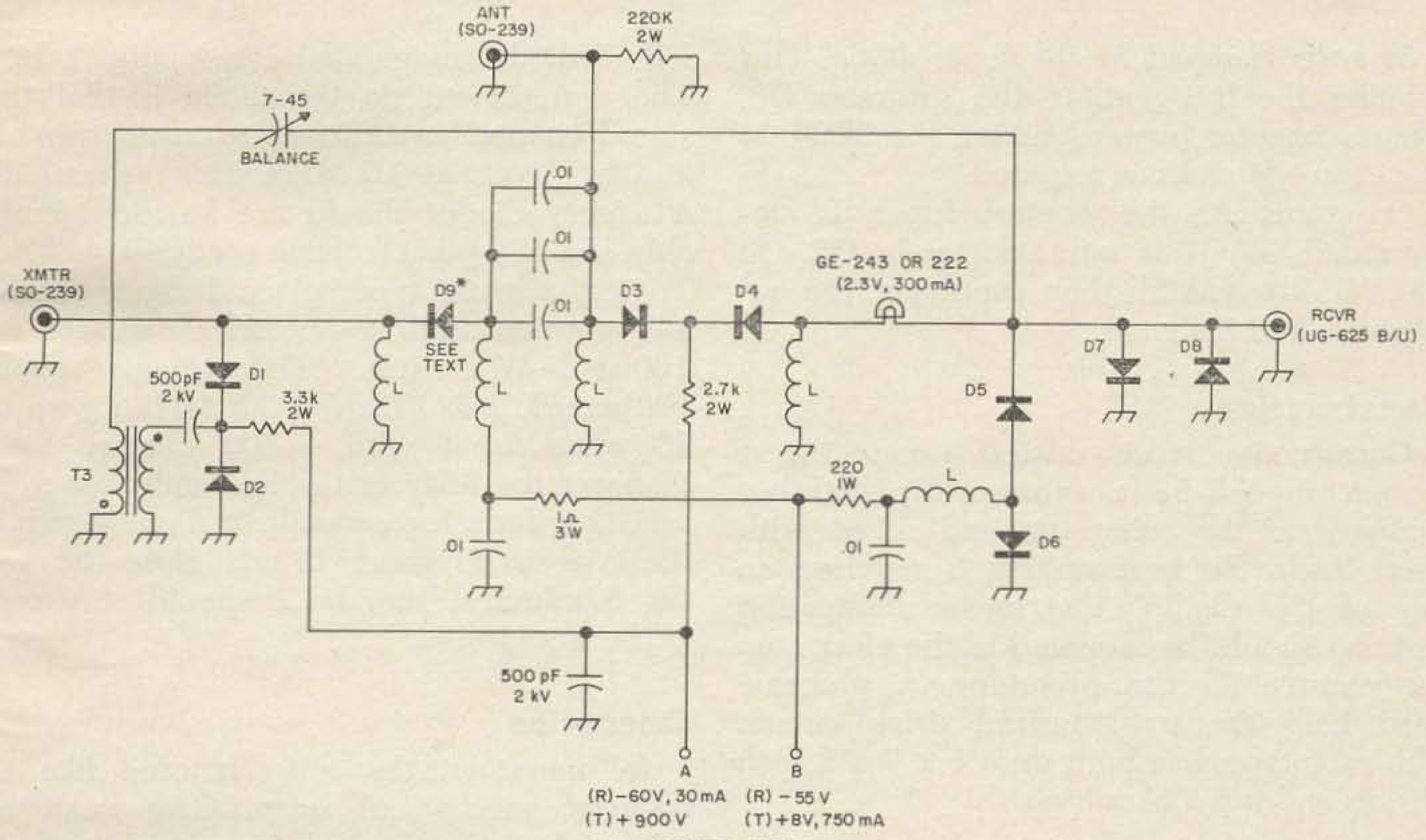


Fig. 4. Rf switch sub-unit. D1 through D4 are 2000 PIV silicon recifiers. D1 and D2 are matched with L in series with D1. D3 and D4 are matched for V_F at 10 mA forward current. D5, D6 are 200 V, 1/4 W rectifiers. D7 and D8 are 1N191, 1N3666 or 1N34A. D9 is five diodes in parallel. See text. Each L is 12.5 feet of number 37 enamelled wire on a 3/8" diameter fiber tube, 3/4" long winding. (60 μH, 4Ωdc resistance.) T3 is 10 turns of number 25 Formvar bifilar wound on 3/16 ID, 3/8 OD thick Q2 ferramic core.

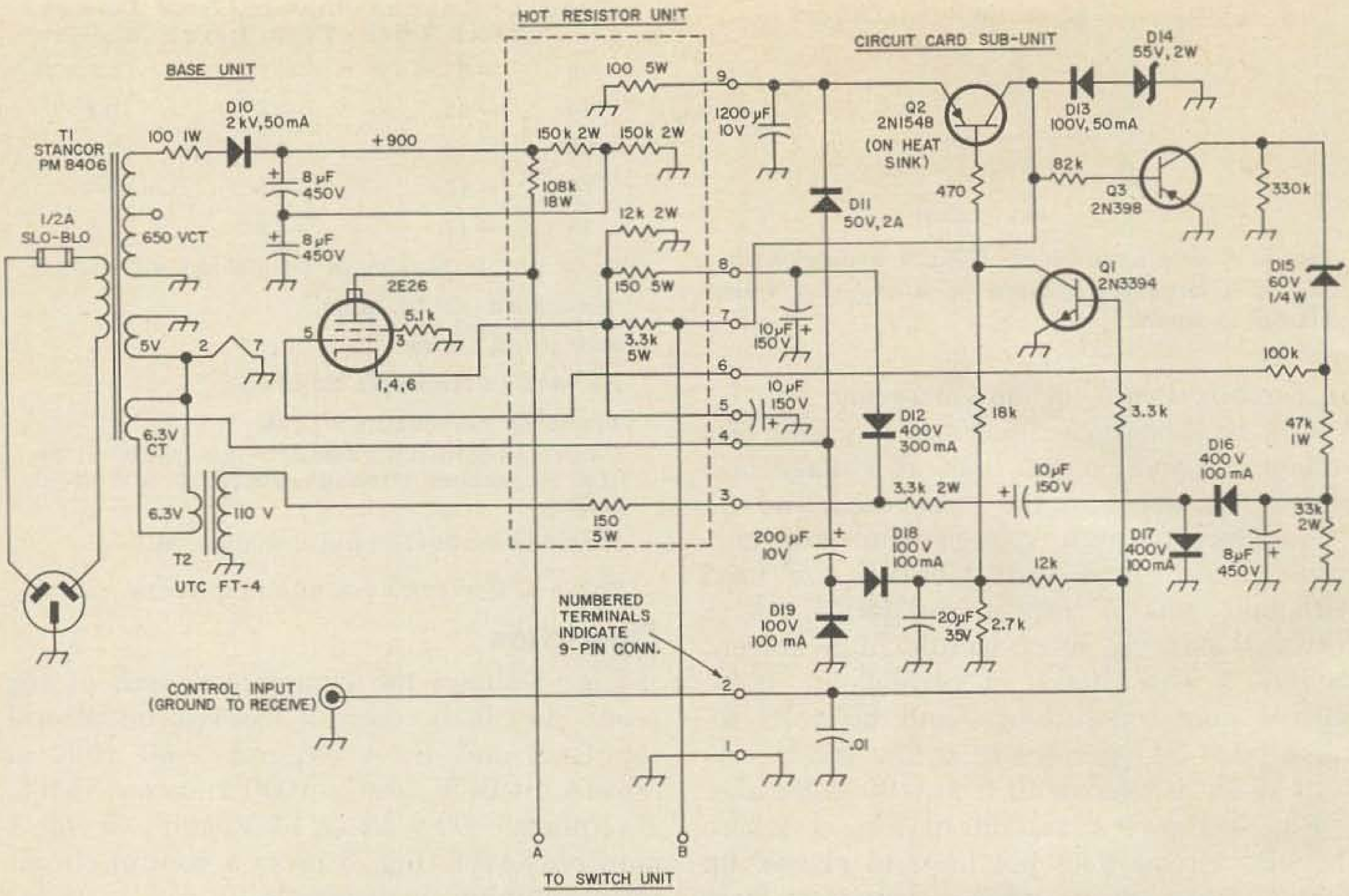


Fig. 5. Power and control for the antenna switch. D10 is a 2000 V, 50 mA rectifier (1N2328). D11 is 50 V, 2 A. D12 is 400 V, 300 mA. D13 55 V, 2 W zener. D15 is 60 V, 1/4 W zener. D16, D17 are 400 V, 100 mA. D18, D19 are 100 V, 100 mA. Q1 is NPN silicon, H_{FE} over 20 and V_{CEO} over 25. Q2 is PNP, H_{FE} over 75 at 1 ampere and V_{CEO} over 75 V in TO-3 case. Q3 is PNP, V_{CEO} over 100 V.

−54 volts clamped by the zener diode. This supplies the B signal. It also saturates Q3, whose collector forward biases, the 2E26, so that A is −60 volts as required.

On transmit, the control input is ungrounded, so Q1 is saturated, as in Q2. Q3 and V1 are cutoff, thus supplying the required A and B signals.

Construction

Construction is not critical, except the rf section should be a subassembly laid out similarly to the schematic and wired with short leads. No heat sinking is required on any of the diodes. The power dissipating resistors should be mounted in the clear atop the chassis. In the prototype, a plugable card held the transistorized drive circuit. The prototype was built on a 5 x 7 x 2 inch chassis and is 6 inches high.

Special components

The diodes used for D9 in the switch unit must be carefully chosen. The authors used 400 PIV 1 amp units similar to IN1763. Each unit could handle 1 amp rf with 100 mA dc bias. (50 watts at 50Ω) Since $P = I^2R$, 5 diodes in parallel can handle 1 kW. The requirement on the diode is that the stored charge be sufficient to avoid turn-off in a half cycle at 3.5 MHz. This means high efficiency diodes should not be used. Probably most "top-hat" silicon rectifiers will do. To test a given type, place 1 diode at the D9 position and temporarily replace R1 100-Ω 2–W resistor. (This will give about 100 mA dc bias.) Load a 3.5 MHz rig up to 75 watts input with a 50Ω dummy load. Connect the relay in the line and close your relay key for a few seconds. If diode gets hot, the type is no good. If not, close the key for 5 minutes; the diode should stay cool to be acceptable.

Operation

In operation, the relay is used like an ordinary mechanical relay. Care must be taken that the control signal is properly sequenced to avoid applying rf when in the receive position. **Table 1** shows the loss, isolation and switching times. Needless to say, this unit lends itself to fast highpower break-in with one antenna.

. . . K2IYC

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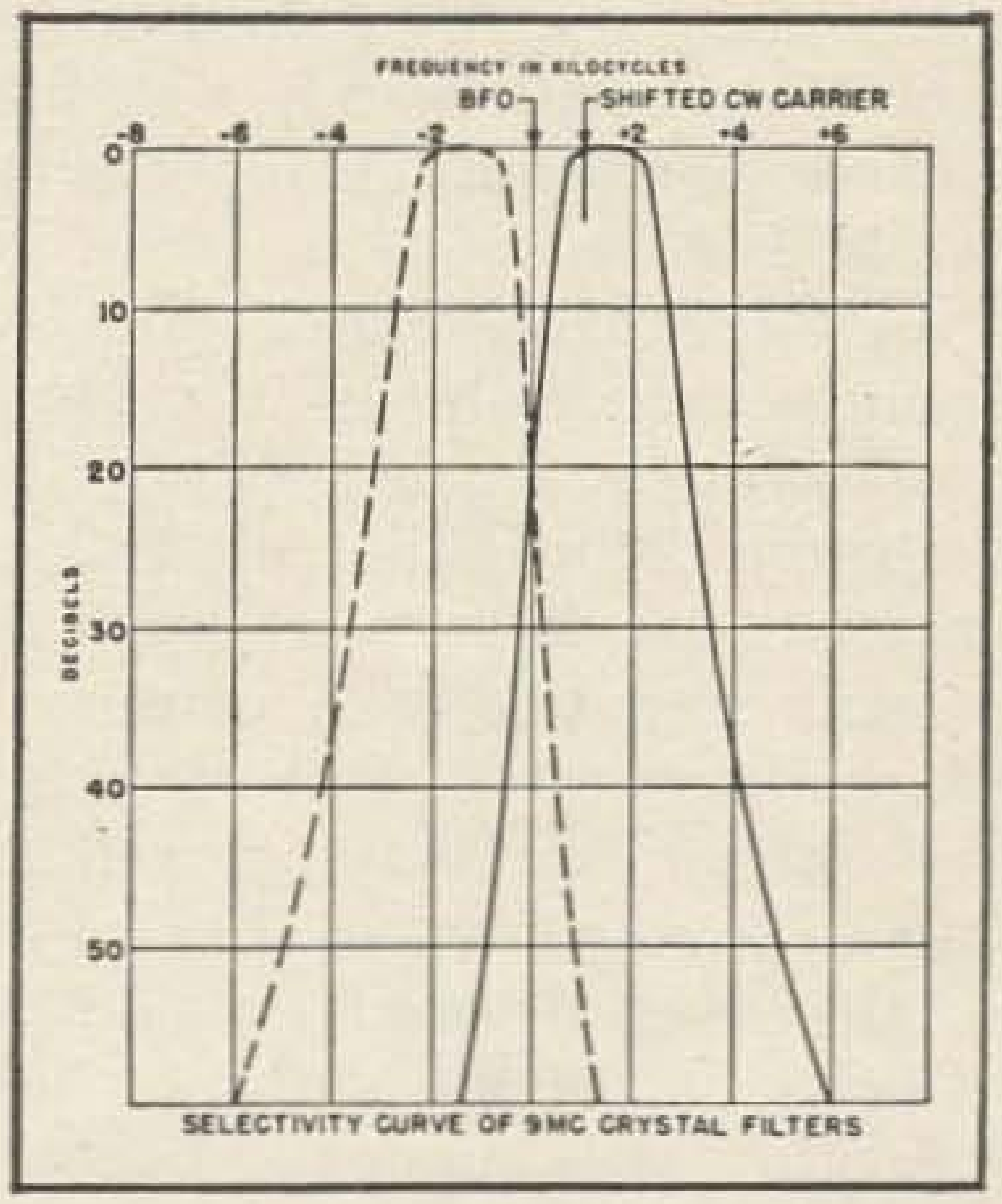

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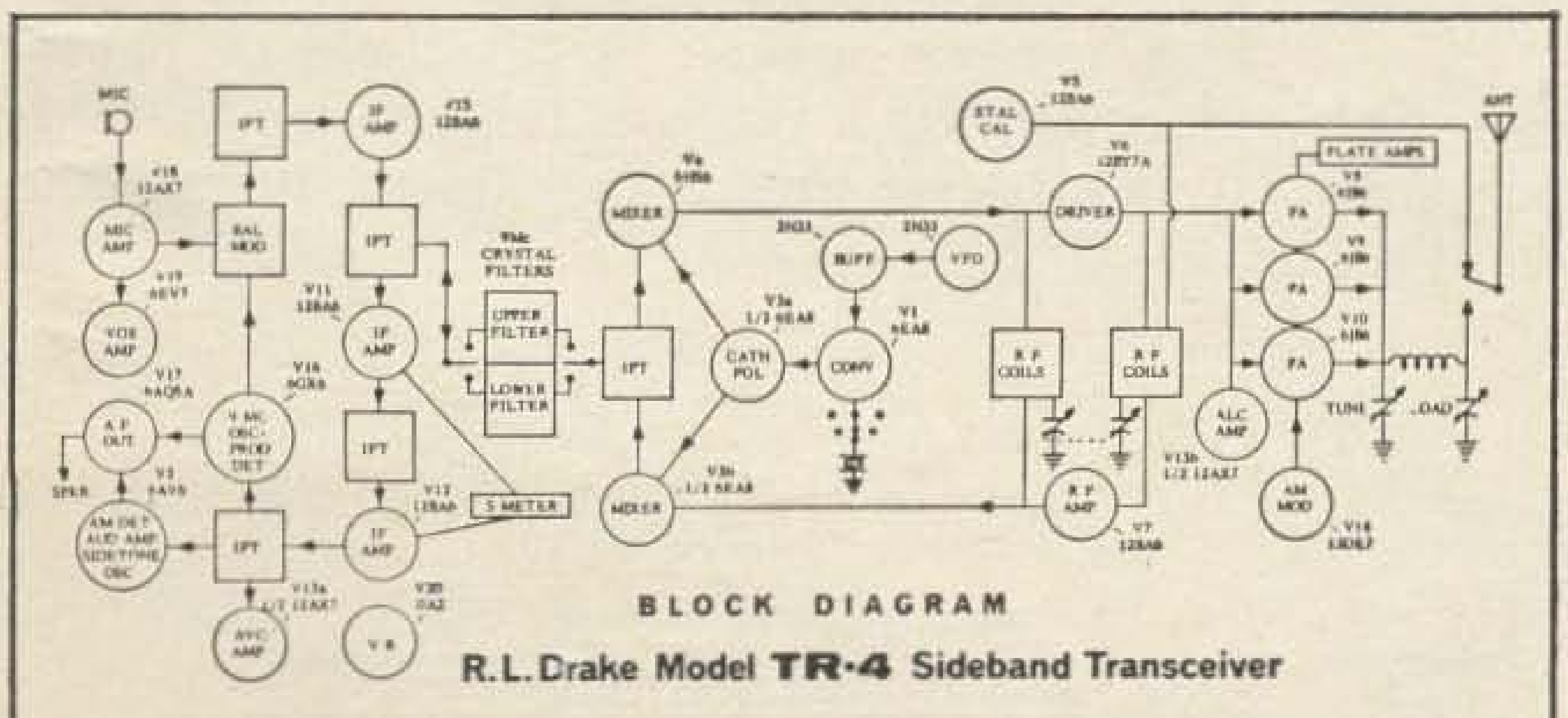

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Video Camera Tubes

There are many ways to generate a video signal. This article discusses them, whether they be well-known or rare.

Many developments have been made in the field of television, the modern camera tube being one of them. The tube, as a unit, has come a long way from the first type which was used in the 1939 World's Fair. This early device was known as the Nipkow Disk, and its operation was quite simple (**Fig. 1**).

As the wheel rotates, the light, coming through each hole as it passes the object, goes through the wheel and then to the photocell. Since the photoelectric cell is sensitive to changes in light intensity, the varying intensity will cause a voltage to be produced that will vary directly with the light. This varying voltage then becomes the video signal. Each individual hole in the Nipkow Disk contains a lens to properly focus the light to the photocell. A further development of this system that worked along the same lines as the original, with some variations, was known as the Modified Disk (**Fig. 2**).

An arc light is placed behind the disk and the object is kept in complete darkness. The light coming from the arc lamp is made to pass through the holes in the disk and is then reflected off the object. The light variations are picked up by the sensitive electric eye. These light variations cause a voltage to be developed in the cell. This voltage represents the varying light intensity and is the video signal.

Fly spot scanner

The modern camera tube evolved from these primitive systems, the first type being called the "Fly Spot Scanner". The theory of operation of the Fly Spot Scanner is much the same as that of Nipkow Disk, except that the arc light and the disk are eliminated. This system is still used extensively in the transmission of television, especially in color television. It has also found much use in closeup and still work, as well as the transmission of the television test pattern.

Extensive research in the field of photoelectricity and vacuum tubes brought forth a new development in camera tubes. The

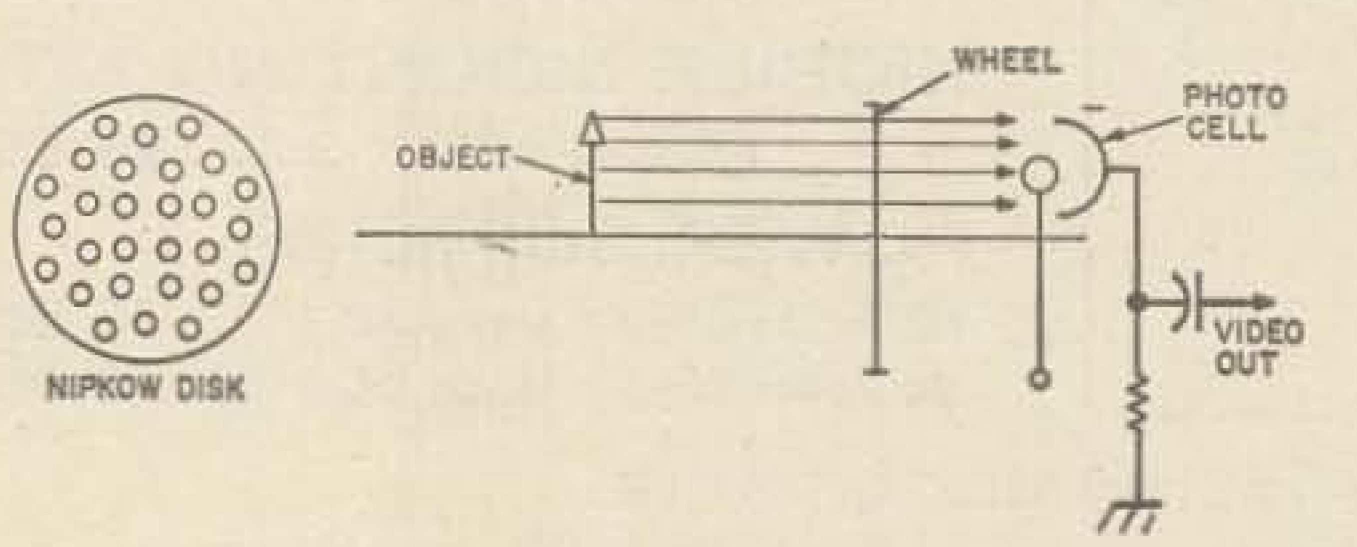

Fig. 1. Nipkow disk video pick up.

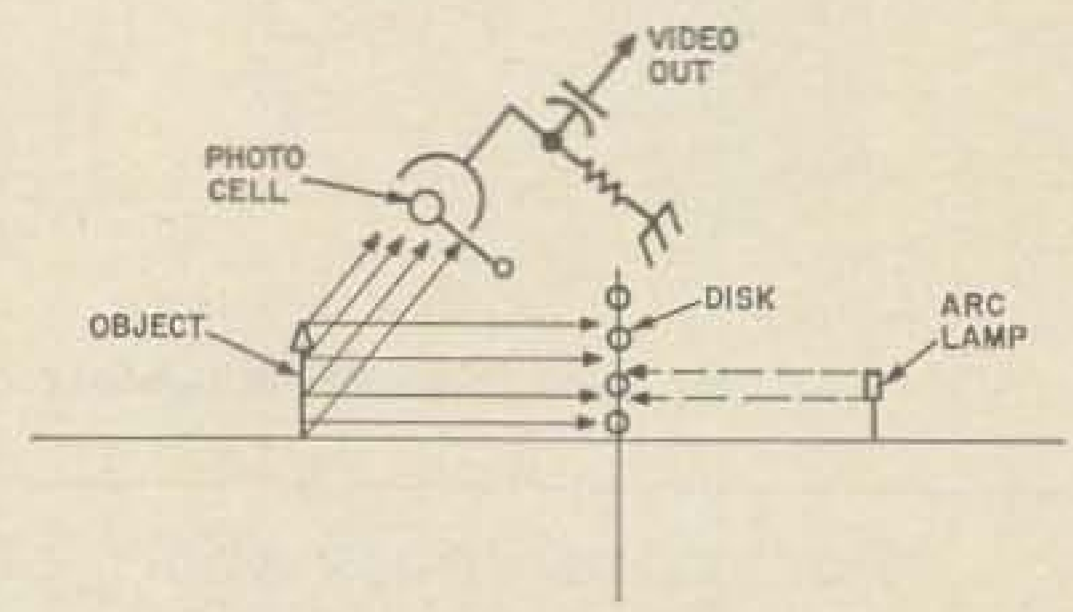

Fig. 2. Modified Nipkow disk.

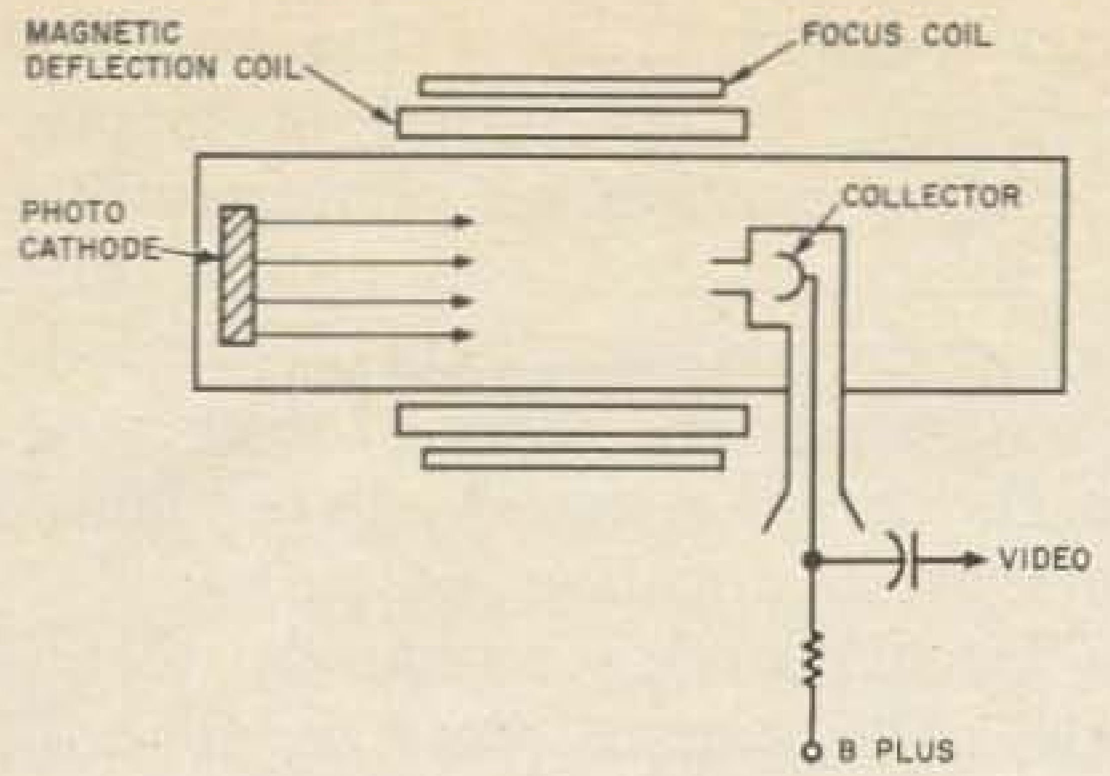

Fig. 3. Image dissector.

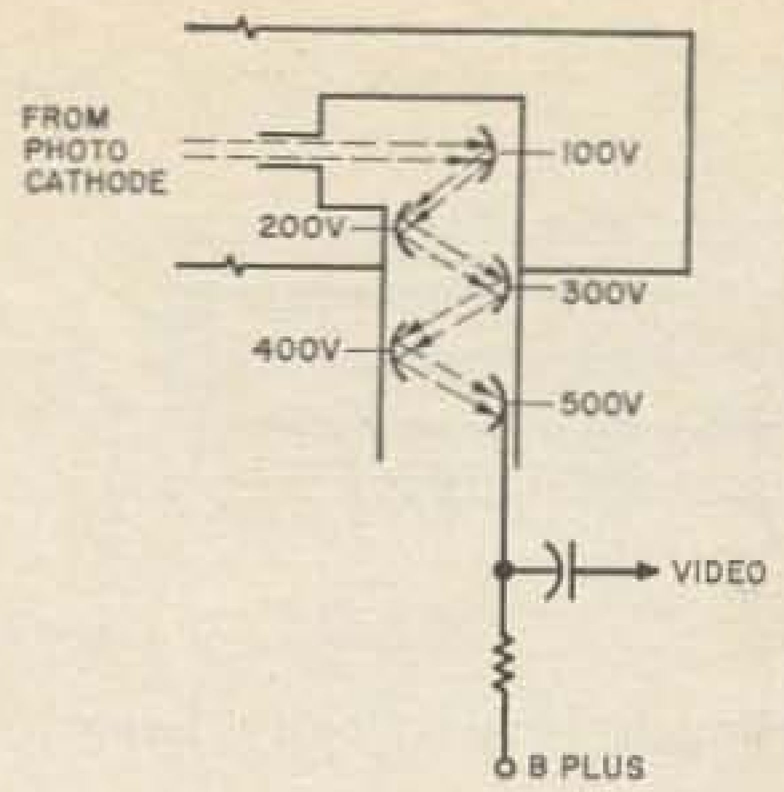

Fig. 4. Electron photomultiplier tube.

idea of the original Nipkow Disk and the photoelectric cell was incorporated into a device called the "Image Dissector" (**Fig. 3**). This was to be the first camera tube that could reproduce moving images. In order for the tube to properly operate, a photosensitive cathode had to be developed. This element emits electrons when placed under the influence of light. Inductors wound on an iron core, called focusing coils, are placed in certain positions around the outside of the tube. These focusing coils are used to keep the electrons, which are emitted from the cathode, traveling in a straight line or stream. Through the action of the focusing coils, the electrons are deflected in a horizontal direction as well as a vertical direction.

At one instant in time, all the electrons will hit the collector. However, in this process, a great deal of electrons are lost or wasted. In order to compensate for this waste of electrons, an electron multiplier is built into the vacuum tube (**Fig. 4**). The electron multiplier is a device in which each plate is at a higher potential than the previous one. When the electrons leave one of these plates to go to the next one, their velocity is increased due to the laws of electron ballistics. This action increases the force of the electrons as they strike the light-sensitive cell which results in a theoretical amplification of the original light. A greater potential is then developed at the output of the camera tube, which, in effect, results in a larger video signal to be produced and fed to the video amplifier.

As the state of the art improved, more advanced types of video camera tubes were developed. Among these were the Inconoscope, Orthicon, Image Orthicon, Vidicon, and Monoscope. In the following discussion, each of these video camera tubes is explained.

Iconoscope

The Iconoscope is shown in **Fig. 5.** On the mica sheet there are little globules of silicon. Each of these globules is insulated from the other by baking which results in oxidation of the silicon globules. The silver backing, which is coated with cesium, and the mica sheet make up the mosaic.

The scanning beam drives the point on the mosaic that is being struck to approximately 3 volts positive over the value of high voltage. This increase in potential is developed because of the loss of electrons from the mica sheet. These electrons form a cloud that exists close the face of the mosaic. While the beam is driving electrons into the cloud, there is a continual "rain" of electrons back on the entire mosaic. In the case of NO PICTURE on the mosaic, the amount of "raining" electrons is equal to the amount of secondary emitted electrons, and the net charge is zero. As a result of the zero net charge on the face of the mosaic, no current flows through output load resistor R_L.

When a picture of differences is pro-

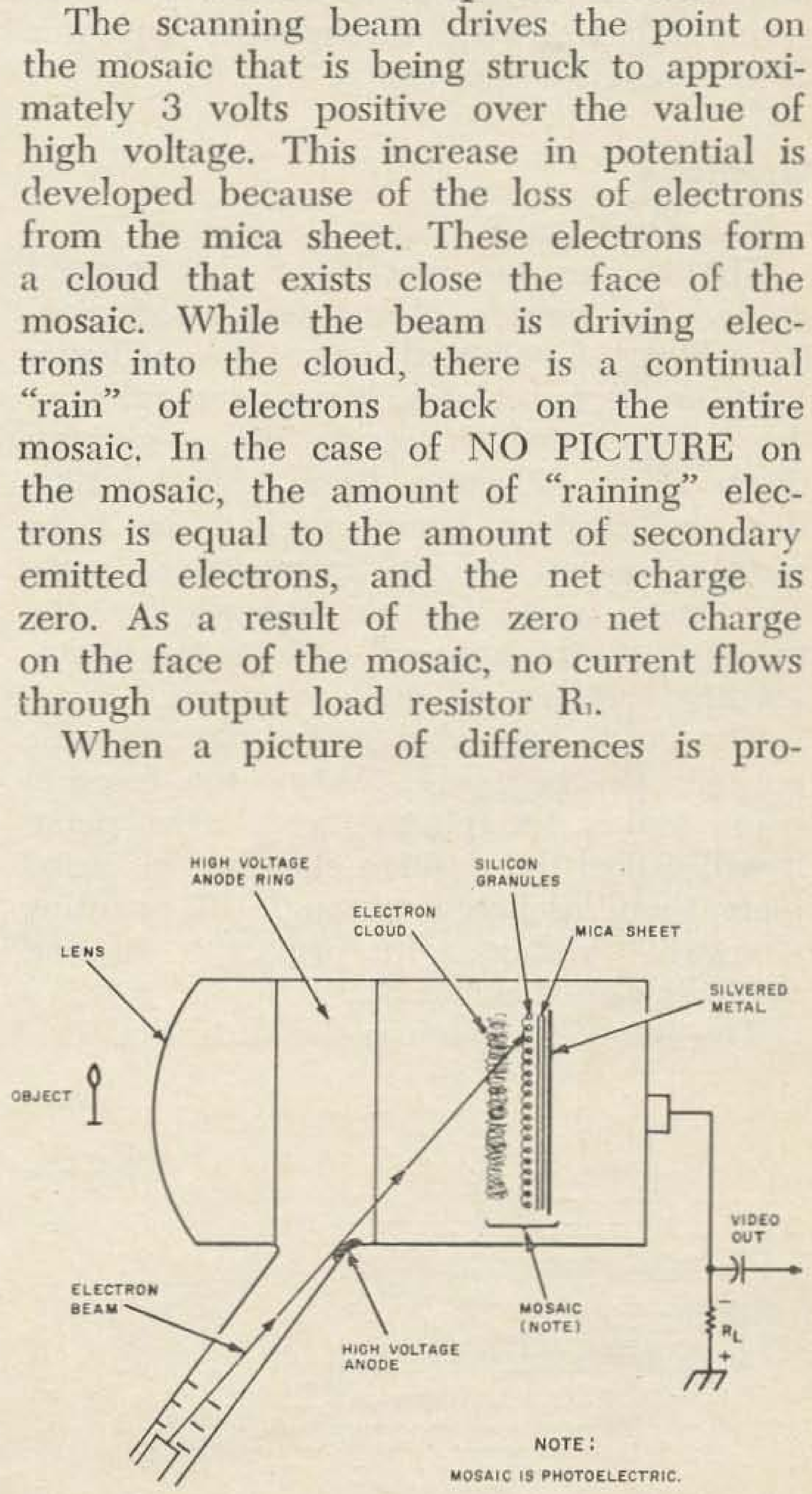

Fig. 5. Iconoscope.

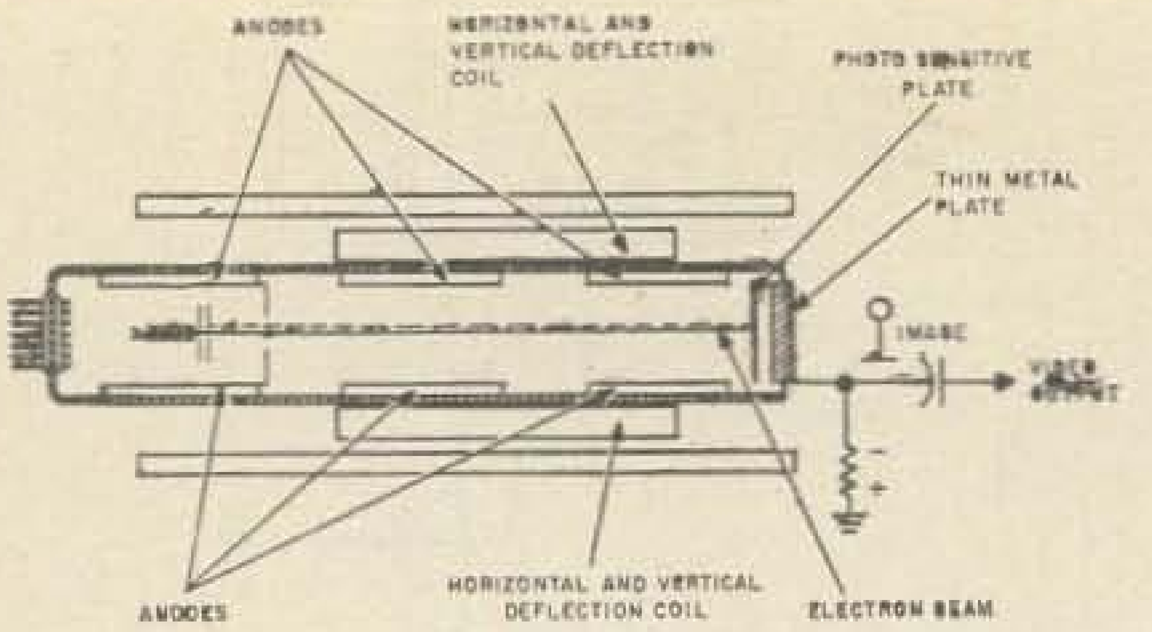

Fig. 6. Orthicon (low velocity beam).

jected on the mosaic, the bright areas under light charge up through the photoemission process and are positive with respect to the dark areas. When the electron beam strikes a bright spot, less secondary electrons are given up. Thus, the amount of "raining" electrons will exceed the amount of secondary electrons and will be equal in value on a dark spot. The greater the brightness, the greater the difference. The unbalance is reflected across the load resistor and is coupled through the capacitor as the changing video signal.

Orthicon

The Orthicon is shown in **Fig. 6.**

The anodes are metallic rings wrapped around the outside of the tube. The electron beam is emitted from the cathode. Each anode is set at a lower potential than the previous which results in a slowing down of the electron beam. At the time that the electron beam reaches the front metal plate, its velocity is practically zero. The metal plate is thin enough for the image to go through and activate the photosensitive surface to emit electrons.

The image light charges the photocathode positive on the inside. When the electron beam strikes the photocathode at a point, it will cancel the positive charge. The metal plate then discharges through RL, causing a negative voltage with respect to ground to be developed across RL.

The Image Orthicon is shown in **Fig. 7.**

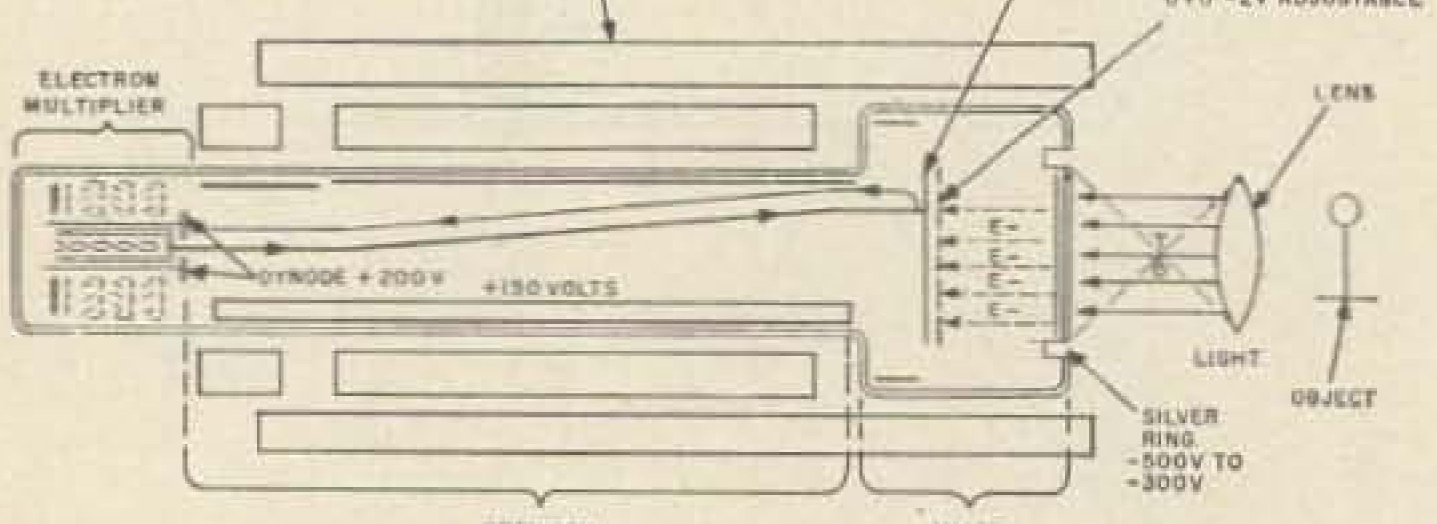

Fig. 7. Image orthicon.

Image Section. This is the wide end of the tube and is comprised of a piece of glass with a coating of photosensitive material (photocathode). The optical image is formed on the photocathode on the light side while electrons are released from the side facing the target glass. A silver ring, which is kept at a negative potential of −500 to −300 volts dc, surrounds the photocathode. The target glass is placed near the orthicon together with a very fine mesh wire (approximately 75 percent transparent) called a "Target Screen" with an adjustable potential of 0 to −2 volts dc applied. The target glass is a very fine glass with very low resistance. When light strikes the photocathode, electrons are emitted, the amount of emission being directly proportional to the illumination of the photocathode. The electrons (E-) achieve an extremely high velocity as they are attracted toward the target screen. The voltage on the target glass is at the same potential as that on the photocathode.

Scanning Section. The scanning section consists of both the orthicon and electron multiplier. The electron multiplier produces an electron beam that is deaccelerated as it travels through the orthicon section. The electron beam is focused at the target by the magnetic field of the external focus coil. An alignment coil is also provided to develop a magnetic field that can be varied to adjust the scanning beam's position to correct for electron gun misalignment. Electron beam deflection to scan the entire plate is accomplished by the magnetic field of the vertical and horizontal deflection coils that are externally mounted. When the electron beam arrives at the target glass, its velocity is zero and, depending upon the potential of individual areas in the target, some of the electron beams land on the target while others stop at the glass surface and return to the electron gun. At white, the return charge potential is zero; at black, the return charge potential is

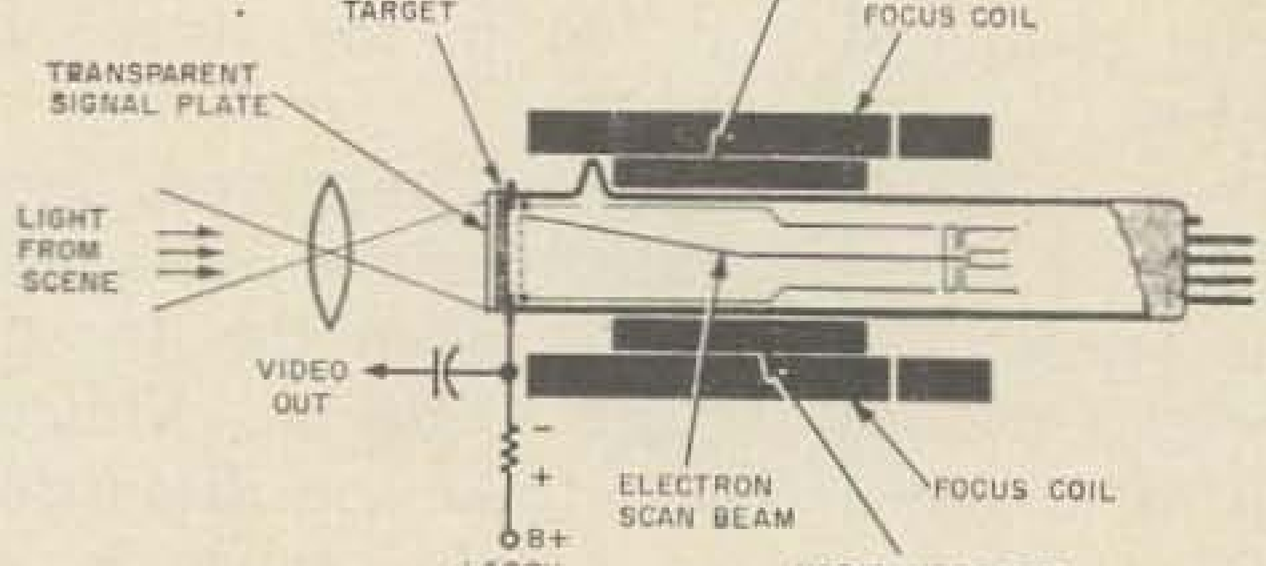

Fig. 8. Vidicon.

maximum. Shades of gray are potentials between zero and maximum. These charge potentials are returned through the electron multiplier for amplification and become the video signal current.

Vidicon

The vidicon camera tube (**Fig. 8**) operates on the principle of photoconductivity, whereas all the other camera tubes function under the principle of photoemission. The beam hits the target with a low velocity, but not zero as in the Orthicon. Resolution is poor, and frequency response is good up to 4 MHz only. The vidicon has no shading requirement and has no burning effect. Its sensitivity is as good as the image orthicon.

The target is a thin plate, coated on the beam side by a photoconductive material. This material has a very high specific resistivity in darkness. When the beam strikes the dark portions of the target, a small charge is developed because of the high resistance. When the beam strikes the light portion of the target, the charge developed is greater because of the lower resistance of the light portions of the target. The video, a voltage function of the differences in charge potential, is developed across the load resistor and the variations are coupled through the capacitor. With a signal current of 0.1 μA for highlights in the scene across a 50-kΩ load resistor, the camera signal output voltage is 5 mV.

Monoscope

The monoscope (**Fig. 9**) is a camera tube with a fixed image and is used for camera signal test purposes. The operation of the monoscope is similar to that of the iconoscope. However, instead of the mosaic, a test pattern is printed directly on the etched plate.

