AMATEUR RADIO

73

February 1962
40¢

V-Loop Beam
Final Tanks
RTTY

73 Magazine

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1379 East 15th Street—Brooklyn 30, New York

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. . . de W2NSD

. . . never say die

That New-Tronics contest sure cut into my time this month. I've been mulling over all sorts of names for that new mobile antenna system of theirs. With me it is the fun of the chase, not the prize, for I have no doubt that down somewhere in the fine print I'll find that editors of magazines with two or three numbers or letters in their titles are not eligible. Since I'm the hopeless victim of a love affair with a six volt car that KWM-2 they're giving away (with all the trappings) wouldn't really be useful and would only bring on melancholia.

N-T is ready to lavish all this joy on whoever dredges up a name for their new mobile antenna system. It is just as well that I don't have a say in this thing, for the names that come to my mind would probably set up shock waves out in Cleveland. I'm just not serious enough. Gems like "Old Foldie," or "The Folding Rover" or even "The Roving Folder" scare away more reasonable suggestions.

Maybe I'm giving something away, but it has been my experience that very few fellows really makes a serious effort to win contests like this and there is a good possibility that you might drive off with the cornucopia if you beat out that March first deadline.

Interference With Basic Rights

San Mateo (California) has gone too far. I sure hope that someone will start the ball rolling out there for a showdown. On October 19th, 1961 a new zoning code classified ham radio as a "special use" which required the review and authorization by the San Mateo Planning Commission before a new amateur station could be installed. This did not apply to presently established stations unless there was to be some change in the transmitting antenna. A letter from the Director of Planning says, "The objective is to provide more adequate protection to life and property in the location and erection of antenna, and to regulate the operation of the amateur station for the convenience of all concerned." The last part is what this is all about . . . the regulation of the operation of the amateur station. Unless I am all at sea legally (and I don't think I am), they can be stopped in this interference with interstate communications. This is a federal rap fellows, and many communities that have tried to meddle with us have pulled back broken stumps. I'll bet that Maurice Hindin W6EUV could put a stop to it if you let him know. I understand from Brat W6OWP that it costs you $50 to get a permit to erect a new antenna, and this is after a hearing at which all neighbors who live within 500 feet may be heard. I'll bet that darned few new hams move into a place like that!

Nickel Nurser

What a bunch of pinchpennies we are! I just stopped to think it over and was amazed at the comparison of ham radio with other hobbies and interests. While it may be cheaper to collect used matchbook covers, you would be hard put to work up much of a list of hobbies that take less investment or maintenance.

How many hams spend as much on their station as a boating enthusiast? Precious few, that's how many. There are some 400,000 boaters floating around the country and they pay an average of about $3500 for their boat, watch it depreciate at about $500 a year and then spend about $800 a year on upkeep, accessories, mooring, yacht clubs, gas, and insurance. Just imagine the ham station you could have if you spent like this on it! And you wouldn't have to use it only half of the year as most boatmen do.

How about the 100,000 pilots around the country? What kind of hamshack would you sport if you invested $7500 in the original equipment and added about $1500 a year to it. New planes average around $7500 and yearly expenses for overhauls, new carburetors, patching damage, fixing broken struts, new tires, tie-down fees, accessories, charts, instruction, etc., all played as a counterpoint to the melodic tune from the aviation gas pump rack up an easy $1500. Flying is an exciting hobby . . . one where you can easily kill yourself (the leading magazine devotes space each month to detailed accounts of how pilots managed to kill themselves and their passengers during the previous month). If you think hamming is dangerous just ask your insurance broker and find out what happens to the rates when he learns that you are taking up flying. And you can ham when it is raining, fogging, snowing or just plain windy.

You want me to name more? Well you have to figure on about a minimum of $800 a year in upkeep for a horse unless you have a farm. The horse can cost from $200 for an old used one to $2000 for a new model, a lot like a car. How about a car? We're talking hobbies so let's consider a sports car: $3000 to $5000 down and several hundred a year on upkeep and depreciation.

Maybe we should consider investing a little more in our hobby of ham radio. Like any

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other hobby, the better the equipment you have the more fun you get out of it. Sure, you can get a kick out of working 5000 miles with a transistor rig, but suppose this is all you had? How many days before you got tired? We aren't allowed very many days on this earth and those few that we do have seem to slip by mighty fast. Suppose you had bought that big rig you were thinking about last year. By now you'd have a bunch of friends all through Europe that you talk to every few days. You might even have your DXCC by now. How about that mobile setup? Look at all the fun you've missed by putting off getting that new rig!

Ham equipment prices are really very reasonable. Compare what it costs to have one of the finest ham shacks in the world with what it costs to have one of the finest horses, the finest sports cars, or the finest plane. No comparison. For that matter you can put out a signal every bit as potent as anyone else in this world for less than most people are spending for their cars, boats, etc. And you can buy the equipment on time just like they buy their cars and boats.

Now, check book in hand, let's read those ads.

Europe

As the April first date of our flight to Europe gets closer I find myself thinking more and more about the trip. I think of little things, like how can we afford it? . . . how will the magazine do with me away for a month? Lord, if I can't keep up with it while I'm here working every minute, what is going to happen with me away for a month? Aaagh!

Virginia and I have been working at 73 for two years now and I guess we're not out of line to relax for a month and visit ham clubs and hams all through Europe. By the way, if you have anyone we should look up over there drop me a line and we'll try to put 'em on the list.

Of Porsche

I was a bit vague last month in the editorial and some question has been raised among the few stalwarts who brave their way through this morass about my Porsche. Complete explanation: Back in late 1957 I became increasingly aware of sports cars and decided that this was for me. Consultation with Sam Harris W1FZJ and Ken Grayson W2HDM made it obvious that the finest car I could buy would be a Porsche. Byron Kretzman W2JTP put me in touch with Dave Brown K2IGY, a Porsche owner, who in turn located a new Porsche for me. This was a silver 1958 Porsche Speedster. They were right, the car was fabulous. In the late fall of '58 I got a chance to make my first trip to Europe, as previously described, so I ordered a '59 Porsche (red) and picked it up at the factory. Following my usual pattern of holding on to things I kept the '58 Speedster. The new model was much nicer: roll up windows, big comfortable seats, etc. But after driving it for a few thousand miles I began to like the old car better with its bucket seats and lower outline. The new one, used very little, was the one that I finally had to sell in order to put 73 on the newsstands. K2GZO is now the proud owner.

While it would be nice to order one of the brand new 1962 model Porsches on our flight in April, our problem has been one of having enough to eat, not what car to buy. We've just shipped the '58 Speedster via Stu Danoff K2RBM back to the factory for some up-fixing. We'll drive this around and then ship it back later. This seems to be the most practical for a pauper tour of Europe.

Disneyland

A letter from Ted Glick K6LJA, the General Chairman of the 1962 Southwestern Division ARRL Convention, points out that most of the suggestions that I made about conventions paralleled the plans of the convention committee. The General Registration fee is $1.50, etc., etc. It sure sounds like they're going to have a fine show for us on June 1-2-3. Virginia and I will be there. This is Virginia's first trip to California so try to keep the smog down, eh?

Central Electronics

It was with great disappointment that I learned the other day that Zenith has decided not to continue producing the Central Electronics line of equipment. The decision apparently was made on the basis that the amateur market had not turned out to be as large as they had hoped it would be. I'll bet that we'll be hearing a lot more from Wes W9DYV as soon as he can get things organized for a fresh start. It's too bad that there isn't some profitable way for a chap like Wes, who is probably one of the best engineers we'll ever see, to design equipment and not have to spend most of his time with production, procurement, testing, sales managing, advertising, expediting orders, going to conventions, and the hundred other hats that he has had to wear. There are several fellows around the country that would serve us all best if we could provide them with a comfortable living, keep them supplied with parts and just let them build ham gear. Maybe someday, when 73 can get out of its own way, we can set up something like that. Imagine what would come out of a group like Wes, Sam Harris W1FZJ (winner of the coveted ARRL Amateur of the Year award for 1961), Bill Ashby K2TKN, and Frank Jones W6AJF. I'll bet they could outstrip any research lab in the country.

(Turn to page 77)

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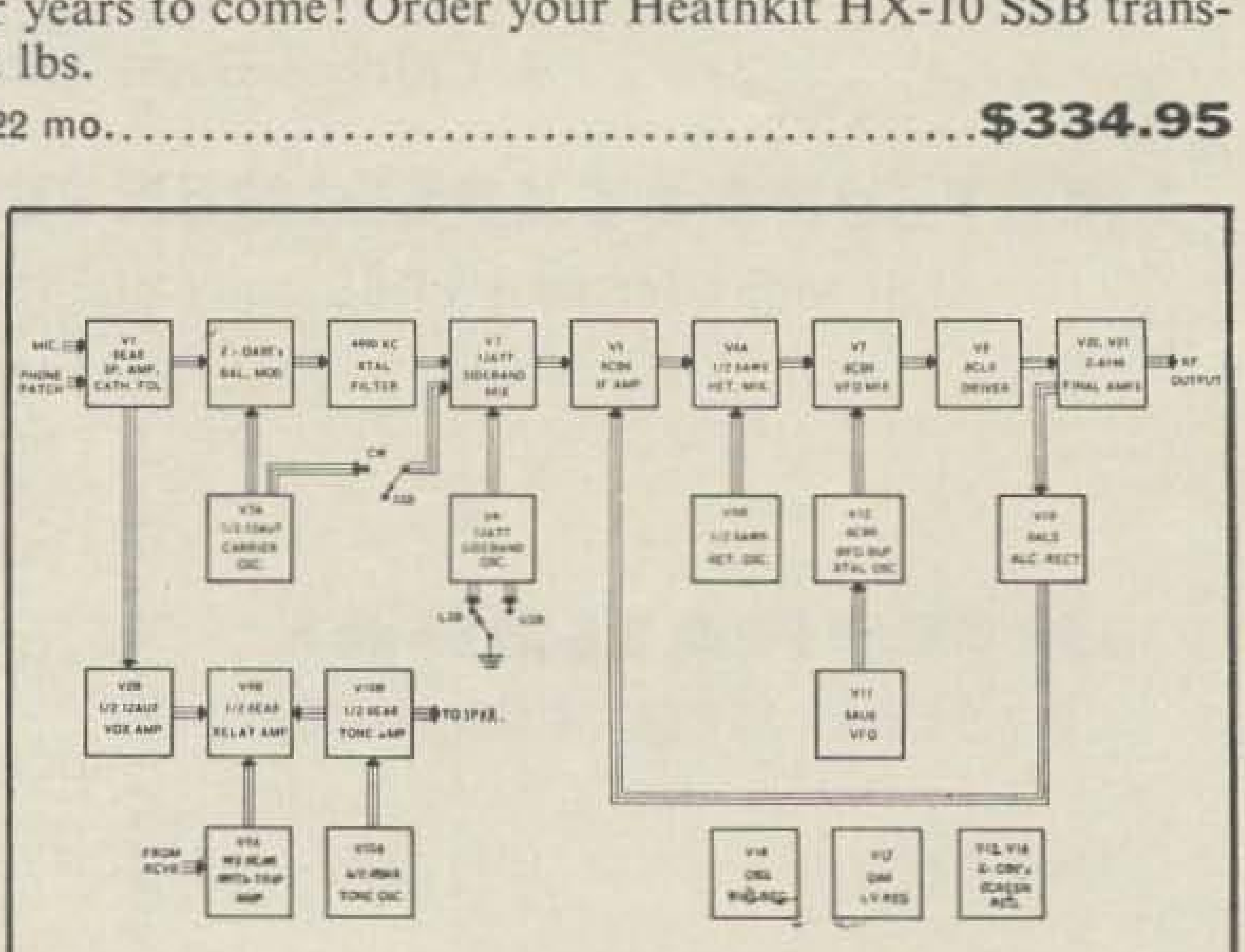

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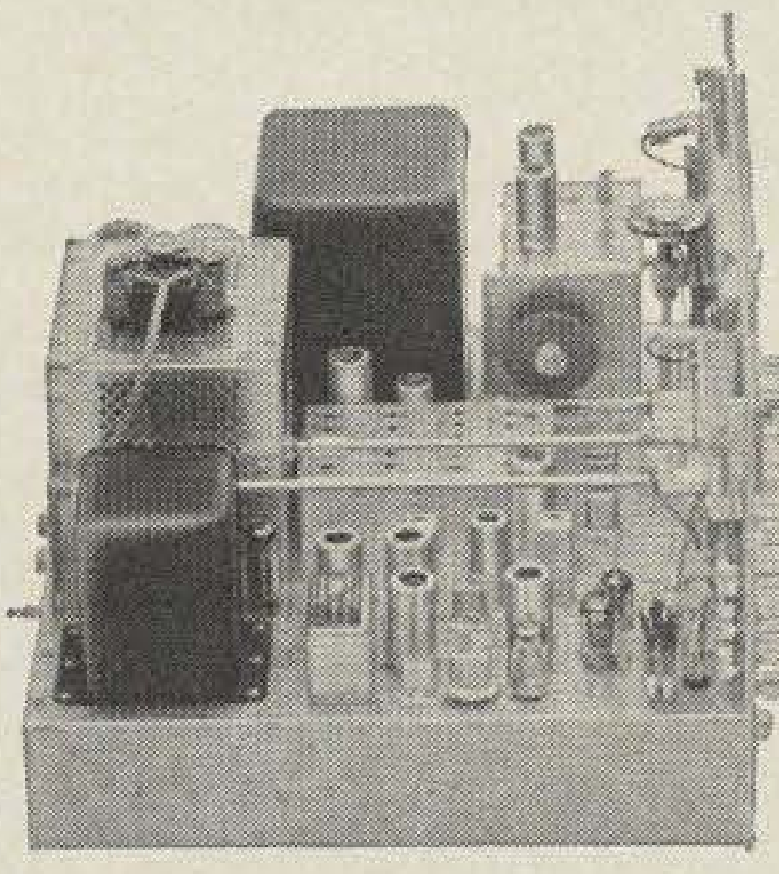
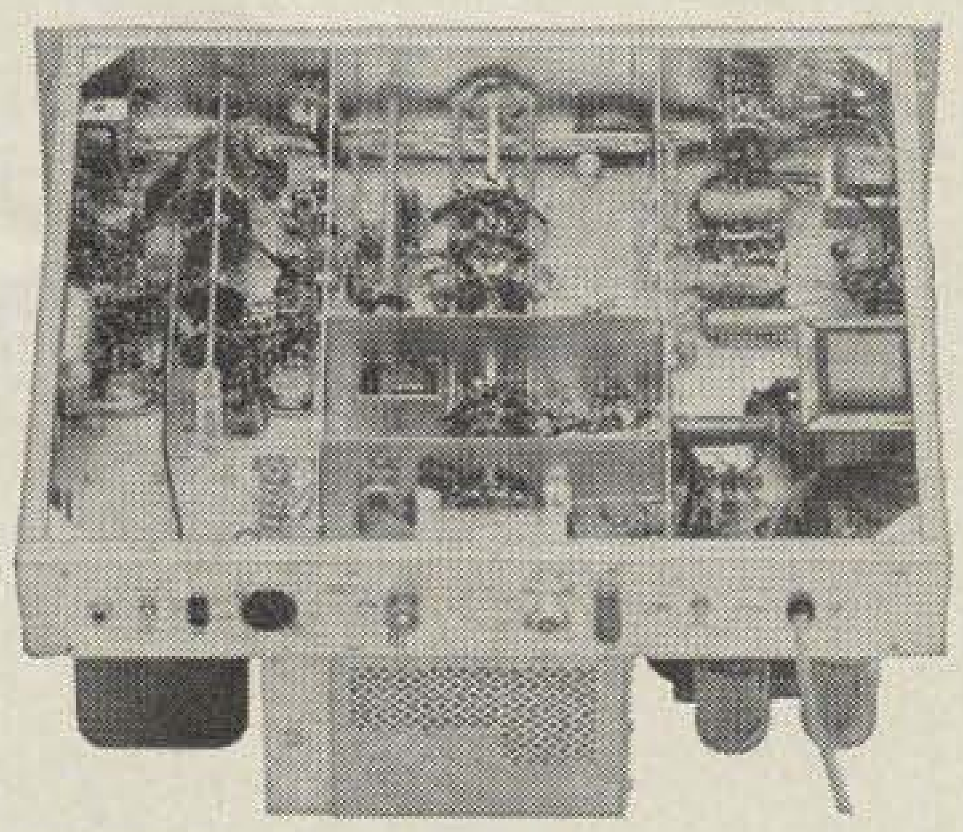
33. ALL CONTROL FUNCTIONS ARE LOCATED ON THE FRONT PANEL—NO DOORS OR HATCHES TO OPEN—CONVENIENT TO OPERATE



TOP VIEW—Quality components used throughout assure years of dependable, trouble-free performance. Shielded final amplifier is forced-air cooled by a noise-free fan. Chassis screening clearly identifies all tubes, adjustments, etc. for future reference.



BOTTOM VIEW—Compartmental construction provides necessary isolation and shielding of transmitter sections for top performance . . . adds rigidity to the chassis for rugged, dependable service and long life. Neat circuit layout through careful design and a precut, cabled wiring harness permit easy assembly.

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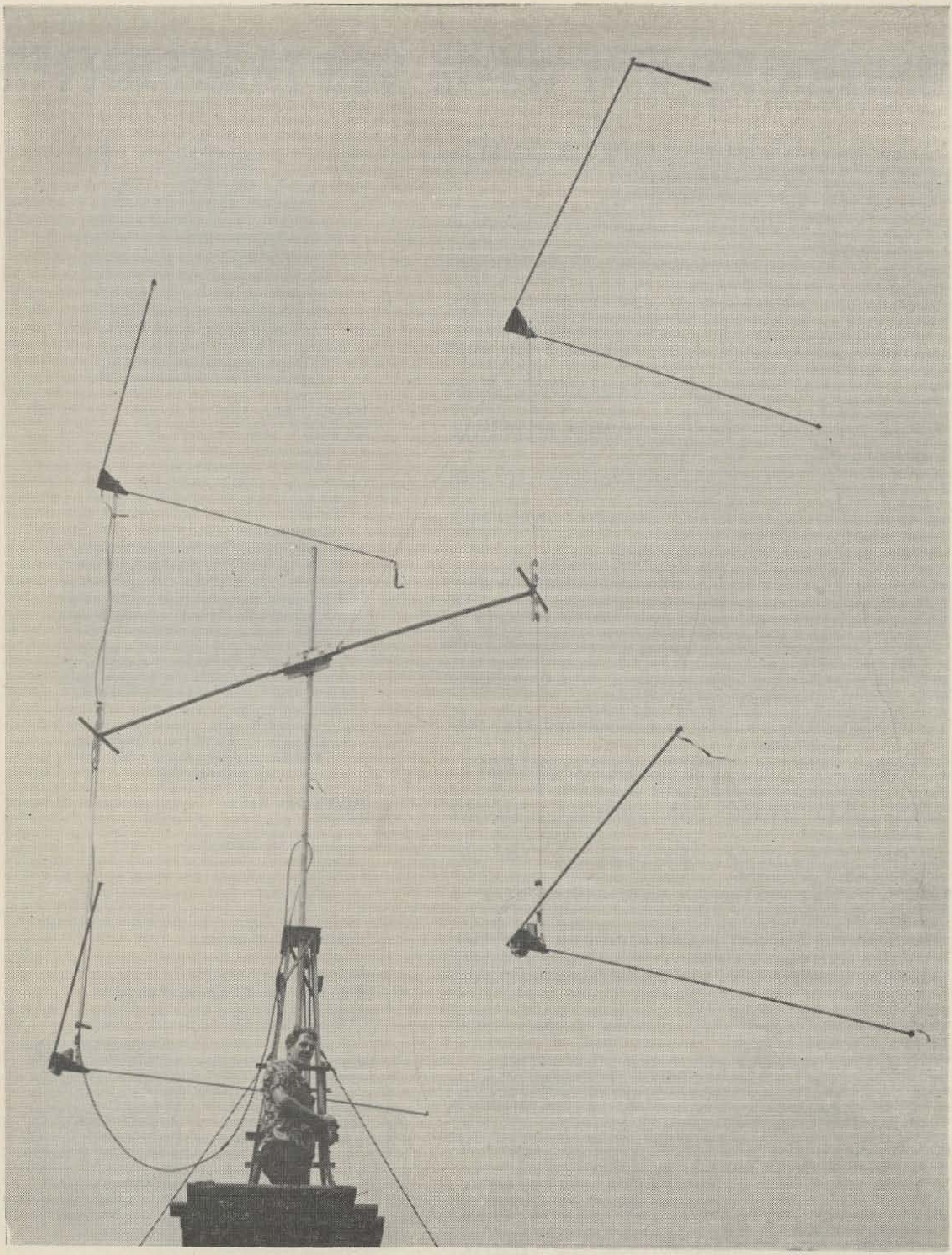


The V-Loop Beam

Angel Fernandez W2NQS
2017 Homecrest Avenue
Brooklyn 29, New York

FOR the past year I have been experimenting with various types of closed-loop beams, doing my work up on 420 mc where a half wavelength is only 14" long. This is the answer for fellows like myself who have to work things out by trial and error rather than with a text-book and computer. The method works, as you will see.

And what did all this come to? A lot of decibels which we can all use to advantage.

The V-Loop dipole (Fig. 1) provides almost 1.5 db of gain due to the directivity provided by the upper and lower sections operating in phase. A 90° angle results in the two V wires forming a bi-directional beam, just as you would with a longer legged V-beam. By adding a second V-Loop spaced 0.15 wavelength away as a parasitic reflector (Fig. 2) we add 8.5 db for a total of 10 db forward gain. The front-to-back ratio measured better than 36 db! I was unable to measure the front-to-side ratio, it being greater than my equipment could handle.

Once worked out empirically on 420 mc, it was only logical to reproduce the beam in the twenty meter size and see what the results would be. Each leg is ⅛th wavelength long and the V's are ¼ wave apart vertically. A stub and tuning condenser was placed in each of the lower V's to provide fine tuning of the beam. See Fig. 3!

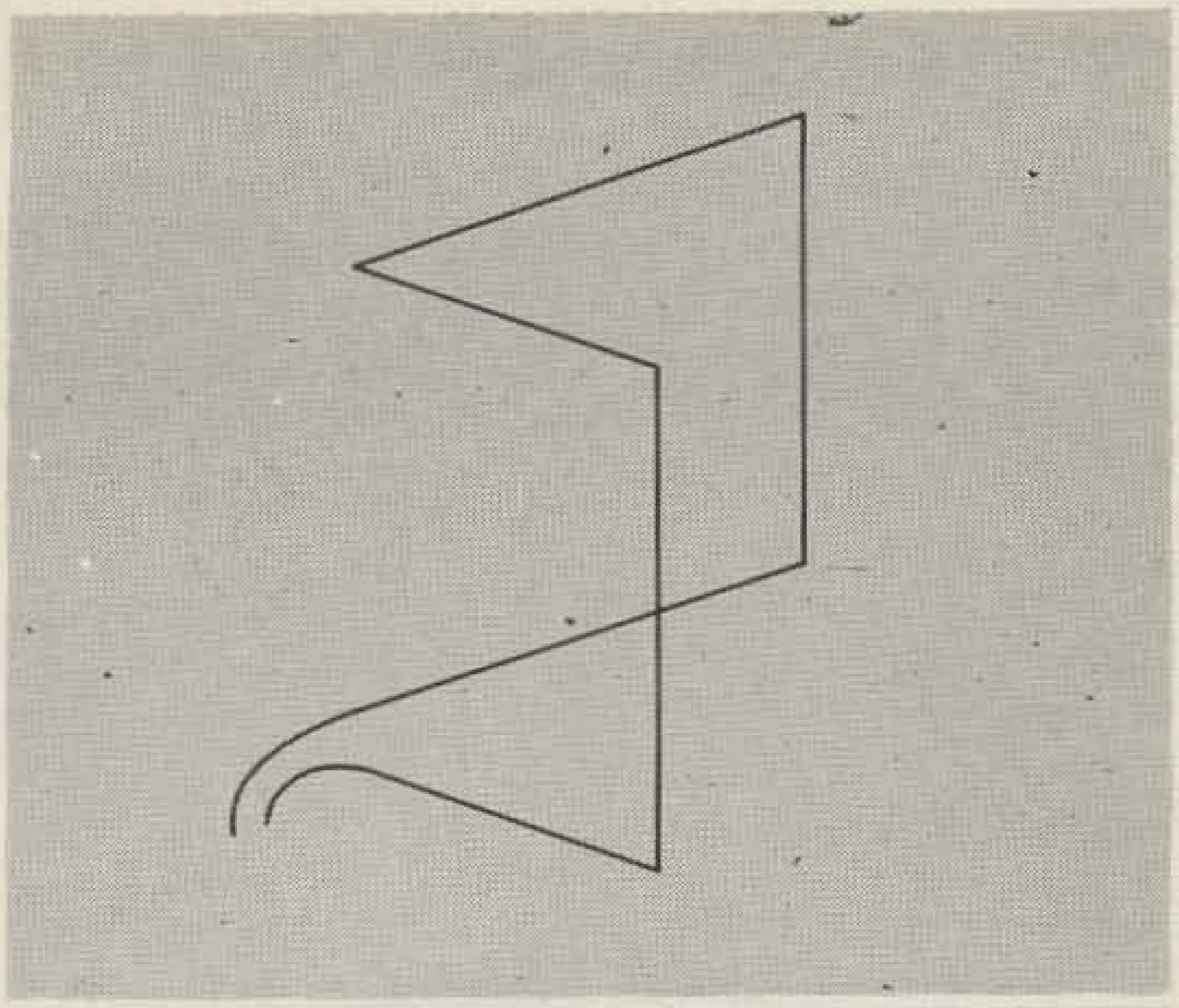
Construction

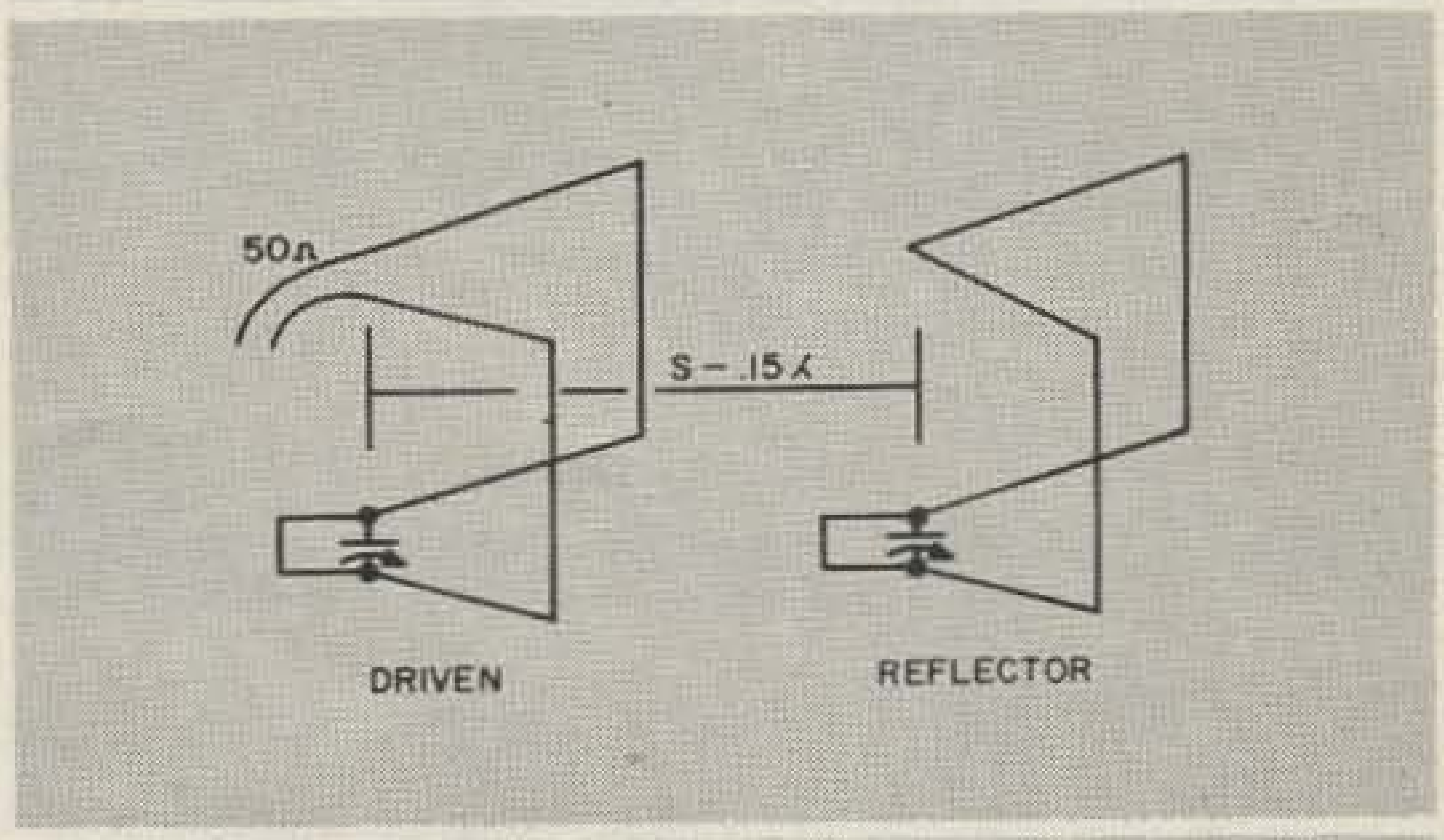
The main items you have to make are the four supports for the V's. Cut four pieces of plywood per Figs. 4 & 5 and apply a heavy coating of fiber glass resin, which you can get at any boat supply store, and let it dry overnight. Join the two V-shaped pieces of plywood, as shown in Fig. 6, using a 1" x 1" x ⅛" aluminum angle strap. Then follow through as in Fig. 7.