. . . WB2GYS

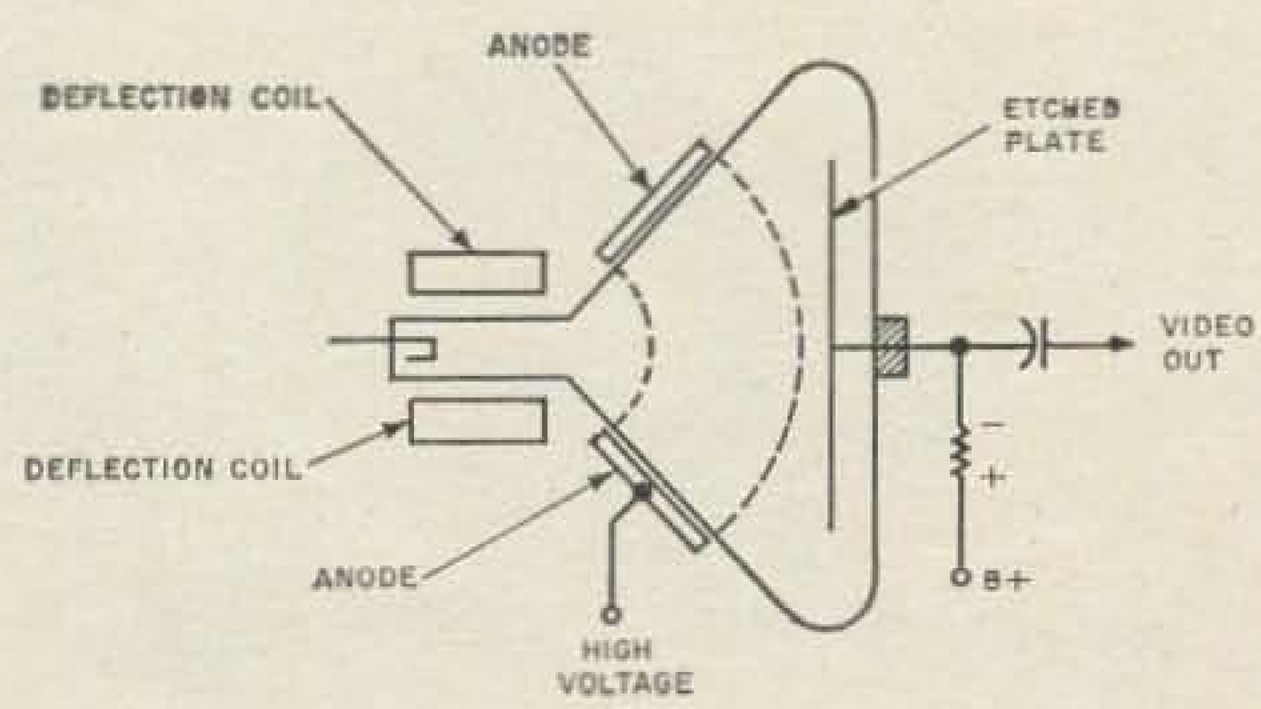

Fig. 9. Monoscope.

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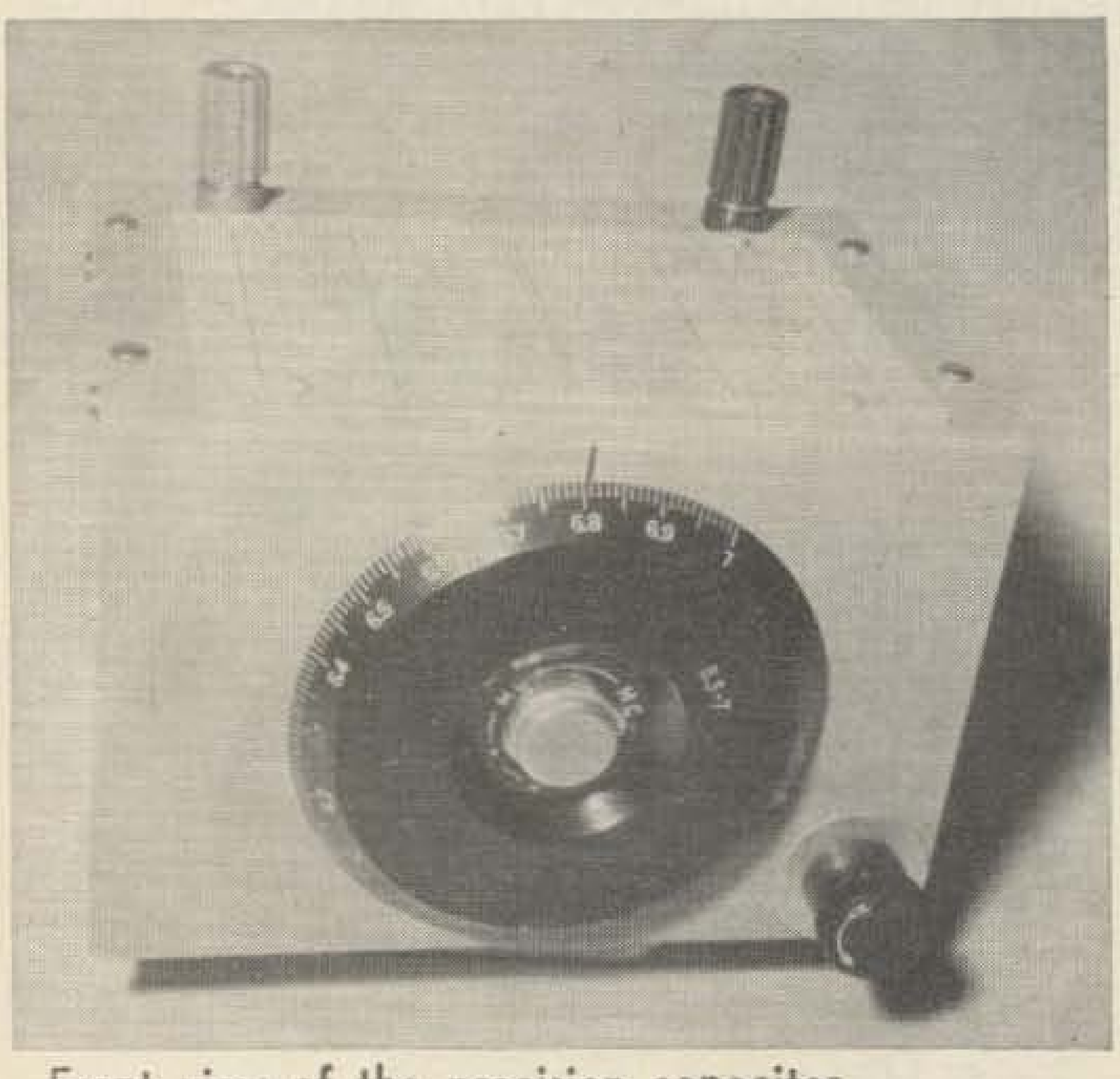
A Semi-Precision Capacitor

The precision variable capacitor is a very useful piece of test equipment which most hams don't have in their shacks. A capacitor of this type may be used in conjunction with signal generators and detection circuits for making many useful measurements; in fact, some measurements are very difficult, if not impossible, without a precision variable capacitor. Commercial precision capacitors are completely out of the reach of the average ham, but a neat substitute that will satisfy most amateur work may be found in the variable tuning capacitor from an old ARC-5 transmitter. These varable capacitors are extremely well made, stable, and incorporate an excellent antibacklash drive mechanism. Even at the currently high ARC-5 prices, the tuning capacitor would be difficult to duplicate.

The variable capacitors from any of the high frequency ARC-5 transmitters may be used as a semi-precision capacitor. Fortunately all of the tuning capacitors in this series of transmitters use the same range of capacitance, 34 to 154 pF. The manufacturing processes were very well controlled when these capacitors were originally made, so there is a direct correlation between capacitors from many different ARC-5 transmitters. I had an opportunity to check out several of these capacitors on precision laboratory equipment, and in each case the capacity at each point on the dial was within 0.5 pF of the other units; that's what I call pretty good correlation!



Front view of the precision capacitor.

Most amateurs have an old ARC-5 transmitter laying around the junk box, so getting the necessary capacitor should be no problem; it doesn't make any difference what the frequency range of the transmitter is, they all have the same tuning capacitor. After you get the ARC-5, there are two ways you may proceed; you can cut down the ARC-5 chassis or you can build up a chassis similar to the one shown in the photographs. The cutup ARC-5 chassis isn't too pretty, but it's a little easier to make. The dial calibration of the completed unit won't differ between the two types of construction, so you can take your pick.

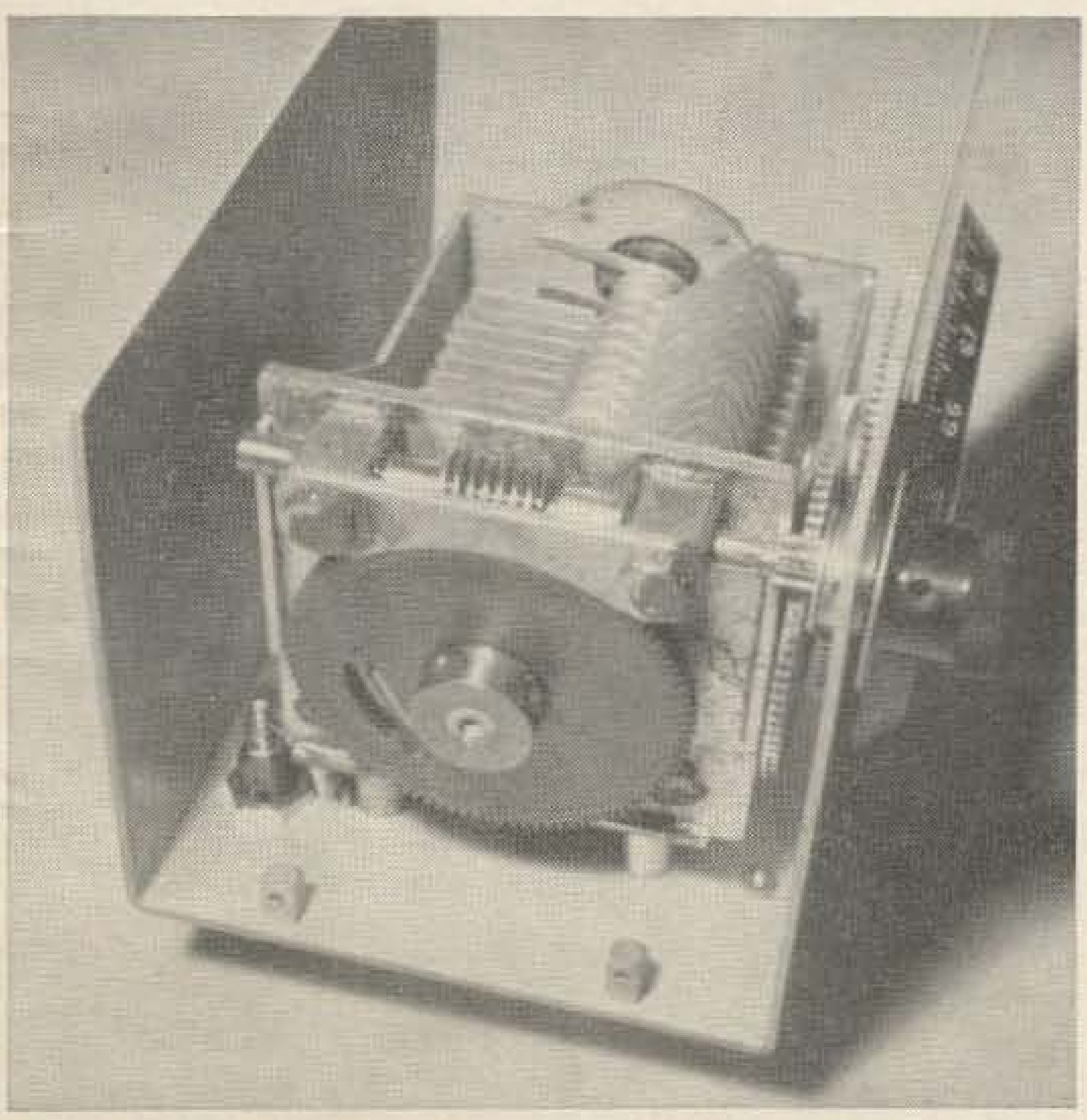
If you elect to chop down the ARC-5 chassis, remove the roller coil assembly and saw through the chassis 3⅜ inches back from the front panel. Bend the bottom plate up at ninety degrees and trim it off so it is flush with the top deck of the chassis. Cut off the top half of the front panel just above the point where the dial index is attached. Now install two terminals; an insulated unit for the stator connection and a grounded one for the rotor. These terminals should be installed ⅜ inch in from the back edge and ⅞ inch in from each side.

For the more complicated chassis shown in the photographs, refer to Fig 2. This chassis consists of two U-shaped channels made up from 1/16 inch aluminum sheet; one for mounting the capacitor, the other for a cover. Two pieces of hardwood clamped in a vise will help in making sharp 90° bends.

After the chassis is completed, you have to remove the tuning capacitor from the transmitter. This isn't too tough, but it takes a little perserverance and the right approach. After the bottom cover is removed, note that the tuning capacitor is connected to another variable capacitor in the rear of the unit through a flexible shaft. This shaft is pinned to the drive shaft of the tuning capacitor. Turn the shaft so the end of the pin is facing you; then, using a small pin punch, carefully drive the pin out. if you don't have a punch small enough, an awl will do. Unscrew the large nut which holds the dial in place and carefully remove the dial. Be careful not to lose the small pin which locates the dial in the proper place. Usually this will stay imbedded in the drive collar, but sometimes it falls out. Now remove the dial lock knob. This is also pinned to a shaft and although sometimes it may be removed intact, usually it is frozen to the shaft and it's necessary to break it off with a pair of pliers. Remove the four screws which hold the capacitor to the transmitter and remove the rotor and stator connecting wires. The capacitor may now be removed from the ARC-5.

Before you discard the ARC-5 chassis, remove the large rectangular can on the rear of the chassis and note the four square studs that hold it to the main chassis. These studs will be used to hold your new chassis together. They may be removed by taking out the screws from underneath. These are the only four studs that will work; the other studs are riveted in place.

Installation of the capacitor in the new chassis should pose no problems if the holes have been drilled in the right place. Usually this is a little tricky however, since bending always seems to have a tendency to move the holes the wrong way. A little reamer will save a lot of cuss words here. Note that



Interior of the semi-precision capacitor. Note the two small square studs in the foreground which are used to hold the two U-shaped chassis together.

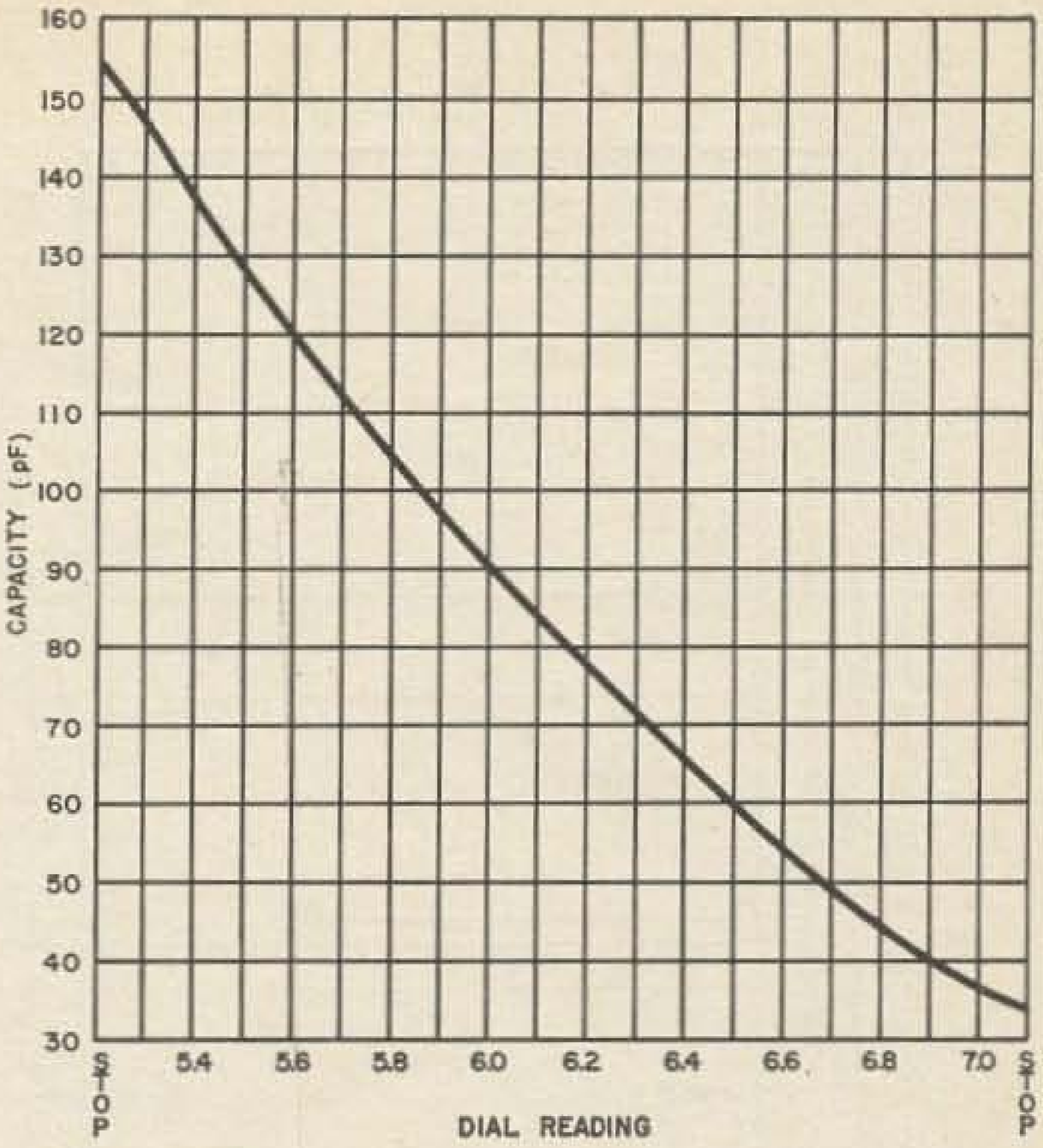


Fig. 1. Calibration curve for the semi-precision capacitor from a 5.3 to 7 MHz ARC-5 transmitter. Corresponding dial points for capacitors from 4 to 5.3 MHz and 7 to 9 MHz ARC-5 transmitters may be found in Table 1.

the chassis shown in Fig. 2 is based on the use of 1/16inch stock; the holes will end up in the wrong places if you use any other thickness. After the capacitor is in place, install a couple of insulated terminals in the holes provided, connect up the rotor and stator wires, and the semi-precision capacitor is complete. On my unit I cut out a one inch disc of aluminum and epoxied it to the knob for a skirt. It doesn't add anything functionally, but it does dress it up a bit.

Dial Reading			Capacitance
5.3-7.0 MHz	4.0-5.3 MHz	7.0-9.0 MHz	(pF)
Stop			154.0
5.3	3.99	7.01	148.0
5.4	4.07	7.13	138.5
5.5	4.15	7.25	129.0
5.6	4.22	7.38	120.0
5.7	4.30	7.50	112.0
5.8	4.38	7.62	104.25
5.9	4.46	7.75	97.0
6.0	4.53	7.87	90.25
6.1	4.61	7.99	83.75
6.2	4.68	8.11	77.5
6.3	4.76	8.23	72.5
6.4	4.84	8.35	66.25
6.5	4.91	8.46	60.75
6.6	4.99	8.59	55.75
6.7	5.07	8.70	50.75
6.8	5.15	8.82	46.0
6.9	5.22	8.94	41.5
7.0	5.30	9.06	37.0
Stop			34.0

Table 1. Individual calibration points for the semi-precision capacitor. This table is based on the major dial points of a tuning capacitor from a 5.3 to 7 MHz ARC-5 transmitter. Corresponding dial calibration points for 4 to 5.3 MHz and 7 to 9 MHz units are also listed.

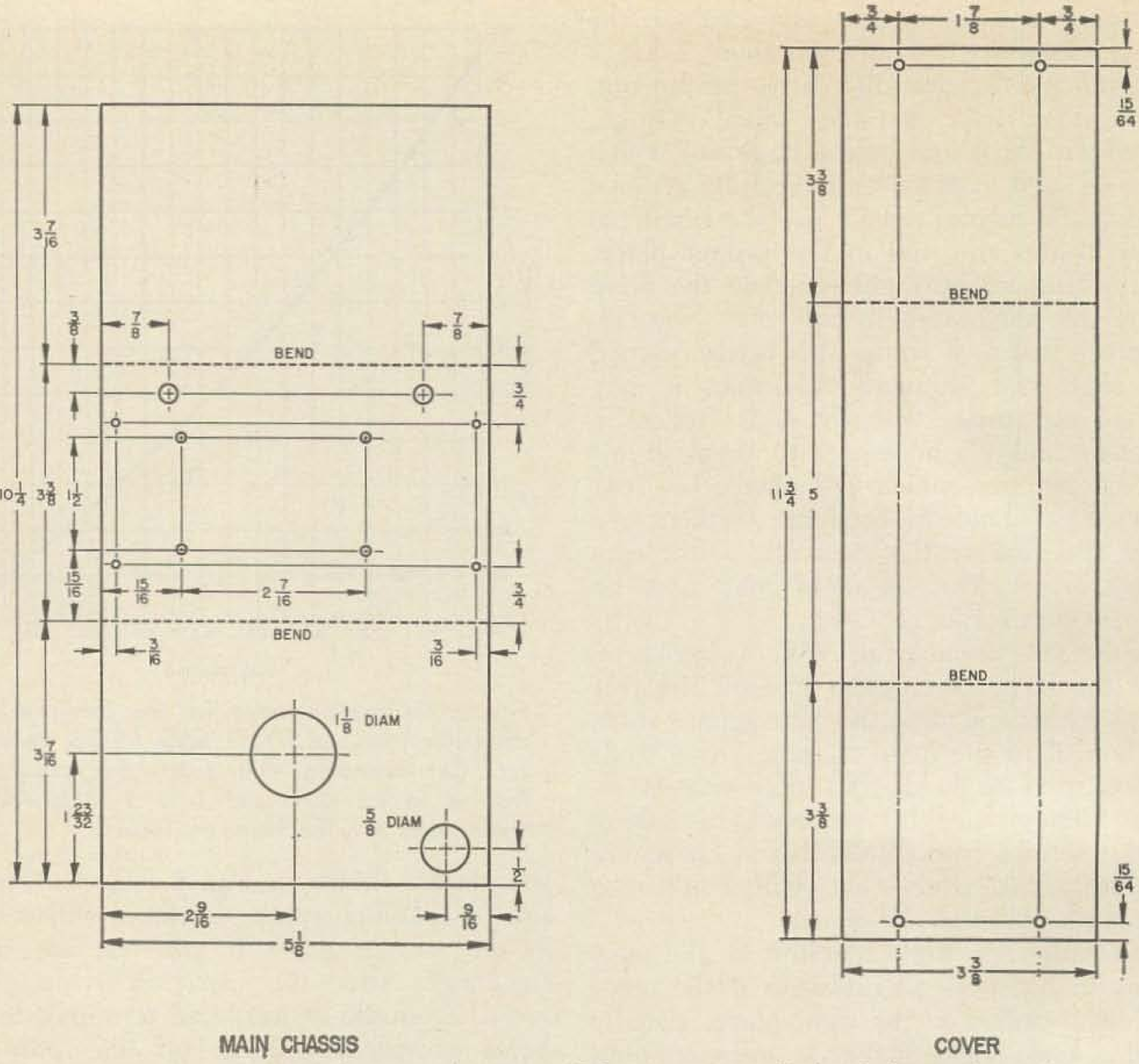


Fig. 2. Chassis for mounting the semi-precision ARC-5 capacitor. Each of these pieces is cut out from 1/16 inch aluminum and bent into a U. The dimensions will not work out properly if other than 1/16 inch material is used.

As a finishing touch you can put the calibration sheet on top of the capacitor and cover it with a sheet of thin plastic. Oh yes, four ⅜ inch rubber grommets on the bottom act as feet.

If you use the calibration figures listed in the accompanying table, your semi-precision capacitor should be within about 0.5 pF any place on the dial. For more accurate calibration of course, you can borrow a lab capacitor and hand calibrate the unit exactly. When making measurements with the capacitor, the addition of six inch connecting leads will add 3 pF to the dial reading.

Now, you may ask, that I have a precision capacitor, what can I do with it? Well, there are many measurements that its use will simplify and some where its use is unique. I'll give you a few examples and let your ingenuity do the rest. The most obvious use of course is in the measurement of capacity. Connect the precision capacitor across an inductor and use a grid dipper to determine their resonant frequency. Now,

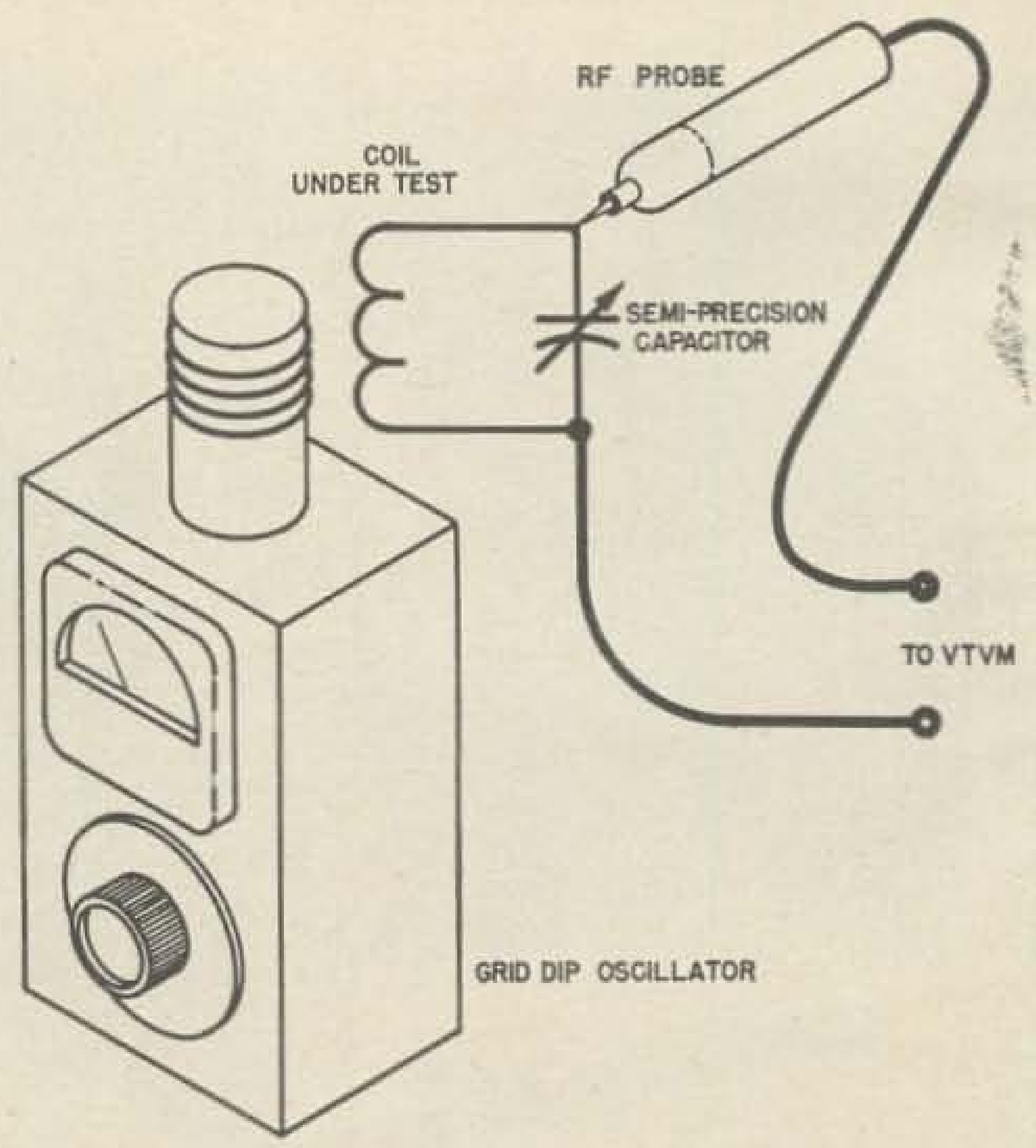


Fig. 3. Test setup for measuring the Q of a coil with the semi-precision capacitor. For highest accuracy, the VTVM should be set on its most sensitive scale and the GDO decoupled for full scale deflection.

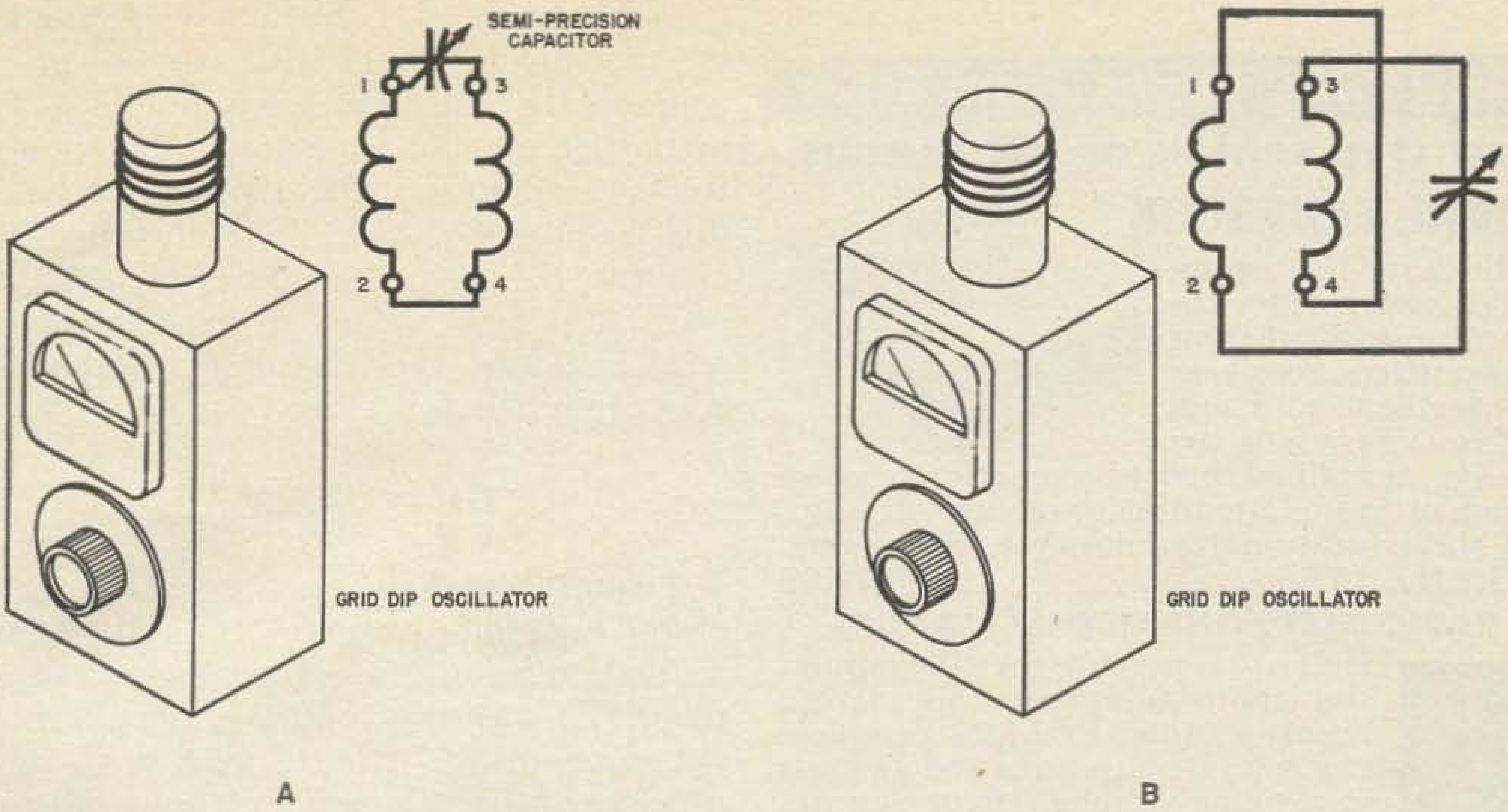


Fig. 4. Test setup for measuring the coefficient of coupling between two coils. Two measurements are required: one with the coils connected as shown in A, the other shown in B.

without disturbing the dipper, connect the unknown capacitor in parallel with the semi-precision capacitor, and tune the variable capacitor for another dip. The value of the unknown is the difference in readings on the precision unit. This method is very useful because it is very accurate, and with care quite small capacitors may be easily measured. Another method of measuring capacity is to place the precision capacitor in one leg of a bridge with the unknown in the other. A similar approach is used in many laboratory impedance bridges.

Where the precision capacitor really shines is in measurements that are difficult to make without it. The Q of an inductor is one of these. In addition to the capacitor, you will need a VTVM and an rf probe plus a source of rf such as a GDO for this measurement. Connect the coil to the precision capacitor as shown in Fig. 3, set the capacitor at some convenient high value of capacitance (C_R), set the VTVM on its lowest range and loosely couple the GDO to the circuit. Now tune the grid dipper for maximum deflection of the VTVM. If it pins the meter, move the GDO further away. Without disturbing the frequency of the dipper or its coupling to the coil, set the precision capacitor to a lower value than C_R so that the VTVM reads 70.7% of the voltage recorded at resonance. Record this new value of capacitance as C_L and set the precision capacitor to a value greater than C_R so that the VTVM again reads 70.7% of the original reading. Record this value of capacitance as C_H. The Q of the coil may be calculated from the following formula:

$$Q = \frac{C_R}{C_H - C_L}$$

where all the capacitances are in pF.

The precision capacitor is also helpful in determining the inductance of a coil. For this measurement all you need is a grid dip oscillator. Simply connect the coil across the capacitor and adjust the capacitor for a dip on the GDO. If the dipper is set to 10 MHz, and the capacitor tuned for a dip, it simplifies the math in the following inductance formula:

$$L = \frac{25{,}400}{f^2 C}$$

Where L = inductance in microhenries
f = frequency in MHz
C = capacity in pF

In some cases it may be desirable to measure the distributed capacitance of an inductor. This may be easily done with the precision capacitor. In cases where a small value of capacitance is used in measuring an inductor, the distributed capacitance of the coil can cause a large error in measurement. To reduce this error, measure the distributed capacitance of the coil (C_D) and add it to the test capacity (C in the above formula) before making the inductance calculation.

To measure the distributed capacitance, set the precision capacitor to 50 pF and connect the coil across it. Couple a GDO to the circuit and tune for a dip; note the frequency and set the dipper to one half this frequency. Now restore the dip by increasing the value of the capacitance. Record this new value of capacitance (C_A) and calculate the distributed capacitance (C_D) from the following formula:

$$C_D = \frac{C_A - 200}{3}$$

Two other inductance tests where the precision capacitor is useful is in determining mutual inductance and coefficient of coupling. To measure mutual inductance, connect one of the two coupled coils to the precision capacitor and determine the resonant frequency with a grid dipper; calculate the inductance of the coil with the formula previously given. Do the same thing with the other coil. The value of mutual inductance (M) may then be found from:

$$M = \frac{L_1 - L_2}{4}$$

where L_1 is the larger of the two inductances.

To measure the coefficient of coupling between the two coils, determine the mutual inductance as shown above. Then connect the two coils to the precision capacitor as shown in Fig. 4A and calculate the total inductance using the resonant frequency method; record this value as L_1. Now connect the two coils as shown in Fig. 4B and again determine the inductance (designated L_2). The coefficient of coupling (k) may then be determined from:

$$k = \frac{M}{\sqrt{L_1 L_2}}$$

These examples show just a few of the things that the precision capacitor may be used for; most of them may be accomplished by other more exotic methods, but the use of the precision capacitor greatly simplifies things. Before I built the precision capacitor, I solved most of the problems involving inductance, mutual inductance and coefficient of coupling by the old cut and try method. The precision capacitor gives me immediate answers to these problems and saves a lot of time and frustration. In addition, it is a very versatile unit and every day I find new and unique uses for it in my shop.

. . . W1DTY

Leonard Yerger W3BTQ
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Rockwall, Texas

Down With the Rotator

Can't put up a tower? Why not use a TV telescoping mast with the rotator at the base?

Every ham can't have a tower. There are various reasons why a tower just isn't in the scheme of things. The three main reasons are—they cost too much, look too large, and take too much planning and work. For the VHF man, the solution is simple—each obstacle can be overcome.

Assume that a sixty foot crank-up tower would satisfy the requirement. The VHF beam could be at the sixty foot level, and when the tower is cranked down, it would be no higher than twenty five feet. For many of us, even twenty five feet is too high for comfortable work. Let's go one better.

What's wrong with a TV telescoping mast. Nothing at all. It will get your beam up close to sixty feet, hardly dent your pocketbook, won't look bad, and best of all, you can just about push it up and down alone. Further; when it's down, you can work on the beam at head level or at most, by resorting to a step ladder or picnic table.

The fifty foot telescoping mast can be procured at most of the radio supply stores. You can transport it home with the family car and carry it around by yourself. While the mast has washers for guying at every ten feet level, the writer has found guying at three points adequate. However, supports at four points would give greater comfort to your nervous system during storms.

It may be possible to push up the mast with a two meter beam, a six meter beam, and a CD type rotator at the top, but, when I tried it, it seemed to be too much like balancing a piece of wet spaghetti on end. As a result of a mental picture of the consequences, it was decided to put the rotator, the heaviest unit, at the base where it really belongs.

In the case of WA6SJH, it was decided to erect the mast adjacent the patio, whose roof was at the eight foot level. Accordingly, a heavy aluminum angle was formed and bolted to the patio roof siding. The horizontal face of the bracket was designed with a hole that permitted the bottom section of the mast to slide through it, but not bind.

A plumb line was then dropped through the hole center. At this spot on the ground, a four foot length of 2½ inch pipe was driven about two feet into the ground. As the pipe was driven, the top center of the pipe was periodically checked to assure its verticality. The top was then sawed off to present a smooth end. The rotator was then mounted on the pipe.

Next, by standing on the roof, the mast assembly was lowered through the hole and into the rotator and clamped. With no antennas installed, the mast was pushed up and checked for smooth rotation.

With the mast down, the guy wires were attached to the washers provided. Since only two sets of guy wires were desired, one washer was arranged to turn near the center of a section to provide better guying balance. The mast was again pushed up and the guys attached and adjusted. The guyed mast was then checked for smooth rotation. Friction from the guy rings was just right for smooth braking.

The mast was then lowered and a ten foot aluminum pipe was slid about two feet over the top of the push-up mast and bolted to prevent rotation. An eleven element two meter beam was mounted at the top and a pair of five element six meter beams below.

The assembly was then pushed up, carefully locking each section to prevent sectional slipping or rotation. One man can do the job, but two are better, since at maximum height there is push down against the guy wires and a slip at this stage would drop the top assembly ten feet.

This antenna system withstood the strong winds of the San Fernando Valley for over a year, until it was dismantled when the QTH was changed.

Rotation was always smooth and the rotator was at ground level where it could be easily serviced. . . . W3BTQ

A. A. Wicks WB6KFI
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Mountain View, California 94040

Mobile Logs Personalized

Why not use personalized logs for your mobiling? They're simple to prepare, inexpensive and convenient.

Personalized mobile logs may at first appear to be an unnecessary luxury. However, when cost and convenience are considered, their value outweighs the slight extra initial cost involved.

Just as QSL cards may be designed especially for one person, or a stock design used at a lower cost, personal logs may be prepared in the same way. For those persons who would like to completely design their own logs the information regarding FCC regulations and printing information will be of interest. For those who wish to follow the shortest route, the example may be used. The example may be removed from this magazine intact. Then, in place of my call, carefully transfer your call sign, in a type style and size that you prefer, from a sheet of the many dry transfer lettering sheets now available. Any art supply store and most radio parts suppliers now carry these sheets in a great variety of styles and sizes. The dry transfer process is particularly recommended, although other processes are available, because it is simple to use, errors can be rubbed off and started again, and yet it adheres well once applied.

MOBILE LOG

OF

WB6KFI

FREQ ________ MC   PWR INPUT ________ WATTS

CALL	TIME IN	TIME OUT	LOCATION	REMARKS

A personalized mobile log is very convenient.

Take the sample page, now complete with your call sign, to any print shop that provides offset printing service. Usually the smaller shops are better equipped and more receptive to small jobs such as this. A shop that works on QSL cards would be particularly suited for this work.

Your order to the print shop will be for: proper size offset printing, quantity as you desire, and either padded in fifties or loose, as you may wish to keep the log sheets in a loose leaf binder. If you can locate a printer who used the "Itek" process negatives the cost for production may be slightly lower than a printer who must use a film negative. The quality difference of the final printed piece is negligible between the two processes. Also, if absolute minimum cost is desired with possibly somewhat lesser quality, specify paper plates to your printer. However, keep it in mind that subsequent printings will require a new plate, whereas a metal plate can be re-used many times.

The sample shown meets all FCC regulations for mobile operation, provided that the operator signs the log after each period of operation; or, if only one operator, he signs each page. For those wishing to design their own logs the printing cost will not change no matter how complex the design, as long as only one color is used. However, the log must show:

1. Date and time of each transmission. One entry for each day of operation is sufficient and can be placed across the "In–Out" column.
2. Signature of each operator. This may be placed at the bottom of each sheet in the "Remarks" column together with 3. below.
3. Type and identity of vehicle.
4. Call sign of station called (whether worked or not, remember!)
5. Input power
6. Frequency band
7. Type of emission. This can be placed once in Remarks column at the beginning of each sheet unless the mode changes before the sheet is completed.
8. Approximate geographical location of the mobile station. Normally one entry for each station worked is sufficient to comply with regulations as "US 80, ten miles W. Reno." This is the type of location identity that is legally required, rather than what is frequently heard such as "W6 . . . mobile W7." However, if you are covering a great deal of distance fast you are wiser to enter something like "US 80 between Reno and Fernley" for instance. The regulations say "approximate" and Webster says that is "nearly correct or exact", so there is some leeway allowed.
9. Messages handled. If traffic is handled, the information regarding their numbers may be placed in "Remarks".

The foregoing outlines what you must enter in the log to abide by the regulations. A review of Sections 12.136 and 12.137 should be made if you are in doubt about any portion of them.

A typical cost for printing 100 sheets is about $3.00. Subsequent printings by the same printer will be less. Be sure you request return of the negative and plate he will produce. The plate is all that is necessary when requesting subsequent printings.

This log is very convenient to use on the car seat right beside you (provided you are not a southpaw!). No rulings across the page are provided because it is too difficult to follow a straight line in the log at the same time as you follow one on the road. In fact, if necessary, it is quite easy to keep a respectable-looking log with barely a glance. For safety reasons, obviously, the best policy is to have the second operator keep the log.

By following the procedures given, you may also prepare your own personalized fixed station logs. In this case, rulings and additional information may be added to any extent you desire. Just remember to provide all information that the regulations require. As in the case of the mobile log, no matter how many items are added, your printing costs will remain the same for the same size sheet.

For those who would just like to purchase the log sheets without any of the preparation described, the author has arranged to have these made available, with your call imprinted, from WA6GMD at $3.00 per hundred, including postage. Send requests to WB6KFI at address shown at beginning of article.

. . . WB6KFI

Attaching Shafts to ARC-5 Tuning Capacitors

The variable capacitors from ARC-5 receivers are very popular in amateur construction because they are well built and relatively inexpensive. There is one inherent problem though: how do you connect a conventional ¼ inch shaft to the splined shaft? The best method I have found uses a short piece of masking tape, some epoxy cement and a standard ¼ to ¼ inch shaft coupler. First of all, take a strip of masking tape about ¼ inch wide and wrap it around the splined shaft to build it up to ¼ inch diameter. Put a little extra on and take it off turn by turn until it fits snugly into the shaft coupler. Now coat the tape and one end of the coupler with epoxy cement and put them together. In 24 hours you will have a firm coupling that may be attached to a standard quarter inch shaft.

. . . Jim Fisk W1DTY

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Add a Crystal Filter to Your Receiver for less than $10

Crystal filters are a luxury found only in the more expensive receivers. For some unknown reason, most literature available to the ham and the tinkerer sheds little light on how to make them. The advantage of having a crystal filter is unquestionable, especially with the crowded conditions of today's ham bands. The filter shown in this article is intended mainly for the CW man although it will be of some use in SSB. It has a continuously variable bandwidth from about 200 hertz each side of center, (or less) to somewhere around 3 kHz. A phasing control moves a sharp rejection notch through the passband virtually eliminating interferance almost on top of the signal you want.

Fig. 1 shows the passband of the filter. The steepness of the sides really depends on how carefully you build it. But even a poor job of construction can be a tremendous improvement over a low priced receiver with no filter.

Its operation is really quite simple to understand. Remember that a crystal looks, electrically, like a series tuned circuit with a very high Q. Also, the Q of the whole thing depends on how you load it. Finally, the Q determins the bandwidth, ($Q = {}^{f}/_{bw}$). Fig. 2 is a schematic of the filter. Part values will be given shortly. The crystal is ground to the *if* frequency. The *if* can feeding the filter has a heavy load resistor on it. (R1) This makes its passband very broad so the filter is the main controlling factor for that stage. When you don't want the sharp bandwidth the switch (S1) shorts out the crystal. A parallel tuned circuit (L1-C1) loads the crystal. The potentiometer (R2) varies the Q of the tuned circuit, thereby controlling the bandwidth. The variable capacitor (C2) balances out the capacitance of the crystal. The position of the notch is influenced by this control.

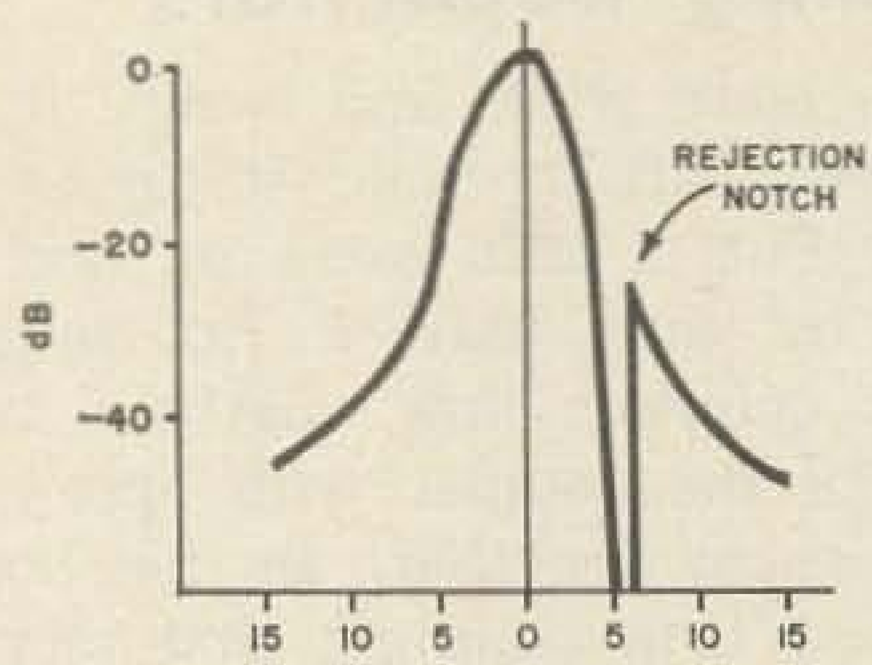

Fig. 1. Typical crystal filter curve at 3 kHz pass band.

All parts for the filter should be positioned to keep lead length at a minimum. Otherwise you will have problems. (i.e. it will oscillate like a bird!) You would be wise to build the filter in a 2 x 2 x 3 Minibox and run shielded leads to the tie points. Controls can be brought out to the front panel by shaft extensions. Ground all your shields only at the filter end and then run a separate ground wire to the common point in the *if* section. If the receiver has two or more *if* stages, insert the filter at the input of the last stage. If the receiver has only one *if* stage, use a larger Minibox and build another.

You will have to doctor one of the cans so it can feed the filter. My suggestion is that you remove the can from the receiver and mount it on the filter box. This will also leave a convenient hole to bring leads in. Now, most *if* cans have their tuning capacitor built into the base. This has to go. If you break off the lug which connects to the internal capacitor. Then you can build up the base again with epoxy resin. If the can is tuned with a mica capacitor mounted where you can reach it simply cut it out and you're in business.

The two series capacitors, Cc replaces the tuning capacitor of the can. Unfortunately most manufacturers don't tell you what this capacitance is, so you're going to have to have to diddle. Trial and error is the best method. Connect the can back into the receiver with the capacitor removed, tune in a strong station such as a local broadcast station, and try different values of fixed mica capacitors. The value which gives the strongest signal is your resonating capacity. If you have a National receiver with a 230 kHz *if* you will find 180 pF to be close enough. When you find this value, make each Cc twice that amount. (In the above instance, two 360 pF capacitors were used.)

O.K., so you build the thing and install it. Now you have to align it. If you have a signal generator you're lucky, but suppose you don't? Don't throw in the towel yet. A true ham knows how to make do. You need a steady CW signal (No modulation). You can use a VFO if you have one. However, if you're a poor man like me, use a cheap AM radio! Set the radio within handy reach and tune it to the top of the broadcast band. Take a single wire from the antenna lead of the receiver and let it dangle inside the case of the AM radio. You will find a nice strong CW signal somewhere around 2.055 MHz.

Peak up the can with the crystal shorted out. Then tune C1 for maximum output. Now set R2 for minimum resistance (widest bandwidth), unshort the crystal and peak up the whole thing all over again. I will warn you at this point that the tuning is awful sharp. When you throw in the crystal re-tune your signal source, or the receiver front end. Do it very carefully. With R2 at maximum, the signal will almost seem to ring. (I assume you are using the CW oscillator.) It will be very critical to tune and will sound very peculiar to one who is not used to crystal filters.

The filter has the narrowest passband when the load is heaviest. Just the opposite to what you might expect. The following table gives parts values for 240 kHz and 455 kHz. The calculation of these values involves a lot of hairy math. If you are a whiz at math, or have had a couple of years of college, you will find the whole design process in the Radiotron Designer's Handbook. Otherwise forget about computing it yourself.

The filter is not too difficult to install. The input can of the filter is connected to the output of the preceding *if* stage. The filter is then capacitive coupled to the following stage. Notice that the bypass which was at the low end of the can before installing the filter is removed altogether. The resistor to the AGC line now goes directly to the grid, thus providing a dc return path. Bring a ground lead from the filter to a ground point in the *if* strip. Shield all leads connecting the filter into the circuit. Ground the shields only at the filter end. Mount the filter in such a position as to insure shortest leads.

The crystal is of the same type used for frequency control. When you order it, specify a series resonance at the *if* frequency. You can get one quite reasonably from Abbott Electronics, 85 Elm St., No. Woburn, Mass., if your local supplier can't get it.

If you buy a new *if* can, the supplier may be able to find out the value of the internal capacitor. This will save you some work, since Cc must be twice this value. Meissner makes a pretty good can as do quite a few others. The switch should be a SPST rotary type. You can get that in the five and ten. As for shafts and couplers, most suppliers have an ample stock to fit most needs. National has a wide variety of these.

. . . W1USM

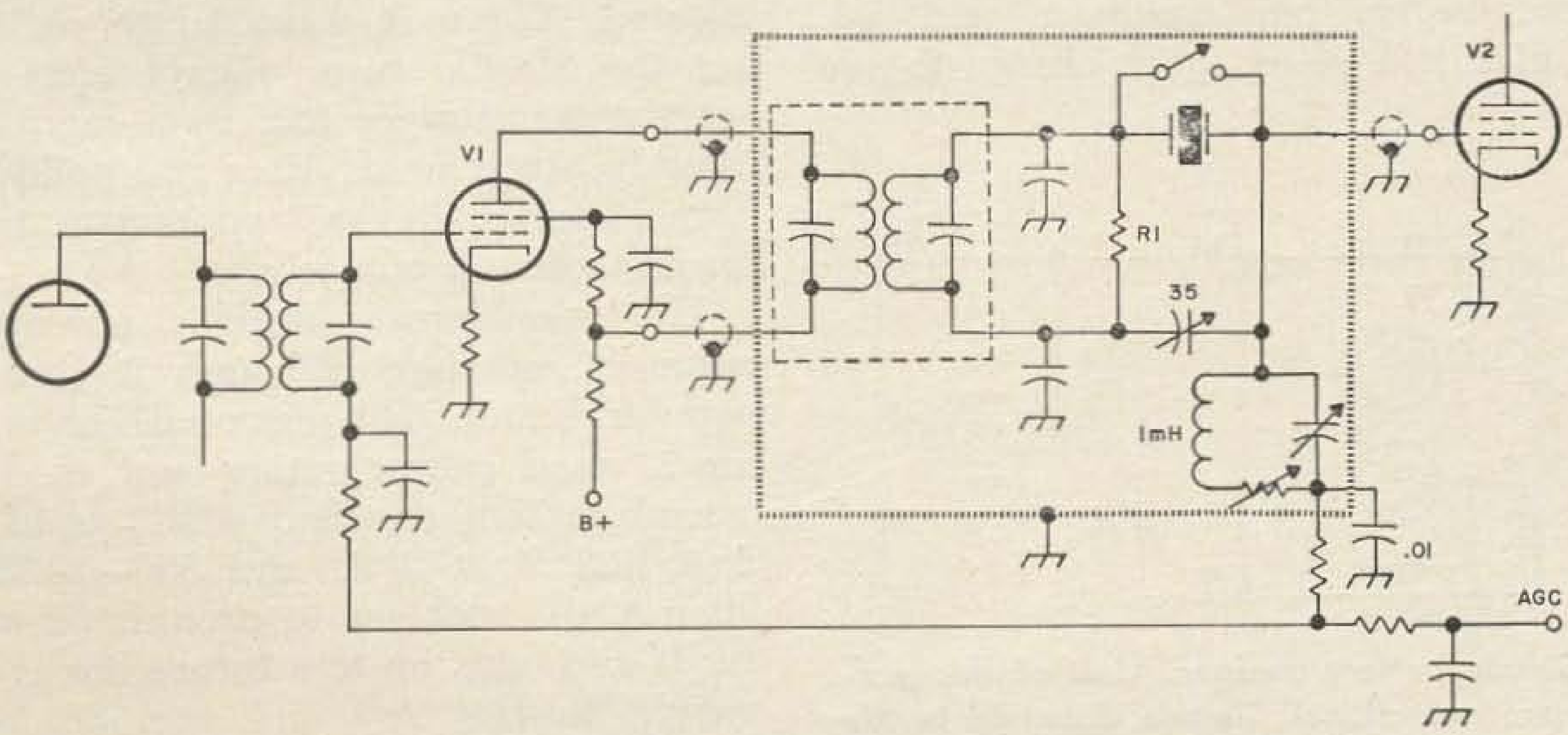

Fig. 2. If strip modified to include a crystal filter. R1 should be 3 kΩ for 240 kHz or 2.7 kΩ for 455 kHz. R2, 50Ω at 240 or 750Ω at 455.

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A Reactivator for the Semiconductor Activator

A simple charger for automobile storage batteries.

Semiconductor circuits in general require a stable low-impedance source of power. While well-regulated low-impedance supplies can be built, and usually are included as an integral feature of the equipment, a separate power source is quite attractive for numerous reasons. Perhaps the most important is the feeling of confidence that if trouble develops, and it usually does, the trouble is confined to the circuit and not in the source of power.

Dry cells and the like are out as primary sources of power. They have fairly high impedance, intermittent connections if a pressure plate is used as with numerous flashlight cells, and can be quite noisy. The lead-acid storage battery is preferable in many respects. It can withstand heavy loads without budging due to its low internal resistance. It also has a very low ac impedance which is very suitable for powering amplifiers which may have regenerative (or degenerative) effects when used with less efficient power sources. But, the lead-acid battery does have a few disadvantages. It requires charging, is messy, and is rather expensive. Read on.

The first problem is getting the battery. Most gas stations have a few old trade-ins lying around. Casually pick out one that appears to be in fair condition and ask them to give it a short quick-charge to see if will absorb the soup. On the way to the charger it wouldn't hurt to accidently drop the battery in a carefully planned trajectory on its bottom edge. This will serve to break loose the chemical build-up which frequently tends to short out cells. An old style battery with the lead straps exposed on the top is much better for obtaining tapped voltages. The second problem, the messy deal, is simple to overcome. Build a box out of old scrap lumber and hide the thing. Be sure the bottom is nailed inside the sides, rather than under them, so it won't fall out. Add a couple of pieces of wood for hand-holds. A top cover will help to keep the dust and dirt out, but be sure to leave ventillation holes for the gas to escape. We still have the third problem to overcome, so let's charge on.

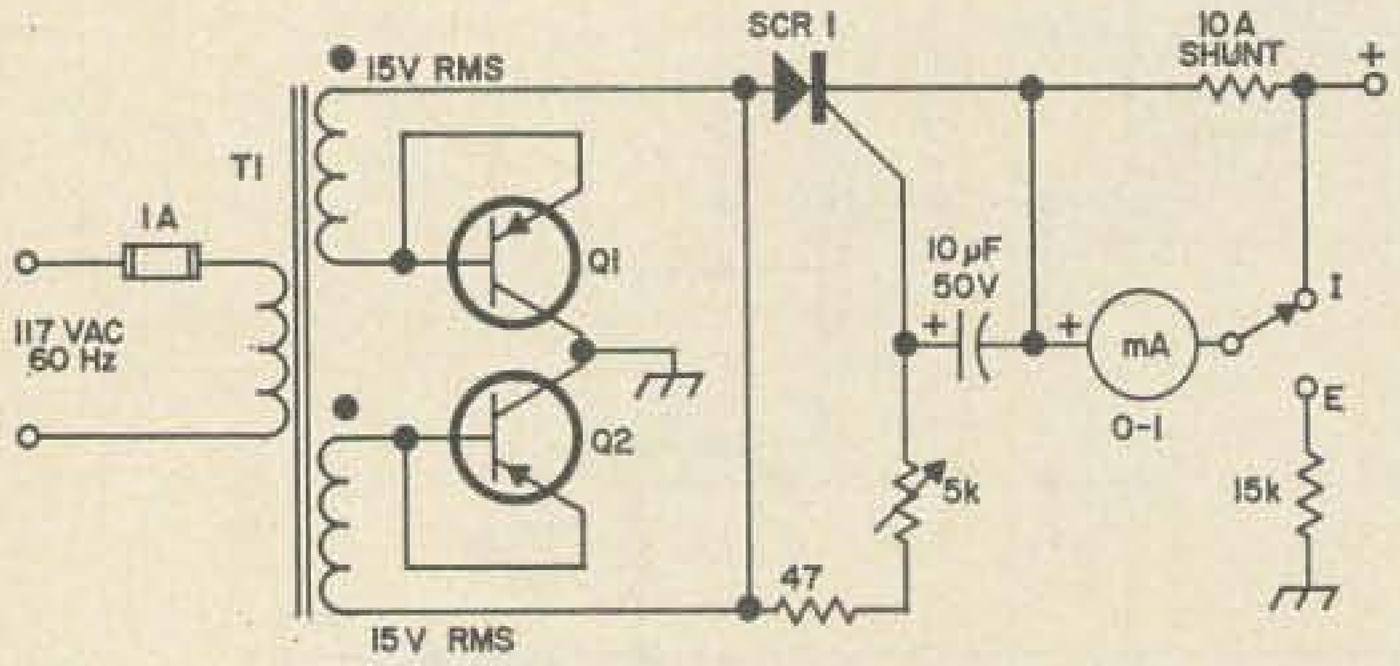

Fig. 1. Simple battery charger. Most of the components are not critical. They're discussed in the text. The dots by the transformer windings indicate the polarity of the rewound secondaries.

The complete circuit is shown in **Fig. 1.** It uses a pair of obsolete germanium transistors as rectifiers, and an inexpensive SCR as a current regulator. Manual control with a potentiometer is provided for current conditioning. Metering to check the charging rate and the battery voltage is accomplished with the standard 1 mA indicator.

The transformer selected was originally rated at slightly over 60 watts. So—to avoid complications—a one ampere 3AG fuse was selected. There is some surge on turn-on, but the Slo-Blo fuses always seem to take out the transformer too, so a regular quick blow fuse was used. After you build a transformer personally you appreciate the need for protecting it properly.

The transformer used is not listed by name or number, although it *was* a very popular brand. The essential characteristics are a good power rating and ease of disassembly. This one had windings of 5 V at 2 A, 6.3 V at 3 A, and 350–0–350 V at 90 mA. It adds up to around 62 watts or so. It also adds up to a future life as a paper weight in this day and age. So, off with the secondarys. Cut off the high voltage one. When unwinding the 6.3 V and 5 V sections count the number of turns. This is helpful in determining how many turns to put back on. Most standard transformers have the primary as the bottom or inner winding. Some special ones have the primary as the outer winding and should be avoided like work.

For up to ten or fifteen amperes, #18 wire is perfectly suitable. It only carries the current half the time, since a full wave rectifier is used. Use some fairly rugged paper for insulation between the layers. This helps to keep the winding smooth. On reassembly, it may be found that a few of the iron laminations won't fit in. Don't worry about it. If you used ordinary care in winding, stretched the wire to straighten it, etc., you now have a good quality suitable transformer. So put a load on it and connect it to the power line. It buzzes? Coat the laminations with lots of shellac.

Rectifier voltage drop is an important consideration at these potentials. If silicon rectifiers are used instead of the inexpensive germanium transistors, a few more turns must be added to the secondary windings. PNP germanium transistors are about the cheapest type low voltage rectifiers available today. They are mounted directly on the bare metal of the case, without mica washers or the like, to provide low thermal resistance. Delco 119-0016 were used but any suitable 10 or 15 amp types are ok. The SCR is also an oddball. Its ratings are required to be only 30 volts or thereabouts breakdown and 10 to 15 amps conduction. It is most easily mounted directly to a flat piece of aluminum as a heat sink, and the heat sink then insulated from the enclosure. The power supplied to the SCR regulator is not actually dc, but rather a full-wave rectified ac. The simple resistor-capacitor network allows setting the gate turn on point as desired for the required current output.

Metering is done by an ordinary inexpensive 1 mA meter. A 10 amp (or 15 amp) shunt is easily constructed by making an air wound coil of #18 or #16 gauge wire. Measure it carefully, after consulting a wire table to find the resistance per unit length. For instance, with a 1 mA meter of 100 mV sensitivity, 9,999 mA must go through the shunt with the same voltage drop. It works out to about a dozen turns of #18, an inch diameter. Don't try to switch the current. This will create troubles. Switching the meter also allows checking the battery voltage. This information, while of doubtful value, does prevent errors such as reversed connections.

It will be found that the charging current is initially quite high, then tapers off to a steady value. No provision is made for an automatic cut-off so it is necessary to do that by hand. Unplug it. It should be unplugged anyway when using the battery for testing out circuits. Avoid AC ground loops.

. . . K6EAW

Antipodal Bearings

Several months ago, in reply to a comment about a QSO being long-path, VQ9TC remarked, "There are *two* long paths!" It may be a long way from W6 to VQ9, but it is a problem to determine where those paths are. An inspection of a great-circle chart will disclose that one longitude and one latitude occupy the entire border of the chart. This makes it clear why a station at your antipode may be heard from any direction that provides a good signal path, even though this path is neither "short" nor "long". When the antipode of a desired point falls close to your location, a small difference in the place on which the chart is centered, will make a very large change in the indicated bearing.

Even though you do not have a world globe at hand, there is a quick way to determine the bearing of a place close to your antipode. First, pick off the latitude and the longitude of the distant place. Consider the South latitude as North latitude. Subtract the longitude from 180 degrees. distant point.

Let us take an example. The Callbook's World Atlas shows Kerguelen Island, FB8XX, at about 47S and 69E. Subtracting 69 from 180, we determine the antipode of Kerguelen to be about 47N and 121W. This falls approximately on Seattle, Washington. It is easy to appreciate, therefore, that the bearings from various points in the U.S.A. to Seattle differ drastically. A small change in the location of the distant point (such as by using Heard island instead of Kerguelen) also can make a surprising change in the bearings from your location.

. . . E. H. Conklin K6KA

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The Ancient Marriner

An antenna tuner for co-ax-fed Tri-Band Beams

If you have tried all of the other tuners for matching your transmitter to a 52-ohm coax-fed beam with no results, try this one. Beam antennas generally are not very broad band. They resonate at one particular frequency and at that point the SWR might be 1:1. As tuning departs from that resonant point the SWR increases. There may also be other causes for high SWR, the amateur may have taped his coax to the leg of the metal tower and un-balanced the line. This article is not written to discuss means of getting rid of SWR but how to live with it. It is doubtful the efficiency across any amateur band will fall off to where it makes very much difference in signal strength. This article is concerned with, however, how to make sure the transmitter is looking into 50 ohms at all times. This will assure the antenna load will absorb the power out of the tubes so that they will not have to be replaced after you hold the key down.

Several years ago no one would give much thought to SWR on the feed line because the higher plate dissipation tubes were used in the output of the transceivers. As manufacturers started to use small TV sweep type tubes in the final, the operator had to be careful that he did not burn up the tubes.

Check your rig. Turn out the shack lights, load the rig up and press the key with the frequency tuned off from the resonant frequency of the beam. Observe a thin red line on the plate of the tube. Now connect a 50-ohm dummy load in place of the antenna, load up the rig and press the key. It is likely that the tubes will stay cool. This should prove to the operator that steps should be taken to do something about his antenna set-up before he has to replace the final tubes.

One solution to the problem would be to use some kind of a beam that could be tuned to the operating frequency. Generally this is not possible and the amateur is stuck with his coax fed beam. The solution now is to use a tuner so that the transmitter looks into 50 ohms regardless of the SWR on the antenna feed line.

The design of this tuner was just stumbled on by accident while fussing around with the 50-ohm Trans-Match described in the ARRL handbook. The split-stator capacitor was replaced with separate capacitors, and it was found that the SWR could be tuned down to zero. The values of the variable condensers should be at least 6250 pF for the 20-15-10 meter bands. It was also found that using a roller coil a better adjustment could be made for the null position. Once the minimum spot is found for one frequency in the band, only a slight adjustment is necessary with the roller coil to bring the SWR down at the new frequency.

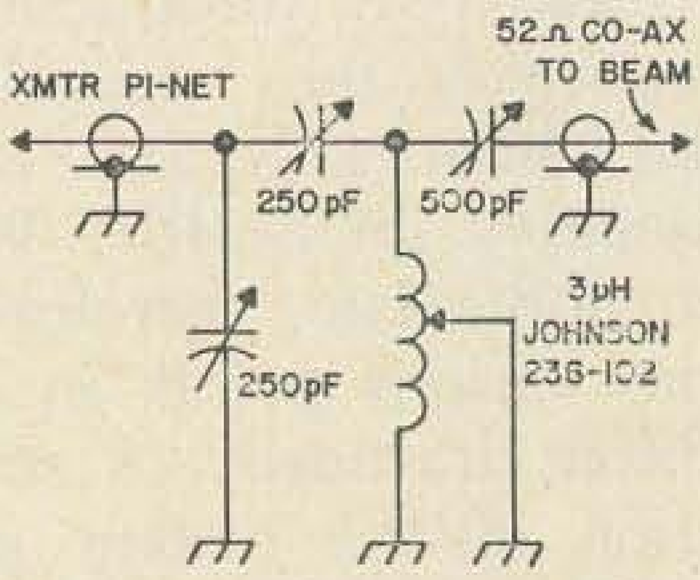


Fig. 1. A tuner for coaxial-fed antennas can help your transmitter see a 50-ohm load even though it has no effect on the SWR of the line running from the tuner to the beam.

Tuning procedure

First tune the transceiver by using a 50-ohm dummy load. Next switch from the load to the beam antenna and use only a minimum of output, or just enough to see the SWR indicating. Adjust all of the variable condensers to a minimum of SWR, and also adjust the roller coil, which takes about three turns on ten meters and four turns on fifteen meters. The coil is one inch in diameter and uses #12 wire.

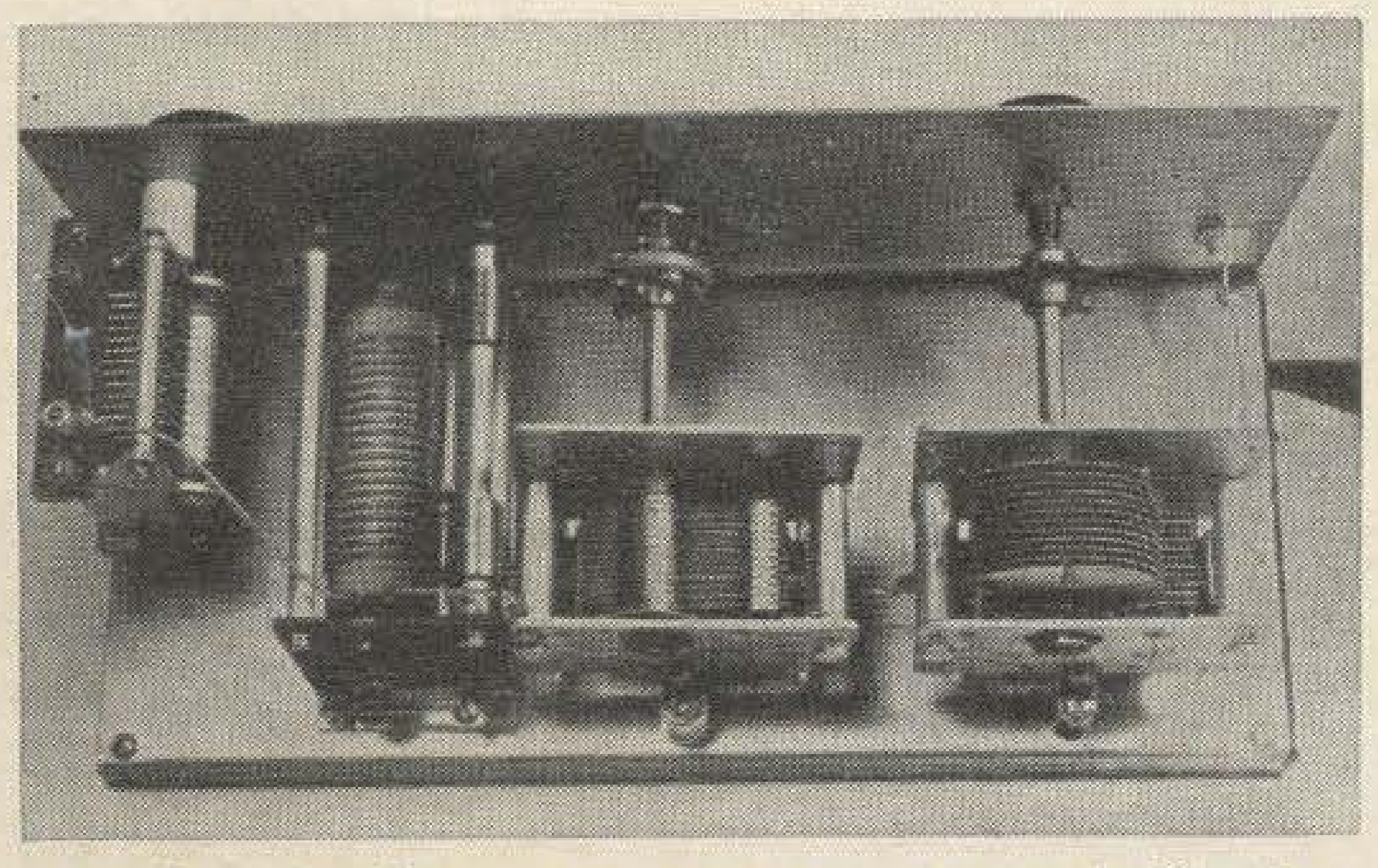
No tuner is used on 40 meters because the dipole cut to mid-band seems to do the job. The eighty meter band is 500 kHz broad and a dipole does not work across the whole band. Here it is better to use a center fed zepp and a match box tuner, unless the operator is only interested in the phone portion of the band.

Conclusion

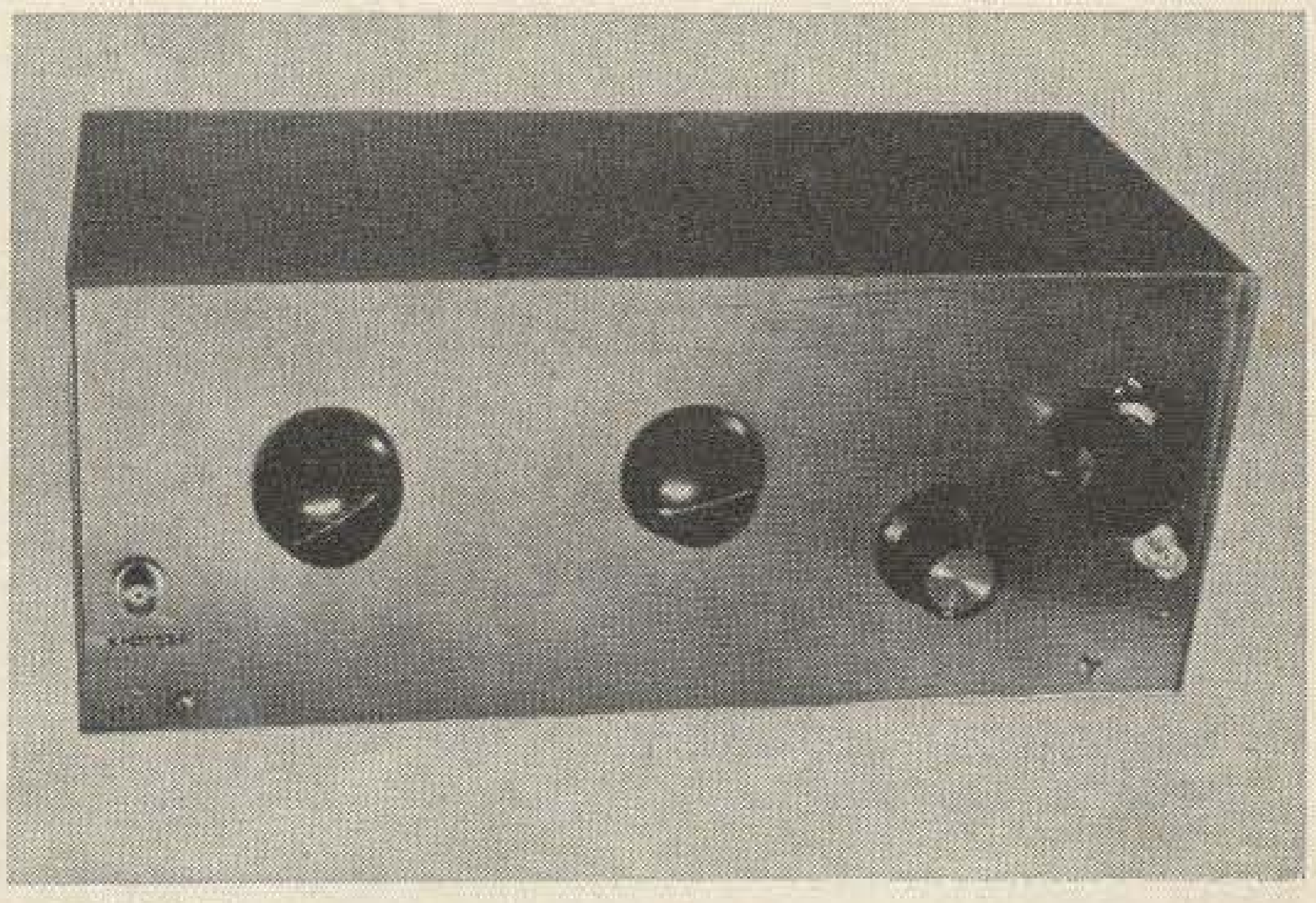
If you own a transceiver with small sweep tubes, and operate CW with a long duty cycle, just make sure the tubes are not getting hot from too high an SWR on the line. On the air fellows will tell you the pi-network will match the antenna, or they have never had any trouble. The pi-network, however, can't make a non-resonant antenna take out the power, and it will be dissipated in those cherry red plates. To save your tubes a coax tuner should be used.

Maybe someday in the future, beam construction will incorporate a way of resonating the driven element to the operating frequency. Let's hope so, then there will be no need to keep worrying.

. . . W6BLZ



Inside of the coax antenna tuner built by W6BLZ.



W6BLZ's coax antenna tuner.

Howard W. Pyle W7OE
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Mercer Island, Wash.

Climbing the Novice Ladder

Part III: Judy and Joe are really pitching!

After completing their code practice oscillator in FN's shop a few weeks back, Joe had stopped at Judy's place before going home. Her mother greeted him cordially and called Dad in from his cabinet shop on the rear of the lot; Judy's father was well known in the neighborhood as a master craftsman in wood. Joe immediately felt at ease with this middle-aged couple; it was obviously a happy family which also included Judy's brother now away at school.

It being lunch time, Mrs. Mansfield insisted that Joe remain and share it with them; they could discuss their code practice arrangements during the meal. When Judy explained that she and Joe would like a quiet corner table somewhere that they could use several times a week for awhile, her Dad immediately offered a corner in his plywood storage shed which already had a long built-in, shelf-like table.

"Swell," Judy exclaimed, "it's still summer so we won't need any heat and there's a big window right over the table so we'll have plenty of light; I'll show it to you Joe right after lunch".

Inspection of the code practice 'shack' confirmed Judy's opinion and as they had already arranged to get together every other afternoon until school started, Joe mounted his Honda and headed for home. The arrangement proved ideal. When Joe appeared in the early afternoons, not forgetting to pick up a few bottles of Coke, both youngsters industriously applied themselves to mastery of the code with occasional conversational rest periods and the always welcome 'snack'. It was not too many days before their efforts bore fruit; neither was giving more than an occasional glance at the printed code chart in the little book which FN had loaned to Joe. Their young minds quickly absorbed the dot and dash combinations which made up the various letter characters . . . figures and punctuation came a little harder. Diligent application with the emphasis on these soon eliminated that stumbling block and it wasn't long before they were not only identifying the individual letters as sent by their partner, but short simple words as well. Toward the end of the second week Joe said, "Say, Judy", it's about time we went back to see FN and let him check our progress; he asked us to, you know. What say we peddle out there Saturday morning?"

"Fine with me Joe," Judy returned, "I'll meet you out there about 9 o'clock . . . OK?"

"Suits me," Joe replied, "see you then . . . s'long and . . . 73"!

"73 yourself OB and CUL" was Judy's very much ham-flavored reply. They had found these ham abbreviations in FN's little book and had memorized a few of them; 'OB' for Old Boy, 'YL' for young lady, 73 for best regards and 'CUL' meaning see you later . . . quite a string yet to go but they were picking them up as they went along.

Shortly after nine Saturday morning Joe had arrived at FN's shack and Judy was not far behind. They were welcomed with, "Well; you kids haven't been out for a couple of weeks now . . . how're you getting along with the code?"

"Well Gramps," replied Judy, "we think we're doing pretty good; Joe and I can talk to each other a little bit now with the key".

"Sounds good to me," said FN, "let's set up a practice set here on my bench and see just how good". So saying, he lifted his CPO from a shelf and plugged in the headphones from his shack. "You bring another pair of phones?" he questioned.

"Oh yeah", Joe replied, "they're in the carrier on my Honda . . . I'll get 'em". He returned in a few moments and plugged them into the dual clips on the CPO.

"First," said FN, "let's see what your sending sounds like; here Judy, send me the first line on this card", handing her an advertising circular. Slowly and carefully, Judy made it without error. "Now Joe, you send the same line" which Joe did but spoiled a letter 'S' by inadvertently adding a dot, making an 'H' of it. "All right," said FN after pointing this out, "let's sit down now and talk about **sending** before I see how well you can copy which is what we call it when we are receiving from the other guy". Joe pulled out FN's thinking couch and he and Judy settled themselves while FN wheeled his office chair from the shack and joined them.

"Judy, you've got the makings of a good 'fist' . . . that's how we refer to a fellow's sending style. Right now you're a wee bit hesitant . . . not quite sure of yourself. That's evident from your dots which are a bit too light. Make 'em more **firm** . . . like this" and FN reached over to the bench, handed them their headphones and made a string of dots on the key. "See what I mean? Don't forget though that the dot is just one third the length of a dash . . . not necessarily by 'micrometer' measurement but so that it will **sound** that way to a listener; try it now". Judy reached across Joe to the bench but FN stopped her with, "Uh uh . . . you can't send good with your arm in thin air Judy; get up and rest the big muscle of your forearm on the bench . . . push your key back about 18" from the edge. That's better, try it now . .. make a string of dots . . . no, no . . . don't quiver them out fast like that . . . take it slow but firm . .. there, now you've got it. Now make several dot letters, 'I', 'H', 'S', and the figure '5'. That's much better now; keep it in mind. Aside from that you are doing all right although you both are a bit tense in your grip on the key; I'll give you a tip on that in a minute. Now Joe, you go ahead and send the same line on the card". Profiting by FN's advice to Judy, Joe came through with better dot formation but showed a tendency to drag his dashes a bit now and then making them closer to four dots in length rather than three. Pointing this out to him FN said, "Uniform Joe . . . uniform . . . make **all** of your dashes the same length. Go ahead now and send me the letters 'O', 'M' and a few zeros several times" which Joe proceeded to do. "That's better, Joe, but practice it . . . your dashes still vary a bit . . . watch it and have Judy check you on it from time to time and you check her for light dots too. Now let me give you that little tip to break finger tension in holding the key. In the first place, don't grab it like it was going to run away from you nor simply tap it with one finger; just a firm, light grip does it. I'm not going to try to tell you **how** to hold the knob . . . just grip it in the way that's most comfortable for you. A lot of manuals will detail just what fingers to place where . . . skip it for now. As you

FN recommended that Judy and Joe get these three inexpensive booklets to help them learn the things they'd need to pass the novice exam.

progress there's a 99% chance that you'll slip into the "thumb, forefinger and middle finger" grip that is used by practically all experienced operators both amateur and professional. Don't try to rush it though . . . let it develop naturally. Every fist has a distinctive style of its own; most experienced operators can immediately identify what operator is holding the key even before he signs his call letters, just by his style of character formation, if he has heard or worked him a few times previously. It's a good deal like writer's style in that respect; they follow much the same pattern. I'm drifting away from the point though; holding your fingers stiffly straightened out will soon tire your sending hand and you'll eventually develop what we call glass arm, a form of telegrapher's paralysis which will make sending extremely difficult and your character formation very hard to read. Before you do any sending again, hold a little rubber ball, a plum, small orange or even a wad of paper . . . something about the size of a golf ball . . . in the palm of your hand and **keep** it there while sending. It will help keep your fingers rounded and prevent tension from developing . . . this way, see?", and taking a scrap of old newspaper from under the bench he crumpled it into a ball, cupped it in his palm and sent them a few characters on the key, then had each of them try it.

"Gee, F. N., it really helps, doesn't it Judy?" said Joe.

"Oh yes . . . it seems much more natural and it's easier to send" and she rattled off a few characters to prove it!

"OK then," said FN, "so much for **sending**; now let's see how well you copy. You put the headphones on . . . I won't need any while sending. Here's a scratch pad and pencil for each of you. I'll send you just straight English from this page in my book; see what you can do with it". FN sent for perhaps two minutes at a rate of about 5 words a minute. Long practice enabled him to judge speed pretty accurately. He stopped sending and they passed him their copy. After a few minutes thoughtful study, FN announced, "Well, that was pretty close to five words a minute which will be what you'll get in your examination. Neither of you copied it solid which is a term we use to mean every letter; you both made a few misses here and there particularly in the few figures and common punctuation I sent you. How come you missed all three periods Judy? Think a minute and you'll recognize the characters for a period as being simply three letter A's run together to make one character. Joe got all the periods but his weak letters seem to be 'Y, 'F' and 'L'; you didn't do so well on the 'L' either Judy; both of you seem to get 'F' and 'L' confused. When I sent you 'L' you both wrote 'F' every time! True, they are opposites in that 'F' is 'dit-dit-dah-dit' and 'L' is 'dit-dah-dit-dit' . . .'F' turned around. Your job will be to untangle 'em . . . choose words with lots of these two letters when you practice. Also, try the simple words you learned when you were babies; dad, sis, mommy, baby, boy, girl, dog, cat, etc . . . that kind of stuff; lots of good practice material there.

"Well, you've shown me that you aren't quite equal to five words a minute yet which was hardly to be expected in this short time but your progress is excellent. Suppose we see now at just what speed you **can** make solid copy. I'll send for exactly two minutes by my stop watch and at a little slower speed using different words. Ready? go! Two minutes of silence except for the faint click of the key. Both kids turned in their papers and FN found one error on Joe's . . . the 'Y' again; he had written 'X'; Judy showed two errors but she got both periods correct this time. Her slips were between 'U' and 'V', only one dot different. FN then counted characters and said, "I was sending just a mite over 3½ words a minute . . . not quite 4. Judging from that I'm going to credit you both with solid copy at 3 words per minute; not a bad showing in two weeks. We'll drop the code angle now and discuss some of the other requirements for your license exam.

"First off, let me tell you a bit about the 'formalities'. You may think as a lot of budding hams seem to, that you will have to appear among a group of strange applicants and be examined by a Federal officer in totally unfamiliar surroundings. Any group examination as you know from your school tests, creates a mild form of nervous tension which has a tendecy to interfere with your thought track to some extent. In a radio code examination particularly, this is often responsible for failure to pass the first time and sometimes even the second even though the applicant has appeared qualified after having been checked by a friendly ham. The novice class however, gets a real break; they can be examined right in their own home or at any other place which both their examiner and theirself mutually agree upon. And, the examiner is **not** a Federal officer nor anyone else special; he (or she) can be anyone 21 years old or more who holds a valid amateur General class license or higher . . . even a member of your own family if he meets these requirements! I can act as your examiner, so can Larry . . . any ham with a General class ticket or better . . . you can choose your own examiner. You'll find all of the information in this little pamphlet and you can get a copy free by simply sending a postcard to 73 Magazine, Peterborough, N. H. 03458 and asking for "FCC Part 97, Amateur Radio Rules and Regulations". I suggest that you both do this; I'll loan you this copy until yours comes".

"What I'd like to do is this;" FN continued. "I would prefer that Larry, if he is willing, or one of the other qualified club members conduct the examination for Judy and I'll examine you Joe; that way neither of you will have a family examiner which will help condition you for your General exam which must be taken before a total stranger . . . the FCC engineer who will then examine you. If that's OK with you kids, suppose you ask Larry, Joe, if he will take Judy on when she is ready; I'm sure he will . . . you know him don't you Judy?"

"Oh yes, Gramps, he was a senior when I entered high school and I knew him slightly then and I've talked with him a couple of times since at the ham club . . . he's fine with me for an examiner".

"Good" FN replied, "you see what Larry thinks then, eh, Joe?"

"Oh sure . . . he'll do it though I know" said Joe.

"All right then, so much for the examination; it will be a few more weeks before either of you will be ready but we might as well start laying the cards. Now let's talk about another phase; what many hams refer to as the technical part of the examination. It really isn't technical in the true sense of the word . . . you Joe, with a couple of years of high school physics behind you and your own electrical experiments at home, won't have a bit of trouble there I'm sure. Judy may be a bit puzzled when a few terms such as watts input, final amplifier and such come her way . . . you can coach her here, Joe, as you run across unfamiliar terms in your study. For study material I'm going to suggest that one of you pick up the little book, Radio Amateurs License Manual, put out by the ARRL . . . that's the American Radio Relay League, a club to which about a third of the American hams belong. You'd better get that one, Joe, and Judy, you get a copy of the ABC's of Ham Radio published by the Howard W. Sams Co. With these two books which you can exchange between you, you'll find much more than you'll need to know for the exam and the little pamphlet on regulations you are sending for will take you over that hump. Your exams will be of the multiple answer type where you just make a mark opposite to what you think to be the correct answer among a number which you'll be given with each question. You won't have to draw a single schematic or wiring diagram; just check off your answers.

"Pay particular attention to the laws and regulations applying to radio amateurs; all three publications will give you these. You see, the FCC must be assured by your knowledge of these that you will be capable of legally operating an amateur radio station if a license is granted you. Knowing the rules is largely a matter of memorizing but you're going to have to read them a number of times so that you can intelligently answer questions on them. You don't necessarily have to memorize them word for word but get the meaning of each clear in your mind so that when you get a question reading like this; 'What is the penalty for transmitting a false distress signal?' you will immediately know which of the several possible answers given you on the sheet you should check as the correct one. You'll find plenty of sample questions and answers in both the License Manual and the ABC's book as well as a wealth of additional material which will clear up many points of ham operation for you . . . pick up these books as soon as you can . . Jim Turner's Electronics Supply Co., here in town, has them both.

"Now you kids run along, pick up your books and keep on with your code practice. I'd like to see you back here in a couple of weeks and if you apply yourselves well you should both be doing your five word a minute or better in that time. Next time, after checking you out on code, we'll talk a bit about the equipment you're going to need to put a station on the air when you get your licenses. For now then, CUL and 73".

Off they went, tossing back like real dyed-in-the-wool hams, "73' to you too ol' timer . . . BCNU!"

. . . W7OE

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Portable Operation Without Tears

The author was bitten by the Portable Operation Bug early in his ham career—in fact a mere six weeks after first being licensed. The first mild infection was contracted from a publication called "QST", which urged us all to take to the hills during an event called Field Day. The disease has now reached it's most virulent form, and friend K4LHB has been infected as well. This results in such things as operating the January VHF Sweepstakes from mountain-tops, impromptu trips to investigate various high places, and even the expenditure of hard cash for various items which by no stretch of the imagination would be handy around the home station. A great many lessons have been learned (most the hard way) which are presented here for when the bug bites you.

The location: For Field Day, a "DXpedition" to a rare county (that's right, no "r", just "county") or just the urge to get away for a day or a weekend, the main considerations are (1) a quiet location, with a minimum of man-made noise such as ignition, TV oscillator radiation, fluorescent lights, neon signs, etc., (2) a source of power (which may conflict to some extent with the requirement for no noise) and (3) availability for hamming purposes—both accessability and permission to use the location. For VHF operation, add altitude—the more the better. It is best to scout several prospective locations in advance, preferably with mobile gear in operation. Excellent maps are available from the government (Note 1) to aid in determining height and locating access roads. Permission is best obtained by stressing that the use of the location will be in practice for operation on an emergency basis should a disaster strike the area. U.S. and State parks can usually be used, but permission will usually require a preliminary inquiry followed by a formal letter to the main office, so start early.

What equipment? Portability sounds like the first thing to consider, but experience puts it well down the line, to be considered only in relation to what is available for transportation and operating space. Reliability comes ahead of everything else, and anything that isn't 101% dependable at home should not be taken out where erratic voltage, temperature variations and possible high humidity (not to mention being bumped around a bit) may be encountered. Compatability must also be considered when using gear from several different sources, as frequently happens. Get the interconnections made and checked out in advance.

Power: For any serious operating, 110 volt AC power is still almost a must. If a power line is available, it may well have generally low voltage and poor regulation, so a husky Variac might be necessary. If a "putt-putt" is used, it shoud be checked for correct speed by running an hour or so under full load with an electric clock connected. Compare this clock against WWV or another clock connected to the local power line. The generator should be adjusted so that the clock connected to it does not lose any time, which then assures that the minimum speed (full load) will produce 60-hertz current. Lower frequencies will cause heating of transformers and poor filtering of dc voltages, whereas any higher frequency will have a negligible effect on the equipment. This is also a good time to check for noise from ignition and arcing at the commutator, especially if a borrowed or rented generator is to be used. Plan on a minimum of 100 feet beetween generator and gear, with a hill or other obstruction in between to keep down both electrical and exhaust noise. A voltmeter to watch for extremes of voltage should be in use at all times, plus some means of disconnecting all the gear at once should the generator overspeed or bog down. For this purpose, any old meter with a rectifier diode and enough resistance in series to bring normal voltage to a logical spot (usually center) on the meter scale will serve. Storage battery power is more practical now than it was a few years ago, what with 12 volt systems, alternators, and transistorized dc to dc supplies, but there are still disadvantages such as forgetting to start the car before the battery runs down too far. Dry cell power is obviously impractical unless the only means of access is on foot, which makes this type of operation not worth the trouble unless you can find a very rare location and/or a goshawful high hill.

Antennas: The usual things apply here, but everything is temporary, so lots of rope can be used to put things up and hold them there. On a hilltop, there is rarely any benefit to be gained by going any higher than is necessary to get the antenna away from ground effects. For some locations, it is practical to set up the antennas a day or more in advance, since this usually amounts to almost 50% of the work of setting up. For large operations, it is best to select the best qualified "antenna engineer" to oversee the whole operation, including checking that feedlines and rotor control cables are connected before giving permission to "hoist away". My previous article on antenna raising in 73 for November 1964 gives many ideas that will help get the antennas up in the air with the least colorful language and damage.