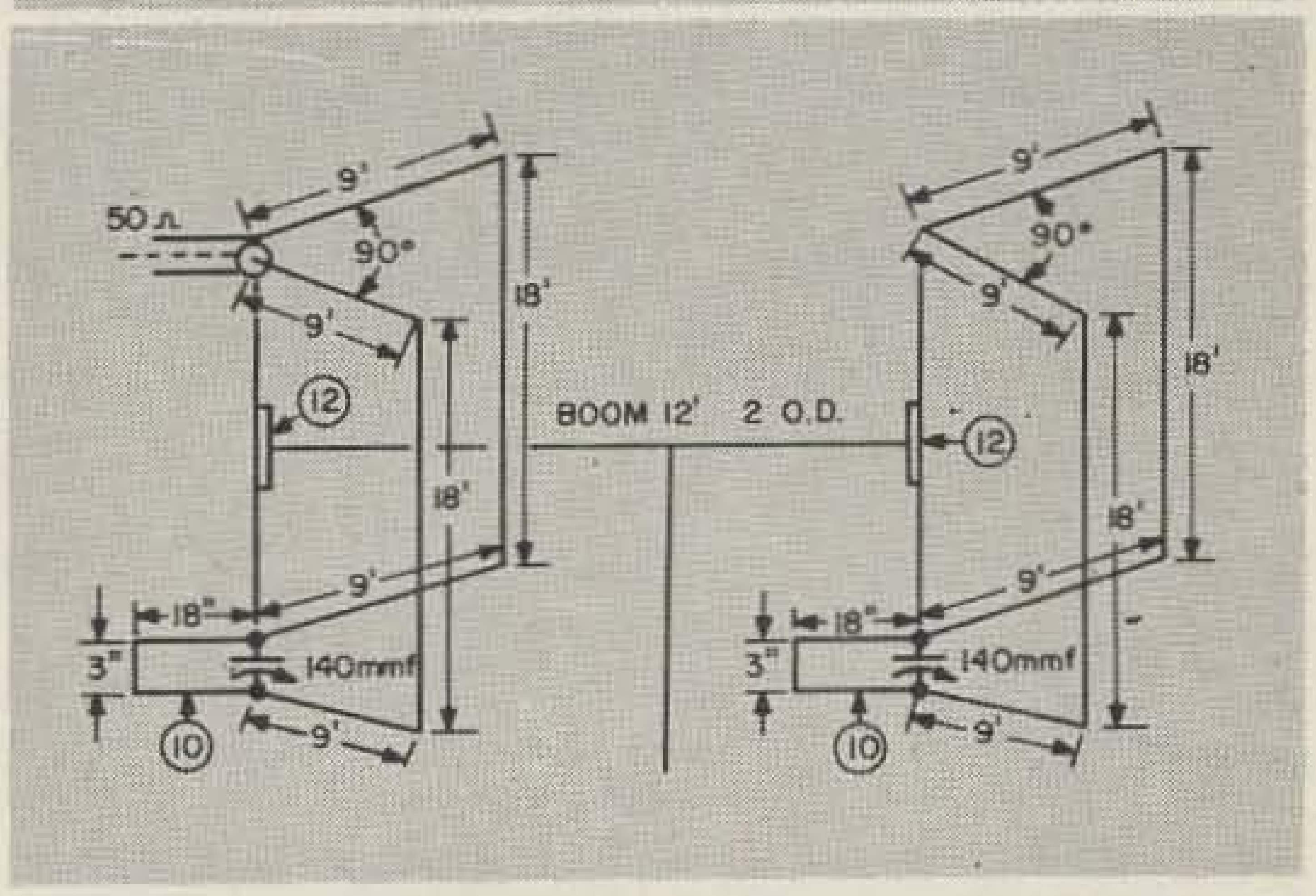
Tuning the Array

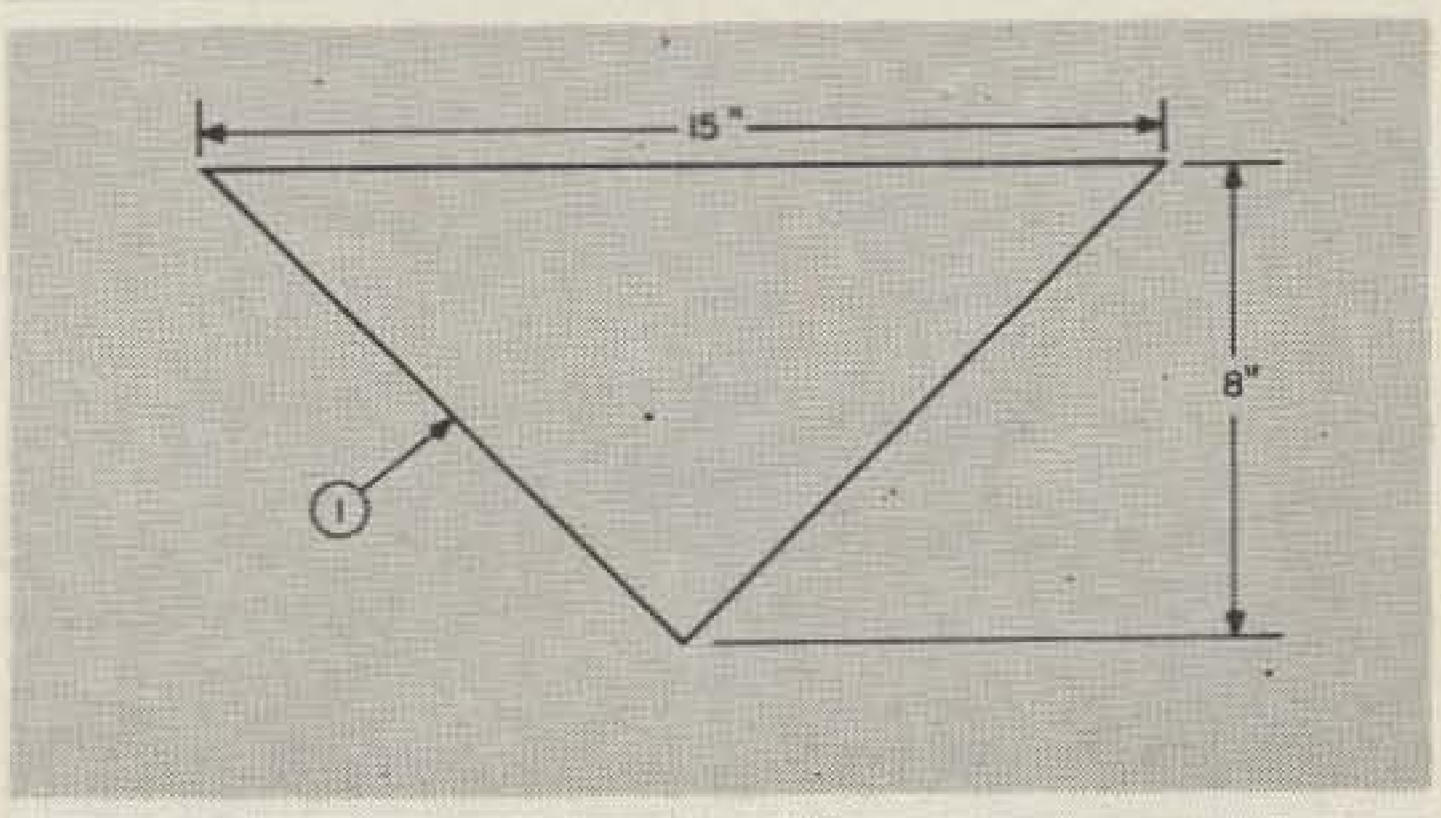
You should now mount the (V) beam at least 30 feet in the air as measured from the bottom of the beam for best results. Bend both hairpins to form a half circle and tape the shorted end with Scotch electrical tape and secure to the vertical boom. Connect a half wavelength of RG-8U cable to the top segment of the driven element and tape the cable at several points all the way down the vertical boom. At the other end of the cable connect an S.W.R reflector meter and tune the variable condenser for a minimum S.W.R meter reading at any frequency desired.

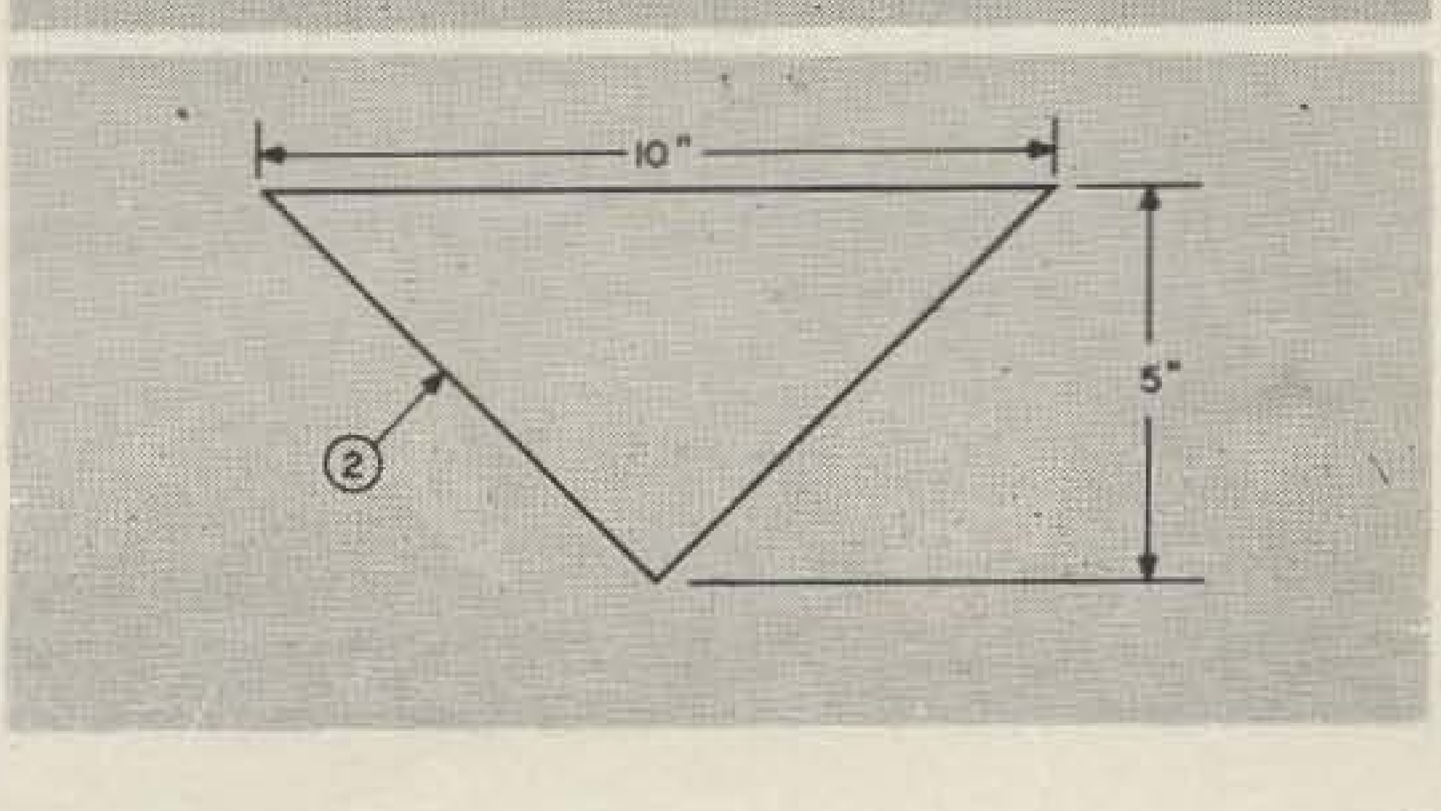
The assistance of a nearby amateur is now required to supply a steady signal for adjustment purpose. The back of the array is now aimed at the signal source. Receiver gain is adjusted to produce an (S) meter reading of (S-9). The variable condenser at the bottom segment of the reflector should now be tuned for minimum signal. Now go back once more

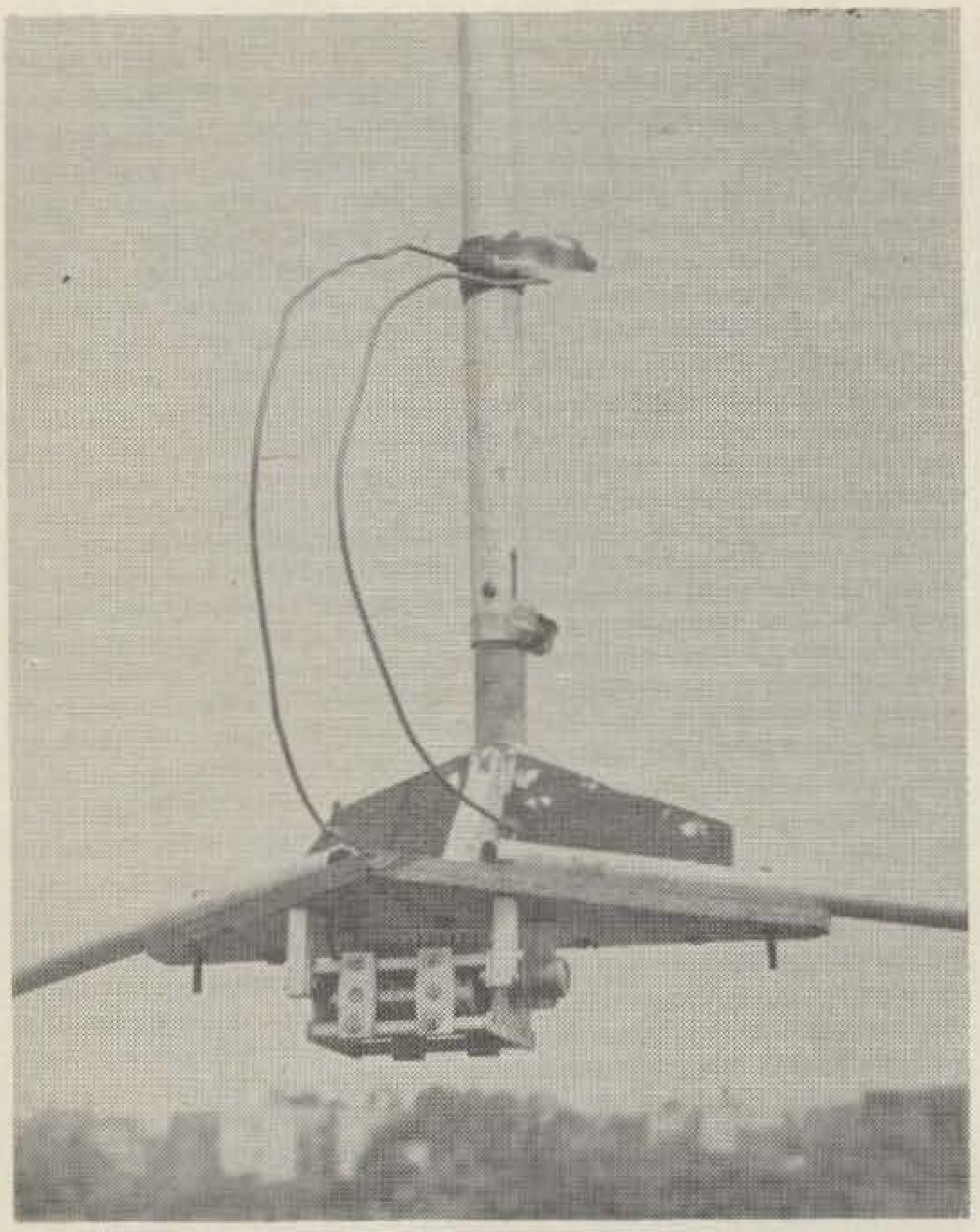


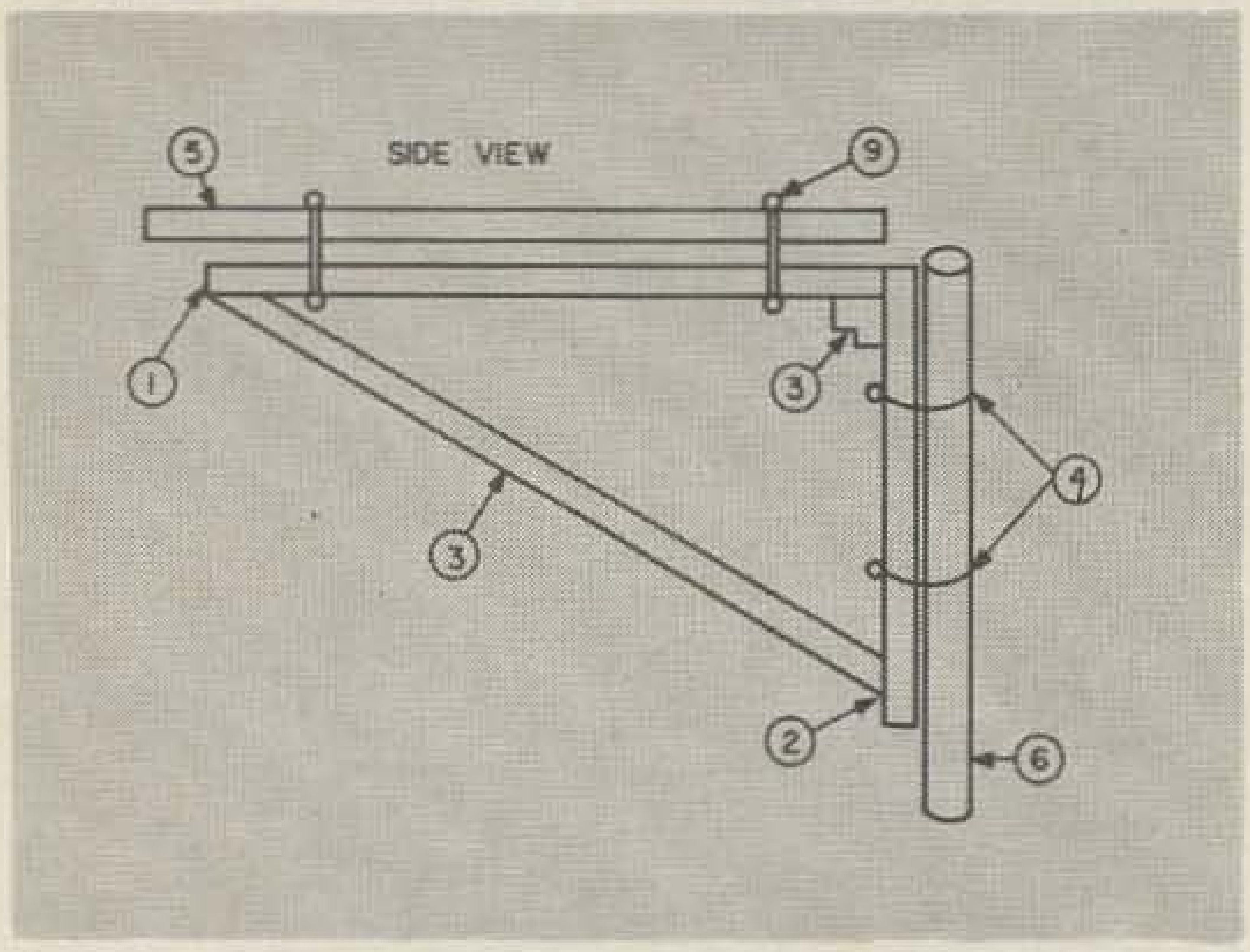


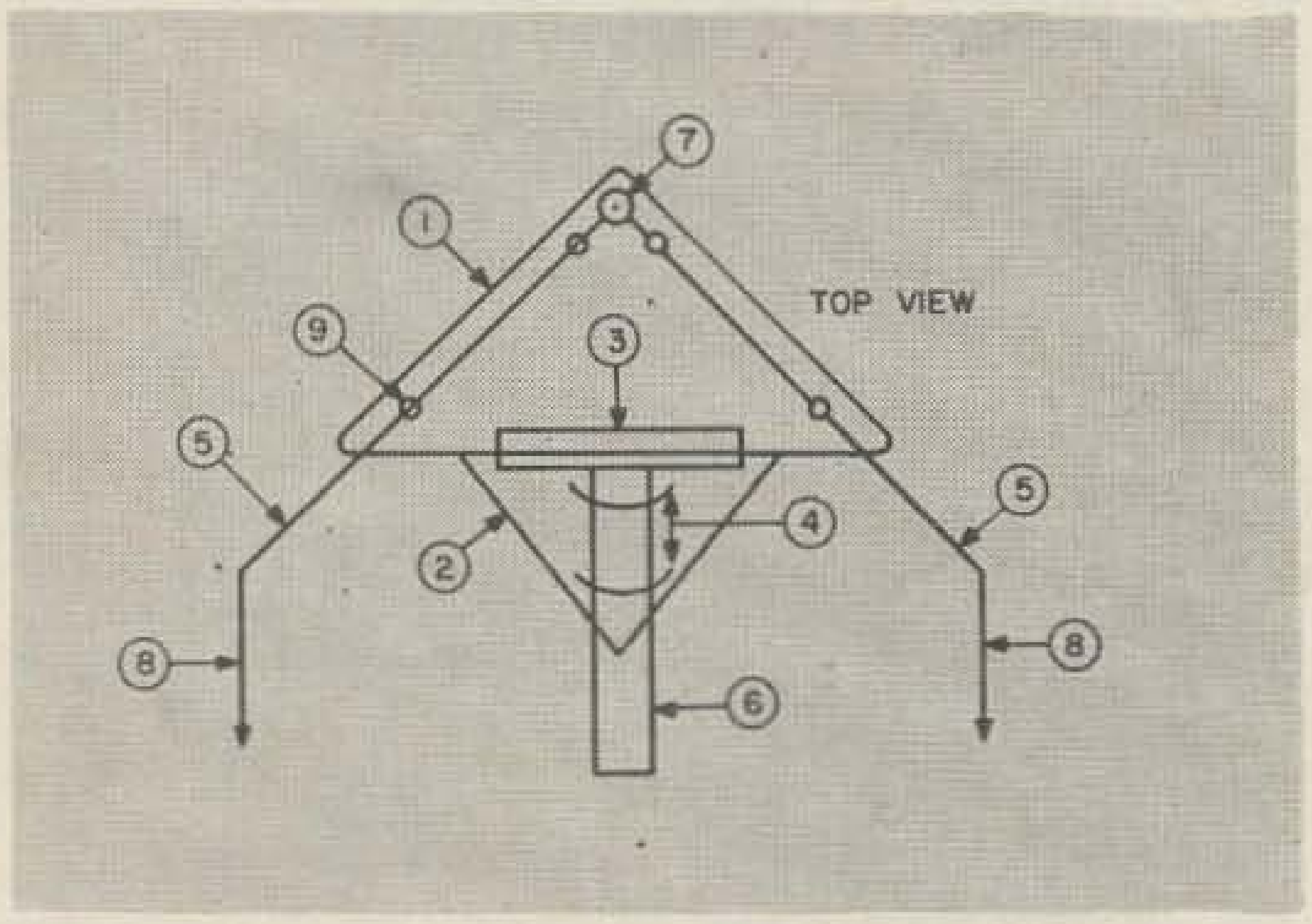












to the driven element and tune again for lower S.W.R meter reading.

On the Air Test

While running 50 watts input and the beam but only 14 feet from electrical ground I was able to override K2JSO who was running 500 watts to a 50′ high 3 element beam and K2DNX who was running 150 watts to a 65′ high Quad, while working W4JGR in Miami, Fla.

All in all, the antenna has been a delight to have around. In fact, when I don't get them on the first call I go down the basement to see if the transmitter has blown a fuse or something.

. . . W2NQS

Part List

1—Four pieces of 15″x8″x½″ Plywood
2—Four pieces of 10″x8″x½″ Plywood
3—Four pieces of 10″x1″x1″ ⅛″ Alum. Angle
4—Eight pieces of 1″x½″ U-Bolts
5—Eight pieces of 9′ ¾″ D. .049 Wall Alum. Tubing
6—Four pieces of 9′ 1½″ D. .058 Wall Alum. Tubing
7—Co-Ax fitting
8—18′ each of No. 8 Alum. Ground wire
9—16 pieces of 10/32 Brass screws and nuts
10—Hairpin 18″ long and 3″ wide—No. 8 copper wire
11—2-required 140 mmfd variable condenser in water-tight box
12—2 Cesco Quad arms
Match all circle numbers as per (Figs. 4-5-6-7)

A Simple RTTY Interconnections Unit

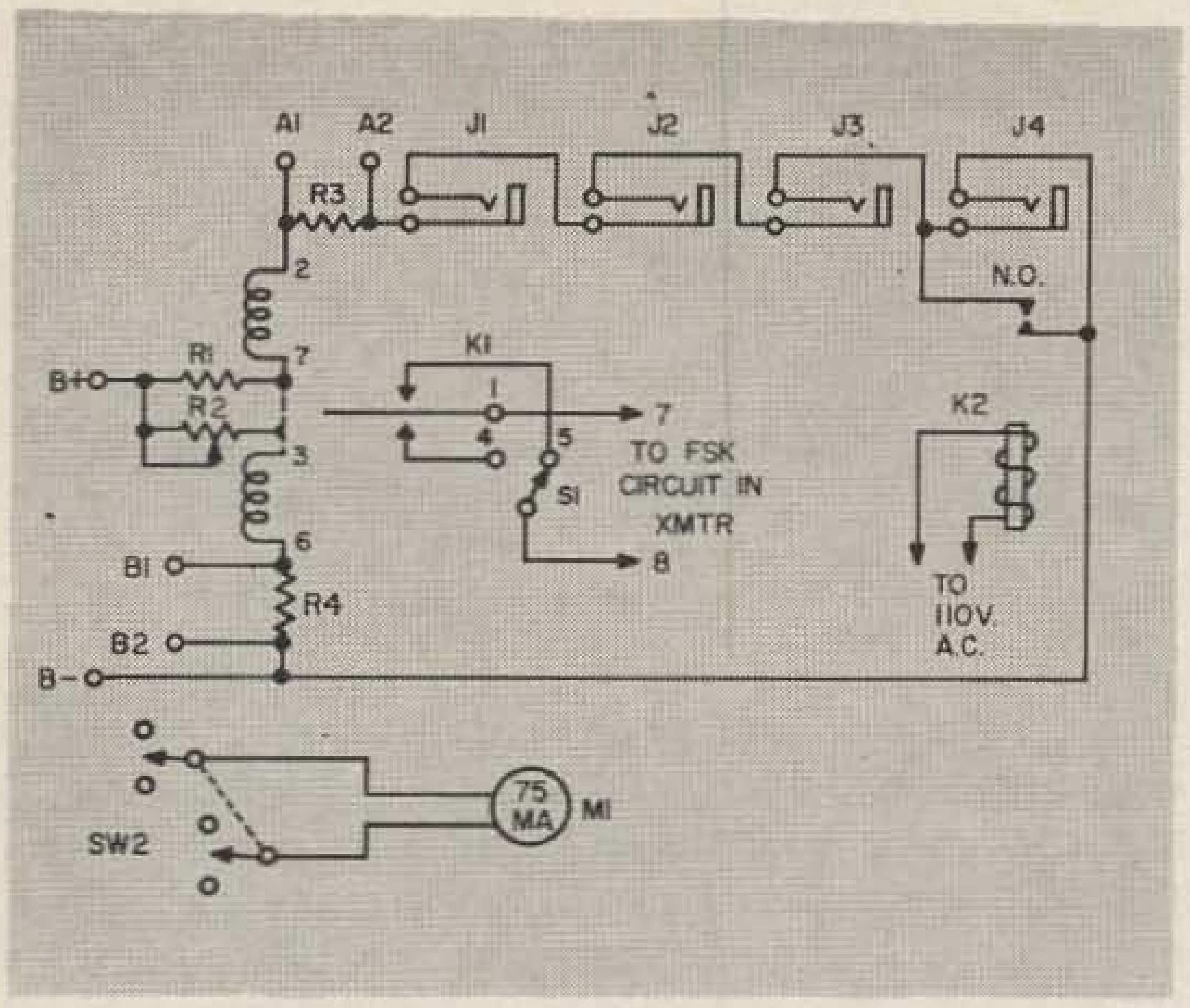
Gordon E. Hopper W1MEG

AS a newcomer to RTTY operation, one of the first problems encountered is the necessity of providing a dc loop circuit and a method of tying the various RTTY units together. The newcomer, naturally, will possess a printer, a receiving converter and his communications receiver.

There are many ways of interconnecting these units into a workable system and this article will describe the simplest way of accomplishing the job. As you progress further into the art, you no doubt, will outgrow this unit, but the primary purpose of this article is to get the newcomer started as easy as possible.

The writer, as is the case of other Army MARS members, uses a Model TG-7B (15) printer, a TG-11 perforator, a Transmitter-Distributor and an audio-type converter.

A 110 v dc power supply is needed to supply power for the printer magnets and an inter-



connections unit is necessary to allow the transmit/receive switching, to key the F.S.K. VFO unit and to allow easy connection and disconnection of auxiliary equipment.

The schematic shows an interconnections unit which accomplishes these functions.

If your audio type converter has its own polar relay, the output of the converter plugs into J4. This will key the 60 ma. dc loop and any other units plugged into the other jacks.

Incidentally, these jacks are of the closed-circuit type and are insulated from the chassis.

K1, the polar relay, is used to frequency shift key a Viking 2 VFO keyer. SW 1 is used to provide "mark high" or "mark low" without retuning the receiver. K2, a SPST, 110 v ac relay, is used to short out the converter during the transmission period. Voltage for this relay coil is obtained from the rear of the Viking 2. R3 and R4 are metering shunts. Control R2 is used to set the loop current as operating conditions determine change to maintain the necessary 60 ma. The red connector (selector magnets) plugs into J1, the black connector (keyboard) plugs into J2. These are the two lines from the printer. The Transmitter-Distributor plugs into J3.

The entire unit is built on a 8x6x4 inch chassis. The power supply used is a surplus RA-87 unit, but any good dc supply capable of delivering 100 ma. will suffice.

If you have difficulty locating the polar relay they should be available from Feliciano I. Esteban, W2ZKV, 84/24 57th Ave., Elmhurst 73, N.Y.; Tom Howard, W1AFN, Box 19, Boston 1, Mass.; or from Radio Bookshop (p. 60).

Parts List

K1—W.E. 215-A or 255-A Polar Relay **with socket.**
K2—SPST 110v. ac NO Relay.
J1, J2, J3 and J4—Closed circuit. insulated phone jacks.
SW1—SPDT toggle switch.
SW2—DPDT toggle switch.
M1—75 mils.
R1—2,000 ohms, 10 watts.
R2—5,000 ohm potentiometer, 25 watts.
R3 and **R4**—20 ohms, 1 watt.

Final Tanks

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HAVING the proper L/C ratio or "Q" in an rf amplifier is important for best operation. The proper Q is necessarily a compromise, depending on the type of operation. For Class C operation the Q must be relatively high to attenuate harmonics. But the higher Q, due to higher circulating currents, has higher losses. For Class B operation (linear amplifiers) the harmonic attenuation factor is unnecessary, assuming a clean exciter. Therefore, a low Q is acceptable. In theory, maximum tank circuit efficiency is with a Q of zero. This means no circulating current losses. Excessively high Q values can result in serious circulating current losses and can require very large components to handle the losses.

"Q" is defined in several ways. The more common is the ratio of the reactance of either leg of the tank to the series losses of the circuit including the coupled losses or load. Likewise it is defined as the ratio of the shunt losses, including the load, to the reactance of either leg. Another very useful way of defining "Q" is the ratio of the tank circuit volt-amperes to the output watts.

This last definition is particularly useful as the values are readily available to us.

For example let us design the tank for a 1 KW input CW or AM amplifier. For purposes of harmonic attenuation the desired value of Q is 12. Assuming 65% efficiency for good stability, the output will be 650 RMS watts. From the formula Q=VA/Output, we find that Q x Output = VA. 12 x 650 = 7800. Therefore, we will need a tank circuit with 7800 RMS volt-amperes in it.

The peak rf voltage in a properly loaded Class C rf amplifier is very nearly 90% of the dc plate volts. If we decide to use 3000 volts on the plate of the amplifier, the peak rf volts will be 2700. The RMS volts will be 1900. With the tank circuit volt-amperes equal to 7800 and the tank circuit volts equal to 1900, we find the tank circuit circulating current is 4.1 amperes RMS (7800/1900).

The reactance of either leg of the circuit must equal E/I so $X_c = 1900/4.1$ or 465 ohms.

Of course you can calculate the capacity whose reactance is 465 ohms at the operating frequency using the regulation formula

$$X_C = \frac{I}{2\pi F(C)}$$

or you can use reactance charts, reactance slide rules, etc.

As a check on your calculations, use the basic figures 100 mmfd equals 100 ohms at 16 mc (actually 15.9 mc). From this basic figure, you can go up or down. For instance at 4 mc, one-fourth of basic frequency, 100 mmfd is four times the reactance, or 400 ohms. Or at 32 mc, twice the basic frequency, 100 mmfd is 50 ohms. At 32 mc 25 mmfd would be 200 ohms, etc.

Using this rule of thumb, it can be seen that 465 ohms at 4 mc will be in the vicinity of 100 mmfd. It calculates out to be 90 at 3.8 mc. The above calculations were based on several approximations so there is no reason to assume that the calculated 90 mmfd is appreciably better than the rough calculated 100 mmfd. The value is not that critical. So we can say that about 100 mmfd of input condenser and enough coil to resonate with it will be OK for our 1 KW amplifier with 3000 volts on the plate. Further, we will have about 4 RMS amperes of circulating current in the tank when properly loaded. So the tank coil will be required to "keep cool" with 4 RMS amperes tickling it. More on this later.

The tank circuit of an amplifier functions as an impedance transformer between the tube and its load. In the amplifier under discussion, the plate impedance that the tube would like to see is between 4500 and 5500 ohms depending on what rules of thumb are used and what assumptions are made. If this amplifier is to see the usual 50 ohm load, we need an impedance transformer of about 5000 to 50 ohms or an impedance ratio of about 100 to 1.

With a Pi net output circuit, there is a minimum Q, below which the network will not function as a Pi net, but will function as an L net. This will result in the output condenser of the Pi net losing control of (having no effect on) the loading. This minimum value of Q is approximately equal to the square root of the impedance ratio of the output circuit.

$$Q_{min} \cong \sqrt{\frac{R_P}{R_L}}$$

R_P = PLATE IMPEDANCE
R_L = LOAD OR ANT IMPEDANCE

In the amplifier being discussed, with an impedance ratio of 100, the minimum Q for a Pi net would be approximately 10. A design figure of 12 was used so that is OK for this case.