Spare gear and parts: Anything available can be taken along to keep the station on the air if the main gear fails, but this can be carried to extremes. For example, a Gonset Communicator makes a real nifty spare for 6 or 2 meters, whereas another transmitter, receiver, modulator, and power supplies for all would be practical only if you had an exceptional amount of space available. It is probably best to take a carefully-calculated kit of spare tubes and parts, such as:

- 1—50,000 ohm, 50 watt resistor, with slider.
- 1 each—47 ohms, 220 ohms, 470 ohms, etc., (through 2.2 megohms) 2 watt resistors.
- 1 each—50, 100 and 500 pF and .001, .05 and .01 μF disc capacitors.
- 1 or 2—8 to 20 μF capacitor, rated for highest voltage any of your equipment uses.
- 1 spare for each final amplifier tube, and any other tube that runs in Class "C" or otherwise handles any appreciable power.
- 1 each—5U4 or 5R4 (or silicon replacement); 12AX7, 12AT7, or 12AU7; 6BQ7, 6BK7 or 6BZ7; 6AU6 or 6BA6; 6BE6 and 6AQ5 (or the 12 volt or octal equivalents).

This list will repair, at least temporarily, about 95% of the things that are likely to go wrong with communications gear. It should be modified to include any uncommon tube types or otherwise critical parts your particular equipment uses, but interchangeability should be stressed. For instance, the 12AT7, 12AU7 and 12AX7 all have the same pin connections, and will replace not only each other, but 12DW7, 12AZ7 and quite a few others as well in a pinch. Likewise, resistor and capacitor values are rarely so critical that those listed will not handle any replacement problem.

Shelter: Assuming there is no building at the operating site and you have to operate from a tent or a vehicle, check out the lay of the land before setting up, and take advantage of any features of the terrain that will help with the problems of heat and cold plus wind. As a general rule, "even in summer, hilltops are breezy and" cool at best and can get downright horrible in winter. It is therefore best to arrange for minimum wind, and for that to blow across the gear toward the operators. Since it is necessary to have something to cook on, or at least to heat water for coffee, a stove or heater should be chosen, but to serve primarily to heat the temporary "shack", with cooking capabilities strictly secondary. A kerosene heater, although smelly if not operated properly, seems to do better than the gasoline variety, and presents less of a fire hazard. In summer, mosquitoes and other "critters" become a problem, and all lighting should use the yellow bug-repellent type of bulb. On lower ground, assume that it is going to rain, and set up accordingly so you won't end up in six inches or more of water.

Food: Keep it simple is the word here. Coffee and soft drinks and/or 807's will be the most-consumed items, with not too much solid food consumed. A big batch of stew, chili, or reasonably solid soup prepared in advance, backed up by sandwich materials, is by far the easiest to handle. Frozen foods usually turn out to be a disappointment, since they thaw out before being used and just don't taste right—or conversely, if it's cold enough to keep them frozen, then it's almost impossible to heat properly. Who can operate on half-frozen stuff?

Don't forget's: It is highly frustrating to get all set to operate, and then discover that all but one crystal has been left home, or there are neither speaker nor phones for the receiver, or no feedline for the antenna, etc., etc. To avoid this, a list should be made up in minute detail of everything that is to make the trip. For example, don't just list "transceiver"; instead list individually the transceiver, power supply, cable to connect them, mike, key, speaker, etc., etc., to be checked off one by one when the gear is loaded. Start the list well in advance and add anything the minute you think of it. Also save your lists from one outing to the next. Items which are usually forgotten are: log and pencils, clock, rotor control box, toilet paper, cooking and eating utensils, small parts of anything which must be dis-assembled.

Miscellaneous: You might think you have picked the most remote place in the world, but if you drove there, so will someone else before your operation is over. I have yet to operate without having visitors, friendly or otherwise, and even the casual ones will usually ask what you're doing. This is the time for the good old public relations pitch, explaining that you are testing your capabilities of providing disaster communications, which you are doing whether you planned it that way or not. This approach is good even in the face of some TVI complaints. However, if you get the "pure ungarbled word" that you are operating on private property, getting into the State Police radios, or some such thing —don't argue or try to make adjustments to the gear. Just apologize, pack up quickly, and leave. Finally, the most important advice of all: Portable operation is meant (like any other hamming) to be fun. Although a fairly business-like approach has been detailed here, it is like waxing the skis, checking over the fishing tackle, or filling the SCUBA tanks. In other words, a little foresight will mean just that much more enjoyment later on.

. . . K3LNZ

Note 1: Index Maps of the various states, showing areas for which detailed maps are available, are available from:
Denver Distribution Section
Geological Survey
Dept. of the Interior
Federal Center
Denver, Colorado
(States West of the Mississippi, all or part)

Washington Distribution Section
Geological Survey
Dept. of the Interior
Washington, D.C.
(States East of the Mississippi)

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Practical Tips on Building Transistor Transmitters

Want to experiment with transistor transmitters? This article gives you the practical information you need.

From recent articles in the ham magazines and on-the-air conversations, it is obvious that interest in transistor transmitters is high. The thrill of working a station on the opposite coast with nothing but batteries for power is hard to beat. Many hams would like to build a solid state rig but shy away when confronted with pages and pages of formulas. I don't know very many good formulas so I'll pass along a few helpful hints and circuits, gleaned from hours of old-fashioned cut-and-try.

Test equipment

Before starting on a transmitter, a simple wave meter to indicate how much rf and at what frequency is in order. A helpful gadget for looking at rf in VFO and low power amplifiers is shown in **Fig. 1.** The probe end of the shield is not grounded to the gear under test. This unit can be constructed in an evening or so and calibrated with a signal generator. Its calibration is affected slightly by metal tables, etc., so when in use, make it a rule to set it on the type of material that you originally calibrated it on.

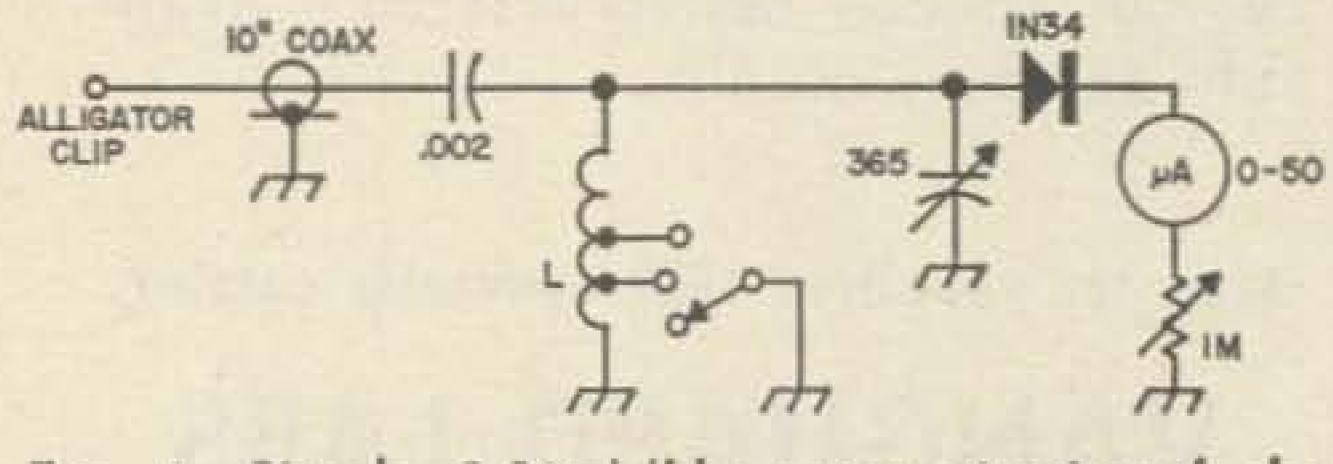

Fig. 1. Simple 3-30 MHz wavemeter-tuned detector useful for checking low power oscillators and amplifiers. L is 30 turns number 20 16 turns per inch, tapped at 14 and 5 turns from cold end.

If you have to purchase a meter, an imported S meter works fine and is pretty easy on the pocketbook. When coupled to a small pickup antenna, window screen, or SWR meter pickup, the wavemeter doubles as a field strength meter for on-the-air checks.

VFO's

VFO and VFO Mixer articles* are numerous so we won't go into that. In fact, a stable transistor VFO is probably the easiest part of a solid state rig to build. It is worth mentioning, however, that for an all-band rig, a mixer type setup is easier in the long run. When you consider stability, break in, and calibration, it beats the oscillator-doubler-tripler business hands down.

Power amplifiers

Getting the drive from the VFO up to a useful level to drive a final on more than one band can be a pretty frustrating experience. The class C amplifier works very well with a bare minimum of parts and requires no keying, as the drive determines collector current. **Fig. 2** illustrates two common emitter amplifiers. **Fig. 2A** uses capacitive input coupling, and **2B** uses link coupling. An emitter stabilizing resistor can be placed in the emitter lead (bypassed, of course) if you have lots of drive. My experience has been that more output can be realized from a stage by omitting the emitter resistor and using a healthy enough

*QST. September 1964. McKinley. "A Power Saving Conversion VFO."

transistor to hold up under the full output of the preceding stages.

The tank circuit is the big hitch in a transistor power amplifier. Trying to use tapped coils for a multi-band rig is a little impractical. You wind up with a cabinet full of band switches and Miniductors, not to mention burned fingers and strained eyes trying for the best impedance match. Fig. 3 shows an interstage tank circuit using an Ami-Tron toroid that is fairly easy to build and works, too. This approach combines good Q, power transfer, and impedance matching, all in one neat little package. If you're a miniaturization nut, the toroid will fit in with your schemes nicely, as it is relatively unaffected by nearby components. The large Ami-Tron "E" core is used. Two or three turns will suffice for the links. The number of turns for the links are a compromise for all band operation. If the best impedance match is used for the highest band where operation is intended, the circuit will tend to provide equal output on the lower frequencies. Transistor gain dribbles off at higher frequencies so we shoot for the best match here. A single section broadcast capacitor works well for the tank capacitor and is available for 98c or so from many mail order houses. With 365 pF it is possible to cover two bands on the same tap so be sure to check output frequency with the handy wavemeter.

Output tank

The same arrangement can be used for output circuits with good results. Slight variations will improve the versatility. First, the use of a large tank capacitor will help maintain a decent Q. A double (700 pF) BC variable works nicely with just a few turns on the toroid. Link coupling can be used to the antenna or closer match can be obtained using a sort of sliding tap with capacitors as shown in **Fig. 4.** Loading up with three knobs is only one step above plug in coils as far as conveniences goes, so a differential capacitor is recommended for C1A and C1B. Since not everybody has one of these things nor the inclination to buy one, you can manufacture one from two identical stators bolted face to face on the same base plate with a common rotor. A close look at some old bolt-together type capacitors might reveal manufacturing provisions for this type of arrangement. (Now you know what all those extra holes in the ceramic are for.) If all else fails—two capacitors can be ganged to achieve the same

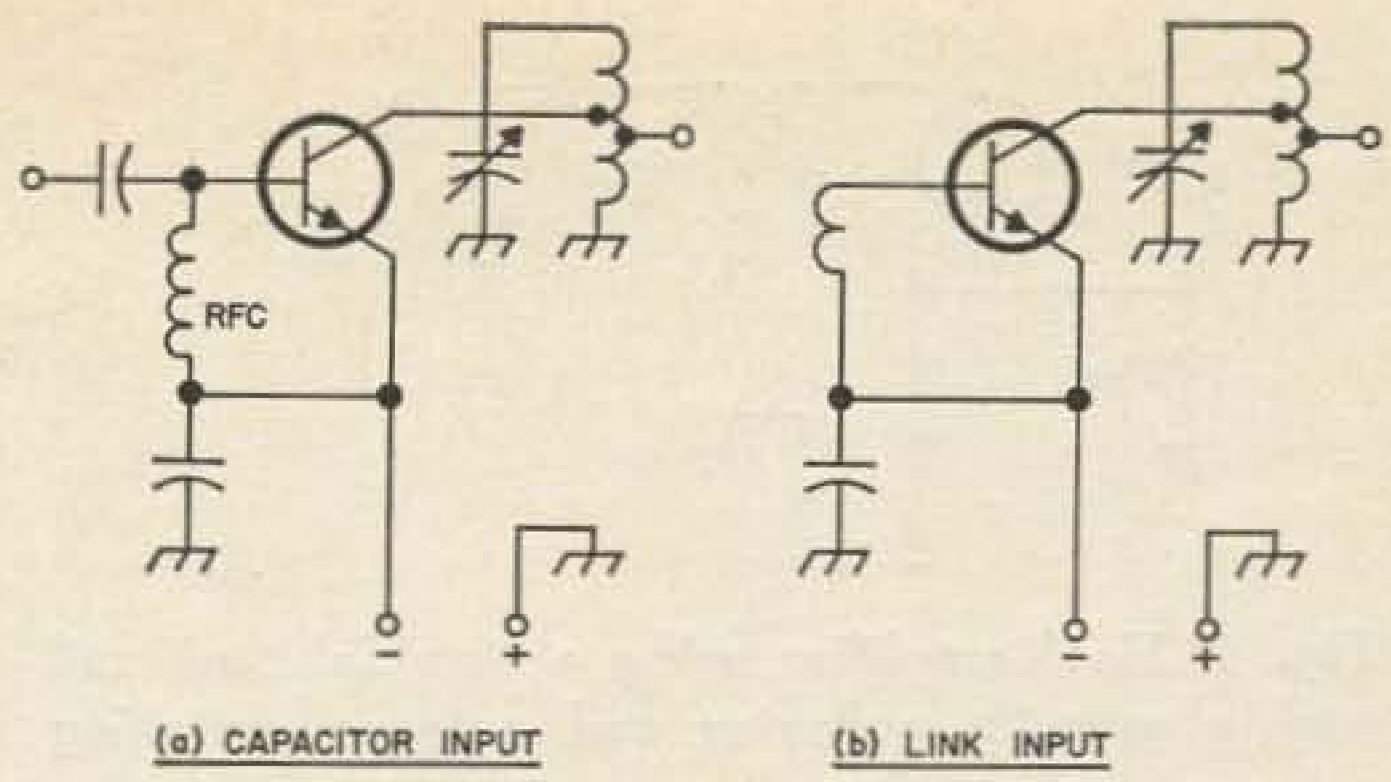

Fig. 2. Class amplifiers. Both are common emitter amplifiers.

effect. The idea being to have C1A decrease with a corresponding increase in C1A and vice versa.

What transistors?

One look at a transistor handbook and the dazzling array of a couple thousand types is almost enough to make you throw in the towel right there. Several articles have been written on choosing a suitable type for rf work so I won't elaborate (too much). The best low power (VFO, follower, etc.) type I've run across is a small NPN found on garden variety 3 by 5 surplus IBM cards at three cards for a dollar. A whole fistful of these for a dollar is an outstanding buy —especially with inflation upon us. If you go for higher power (say you want to light a No. 47 pilot lamp), I'd suggest the RCA 2N3053. These will stand 5 watts cw with a small clip-on heat sink for quite a while. I can't say how long because the originals in my rig are still there. Two in parallel will put a pretty healthy signal on the air and they're cheap—99c at last count.

Circuits and Construction

All the rules for regulation tube transmitters as far as shielding-layout, etc., apply to transistor rigs as well. They do have a few quirks, though, that we must consider. A common ground connection is a **must** because of low impedances involved. Along

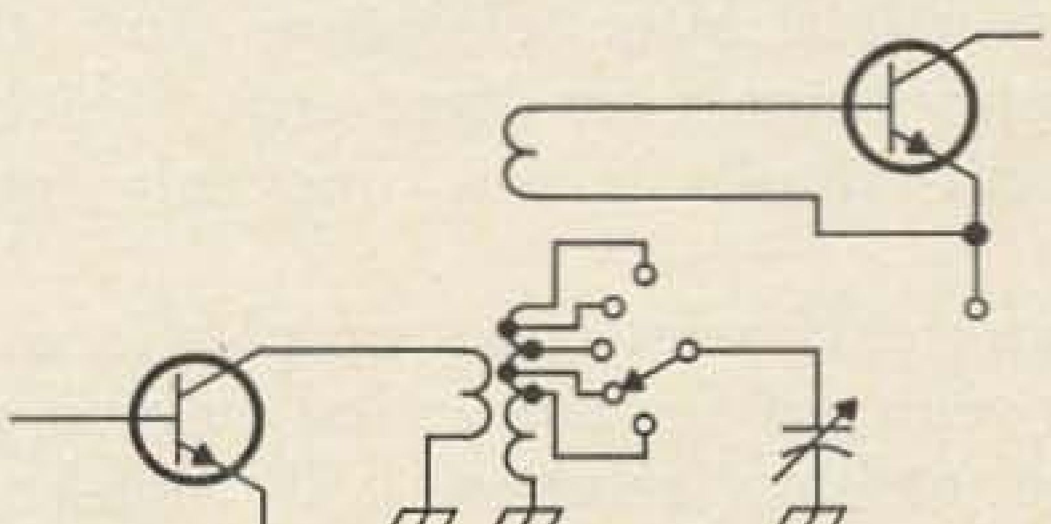

Fig. 3. Toroid tank coil and matching circuit. The links are one or two turns on the toroid. Tuned winding data is supplied with the toroid.

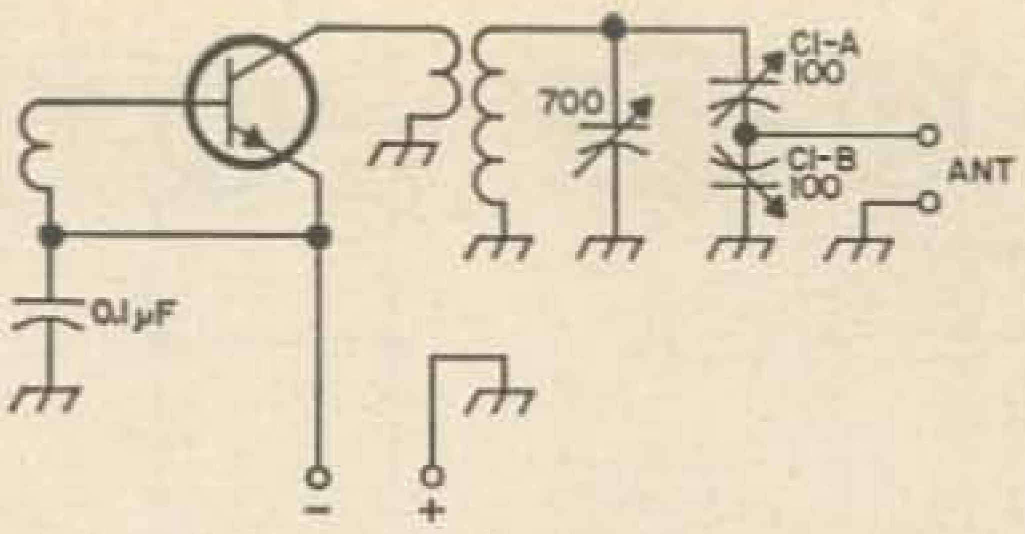

Fig. 4. Final amplifier using a toroidal tank coil and a versatile collector and antenna matching scheme.

this same line, use large bypass and decoupling capacitors. .1 µF is not too big. Most power transistors have the collector connected to the case so it is a good idea to check this before you go to all the trouble of installing your heat sink on the chassis.

Designing around a positive chassis is a good idea. That way you can use NPN transistors and ground one side of your tank circuits. High gain NPN rf transistors seem to be easier to come by than PNP's.

Power supplies

Whether you use batteries or the AC line is up to you. I prefer batteries for their good regulation and portability. Since buying dry cells gets a little old after a while, for a rig over 5 watts, a couple of cheap car batteries and a charger make a good setup for home use, though a little unsightly. A trip to your local Honda dealer will produce some small plastic cased motorcycle batteries that will perch nicely behind your rig in a small poly tray, the latter being filched from your ever-patient, ever-sighing XYL. A 2 ampere-hour 6-volt size costs around $4.00 and is good for many hours of operation with a 10 watt cw rig.

I hope the foregoing tips will make it easier for those interested to build a workable transistor rig. See you on 20 with your peanut whistles!

K0CJF

The Drano Finish

One of the nicest finishes that the home constructor can put on an aluminum chassis or panel is an etched finish. Normally this is done in a lye bath, but a much simpler approach uses materials which are normally available in the average household. Lye can be purchased in many grocery and hardware stores, but because it is dangerous, most people don't want to keep it in their homes. On the other hand, Drano is found in most kitchens and will provide the same results as the lye bath.

To etch the surface of an aluminum chassis or panel, the item to be etched must be absolutely clean. This may be accomplished by removing all the oil, greasy fingerprints and dirt with lacquer thinner, followed by a bath in hot, soapy water. Be sure to rinse the aluminum well in hot running water after cleaning; any traces of lacquer thinner or detergent which remain will result in an unevenly etched piece.

A large enameled pan or plastic mixing bowl is required for the actual etching process; the etching solution will attack most other materials. Be sure to select a container that is large enough so that the item to be etched may be completely submersed in the solution. To prepare the etchant, mix approximately two tablespoons of Drano with each quart of water required to fill the container. Use the hottest water that is available from your kitchen tap; the hotter the solution, the faster it will work.

To determine how long the aluminum should be left in the solution, a small sample should be etched before the chassis or panel is tried. This is because the required etching time is dependent upon many variables, including the type and hardness of the aluminum, the temperature of the solution, and the mineral content of the water. In some areas where the water is extremely hard, it may be necessary to use distilled water to obtain an evenly etched surface.

When the etching time has been determined, place the chassis in the solution and wait the required amount of time; make sure that it is completely submersed in the solution. Do not put your hands in the solution when it is time to remove the chassis, use tongs or rubber gloves. This type of solution is quite strong and will result in severe burns where it touches the skin. After the item is removed from the etching solution, thoroughly rinse it off in hot running water. The resultant finish is pleasing to the eye, mar resistant and long lasting. . . . Jim Fisk W1DTY

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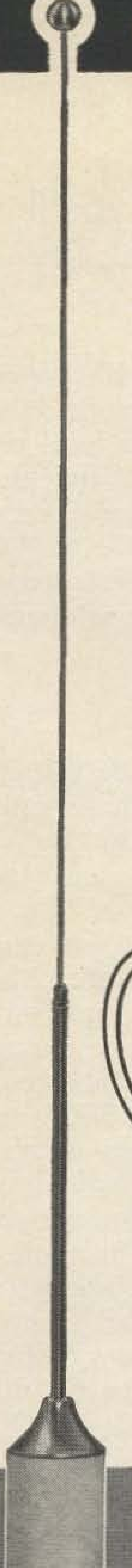

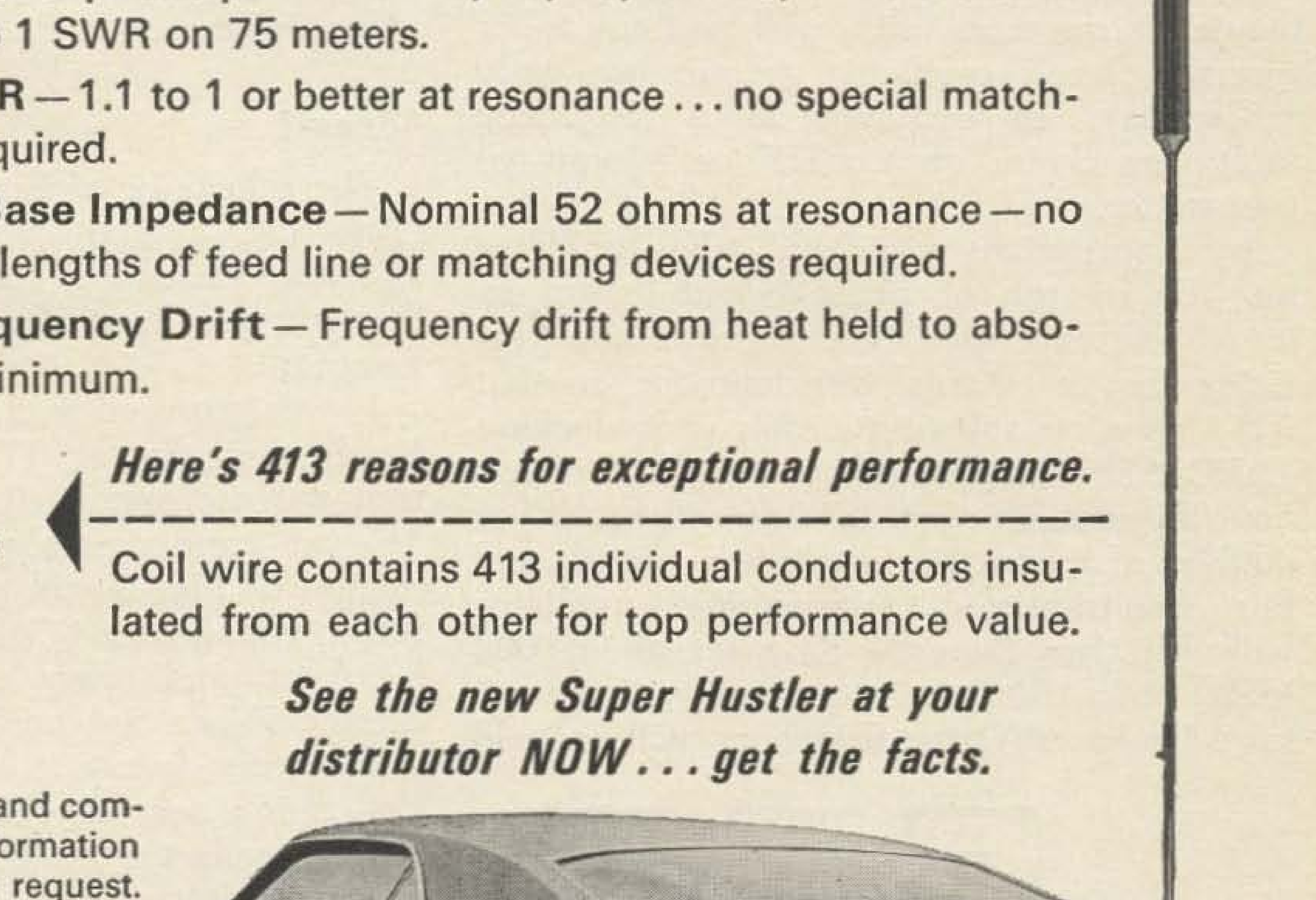

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A Phase-Locked UHF Microwave Oscillator

Philip Moldofsky K3OJK
Michael Paolini
Jerrold Electronics Corp.
Philadelphia, Pa.

Even if you don't expect to build this stable oscillator, you'll likely find the description of it interesting. It provides stability within 1 Hz at even 6.25 GHz.

The solid-state oscillator described below provides up to two watts output with rock-stable frequency control from approximately 400 to 900 MHz and can be tuned for second harmonics up to approximately 1800 MHz with as much as 500 mW out. The power and the phase-locked frequency stability on both fundamental and second harmonic frequencies are well suited to a receiver local oscillator (requireing only milliwatts), an oscillator in a frequency multiplier chain, or a UHF or microwave transmitter.

By appropriate switching, the oscillator may be freerun or phase-locked to an external reference oscillator. There is also provision for an external discriminator, so that AFC may be substituted for phase-locking (APC). For simplest construction and operation, the oscillator can be run without either method of automatic frequency control, and this one-transistor, freerunning oscillator will drift less than 30 KHz (at about 600 MHz) in a fairly constant room temperature. Under AFC the frequency will be held constant while the signal may be FM voice deviated. In the phase-locked mode, the oscillator can be used as a receiver local oscillator or as a CW transmitter, and the UHF output is locked *precisely* on a crystal harmonic. The phase-locked 400 to 900 MHz signal will be not even one hertz away from the chosen harmonic of your reference crystal frequency.

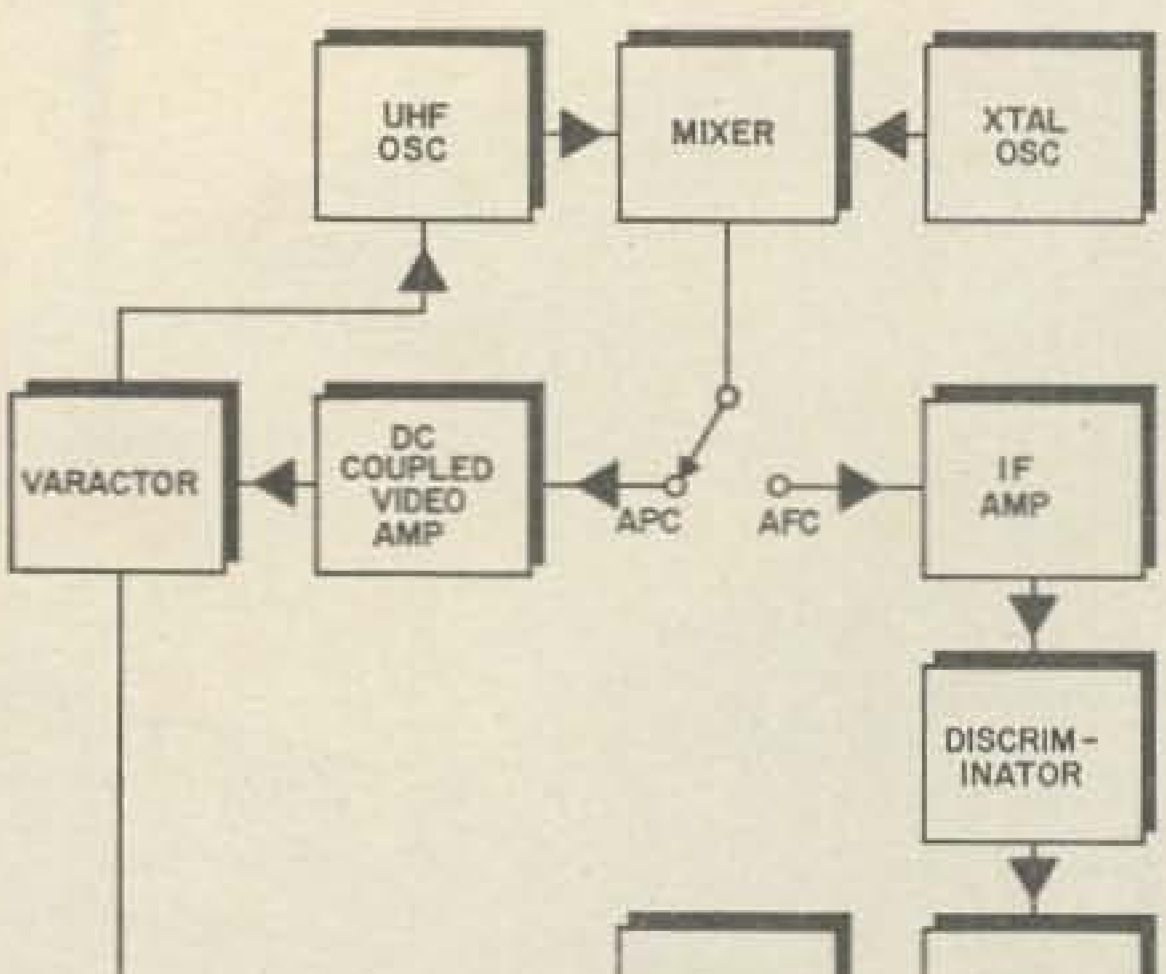


Fig. 1. Block diagram of the oscillator with various means of frequency control.

Circuit

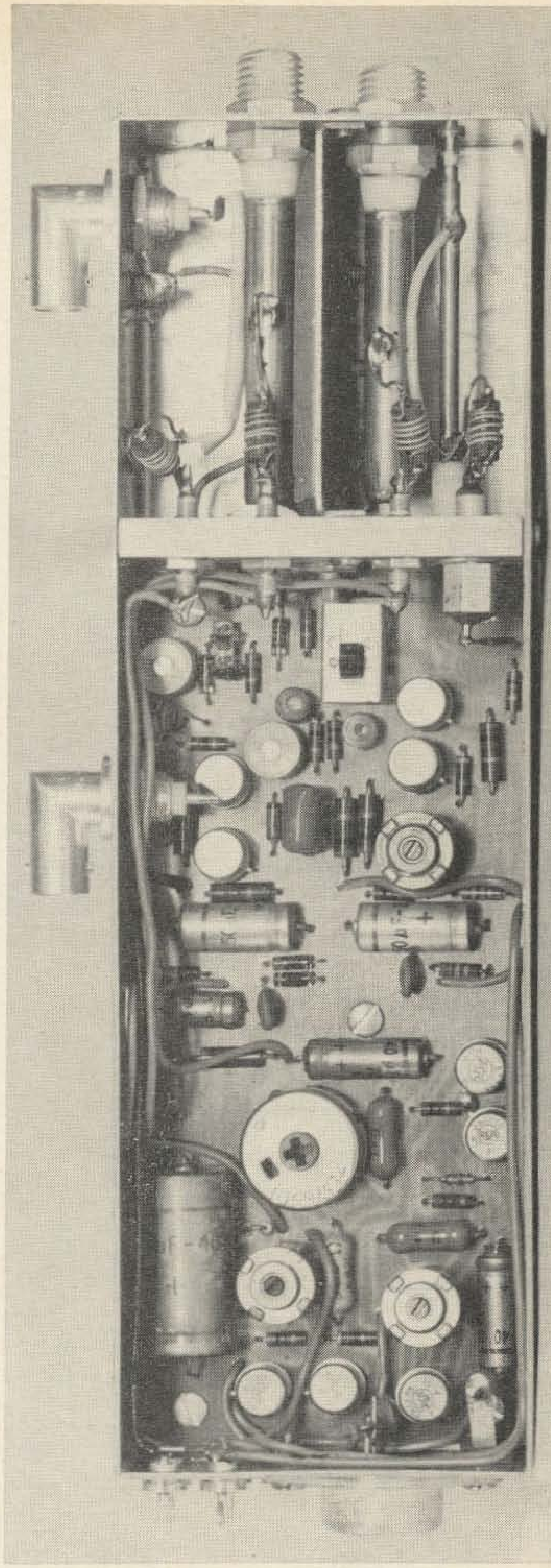
The schematic of Fig. 2 shows the voltage regulating, current limiting power supply and the phase-lock circuitry consisting of the mixer, the video amplifier, and the varactor.

Power required is 25 to 35 Vdc, unregulated, typically at 175 to 300 mA. Also required are regulated +18 Vdc and −18 Vdc at approximately 75 mA. The power section of Fig. 2 will provide regulated collector voltage for Q7 from the 25-35 V unregulated and offers an adjustable current limiter. When not oscillating, Q7 will draw damagingly heavy current, so the current limiter is a necessity. The 25-35 V is applied to the collector of Q1 and the regulated output voltage is taken from the emitter through a fixed drop, R3. Now, a variation in the output voltage will unbalance the differential amplifier consisting of Q5 and Q6, applying a restoring voltage to the base of Q3. This is built up through Q3 and Q2 and applied to the base of Q1, turning it further on or off, as required by the original output voltage variation. If output voltage increases, Q1 is turned slightly further off, thus dropping the output. A decrease in output voltage turns Q1 further on, decreasing the drop across it, and bringing up the output. Thus, regulated dc is applied to the collector of Q7, the oscillator. The base voltage is held by zener CR3 at 0.7 V. (The transistor may be damaged if the base is at more than 1 V.)

The current limiter consists of Q4, which senses the current being drawn by looking at the voltage drop across R3. The emitter-base voltage depends on the amount of current flowing through R3, so as more current flows, Q4 brings the base of Q3 closer to the output voltage. At a current level set by R4, Q4 will go to saturation and clamp the base of Q3 at close to the output voltage, so that no higher current can be drawn through Q1. R5 assures that even with no resistance from R4 between the emitter and base of Q4, the current will be limited to about 500 mA.

The dotted lines of **Fig 2** indicate the contents of and feedthroughs to the tuned cavities. The collector and the base are tuned in twin 50Ω cavities which have the dimensions given in **Fig. 4.** Q7 is a 2N4040 or a 2N4041, the 4040 being a double transistor in one case. With the 2N4040, up to two watts may be obtained on the fundamental frequencies from about 400-900 MHz and the cavities may be tuned to put out up to about 500 mW on second harmonics. Using the 2N4041, these power outputs are approximately halved. The circuit is the same for either transistor, so the choice is dependent only on cost and power desired. The output is taken from a coupling loop in the collector cavity. If the load into which the oscillator is working is highly non-linear, such as a varactor or a step diode, it may be necessary to provide a 2 dB attenuator at the output. Although this cuts output power by about ⅓, it does provide some isolation, which may make the oscillator easier to bring on when working into this special type of load. The 2 dB attenuator is made of three resistors, as shown in **Fig. 2,** and placed near the output BNC connector in the collector cavity. Ordinarily, when feeding into an antenna or working into a receiver circuit or any other load that is not highly non-linear, the attenuator is not needed.

The circuitry described above is all that is required for a freerunning oscillator. For frequency control, either AFC or APC may be used; **Fig. 2** gives a complete schematic of the APC, or phase-locking, circuit. For AFC, refer to block diagram **Fig. 1.** The blocks supplied for AFC by the circuits of **Fig. 2** are UHF OSC, MIXER, DC AMP, and VARACTOR. The external IF AMP and DISCRIMINATOR may be connected between TP2 and TP1 with the switch in the TP position; TP2 is then the mixer output and TP1 the dc-coupled video amplifier input.



UHF-microwave phase-locked oscillator.

Phase-locking is accomplished in the following way. A pickup wire from the collector cavity feeds a portion of the oscillator output into the mixer, to be mixed with the output of an external crystal reference

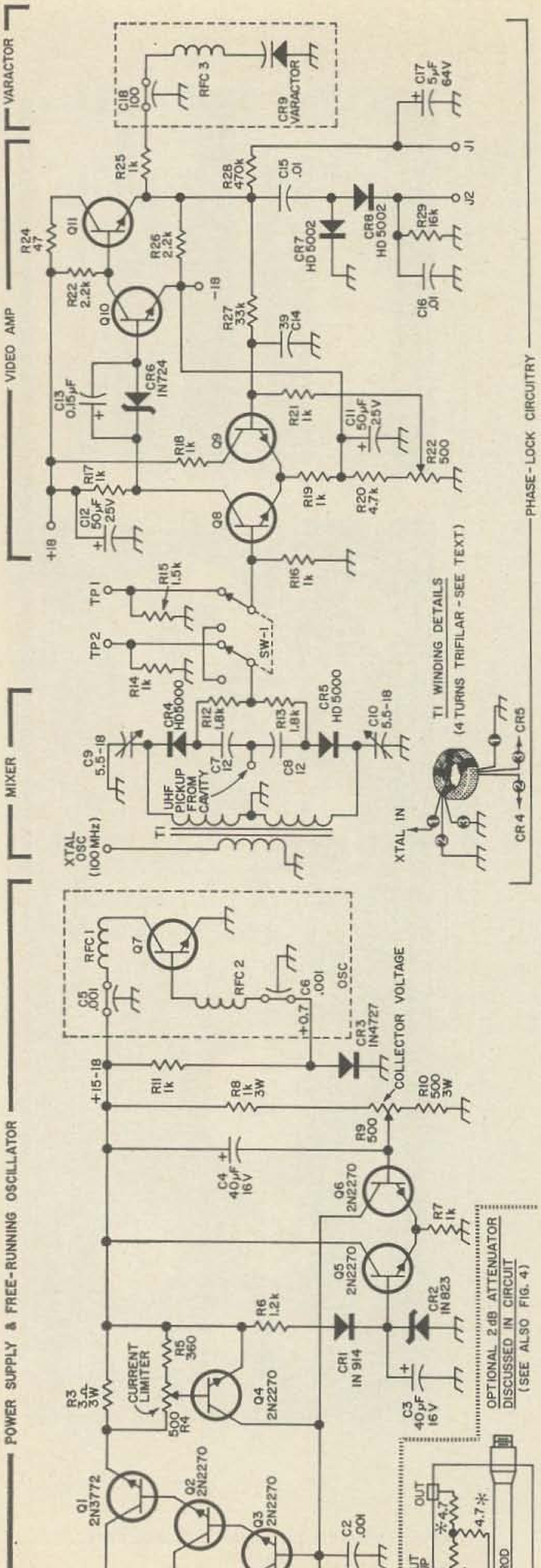


Fig. 2. Schematic of the power supply, UHF-microwave oscillator and APC loop. Dotted lines indicate feedthroughs to or parts located in the cavities. For cavity tuning elements, see Fig. 4. CR9 is a Motorola MV1864B, Q7 is a TRW 2N4040 or 4041, Q8-Q11 are 2N3866 (preferred) or 2N2270, 2N697 or 2N914. RFC1-3 are 6 turns #30 DNB on 1/4" phenolic form spaced to 3/8", and T1 is 4 turns #30 DNB trifilar wound on 1/8" to 1/4" diameter powdered iron core.

oscillator, fed in through T1. We should like the external crystal oscillator to operate at as high a frequency as possible, since the available phase-lock frequencies will differ by the crystal frequency. It will be easier to determine (by a method to follow) the phase-locked operating frequency if the possibilities are 100 MHz apart than if they are closely spaced and numerous. Also, with higher reference frequencies, we can lock on lower order harmonics and take advantage of their higher power. We used a crystal reference frequency of 125 MHz and recommend something on the order of 50-100 MHz. Of course, if you have in mind an exact phase-locking operating frequency, your crystal frequency must be a subharmonic (e.g., for 432 MHz you might use a 54 or 144 MHz crystal reference oscillator). Between ¼ and 1 watt are required from the reference oscillator on its fundamental frequency. When SW1 is in the phase-lock position, the mixer output is fed into a dc-coupled video amplifier. The operating bandwidth of this amplifier determines the lock-in frequency range. For example, our amplifier went out to 10 MHz before it dropped off considerably, so the UHF oscillator tuning elements (including the internal capacitance of Q7) could be tuned up to 10 MHz above or below lock-in frequency and the resulting error signal from the mixer would

	Voltages		
Transistor	Collector	Base	Emitter
Q1	25-35	23.2	22.6
Q2	25-35	23.8	23.2
Q3	25-35	24.4	23.8
Q4	24.4	25	25
Q5	17	6.5	6
Q6	27	6.6	6
Q7	15-28	0.7	0
Q8	6.3	0	−0.8
Q9	12	0	−0.8
Q10	8	−17	−18
Q11	17	8	8.5

Fig. 3. Typical transistor voltages. Measurements made with oscillator phase-locked and putting out 800 mW. Voltage on collector of 2N3772 (Q1) was 28 V.

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still pass through the video amplifier, reach the varactor, and continually keep the base tuned to precisely nf_{xtal}.

The choice of transistors Q8-Q11 depends on desired lock-in range. We used 2N3866's to achieve the 10 MHz usable amplifier bandwidth. However, if smaller lock-in ranges will be satisfactory, or if external AFC is used and the amplifier will pass only audio frequency deviation, 2N2270's, 2N697's, or 2N914's may be used with no other circuit changes. The amplifier, using 2N3866's, had 30 dB of voltage gain.

Now, with APC switched in at SW1, if the UHF output frequency starts to drift from nf_{xtal} (phase-lock frequency), the phase-lock loop sees this attempt to leave frequency as an attempt to go out of phase with the crystal oscillator signal. The mixer immediately puts out an ac error signal, which passes through the video amplifier and is applied to the varactor, keeping the UHF oscillator continually on the phase-lock frequency. For example, if the oscillator is tuned 3 MHz from lock-in frequency when it is turned on, the phase-lock loop senses that the signal is trying to go out of phase with the crystal oscillator at a 3 MHz rate, and retunes with the varactor immediately. While operating phase-locked, the output frequency can be no more than 1 Hz away from nf_{xtal}. (If the crystal oscillator drifts, the phase-locked UHF output will, of course, follow the drift.)

Construction

The entire unit—power circuits, phase-lock loop, and twin tuned cavities—was built in a copper box, 8½" x 2½" x 1 5/16". An etched circuit board made this tight construction possible, but etched circuitry is not absolutely necessary. The copper box serves two purposes; it provides a heat sink for Q7 and it forms four walls of the cavities. For best operation, a copper, brass, or aluminum block should be used as the combination heat sink—cavity wall. (See **Fig. 4.**) However, the four other walls of the cavity (and the other walls of the box) may be fabricated from copper clad board. Skin effect makes the wall thickness unimportant. If copper clad is used, all corner seams must be completely closed with solder. Such a box will not be as sturdy as one formed from 1/16" copper, but it may be more easily fashioned.

The power and phase-lock circuits may be housed in any chassis, but the dimensions of the tuned cavities must remain those of **Fig. 4**, with the possible exceptions noted in the following paragraph. Whatever type of construction is used (etched circuits, etc.), leads of the crystal oscillator input to the mixer and UHF pickup loop from the cavity should be short. This means placing the crystal oscillator input BNC connector and the components of the mixer (**Fig. 2**) close to the cavity.

For construction of the twin tuned cavities see **Fig. 4.** The two leads of Q7 shown are the collector and the base, which are soldered to the ends of their respective tuning rods. The two emitter leads should be soldered to the grounded dividing wall, with leads as short as possible (less than ⅛"). If sheet copper is used, a flange along the bottom of the dividing wall may be used for support. With copper clad board, the dividing wall may be soldered to the other walls on three sides. C_a and C_b are concentric cylindrical capacitors, with a range of about 1.5-7 pF.
However, it may be useful to obtain similar capacitors with larger ranges, which will be desirable to reach lower frequencies. When C_a and C_b are 1.5-7 pF, the oscillator can be tuned as low as about 600 MHz. To reach lower frequencies, the *length* of each cavity may be increased, along with the tuning rod in it. To fit the tuning rods to various cylindrical capacitors, the rod diameter may be varied slightly, but the cavity height and width must also be increased in proportion of maintain a 4:1 width-to-rod diameter ratio (e.g., 1¼": 5/16"). To tune as low as 400 MHz, the cavities should be stretched to hold rods 11 cm (4.3") long, and C_a and C_b should each have a range up to about 40 pF (which may be partly from the variable and partly from a fixed TCZ capacitor between points A and B and between C and D of **Fig. 4**). Concentric cylindrical capacitors are made by the Johanson Co., 400 Rockaway Valley Rd., Boonton, N. J. and by JFD Electronics Corp., Brooklyn, N. Y. 11219.