However, in a linear amplifier the high Q is not required for harmonics attenuation; is

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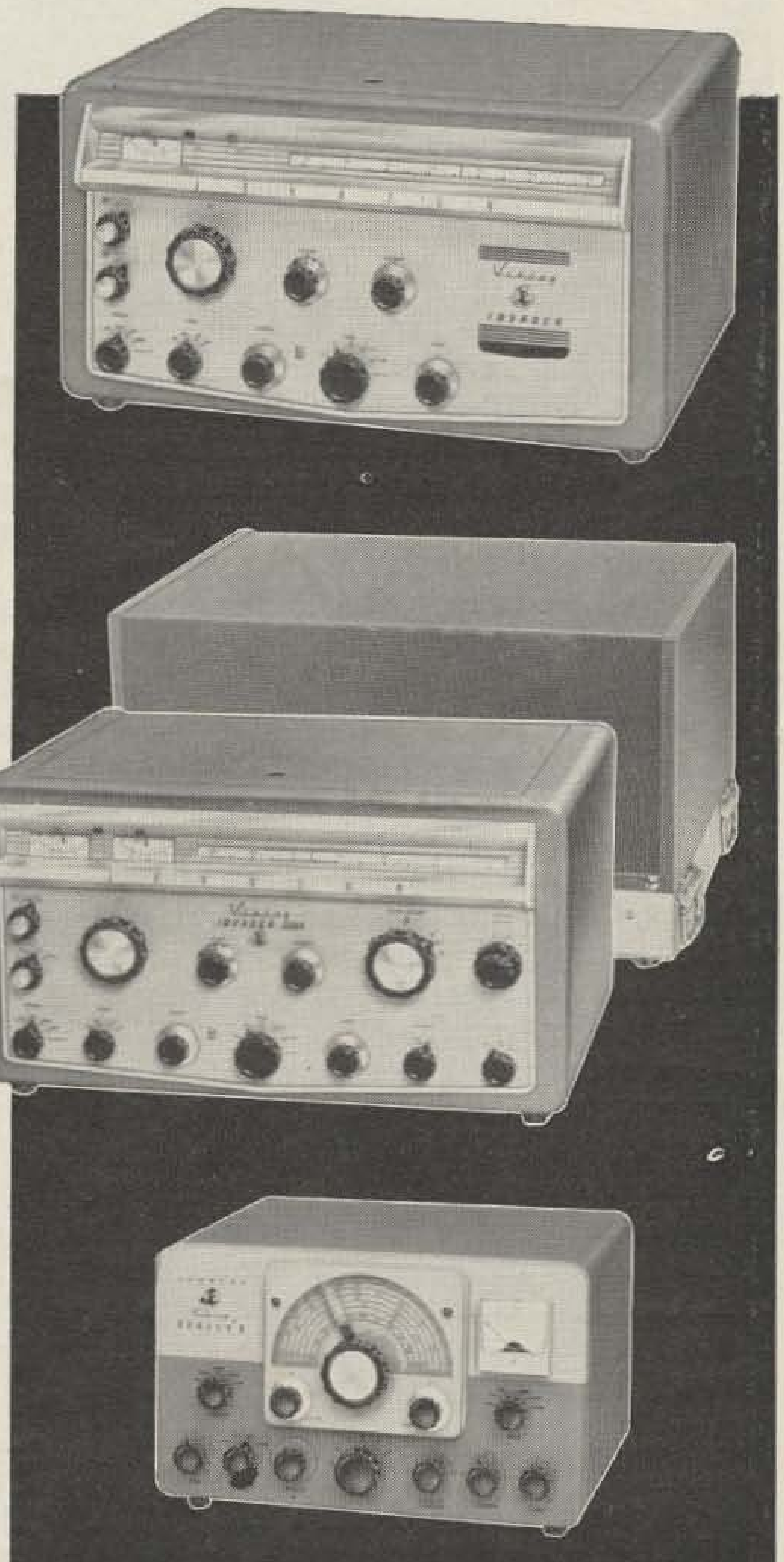

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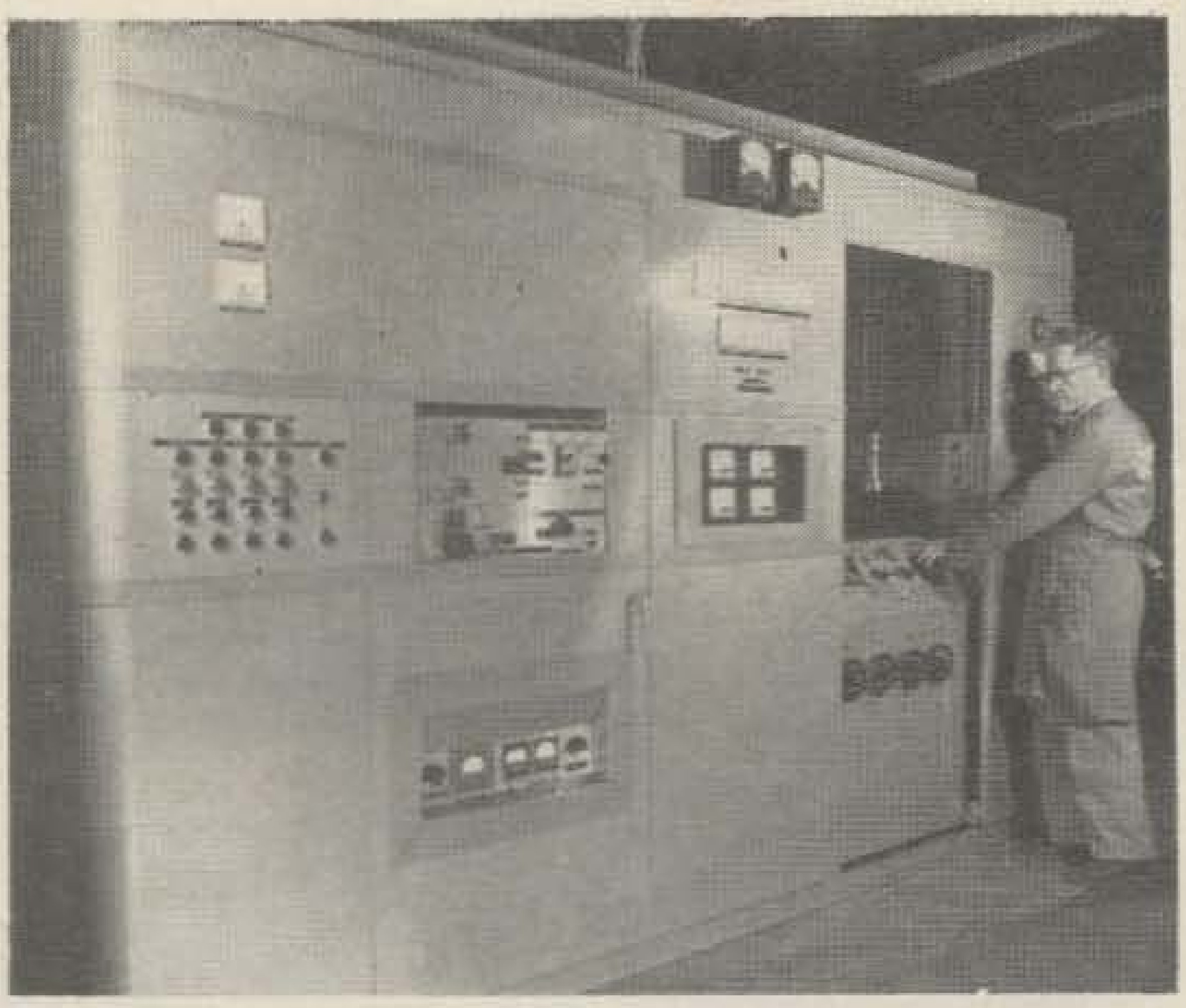


undesirable due to circulating current losses, and is undesirable from the standpoint of broadbanding. If a lower Q is used, the amplifier may be used over a wider range of the VFO without returning the amplifier. A "Q" of the order of 3-5 is desirable from the standpoint of tank circuit losses and broad banding, provided no problem of harmonics is present. This is usually lower than can be obtained with the usual high impedance tubes in use.

Four 811A tubes with 1500 volts at ½ amp peak plate current could be run as low as Q = 6. This would calculate to be 140 mmfd at 3.8 mc. This linear amplifier has been built and put into operation at "Doc" Jack Vogelman's QTH (W6CJY), and works fine.

The accompanying nomograms may be used to determine the values of capacity, voltage, current, or frequency necessary in designing a tank circuit. When any three of these four variables are specified, this automatically determines the fourth.

One nomogram works with capacitive reactance, frequency, and capacity. Given two of the variables, it will determine the third.

One nomogram works with rf current, rf voltage, and capacitive reactance. Given two of the variables it will determine the third.

A straight edge laid across either of these nomograms connects the three values that will satisfy the equation.

$$X_C = \frac{I}{2\pi F(C)} \qquad I = \frac{E}{X_C}$$

Peak values may be changed to RMS values by multiplying RMS by .707 or ½ $\sqrt{2}$. RMS values may be changed to peak values by multiplying by 1.414 or $\sqrt{2}$.

$$\text{RMS} = .707 \text{ Peak}$$
$$\text{Peak} = 1.414 \text{ RMS}$$

RMS values are 70% of peak values and peak values are 41% higher than RMS values.

Tests have been run on various sizes and types of rf coils to determine their current rating. It was arbitrarily decided to rate them at the current that would bring them to a stable 188°F without extra cooling, such as blowing, etc. Even a small air movement over the coil increases its rating (as here defined) appreciably.

The coils were tested by resonating them with a parallel condenser and coupling them to the tank coil of a test transmitter. Then the current was measured at the level that just brought the coil temperatures up to 188°F.

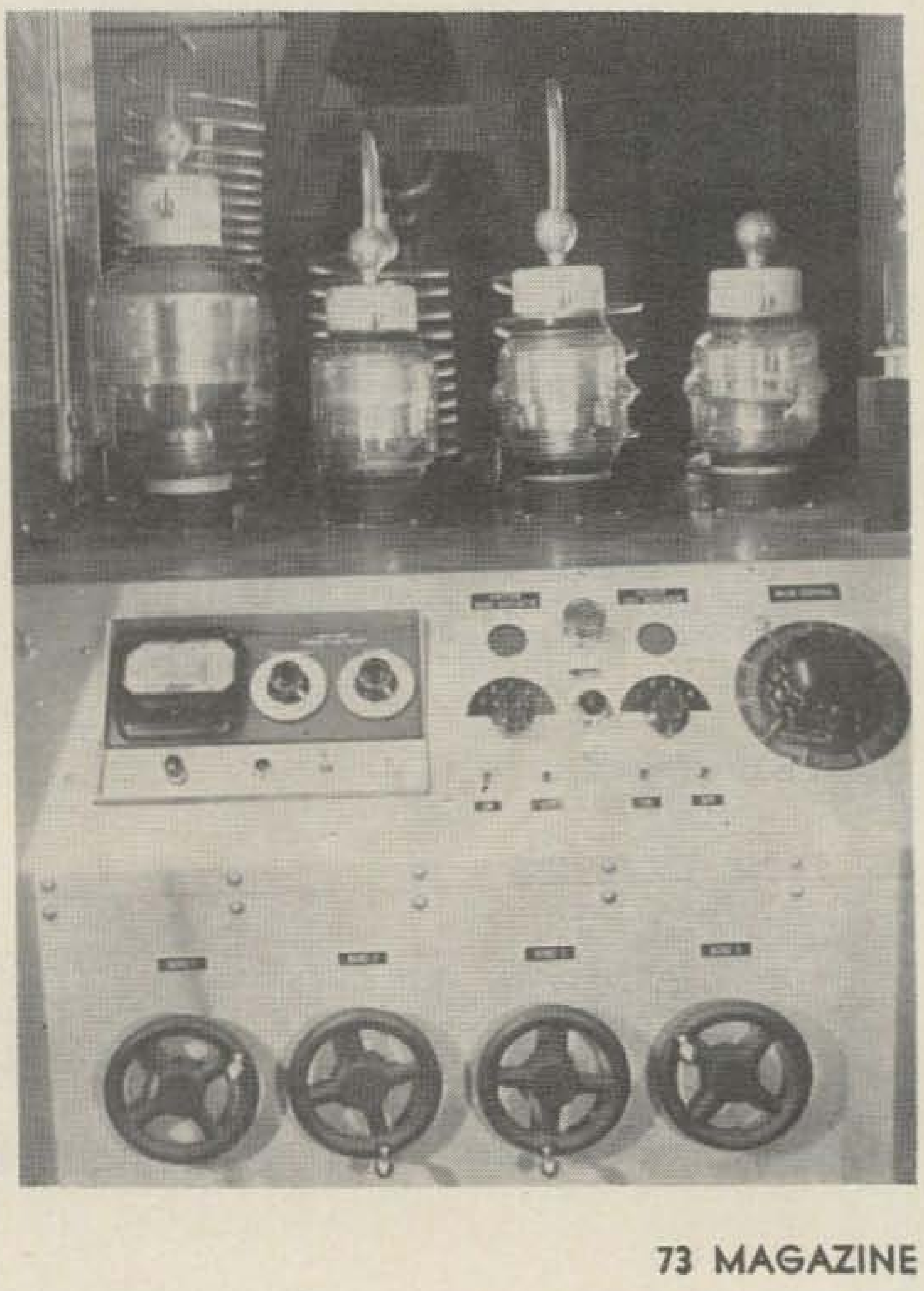
Note that the current rating at 16 mc is only about 60% of the current rating at 2.5 mc. The charts are for normal convection cooling, (not forced air). Note also that the spacing between turns has a great deal to do with the current rating. The larger conductors, due to circulating current in the capacitance between turns, do not carry proportionately more current.

Figure 1 is a general view of the 100 KW bandswitching 2.5-25 mc SSB rig of the Jennings Radio Frequency Testing laboratory on which the coil tests were run. The operator is Lloyd Saxon, W6EEX, who largely built the rig.

Figure 2 is a close-up of the testing cabinet of the rig where the actual tests were performed.

It is permissible to consider the duty cycle involved when selecting the proper coil size according to its current rating. For instance an AM rig would probably be considered 100% duty cycle, so a heavy continuous duty coil would be necessary. For CW or SSB, a 25% to 50% duty cycle could be used. Therefore, a smaller coil and resulting space saving could be used.

By using a low "Q" circuit, a little air (possibly diverted from the tube fan) and a short



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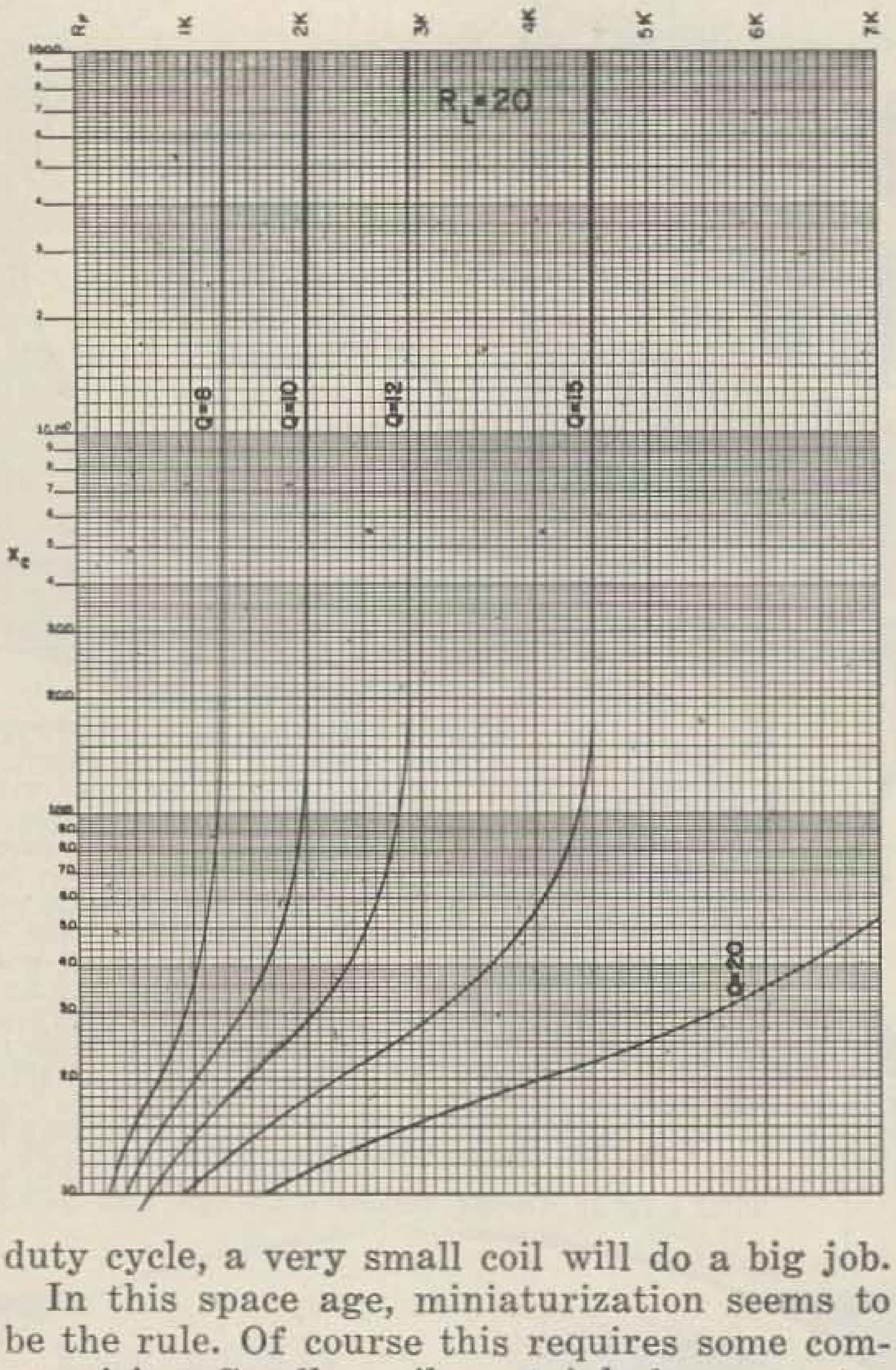
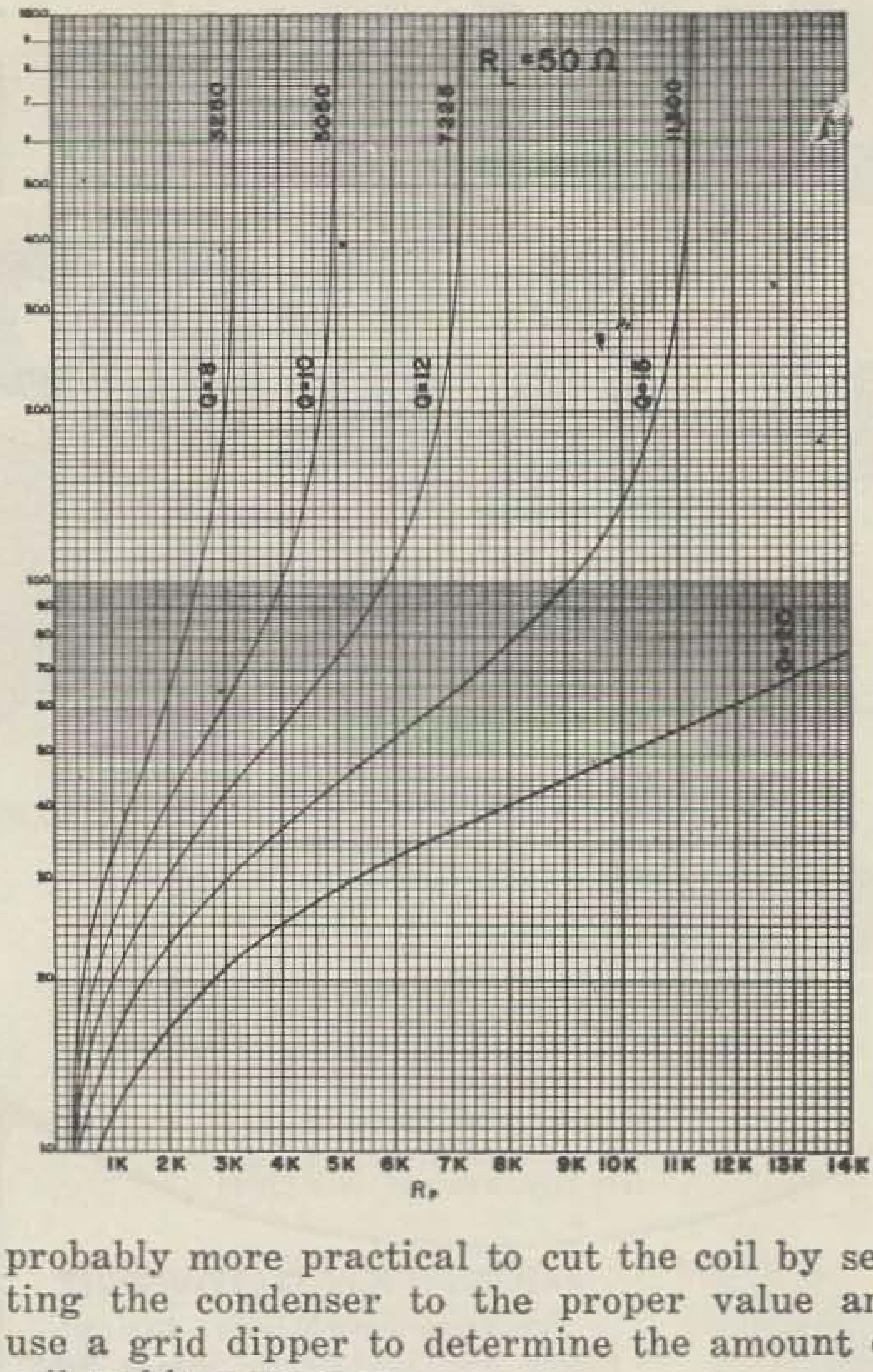




duty cycle, a very small coil will do a big job.

In this space age, miniaturization seems to be the rule. Of course this requires some compromising. Smaller coils certainly have greater losses, but DB-wise, at the receiving end of a signal the losses are negligible. Even losing half the output of a rig (horrors) is almost undetectable at the receiving end.

Another space saver that works well on 20, 40, and 80 meters (but not too well on 10 and 15 meters) is to tap up a few turns from the grounded end of a parallel tuned plate circuit,

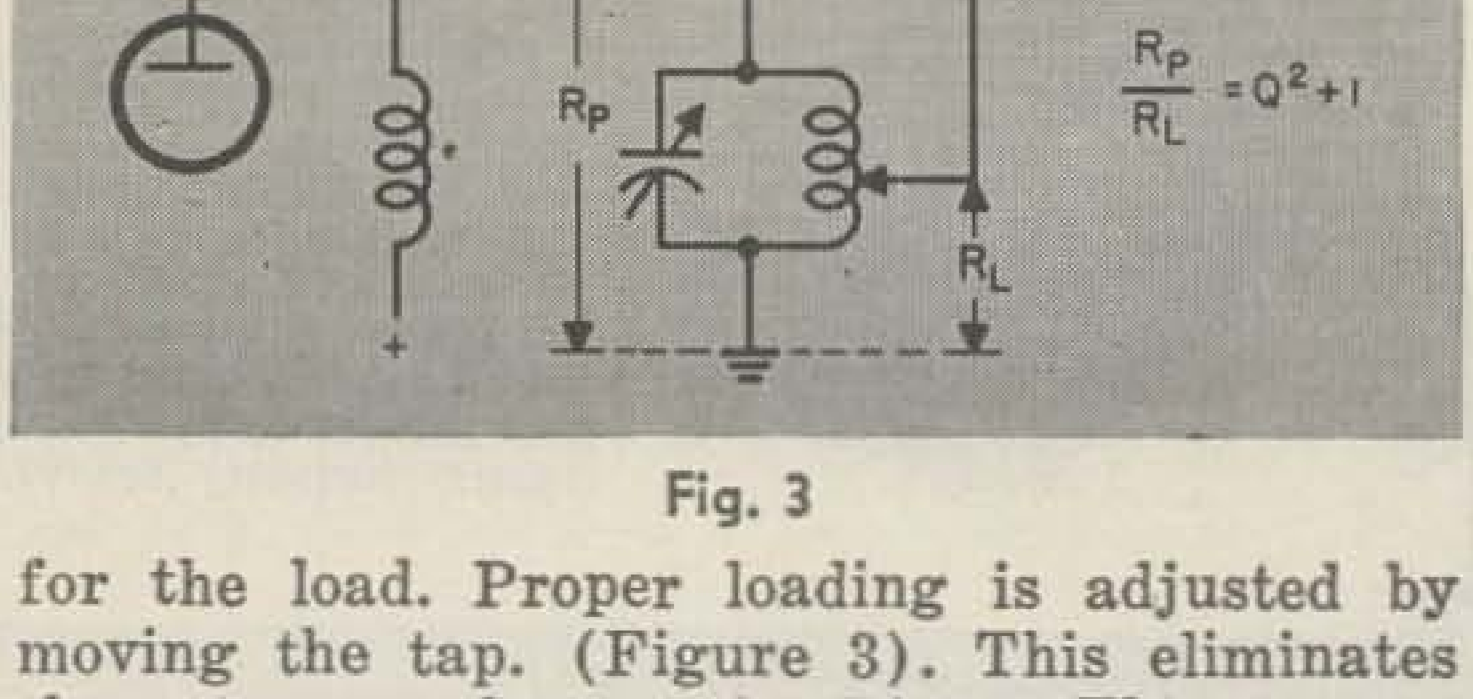


Fig. 3

for the load. Proper loading is adjusted by moving the tap. (Figure 3). This eliminates the output condenser of a Pi net. This system, a form of an L net, should only be used where harmonic attenuation is not a factor (linear amplifiers). It has been in use at W6JAT in a bandswitching 4CX2000W SSB final for two years. A complete new tank is switched in for each band.

The foregoing will determine the tuning condenser of a parallel tuned tank circuit or the input condenser of a Pi network. It is probably more practical to cut the coil by setting the condenser to the proper value and use a grid dipper to determine the amount of coil to hit resonance.

A Pi net is actually two L nets, back to back, but the amount of inductance in the output L net is low, and the C is high, so turning the output condenser of a Pi net to max. and setting the input condenser at the proper calculated value will give only a small error in grid dipping the coil. The coils do not have to be grid dipped in the set with the transmitter input condenser. They may be dipped on the bench using any convenient proper value condenser. Then transfer the coil to the transmitter, without changing its physical dimensions.

However, you often can not get by so easily

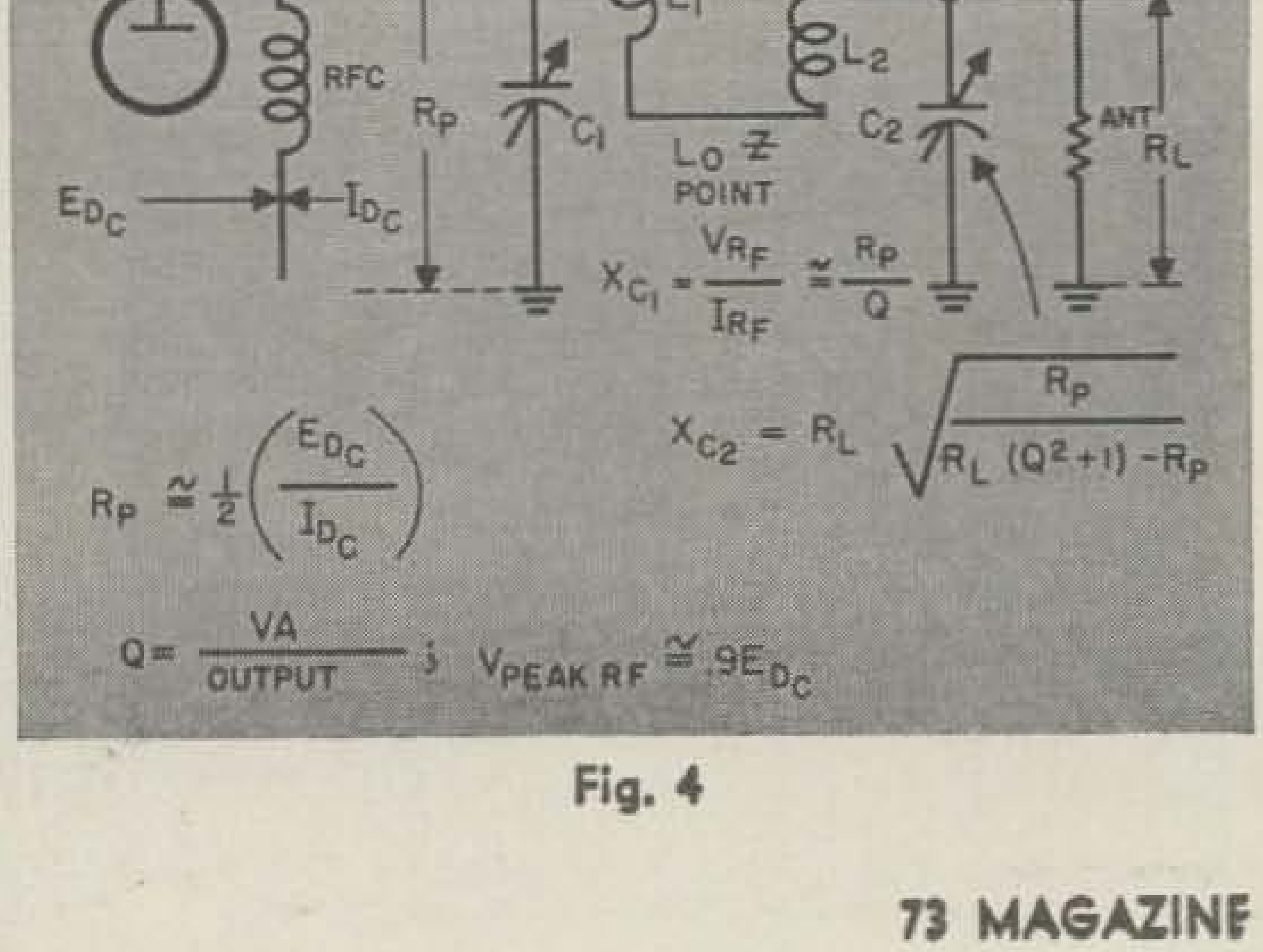
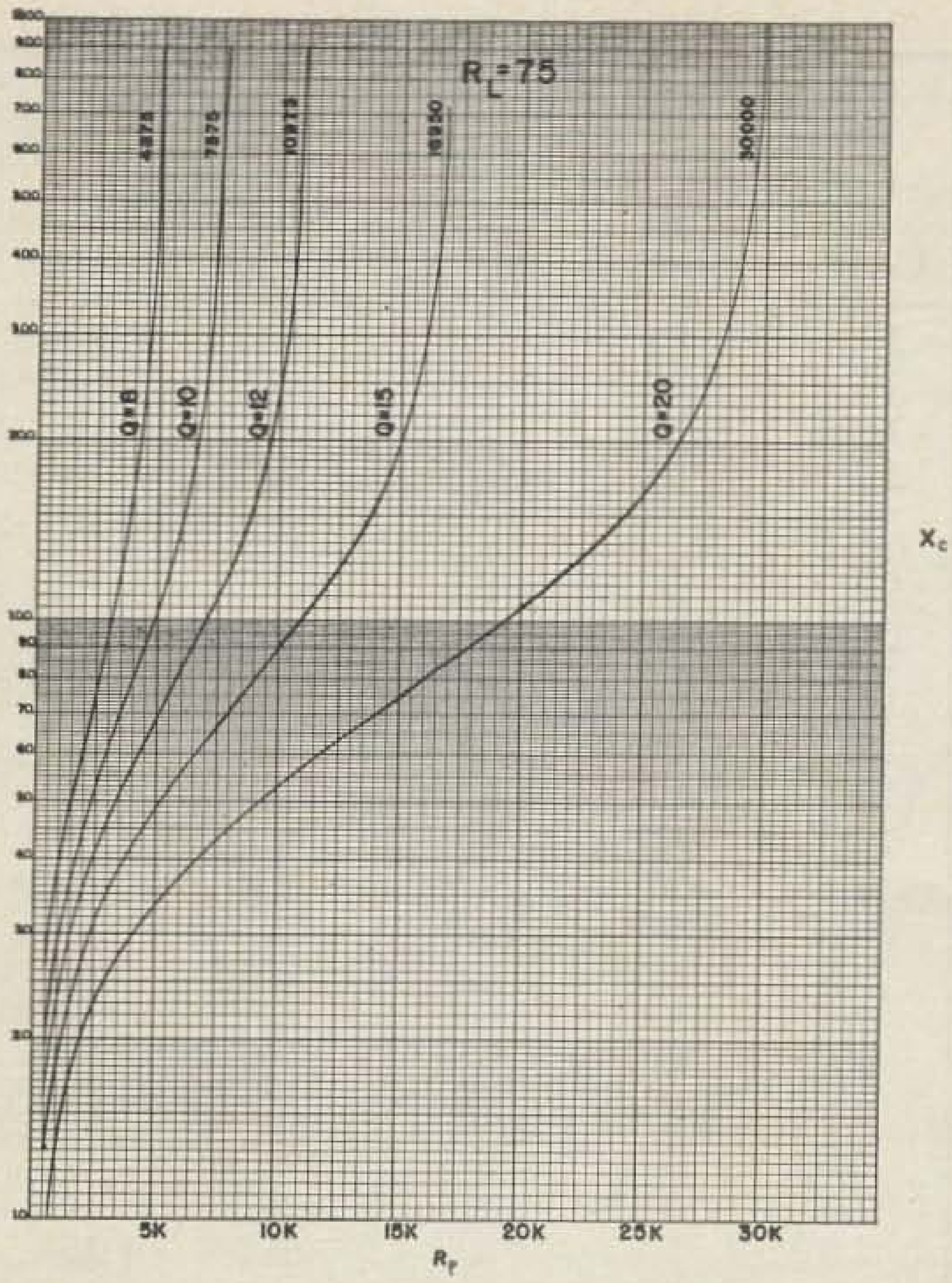
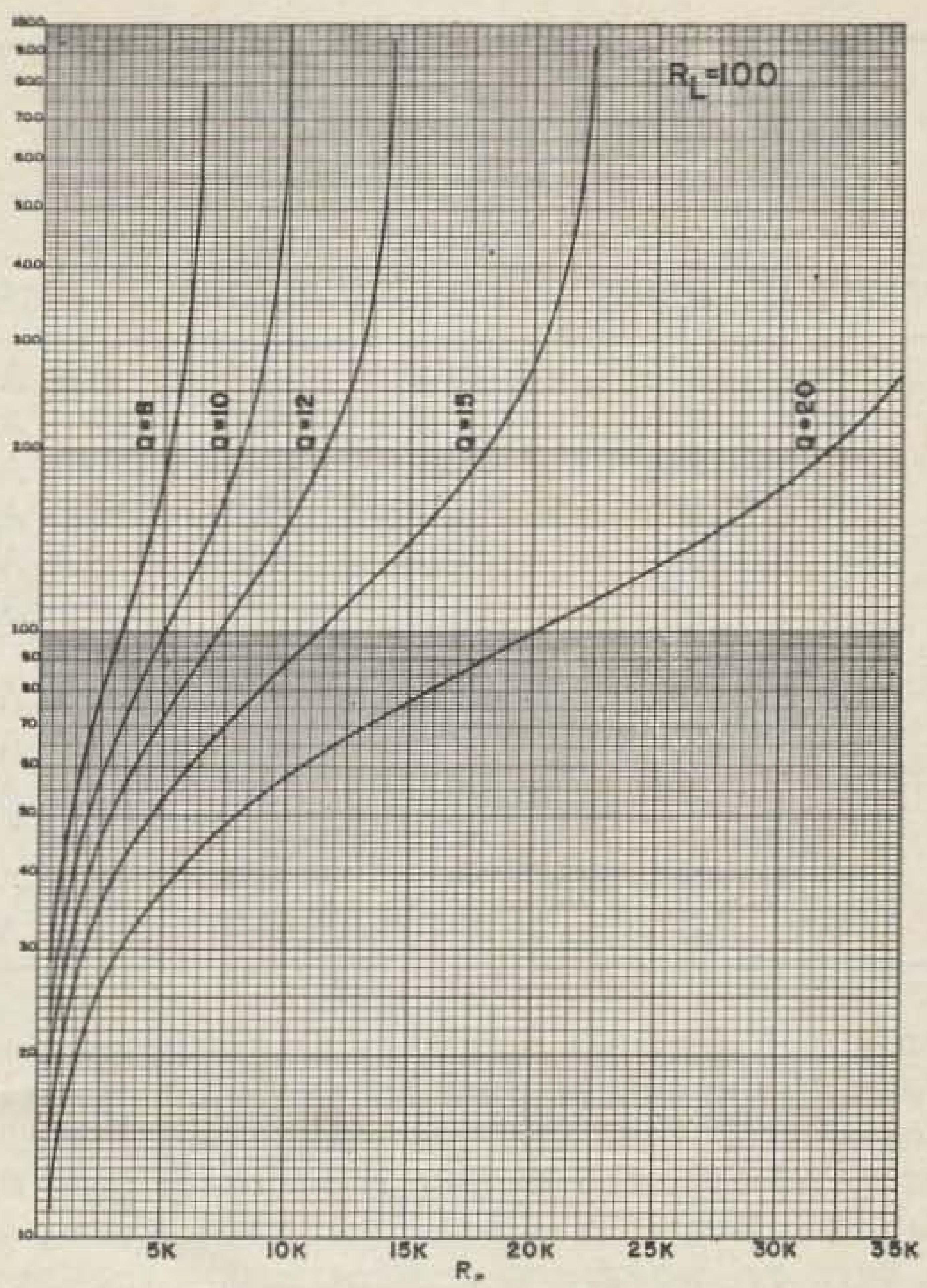


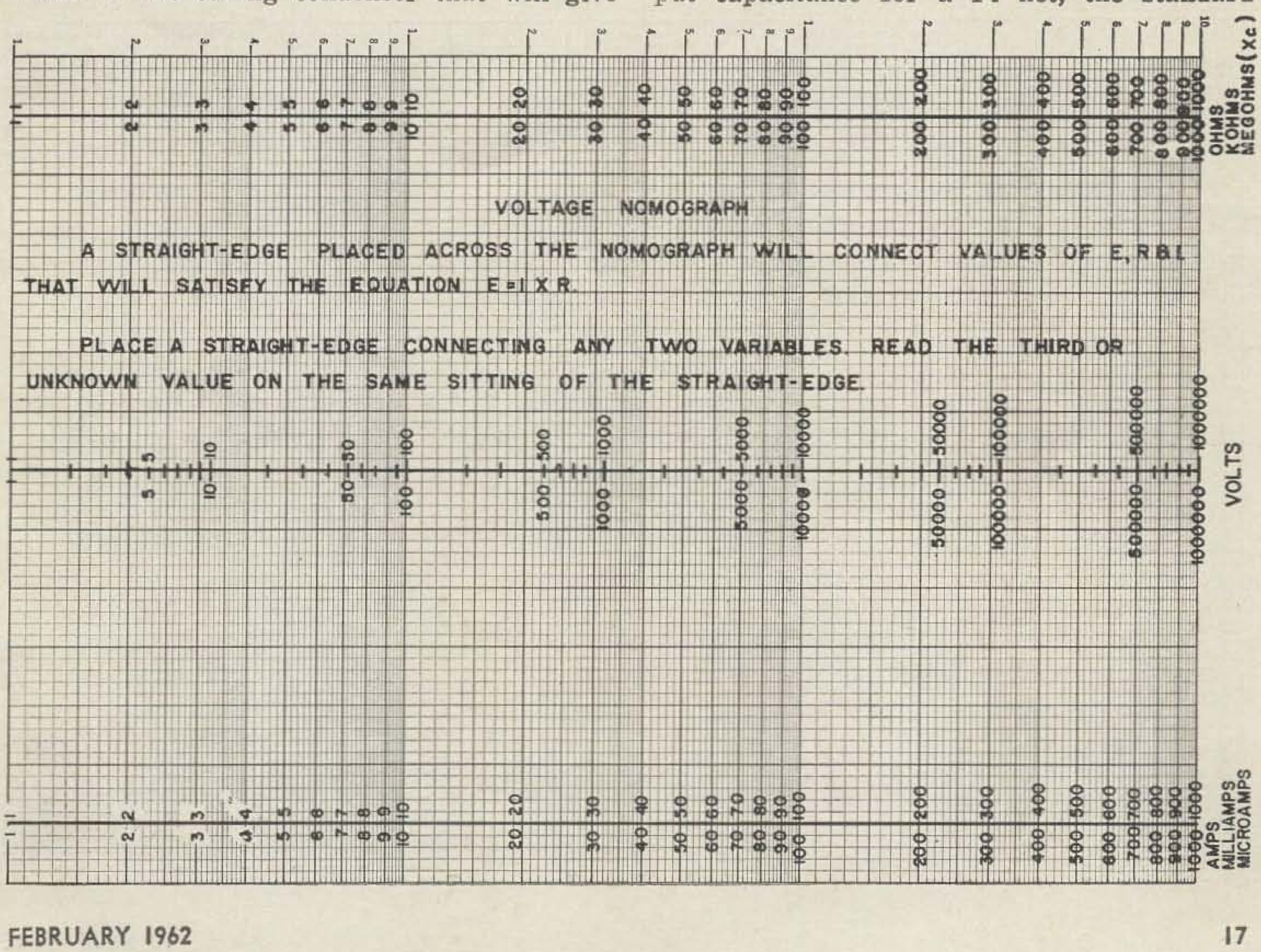
Fig. 4





on the 10, 15, and possibly 20 meter bands, as the calculated input capacitance values are usually lower than the output capacitance of the tube, plus stray wiring capacitance. Therefore, you will have to operate at the lowest value of the tuning condenser that will give you a little tuning control, minimize stray wiring capacitance, then cut a coil with the grid dipper. The resulting coil will have a higher "Q" than the calculated value.

For determination of the value of the output capacitance for a Pi net, the standard



Current test of various Illumitronics air wound ribbed coils of tinned copper wire except one #11B & S aluminum wire.

F. MC	Coil diam.	Wire size	Turns spacing	I RMS
2.5	2½"	#12	5/32"	6.5 A
2.5	3"	#10	¼"	11 A
2.5	2½"	#17	3/32"	2.7 A
2.5	3"	#11	¼"	10 A
2.5	3"	#10	3/16"	8.5 A
2.5	3"	#11 alumin.	3/16"	8 A
2.5	3"	#14	⅛"	4.5 A
2.5	3"	#11	5/32"	8.5 A
16	3"	#11	5/32"	3.5 A
16	3"	#10	¼"	6.3 A
16	2 1/5"	#14	¼"	4.5 A
16	3"	#10	3/16"	5.3 A

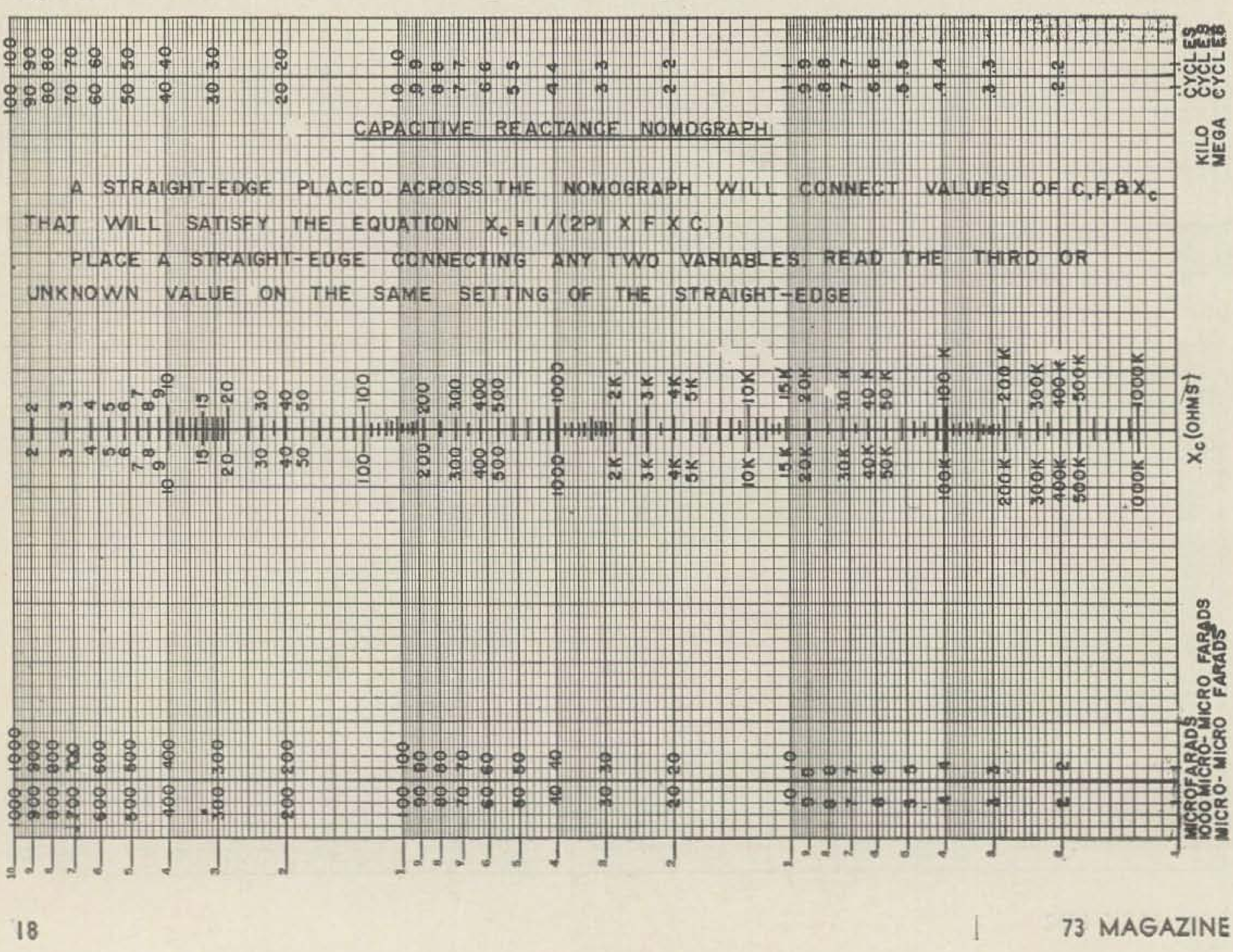
Current test of copper tubing air wound rf coils.

F. MC	Coil diam.	Tube size	Turn spacing	I RMS
16	3"	⅜"	⅝"	14
16	3"	¼"	⅝"	11.5
16	3"	¼"	7/16"	10
16	3"	¼"	⅜"	8
16	3"	3/16"	⅝"	10
16	3"	3/16"	½"	9
16	3"	3/16"	⅜"	8
16	3"	3/16"	¼"	6.3
16	3"	⅛"	⅝"	8
16	3"	⅛"	½"	8
16	3"	⅛"	⅜"	8
16	3"	⅛"	¼"	7
16	3"	⅛"	3/16"	5.3
2.5	7"	⅜"	11/16"	30
2.5	3"	¼"	⅝"	20
2.5	3"	¼"	½"	18
2.5	3"	¼"	⅝"	20
2.5	3"	¼"	½"	18
2.5	3"	¼"	⅜"	17
2.5	3"	3/16"	7/16"	16.5
2.5	3"	3/16"	⅜"	15
2.5	3"	3/16"	5/16"	14
2.5	3"	3/16"	¼"	9.5

handbook formula seems to be quite satisfactory. If the output condenser of a Pi net fails to control the load properly (assuming a proper load), the trouble is probably that the Q is too low. It may be corrected by taking off a turn or two of coil and increasing the input condenser.

It pays to check the actual efficiency of an amplifier. If the efficiency is below about 60% it may well be that the Q is too low. Again reduce the inductance and increase the input capacitance until reasonable efficiency is obtained.

In tuning a Pi net, consider that the output capacitor is shunting the rf to ground. Start



with maximum capacity on the output or loading capacitor. Tune the circuit to resonance with the input capacitor. Note the deep plate current dip. Do not stay at this point long unless you have a heavy duty tank coil. Reduce the output capacitor, thereby shunting less rf to ground and more rf will remain available for the load. Redip the plate current of the final. Continue reducing the output capacitor and redipping the final until proper loading is obtained.

An examination of the graphs for determining the output condenser of a Pi net may explain why Pi nets sometimes become balky or refuse to cooperate the way we think they should.

Suppose we have a 3000 volt, KW rig, (one third amp). The plate load should be approximately one half the dc load the power supply sees. This figures out to 4500 ohms Rp. If the antenna is actually 50 ohms (happy day), a Q of 15 would work well and even a Q of 10 would be OK. But if the antenna were to present a load of only 20 ohms to the amplifier, a common possibility, (SWR 2.5), a Q of 15 would barely make it, and any lower Q would refuse to load. Solution: either correct the load or increase the Q.

The graphs also show that high impedance tubes require a high Q for operation of a Pi net. If a broad tuning amplifier is desired, a low Q is necessary, and this dictates low impedance amplifier tubes.

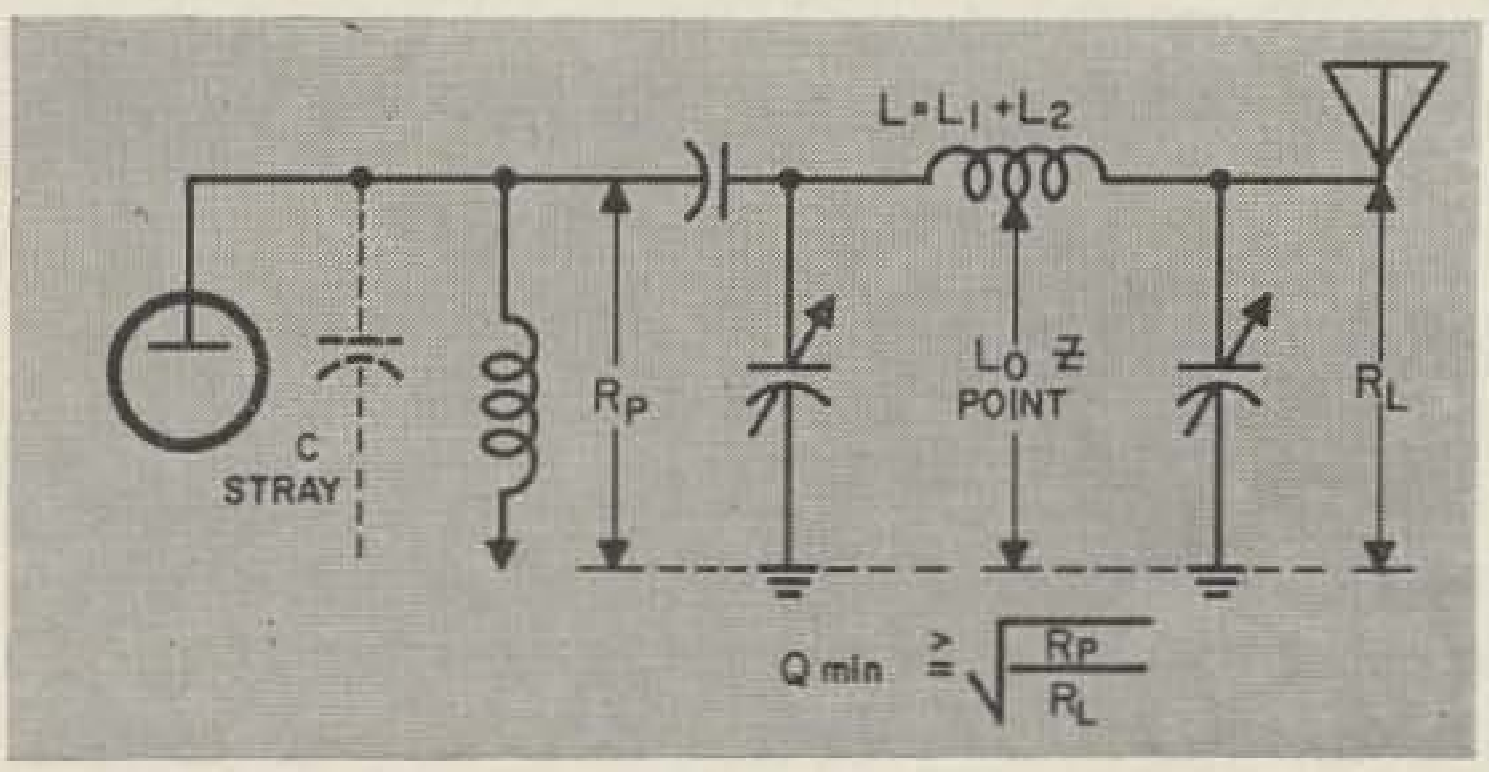


Fig. 5

For example, from the Eimac catalogue, two 304TL tubes could be run as a linear amplifier at 1500 volts and 1140 ma. This figures a plate resistance of about 650 ohms. Now a Q of 8 could be used. This would result in a linear amplifier that would broadband across most of an amateur band. . . . W6JAT

Converting 6 Volt Radios To 12 Volts

Warren Rudolph W4OHM
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Winchester, Virginia

SINCE 1954-55 most automobile manufacturers have changed over to 12 volt systems, with the result that thousands of 6 volt radios are available for next to nothing from used car dealers, junk yards and radio repair shops. In addition many hams have 6 volt mobile units which are useless on the newer 12 volt cars unless a complete conversion job is performed on them. Most amateurs hesitate to attempt a 6/12 conversion either because of the work involved or else because of the expense. The purpose of this article is to illustrate an extremely economical conversion method and at the same time one that is not beyond the ability of the average ham.

The author has converted a considerable number of 6 volt units to 12 volt operation, including such transmitter-receiver units as the Link 2365, which uses a dual transformer, dual vibrator, voltage doubler power supply; the Link 2210 which uses a single transformer, single vibrator, voltage doubler power supply; Motorola FMAR-13V and Link 35-UFM receivers, which use conventional full wave vibrator power supplies; and a number of broadcast receivers such as the Motorola 505, which is the subject of this article.

In each instance the performance has equaled the original 6 volt performance. Some of the Link and Motorola units have seen 24 hour a day police service for the past couple of years and the 12 volt conversion has been in every way equal to the original 6 volt system.

While the unit covered here is the Motorola 505 broadcast receiver, the principles involved are adaptable to just about any piece of mobile radio gear using vibrator type power supplies. Of particular interest to hams is the conversion of broadcast receivers since many mobile units consist of a multi-band converter working into a regular broadcast receiver. However, the amateur should not overlook the many bargains now available in commercial 2 way gear of the 6 volt variety as these units make excellent RACES, AREC or amateur net units and many of the ham clubs around the country are beginning to set up 10, 6 or 2 meter nets using this type of equipment.

Details

Examine the filament circuit and the general wiring layout. At this point begin the rewiring of the filaments for series-parallel operation. Keep in mind that it is not necessary to rewire each filament pin since one pin of each tube filament is already grounded and the other is hooked to the hot "A" line. It is only necessary to break the hot line to the first tube and the ground connection to the 2nd tube and connect a wire between these two pins. Fig. 1 gives the before and after circuit of the filament wiring. Be careful to obtain the 12 volt filament current from the same point as the original 6 volt current was obtained in order to take advantage of the hash interference chokes, etc. In the case of the 6X5 rectifier tube you will not be able to follow this exactly as the 6X5 filament power was originally obtained from a different tap on the circuit from the other tubes. Also, since the 6X5 and 6V6 must be paired together and there is a difference of .15 ampere in the filament current it will be necessary to parallel the 6X5 filament with a 39 ohm 2 watt resistor (the figure actually works out to 40 ohms but 39 ohms is the nearest stock resistor and for this purpose is close enough).

Modifying The Vibrator

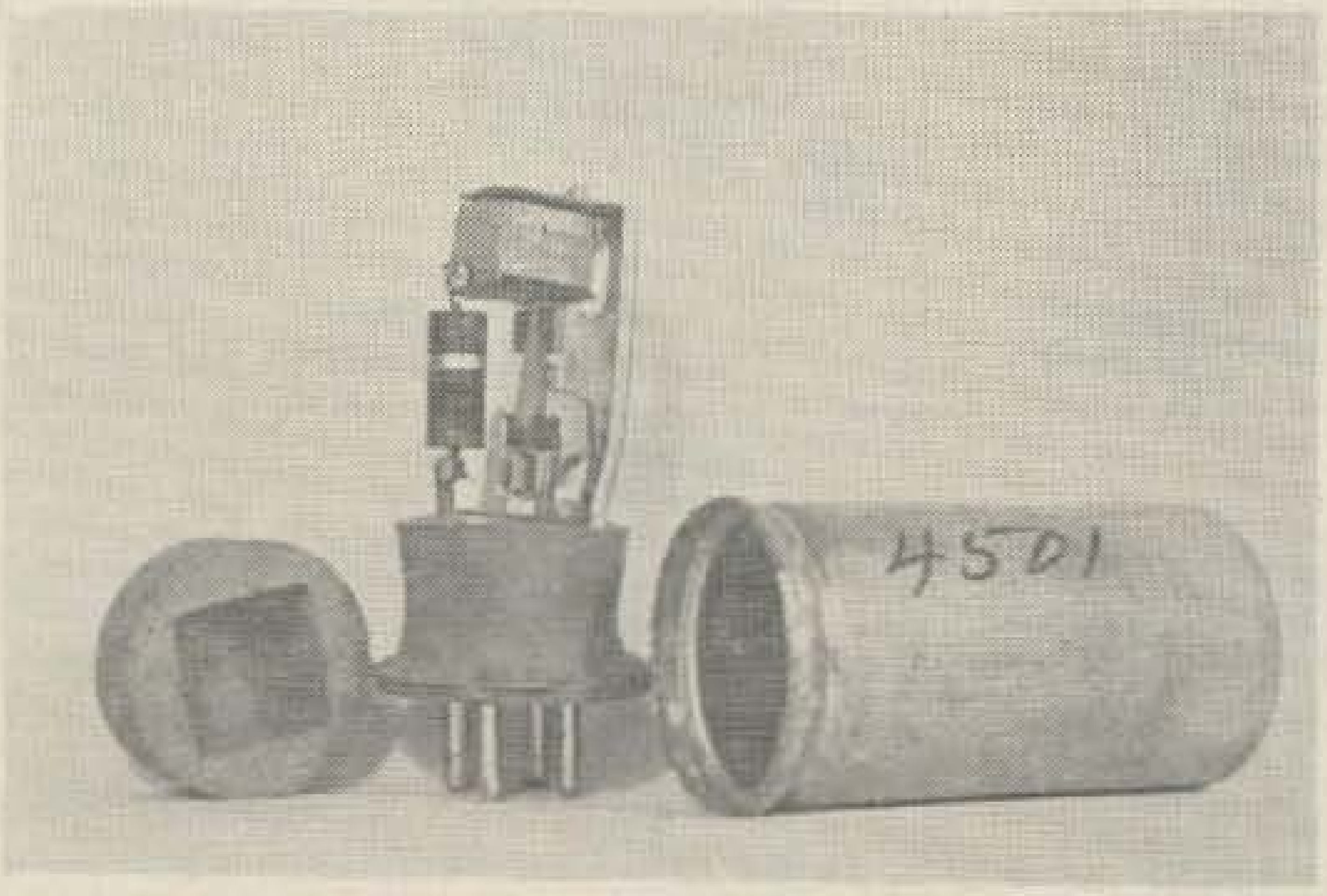
Of course the simplest way here would be to merely replace the 6 volt vibrator with its 12 volt equivalent. However, this requires a needless outlay in cash as the old vibrator probably has a considerable amount of useful life remaining.

Remove the vibrator from its socket. With a pair of side cutting pliers, carefully pry open the crimped edge of the bottom of the vibrator can and remove the vibrator assembly from the can. Remove the sponge rubber cap from the top of the vibrator mechanism and carefully examine the parts arrangement. At the top of the assembly you will find a small coil of wire, one end of which will be attached to the vibrator frame. From the other end of the coil you will note a wire running either to a separate pin on the vibrator base or else to the same terminal point as one of the vibrator contacts. Cut this wire and with an ohmmeter measure the resistance of the vibrator drive coil. This will usually average from 9 to 15 ohms (15 ohms in the vibrator in the 505 modified here). After determining the resistance of the coil, determine by Ohms' law the amount of current it will draw at 6 volts. This is determined by dividing the 15 ohms resistance into the 6 volts, which gives a result of .4 amperes of current. Multiply the .4 ampere

current by the voltage to obtain the wattage, which in this case is 2.4 watts. Actually the current drawn during operation is less than this amount due to the fact that the vibrator is constantly interrupting the flow of current through the coil. Measurements taken here indicate a duty cycle of about 40% as the current actually being drawn by the coil was 160 ma. Therefore our actual wattage is .96 watts and a 2 watt resistor is more than adequate.

Solder this resistor between the same points originally connected by the wire removed in the preceding operation and position the resistor so that it will not short to the vibrator frame. Replace the sponge rubber cap on the mechanism and reinsert the vibrator into its can. Re-crimp the edge of the vibrator can over the insulated base plate and reinsert the vibrator in its socket.

This completes the vibrator modification and will permit using the 6 volt vibrator on a twelve volt system to the end of its useful life. When the modified six volt vibrator finally "gives up the ghost" merely replace it with the 12 volt equivalent. To make sure that someone does not accidentally replace it with an unmodified 6 volt vibrator it is suggested that a printed tab be pasted on the vibrator can stating, "This vibrator has been internally modified for 12 volt use. When it becomes necessary to replace this unit, do so with the 12 volt equivalent of this vibrator."



Note: Some vibrators use a series drive coil which is connected to a separate pin on the base plate. The 505 is wired to use either the series or parallel type vibrator and with the series drive type of vibrator it is possible to wire the resistor into the circuit under the chassis by putting it in series with the wire running to the vibrator pin feeding the drive coil. This will eliminate the necessity of opening the vibrator can but it will require that all future replacements be made with 6 volt vibrators. Since this actually results in slightly more current being drawn from the battery than the straight 12 volt vibrator and also due to the ensuing confusion from having to replace a vibrator on a 12 volt system with a 6 volt vibrator it is suggested that the resistor be mounted inside the vibrator can.

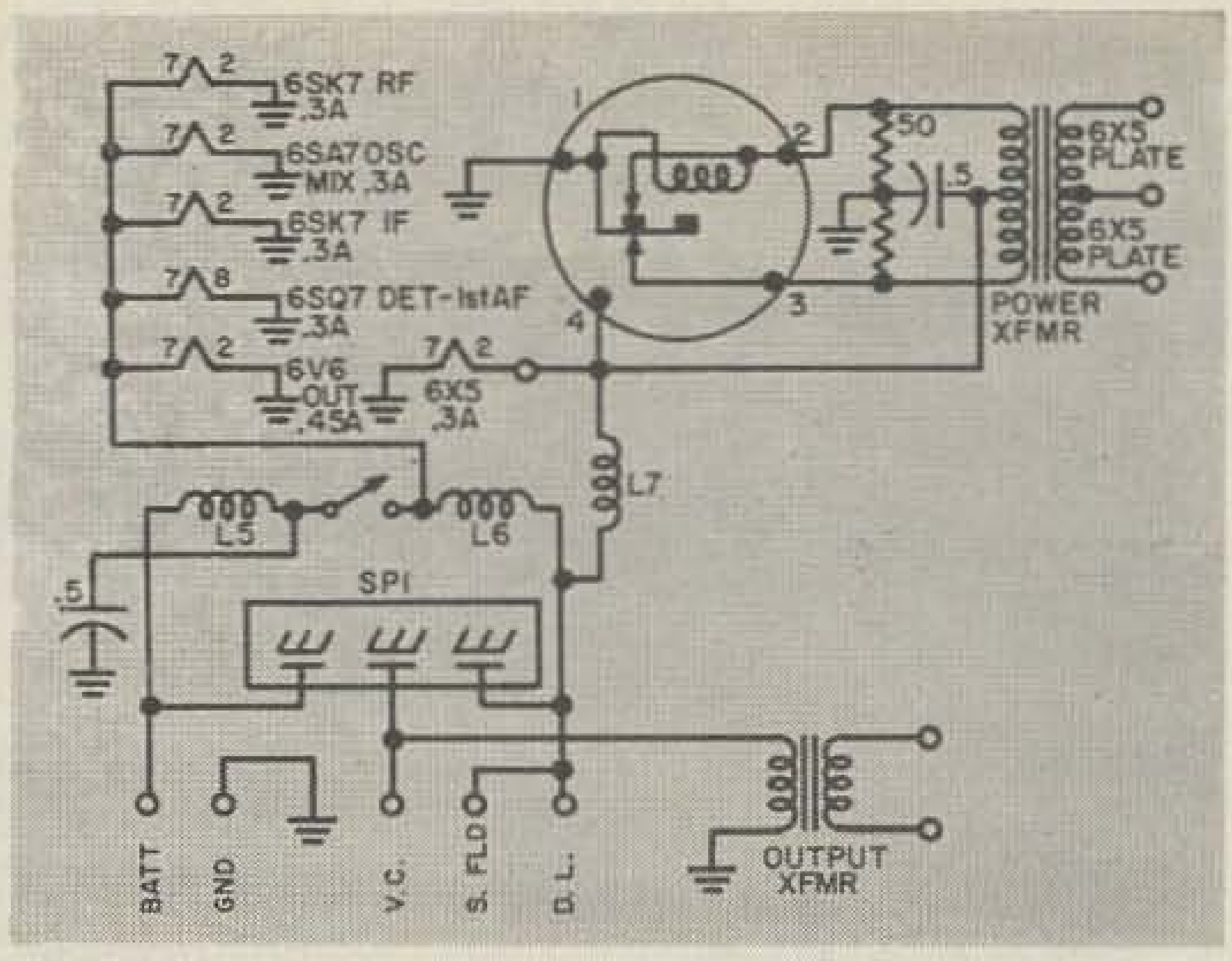


Fig. 1A

Modifying The Transformer

The transformer in the Motorola 505 is of the potted type and is held to the chassis by 4 self tapping screws which run through the chassis and up into pre-formed slots in the corners of the transformer cover. Examine the underside of the chassis and make a sketch of the placement of the transformer wires and the color coding on each wire so that you can re-attach the wires of the modified transformer to the correct points. Cut or unsolder each wire from the pin or tie point to which it is attached, remove the 4 self tapping screws and remove the transformer from the set. Remove the piece of cardboard from the inside bottom of the transformer can and chip away enough of the transformer pitch to enable you to get hold of the transformer core with a pair of pliers. Be careful not to damage any of the wires or insulation. Next, place the transformer, open end up, in an old coffee can or other container and "borrow" the XYL's hot plate for a few minutes. Take the hot plate and transformer outside or into a work area as the next step will create some slight smoke and fumes. Place the can containing the transformer on the hot plate and turn it on. Watch the operation closely as it will not take too long for the pitch to heat sufficiently to allow you to grasp the transformer can with one pair of pliers and the core with another pair of pliers and pull the transformer out of the can. Do not pull on the wires during this operation as you may tear the paper insulation or even pull out a wire or cause a short in the secondary. The primary is not important at this point as we are going to discard it anyway. After removing the transformer from the can, carefully chip away all the pitch still remaining on the metal and paper parts of the transformer. Now examine the transformer laminations carefully.