The varactor, located in the base cavity, is coupled to the base by the varactor's supporting rod and by an extra loop of insulated wire that may be brought closer to the base tuning rod. The varactor rod must be kept above ground, so the construction of **Fig. 4** is used. The rod fits snuggly into a hole in a piece of Teflon, or other insulator, shaped as pictured. This, in turn, is mounted in the cavity wall. The hole for the copper rod is deeper than will be necessary to accomodate

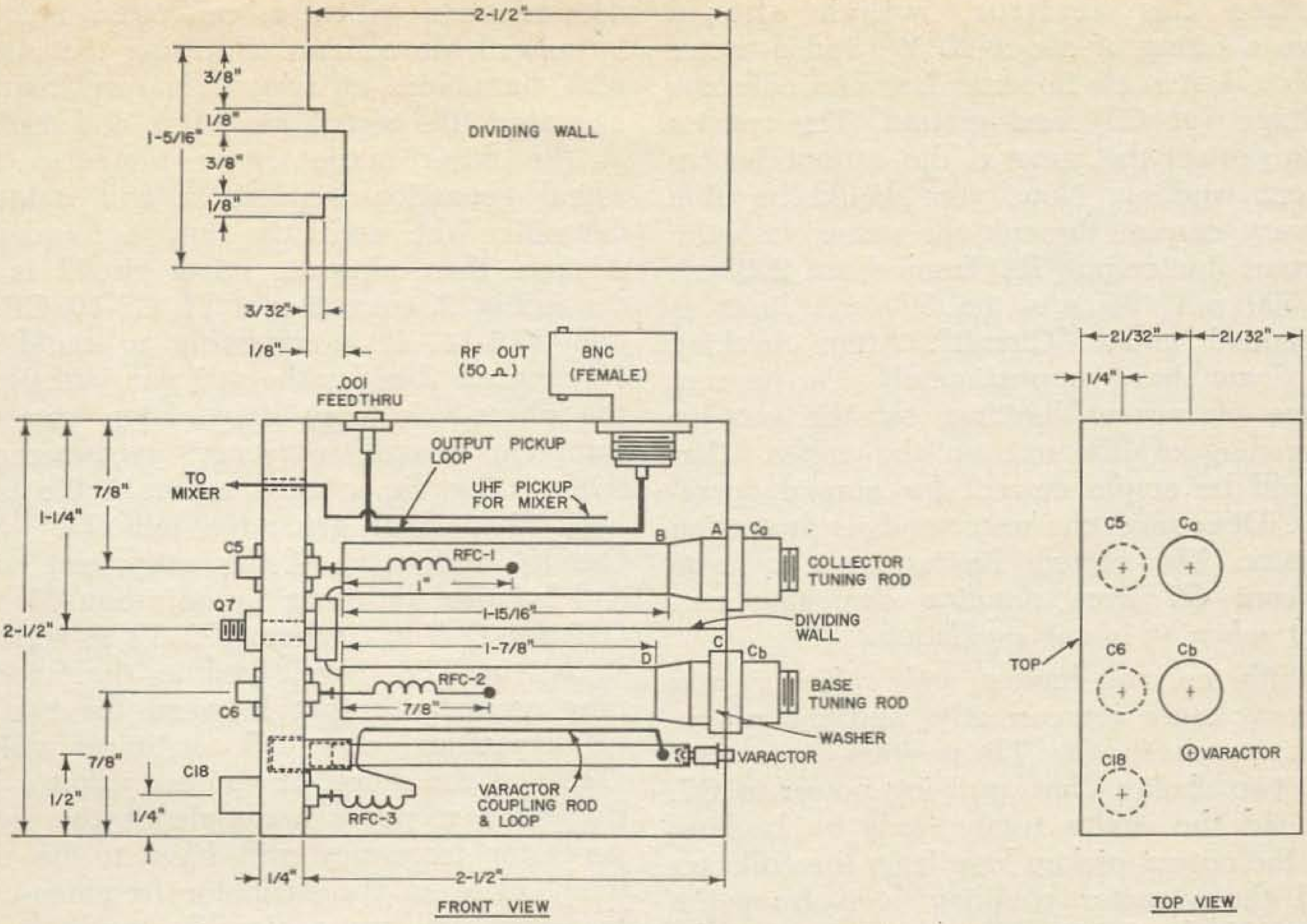

Fig. 4. Twin tuned cavities. See text for details on tuning capacitors Ca and Cb and for information on points A—D. The base and collector tuning rods are hollow brass tubing, 5/16" O.D. and the varactor rod is 1/8" diameter solid copper. The varactor coupling loop is insulated wire, about #26. The output coupling loop may be #18 insulated wire or a 1/4" brass strip, insulated by spaghetti, and the UHF pickup is #22 insulated wire.

it. This facilitates locking the varactor in position by pushing the rod into the Teflon, then backing out until the varactor is held between mounting holes in the rod and the opposite wall. A dab of solder on the rod, just outside the Teflon, now secures the varactor rod by preventing it from reentering the teflon.

The leads from the three chokes entering the cavities are soldered to the Teflon end of the varactor rod and to the collector and base rods at the places indicated in **Fig 4.** 50Ω BNC connectors are used for the crystal oscillator input to the circuit and the rf output from the cavity. This completes construction of the twin tuned cavities.

Tuning up and operation

The procedure for tuning up the oscillator consists of first checking out the power supply, then giving power to Q7 and adjusting the twin cavities to resonance. Once the oscillator is freerunning, the mixer is balanced, the video amplifier given power, and the varactor reverse bias set. Methods of determining when the oscillator is locked on frequency are discussed, as well as methods of determining frequency of the UHF output.

When the power and freerunning oscillator circuits are completed, disconnect RFC1 and RFC2 from feedthrough capacitors C5 and C6. *Caution*: You must not apply power until Q7 has been taken out of the circuit by the removal of these two chokes. If the power supply is not working properly, Q7 could easily be burned out. (There should never be more than 1 V on the base or 28 V on the collector.) With Q7 thus disconnected, apply the 25-35 Vdc as in Fig. 2. Place SW1 in the TP position and do not yet apply the plus or minus 18 V. Measure voltages at the base and collector feedthroughs to the cavities. The collector voltage should be set with R9 to the highest voltage possible in the range 15-28 V. Now, the base should be at 0.7 V, held by zener CR3. With these two voltages correct, you can test and adjust the current limiter as follows. Choose a resistor to place between the collector voltage and ground so that about 600 mA would flow through it

$$(R = \frac{Vcol}{0.6}).$$

Place this resistor, which should have a rating of about 20 W, and a meter with a 1 A scale in series between collector voltage (at C5) and ground. The resistor is to protect the meter if the current limiter is not working. Now, you should be able to vary current through the meter with the current limiter pot, R4, from about 200 mA to 500 mA. R5 sets the 500 mA limit as explained under "Circuit". After checking that you have approximately the correct range of current limiting, set the pot for a reading of 350 mA on the meter. That should be ample current for normal operation. Disconnect the meter and its protection resistor. *The current limiter must work to prevent Q7 from drawing damaging current when it is not oscillating.*

With current limiter and collector and base voltages set correctly, and the phase-lock switch in the TP position, reconnect the two chokes, thus applying power to Q7. Unload the cavity tuning rods by backing off the output pickup loop from the collector and the varactor coupling loop from the base. Neglecting output frequency for the moment, tune the collector and base capacitors (C_a and C_b in **Fig. 4**) for most power out as indicated on a power meter or a receiver connected to the output BNC connector. Now, move the output pickup loop closer to the collector rod for maximum output. If the C_a and C_b used had ranges up to 7-10 pF, the frequency of your initial you have determined, with the power meter or receiver, that the oscillator is freerunning, you are ready to tune to within the phase-lock frequency range and set up the phase-lock loop.

We tuned up using a Hewlett Packard Spectrum Analyzer, which allowed us to tune for frequency and peak power with no trouble. However, as this instrument is not commonly available, the following procedure may be used to determine output frequency. Of course, if a calibrated receiver is available, it may be used to determine frequency and the method below may be disregarded.

To complete the adjustment of the oscillator and phase-lock loop you will need a scope, an rf signal generator (such as Heathkit IG102) or a receiver, and a vom. The higher the frequency response of the scope, the easier it will be to locate your operating frequency, but a 5 MHz scope will be adequate. The method of frequency determination when a calibrated receiver is unavailable consists of mixing the output with harmonics of several known frequencies from the signal generator and looking at the mixer output on a scope. A few signal generator frequencies will uniquely determine the oscillator output frequency. A more than adequate mixer circuit is the one in **Fig. 2**, consisting of T1, C7-10, CR4-5, and R12-14. It is advisable to build another mixer (besides the one you will use in the phase-lock loop) since, later, you will want to make frequency measurements while using the original mixer in the loop. Feed the signal generator into T1 ("Xtal Osc In" of Fig. 2) of this extra, test mixer and balance the mixer by adjusting C9 and C10 for O Vdc (±about .02 V) as read on a vom at TP2. Now, feed in the freerunning oscillator output between the two 12 pF capacitors, and look at mixer output (TP2) on the scope. If you are using a low frequency scope, a harmonic of the signal generator frequency will have to be relatively close to the oscillator frequency before you will see a sizeable trace on the scope. An example of frequency determination in this way follows. Tune the signal generator from, say, 100 to 150 MHz. Assuming that the freerunning oscillator is operating in roughly the range 600-750 MHz (for this example, say, 600 MHz), as you tune the generator you will see a mixer output on the scope as you approach each subharmonic of the oscillator frequency (here, 100, 120, and 150 MHz). When the mixer shows a sine output, tune the generator harmonic to zerobeat the oscillator (indicated by a straight line on the scope that becomes a sine wave upon tuning the signal generator either up or down slightly). Thus, if you find a zerobeat at 100 mc on the signal generator, you know the oscillator is operating at either 600, 700, 800, or 900 MHz. (With 7 pF maximum for C_a and C_b the cavities will not resonate below about 600 MHz. If your tuning capacitors have a higher range, the possible frequencies of this example would also include 400 and 500 MHz.) Now, to determine which of these harmonics is the actual operating frequency, tune the signal generator for a zerobeat at another frequency. In this example you would find one at 120 MHz. Since the only one of the 100 MHz harmonics that is also a harmonic of 120 MHz is 600 MHz, the operating frequency has been uniquely determined.

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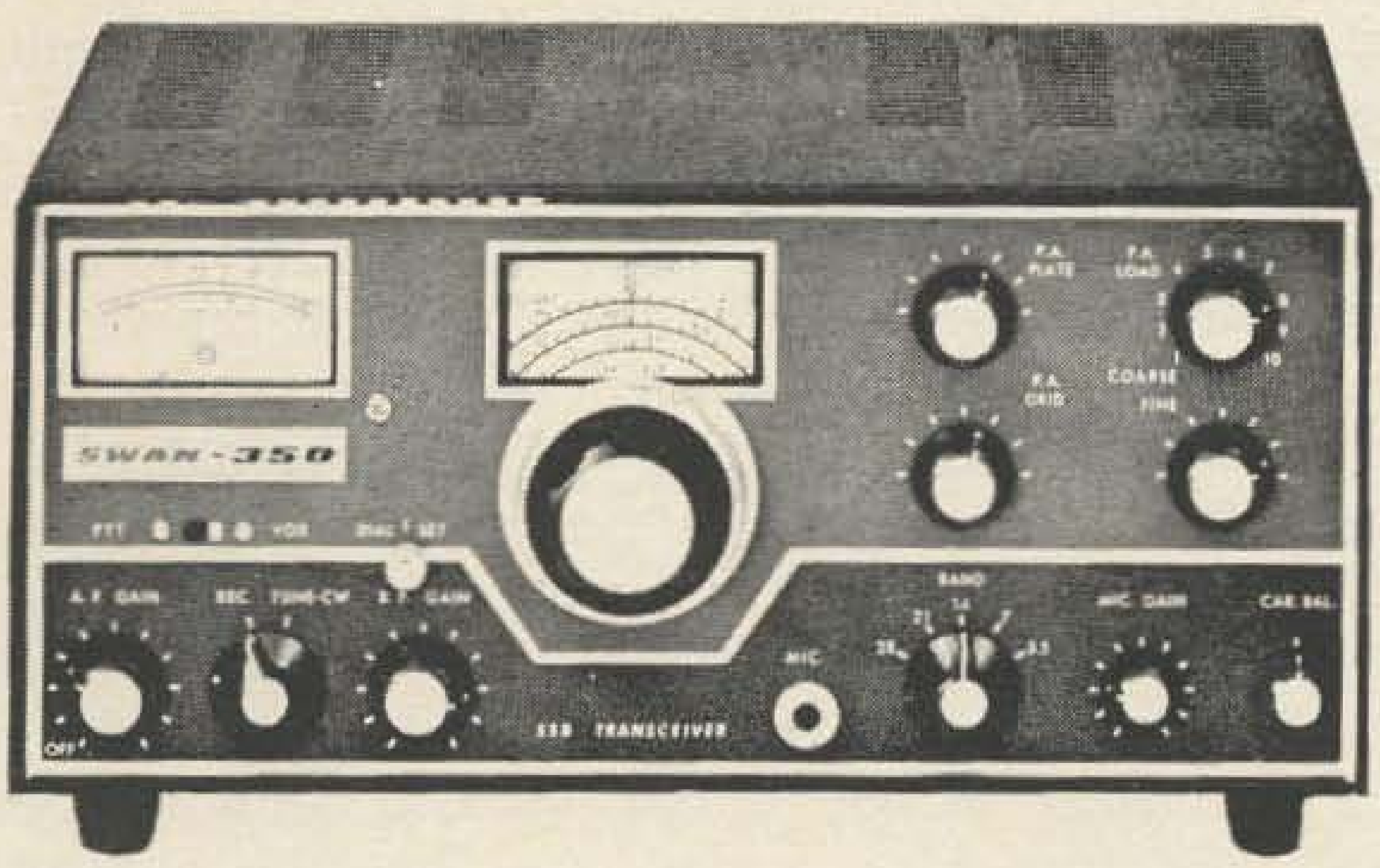

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freerunning oscillator, you know which way and how far to tune the cavities to reach the desired harmonic of your crystal reference oscillator. Replace the signal generator with your crystal oscillator and use the above frequency determining method (or use a calibrated receiver) to tune first the base, then the collector slightly, alternating the tuning until the freerunning oscillator reaches the desired reference crystal harmonic. (Turning the capacitor screw in adds capacitance, lowering the frequency.) If it is desired to tune below about 600 MHz, the 12 pF fixed TCZ capacitor (Centralab) added to each cavity may be replaced with a TCN (negative temperature coefficient) or a positive temperature coefficient capacitor to compensate for any local heating effect you find. We did not find compensation necessary. In any case, keep the capacitor leads 1/16" or less. When the oscillator is freerunning at the desired harmonic of your reference oscillator, you are ready to adjust the phase-lock loop.

Begin by balancing the mixer. With all power to the circuits of **Fig. 2** off and the crystal oscillator signal (¼ to 1 W on its fundamental) into T1, adjust C9 and C10 for OVdc (± about .02 V) on a vom at TP2. Now, connect plus and minus 18 Vdc as indicated in **Fig. 2.** Adjust R22 for approximately 9 Vdc on the varactor. You can measure this directly between C18 and RFC3. The range available by adjusting R22 should be about 6-16 V. Place SW1 in the APC position and turn on the oscillator power. If the oscillator was freerunning near a lock-in frequency (nf_{xtal}), it may come on phase-locked. If not, tune the base and collector until it does lock. To determine when the signal is phase-locked, place SW1 in the APC position and look at J2 on a vom. The mixer will have no measurable ac output throughout the lock-in range (while locked, $nf_{xtal} - f_{osc} = O$). Therefore, there will be no ac on the varactor and no dc indication of varactor ac at J2. If the oscillator is phase-locked, you should be able to tune the base and the collector slightly (the collector will affect frequency less than the base) with the voltage at J2 remaining a *constant* minimum. At the same time, the voltage at J1 will vary as you tune. If you tune far enough to jump out of lock, the mixer will put out an ac error signal and the dc indication at J2 will no longer remain constant as you tune, but will vary as you go farther from lock-in frequency. Using J1 and J2 in this way, you can determine when the oscillator is phase-locked.

To determine the extent of your lock-in range, tune the oscillator one way until it jumps out of lock. Use the previously discussed method of frequency determination to measure the output frequency at this point. Now, tune back through lock-in range until the oscillator reaches the other lock-in range limit and jumps out of lock. Measure this frequency. The difference between the two range limits is the total lock-in range. This range may be increased by (1) placing the varactor coupling loop closer to the base tuning rod, (2) lowering the dc reverse bias on the varactor with R22 (but do not go lower than about 6 V), or (3) placing the UHF pickup loop closer to the collector tuning rod.

One further method of increasing lock-in range is to improve the frequency response of the video amplifier. This may be accomplished by decreasing the feedback, thus increasing the gain, at high frequencies with a larger value of C14. With 2N3866's for Q8-Q11, and 39 pF for C14, the response was 6 dB down (or 2:1 in voltage) at 10 MHz. You may measure the frequency response of your amplifier by placing SW1 in the TP position, connecting a signal generator at TP1, and noting on a scope the amplifier output at the C18 end of R25 as the generator frequency is run up to about 10 MHz. Do not forget to take into account the frequency response of your scope.

When you have the desired lock-in range (probably plus or minus about a megacycle for CW operation, or 20-50 KHz if the video amplifier is to be used only for audio deviation in conjunction with an external AFC circuit), check the output on the power meter or receiver. Output power may be increased with larger collector voltages (but do not exceed 28 Vdc) and with tighter coupling of the output pickup loop to the collector. Also, make sure that the current limiter is not holding the power down. The current limiter should be set so that increasing the limit does not appreciably increase power output. Again, about 350 mA should be sufficient for normal operation.

With reasonable power out and the desired lock-in range. adjustment of the phase-locked oscillator is complete.

Application and results

As mentioned, the oscillator can be run in three modes—freerunning, phase-locked, or AFC (with external circuity). This article is centered, as were our applications, around the phase-locked oscillator. We spoke, in "Circuit", about connecting an external *if* amplifier and a discriminator between TP1 and TP2 and using the dc coupled video amplifier, the oscillator, mixer, and varactor of **Fig. 2** to accomplish AFC. (See **Fig. 1.**) Such a hook-up will allow FM voice deviation, Using any *if* frequency and any discriminator, tube or solid state. We also tried running the oscillator CW in the phase-locked mode as a CW transmitter, in a frequency multiplier, and as a receiver local oscillator.

Used as a phase-locked CW transmitter, we need a method of keying the oscillator. Not wishing to turn Q7 on and off, heating and cooling it, we keyed the rf output. By running the output through a cable with a BNC "T" connector in it, we can key the signal by keying a capacitor directly across the open "T". (See **Fig. 5.**) We found that a small 1.5-7 pF trimmer across the length of the BNC "T" resonated at about 600 MHz, placing an effective short across the output. This does not damage Q7 and we were able to tune the trimmer for a 30 dB difference (1000:1) in power output between "key up" and "key down". You may

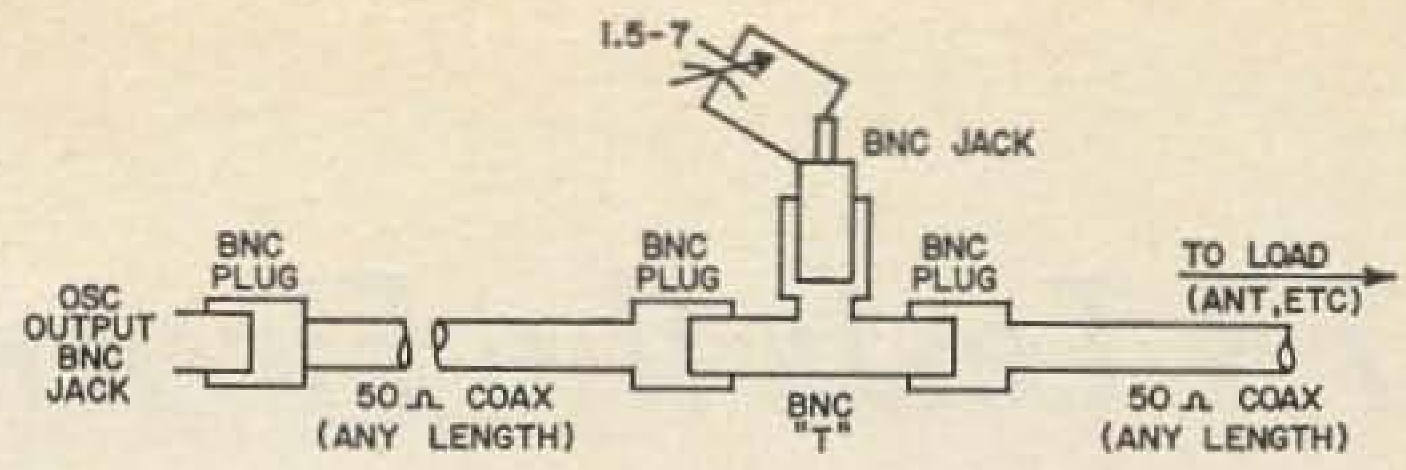


Fig. 5. Keying the oscillator by means of a tuned short across the output.

wish to try other methods of keying by shorting the output, such as a biased diode across the line, where the bias is keyed.

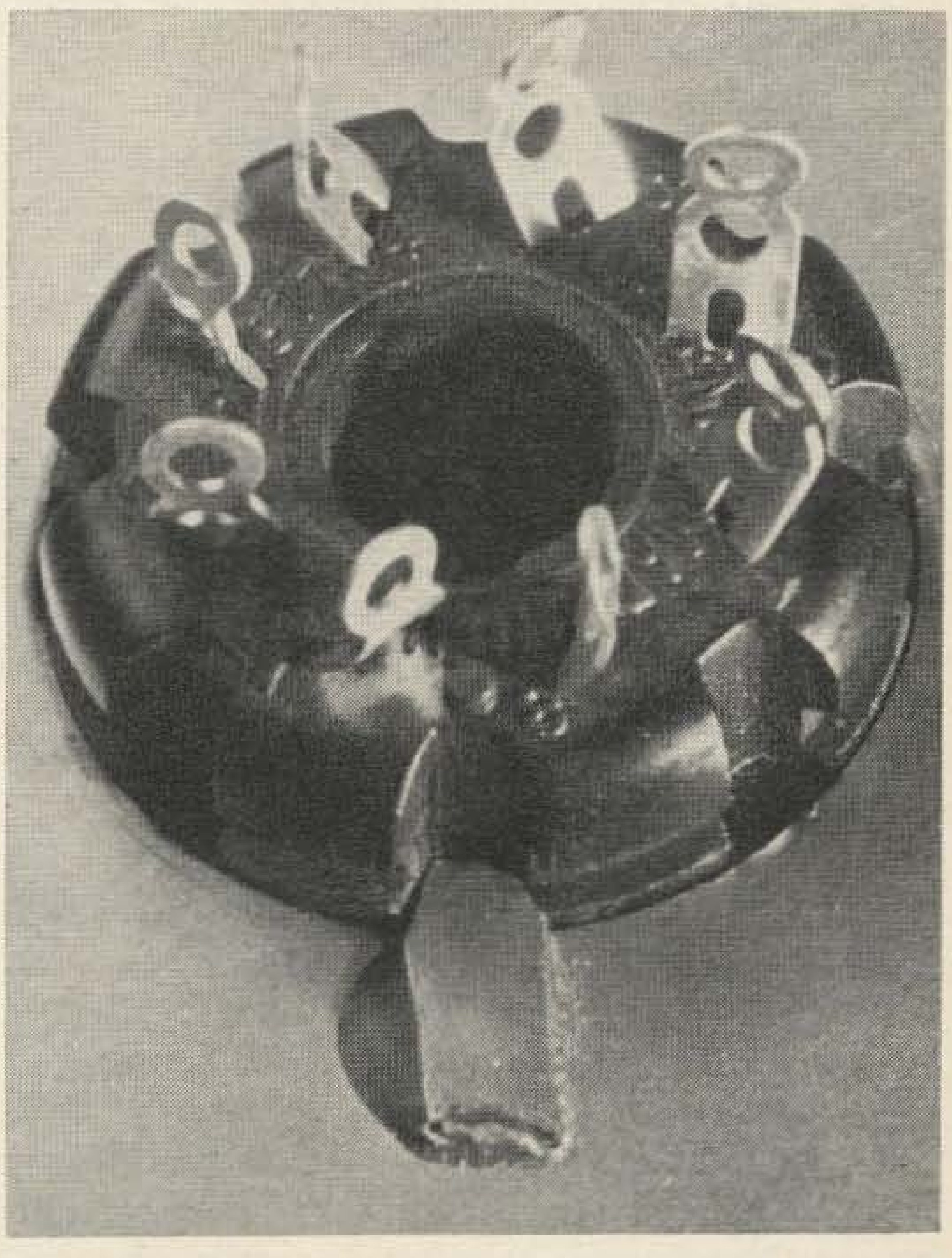
For those considering using the phase-locked oscillator as a receiver local oscillator, the S/N ratio is at least 70 dB at room temperature, for a 30 MHz bandwidth. The low noise aspect of the oscillator may interest radio astronomy enthusiasts, as the oscillator's second harmonic range includes the 1420 MHz hydrogen line and other atomic transition frequencies.

As the stable oscillator in a frequency multiplier, results were very good. Using a varactor multiplier we obtained 40 mW at 6.25 GHz (for a receiver local oscillator), taking about 300 mW from the phase-locked oscillator at 625 MHz. 625 MHz or 6.25 GHz, plus or minus not even 1 Hz, is something to think about.

. . .K30JK

Improving Tube-Socket Mounting Holes

Many retainer-ring-mounting tube sockets, such as the Amphenol Type S, have a number of notches on the edge. A tab on the edge of the mounting hole is supposed to project into one of these notches and prevent the socket from turning. This tab is commonly produced by a special socket punch which is quite expensive and not readily available. However, a hole produced by a conventional socket punch can be easily equipped with a tab, as shown in the photograph. From the material removed by the socketpunch, cut a piece 3/16 inch wide. Bevel the corners at one end so that it will fit the notches in the socket. Then fasten the piece to the underside of the chassis in the desired position with solder or epoxy cement. The tab will not interfere with the insertion of the retaining ring if the material is not overly thick.



Miniature-tube sockets using retaining rings require a flat in their mounting hole to prevent them from turning. This can be provided by a similar technique.

. . . Charles Cohn

73 Tests the Eicocraft Code Oscillator

Here's the way the kit comes.

Eico is well known for its excellent electronic kits. I've built a number of them, including a stereo amplifier and 460 scope, and found them very satisfactory. Their new transceiver kit has received a lot of attention, and many hams have bought, built and used them.

A new Eico venture is a line of inexpensive kits for the hobbyist and experimenter. You'll see these kits in many electronics stores around the country. Among the Eicocraft kits are a fire alarm, intercom, burglar alarm, light flasher, siren, metronome, tremolo, audio power amplifier and ac power supply. They range in price from $2.50 up, but not very far.

We received an Eicocraft code practice oscillator kit for test, and decided that the fairest test would be to have a person with no knowledge of electronics build the kit. Looking around the office for a suitable person, my eyes fell on the cute 18-year old girl who helps out in our subscription department. Judy agreed to try the kit, and she took it home to work on. I later heard that she'd had some problems, mostly with her husband, who wanted to build the kit, but she finished the kit and it worked properly. Here are some of Judy's comments:

> It wasn't too difficult to assemble the solid state electronic code oscillator. The instructions were quite easy to follow. Most parts were simple to identify and position, however, some were poorly labeled. With the use of both the diagrams and the assembly procedures, I eventually figured each one out.
>
> Being quite unmechanically inclined, I found soldering to be the most difficult phase of the project. Just anybody certainly couldn't use a soldering iron without some basic instructions or some samples to practice on in order to avoid ruining the kit. The instruction sheet seemed to be lacking here.
>
> I also had some problems with connections to the board from the speaker, key and battery since I didn't know how to strip wire. However, I did get the wire stripped after a few tries. Then I connected them all up and pushed the key. It worked!

And a few other notes. The parts were all of good quality and the oscillator worked fine and emitted a loud, clear tone. I'm sure that any budding electronics hobbyist would enjoy this kit and many of the others in the line.

. . . WA1CCH

Judy working on the Eicocraft code oscillator.

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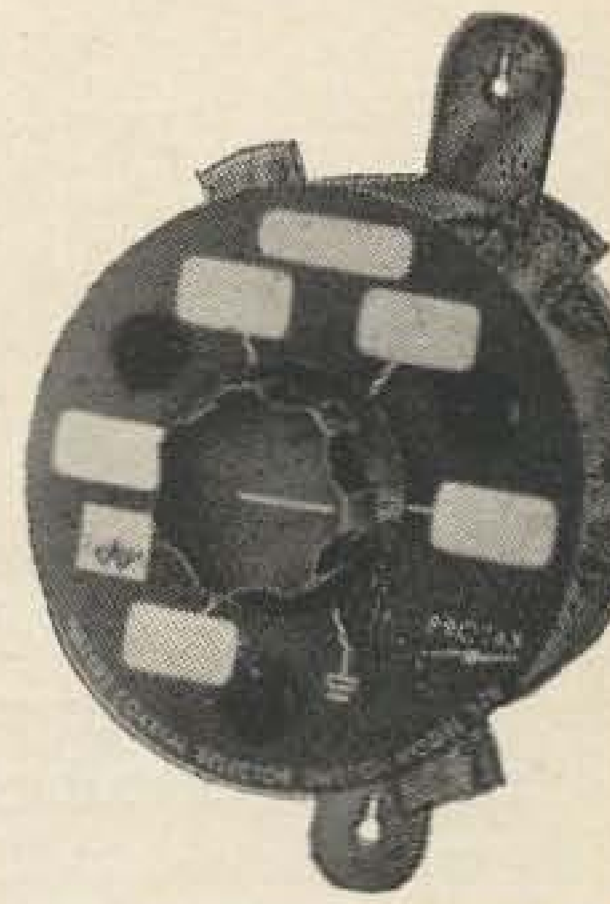

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100 Watts Out on Two with Compactrons

Here's a higher power final amplifier for two meters for all of you devoted K1CLL followers.

This article just about completes our present series of low cost transmitters up to 100 watts output for six and two meters using today's tubes[1]. Here is a transmitter for two meters which can put you well out of the 2E26-6146 class. Two 7894 Compactrons can put out 100 watts on two with high level modulation.

Considerations

Some interesting thoughts occurred on VHF transmitter design while working on this rig. Push pull has been used for VHF for well over 30 years, and ever since the pre-war days the general design for medium power tubes has centered around the double beam power tube with plates on the top and one glass bottle. Examples of WW2 tubes of this type of course are the 832 and 829. Since then a nice new series of this same type (5894, etc.) have come along. However, they are generally expensive and require a fancy socket. I have had the same one in a Johnson 6N2 for about 5 years and like it very well; perhaps because I keep the dc input strictly at 90 watts.

Today we have a new family of single ended tubes, real toughies, with ratings to 80 watts input on 175 MHz. These are the Compactron transmitting tubes with television priced 12 pin sockets that are intended for single ended use as detailed in several previous 73 articles[1]. However, as you will see, when you **do** put them together in push pull, they go like two outboard motors on a racing hull.

Fig. 1 shows the schematic and **Fig. 2** the pictorial layout of this amplifier using push pull 7894 beam power Compactrons. Each costs $5.00 and the pair is rated at a dc input of 162 watts in IMS (Intermittent Mobile Service). However, if you run this much power, expect to change tubes every now and then. If you don't want to change tubes every so often, then run 125 to 150 watts input to the two tubes.

Make sure that the two plate lines are the same length and that the grid lines are also equal in length. The neutralizing wires and tabs should then cross over each other and be similar as well.

1. Six Meter Heterodyne VFO Transmitter, April 1965. Compactron Two Meter Transmitting Converter, September 1965.
4X250 Transmitter for Six and Two, April 1966.
50 Watts for 50 MHz for $50, June 1966.
75 Watt Twoer Linear, July 1966.
80 Watts for 144 MHz for $80, October 1966.
All by K1CLL and all in 73, of course.

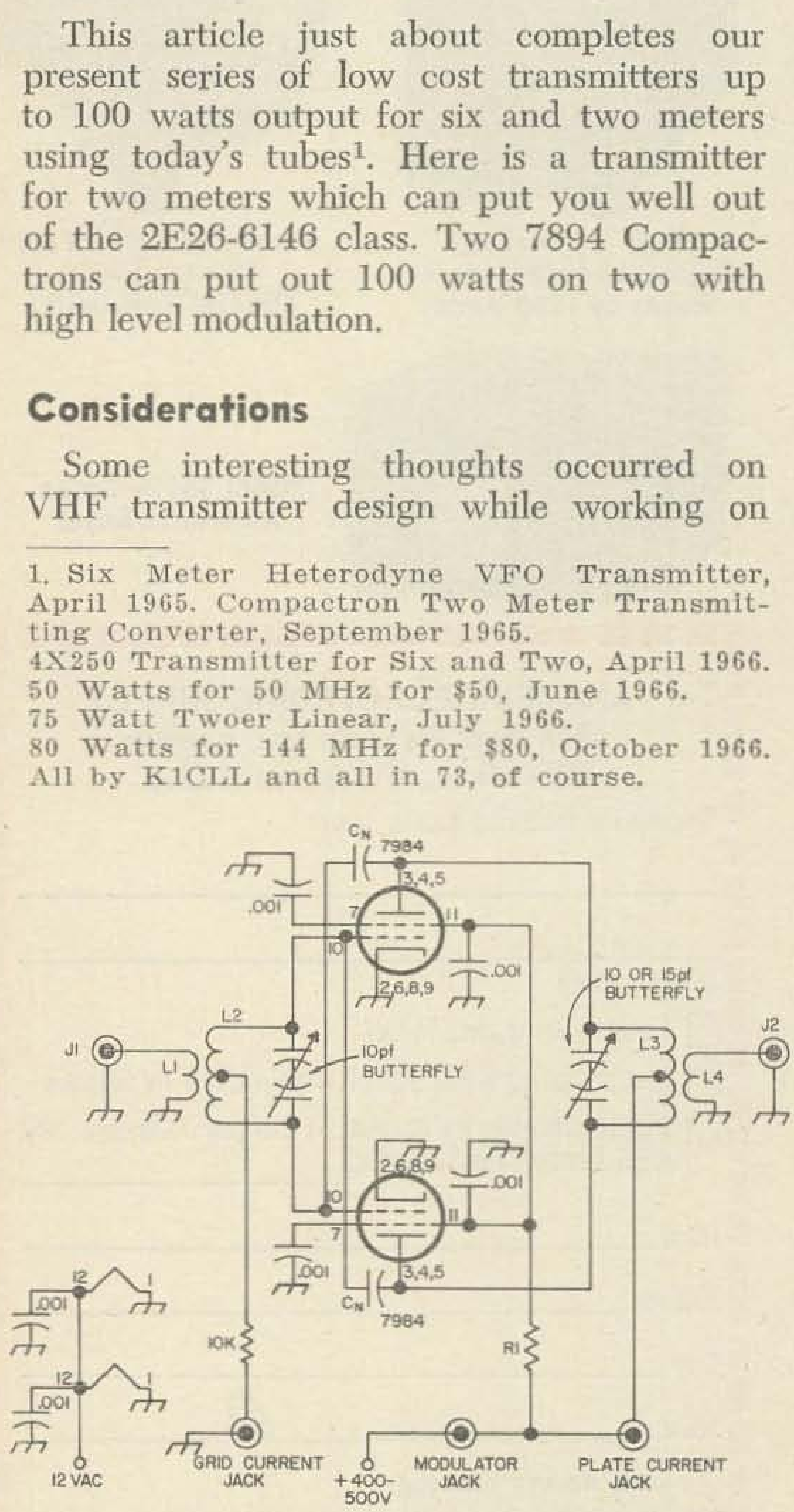

Fig. 1. Schematic of K1CLL's Compactron push pull final amplifier for two meters.

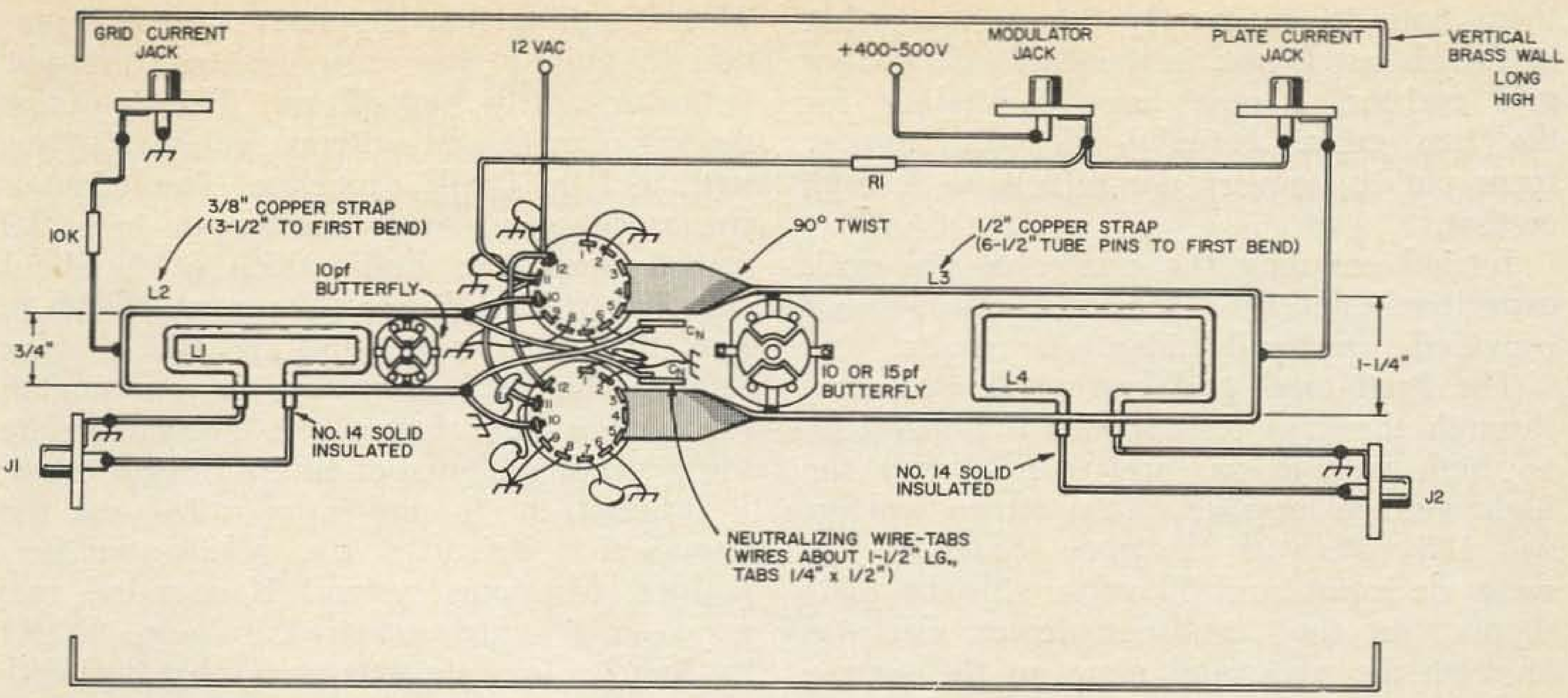

Fig. 2. Layout, coils and details of the two meter Compactron final. This drawing is one-third size.

Solder all eight cathode leads to the chassis, bypass the heater and screen leads with small flat disc capacitors, and you're ready to start "strapping." You can use coils for this type of circuit, but if you have room, lines are preferred. The push pull grid lines showed the usual improvement in length of inductance over the single grid type. Quite a nice tuned circuit was obtained which tuned up very well on two meters.

I obtained 7 mA of grid current through the 10-kilohm grid resistor, dropping to 4.5 mA when the screen and plate power was applied. Naturally some of the electrons which previously landed on the grid are now attracted to the screen and plate by their positive voltages. You should expect that the grid tuning will flatten out a little too. It will!

I tried both small and large size butterfly tuning capacitors on the plate lines, and both worked equally well. For arc-over security, I went back to the larger size.

The neutralization was easy after one or two tries. First I set up an elaborate little brass shield with large holes, subpanel insulator and nice long pins to carry the neutralizing wires through the shield from the grids to the plates. However, I had to go to the shortest possible heavy copper wire, about number 14, directly across the socket from grid one to plate two, etc. Putting 200 mA of plate current and no rf drive on the other tubes, the proper capacitance is easily found by watching for self oscillation with the plate and grid circuits tuned to 144 MHz. The ½ by ¼ inch tabs ended up about ¼ inch from the plate lines. These tabs are really over the plate pins where they are soldered to the strap lines. Using insulated sticks, move the tabs nearer or further away from the plate lines and you will soon find the best place for both wires and tabs. The tabs, to be more explicit, are over the first ¼ inch of the plates lines. Half of each plate pin is bent over so it presents a flat surface to be soldered to the strap, and right over these points and about ¼ inch away are the neutralizing tabs. After the neutralization is completed, there should be no self-oscillation at any point in the 144 to 148 MHz range.

A plate dip of almost 70% was obtained with this amplifier. The pencil arc test with the plate dipped gets pretty hairy with 160 watts input; I would recommend that the pencil be taped onto a dry wooden stick and that the other hand be kept in the pocket. The arc is at least half an inch long. When this plate circuit is loaded it will brilliantly light a 100 watt bulb on two meters. You can use either loop coupling or direct to the 100 watt bulb porcelain socket for a dummy load. I tapped the socket onto the lines about 3¼ inches up from the cold end for maximum loading.

Baluns

Note that the input to the grid circuit has an unbalanced to balanced transformer in it. This is a perfectly legal type of balun and works quite well. Just for a check I inserted two chokes and capacitors in each grid to check the grid currents separately and with considerable satisfaction I found them both to be exactly 6 mA. Note that inasmuch as I put in another 10 kilohm grid resistor, I now have 5 kilohms for the two grids. Actually the grid resistor turns out to be very non-critical so enough on that.

I tried coupling the exciter to the grids capacitively and by a link, but both methods provided practically identical results.

The final total grid current (both tubes) through the grid resistor was 7.3 mA with no high voltage on, and 6 mA with the high voltage applied. The screen voltage was 135 volts with the plate loaded to 100 watts dc input, and 80 volts with the plate dipped. In that condition fewer electrons land on the plate and more on the screen; probably a little better screen regulation is called for.

The grid bias voltage, developed by the rf drive across the grid resistor, was minus 58 volts with the high voltage turned off, and minus 44 volts with the high voltage on and 100 watts of load.

That's about it except for modulation. Theoretically we need 80 watts of audio to properly modulate the 160 watts dc input. Our standard modulator with a pair of 6L6GC tubes seems to be good for a maximum of 55 watts of audio, so either four 6L6's or a pair of 7894's will do the job. Also, two 807's or a pair of 1625's can put out up to 120 watts. You can see that we're skating near the point where everything gets quite a bit more costly, with 1200 volt power supplies, 811A modulators, big modulation transformers, etc. We'll see later about the cost of a good 80 to 100 watt modulator.

On the air

Hooking up the new double conversion superhet exciter, a commercial modulator, and a 500 volt supply which only gave about 125 watts input, I opened up with more power on two meters than I've had since my kilowatt days in 1949-1950. My little four element beam, two over two, about 10 feet over the roof had to do for now. The first thing that happened was the number 48 bulb I was using for an rf output indicator nearly burned out. This is across the 50 ohm output antenna cable in series with a 1 to 5 pF capacitor. The trimmer was wide open, so I had to put in a 0.9 watt brown bead bulb which lit to about one half full brilliance. For now I had to lose that half watt. Shifting the B plus lead to the final down on the muli-match modulation transformer to accommodate the lower impedance of the push pull tubes, I listened in to my own voice on the "Amateur's Friend", the diode-amplifier-padded earphone system. It sounded real good so I tuned across the band. W1KJ in Lynn, Massachusetts was chatting with a friend, so I switched on the exciter B plus, zeroed the exciter carrier in on the receiver pass band and had my first QSO with the push pull 120 watt rig. Don't forget, you *can* go to 160 watts if you have the modulator! Please note also that breaking in on two meters is a welcomed procedure.

A word about zeroing in without a BFO. I used to go to great lengths to heterodyne in with the BFO on, until one fine day I realized that the *if* pass band of a good receiver is fine for that purpose. Just leave the receiver tuned to the desired frequency, reduce the *if* and/or rf gain control, watch your S meter and zero in with only the exciter on. It works great; at least for AM phone.

All reports with this new rig were good. Stations that had heard my 50 watter (rf power out), noticed the increase in signal strength. It is a matter of individual taste just how much power you want to run. All those little decibels add up; beam, height, power, etc. This 100 watter gets you quite a way out of the 2E26-6146 class without jumping into the 1000-1200 volt region. There is quite a jump when you get into *that* class; things get real lethal, costs rise like mad, and size and weight jump too.

Hope to see you on two someday.