Take a blunt chisel or punch and carefully tap the outermost lamination out of the transformer winding. After the first one is gotten out on each side the job will loosen up and go

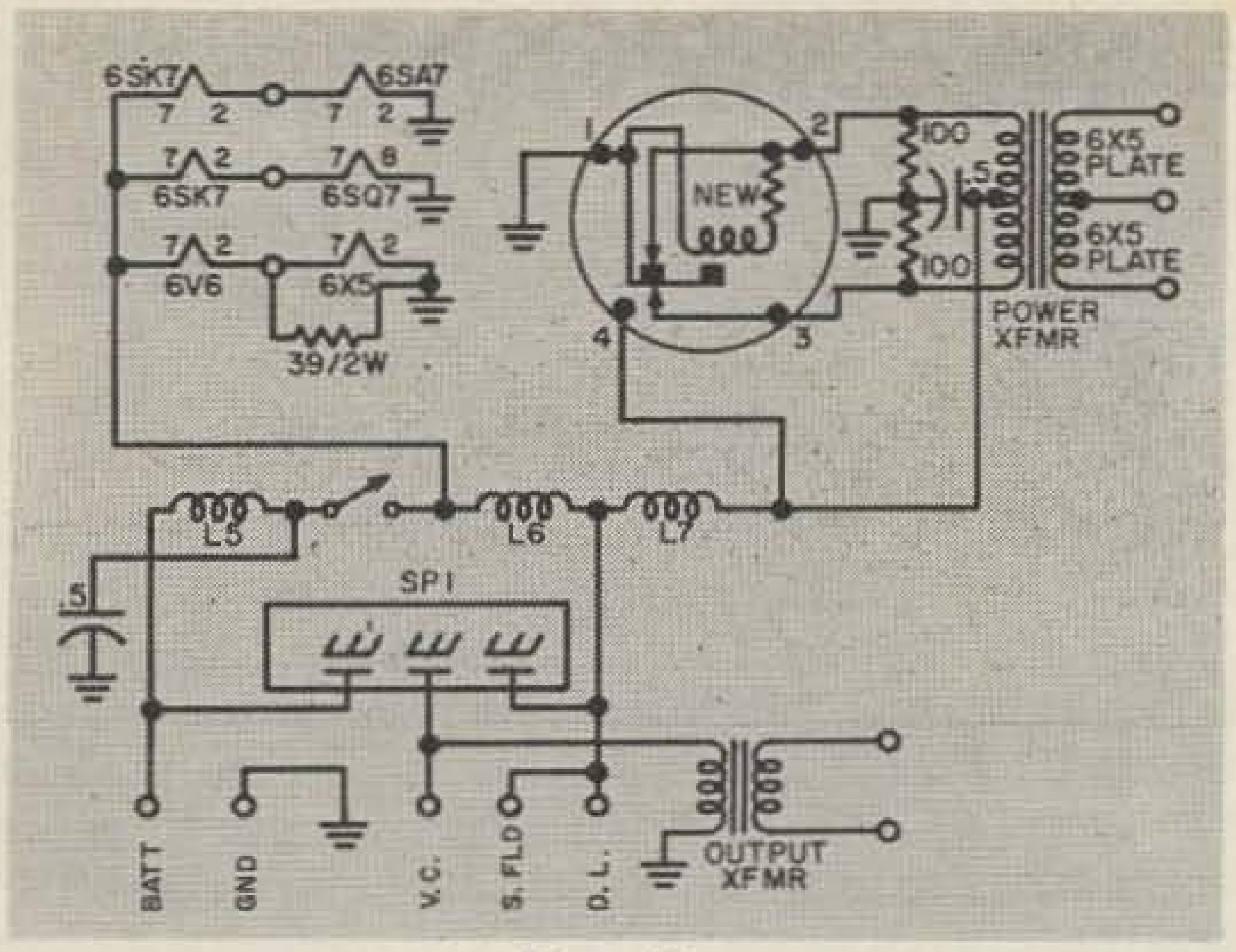


Fig. 1B

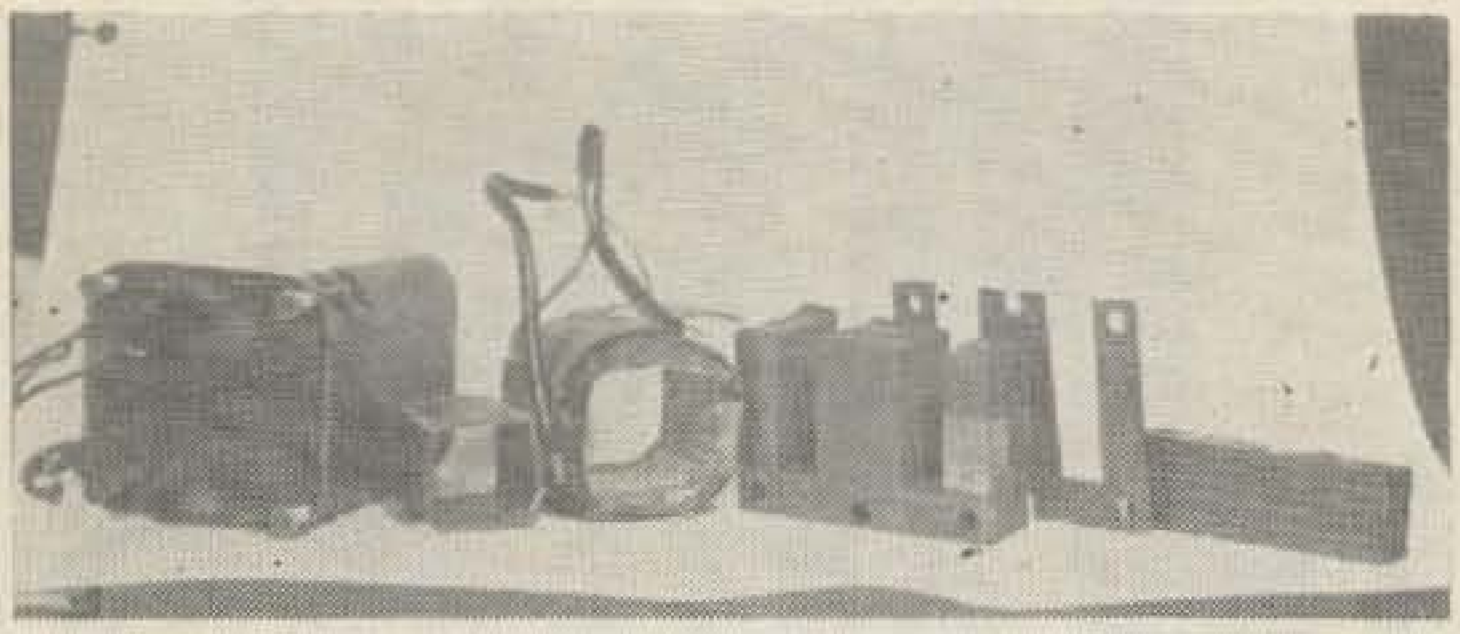
a little easier with the remaining ones. Remove the "E" and "I" sections one at a time and lay them temporarily aside.

The above steps have completed the core disassembly and we are now ready to go to work on the windings. On the 505 transformer modified here the primary winding was on the inside next to the core. However, this may not be the case on all units as some have been found with transformers which had the primary winding on the outside and the secondary inside next to the core.

If the primary winding is on the outside in your unit you merely have to remove the outer layer of paper to reach the end of the outermost winding and start unwinding. However, if your unit is like the one here and has the primary winding on the inside, then you will have to proceed as follows to avoid destroying the center winding form.

Locate the innermost end of the primary winding and note its color code. (1) Carefully start to pull this wire out the side of the winding and keep careful count of the number of turns pulled out. With a little care the wire will pull out the side as it unwinds. After the first layer is unwound you will be able to pull the inside cardboard form out and can then proceed a little more rapidly. Keep count of the turns until you reach the center tap and at that time note the color code on the center tap and the number of turns you have removed. (2) Make a written record of this as you will need the information later when you start to rewind the core. Proceed from the center tap on to the other end of the winding and again note the color code. (3) This has completed the disassembly of the winding.

The 505 six volt transformer is originally wound with #18 Formvar enamel covered copper wire, and has a total of 28 turns each side of the center tap. Since we want to operate the rewound transformer on 12 volts, the current will be cut in half. We therefore want to rewind the transformer primary with twice the number of turns but with wire of half the size. In order to cut the size of the wire in half we must move 3 wire sizes. Most radio sup-



ply houses stock only even numbered sizes so we will rewind our transformer with either #20 or #22 wire and our rewound primary will consist of 56 turns of #20 or #22 wire each side of the center tap or a total of 112 turns in all.

Saw out or otherwise obtain a wooden block about 8" long and of a width and thickness sufficient to snugly fit the inside of the square cardboard tube removed from the center of the coil.

Select an 8 inch length of insulated hookup wire of the same color as the lead attached to the #3 end of the original winding and attach this to the end of the #21 wire with which you are going to rewind the coil. Attach this wire to the cardboard form with Scotch tape. Start the winding about one eighth inch in from the edge of the cardboard form but allow the insulated wire to run the first half inch of the first turn. Proceed with the winding, being careful to keep the turns tight and close together but not overlapped. When you reach a point one eighth inch from the other end of the cardboard tube, hold the winding securely and wrap a single layer of either transformer paper or a good grade of thin linen cloth around the wire layer wound so far. Now continue the winding being sure the turns continue in the same direction around the coil form but lapping the winding back over the layer just completed. When you reach the 56 turn point, bring the wire out of the coil for a distance of eight inches, make a sharp bend in the wire and take it back into the coil. Twist this 8 inch lead to make a "pigtail" and slide a piece of spaghetti over this double center tap, being sure to use the same color spaghetti as the original center tap in step 2, and continue the winding. Take care to adequately insulate the center tap lead and make sure that you continue the second half of the winding with the turns going in the same direction as the first half. When you have completed another 56 turns, securely fasten another 8 inch lead to the end of the wire. Use the same color lead as the lead removed from the original primary in step 1. In making all of the taps be sure to scrape the wire clean of the enamel covering before soldering, otherwise you will have a poor connection or no connection at all. Place a layer of transformer paper or thin linen cloth over the winding just completed and secure the entire assembly with Scotch tape. Take a piece of hard plastic or a rubber mallet and gently tap the sides of the winding to make them as nearly square as possible. Now reinsert this completed winding back into the inside of the secondary which we have not disturbed. If it tends to fit loose, work shims of paper in between the two windings to make a snug fit.

Reassembling The Core

Insert one of the outside "E" laminations (one of the two long ones) into the core. Now, from the opposite side insert another "E" lamination and place an "I" lamination across its end to close the "E". Continue this process by running the "E" and "I" laminations in from alternate sides so that every other "E" lamination comes in from the right with an "I" on the left and the remaining "E" laminations come in from the left with an "I" on the right. When all regular size laminations have been replaced, carefully slide the remaining long lamination back into place. This completes reassembly of the core.

Place the transformer back into the can and shim up the sides with paper or thin cardboard to make a snug fit. Dress the wires out of the can at the same position as the original wires and replace the cardboard bottom plate in the can. Replace the 4 self tapping screws and re-attach the wires to the same points from which they were removed. This completes the modification of the transformer and since the secondary was not bothered and the primary turns were increased by the same ratio as the primary voltage, we do not need to change the buffer condenser.

The only remaining changes to be made are as follows: The vibrator pins to which the outside ends of the transformer primary winding is attached, each have a 50 ohm ½ watt spark suppression resistor from the contact to ground. Replace these with 100 ohm 1 watt resistors, and physically position the replacements as nearly as possible in the same position occupied by the original resistors. Replace the pilot light bulb with a 12 volt equivalent and replace the fuse with one of half the amperage rating of the original.

This completes the conversion from 6 to 12 volts and the receiver will equal its original 6 volt performance in every way.

COST:

One 39 ohm 2 watt filament balancing resistor	.24
One 15 ohm 2 watt vibrator modification resistor	.24
Two 100 ohm 1 watt spark suppression resistors @18¢ ea.	.36
One fuse	.12
One 12 volt pilot bulb	.17
Enamel covered wire for rewinding primary	.22
Total	$1.35

. . . W4OHM

RX for the RTTY Bug

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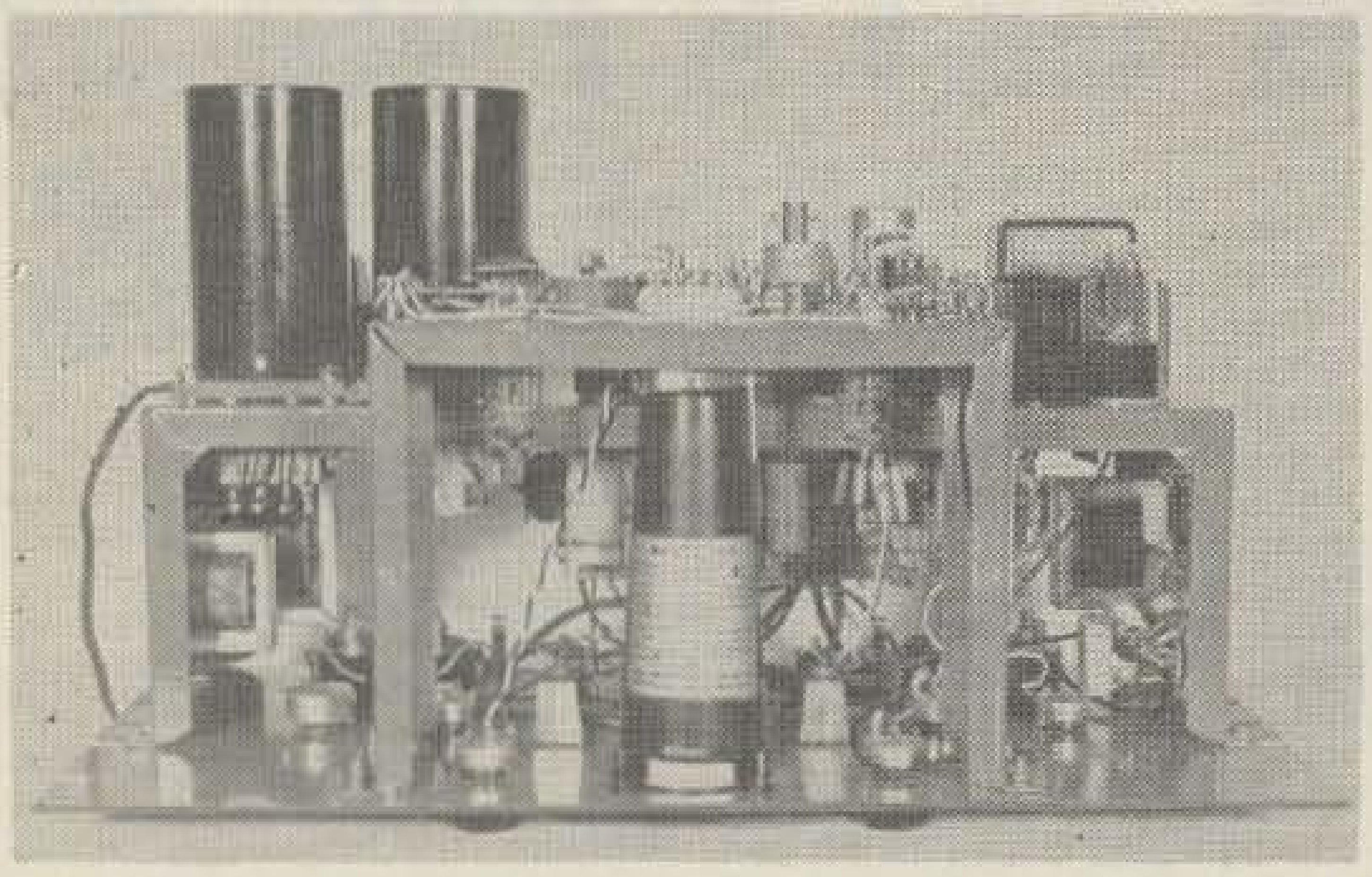
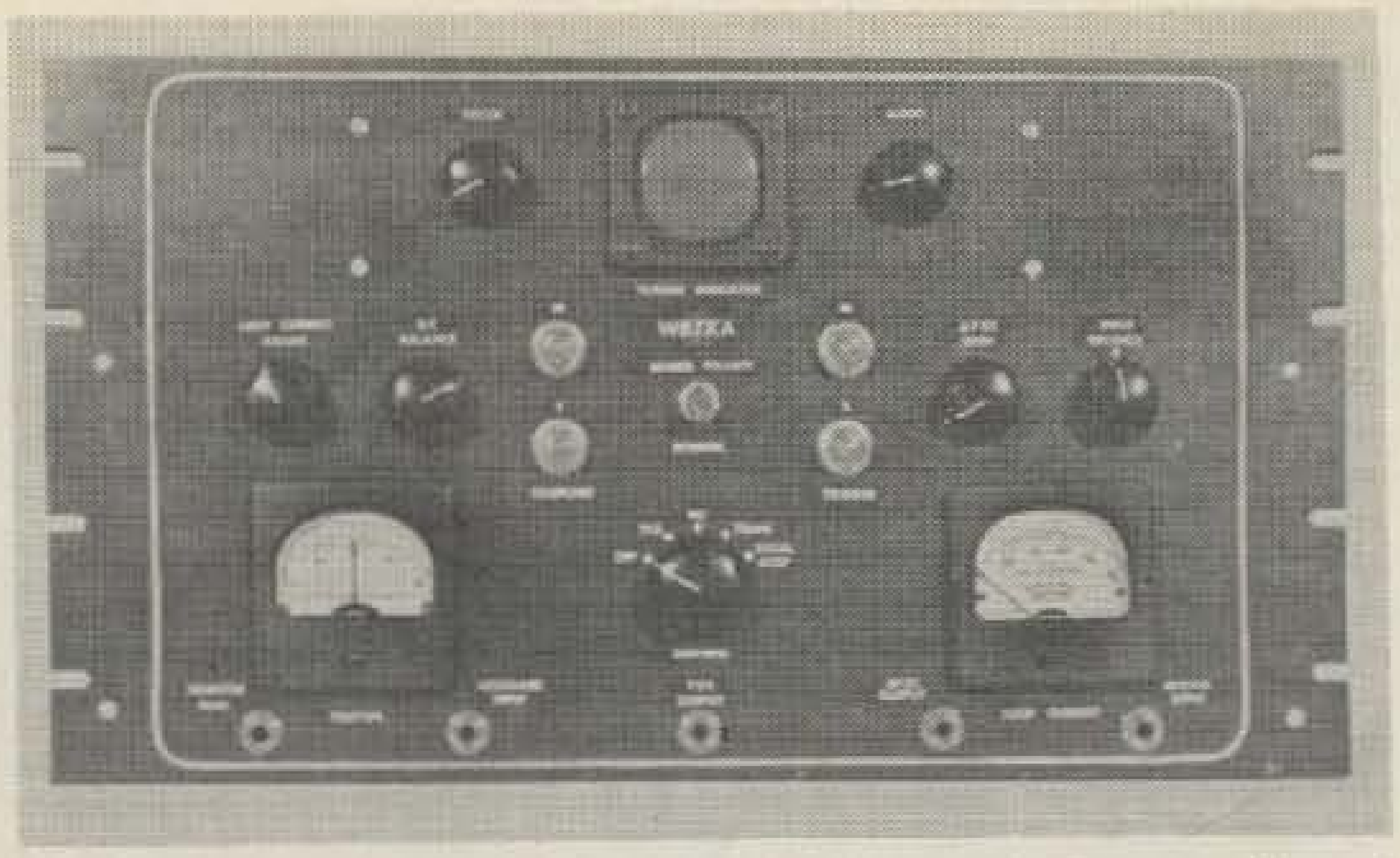
A few months ago I attended a local radio club meeting to observe a demonstration of RTTY equipment. Although at the time I was only mildly interested, the RTTY bug bit me hard a few weeks later. Visits to several active RTTY stations gave me a better picture of just what was involved in a RTTY installation. From these visits, along with searching through the RTTY columns in back issues of CQ plus studying a well-worn copy of the RTTY handbook, I designed and built my terminal unit. The unit described in this article is serial number two that I built for WøZKA 'MAC', and will cost the builder about $100 if all new parts are used throughout.



This terminal unit has two polar relays in the output. One relay is used to control the printer and the other is for keying the FSK input of a transmitter. An AFSK oscillator[1] output is provided for VHF RTTY work or may be fed to the microphone input of a good SSB transmitter for high frequency FSK operation. An adjustable 110V dc power supply is built into the unit for printer operation. A scope type RTTY tuning indicator[2] was included to aid in fast accurate tuning. The 500 ohm output from the receiver is fed to a band pass filter[3] which limits the input frequency response from 2000 cycles to 3000 cycles.



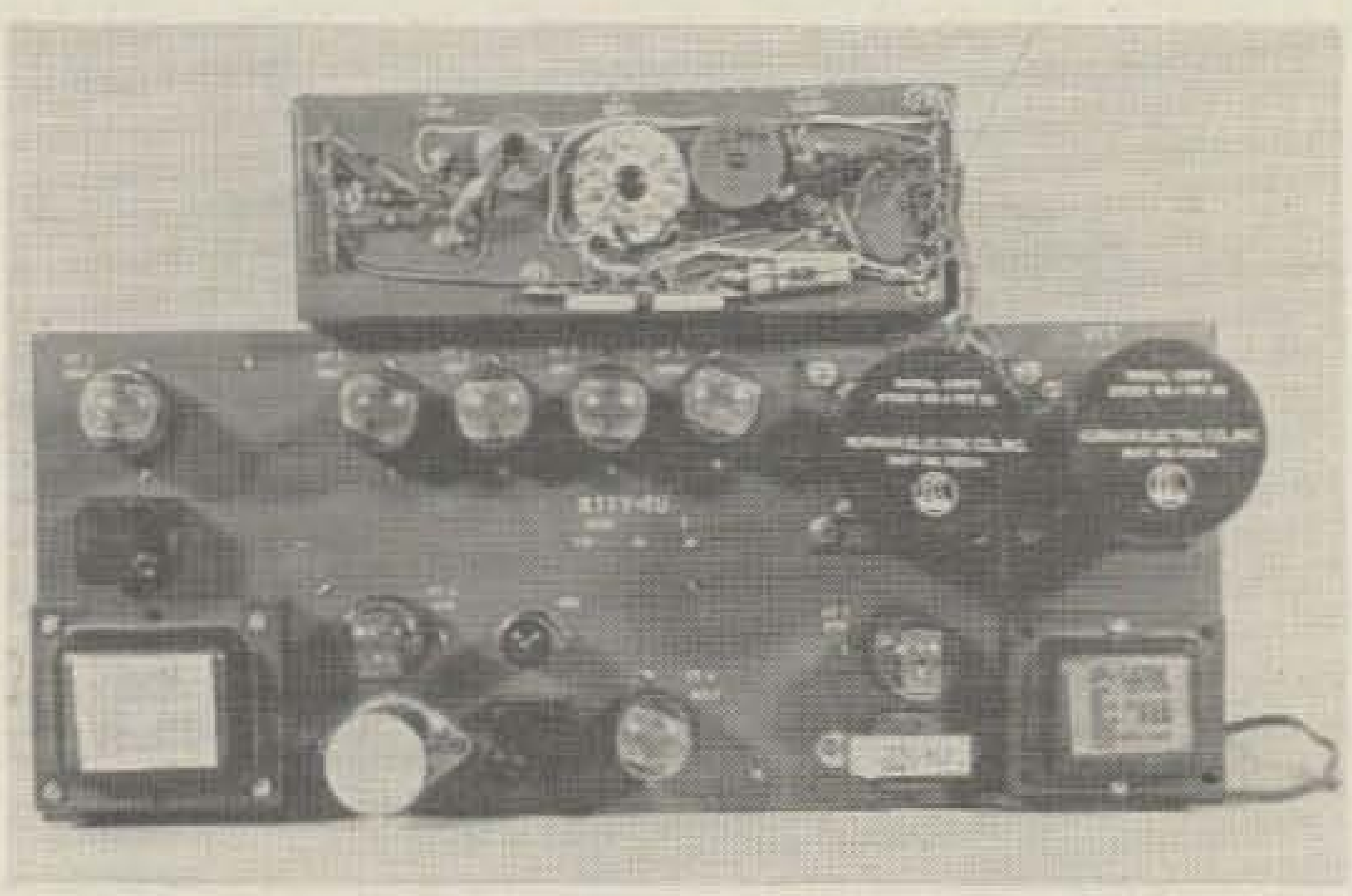
The circuit is a combination of the popular W2PAT[4] and W2JAV[5] systems. Front panel control is provided for all adjustments of the terminal unit. As with any W2JAV type terminal unit, good copy is possible with either the mark or space signal.

Construction

The front panel is 10½" x 19" x ⅛" hammertone gray finished aluminum. When the holes were all laid out and drilled, the panel was washed in soap and water to remove the grease and dirt. A thin ⅛ inch of strip of masking tape was applied to the front denoting the stripe. The panel was then sprayed with two coats of Krylon machine grey paint. When dry the masking strip was pulled loose revealing the stripe. After the panel components were assembled to the panel, the decals were applied and set.

The main chassis is a Bud panel Chassis CB-1373, and is 17" x 5½" x 7". The scope chassis was hand formed from aluminum and is 6" x 9" x 3". The condensers and resistors are mounted on terminal boards made by bolting long terminal lug strips on aluminum brackets. These are then fastened up-right next to the associated tube socket. After all the major holes were punched in the chassis, it was washed, painted with Krylon light grey, and decalled.

The toroids are attached to the chassis by long brass screws. The screw is insulated from the toroid by spaghetti tubing. A small square of scrap felt insulates the toroid from the



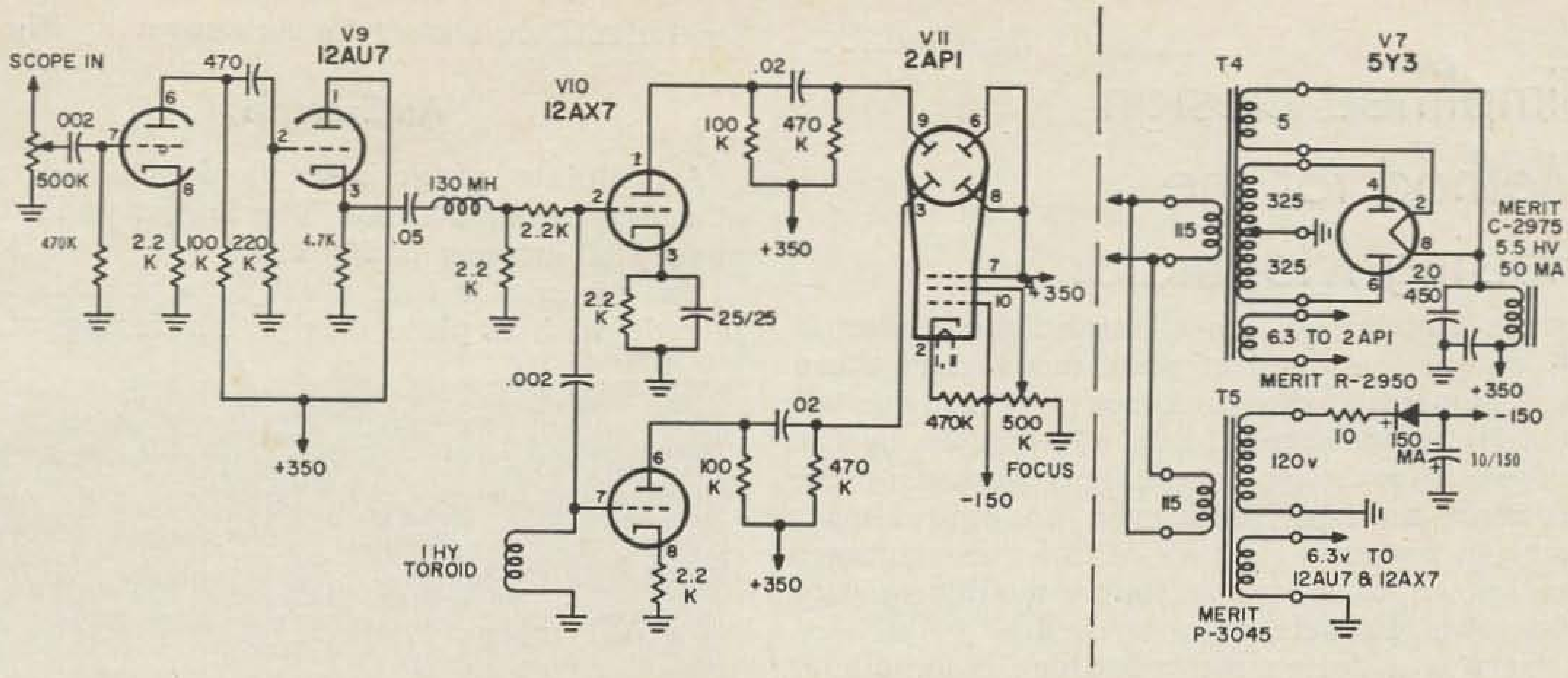
[1] Fig. 4 AFSK Oscillator Schematic Diagram CQ, April, 1958, page 45.

[2] FSK Tuning Indicator—RTTY Handbook, Green and Kretzman, page 65.

[3] W2JAV Input Filter—RTTY Handbook, Green and Kretzman, page 72.

[4] An inexpensive radio teletype converter W2PAT QST, January, 1953.

[5] An Improved Radio Teletype Converter W2JTP CQ, April, 1958, page 42.



Tuning Indicator

metal chassis. After the front panel and chassis are prewired, check for proper wiring and soldering. If you are like me, I missed a few solder connections. The tuning scope was wired next but was not attached to the front panel until the main chassis was tested and adjusted for proper operation.

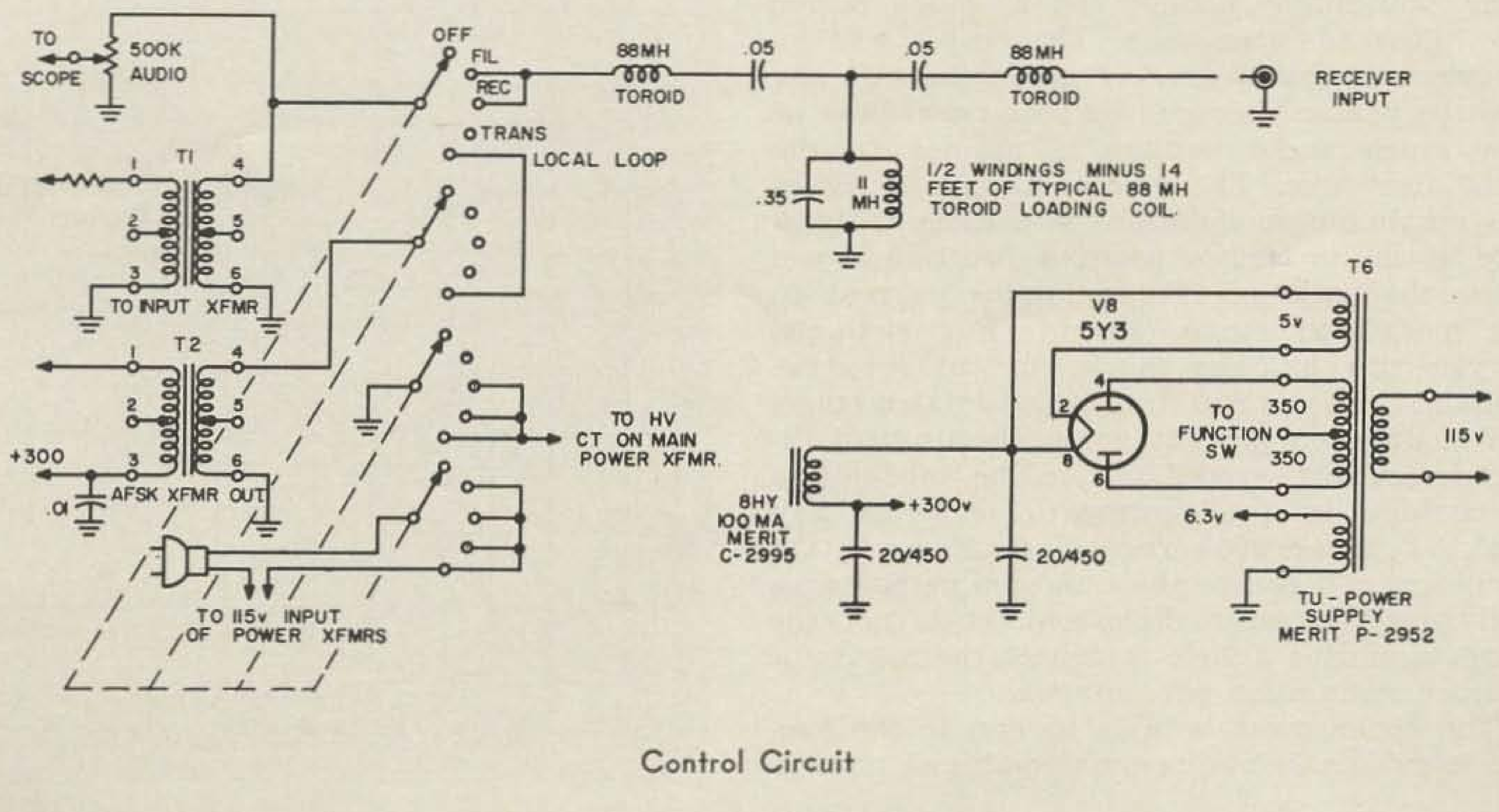
Adjustment

When the front panel has been attached to the main chassis, plug in the polar relays and all tubes, except the 5Y3 rectifiers. Turn on to "FILS" and check to see if all heaters light up. Then plug 5Y3 tube in the proper socket to provide high voltage to main chassis. Set function switch to "REC" and adjust "DC BALANCE" until the "TELETYPE" meter reads "O". Feed in receiver background noise to "RECEIVER INPUT" and adjust "INPUT BALANCE" till "M&S TRIGGER" lights glow evenly. Loosen and reset "INPUT BALANCE" pointer to center mark below title. Disconnect receiver background noise from "RECEIVER INPUT" and feed in test audio signal of either 2215 or 2975 cycles. I found that on both terminal units I built, the mark filter (2215 cycles) was correctly tuned but the space filter (2975 cycles) was low in resonant frequency. A slight amount of juggling in capacitor value was necessary to bring it up to the proper resonant frequency. This completes the adjustment of the TU.