. . . K1CLL

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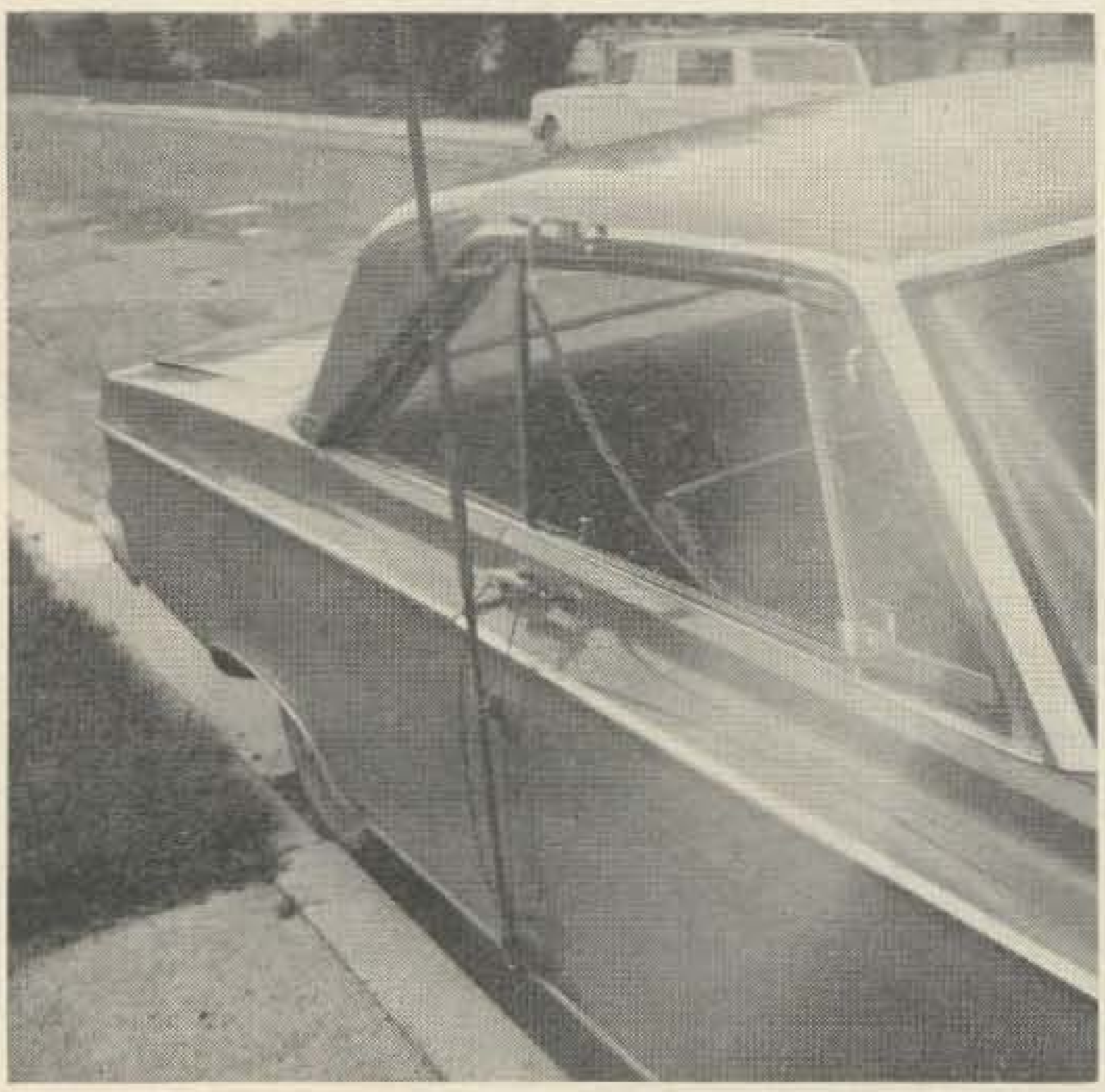
The Poor Man's Occasional Antenna

Here are some very cheap portable antennas that work well.

There are occasions when you want an antenna to use for a short time and you would like not to make a major investment. You'll even settle for something less than optimum. Such situations are representative of the sometimes mobileer, the vacationer in the woods or at the beach, the short time renter and the guy with limited real estate.

The sometimes mobileer

Many of us cringe at the idea of cannibalizing a good automobile. If you live ten minutes from work, mobiling has no attraction as a daily operation. On the other hand you go for a vacation in the summer or a cross country trip for other reasons three or four times per year and you would like to have a mobile ham rig. The rest of the time you could care less.



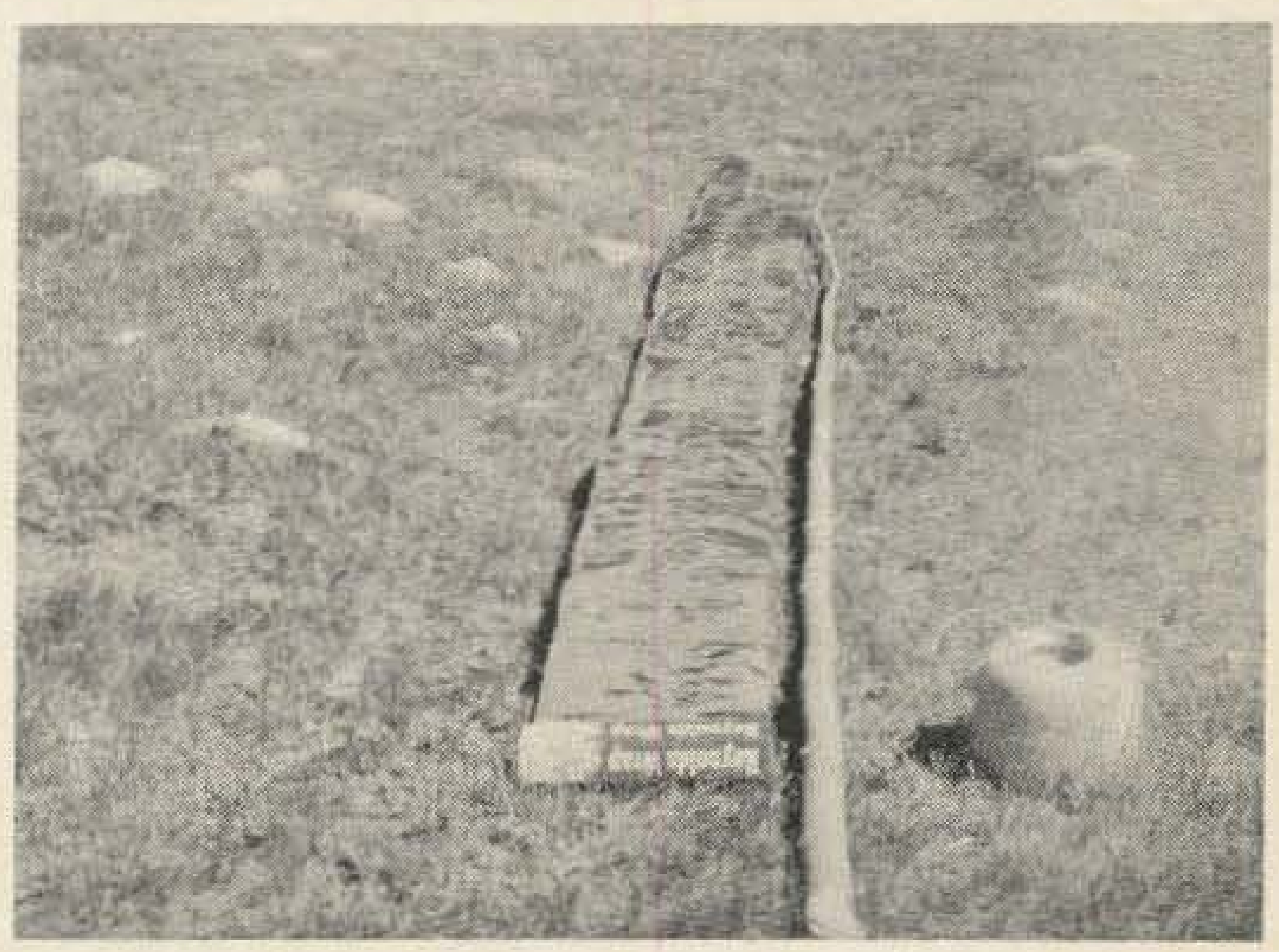
It's not very pretty, but this temporary antenna both stays on the car at 60 mph, and performs well.

There are assorted ways of bolting or strapping in or otherwise securing the rig inside the car without permanently marring anything, which we won't go into. But the major problem is the antenna. Any kind of permanent mount involves cutting holes in the body, purchasing an $8 to $12 mount and another $8 to $12 antenna and mounting same. It is easy to get $25 tied up in a mobile antenna. Now for 23 cents apiece you can buy a couple of rubber suction cups and for less than $4 you can buy a 9 foot fiber glass fishing pole blank. If you wrap the fishing pole with the proper amount of wire you can get it to resonate on any band and what's more it will radiate as well as any store bought antenna you might get. For over 30 years W7CSD has been hamming but never before mobile. We decided to give it a try. The photos show the lash up. The bottom is the remains of one section of a GI antenna upon which the fiber glass pole fits snugly with the help of a little bit of tape for shimming. We formed a hair pin of heavy wire around the bolt in the bottom suction cup bringing the ends together and pushing about 6 inches or so up into the metal rod. The top suction cup is "haywired" to the metal rod and a piece of cord is tied to the door

handle to make sure that nothing blows away. Likewise a cord or strap connects to the lower cup and runs under the door and ties to the door handle or window crank inside. Suction cups will hold by themselves up to 60 miles per hour but may come loose at higher speeds. Secured with cord in this way you can travel at any speed. The transmission line is two pieces of RG-59 in parallel which approximates 36 ohms and a good match for the whip. The line is only about 6 feet long anyway. The inner wires connected together clip on to the end of the winding on the pole and the shield clips to the chrome gutter. Windows may be cranked nearly shut or left open. Now about the pole itself. By the well known method of trial and error we decided to wind 16 feet of wire evenly spaced on the pole for a 20 meter quarter wave. We then ran a single turn between the whip and the gutter and placed the grid dipper coil thru the loop. It dipped beautifully at 21 MHz. So we had a 15 meter antenna. We soldered on at this point and wound a few more close spaced turns and dipped at 14 MHz. Actually we can use either tap and we resonate at 21.35 MHz on the top tap and 14.3 MHz on the bottom. We have worked all over the U. S. and one KP4 from W7 land on 15 and 20 meters with this arrangement. However the ignition noise while in motion is as yet an unsolved problem. The second whip wound for 40 meters works equally well and there is no ignition problem. This time we started out with 50 feet of wire and finally wound the pole four times before achieving the desired frequency. We finally spaced considerably closer at the lower end of the whip. 60 feet evenly spaced would be pretty close. There is no question about getting a dip at the resonant point; it is very positive. Once completed the whole assembly can be installed or removed in a matter of minutes. We have received S9 reports from the Mexican border and the Canadian border both at the same time on 40 meters in the middle of the day. I doubt that a fancy store bought job could do any better.

The vacationer

There are those who go to a beach or mountain cabin and rely on Reddy Kilowatt to furnish energy. Of course the fiber glass whip would work here too. There is no question about it for the higher frequencies the



The makings of an inexpensive (18¢) vertical antenna.

old ground plane is the best bet if you are in a hurry. Of course there are those who still have the old screw together GI whip; they're ok too. Another stunt is to hang a quarter wave of wire between two trees, in a vertical position. A novel idea is to find a 16 foot 2 x 2 or even a 1 x 2 and pull out 16 feet of kitchen type aluminum foil and wrap it length ways around the lumber, clothes pole, sapling or whatever. Support it in a vertical position with some cord guys, string out 3 or 4 radials, connect hot wire to the foil and shield to the radials. With a transmission line of less than 6 feet between the xmtr and the ground plane a 16 foot vertical will work equally well on either 15 or 20 meters. Of course the SWR on 15 will not be good but who cares with 6 feet of line. Any pi net will load into it. We have worked the whole Pacific on 15 with this kind of a lash up. Last but not least is the trusty dipole for low frequencies. One sneaky way is to use some 300 ohm ribbon and run out the necessary 60 odd feet either side of center then clip out a section of one wire at the 33 foot distance and you have a 75–40 meter dipole which will also work very well on 15 meters. Here again let's do it the cheap way. Use 72 ohm ribbon. It looks awful small but actually it will stand about 10,000 volts without breaking down and you can even get away with feeding it a kW. Why mess with bulky and expensive co-ax? You can ground one side of ribbon in your pi network and it will work just as well as co-ax. How do we get it up? Climbing trees is for kids. If you're a kid ok. Otherwise do it some other way. A ball of binder twine is an excellent thing to have any way if you are camping or on a vacation. Throw a hammer or other weight attached to the twine thru the branches of a tree or over a building and hoist the flat top. If you want to get way up, one method we have found that is very effective is to use a bow and arrow. The arrow will pull a light line over a pretty high limb. Binder twine is cheap enough to throw away when you move on. For a permanent support either for a flat top or to guy a ground plane binder twine loses its strength (and so does polyethylene cord).

The short time renter

The fiber glass whip will work well with a few radials strung out under it in a fixed location. Also the aluminum foil ground plane will last for quite a while if well wrapped. Aluminum pipe is quite reasonable and if you are on the second floor with a short transmission line to the ground plane the 20–15 idea will work here too. Of course an added loading coil would make the lower frequencies available. If the only way to go is up and you are permanently located, irrigation pipe comes in 40 foot lengths. A 4 inch one could easily be erected by two men and would be much cheaper than a tower. A lot of people are bothered by the insulating problems of the ground plane. This is not nearly as serious as one might think. In the first place a ground plane is current fed. The voltage at the feed point is very low. Dry wood makes an adequate insulator. Or better yet boil the end of the post, to support the ground plane, in parafin.

All of these low cost antennas will work and deliver a good signal. Try one.

. . . W7CSD

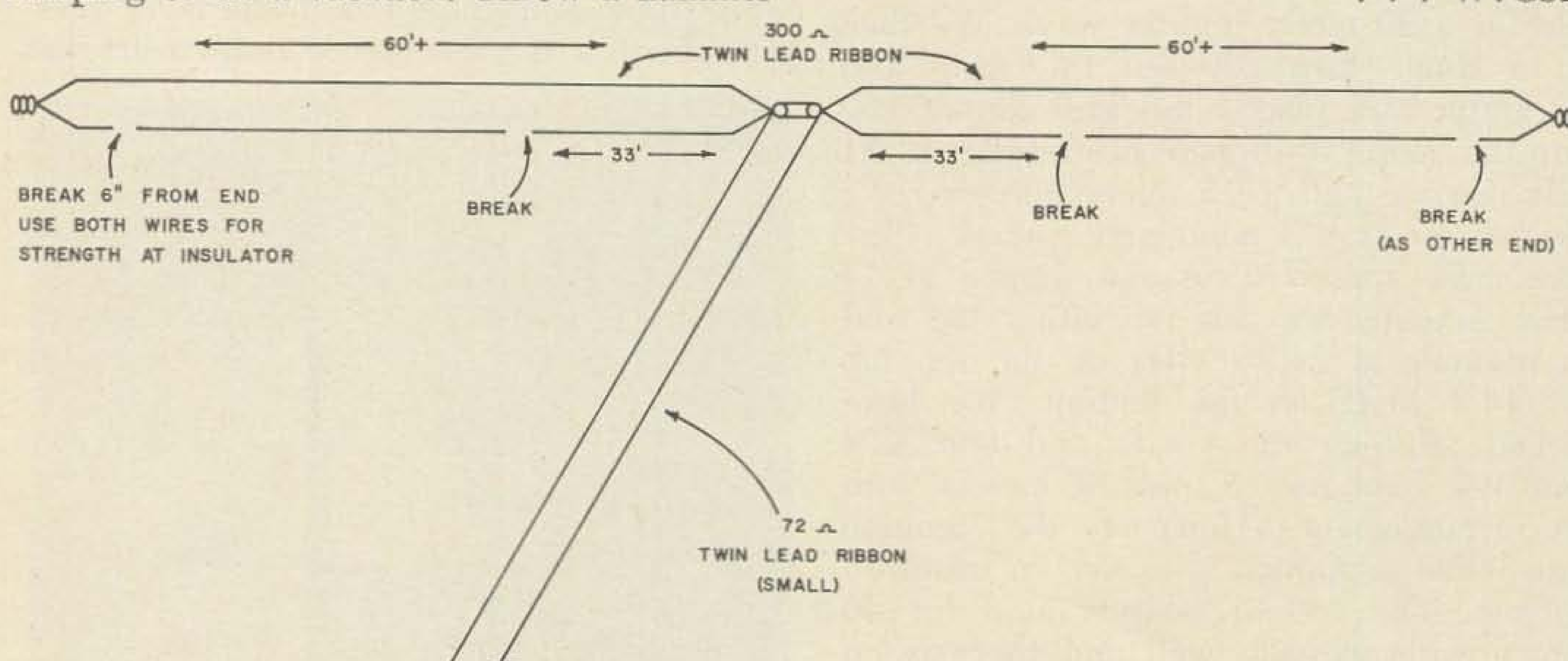


Fig. 1. A simple 75-40-15 meter antenna.

Concerning Service on Ham Gear

It has been said that a chain is no stronger than its weakest link. Applying this logic to our ham business and taking all factors into consideration it seemed that customer service was one area that could be strengthened.

Johnny Q. Ham, in these days of sophisticated circuitry, simply hasn't the means to properly service or repair his gear and when it breaks down and needs attention, Johnny wants it done right and promptly, too. (Isn't that contest coming up next weekend?)

Here at Harvard we have several strong points going for those who want prompt and correct treatment. We have extremely competent personnel each day and evening. We have the most advanced service facilities and we have a most comprehensive library of original manufacturer's service notes or instruction manuals all arranged to speed our work and to insure *your* satisfaction.

The people working here are all practicing hams of long experience; they understand your problems and, more important, how to achieve the original manufacturers' goals of performance. For example David Schilling has worked on and mothered literally hundreds of R388 and R390 receivers. Charles Branch has a kit of specially made tools for cleaning and restoring, like nothing we have ever seen before, and when Charley cleans up your A4 it will be just like new. Mervin McKee, whose specialty is sideband gear, can quickly null out the unwanted carrier and sideband and run a performance check on the overall gain of your SSB rig. Our newest lad Karl is particularly keen on Swan, National and Gonset's transistorized rigs, and on Collins S lines. All the boys are proficient. Dick Tassone loves mobile installations and he's constantly looking for that perfect noise free job.

Equipment wise we have solid state counters to 15 Gc and accurate to one part in 10^8 per day (compare that with your BC221), digital voltmeters, digital ohmeters and HP's 425 micro-micro amperemeter that will measure the energy of a mosquito's flight—that is if we knew enough to harness the critter. The techniques that each person employ are channelled to the kind of job you have for us. The best of Tektronix, G. R., HP and other specialized manufacturers are utilized to advantage.

So fellows if you want your gear serviced even though you bought it elsewhere and you want it done right and quickly drop us a line, or better yet send the piece along with a brief run down of the problem you're experiencing. Our charges are particularly modest considering our investment in facilities: Only $5.50 per hour plus replacement costs. We're *not* in the service business but proper service *is* a necessary adjunct to our ham business.

For those who are considering purchasing new gear, isn't it some consolation to realize that these same service men and facilities are available to fulfill the terms of our warrantee? Very few pieces of new equipment ever need go back to the factory with the time consuming process of service and shipping two ways—causing you needless delays.

Prompt service is a proven factor at this company. Remember also that we sell all standard brands plus a full line of accessories. We're New England's only exclusive ham house.

73
Herb Gordon W1IBY

HERBERT W. GORDON COMPANY

Helping Hams to Help Themselves

Woodchuck Hill, Harvard, Mass., 01451
Telephone 617-456-3548

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Rewinding The Power Transformer

Many radio amateurs feel that the days of rewinding power transformers are long gone, and they may be right in this, but there are still two good reasons for "rolling your own", when it comes to certain cases. These are expense and the fact that transformers for certain voltages are hard to come by.

Actually a transformer is a simple device. It consists of a core, usually laminated iron or steel in a power transformer, and two or more windings of suitable wire wound on the core. The power capabilities are determined by the type of core material, the size of the core, and the diameter or gauge of wire used in the windings.

As an AC voltage is applied to the primary, (the input winding) it causes a magnetic field to expand around the core. That is, the core becomes magnetized. As the magnetic field expands, the magnetic lines of force cut across the secondary or output windings and induces a voltage across those windings. When the input voltage drops to zero as our 60 hertz current does 120 times per seconds, the magnetic field collapses, the lines of force once again cut across the secondary windings and a voltage of opposite polarity is set up across those windings. The process is repeated again and again as long as an AC voltage exists across the primary winding.

Table I

Wire gauge	Current capacity*
10	14.8 amperes
12	9.33
14	5.87
16	3.69
18	2.32
20	1.46
22	.918
24	.577
26	.363
28	.228
30	.144

*Figured on 700 circular mills per ampere

The ratio of the number of turns of wire on the primary to the number of turns on the secondary will always determine the ratio of the voltages of the primary to the voltages of the secondary. This simply means that the following holds true.

$$\frac{\text{TURNS (primary)}}{\text{VOLTS (primary)}} = \frac{\text{TURNS (secondary}}{\text{VOLTS (secondary)}}$$

Knowing these simple facts and that the power capabilities of a transformer do not change when we rewind it, we can proceed to rewind a transformer, for any special application. Step by step instructions are given.

1. First, figure your power, voltage, and current requirements. A 2½ volt transformer delivering 10 amperes will handle 2½ volts X 10 amperes or a total of 25 watts. This means that you must rewind a transformer capable of handling that much power. Most television transformers are designed to deliver 200 to 300 watts continuously, day after day, and will handle much more power in amateur applications.

2. Remove the shell covers from the transformer and identify the leads. Trace the wires back into the windings. Usually the filament winding for the rectifier tube is on the outside, then comes the 6.3 or 12.6 volt winding, then the high voltage winding and finally the primary or 117 volt winding. These can readily be identified by the color code in *most* transformers.

Green	6.3 or 12.6 volts
Yellow	5 volts
Black	117 volts
Red	High Voltage
Red and yellow	Center tap of HV

While this color code is not always used, a little work with the voltmeter will identify all the windings.

3. Remove the paper covering the first winding and count the turns of that winding. Divide the number of turns by the voltage of the winding. For a typical 5 volt winding, there may be 15 turns. This gives us 15 turns/5 volts or three turns per volt. This ratio of turns per volt will exist on every winding of the transformer.

4. Multiply the number of volts of your new winding by the number of turns per volt found in step #3. In my case I wanted 2½ volts for 866A rectifier turbes so I used 7½ turns on the winding. The size of the

wire needed to carry the current may be obtained from **Table 1.**

5. Now carefully (ha!) remove all the windings you are not going to use. In my case I removed all but the primary. You may want to save the high voltage or a winding already in place. By saving a high voltage winding and adding a 28 volt winding we can build a nice transformer for surplus gear.

6. When you have removed the windings you no longer need, you can disassemble the core. Using a screwdriver, a light hammer, and a pair of pliers, force the E shaped pieces out of the core. Notice that there are about three E's facing one way and then three facing the other direction. The first few E's are hard to remove but the rest are easy. Also save the cardboard caps usually found on the ends of the winding area.

7. Now carefully put on the new winding. Formvar insulated wire is excellent for this and may be purchased at a local motor rewinding establishment or if you can't find it there, order it from Allied. Insulate between each layer of a winding and between the various windings. The easiest insulation I found to use was Scotch #33 tape but you can obtain paper for the same purpose. The winding may be put on by hand or if it is a high voltage winding with many turns, the core may be placed on a wooden block and chucked up in a lathe. Keep track of the number of turns or your face will be red later on. Do not forget your center-tap if you need one. A piece of well-insulated, flexible wire should be used and this solder connection should be taped well.

8. After the new windings are in place, tin the ends of the wire and attach flexible leads about twelve inches long. Now add a final layer or two of tape. In my case, since this winding would carry high voltage DC, I added several layers.

9. We're almost done! Reassemble the core, placing three E's one way and then three the opposite way. The last few will go in hard but use all of the core material. When this is completed, put on the shells and tighten the bolts that hold the transformer together. These will probably have to be retightened later as the transformer is used, until they are completely tight. If they are not tight, the transformer will buzz.

10. Install the transformer, use it, and think of all the bucks you saved by winding your own.

The Drake L-4 Linear Amplifier

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The new Drake L-4 linear amplifier has just about all the features you look for in a high power rf amplifier. Since this compact unit is rated for continuous duty, it will loaf along at 2000 watts PEP on single sideband, or a full gallon on CW, AM and RTTY in amateur service. The complete L-4 amplifier consists of an rf power unit and a solid state high voltage supply. There is a long connecting cable provided so the amplifier may be conveniently located at the operating position with the power supply tucked underneath out of the way.

The Drake L-4 may be driven to its full rated input on single sideband by any transmitter that has an output of 100 watts PEP. For full input on CW, AM and RTTY, the exciter must have an output power of 75 watts. For maximum efficiency, the 50 ohm input impedance of the amplifier is matched to the grounded grid power amplifier tubes through a factory adjusted, broadband pi network. There is a separate network provided for each band and when peaked up it will cover the entire amateur band. To cover other frequencies in the 3.5–30 MHz spectrum, these circuits may be adjusted by the operator. This is especially helpful for those hams who handle a lot of traffic on the MARS frequencies. The necessary adjustment is very easy to make and requires only an SWR bridge; the instruction manual gives complete details and the entire procedure shouldn't take more than four or five minutes.

To ensure that the odd order distortion products are suppressed more than 35 dB, a slight amount of negative feedback is obtained in the L-4 by raising the grids above ground with 200 pF grid bypass capacitors. In addition, a very effective ALC circuit is included to prevent overdrive and

Drake L-4 Specifications

Frequency coverage:	All amateur bands from 80 through 10 meters.
Power input:	2000 watts PEP SSB, 1000 watts dc on CW, AM and RTTY
Drive requirements:	100 watts PEP SSB, 75 watts CW, AM and RTTY.
Input impedance:	50 ohms unbalanced.
Output impedance:	Adjustable pi network designed to load into 25 to 100 ohm unbalanced loads (50 ohm coaxial lines with SWR less than 2:1).
Tube lineup:	Two 8163 or 3-400Z triodes operated in class B grounded grid.
Features:	Broadband input tuned circuit on each band for high efficiency with minimum disortion; transmitting ALC; rapid heating filament tubes—3 seconds from initial turn on to full rated input; internal antenna swiching.
Power requirements:	230 volts ac, 50/60 Hz at 15 amperes, or 115 volts ac, 50/60 Hz at 30 amperes.
Size and weight:	Amplifier: 13-15/16" X 7-7/8" X 14-15/16"; weight 32 pounds. Power supply: 6-3/4" X 7-7/8" X 11"; weight 43 pounds.
Price:	$695.00

further reduce distortion. A small amount of rf energy is picked off the input and applied to a semiconductor diode which is normally reverse biased. The amount of reverse bias is controlled by the *transmitting AGC threshold* control, so the point where the rf is rectified may be precisely controlled by the operator. When the rf exceeds this reverse bias, the diode conducts and a negative voltage proportional to the rf signal applied to the grid appears at the ALC output connector. This signal may be used with the exciter through its external ALC input to control audio gain.

The power tubes are matched to the 50 ohm output by a conventional pi network. To maintain high Q and high efficiency, the tank coil is constructed of very large diameter tubing and completely silver plated. A portion of the rf output voltage is rectified and applied to the output meter through a *sensitivity* potentiometer. This little convenience is very helpful in obtaining maximum output from the amplifier since maximum output does not correspond exactly with plate current dip.

An internal antenna changeover relay is included in the amplifier to feed the antenna through to the receiver when receiving or when the power is turned off. To eliminate any diode noise which might be generated by the final tubes during receiving, they are completely cut off by applying 120 volts to their cathodes during receive. Since the tubes used in the final heat up to operating temperature in about three seconds, it only takes this amount of time from the completely off condition to the full rated input. This permits the L-4 and its power supply to remain off until it is required for communications (such as rare DX!). The fan used to cool the final is amazingly quiet and it's nearly impossible to tell that it's on without looking.

The two meters used to indicate plate current, grid current, plate voltage and relative output are of the taut-band type for maximum reliability and long life. This type of meter movement has virtually no friction, so the operator is assured of accuracy and repeatability. The upper meter always indicates final plate current, while the lower one may be switched to read grid current, plate voltage or relative output.

Tuning up the Drake L-4 is a real snap and only takes a couple of seconds. Since the input stages are broadbanded and present an essentially flat 50 ohm load to the exciter, if the exciter is properly loaded into a 50 ohm transmission line with low SWR, turning on the L-4 has no effect on exciter tuning. After waiting three seconds for filament warmup, you can hit the switch, load the antenna, tune for a dip and call CQ. By checking your plate current and plate voltage, your final dc input may be easily calculated from the chart that the Drake Company provides in the instruction manual. This chart takes into account any fluctuations in line voltage (and therefore plate voltage) so that the full legal limit under various conditions may be easily calculated.

Although the high voltage power supply may be operated from either a 115 or 230 volt line, the 230 volt system is recommended for best supply regulation. In fact, when the L-4 arrives from the factory, it is connected for 230 volt operation. For 115 volt operation, it is only necessary to move a couple of the jumpers on terminal strips in the power supply *and* rf power unit. However, if a 115 volt circuit is all that is available, it must be fused for 30 amperes, the circuit conductors should not be less than number 10 and no other equipment should be operated from the circuit. Do not operate the L-4 from a standard 115 volt light circuit because the circuit conductors are not large enough to safely carry this load.

Most homes are equipped with 230 volt service for either an electric stove or a clothes dryer, so it's a relatively easy matter to have an electrician run a 230 volt line into your shack. Another solution, and one that I have used is to make a 230 volt extension cord using three conductor, number 14 house wire. When 230 volts is required, all you have to do is unplug the clothes dryer and plug in your extension. This is not the most convenient method in the world, but it does work temporarily until you can get an electrician to put another line in. Be sure to use large 230 volt plugs and sockets on the extension cord so no one can plug a 115 volt appliance into this line.

The proof of the pudding of any amplifier of course is in the operating, and this is where the Drake L-4 really shines. In amateur operation, probably the toughest conditions are those when a rare dx station is on and dozens of fellows are calling him. Obviously, the strongest signals will consistently work the rare ones first. Another good test is over difficult paths; from the east coast for example, propagation into the south Pacific area is usually open less than an hour each evening. Assuming a good location and a good antenna, the station that can consistently work into Tahiti, Samoa and Fiji from New England has a power amplifier that is really putting out. The L-4 performed magnificently in a recent dx test and added several new ones to the W1DTY countries list, including several from the elusive south Pacific. Running phone patches is another test where the Drake L-4 comes away with flying colors. On 20 meters in the evening it is difficult to find many spots that are void of QRM. Therefore, to run a phone patch, even locally, you have to have an outstanding signal. Here again the Drake does a very nice job, providing strong readable signals where lower power and lesser amplifiers just wouldn't do the job. For the amateur who works dx or otherwise must work over difficult paths, the Drake L-4 linear amplifier may be just the answer. It certainly has done an outstanding job for me.

. . . W1DTY

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The Carrier Again

W7CSD's article, "Amplitude Modulation vs. the Carrier," in the October 73 generated a lot of mail. Here's some further discussion of the topic.

OK fellas, I get the message.[1] If you're a school teacher this happens at least once a week. So you take another approach. Let's start over again in the reverse order. Let's start out with what we know we have and see if we can find out what we started with. A mathematical example will put everything in focus.

Let's assume we have a 100 watt carrier, 100% sine wave tone modulated working into a 100 ohm load. Now I know they don't make 100 ohm coax but this is a handy figure for us to work with. First, we all can agree that this signal consists of a carrier and two sidebands. In this case (most of us will agree anyway) we have a 100 watt carrier and two 25 watt sidebands. Since a scope looks at voltage, let's reduce this to power in terms of voltage and resistance or $E^2R = P$. Solving for E we find that $E = \sqrt{RP}$. In the case of the carrier $E = \sqrt{100 \times 100}$ or $E_c = 100$ volts. Each sideband $E = \sqrt{25 \times 100}$ or $E_{sb} = 50$ volts. This will come as no surprise to most of us.

1. See W7CSD's article on page 82 in the October 73.

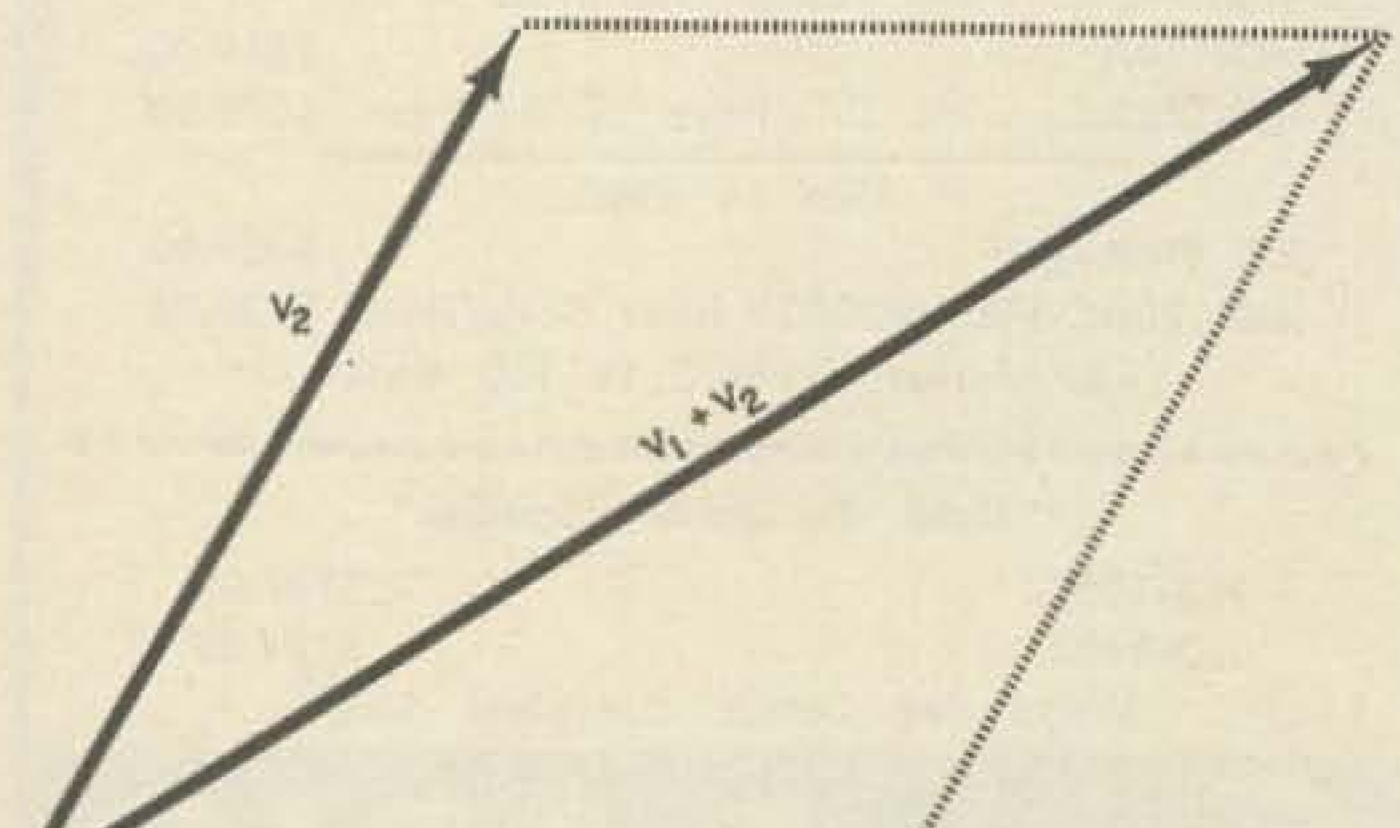


Fig. 1. Sum of two vectors. This is a parallelogram graphic solution.

Now we know that we can represent any ac voltage as a vector (actually a rotating vector or more properly called a phasor). If we have several vectors to add we can add them up by several geometric means; the simplest is to form a parallel-ogram as shown in **Fig. 1.** The diagonal is the vector sum.

Now if all parts of the circuit are at the same frequency we can treat the vectors as though they were standing still and add them up and say this is what a meter will read if you put it in the circuit here. However if we are considering adding vectors at different frequencies we can only do so an instant at a time. In our AM signal (sine wave tone modulated) we have three components at three different frequencies. They must add up to the modulated wave. Let us use V_c, the carrier voltage, as a reference vector. Remember that it is rotating but we can treat it as if it were standing still if we use it as a reference. Then vectors of other voltages at other frequencies are rotating faster or slower than the reference. Now let's see what the vector sums are for several instants in time. At time T_1 we find V_c in reference position, V_u, the upper sideband pointing to the left and rotating counterclockwise (by trigonometry counter clockwise is considered positive and the upper

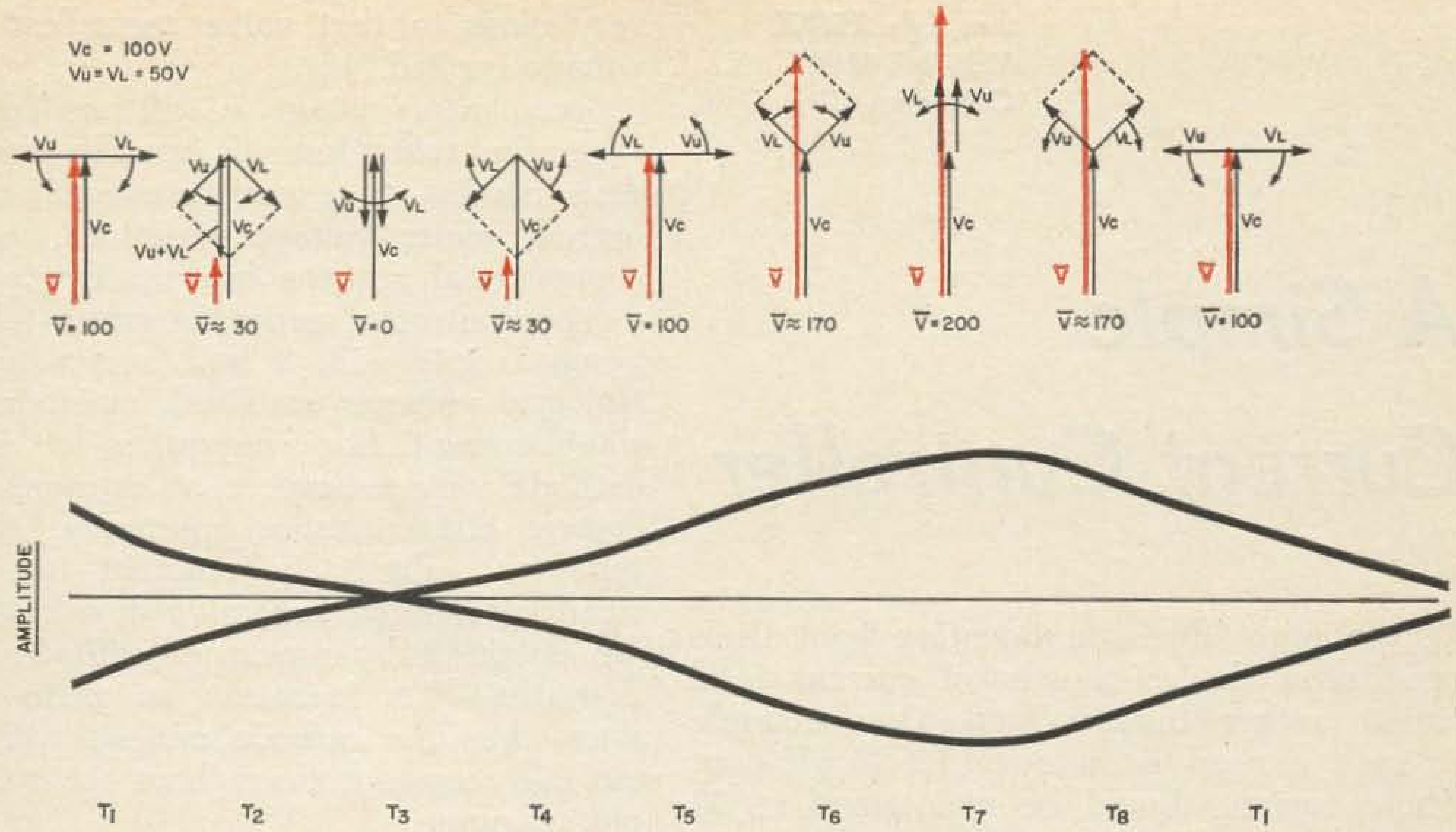


Fig. 2. Modulation envelope plotted from instantaneous amplitudes by vector addition. The color overprint gives the vector sum indicated by V with a short bar over it.

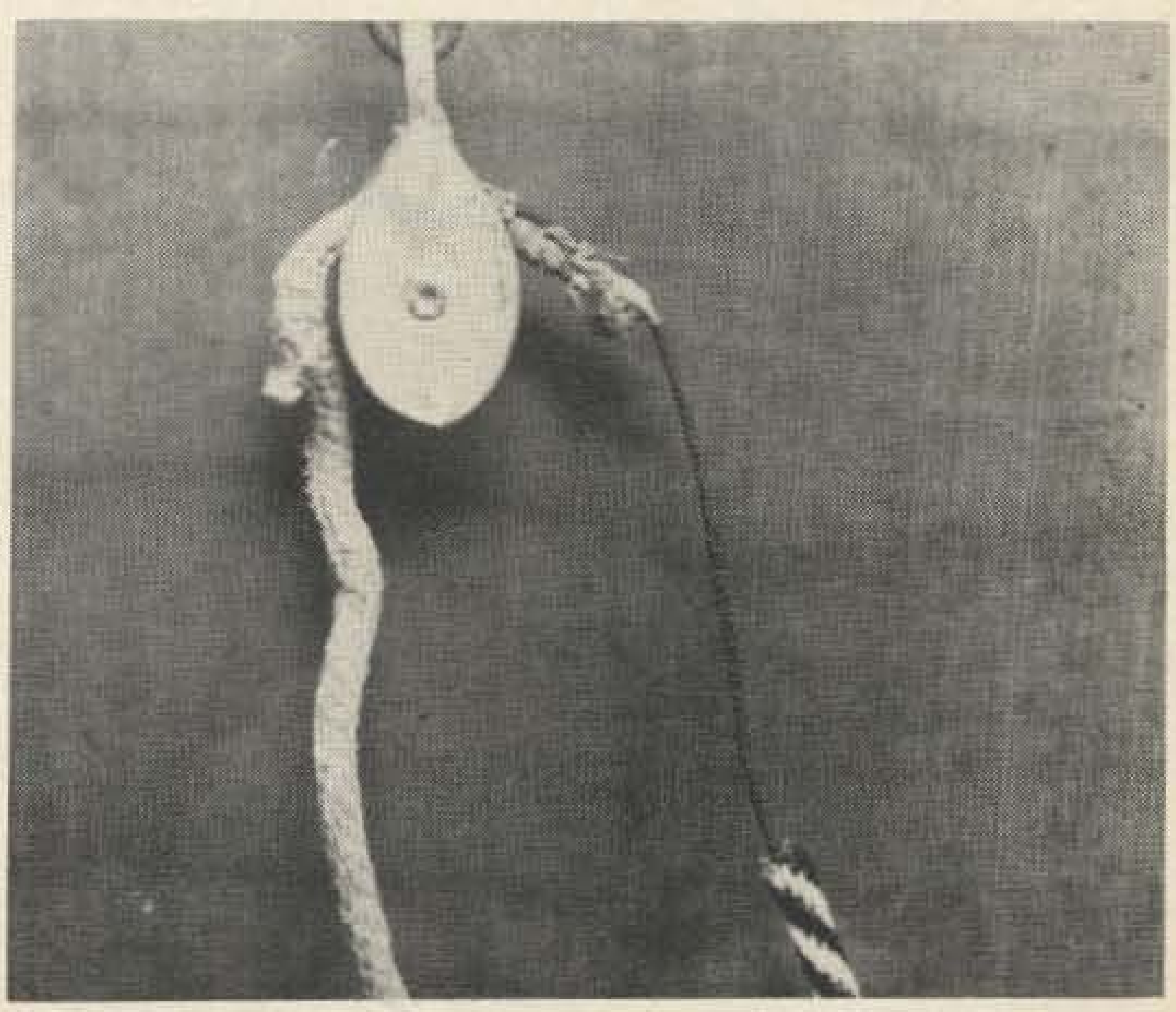
sideband is higher in frequency and therefore rotating faster than the carrier) and V_L, the lower sideband is pointing to the right and rotating clockwise (slower than the carrier). The vector sum is the carrier itself or we are going thru the zero modulation point. 45° later at T_2 we see the resultant is a small fraction of the carrier and we are in the negative modulation area. At T_3 the sidebands completely cancel the carrier and we have 100% negative peak. At T_4 we have the same condition as T_2. At T_5 we have the same condition as at T_1. At T_6 the resultant is greater than the carrier and is in the positive modulation region. At T_7 all vectors add directly and we have twice the amplitude of the carrier. 100% positive peak many other points in time could be taken. Thus we generate the well known AM envelope by vectorially adding the side bands and the carrier. *Note, the carrier is there all the time.* The question immediately arises. What happens if you over modulate? Now you cease to talk about two discrete sideband frequencies, upper and lower. You are now making a square-bottomed envelope and additional sidebands (splatter) are generated. What ever these additional sidebands may be they will make the vector sum of the carrier and all sidebands add up to zero on the negative peaks and the carrier will still be there.

. . . W7CSD

Replacing Halyards

Replacing halyards has always been a problem because a knot will not pass through the pulley hole. I have been using nylon ski rope which only costs several cents a foot and lasts for years. I found that when it had to be replaced I could cement the two pieces of rope together by using a small piece of Nylon twine between them. The small twine is inserted in the ends of the ropes and a match held underneath it until it becomes sticky. In a few minutes it will solidify and be secure. Now, by pulling on the old rope, the new one will come right on through the pulley.

. . . Ed Marriner W6BLZ



Jim Kyle K5JKX
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A Simple Current Controller

Frequently the experimenting ham finds need of a device to control *current* in a circuit, rather than voltage. One example of such a need is in a RTTY local loop, where current should be maintained at 60 mA (for a Model 15) even though line voltage, and as a result the dc supply voltage available for the loop, may vary. Another example is the bleeder resistor of a power supply, which must always draw a minimum current but which is only wasting power if more than that minimum is drawn.

The conventional approach to this situation is to use a voltage much higher than desired across the load, and drop it through a high-valued resistor. For instance, RTTY circuits often use a 125-volt supply and a 2000-ohm resistor, so that 60 mA can flow under short-circuit load. Small voltage changes then result in little current change.

In the case of the bleeder resistor, the resistor value is merely figured so as to draw minimum permissible current with the minimum voltage expected. As voltage rises, so does bleeder current, but we don't worry too much about the wasted power.

However, because of the unusual characteristics of tetrode, pentode, and beam-power tubes, it's simple to build a true constant-current generator, or controller, which can be set for any desired amount of current and will maintain current flow very close to that value regardless of the voltage applied.

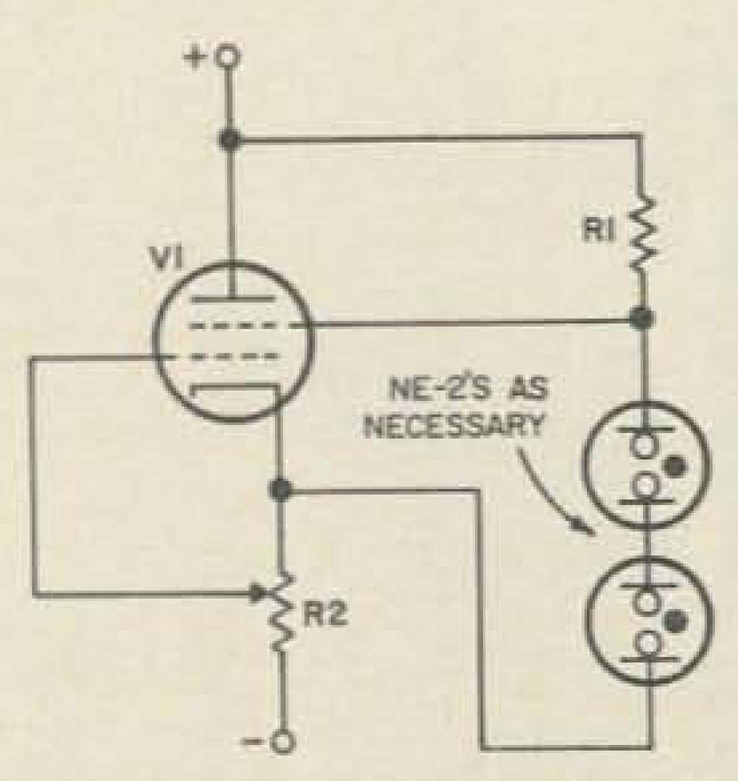

Fig. 1. A simple current controller.

Some extra voltage is still needed to operate the tube, but it's usually much less than needed to assure reasonably-constant current under voltage variations, were the conventional resistor hookup employed.

The controller works because a tube with a screen grid will, if both screen and control grid voltages are fixed, maintain a constant current flow regardless of plate-to-cathode voltage (except at extremes of operating characteristics). Actually, the current isn't absolutely constant—but if, instead of holding control-grid voltage fixed, we obtain it by means of cathode bias so that the bias increases as plate current does, then the cathode current will remain virtually constant throughout the tube's operating range.

The circuit is shown in the schematic. No parts values are given because they will depend entirely on the individual application. The tube can be any screen-grid type which will pass the desired amount of current; in general, TV horizontal-output tubes seem to work best as their effective amplification is high. However, the 6V6 is also excellent.

The screen voltage should be chosen to allow the desired current to pass with the grid voltage placed about halfway between zero and cutoff. It should be regulated by a string of NE-2's or VR tubes as shown so that it won't vary with the current. R1 is simply a dropping resistor and should be chosen so that the NE-2's all light under operating conditions.

The value of R2 will determine the range of current control possible. Its maximum setting should be such that cutoff voltage for V1 will be developed by the minimum current desired. Then with the arm toward V1's cathode, current will increase, and with maximum resistance in the circuit, current will be at a minimum.

To see just how this works, let's plug in a few numbers. Let's assume we're using a 6V6 for V1, and are holding its screen voltage at 250 volts. Furthermore, we want to have 20 mA current flowing in the external circuit.

A look at the curves for the 6V6 shows that with a screen voltage of 250 volts, and the same voltage on the plate, a grid-to-cathode bias of 20 volts will allow 20 mA of current to flow. This 20 mA will develop the required 20 volts across a 1000-ohm cathode resistor, so we use a 1000-

ohm unit for R2 and bring the grid back to the lower end (with a larger pot, we set it for 1000 ohms between grid and cathode).

Now if the load should attempt to make current increase to say 25 mA, the grid bias voltage would also increase to 25, reducing current flow to about 9 mA. Of course, as the current flow dropped the grid bias would drop accordingly, so that as current passed 20 ma going down the grid bias would be back at our 20-volt starting point and the practical effect would be that the current never got a chance to change at all.

If the voltage applied to the current-control and load together were to increase so that there were 400 volts across the 6V6 instead of 250, the 20-volt bias would still hold current to 21 mA. However, 21 mA of current would increase bias to 21 volts, which would result in current dropping to about 18 mA, and as before it would stop before dropping so low. The stop this time wouldn't be right at 20 mA, but would occur at approximately 20.05 mA—which is fairly close control!

Should we want to deliberately increase the current from 20 to say 40 mA, the curves tell us that grid bias should be 13½ volts. Ohm's Law tells us that about 338 ohms is the size resistor needed to develop 13½ volts with 40 mA flowing, so that's the setting for R2.

Now an increase in load current from 40 to 60 mA would give us a bias increase to 20¼ volts, which would in turn reduce current to about 20 mA, and on the way down things would lock up at 40 mA where they started, just as before.

Thus, by making R2 adjustable, we can dial the amount of current we want to flow in the circuit, and the controller keeps that current constant.

Should supply voltage drop so low that the screen voltage of V1 drops out of regulation, the gadget fails. This can be overcome by supplying the screen from a separate source, because plate voltage can be allowed to drop far below the screen value before the device stops working. However, in many applications the major problem is a change in current drawn by the load,

Used as a bleeder resistor, this circuit will draw only the amount of current it is designed to pull no matter how high the supply voltage goes (until V1 blows up from overvoltage around 1500 volts or so!).

Second-hand 6L6's are cheaper than 25-watt resistors, and far cheaper than 100-watt bleeders. The wattage requirement in a bleeder comes primarily from the power thrown away by excess current at highest voltage; this hookup will let a single 6L6 bleed a 750-volt supply, without wasting any current either.

. . . K5JKX

What's New for You?

This second of our monthly columns devoted to any topics of special interest to the technically-minded ham will be a bit short as the first announcement of the column didn't reach readers in time for them to submit items. We'll be looking for something from you in next month's 73.

This column is interested in short notes about new semiconductors, newly available surplus, technical nets, technical meetings, new records, comments about articles that have appeared in 73, notes about equipment and other topics. Please make your comments short and get them in to us early. The deadline for items for the next possible issue of 73 (April) is the 10th of February.

Paul Franson WA1CCH

Correction

The "Home Brew Rectifier" described on page 52 of the November issue is wired for a negative output voltage rather than positive. If you wish to use this circuit for B+, reverse the diodes.

Attention Galaxy Owners

Owners of Galaxy 2000 Linears and Galaxy remote VFO's should write for service bulletin 6-1, which gives some useful information including the use of the remote VFO on RTTY. Write Owen L. Meyerson, Galaxy Electronics, 10 South 34th Street, Council Bluffs, Iowa 51504.

Correction

In the article by W1OOP in the September 73, "Add AGC to your receiver," the diodes in Fig. 2 on page 27 are reversed.

Correction to Correction

Sigh. The correction on page 113 in the December issue is wrong. The N-channel and P-channel FET's are reversed.

Tom Lamb K8ERV
1066 Larchwood Rd.
Mansfield, Ohio

Equalizing AFSK Tones

Common methods of keying audio oscillators for AFSK lead to unequal mark and space amplitudes. This article describes a simple method to avoid this.

The common method of obtaining an audio frequency shift signal is to switch the tuning capacitance of an audio L-C oscillator, as shown in **Fig. 1.** The space frequency (2975 Hz) is formed by L-C_1, while the lower mark frequency (2125 Hz) is formed by L-(C_1+C_2). While adding C_2 lowers the frequency, it unfortunately lowers the circuit impedance which usually lowers the Mark output level. I say "usually", because it depends on the oscillator circuit and the circuit Q. This reduced mark output can cause distortion in the receiver TU, and lowers the mark S/N ratio.

A review of the literature shows that this mark-space amplitude difference is either neglected or equalized by a C or LC network in the oscillator output. I would like to propose a much simpler method of tone equalization.

The Twin City AFSK circuit was used as a typical oscillator for tests, with the keying circuit temporarily omitted (**Fig. 2**). The mark amplitude was measured at 3 dB below the space amplitude. Let's see what can be done about this.

Instead of thinking of the mark amplitude as being too low, let's consider the space amplitude to be too high, and look for an easy way to lower it. Adding resistor R_1 (**Fig. 2**) across the switch does the trick. The mark circuit (L-C_1C_2) is not affected, but the Space circuit now has its Q lowered by R_1 in series with C_2. As the value of R_1 is decreased from a very high value the space amplitude drops quickly, but the space frequency is almost unaffected, as shown in **Fig. 3.** For this particular circuit the tone amplitudes will be equal if R_1 is 125kΩ. The space frequency shift due to R_1C_2 is only 3½ Hz.

Now let's continue with the diode keying circuit of the Twin City circuit, **Fig. 4.** R_1 loads the space circuit through the keying diodes, D_1 and D_2. The circuit characteristics were first measured using silicon TV diodes

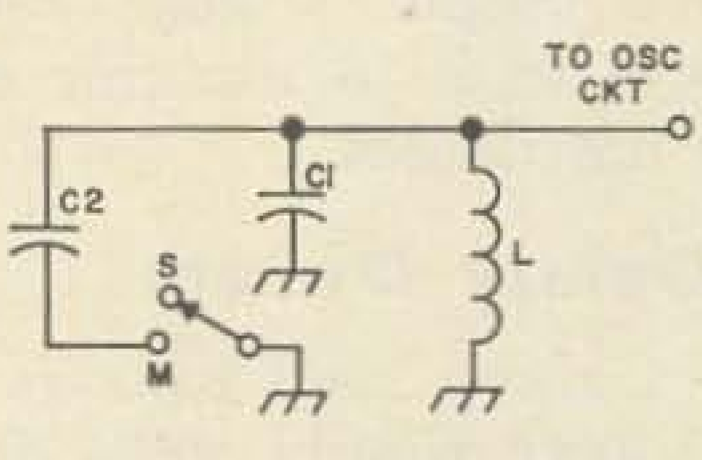

Fig. 1. The common method of obtaining an audio frequency shift for RTTY.

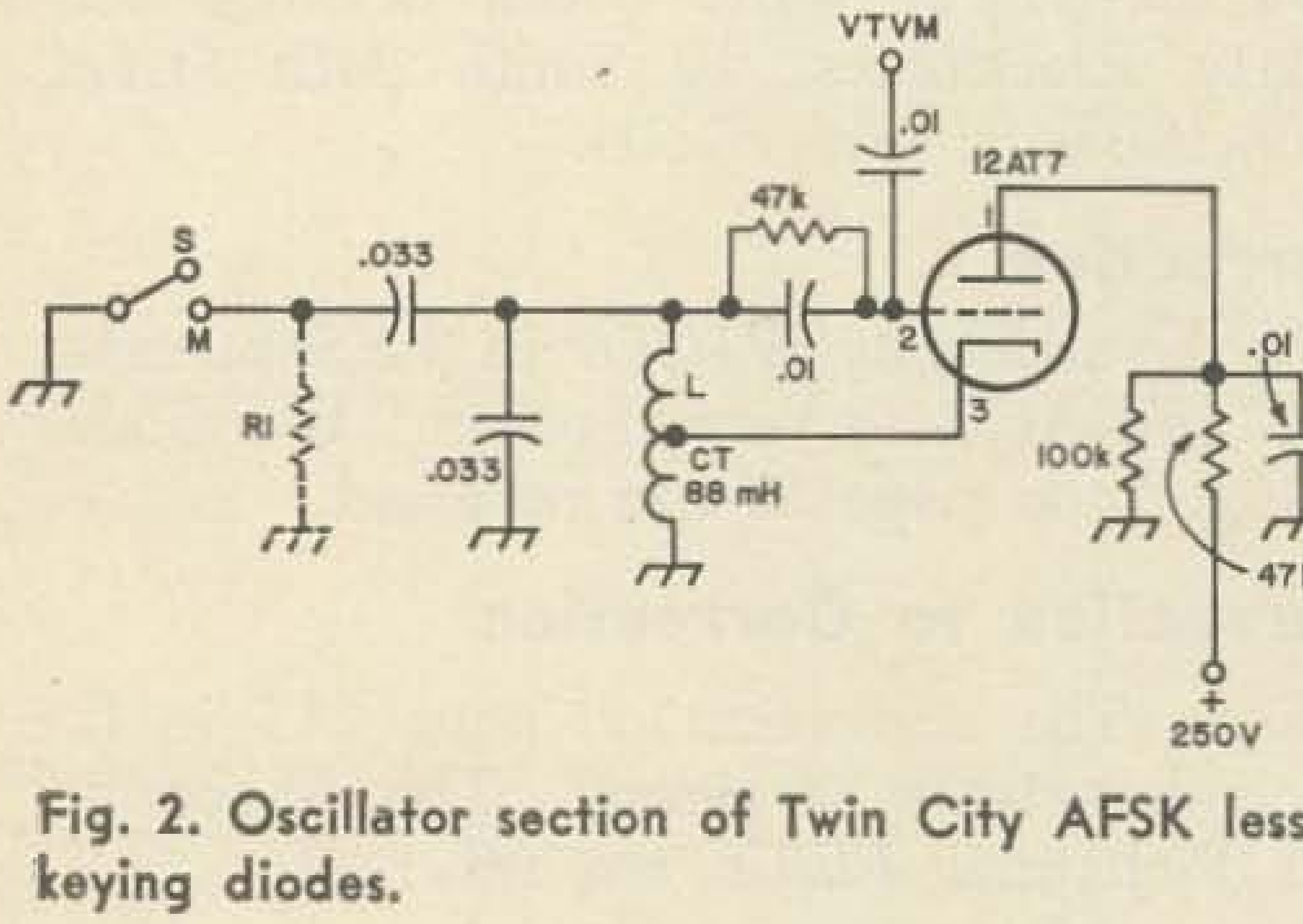

Fig. 2. Oscillator section of Twin City AFSK less keying diodes.

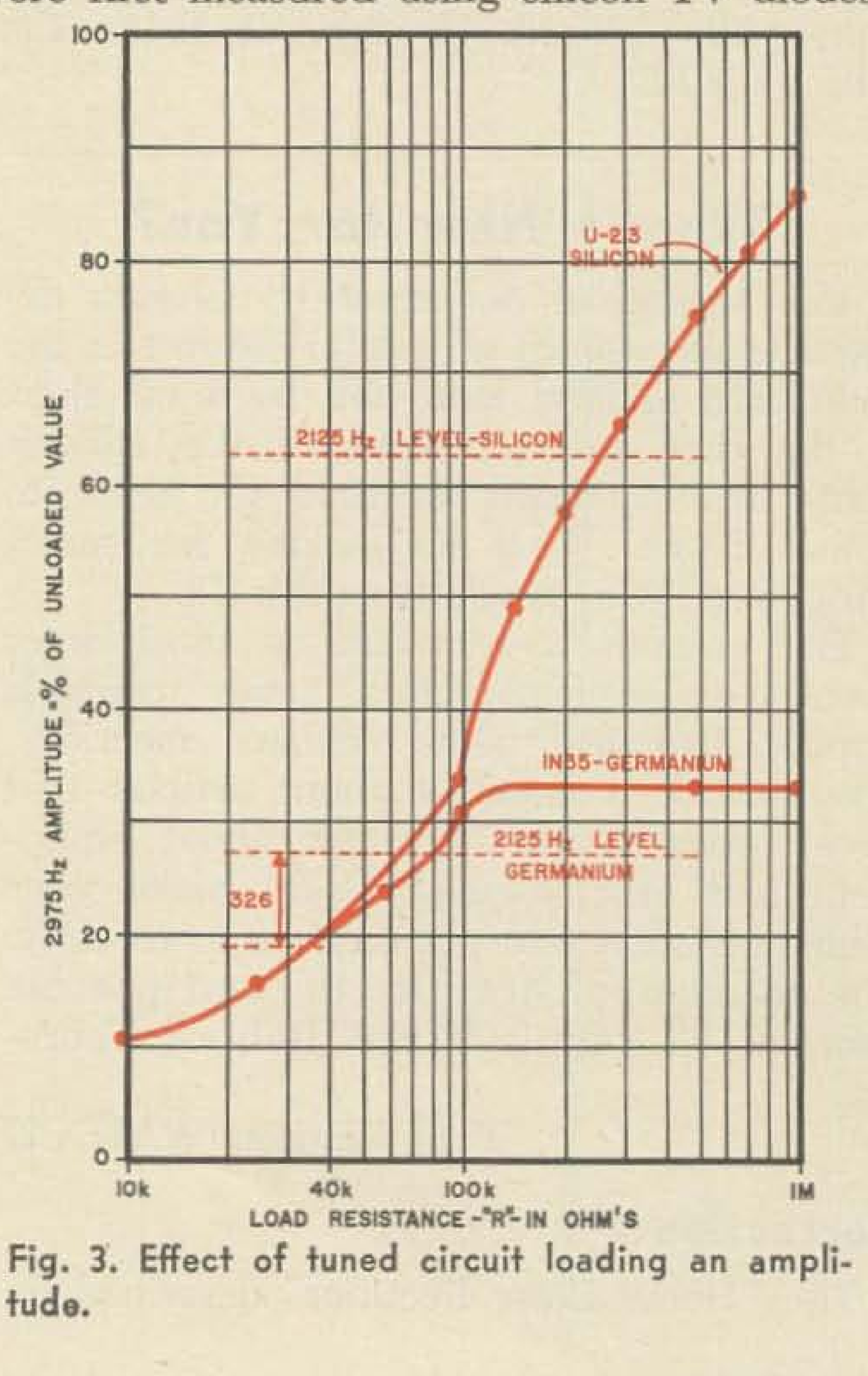

Fig. 3. Effect of tuned circuit loading an amplitude.

(Texas Instruments U-213) for D_1 and D_2, with the results shown in **Fig. 5.** Note that the mark and space tones will be equal in amplitude if R_1 is 250kΩ.

Next germanium 1N35 diodes were tried. These are similar to the Twin City 1N54's, which I didn't have. **Fig. 5** shows that the germanium diodes load the space circuit, due to their low back resistance. R_1 should be about 85kΩ for equalization, but this will vary with the particular diodes used. (The voltage across the oscillator circuit is a bit high for 1N54's and 1N35's). If R_1 is 39kΩ as shown in the Twin City circuit, the space amplitude will be about 3 dB below the mark, just the opposite of the usual situation.

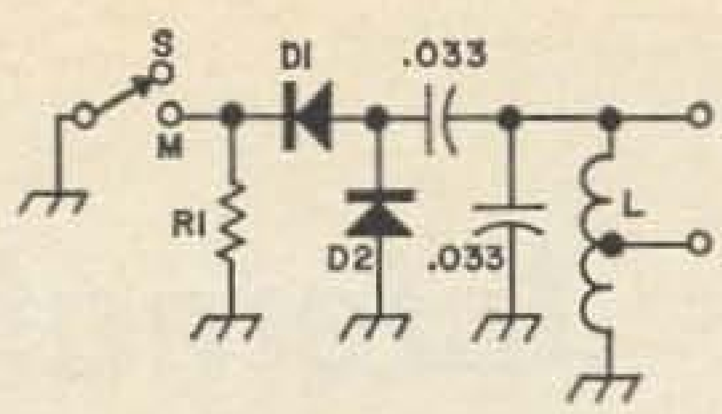

Fig. 4. Twin city keying circuit.

While the proper value of R_1 will vary with the circuit used, I believe an equalizing value can be found for almost any oscillator and keying circuit. Remember that equal mark-space *percentages of modulation* are the goal. If your speech amplifier is not flat, this system will permit the proper amplitude adjustments.

. . . K8ERV

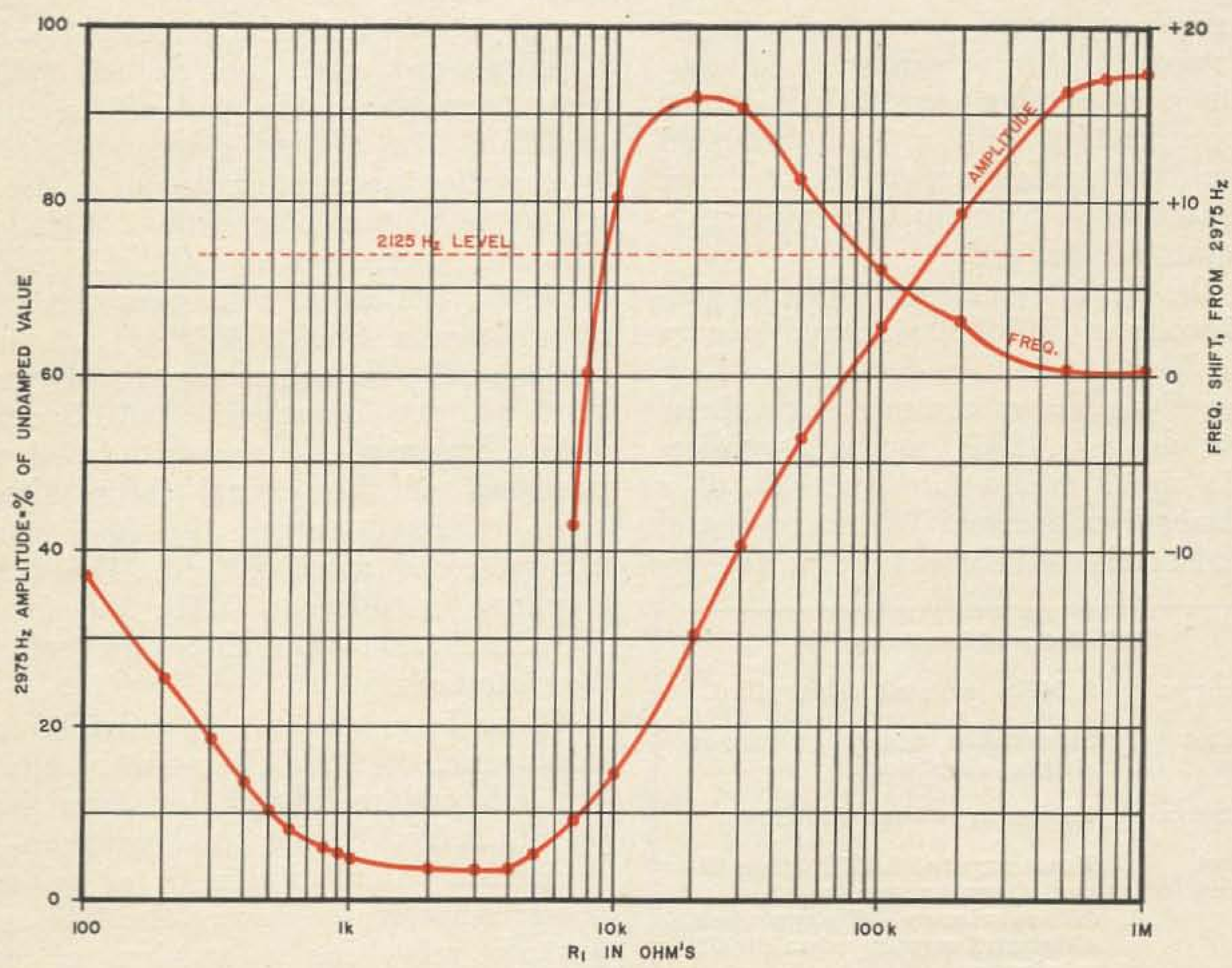

Fig. 5. Effects of diode loading on space amplitude.

Cutting Holes in Window Screens

When you bring a transmission line into the shack, many times the most obvious route goes right through a window screen. Much to the consternation of the XYL, many hams are apt to stick a screw driver into the screen and spread the strands a little bit. A neater method is to use a conventional chassis punch about a half inch in diameter. To prevent the strands from unraveling, several techniques may be used. If the screen is brass or copper, the strands around the opening may be soldered together. For aluminum or plastic screens, a little bathtub caulk does a marvelous job. If care is taken in choosing the size of the chassis punch, the cable will fit snugly in the opening and no insects will get in. Furthermore, if the hole is placed near one of the corners, it may be patched up later with little notice.

. . . Jim Fisk W1DTY

Jim Fisk W1DTY
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Rindge, N. H. 03461

International Crystal SBX-9 Sideband Exciter

If you're one of those fellows who has been procrastinating about getting on VHF sideband, the new International Crystal 9 MHz sideband exciter is just what you're looking for. The high frequency addicts can read on too, because the SBX-9 is equally suitable for any of the ham bands below 30 MHz. Basically, this new exciter from International Crystal is a crystal controlled 9 MHz single sideband generator with selectable upper or lower sideband. It uses a very steep sided four crystal half lattice filter in conjunction with a 7360 balanced mixer to obtain a minimum of 45 dB carrer suppression with at least 40 dB suppression of the unwanted sideband.

In all, the SBX-9 uses four tubes to generate 0.5 volts of 9 MHz sideband energy across the 50 ohm load. In the input a high impedance dynamic or ceramic microphone is used to drive a 12AX7 audio amplifier; this audio signal is fed into one side of a 7360 balanced modulator. The control grid of the balanced modulator tube is fed by the 9 MHz rf carrier which is generated by a 6BH6 crystal oscillator stage. The carrier is balanced out in the 7360 by the balance control which is connected to the tube's beam deflection plates. When the audio signal reaches the 7360, the balanced modulator becomes unbalanced at an audio rate and produces a double sideband suppressed carrier signal. This signal is fed into a crystal filter where the undesired sideband is suppressed and the desired sideband passes through to the grid of the 6BA6 rf amplifier. The desired sideband is selected by choosing the exact frequency of the 6BH6 crystal oscillator. Since the 2 kHz crystal filter is centered on 9000.00 kHz (9 MHz), the upper sideband will pass through the filter when a 8998.5 kHz crystal in used in the oscillator; conversely, the lower sideband will get through if a 9001.5 crystal is used. Because of the steep sides and narrow passband of the crystal lattic filter, the audio sideband outside the filter passband is suppressed some 50 dB. The 6BA6 rf amplifier is tuned to MHz and feeds the 50 ohm output through a link coupled to the plate tank.

SBX-9 Specifications

Frequency:	9 MHz crystal controlled.
Operating mode:	Selectable upper or lower single sideband.
RF output:	0.5 volts across 50 ohms.
Sideband generation:	Four crystal half lattice filter. Carrier suppression 45 dB minimum. Unwanted sideband suppression 40 dB minimum.
Audio input:	High impedance dynamic or ceramic microphone.
Tube lineup:	6BH6 oscillator, 12AX7 audio amplifier, 7360 balanced modulator, 6BA6 rf amplifier.
Features:	Push to talk relay; front panel control of balanced modulator; full metering of rf output for balance adjustments.
Size and weight:	8¾"x5⅝"x9⅞". 12 pounds.
Power requirements:	115 volts ac, 50/60 Hz, 36 watts.
Price:	$125.00

There is a test switch provided on the front panel of the exciter which unbalances the balanced modulator and keys the push to talk relay. This is used where a carrier is necessary for adjustment of an external power amplifier or mixer. The internal push to talk relay has a number of contacts which are brought out to the accessory socket. These auxiliary contacts may be used for turning on external power amplifiers, switching antenna changeover relays and muting receivers and converters.

Since the SBX-9 has a fixed 9 MHz output, the front panel has a minimum number of controls. In fact, to put it on the air all you have to adjust are the carrier balance and audio gain controls. And, once the carrier balance is set, it requires very little further attention. A 100 microampere meter is connected across the plate circuit of the 6BA6 rf amplifier to measure the amount of carrier. All the operator has to do is

International Crystal SBA-50 50 MHz SSB Mixer-Linear Amplifier

turn the SBX-9 on, key the push to talk relay and adjust the balance control for minimum indication on the meter; then talk into the mike and adjust for proper audio gain as indicated on the meter. The complete adjustment takes only a couple of seconds and results in a minimum of 45 dB carrier suppression.

The SBX-9 is designed primarily as an exciter for the SBX-50 50 MHz mixer-amplifier, but it may be used with homebrew mixers on other amateur bands by the proper selection of frequencies. The use of a 5 MHz VFO and suitable mixer-amplifier circuits for instance would provide single sideband on either 75 or 20 meter phone. Other frequencies may be added by the addition of appropriate crystal controlled mixer stages.

The sideband signal from the SBX-9 is very clean on the scope and sounds very crisp and sharp. The high quality crystal filter and use of double tuned circuits results in high efficiency with maximum suppression of undesired signals. For the amateur who is interested in getting on sideband without going to a transceiver, particularly on the VHF bands, the International Crystal SBX-9 is an ideal choice.

The new International Crystal SBA-50 50 MHz single sideband mixer-linear amplifier was designed as a companion unit for the SBX-9 sideband exciter for operation on six meters. This dandy little transmitter takes the 9 MHz sideband output of the SBX-9, mixes it with a crystal controlled signal in the 41-45 MHz range and puts out 10 watts of single sideband single tone on six meters.

The circuitry of the SBA-50 is quite straightforward, starting out with the triode half of a 6U8 in a simple third overtone crystal oscillator circuit to provide the necessary output on 41 to 45 MHz. If VFO operation is designed, it may be connected to the SBA-50 through the accessory socket on the rear deck of the unit. However, one of the three crystal positions must be vacated and that switch position used when the transmitter is VFO controlled. The tetrode half of the 6U8 is operated as a VHF mixer. In this section of the 6U8 the 41 to 45 MHz signals from the crystal oscillator are heterodyned with the 9 MHz signal from the single sideband exciter. The resultant sum frequency at 50 to 54 MHz is selected by the tuned mixer plate circuit and inductively coupled to the grid circuit of the 12BY7 linear buffer amplifier. This six meter signal is further amplified by the 6360 linear power amplifier and link coupled from the power amplifier tank circuit to the 50 ohm coaxial output. This signal may be used for communications within the six meter band or used to drive a larger linear power amplifier.

SBA-50 Specifications

Frequency coverage:	50-54 MHz. Three crystal conrolled channels selectable from the front panel or external 41-45 MHz VFO may be used.
RF output:	10 watts single sideband single tone.
RF drive required:	9 MHz single sideband, 0.5 volts across 50 ohms.
Output impedance:	50 ohms nominal.
Tube lineup:	6U8 crystal oscillator/VHF mixer, 12BY7 linear buffer amplifier, 6360 linear power amplifier plus two 0B2 voltage regulators.
Crystals required:	3rd overtone type in the 41-45 MHz range; three crystals furnished with unit.
Features:	Crystal or VFO control; provision for external push to talk control; complete metering of 9 MHz drive, oscillator grid, buffer grid, power amplifier grid and rf output.
Power requirements	115 volts ac, 50/60 Hz, 37 watts.
Size and weight:	8¾" x 5⅝" x 9-9/16". 13 pounds.
Price:	$145.00

The SBA-50 is very easy to use and it only takes a few moments to completely tune it up. Once the SBX-9 9 MHz exciter has been properly tuned up, it is a simple matter to tune up the SBA-50. The switchable meter circuit may be used to read any one of five different circuits within the amplifier; the oscillator grid, 9 MHz drive (mixer grid), buffer grid, power amplifier grid, and rf output. Except for the input and output circuits to the final power amplifier stage, all the circuits have been factroy adjusted so there is a minimum number of panel controls to worry about. Since most six meter operation is limited to 52 MHz and below, the circuits within the transmitter are broadbanded enough to require no further tuning. However, if operation from one end of the band to the other is required, it may necessitate tweaking up the circuits slightly when going from 50 to 54 MHz.

Adjustment of the final amplifier tuning controls is very straightforward; put the SBX-9 exciter in the test position, place the meter switch in the PA grid position and adjust the grid tuning control for maximum reading; then place the meter switch in the rf output position and adjust the plate tuning and loading controls for maximum rf power out. Once the audio gain control has been adjusted for the proper meter reading, you're ready for your first six meter single sideband QSO.

You won't find a great deal of six meter single sideband activity in some parts of the country, but with units like the SBX-9 and SBA-50, it shouldn't be too long before all the stations on 6 meters are using this more efficient mode found on the lower frequencies.

These two new units are ideally suited for the amateur who is interested in sideband communications on our VHF bands. Although this complete unit is designed for six meters, the resultant six meter signal may be heterodyned up to two meters, 220 or even 432 with a simple homebrew mixer circuit. These units are extremely well made, stable and put out a very clean and crisp signal. With the sunpots on the upswing, it won't be too long before there will be world wide openings on six meters. When the DX going gets rough, it has been proven that ssb is the mode to be using; the SBX-9 and SBA-50 provide an excellent base for an outstanding ssb signal on six meters.

. . .WIDTY

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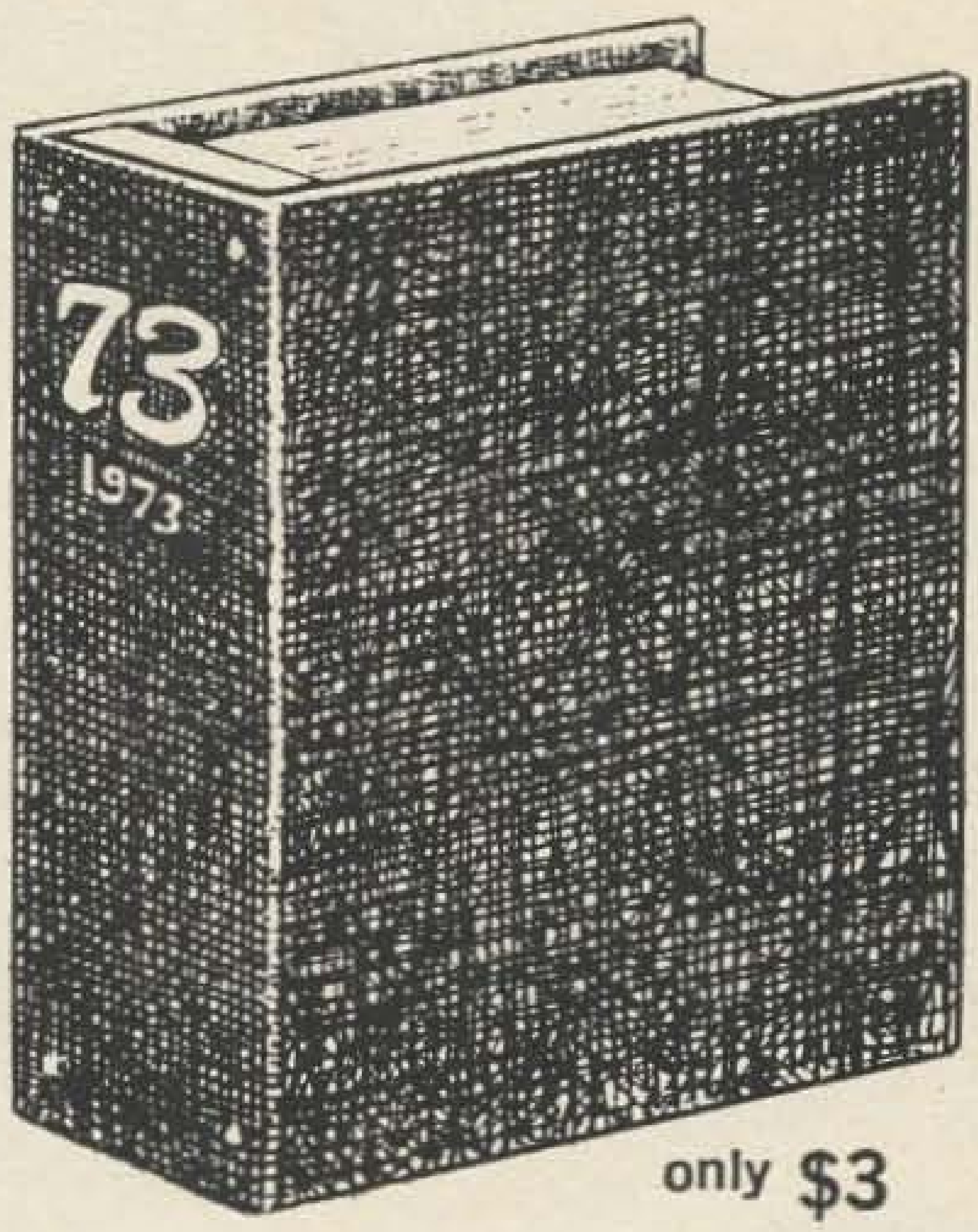

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73 Magazine **Peterborough, N. H. 03458**

The National 200

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

When National came out with their new model 200 transceiver a few months ago at a lower cost than any other five band transceiver on the market, I just couldn't believe that it would perform as well as the more expensive models. But—after using it for several weeks in chasing DX, I find that they have done a superb job and it performs right along with the best of them. The sensitivity is fine, the selectivity afforded by the steep-sided crystal filter is excellent, and the audio reports, if I am to believe the fellows on the other end, have all been good. Reports of, "tremendous audio quality," "really sounds good," and "very clean and crisp," have been normal reports during the time I have had the 200 on the air.

In the National 200 the final amplifier pi network and the driver tuning circuits also double as the rf circuits for the receiver. The VFO and carrier oscillator are common to both transmitter and receiver and the first if stage in the receiver also serves as a low level amplifier in the transmitter. The use of common crystal filter and rf input components results in a sensitive and relatively image-free receiver and highly efficient ssb transmitter. Sideband switching is automatic with lower sideband on 40 and 80, and upper sideband on 20, 15 and 10 meters.

The front end of the receiver starts out with a 6BZ6 rf amplifier, followed by a 12BE6 mixer, the 5.2 MHz crystal filter, two 12BA6 *if* stages at 5.2 MHz, a 12AX7 AM detector, product detector and first audio, and finally, a 6AQ5 audio power stage. The AGC voltage is derived from the second *if* stage, run through a semiconductor diode voltage doubler to get it up to the proper level, and then applied to the first *if* and rf stages.

The 8.7 to 9.3 MHz high frequency mixing signal from the VFO is premixed in a 6GH8 stage with a crystal controlled signal on 40, 15 and 10 meters so only one stage of conversion is required in the receiver itself. On 80 and 20, the VFO signal is mixed directly with the incoming rf signal to obtain the 5.2 MHz *if*. This procedure somewhat simplifies things and eliminates many problems with spurious responses and birdies that might appear in the receiver tuning ranges.

The tube lineup in the transmitter begins with a 6GH8 microphone preamp, then to a 6GH8 speech amplifier and solid state balanced modulator where it is mixed with the 5.203 MHz signal from the 12BA6 carrier oscillator. The sidebands at the output of the balanced modulator are fed into a 12BA6 transmitting *if* amplifier and then into the crystal lattice filter. The sideband output of the filter goes through another 12BA6 for further amplification, then to a 6JD6 transmitting mixer where it is mixed with the VFO and carrier oscillator signal available from the 6GH8 premixer. A 6GK6 driver and two 6JB6's in the final complete the layout of the 200 watt ssb transmitter. The excellent sideband qualities are a direct result of the very steep sided crystal lattice filter and the use of double tuned circuits in the transmitting *if* stages.

National 200 Specifications

Frequency Coverage:	3.5-4.1 MHz, 7.0-7.5 MHz, 13.9-14.5 MHz, 21.0-21.6 MHz, 28.5-29.1 MHz with crystals provided.
Types of Emission:	SSB (upper sideband on 20, 15 and 10 meters; lower sideband on 80 and 40 meters), AM, CW.
Power Input:	200 watts PEP SSB, 200 watts CW, 100 watts AM.
Power Output (Nominal):	120 watts PEP SSB, 120 watts CW, 30 watts AM.
SSB Generation:	Crystal lattice filter; 6-50 dB shape factor 2.2:1. Bandwidth 2.8 kHz at 6 dB. Carrier suppression −50 dB; unwanted sideband suppression −40 dB; 3rd order distortion products suppressed −30 dB at full output.
Receiver Sensitivity:	0.5 μV for 10 dB S/N in SSB mode.
Features:	Full AGC and S-meter on receive, push to talk or manual operation on transmit with ALC for ssb. Automatic carrier insertion for AM or CW. Product detector for SSB and CW, AM detector for AM on receive. Grid block keying on CW.
Tuning dial:	45:1 tuning ratio. Dial calibrated at 5 kHz points on all bands.
Tubes and semiconductors:	16 tubes, 10 semiconductors, parallel 6JB6's in the power amplifier.
Accessories:	AC-200 power supply for either 117 or 234 Vac, 50/60 Hz; XCU-27 100 kHz crystal calibrator.
Size and weight:	6-3/16" x 13⅜" x 11". 15 pounds.
Power requirements:	700 volts dc at 300 mA, 280 volts dc at 200 mA, −80 volts dc at 10 mA, 12.6 volts at 5 A.
Price:	$359.00

The National 200 incorporates a very sensitive automatic level control (ALC) circuit in the final. This circuit makes use of the fact that when the control grids of the power amplifier tubes are overdriven on voice peaks, the resultant positive voltage on the grid causes grid current to flow. This current in turn causes a negative voltage change in the bias network; the resulting audio signal on the bias circuit is capacitively coupled to a voltage doubler for rectification and fed back to the first *if* stage to control the audio gain. When the final amplifier is overdriven, the gain of the first *if* stage is reduced, resulting in less driving signal at the fnal. The ALC voltage cannot discharge through the voltage doubling circuit, so the resultant action is a fast attack and slow release. The circuit is designed to provide an automatic leveling control for 10-dB variations in the audio signal. This makes the setting of the microphone gain quite noncritical and changes in the voice level or large background noises are controlled without distortion. When the National 200 is used with a linear amplifier, there is provision for using an external ALC signal from the linear to control the audio stages of the 200.

The variable frequency oscillator used in the National 200 uses a straightforward grounded-cathode Hartley oscillator. To minimize the effects of warmup drift and to insure long term frequency stability, all the frequency determining components in the VFO have been carefully selected. To further insure the frequency stability of the unit, the output is taken from the screen grid of the oscillator tube. After a 30-minute warmup, the stability seems to be very good. Variations in line voltage have only a very slight effect; not enough to require retuning the station you're working. After an initial 5 minute warmup, the unit drifted about 1000 Hz over the next 25 minutes; after this 30 minute period the drift was insignificant.

In addition to operation on single sideband, the 200 may be used on CW or even AM. A simple adjustment on the back sets the carrier insertion for CW and AM. Once this control has been set for one band, it may be left alone. The mode switch on the front panel automatically suppresses this control for ssb operation but permits full carrier insertion on AM and CW. Actually, when this pot is switched into the circuit in the AM and CW modes, it is used to upset the balance of the diode modulator. In addition, for AM or CW, the bias is removed from the 12BA6 transmitting *if* stage, providing full carrier insertion of 60 to 300 mA.

This transceiver is designed to load into a 40 to 60 ohm unbalanced load. When the load is within these limits, it loads up very nicely and quite quickly with the three controls required. In this respect, the National 200 is similar to many other transceivers on the market—peak the exciter, load the power amplifier and tune for a dip. Since the receiver uses the transmitter tuned circuits in its input, when the transmitter is tuned up, the receiver is also matched to the transmission line. In the transmit mode, the meter reads final amplifier cathode current; in the receive mode it functions as an S-meter.

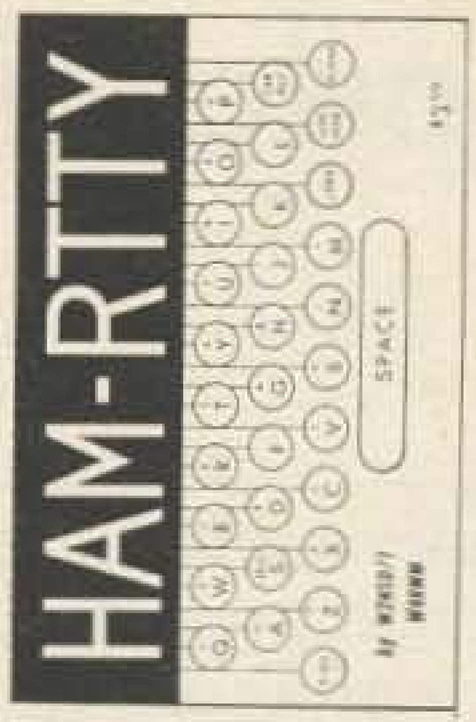
The National 200 may be used either in a fixed station from the 115 volt line with the AC-200 power supply, or mobile with a power supply that furnishes all the necessary voltages. To aid the mobileers, National has thoughtfully included a mobile mount in the package with the 200. This mount is a U-shaped bracket that may be clamped under the dash of your car; the transceiver fits into the bracket and is held in place with a couple of large knurled thumb nuts. To remove the unit for fixed station operation, all you have to do is disconnect the antenna and power plug and remove the thumb nuts.

All in all, the National 200 transceiver seems like a very good investment for those of you who are shopping around for a good all band transceiver. It is compact, lightweight, easy to use, and best of all, it works well. It's not often that you get all these attributes in one package!