Operation

To put the TU into service, connect the output of the receiver (500 ohms) to "RE-

(Turn to page 29)



Control Circuit

James L. Tonne W5SUC

Simplified Design Method for the Heising Modulator

THE Heising or choke-coupled modulator is one of the simplest plate modulators there is. Frequently, the junk box will provide all of the needed parts. But a complete design procedure covering every aspect takes of the order of an hour, and even an approximate solution assumes that all of the tube voltages are known, and further that a modulator tube of known characteristics is used.

Here is a design method which is simplicity in itself and involves only the simplest of calculations. It will yield a circuit design which technically is indisputably correct and conservative.

How to do it

First select the modulator tube. It should be a pentode or tetrode, with a plate dissipation rating equal to or greater than the power input to the modulated stage.

Next, connect the tube as shown in Fig. 1.

Finally adjust the cathode resistor until the plate current in the modulator tube is the same as the plate current in the modulated stage. That's all there is to it!

With the application of audio voltage as shown, the modulator will be able to modulate the modulated stage 100% in the upward or positive direction and about 90% in the downward or negative direction.

How to be sure it's OK

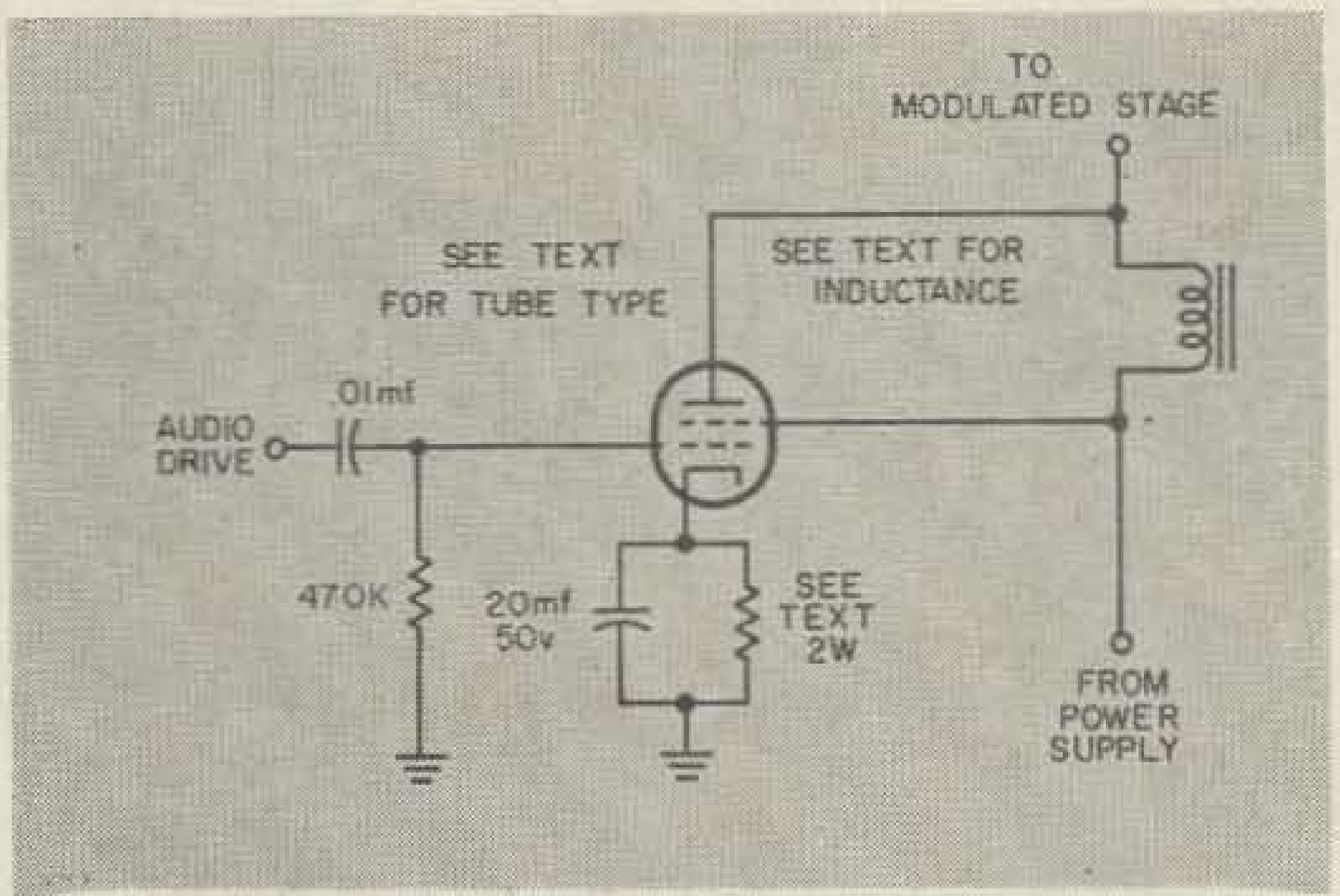
For long tube life, do not run more power into the modulator tube than its plate dissipation rating will allow. If you must use a tube of small plate dissipation as the modulator, you simply cannot run as much power into the modulator tube. The result will be a lower possible degree of modulation on the positive peaks. This will be true regardless of how much audio voltage is applied to the modulator tube. The graph of Fig. 2 shows the maximum modulation percentage obtainable in the upward or positive direction if you know the ratio of the modulator current to the modulated stage current. For example, if you run half as much current into the modulator as you run into the modulated stage, the modulation percentage in the upward direction cannot exceed 50%. The modulation percentage in the downward direction can peak at about 90% regardless of operating conditions. Of course these uneven percentages will result in some distortion. It is not the purpose of this article to debate the merits of various modulation percentages.

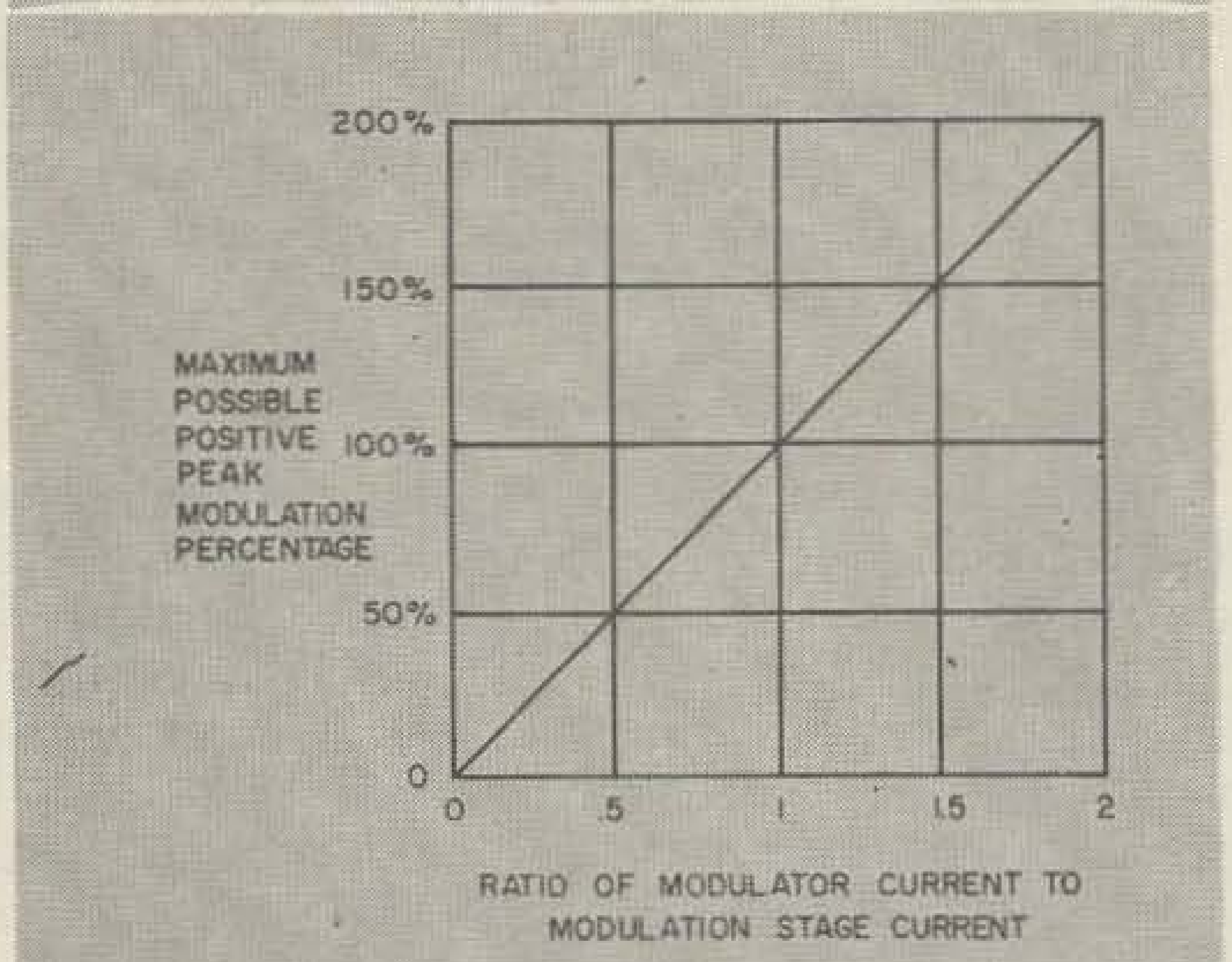
The choke must be able to handle the sum of the modulator and modulated-stage currents. Its inductance should be as shown in Fig. 3.

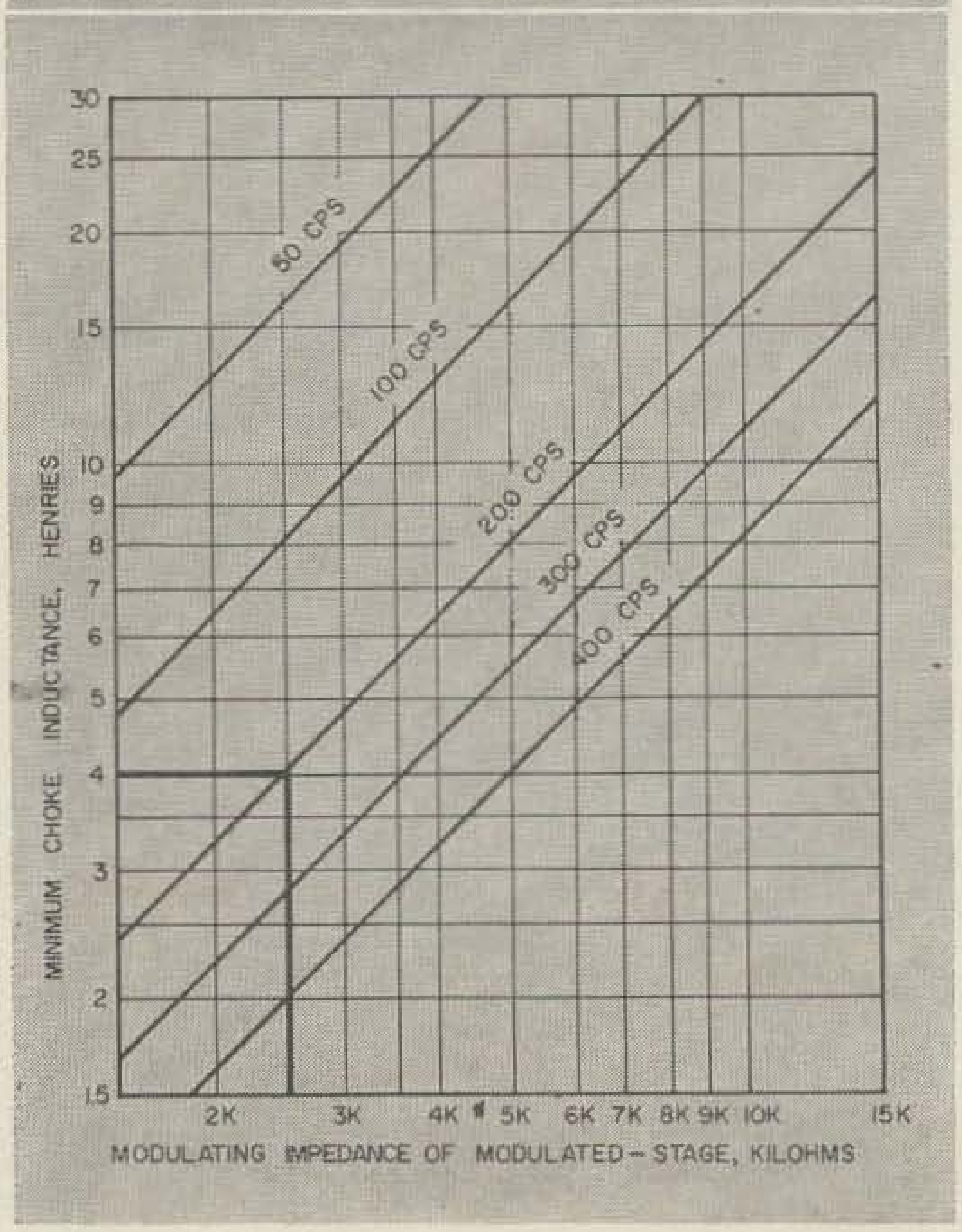
An Example

A modulated stage is supplied with 250 volts at a current of 100 ma. The lowest audio frequency of interest is 200 cps.

The modulator tube must be a pentode or a tetrode with a plate dissipation rating of 25







watts or more (250 volts times 100 ma.). The choke must have an inductance of 4 henries minimum, at a current rating of 200 ma (the sum of the modulator and modulated-stage currents). Remember that the power supply, too, must be capable of delivering this amount of current.

The typical audio drive voltage required by the modulator will be about 10 volts or so for tubes in the 25 watt category.

Sideband With Tuneable Converters

I'm sure that there are still a lot of the very good RME HF-10-20 converters and similar units around and in use. Moreover I'm also sure that the vast majority of these units are being used with older and poorer receivers with weak BFO's and, of course, no product detector circuits and the like.

Now! I'll wager that lots of these people would very much like to receive SSB #1. Cheap 2. Easy 3. Without receiver modification 4. WELL!

Here's the trick. V-e-r-y simple, and it works like a dream.

The HF 10-20 converts 10, 15, and 20 meter signals to a freq. of 6950 kc (can be varied slightly). Now, as everyone knows, there are two good ways of receiving side band signals. The first, and more or less standard way is to restore the carrier at the detector. The second is to restore the carrier in the front end. This has obvious disadvantages, since we like to tune around a bit. However, in this case, (you're way ahead of me) we're dealing with a single freq. (the conversion freq.).

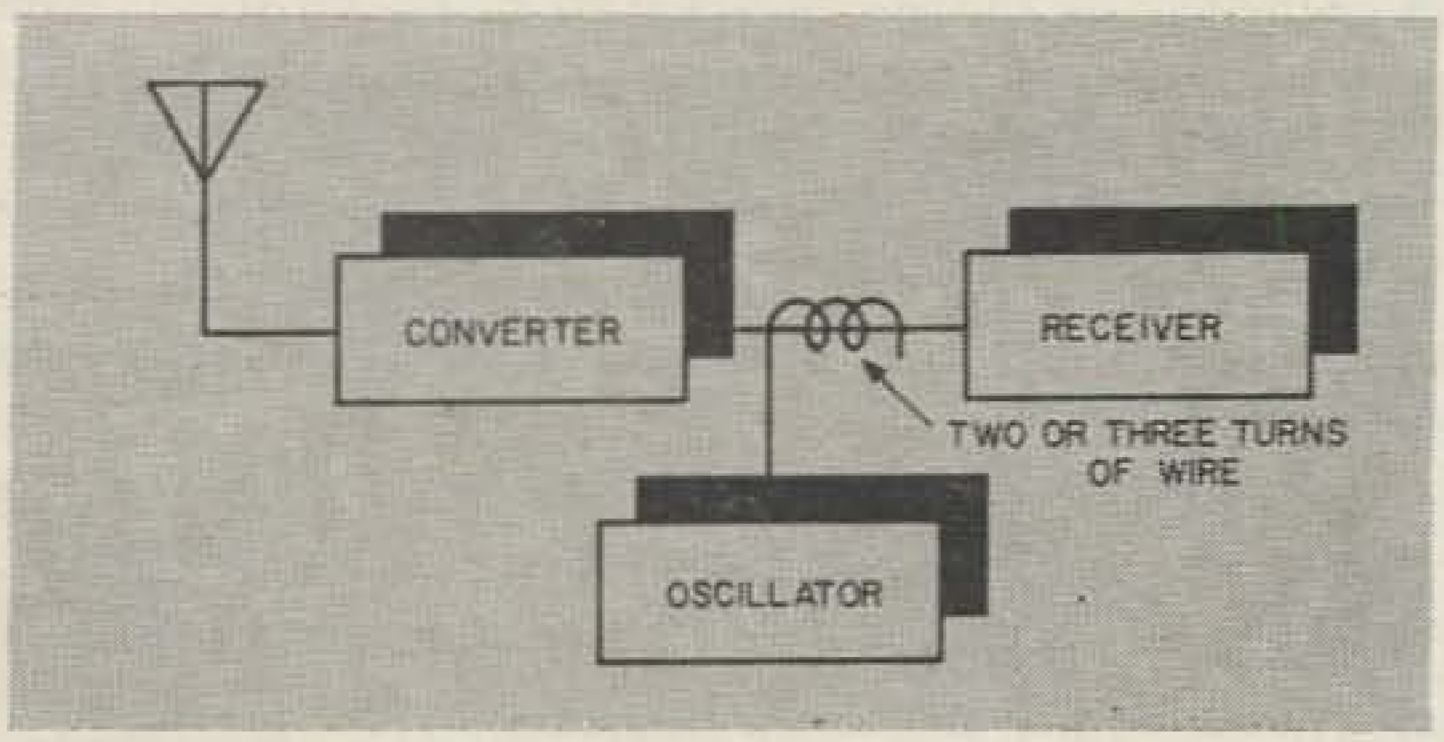
Now, if you haven't left me to plug in the soldering iron, I'll say what you know I'm going to.

The simple, easy, etc. way is this. Make a simple osc. (one tube or a couple of transistors) with a variable injection level control for the conversion freq. Connect as per the block diagram, and presto! SSB is suddenly AM. Merely tune the osc. slightly on a good, average SB signal, touch up the injection level, and there you are!

I won't give any const. details, as there are scores of circuits for an osc. of this type around.

That's it, go to it, and maybe you, too, can become a SB addict.

. . . WøWUZ



(RTTY from page 27)

CEIVER INPUT." Plug the 'Red' plug of the model 15 Teletype machine into the "SELECTOR MAGNET" jack. Connect the keyboard to "KEYBOARD INPUT" and connect "AFSK OUTPUT" to the two meter transmitter modulator. Set function switch to "FIL" and tune receiver for proper X presentation on scope, from RTTY signal. Set function switch to "REC" and adjust loop current for 30 milliamperes. (Model 15 machine). Machine should print normal copy; if not, switch polarity. To send and make a local copy, switch function to "LOCAL LOOP." Receiver output is then automatically disconnected and AFSK output is fed to the transmitter. The AFSK signal is also sent through the terminal unit and drives the printer.

My T-U has been in operation on 40 meters FSK and 2 meters AFSK for several months. No problems in TU equipment operation or malfunction have occurred. My only problem has been dirty contact points on the keyboard causing errors in copy. A good cleanup using lacquer thinner cured this problem. I would also like to add that if the reader decides to build such a unit as this, do not be worried when you come to some problems you have not expected. Just contact one of your local RTTY'ers for the answer, as he will probably have had the same or similar problem. This is because "RTTY'ers build their own."

. . . WøRQF

Sideband the Easy Way

or tricks with the 10A

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Gary 3, Indiana

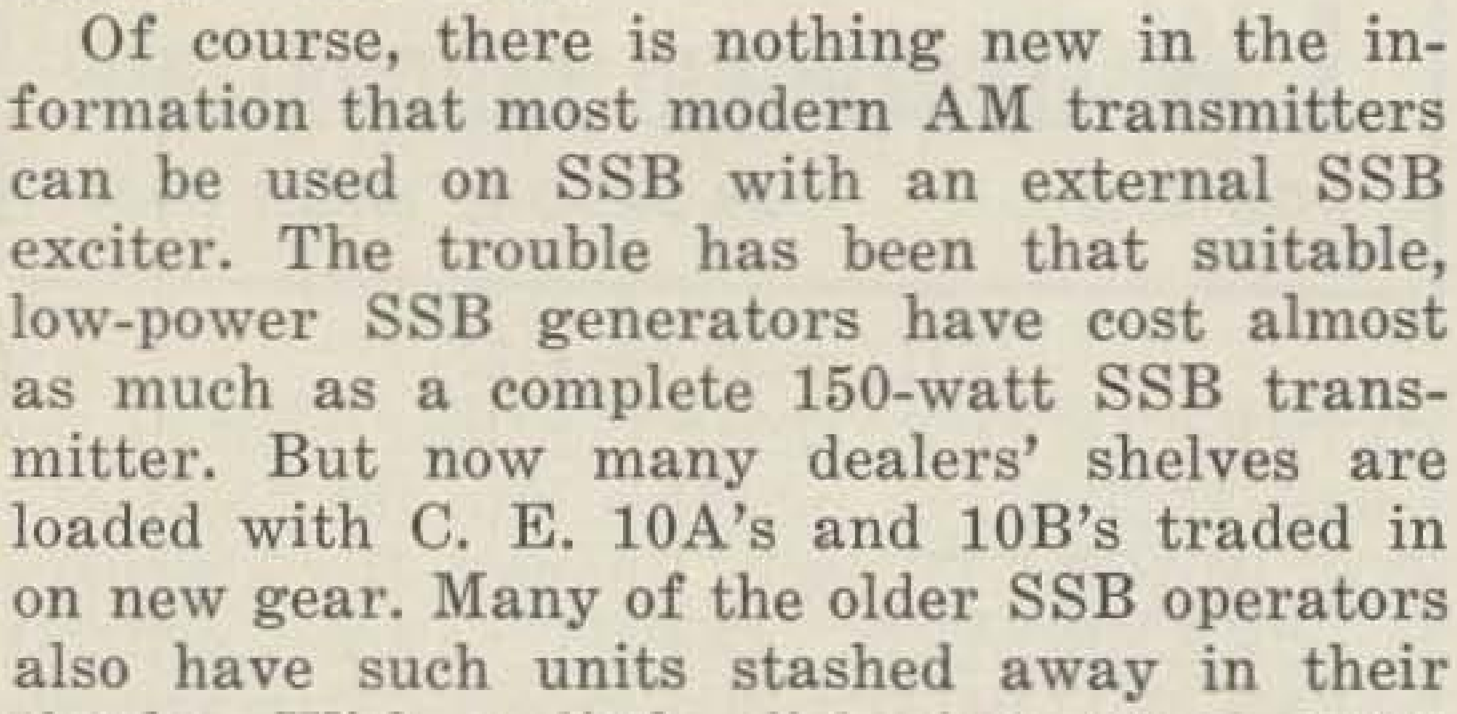
IF you would like to give SSB a whirl and have a good AM transmitter which you don't want to discard, the whirl can be a lot easier and less expensive than you may think. Central Electronics 10A and 10B SSB generators are naturals for converting transmitters like the E. F. Johnson Viking "Valiant," "500," or the Globe "Champ," or "King," etc., to SSB operation without affecting their AM capabilities in the least. All you do is feed the output of the SSB generator into the SSB input jack on the transmitter.

The 10A shown on these pages is currently driving a Johnson Valiant; it has also driven a variety of tetrodes in class AB1 and class AB2 amplifier service on all ham bands from 3.5 to 29.7 mc at power levels up to the proverbial "cool KW."

Of course, there is nothing new in the information that most modern AM transmitters can be used on SSB with an external SSB exciter. The trouble has been that suitable, low-power SSB generators have cost almost as much as a complete 150-watt SSB transmitter. But now many dealers' shelves are loaded with C. E. 10A's and 10B's traded in on new gear. Many of the older SSB operators also have such units stashed away in their shacks. With a little dickering, these units can be picked up at very reasonable prices.

"But," I hear you protest, "these exciters use a pretty old circuit. Besides, I don't like the idea of tying my bandswitching transmitter to an exciter with plug-in coils."

Omit the final amplifier stage and some of the frills on many of the phasing-type SSB exciter/transmitter units around today, and what is left is basically the circuit of the 10A and 10B. Incidentally, there are only minor differences between the 10A and 10B. It is because many other hams feel the same way as you do about plug-in coils that 10A's and 10B's are available so reasonably today.



Front view of modified 10A exciter. Added controls discussed in text.

It is a simple matter to add bandswitching to these units and modernize them in other ways. No true ham ever follows modification instructions exactly, so the following discussion is in general terms. The pictures and diagrams should clear up any doubtful points.

If you have a choice when picking up a 10A or 10B, take the "B," but don't pay too much of a premium for one. But do get one with a plug-in QT-1 "anti-trip" unit. The QT-1 prevents signals from your loudspeaker from tripping the VOX circuit and putting your transmitter on the air. Also, try to get a full set of plug-in coils. However, you can replace any missing coils from the data in our coil table.

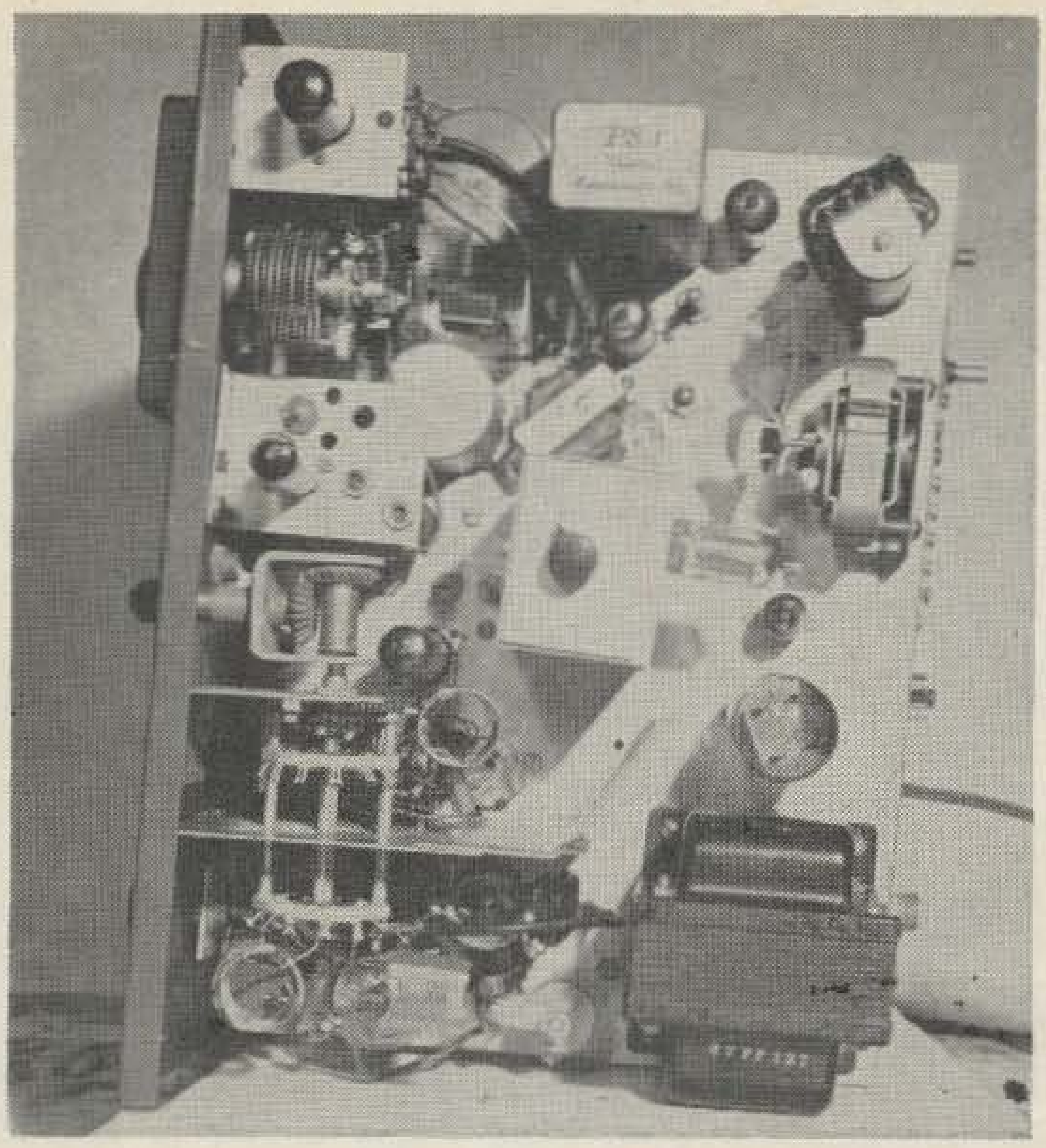
Bandswitching

Besides the coils, you will require a 2-section, 2-pole-per section, 5-position, rotary switch and a right angle drive (National RAD or equivalent) to install bandswitching. The switch may be a standard 3-section switch such as the Centralab 2023 with the center section removed, or it may be assembled from Centralab Switchkit components—2 PA-3 switch wafers and a 301 shaft and index assembly.

Replace the metal partition between the 6BA7 and 6AG7 stages in the exciter with a new one, as shown in the photos, to shield the complete set of mixer and amplifier coils from each other. Assemble the switch with one wafer on either side of the partition. After removing the coil sockets, mount the switch to the front panel with a metal bracket. Then, rewire the circuits as shown in Fig. 1.

The amplifier coils are removed from the plug-in forms and connected to S2 without modification. Refer to the coil chart for the number of turns on the revamped mixer coils. A single 20,000-ohm resistor salvaged from one of the mixer coil forms is connected across the mixer tuning capacitor for circuit "swamping." In the amplifier circuit, however, the original resistors from the plug-in coils are connected across the coils individually as required.

In operation, the exciter works exactly the same as before bandswitching was installed, except, of course, for the added convenience in switching bands.



Top view gives bird's eye view of added bandswitch, VFO and fan.

A Built-In VFO for the 10A

The converted BC-457 and 458 "Command-set" transmitters usually used as VFO's with the 10A's and 10B's work fine, but they are so big! There is room for a VFO inside the 10A cabinet. Refer to Fig. 2 and the pictures for details. By ganging S3 with the main bandswitch—which I didn't—you can eliminate a panel control. Also, resistors R2 and R3 in Fig. 2 replace the potentiometer marked "driver" to the left of the VFO dial in the front-view picture. The potentiometer turned out to be unnecessary.

By mounting the VFO tuning capacitor on the panel and the coil L1 and padding capacitor C2 directly on it, any flexing of the panel causes the combination to move as a unit. Consequently, the mechanical stability of the unit is surprisingly good. Mount the variable capacitor to place the top of the Millen 10039 dial level with the top of the panel. The 6U8A tube socket and associated components are mounted on an aluminum bracket on one side of the tuning capacitor. A similar bracket on the other side of the capacitor accommodates the OB2 and the plate coils.