. . . W1DTY

73 BOOKS FOR YOU

HAM RTTY



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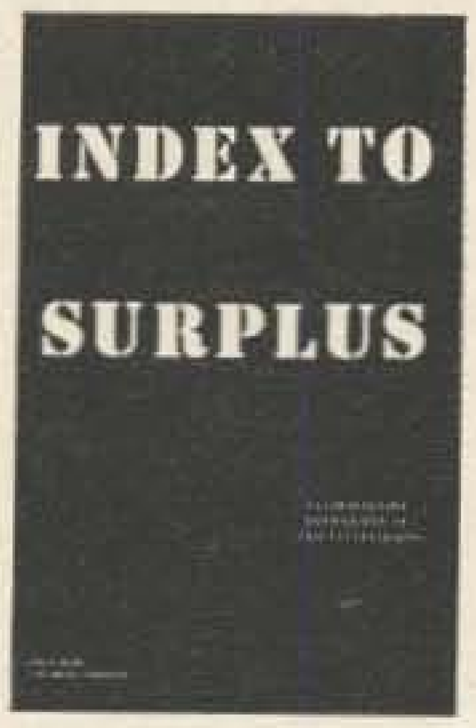

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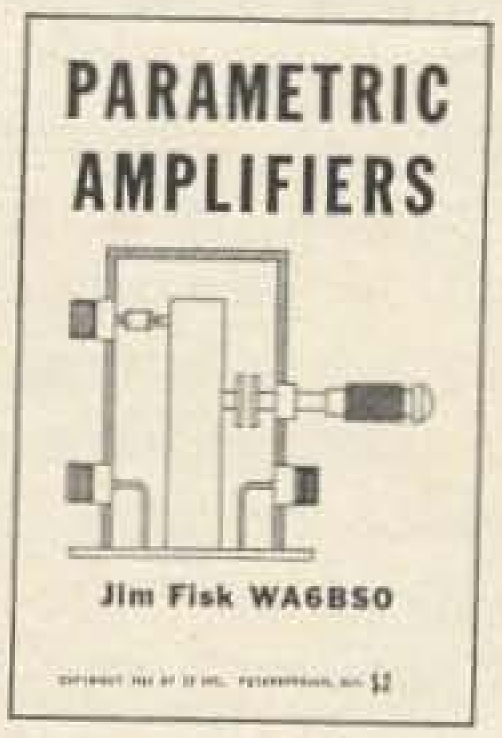

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HAM TELEVISION

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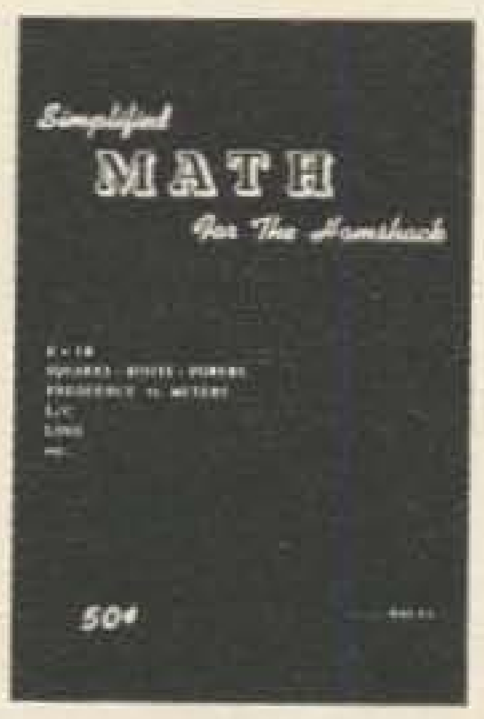

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73 Magazine

Peterborough, N. H. 03458

E. R. Davisson K9VXL
83 Crestview Drive
Greenwood, Indiana

O. G. Wilson K9CLH
RR #1
Paragon, Indiana

A Universal Code Monitor

Want a monitor that requires no external battery, can be used with each and every cathode-keyed transmitter, and is small enough to be mounted to your key?

By taking advantage of the voltage drop across silicon diodes in the forward biased condition, a convenient source of regulated voltage to power a transistorized code monitor is attained.

Referring to **Fig. 1**, the heart of the universal code monitor is shown. Placing three silicon diodes in the ground lead to the transmitter from the key accomplishes two objectives: One, with the key open, any possibility of high voltage being present across the transistor is eliminated; and two, with the key closed, a voltage drop of approximately 2.1 volts is obtained for powering the monitor. (0.7 volts per silicon diode in the forward biased condition) Watch the polarity of those diodes! If they are placed in the wrong direction, it will be readily apparent as no current will flow.

Three diodes have been shown, but the actual number will vary depending upon the overall volume level required. More diodes—more voltage, and hence louder the volume produced. With 2.1 volts to power either of the two transistor circuits shown, the volume is sufficient for the average ham shack. Selection of the diodes will depend upon the current drawn by the keyed stages of your transmitter. To make it universal, 500 mA diodes should be used. The monitor may then be used with any transmitter drawing from 10 to 300 mA. In this application, the PIV rating of the diodes is not important, so relatively inexpensive diodes may be used.

Fig. 2 shows a transistorized circuit which may be used. This circuit draws approximately 2.5 mA at the 2.1 volt level and gives sufficient volume even under noisy conditions in the ham shack. If an output transformer other than that specified is used, some juggling of C_1 and C_2 may be necessary to obtain oscillations.

Got a portable radio around that is no longer used? If so, the parts to build an audio oscillator may be laying there waiting to be used.

Fig. 3 shows an oscillator circuit which may be easily built from parts normally encountered in the small portable radio. The driver transformer may have four leads on the secondary. If it does, simply solder the two middle ones together for the center tap. Use caution in removing the transformer from the portable radio's printed circuit board as excessive heat can open the leads internally.

The speaker can be the one in the portable, or may be one with an impedance anywhere from 3.2 ohms to 100 ohms. The transistor can be the preamp, driver, or one of the output transistors in the audio stages of the portable.

This oscillator does not give the volume that the one in **Fig. 2** does, but is sufficient in a quiet ham shack. Of course, more diodes at the key would produce higher voltage and higher output. With the values shown, this oscillator draws only microamps at 2.1 volts. If lower values of base bias resistors are used, the current drain will go up correspondingly. Changing the values of the capacitors across the transformer will change the tone, but with the values shown,

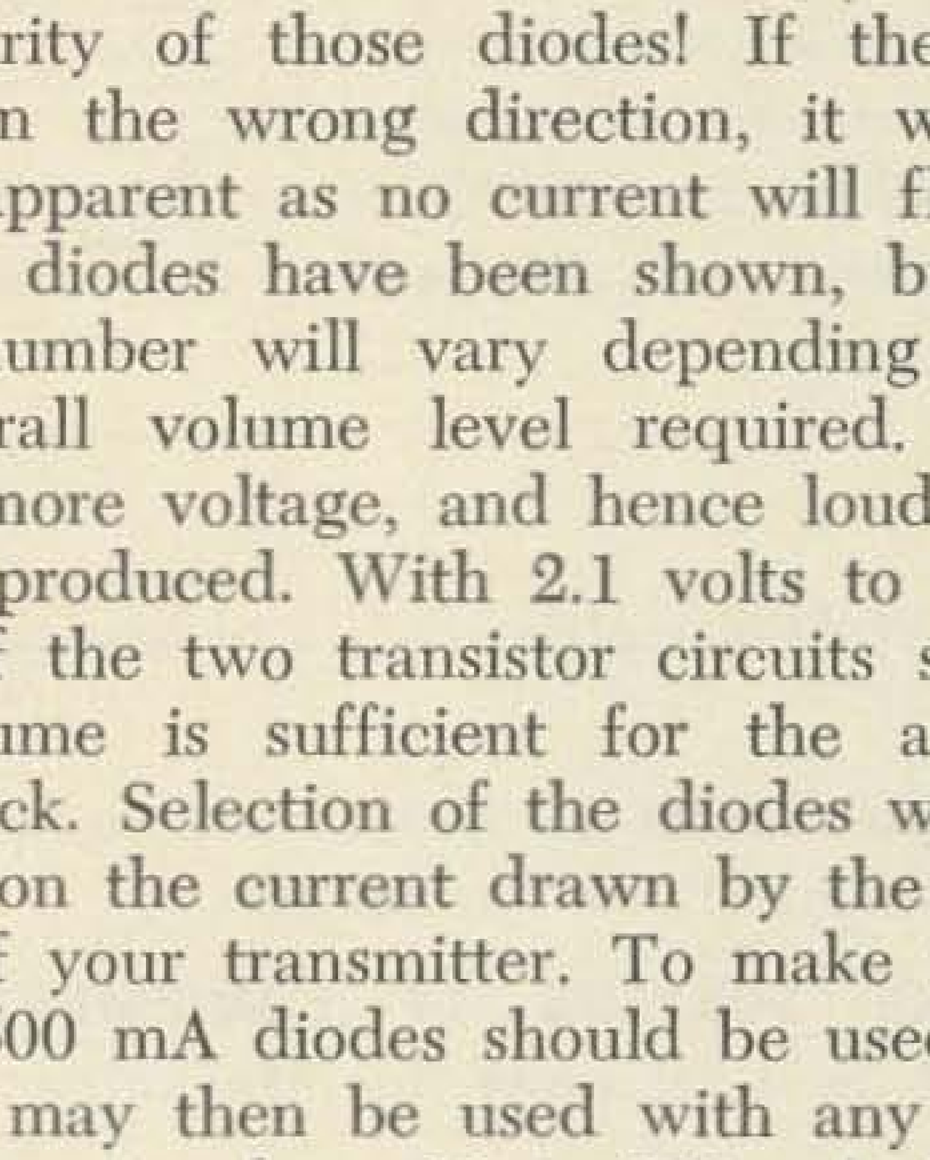


Fig. 1. The voltage drop across three forward biased silicon diodes is about 2.1 V, sufficient for simple oscillators as shown in Figs. 2 and 3. The diodes are shown for a cathode keyed transmitter.

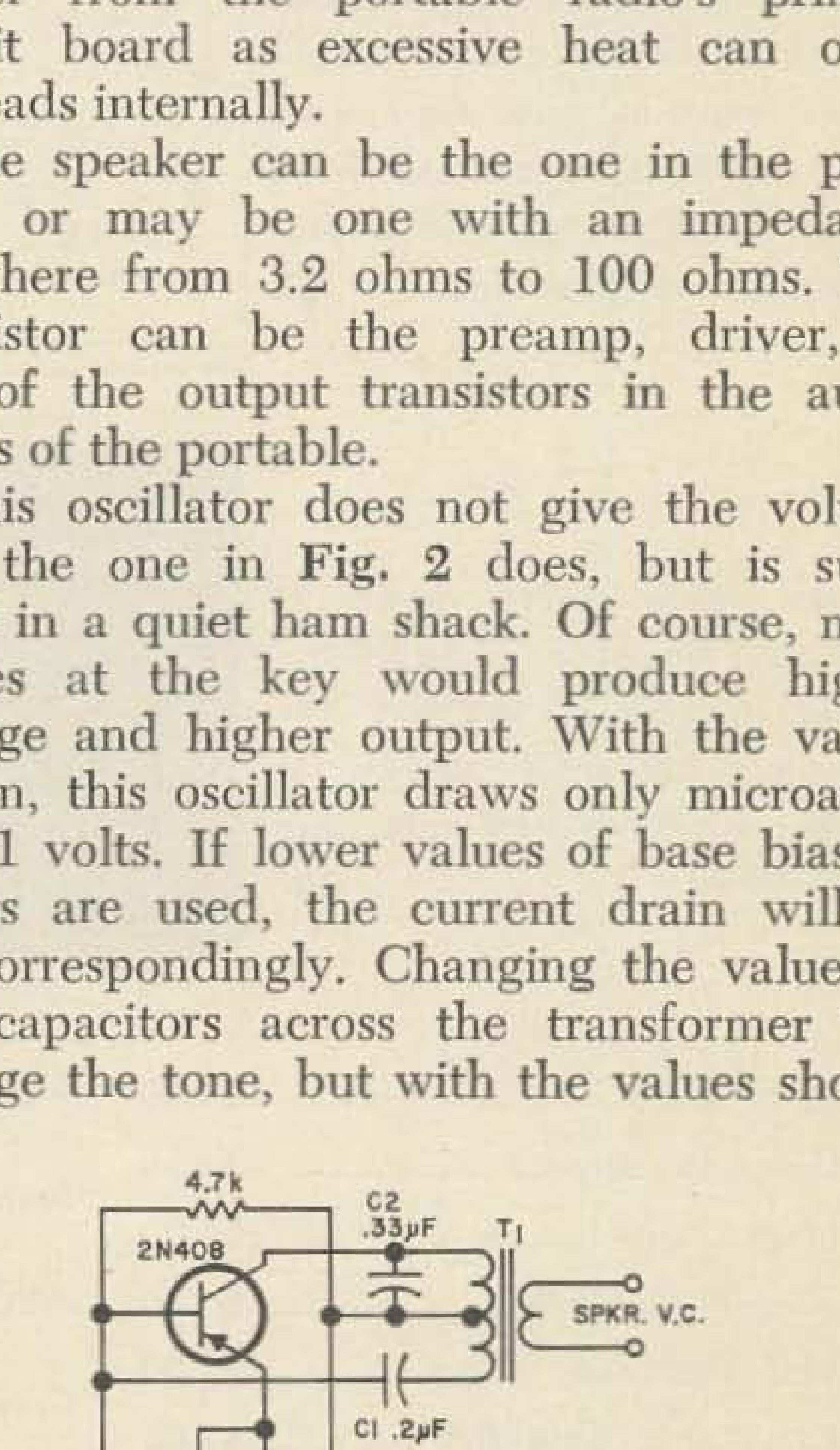


Fig. 2. A simple, loud monitor. It draws about 2.5 ma at 2.1 V.

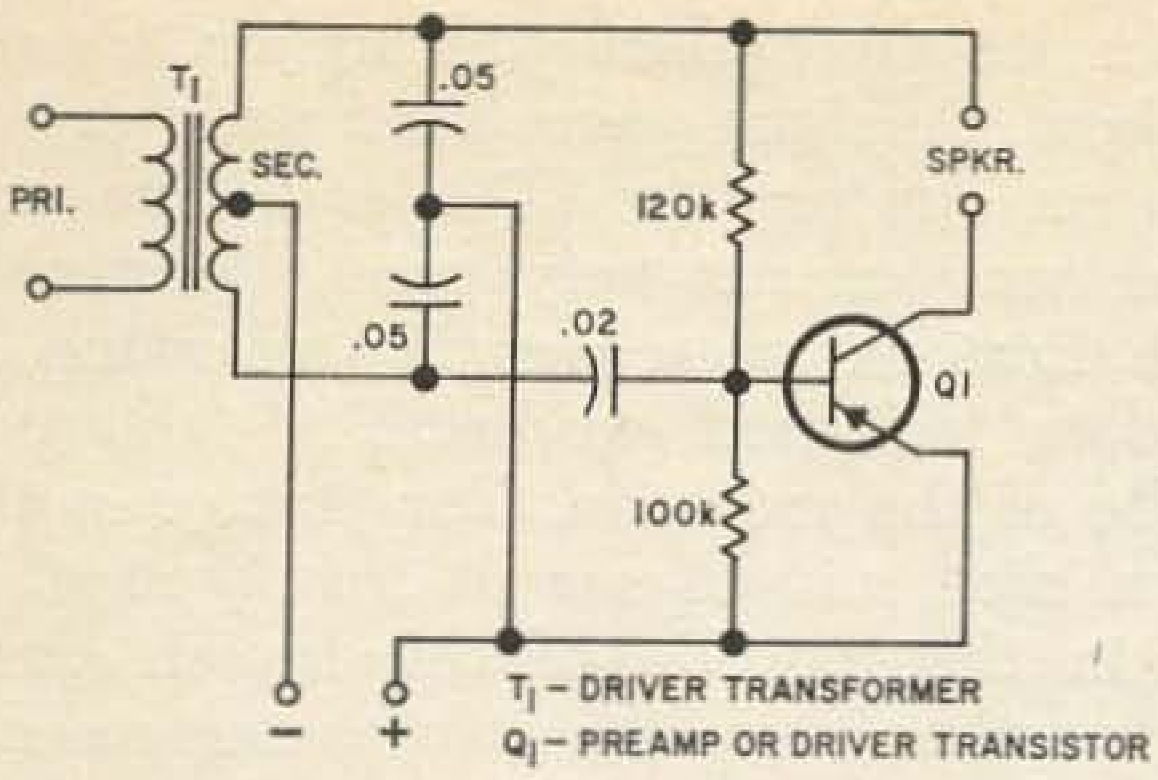


Fig. 3. This monitor can be made from parts from a junked transistor radio.

a pleasing tone is readily attained with most driver transformers. The capacitors shown are generally present in the radio.

Due to the relatively small number of components and their small physical size, the whole monitor may be built directly on the key through suitable means. Changing from one transmitter to another presents no problems as that encountered with monitors which require a pickup loop or external power source. Simply plug your key into the next transmitter.

If you want some additional code practice, just connect a 1½ volt battery to the monitor and you're on your way.

. . . K9VXL, K9CLH

(*Editor's Ramblings from page 4*)

issue, we've been printed by Hildreth Press of Bristol, Connecticut, a division of the Printing Corporation of American. We've endured bad service, indifference, poor quality and improperly-wrapped and late magazines. We have been shooting for a mailing date of the 13th of the month preceding the date on the cover, but haven't hit anywhere near it. For instance, the December issue was mailed in early December instead of November 14. Attempts to improve the situation have been fairly fruitless, and we decided that the only solution was to change printers.

Our new printer is Morton Printing Company in Pontiac, Illinois a central location that should please hams on the West Coast. We're hoping that they will be far more satisfactory in a number of ways, and expect the 73's to be mailed on time. Of course, I have no way of knowing as I write this editorial (on December 14) whether the magazines were mailed on time. Changing printers is rough at best, and lack of cooperation from the printer you're leaving can hold things up quite a bit.

. . . Paul

Gus Browning W4BPD
Cordova, S. C.

Gus; Part 20

In the last episode I was back at Aldabra Island for the second time, but business was not as brisk as before since I had over 7,800 QSOs the first time there a few months before. There must be a new crop of DXERS every few years because I QSO many fellows right now who tell me they still need Aldabra. The second stay there I had something like 3,500 QSO the few days I was there, most of them saying, "Thanks for the new one!" I guess most of these boys must have been on the second and third layers the first time there. I wonder how many were on the fourth and fifth layers? I guess every three or four years any place becomes rare if there is no activity from it during that time. So many fellows keep saying they need this or that even after thousands of QSOs and at times right after I had left a place too.

This second trip to Aldabra was for the purpose of bringing supplies, loading up copra and hauling back "live turtles" to Mahe. This was a pretty fair size ship this trip. After loading up dried fish, copra, exchanging a few island workers we were ready to finish loading up the boat from stem to stern with those big turtles, live ones at that. They were loaded on the ship by a small crane and placed upon the deck upside down and covered with wet coconut and palm branches. These branches were to be kept wet all the way back to the Seychelles to keep the turtles from drying out. It was quite a mess trying to walk around the deck with all these turtles everywhere. Usually you ended up on tip-toeing between them, but at times you had to walk smack on top of them. This did no damage to them since they were tough old critters and it took a lot more than walking on them to kill them. Anchors were lifted and we were again on our way to VQ9 land. The mood of the sea was not very good, because the South East monsoon was in full swing and the date indicated we were in about the middle of the monsoon. You just connot expect a nice smooth sea at this time of the year in that portion of the Indian Ocean. The weather was like it was supposed to be–rough seas. My /MM operating position was up on the "Poop Deck" right beside the big wheel, and strapped down good and solid. We were about 25 or 30 foot above the water and this more or less multiplied the tossing of the ship. The chair was fastened down good and solid too, or I would have slid all over that little room. Radio conditions were excellent. They always seem to be when you are at sea. I still think the world's best operating place is in the middle of the ocean with that beautiful ground all around you. I think its even better than the QTH of W5VA and W3CRA. I bet if a fellow had a full kW and a five element beam on a ship out in the middle of the ocean "no one" would trample on him. He would always be on the top of the pile. After being out from Aldabra only 2 days I was up in the little poop deck operating away about 5AM and out the corner of my eye watching the young fellow at the wheel who in turn were watching the big compass keeping the ship on course many sea birds were all around the ship, a few porpuses were parading pass the ship taking their morning's tour I suppose, and even a few schools of flying fish were seen taking off when the ship caused them QRM. Plenty of activity is always seen at that early hour when at sea, we were getting our second cup of that strong coffee from the galley boy and we were just taking it easy as no big pile was on hand on the bands. I was just enjoying myself and I think the fellow at the wheel was doing the same. We two and one fellow in the engine room, I think was all that were up out of the sack, everyone else was sound asleep waiting for the six bell signal for them to get up. I then noticed the fellow at the wheel was doing a little straining at the wheel which was very unusual because generally he could could turn the wheel with two fingers and never any strain whatsoever. About five minutes later I noticed he was really trying to pull the wheel with both hands and it was not moving at all. I pulled off the phones and asked him what was wrong? He said there was some trouble with the wheel or rudder. After he had pushed and pulled on the wheel a few minutes it suddenly started "free wheeling" and thats when he said, "we have some bad trouble somewhere". Down he went to wake up the captain and the ship turned broadside to the wind, the engines were turned off and all sails let down. Seems like everyone on the ship suddenly woke up when the ship turned broadside to the wind and began to really toss and pitch. The captain and all the rest of us went to the rear of the ship to look at the rudder, there it was turned up at about a 45 degree angle and right when we all were looking, it dropped off the ship and sank to the bottom of the Indian Ocean. We were at least 200 miles from the nearest island and a lot's further than that from Mahe, drifting with the wind and currents. The gang was worried to say the least. We just drifted a few hours while the situation was discussed, the captain did not seem to disturbed about the situation as much as the ship's crew. They were concerned. As for myself I took the attitude that it was not my ship and if it sank it was no money out of my pocket. The radio gear was insured, so Ack said, so nothing to worry about there, and I had a good life insurance policy so I figured the one to really worry was my insurance company not me! I decided since I had no intention of diving overboard to try to find the rudder that I would just head back to the poop-deck and do a little hamming and get my mind off the situation. The little putt-putt was again cranked up and a CQ sent, I had quite a few good ragchews with the boys and did mention to some of them about our rudder being missing. Some said. "That tough Gus". Others said "Sure hope you all find it." (Who was going to dive to the bottom of that Indian Ocean?—NOT ME!), Some W5 said, "Well I'll be doggoned if that ain't tuff, Ole Buddy" Someone asked me over the air what was I going to do, and I said "nothing". Had a FB QSO with some EP2 station in Tehrein and told him the whole story, he said he was going to do what he could for us! He was very interested in the whole story, our exact QTH and all other details about the whole thing. The captain wanted me to try to get in touch with Harvey Brain—VQ9HB in Mahe so he could get a message to the ships owner—Mr. Teemoulgee, the big merchant in the Seychelles. I told him I would have to get the message to Harvey thru (5Z4GT Leny or George 5Z4AQ) that evening. That evening about 6 PM local time I did get a QSO with George 5Z4AQ, and he said "My God" when I told him of our troubles without a rudder, broadside the high winds, water slashing over all the decks and everyone starting to worry—except the Captain and me. I am one of these fellows who thinks when his number is up, it's up. Or else I am crazy enough to just not worry about something that was out of my control, and something I could not do anything about. I gave George all the details, our QTH, directions of the winds, number of people on board, etc. I found out later that since George was working for Kenya Radio that all this info was put out thru the Cable and Wireless and broadcast world-wide for all the news services to pick up. It was picked up in Orangeburg, South Carolina and broadcast probably by all three of the broadcasting stations here. My wife heard this broadcast and this started the ball rolling, all the children was called home, our local Baptist minster was called to our house, lots of weeping and carrying on around the Browning house. Someone suggested contacting Ack, this was done and Ack assured them that we were not in any immediate trouble (I like that word immediate!). So they quit worrying (I think) and things calmed down at home. Things did not calm down on the ship, oh not by a long ways. Everyone was discussing our troubles and making suggestions. The captain had his own opinion as to what he was going to do. He had decided to use a cabin door to replace the rudder. The largest cabin door was removed and large rope attached to it, no hinging was possible, it was going to have to be controlled by pulling ropes. A big "V" groove was sawed in the rear portion of the boat, this was where the Cabin door was supposed to fit in so it could be swung back and forth. Now you picture trying to mount this thing on the rear of the ship and remember those large waves and high winds trying to keep you from doing this. Now Buddy I could see that we had problems and I mean big ones. This cabin door was supposed to be held in place by those ¾ inch ropes being tightened by pulling in from both sides to hold it in the center of the "V" groove. Everybody grabbed their ropes and they edged the cabin door towards that "V" groove, bang, a big wave hit it, it went sailing off across the water, back it was pulled by the ropes. The men were excited, and a number of them were almost pulled overboard. It sneaked down into that little "V" groove again, it gets pretty close this time, and away it goes again, a few little cuss words here and there, a little hair pulling, more discussions and try again, this kept up hour after hour. The Captain showing no signs of discouragement. Everyone else agreed that this task was absolutely impossible and asked me to get a message to Mombassa for a towing ship to be summoned so we could get back to Mahe! We took a position "shot" the next morning and found that we had drifted about 150 miles towards Africa, kind of towards 6O1 land or maybe FL8 land. I was thinking of the money I would save if we did drift all the way to Africa because that was the general direction I were heading when I left the Indian Ocean and this would be a cheap way to get there. I asked the captain if he wanted me to summon a towing ship and he said, "absolutely no". The Captain was the only one on board who thought this cabin door could be mounted so it could be used for a jury rudder as he called it. You try sleeping on a drifting boat in the Indian Ocean monsoon and you find that its tough to even stay in the bunk, much less sleep. I don't think many slept on board the few nights we were tossing all over the place. Remember all the decks were loaded and completely covered with those large turtles when all this was going on, no place for a fellow to walk and all those fellows scampering all over the place, trying to not step on those turtles, and no place to step, and after all the decks got wet those turtles started slipping all over the place. Even a few slid overboard too. Some died and began to smell. Oh yes we were having a time on that boat. These turtles have been known to take a bite out of a leg now and then, so no one hestiated while walking over and between them, needless to say. I was on the air of course most of the time telling the boys about things as they were. We were in daily contact with VQ9HB on Mahe, and a number of times the captain talked directly with the owner of the ship. Even the ships owner asked the captain if he wanted a tow vessel sent out to tow us to either Africa or the Seychelles. To this the captain always said "no". This captain was as hard as nails and like a bulldog. He was not going to give up as long as there was any hope of getting that cabin door mounted in place of that rudder. He was the only one who thought this was possible. Everyone else had a long time ago given up this as out of the question and impossible to be done. Even I had now given up. After three days the turtles really started to smell Q5-S9+ 50 DB, but still they were back there fighting that rudder. And at long last they got it mounted kind of all of a sudden and I think sort of by accident! We were back in business and a ship with a rudder was again on its way to VQ9 land.

A message was sent to the ship's owner on Mahe and back came a message telling us a champagne party was planned for all hands upon our arrival to Port Victoria. Back went a message from me saying, "Make Mine, Cokes, please!" Back came a message to me saying, "It's Cokes for you, Mr. Browning". A letter or news item from Harvey Brain was sent to their local newspaper which was very interesting to read. Oh yes, There was a hero in the article you can bet Guess who? The cabin door proved to be not quite large enough and to keep the ship on course the speed of the engine became the directional control. The usual speed as I remember it was about 250 RPM, but to hold us on course it was reduced to about 175RPM. But we were headed towards VQ9, so everyone was happy. I would say a few drinks were consumed on board that night by everyone except me since there was no Cokes on board by now. They had long ago been drunk. It took us about 10 days to reach Port Victoria, with quite a lot more dead turtles on board. We were a smelly crowd when we arrived there. The local police band were on hand to welcome us back to VQ9 land. We were the heroes of the hour. Cases of Champaigne were brought aboard and one full case of Cokes for me with plenty of ice. I sort of would say maybe a few fellows got drunk that evening on the boat while it was docked there at the "long pier" at Port Victoria. At least that was another one I walked away from, and one more portion of a DXpedition salted away. Back I went to my little thatched hut that's called a hotel room on the north east side of VQ9. The old antennas were put up and on the air as VQ9A again I went. The very first QSO I had was with that fellow in EP2 land—he was some high official in the U. S. Embassy or Consulate there and he told me a very interesting story. He said there were some U. S. destroyers in Zanzibar on some sort of tour down in that area and he got a message to them to sort of stand by with helicopters on board to be ready at a moments notice to be able to take off the ship in case we got into any difficulties and in danger of sinking. I for one was glad we did not have to call on him for help. I am sure Peggy and the kids felt that same way, and especially the insurance companies. It did sort of worry me to think that the insurance companies were worrying. I did not want our DXpedition to end up here because it was just getting started, you might say. There were lots of places to go to yet and operate from. After operating from VO9A for about a week while QRX for a ship to take me to Mombasa, Kenya, I sort of hated to leave VQ9 land with all the beautiful scenery around there. But you know the DXpedition must go on, and this one was not about to stop yet. Everything was taken down, carefully packed, everyone told "good bye". etc. No customs troubles at all. (There is usually none when leaving you know). I was off to Mombasa and then into Africa on the next leg of my trip. More on that next month.

"... Our rig here is a ..."

Technical Aid Group

The first members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a concise question that you think can be answered through the mail, why not write to one of the hams on the list? Please type or write legibly, and include a self-addressed stamped envelope. One question to a letter, please.

If you'd like to join the Technical Aid Group and you feel that you are qualified to help other hams, please write us and we'll furnish complete information. It's obvious that we need many helpers in all parts of the country and in all specialties to do the most good. While 73 will try to help with publicity and in other ways, we want the TAG to be a ham-to-ham group helping anyone who needs help, whether they be 73 readers or not.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, N.J. 08034. VHF antennas and converters, semiconductors, selection and application of tubes.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, Cal. 91780. ATV, VHF converters, semiconductors, general questions.

Stix Borok WB2PFY, high school student, 209-25 18 Ave., Bayside, N.Y. 11360. Novice help.

George Daughters WB6AIG, BS and MS, 1613 Notre Dame Drive, Mountain View, Calif. Semiconductors, VHF converters, test equipment, general information.

Roger Taylor K9ALD, BSEE 2811 W. William, Champaign, Ill. 61820. Antennas, semiconductors, product data, general.

Jim Ashe W2DXH, R.D. 1, Freeville, N.Y. Test equipment, general.

J. Bradley K6HPR/4, BSEE, 3011 Fairmont St., Falls Church, Va. 22042. General.

Propagation Chart

FEBRUARY 1967

J. H. Nelson

EASTERN UNITED STATES TO:

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

CENTRAL UNITED STATES TO:

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

WESTERN UNITED STATES TO:

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

Very difficult circuit this hour.

* Next higher frequency may be useful this hour.

Good: 1, 2, 9-13, 16-22, 28-31
Fair: 3, 4, 5, 14, 15, 23, 24, 27
Poor: 6, 7, 8, 25, 26
VHF DX likely: 12, 13, 21, 27

NEW PRODUCTS

TRW Catalog

TRW Semiconductors has just announced their 1967 short form catalog. This 20-page publication lists all TRW transistors, diodes, and other semiconductors. Copies are available from TRW Semiconductors, Publications Dept., 1100 Glendon Avenue, Los Angeles, Calif. 90024.

Jensen Tool Catalog

Hams often have trouble finding the special tools that make electronic construction pleasant. Even the large mail-order catalogs don't carry all of the specialized tools we like. We've recently found out about a very extensive (58-page) catalog of tools that contains just about anything you're likely to want or need from eutectic solder to #80 drills. The catalog includes many standard tools, too. Prices are good, and there's no minimum order. Write for a free copy of catalog 266. Jensen Tools, 3630 E. Indian School Road, Phoenix, Arizona 85018.

Solid-State Communications

Here is another book from the staff of Texas Instruments on the design of transistorized communications equipment. This brand new book provides the latest information on the design of equipment using FET's, dual transistors, junction transistors and the latest germanium and silicon microwave transistors. This excellent book covers the entire rf spectrum from high-frequency through UHF; it provides much practical information on the design of circuits and in the selection of semiconductors for these frequencies. Some of the topics covered are small signal UHF circuit design, high input impedance techniques, harmonic oscillators, noise characterization of VHF and UHF amplifiers and VHF measurement techniques. $12.50 from your bookstore or write to McGraw-Hill Book Company, 330 West 42nd Street, New York, New York 10036.

Drake Converters

R. L. Drake Co. has just announced that they're making FET converters for six and two meters. The converters feature low noise and exceptionally low cross modulation, excellent image rejection and flat bandpass. Each converter uses field effect transistors for the rf amplifier and mixer stages, and regular transistors in the local injection section. For full information of these new converters, write R. L. Drake Co., Miamisburg, Ohio.

Technical Topics

The best, most interesting single book for the average ham might well be Technical Topics for the Radio Amateur, by Pat Hawker G3VA. This book is a collection of short notes, interesting ideas, and hundreds of good schematics about simple and complex, common and unique, useful ham radio circuits. G3VA writes the very popular column Technical Topics in the RSGB Bulletin, and much of the material in the book is from this column. TT is a densely-packed, thoroughly-practical 100-page book that every building ham should have. The price is only $1.50 from 73, or you can order for 10 s. from the RSGB, 28 Little Russell Street, London W.C.1, England.

Transistor Circuit Analysis and Design

The 2nd edition of this famous transistor sourcebook by Franklin C. Kitchen retains all the readability and clarity of the first, but the many revisions bring this new volume right up to date. In addition to information on junction transistors, this new book places emphasis on the field effect transistor and its operation, tunnel diodes, controlled rectifiers, unijunction transistors and microelectronics. Fitchen spends considerable time in explaining the fundamental circuit properties of transistors and proper ways of biasing them before proceeding into the design of amplifiers and communications circuits. Many practical examples are used throughout and a knowledge of algebra is all that is required to understand this excellent text. This book is highly recommended to the amateur or technician who wants to know the whys and wherefors of transistor circuit design. $8.50 from your bookstore or write to the publisher, D. Van Nostrand Co., Inc., 120 Alexander Street, Princeton, New Jersey.

Solid State Sales Catalog

Solid State Sales has a new catalog of inexpensive semiconductors and other parts. It's well illustrated, and contains hundreds of components with good prices. You can get a free copy from Solid State Sales, P.O. Box 74, Somerville, Mass. 02143.

Handbook of Transistor Circuits and Measurements

Most books designed for textbooks and engineering aren't as useful to the ham as they could be. Hams don't want to wade through a lot of derivation of mathematical formulas and such to find a circuit they need, or have to figure out a lot of values on what is obviously a fairly standard type of circuit. That's why the new SEEC book, Handbook of Basic Transistor Circuits and Measurements by R.D. Thornton et al looks so interesting. The book contains practical circuits for about every transistor use you can think of, and even gives parts values and transistors for each. The transistors are specified by general types, such as silicon, high speed, amplifier, which makes it easy to use either the newest, cheapest transistors, readily-available transistors, or surplus transistors, depending on your tastes. The book also includes enough technical material and data on measuring transistor characteristics to make the book very useful to the engineer who wants a good reference. The book costs $4.50 clothbound, or $2.65 paperbound. Publisher is John Wiley and Sons, 605 Third Avenue, N.Y. 10016.

Shure Reactance Rule

Figuring out resonant frequencies, reactances, Q's, etc., with the standard formulas and arithmetic isn't much fun. A much easier way to do it is with the Shure Reactance Slide Rule. It's easy to learn, easy to use and easy to buy at only $1 from the Sales Department, Shure Brothers, 222 Hartrey Avenue, Evanston, Ill. 60204.

(W2NSD *from page* 2)

public servants resting behind their barricaded desks. We made it through in about an hour, possibly an all time record. You have to pay to get out of Lebanon and pay to get into Syria. You pay for yourself and you pay for the car. You pay and pay and pay.

After an hour or so of driving through desert and mountains we began to come to civilization . . . an occasional house built on the side of the hills. An interesting thing: the water supply for these houses came to them via a ditch dug into the side of the hills. All of the houses were below the supply ditch, which went on for miles and miles, winding along so that gravity carried the water. Below the houses was a second ditch for waste.

We arrived in Damascus just before dark and, after driving around for a few minutes to get our bearings, we started looking for a hotel . . . a hotel that had air conditioners sticking out of the windows of its rooms. It was about 90° or so and we'd learned the hard way in Cairo to settle for nothing less than good air conditioning. I never thought I would go into a Hilton hotel, but a couple of nights in the Shepheards in Cairo and I no longer cared if Conrad got a big bite out of me.

Just as we were disparing of finding air conditioners we came across the Hotel Cattans. Luckily they had one cool room left so we checked in. I called Rasheed and announced that we had arrived. His son arrived to pick us up a short while later and we drove up and up the side of the incredibly steep hill overlooking the city. About half way up, just before the slant became a vertical cilff, we pulled up in front of a nice home.

Rasheed and his wife welcomed us. It was still quite warm so we went out on his patio

Rasheed YK1AA

and had some cool drinks, talking ham radio and looking down on the twinkling lights of the oldest continnously inhabited city in the world. Off in the distance we could see the camp fires of the refugees from Israel, thousands of them.

I was most anxious to put YK1AA on the air and see if I could beat down some of the pileups. Rasheed does the best he can with this, but it is very difficult for him, not having been raised in English, to pull out call letters when they are all in a jumble. Rasheed pointed to his three element beam out on the edge of the patio and I could see why he makes most of his stateside contacts via longpath. The U. S. is directly into the mountain for him and very little rf can get through the shield.

I tuned the band anxiously . . . a couple Europeans, nothing more. Damn. My schedule time with my home station in New Hampshire came around so I gave Jim (WA6BSO/1) a call. I1DFL came back and offered to relay for me. Jim was in there, about an S-1, and my signals were about the same. Through I1DFL I found that everything was going well at home. After a few more short QSO's with friends in Asmara, Stockholm, etc., I gave up and returned to Rasheed and the talking. I1DFL had explained that Jim was the only U. S. station that he could hear on the band, so conditions were particularly bad.

Rasheed works at the airport keeping the electronic gear running. He is high enough in the government so he is able to stay on the air during political shakeups, but not high enough so he gets shot. I don't think he is looking for too much in the way of promotions . . . hi. None of the other hams in Syria are permitted to operate.

The next morning Rasheed met Jim and me at the hotel and we walked to the historical museum. The sophistication of some of the things they made all the way back to 6000 BC is amazing. We would be hard put to duplicate some of the glassware they turned out.

Next we headed for the bazaar section of town. I found an ice cream store right off the bat and yanked them in after me. Fellows, it is like nothing you've ever tasted before. They grind out the usual Dairy Queen slush, put it into freezing vats and then pound it with giant potato-mashers so that the crystalline structure breaks down and the ice cream gets very sticky. They serve it by scraping it out of these vats and putting it into dishes with their fingers . . .

then a little sprinkle of pistachio nuts. Jim blanched at the finger bit, but we put a dish of ice cream in his hand and he had to gulp and eat it. I'll try anything.

We went across the little alley into a souvenire shop. I bought an inlaid backgammon board and a hand embroidered damask table cloth and napkins. I'm not sure why because I haven't played backgammon in twenty years and I don't even have a dining room table. Well, you never know when someone is going to knock on the door and invite himself in to play backgammon . . . I'm ready now.

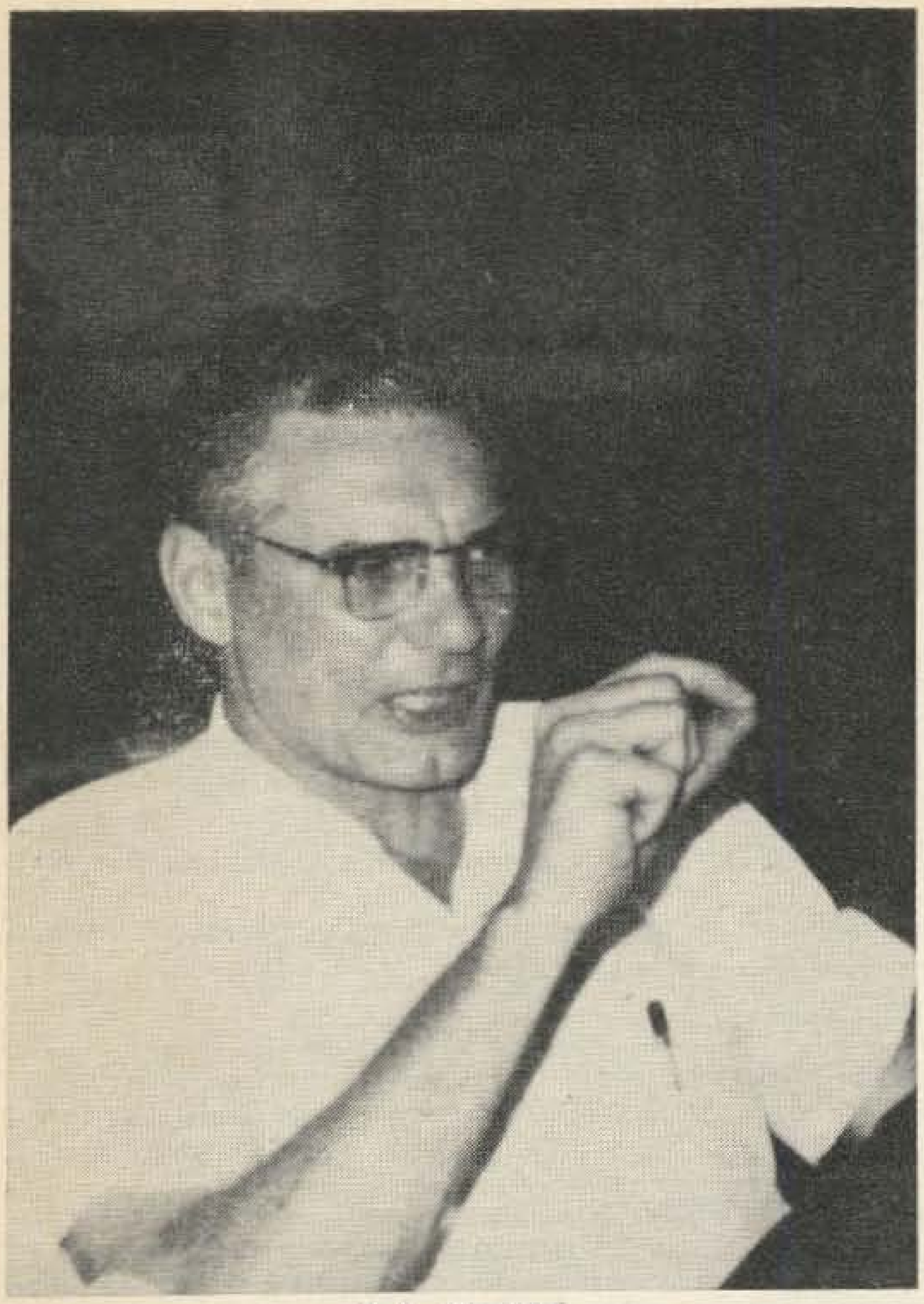
Rasheed took us into out of the way corners of Damascus where we were able to see craftsmen making all of the usual and unusual peculiar to the city. Things like men sitting in their little stalls turning a wood lathe by hand and holding the cutting chisel with one foot, making parts for chairs.

Lunch was spectacular. Rasheed's son manages the finest restaurant in town and he put on a complete Syrian dinner for us, soup to nuts. The soup was yogurt-like, with egg shaped meat balls made out of meat and wheat, but hollow . . . try making something like that sometime. Delicious. The food kept coming and coming and coming . . . we ate for about two hours . . . smoked egg plant (I hate egg plant, but this was great) . . . mashed chick peas with lemon and sesame oil . . . we waddled out into our rented Simca and, with a short prayer that the odometer would continue to be stuck (it froze on the way over . . . heh, heh), we headed back to Beirut and a cocktail party in our honor by the OD5 gang.

Damascus is a fascinating place . . . most of it is very very old, but newer houses are springing up in the suburbs. Few tourists get there, relatively, and as a result the people are very friendly and smiling. None of this running up with the hand outstretched that we had to continually battle against in Kenya and Egypt. After a while you just hide your camera and stop taking pictures in those places.

The border crossing on the way back was faster . . . only about a half hour plus $3 each for visas. The damned odometer started working again in spite of our extreme care in not jiggling it. Oh well, it would have been hard to explain the border crossing stamps on the car papers with only half enough miles on the odometer.

Beirut is a rather modern city and certainly the most international in the near east. Their currency is free so you don't have



Bob OD5BZ

to shop around for money bargains on the black market. The only major problem we had with the city was in finding our way around while driving. We had a map alright, but none of the streets have names on them so once you lose your place on the map you are lost . . . and the map doesn't have all the little streets on it so you get lost right away, no matter where you head. It took us over an hour of bumbling around to find our way out going to Damascus and almost as long finding our way back in on our return.

The cocktail party went off just fine and we got to meet about ten of the OD5 gang in person. Lebanon is in excellent shape as far as ham radio is concerned. Licenses are simple to get and there are a goodly number of Lebanese licensed. The other near eastern countries would do well to use Lebanon as an example in business and amateur radio.

After the party at Bob's apartment (OD5BZ), Bob and I drove to his shack, down by the water. It is no wonder that Bob has one of the outstanding signals from this part of the world . . . what a location! I worked about a hundred fellows before calling it a night.

The next stop on my trip is Baghdad . . .

. . . Wayne

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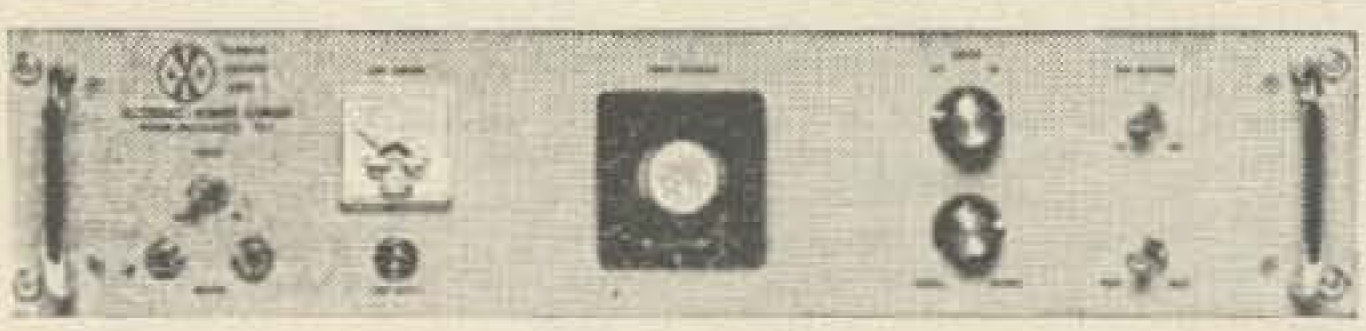

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COMPLETE CONVERSION instructions for the AN/VRC-2, just $1 while the supply lasts. 73 Magazine, Peterbirough, N. H. 03458.

WANTED case for Morrow receiver. WA1CCH, c/o 73, Peterborough, N.H. 03458.

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MANUALS, Signal Corps Instruction Books, Army Electronics Extension course handbooks—many titles. Free List. Also, RTTY lists. Great buys. Jim Cooper, 834-Y Palmer, Maywood, NJ 07607.

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