The triode section of the 6U8A is the oscillator and tunes from 4750 kc. to 5440 kc. Its tetrode section multiplies the fundamental frequencies to the proper values to mix with the 9000-kc. SSB signal in the 6BA7 mixer tube to produce output on the various ham bands. I adjusted the oscillator frequency range by varying the inductance of L1 but reducing the capacitance of capacitor C2 to 360 uuf. and adding a 7-35 uuf. ceramic trimmer across the coil might make precise fre-

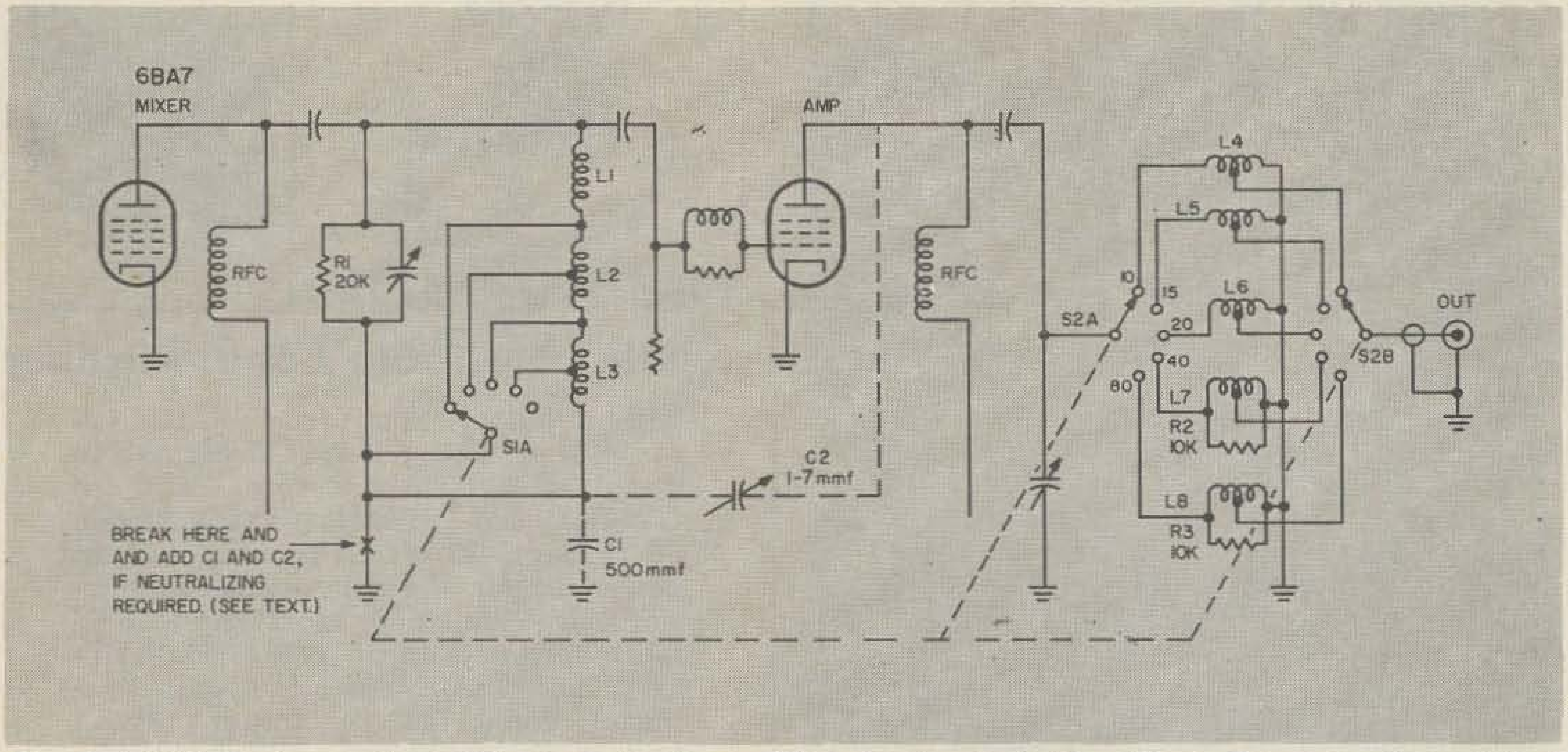


Fig. 1. 10A/10B mixer and amplifier tank circuits modified for bandswitching. Neutralizing circuit in dashed lines required only if 6AG7 amplifier is replaced with a 6146.

quency adjustment a trifle easier.

On 80 meters, the VFO tunes from 5000 to 5500 kc., and on 20 meters it tunes from 5000 to 5350 kc. On these bands, the tetrode section of the 6U8A acts as an untuned coupling stage. On 40 meters, the oscillator range is 5334 kc. to 5434 kc. tripled to 16,000 kc. to 16,300 kc. in the output section of the tube. On 15 meters, the oscillator tunes 5000 kc. to 5075 kc., multiplied six times to 30,000 kc. to 30,450 kc. Finally on 10 meters, the oscillator tunes from 4750 kc. to 5175 kc., multiplied four times to 19,000 kc. to 20,700 kc.

The 6U8A output coils are resonated to the desired frequencies by the circuit capacitances and the capacitance of the 14" length of RG-58/U coaxial cable between the 6U8A and the 6BA7 mixer tube. The coil slugs are peaked for maximum exciter output in the center of the most-used segment of each ham band.

Opening the hinged lid of the exciter causes the VFO frequency to vary somewhat. To foil my humorous ham friends who liked to swing the lid back and forth while I tried to raise a "rare one," I drilled and tapped two holes for 6-32 screws along the front edge of the lid and screwed it down.

Installing a Blower

With the VFO inside the 10A, it took approximately a half hour to settle down from a cold start, which was not too surprising, as the cabinet got almost too hot to touch after a period of operation. A cooling fan seemed to be the answer. A Barber-Coleman tube-cooling fan was installed in the position shown to pull in cooling air through the ventilating louvres in the back of the cabinet. This cabinet doesn't have ventilating louvres on the sides; there-

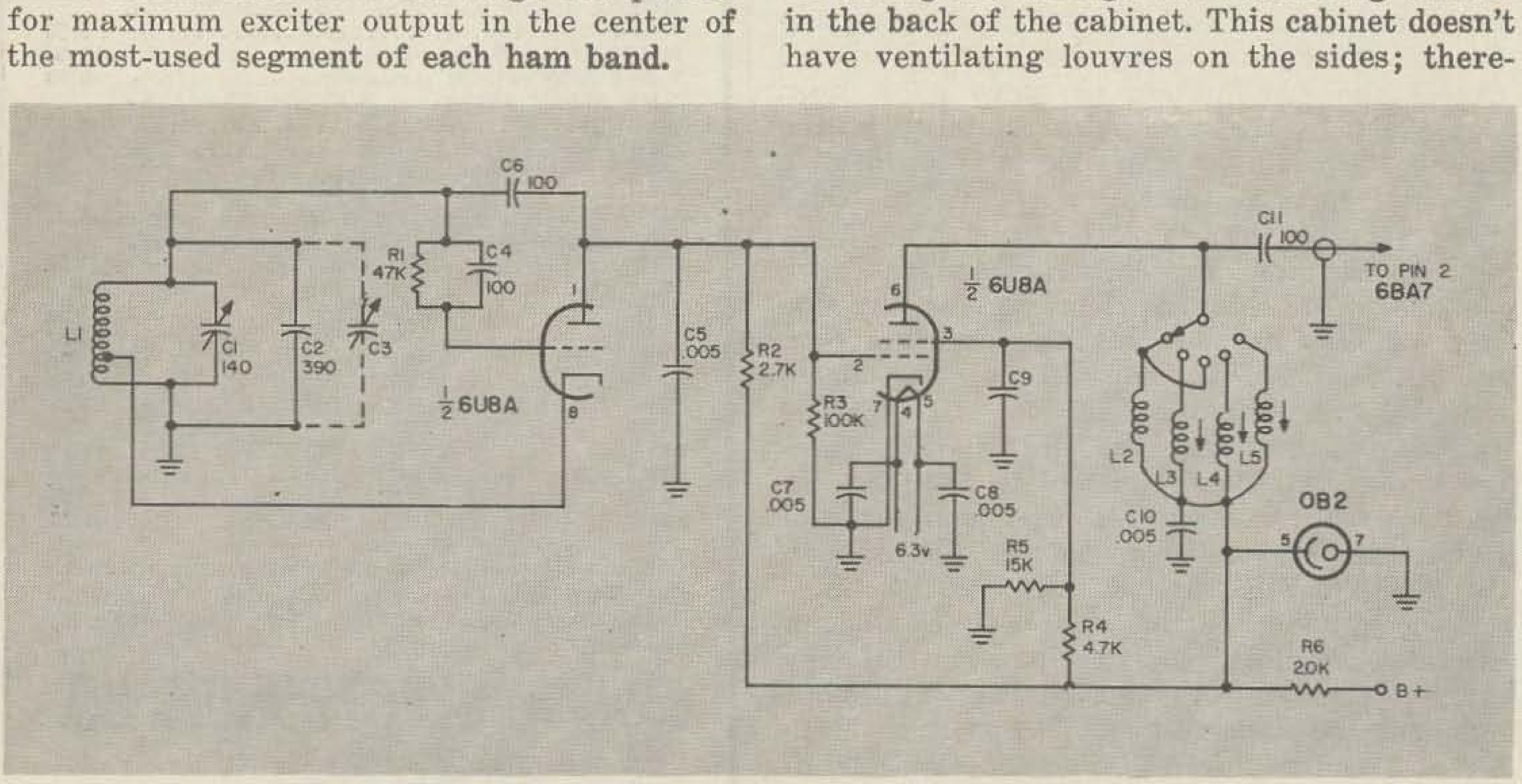


Fig. 2. Diagram for VFO and frequency multiplier for SSB exciter.

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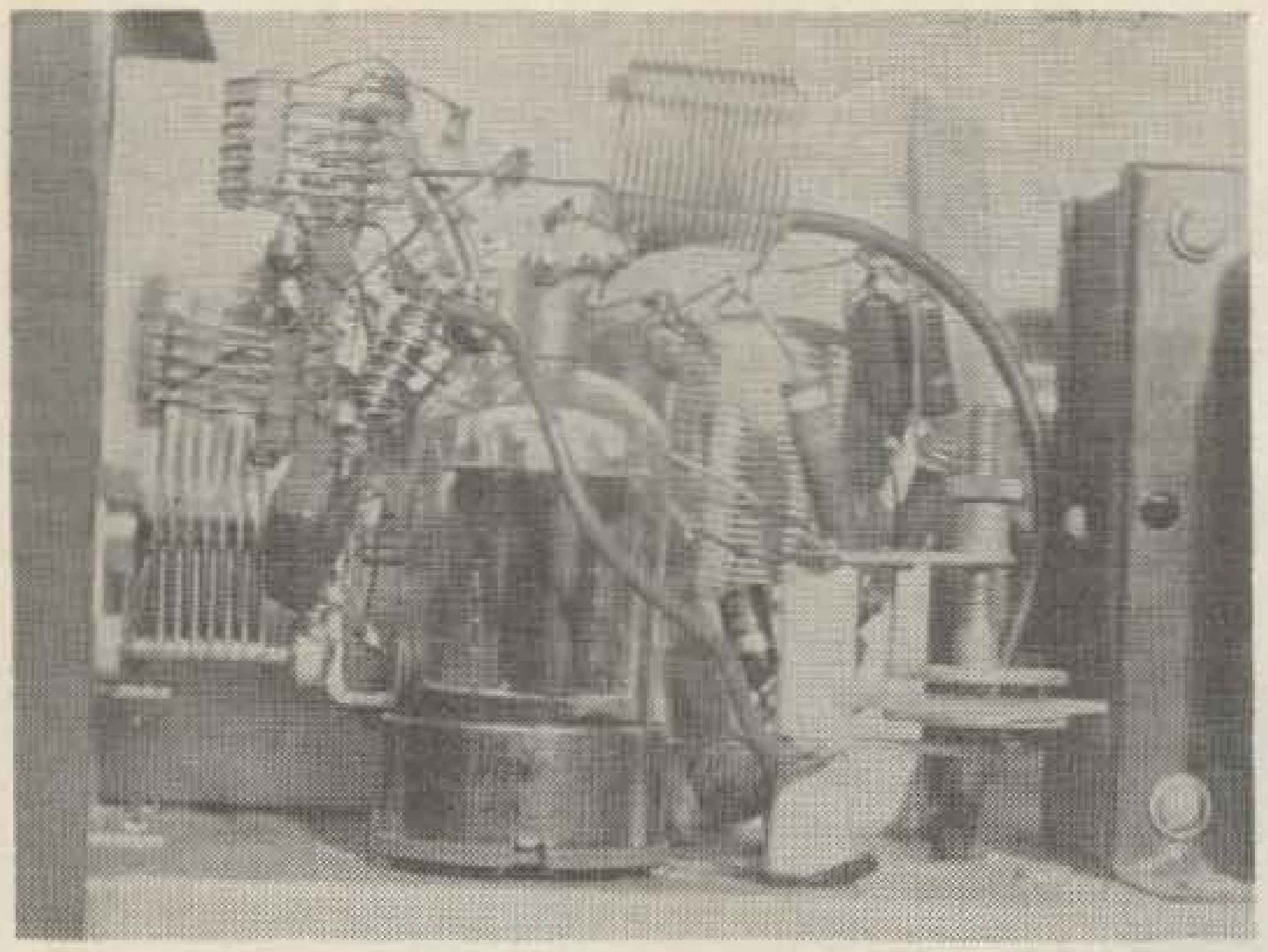


End view showing how amplifier coils grouped around amplifier tube and bandswitch. 20-meter coil hidden behind the tube. See text for more details. (That's why it was written.)

fore, I drilled 20 ⅜" holes in the side of the cabinet near the output tube. These steps cut the VFO warm-up time in half. They also reduced the temperature of the case at least 15 degrees. Although not strictly necessary, adding the blower was a worthwhile improvement. Incidentally, the dual filter capacitor displaced by the blower was replaced by individual cartridge-type capacitors mounted under the chassis.

Installing a 6146

When I used the exciter to drive a plate-modulated amplifier, the 6AG7 output tube got very hot during extended transmissions. Consequently, I replaced the 6AG7 with a 6146, obtaining its screen voltage from the OB2 in the VFO circuit. The 6146 works fine but not a bit better than the 6AG7 did. To discourage you from making this modification, it was necessary to neutralize the 6146 to keep it from oscillating. This, in turn, required changing the mixer tuning capacitor to one that could be insulated from the chassis, in order to obtain the necessary out-of-phase neutralizing voltage, as shown by dashed lines in Figure 1.

Rear view of exciter.

Just for the heck of it, I changed the amplifier tuning capacitor at the same time. This was a waste of time, too.

More Changes

To narrow the emitted signal a war-surplus, audio low-pass filter similar to the Stancor C-2341 with a cut-off frequency of 3000 cycles was installed between the plate of the audio driver tube and the primary of audio transformer T1. If you can pick up a similar filter at a reasonable price, it is well worth installing. Lacking one, connecting 0.001-uf. capacitors from pins 1 and 6 of the 12AX7 speech tube to ground will sharpen up the signal appreciably.

Finally, the VOX relay did not hold in quite long enough between words to suit me. Rather than learning to say "a-a-a-a-h" between sentences to keep the VOX relay closed, I connected an additional 0.5-uf capacitor from pin 1 of the 6AL5 VOX rectifier tube to ground. This increased the relay hold-in time just enough to suit me.

. . . W9EGQ

Added or Modified Parts for Figure 1

C1—500 mmfd mica.
C2—2-7 mmfd neutralizing capacitor.
L1 to L8—See coil table.
RFC1, 2—1-mh, r.f. chokes.
R1—20,000 ohms, 1 watt.
R2, 3—each 2 4700-ohm, 2-watt resistors in series.

Parts List for Figure 2

C1—140-mmfd midget variable. (Bud 1856 or equivalent.)
C2—390-mmfd silver mica, or 360 mmfd, plus C3-7-35 mmfd ceramic trimmer. (See text.)
C4, 5, 11—100-mmfd mica capacitors.
C6, 7, 8, 9, 10—0.005-mfd. 600-volt, ceramic capacitors.
L1—10 turns, 1" dia., ¾" long, tapped 3rd turn from ground end. (Part of B&W 3015 miniductor coil.)
L2—50-uh. r.f. choke.
R1—47,000 ohms, 1 watt.
R2—2700 ohms, 1 watt.
R3—100,000 ohms, 1 watt.
R4—4700 ohms, 2 watts.
R5—15,000 ohms, 2 watts.
R6—20,000 ohms, 10 watts.
L3—11 turns, #24 enamelled wire, ½" long.
L4—6 turns, #24 enamelled wire, ½" long.
L5—9 turns, #24 enamelled wire, ½" long.
Wound on ⅜" dia. iron slug-tuned coil forms. (National XR-50 or equivalent.)

Coil Table for Figure 1

L1—3 turns, 1" dia., ⅜" long. (B&W 3014 miniductor.)
L2—6 turns, 1" dia., ⅜" long, tapped 2 turns from top. (B&W 3015.)
L3—28 turns, 1" dia., 1¾" long, tapped 6 turns from top. (B&W 3015.)
L4—4 turns, 1" dia., ½" long, tapped ½ turn from ground end. (B&W 3014.)
L5—6 turns, 1" dia., ¾" long, tapped ¾ turn from ground end. (B&W 3014.)
L6—9 turns, 1" dia., 1' ⅛" long, tapped 1 turn from ground end. (B&W 3014.)
L7—15 turns, 1" dia., 1" long, tapped 2 turns from ground end. (B&W 3015.)
L8—26 turns, 1" dia., 1⅝" long, tapped 4 turns from ground end. (B&W 3015.)

The BC221 as an Accurate Audio Generator

V. A. Jupe WφOKH
Phillipsburg, Kansas

Many techniques in our hobby indicate the need for an audio source of precisely known frequency. There are many of the BC221 Frequency Meters in amateur stations. By using the methods shown in this article, you will have a frequency accurate source for checking audio frequencies, aligning filters in Teletype TU's, and checking FSK deviation.

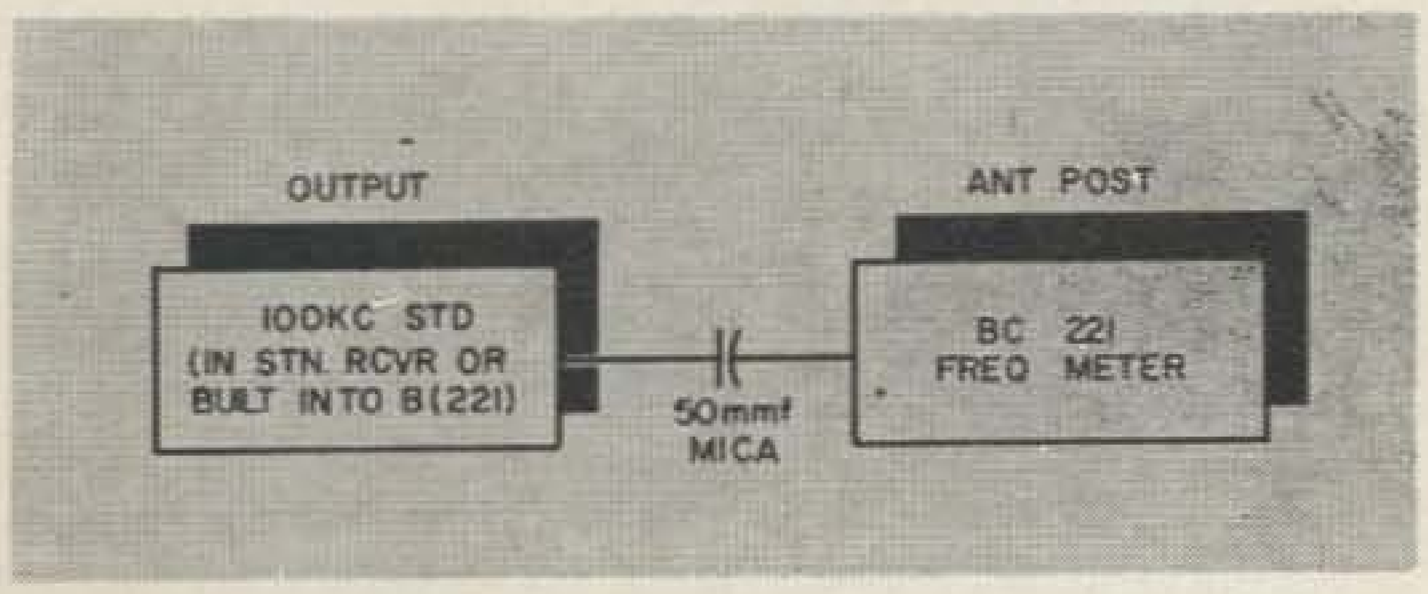
By adding a 100 kc standard oscillator within the case of the frequency meter and operating it from the internal power supply or by bringing a lead from the 100 kc standard in the station receiver to the antenna post of the BC221, you will have a beat-frequency audio standard equal in accuracy to the meter calibration.

The 100 kc standard and the internal 1000 kc standard are zero beat with WWV to establish primary accuracy. The second harmonic of the 100 kc standard is beat against the 200 kc VFO of the BC221 to produce audio frequency output from the phone jack on the meter.

Full page linear graphs covering 600 cycle steps should be plotted starting at the *200 kc check point* in the calibration book. There will be approximately 22 full dial divisions per 600 cycle step. The writer drew graphs to a little over 3000 cycles which covered most used frequencies. The calibration should cover the 200 to 203 kc range in the book to obtain easily read graphs. Mark the 60, 440, and 600 cycle points for later use in verifying the accuracy of your calibration.

After completing graphs, the meter is placed in use in the following manner:

1. Be sure the 100 kc standard plate voltage is *off*.
2. Zero the 1000 kc standard against WWV.
2. Turn 221 to "Operate" on a frequency at least 10 kc away from the 200 kc check point. Turn *on* the 100 kc standard and zero with WWV.



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4. With the 100 kc standard ON and BC221 on "Operate" (assuming that you have calibrated 221 VFO at the 200 kc check-point), you should be able to set 221 to the audio frequency desired by reference to your graphs and hear this tone in the headphones connected to phone jack on the meter.

The 1000 kc internal standard and 2000 kc VFO range combination is not used for audio purposes because of crowded calibration characteristics and poor stability. I have the 100 kc standard built into the battery compartment of my meter with the plate switch coming out of the compartment into the headphone storage compartment. The 100 kc standard should be turned *off* when audio measurements are not being made.

A double-ended male patch cord can be used to take the audio output from the BC221 to a jack on your 'scope or receiver output for audio mixing for measurements. If it is desired to measure the FSK from an exciter, patch meter audio in parallel with your receiver audio output jack. Turn on exciter, zero receiver BFO on edge of at least a 3 kc passband, and zero the receiver on your MARK frequency. Then, with "BC221" set up for 850 cycle output, shift exciter to SPACE frequency and adjust shift until zero beat is obtained against the 850 cycle tone coming from BC221. A 'scope could be used as an indicator if you don't trust your ears.

A patch cord terminated in a coupling capacitor can be used to feed audio TU's for filter alignment.

The waveform of the audio output from my BC221 is not satisfactory for use in aligning SSB phasing exciters; however, by having this accurate frequency indicating source available, I can be sure that I have my af generator set to the frequency needed. The project has been well worth the small amount of time and cash invested. . . . WφOKH

Which Way is Up?

Roy A. McCarthy K6EAW
737 W. Maxzim Avenue
Fullerton, California

GETTING acquainted with new types of circuit elements is more interesting if they are used in such a way as to allow you to baffle, mystify or downright confuse your friends. The tiny thermistor beads, although in use since WW2, are relatively new in the sense that up until recently the cost was rather a bit high. This simple circuit will help get a fair knowledge of their peculiarities. It has never failed yet to attract and hold the interest of even the most casual observers. As a "Gravity Detector" it runs a close second to the plumb bob or the Newtonian apple.

To demonstrate the device, simply move it from side to side, back and forth and up and down. Regardless of the position it is held in output is obtained only when the motion contains a vertical component. The phase of the output signal is dependent on whether the vertical motion is up or down.

The complete circuit is shown in Fig. 1. The load resistor, R2, is selected to set the operating point on the negative resistance slope of the thermistor's characteristic curve. Typical characteristics for an 8 or 10,000 ohm bead are shown in Fig. 2. R1 is used to prevent applying an abrupt surge of current to the bead, since these take appreciable time to reach operating temperature.

The thermistor should be mounted in a small clear plastic case, using extreme care not to break the fragile leads, or lose the thing by sneezing when you open its container. Flexible leads connect to the rest of the circuit. All connections should be soldered, since if clip leads are used and one happened to come loose, the natural tendency is to clip it right back on. That can be disastrous.

Rather than tell your friends how it works, let them try to figure it out. The theory is that the thermistor bead has a little chimney of convection currents of heated air rising from it. Moving it sidewise lets the chimney follow the bead, since the air in the plastic box is trapped there. Moving it up or down changes the rate at which the heated air rises from the bead, modifying its temperature. Because all a thermistor does is change its resistance with temperature, a phase sensitive output signal is obtained, which is observed on a scope or voltmeter. . . . K6EAW

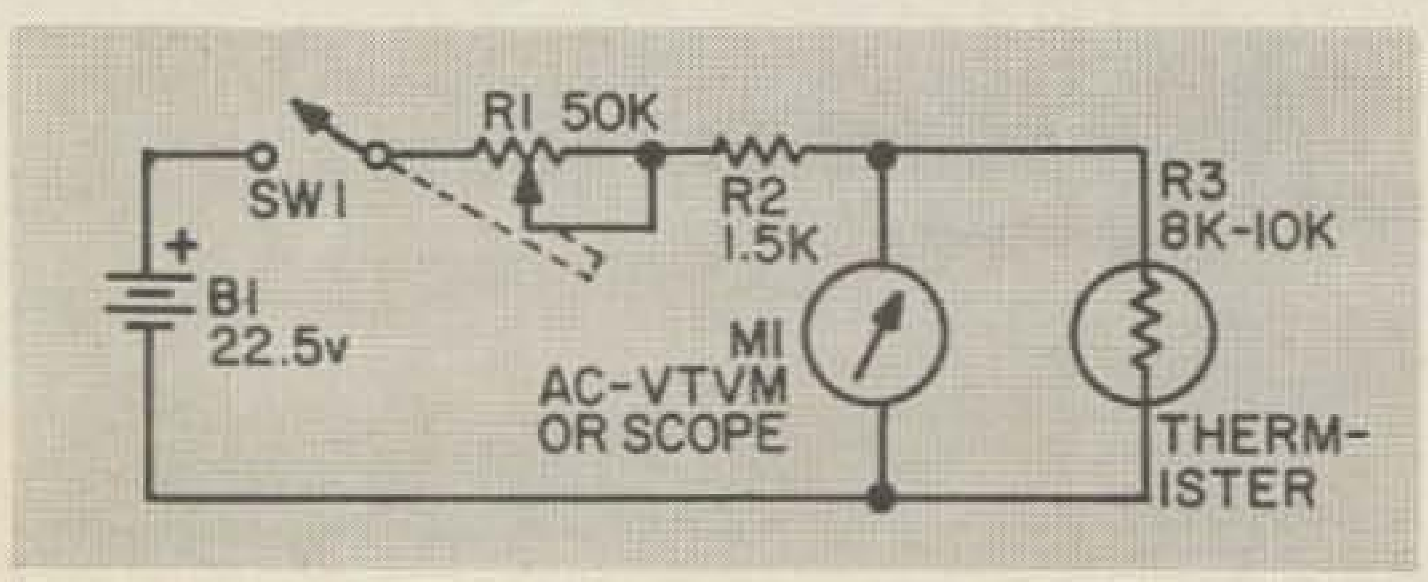


Fig. 1. Schematic of gravity detector.

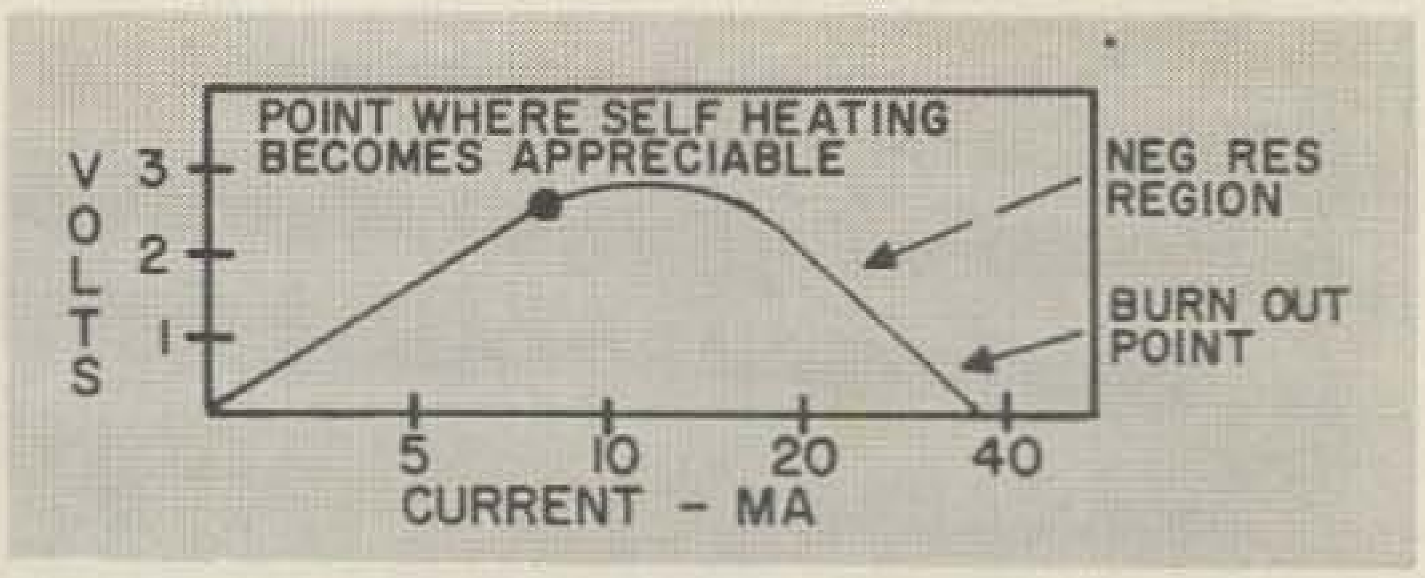


Fig. 2. Characteristic curve for a bead thermistor. Values may vary widely.

REF.: 73 *Magazine, Vol.* 1, *No.* 12, *September* 1961, *Article by Henry Cross, W*1*OOP, "Silicon Rectifiers"*

Silicon Rectifiers... Continued

Dear Wayne:

Congratulations on a job being done in an outstanding manner. The quality of the articles in 73 has been most gratifying.

As an Electronic Engineer I must point out that one *very important* design consideration was not pointed out in the article on "Silicon Rectifiers."

Unfortunately, semiconductor manufacturers do not control the reverse resistance of diodes to any great degree of uniformity. For example, the following chart, (Fig. 1), shows the reverse (back) resistance of 8 Motorola 1N1566 diodes. The following readings were taken with a Belleville-Hexem Corp. E-I-R Meter model 110-A.

Diode No.	Reverse (back) Resistance
D1	750×10^6 ohms
D2	280×10^6 ohms
D3	600×10^6 ohms
D4	480×10^6 ohms
D5	750×10^6 ohms
D6	20×10^6 ohms
D7	60×10^6 ohms
D8	500×10^6 ohms

Fig. 1. Reverse (back) resistance measurements of eight randomly picked Motorola 1N1566 silicon rectifiers.

Motorola lists the following characteristics for the 1N1566 diodes.

Voltage Ratings

Max inverse voltage 400 V

Max sine was RMS input voltage 283 V

Absolute Max Ratings

Average ½-wave rectified for current:

at 25°C ambient temp .... 1.0 amps

at 100°C ambient temp .... 0.5 amps

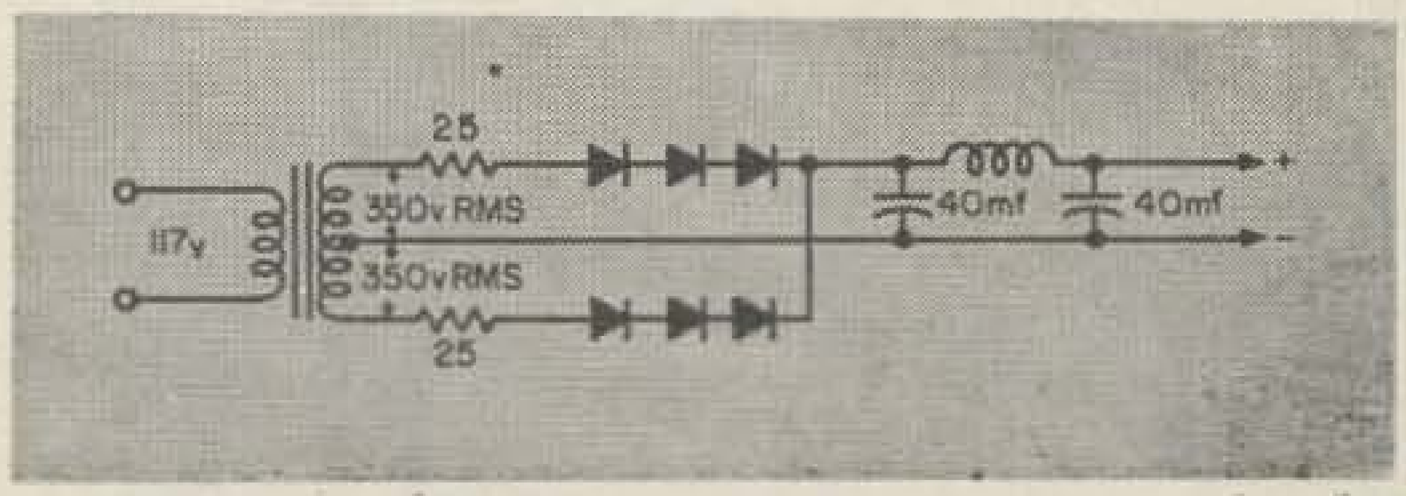
Peak ½ cycle for surge current:

60 cps, 25° ambient .... 70 amps

Peak recurrent forward current:

60 cps, 25°C ambient............... 10 amp

Now for the sake of an example let's consider the example 2B shown in the article by Mr. Cross.



The article stated that by using three 400 PIV diodes as shown in Fig. 2, the power supply could be expected to operate satisfactorily. If you build one as shown, and it works for any length of time, you're just plain lucky!

The reason that the circuit is not a good design will now be shown and the proper steps shown to make it into a reliable and rugged supply.

Let us examine the peak voltage that can occur across any one diode leg of the rectifier circuit.

Since the secondary of the transformer is center tapped the voltages appearing at the ends of the winding are 180° out of phase with respect to the C.T. The total peak voltage possible across the winding is the sum of peak voltages across each half of winding.

The peak value of a sine wave is expressed as: $(V_{RMS})\ (\sqrt{2})$. Now since the halves of the secondary winding are (supposedly) identical then the total peak-to-peak voltage is twice the peak voltage of one-half the winding.

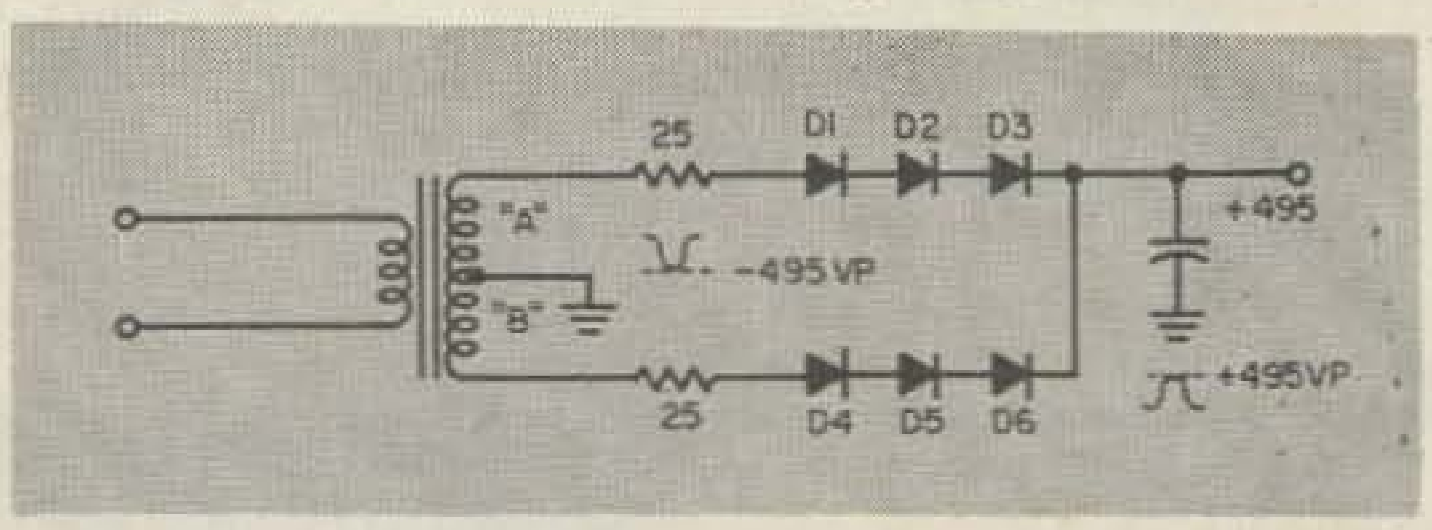
Therefore:

The max peak-to-peak voltage across the secondary winding equals

$(2)\ (\sqrt{2})\ (350) = 989.8$ or approximately 990 volts

Now the input filter capacitor will charge (under no load) to one-half of the total peak-to-peak voltage across the secondary or +495 volts dc max.

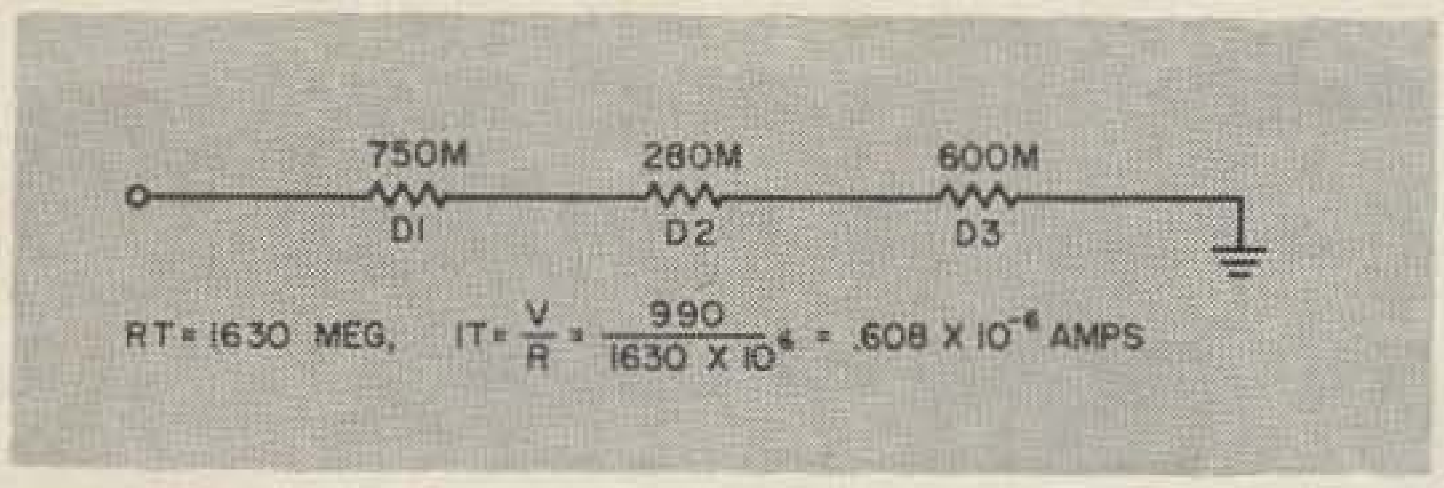
Now consider the following diagram.



Say that the "A" half of the secondary is the max. negative voltage it can go or, —495

V. Therefore, the total voltage across the "A" set of diodes is 495 V +495 V or 990 volts. Let us examine the voltage distribution in the reverse direction across the "A" series string of diodes.

Using the first 3 diodes shown in Fig. 1 the distribution is as follows:



The voltage across the diodes is therefore:

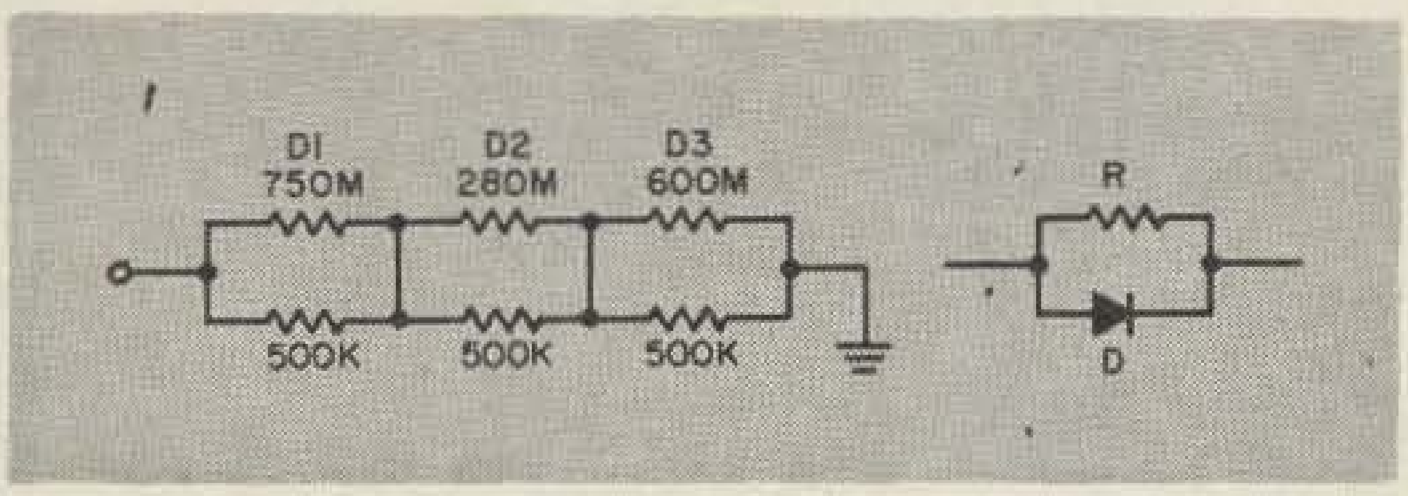
D_1 Volts $= (.608 \times 10^{-6})\ (750 \times 10^{6}) = 455$ volts

D_2 Volts $= (.608 \times 10^{-6})\ (280 \times 10^{6}) = 170$ volts

D_3 Volts $= (.608 \times 10^{-6})\ (600 \times 10^{6}) = 365$ volts

The peak inverse rating of Diode 1 (400 PIV) has been exceeded. If the diode breaks down the resistance in the inverse direction will drop to around 100 ohms. This allows the peak inverse voltage ratings of the remaining diodes to be exceeded and POOF! a shorted secondary in the power transformer.

A simple and inexpensive method to keep this from happening is to parallel each diode with a resistor of approximately 220K to 500K ohms. (Fig. 4)



The effective resistance in the reverse direction is 3 (500K) ohm or 1.5 meg the total reverse current through the resistors is $990/1.5 \times 10^{6} = 670$ μamps. Therefore, the total voltage across the resistor diode pair becomes 670×10^{-6} amp $\times .5 \times 10^{6}$ ohms $= 330$ volts which is well under the maximum voltage of 400 allowable. The forward voltage drop is negligible as the .5 megohm resistors are in parallel with approximately 1 ohm. (Forward resistance of the diodes.)

By going through the same kind of calculations for any given transformer and diode set one can arrive at the proper resistors to use to protect the diodes. As an added note of caution; be sure to check the wattage dissipated in the resistors and use the proper wattage resistors.

Since most hams don't own a meter which will measure 100's of megohms and even if they did, most supply houses wouldn't let him examine a bin full of diodes in the hope that he could find a matched set, it makes sense to add the bridging resistors to protect the diodes.

Charles C. Pierce WA6QFD

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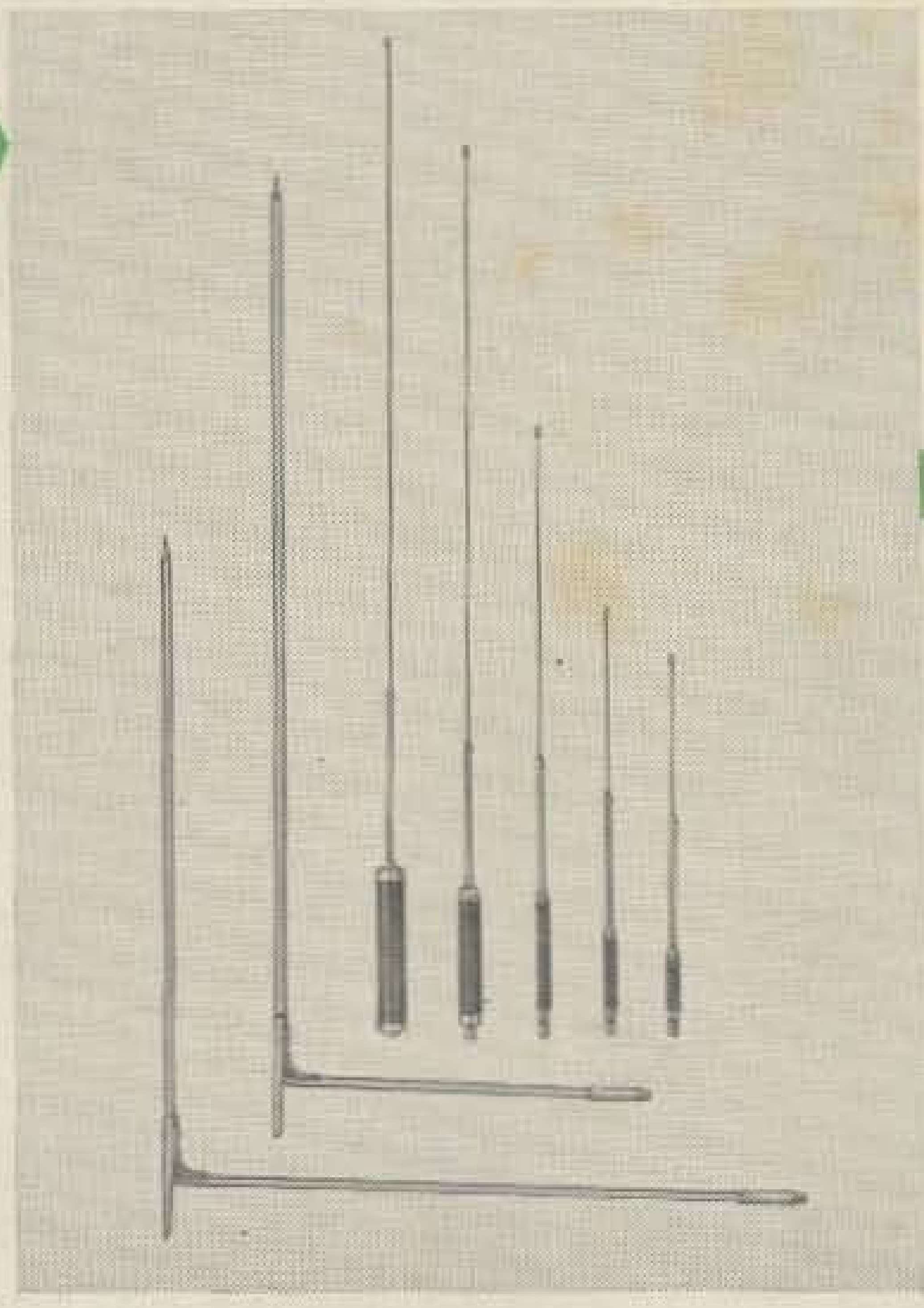

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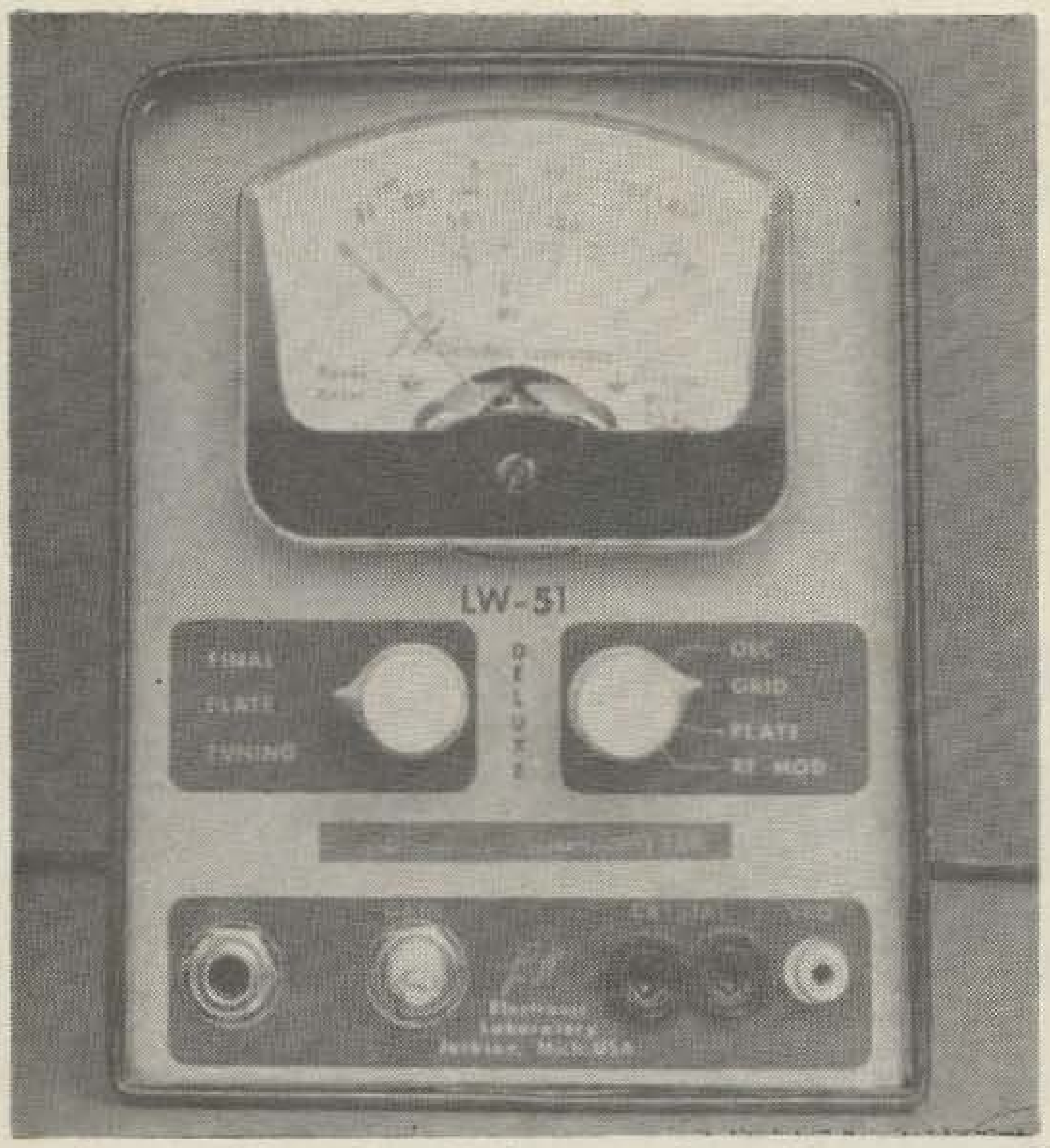


Donald A. Smith W3UZN
Associate Editor

73 builds and Tests the LW-51 2M Xmitter

IT'S an old and well known fact that a small company must really have a good product if they are to remain in business with the large manufacturers as competitors. LW Labs, with their new LW-15 2 meter transmitter kit has, in my opinion, such a product. They are not by any means a new company, but they are a small one.

The little 2 meter rig has a lot to offer. The power input is 45 plus watts. The modulator, which is included on the same chassis, supplies more then an adequate amount of audio to fully *plate modulate* the final. Provisions are made for Hi Z or carbon mike input, by using a different mike plug. The rig uses standard FT-243 8 mc crystals and the final amplifier operates straight through! With a price tag of $59.95 for the rig less tubes, or $74.95 complete with tubes and crystal. A power supply with voltage regulation and a high and low power feature is $49.95 complete, wired and tested (model LW-72A).

Circuitry

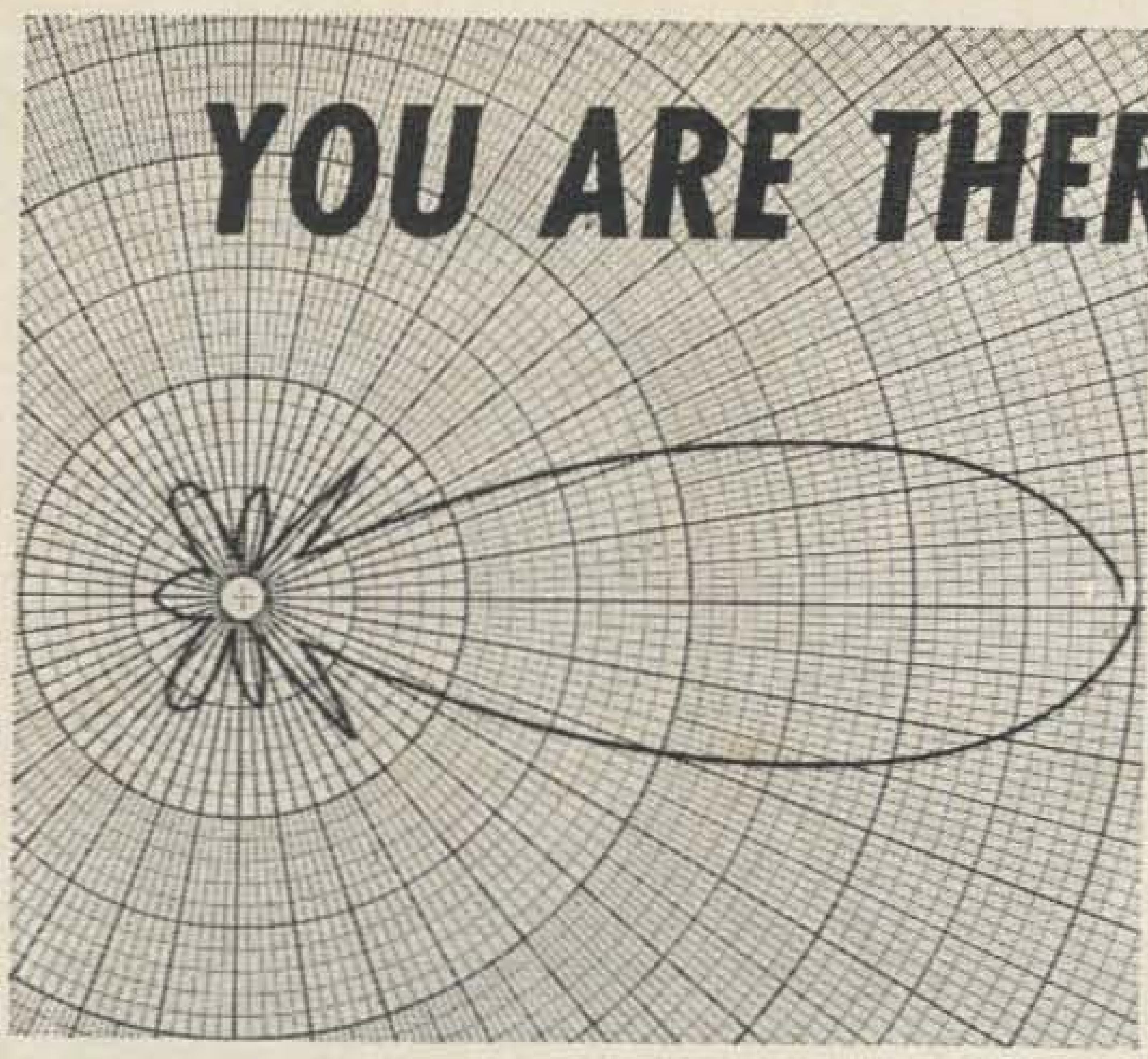
The rig uses the triode half of a 6U8A in a Hartley oscillator circuit, with the plate of the oscillator tuned to 24mc (with 8 mc xtal). The pentode half of the same tube is used as a tripler to 72 mc and it drives a 7558 pentode. The 7558 doubles to 144 mc and is *inductively* coupled to the 6146 final, to reduce harmonic coupling. The final is provided with a good neutralization circuit. If you have built 2 meter rigs you know what a job it can be to neutralize a final amplifier at 144 mc! The final tank is link coupled (and adjustable) to the coax output jack. A variable capacitor is also provided to tune out the reactance in the line.

The modulator uses the pentode half of a 6U8a as a voltage amplifier, feeding the triode half of the same tube. The triode acts as a driver for the push-pull 6CZ5 output tubes. The driver is transformer coupled to the output tubes and they are transformer coupled to the plate and screen grid of the final. The amount of audio modulation is controlled by a pot in the control grid of the triode driver.

The filaments can be connected for 6 or 12 volts, depending on whether you're going to operate mobile in your 12 volt car or use the rig at the shack. The rig also has a diode detector circuit to give an indication of the relative power output and also give the modulation percentage on the front panel meter. The meter is switched to read oscillator, final grid, final plate, rf output and modulation percentage. The meter switch is located on the front panel, making selection a simple and convenient matter.

Construction

As soon as you unpack the kit you notice that there is a big difference between this and other kits. To begin with, the chassis is already mounted to the front panel. The bottom shield and cabinet is in place and it looks as if it is a wired model! All major parts are already mounted! The transformer, meter and

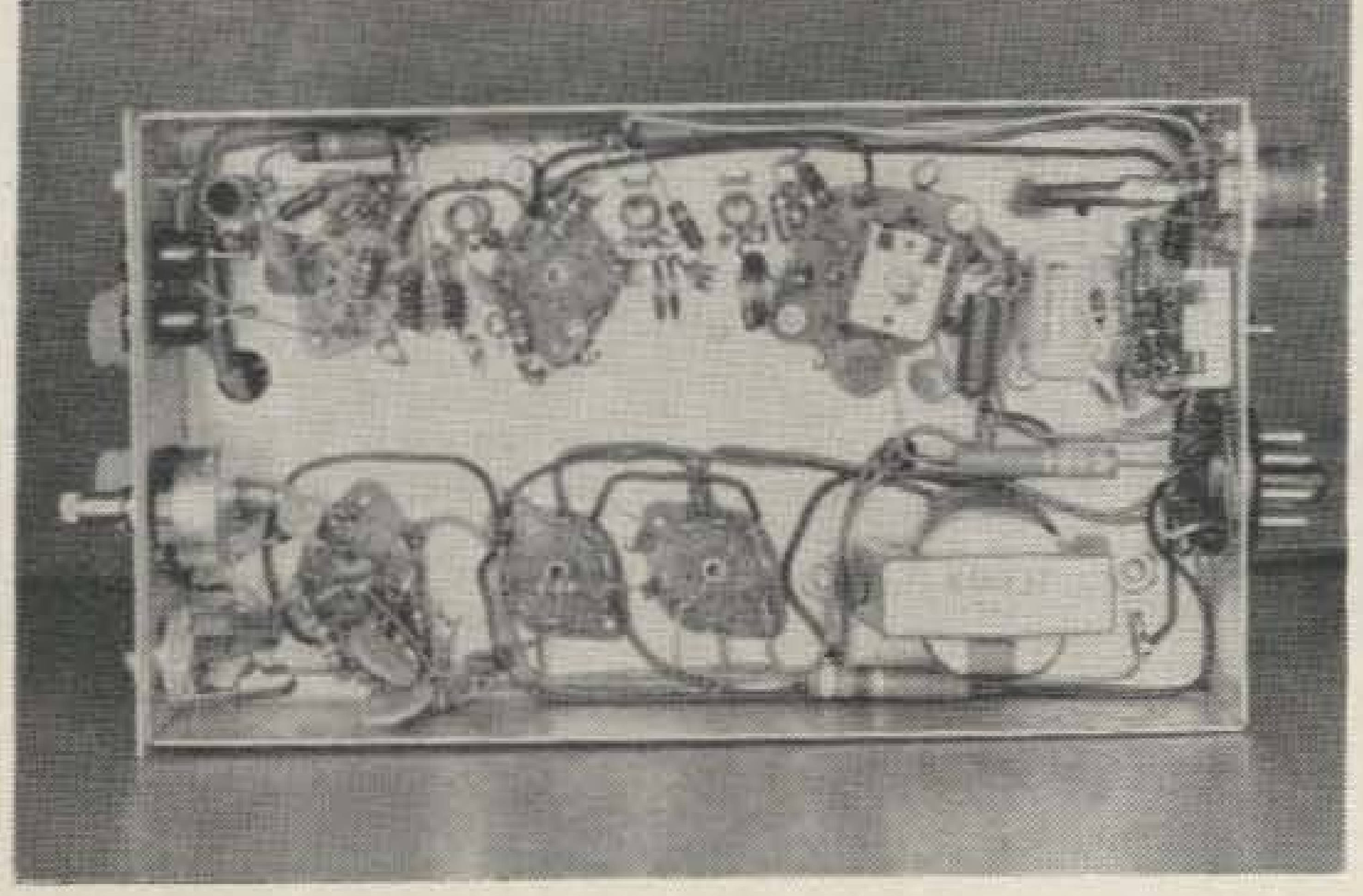


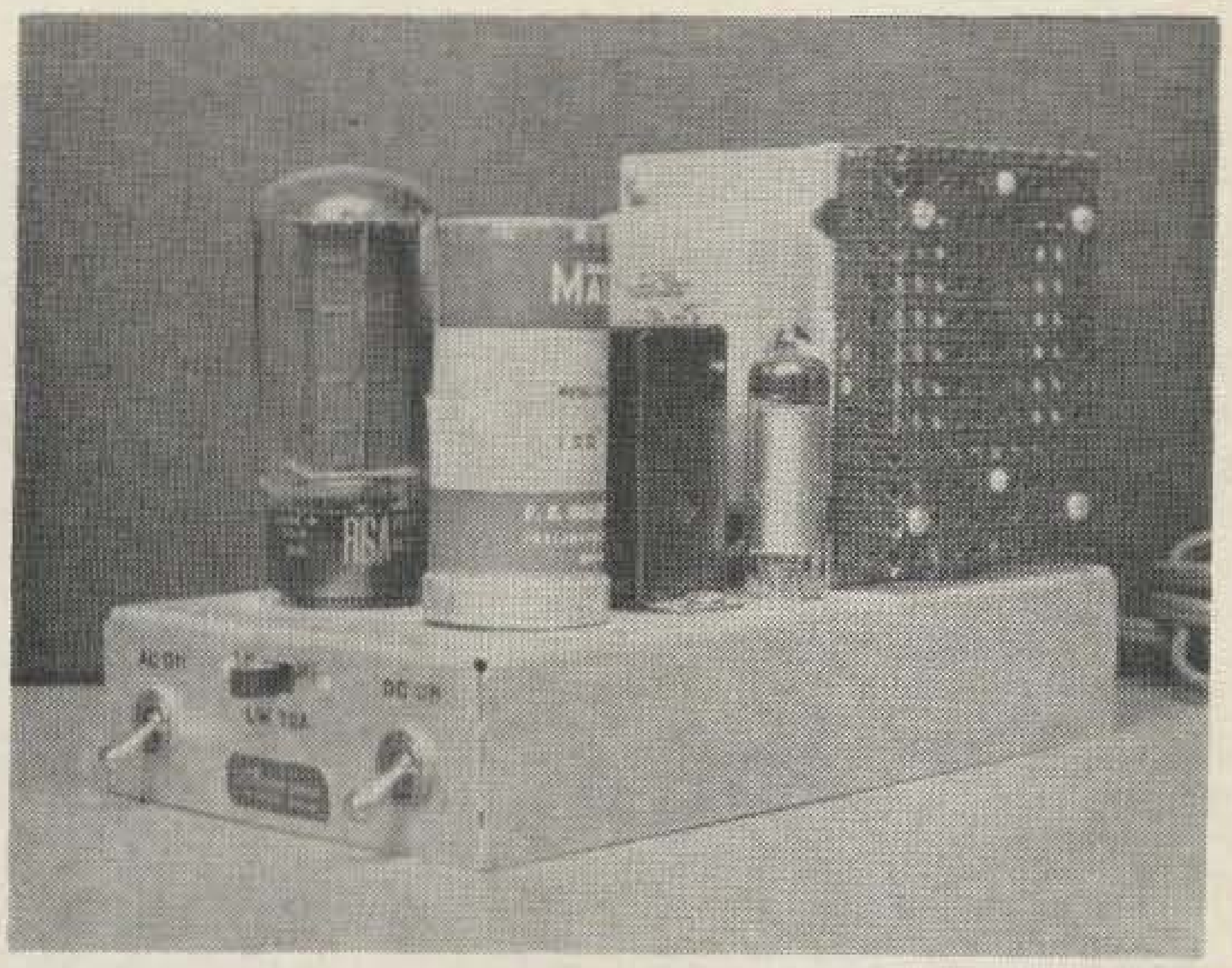
meter switch leads are already connected and the heavy soldering has already been done! Actually over 100 parts have already been mounted!

The kit builders work comes in wiring the filaments, resistors, capacitors, coils, etc. It's a real pleasure to wire the kit. The instructions and drawings are complete and are written in the way an Amateur would like to have them.

A unique method is used for double checking your wiring. LW has designed a chart which shows all of the connections. As you read across the chart, each connection which should be on the pin that is listed in the block. The builder without much in the way of building behind him will find this a very great help.

Complete alignment information is given by the manufacturer and the rig tuned up as per the script. Neutralization was a snap, unlike my experience with some of the 2 meter finals which I have built before. I was curious to see how the meter worked out on reading modulation percentage. To check it, the rig was connected to an oscillascope and the meter cali-





brated as per the instructions with the kit. I was surprised to find that actually the meter was very close. On sustained peaks, with the meter showing 100% modulation, the scope showed approximately 95%. The meter allows you to get maximum "talk-power" out of the rig without creating interference.

On the air checks showed the rig to be stable and very reliable. Two meter stations up to 100 miles away have been worked with excellent reports on signal strength, stability and modulation. TVI was checked carefully (in a fringe area) and found to be extremely low. With a TV antenna only 12 feet away almost no interference was noted on *any* TV channel, 2 through 13!

The rig has excellent quality parts and material furnished with it and very thorough instructions. The rig comes with a crystal of your choice, alignment tools and excellent protective packing. At $74.95, I think you will agree that it's a great buy for the VHF man.

.... W3UZN

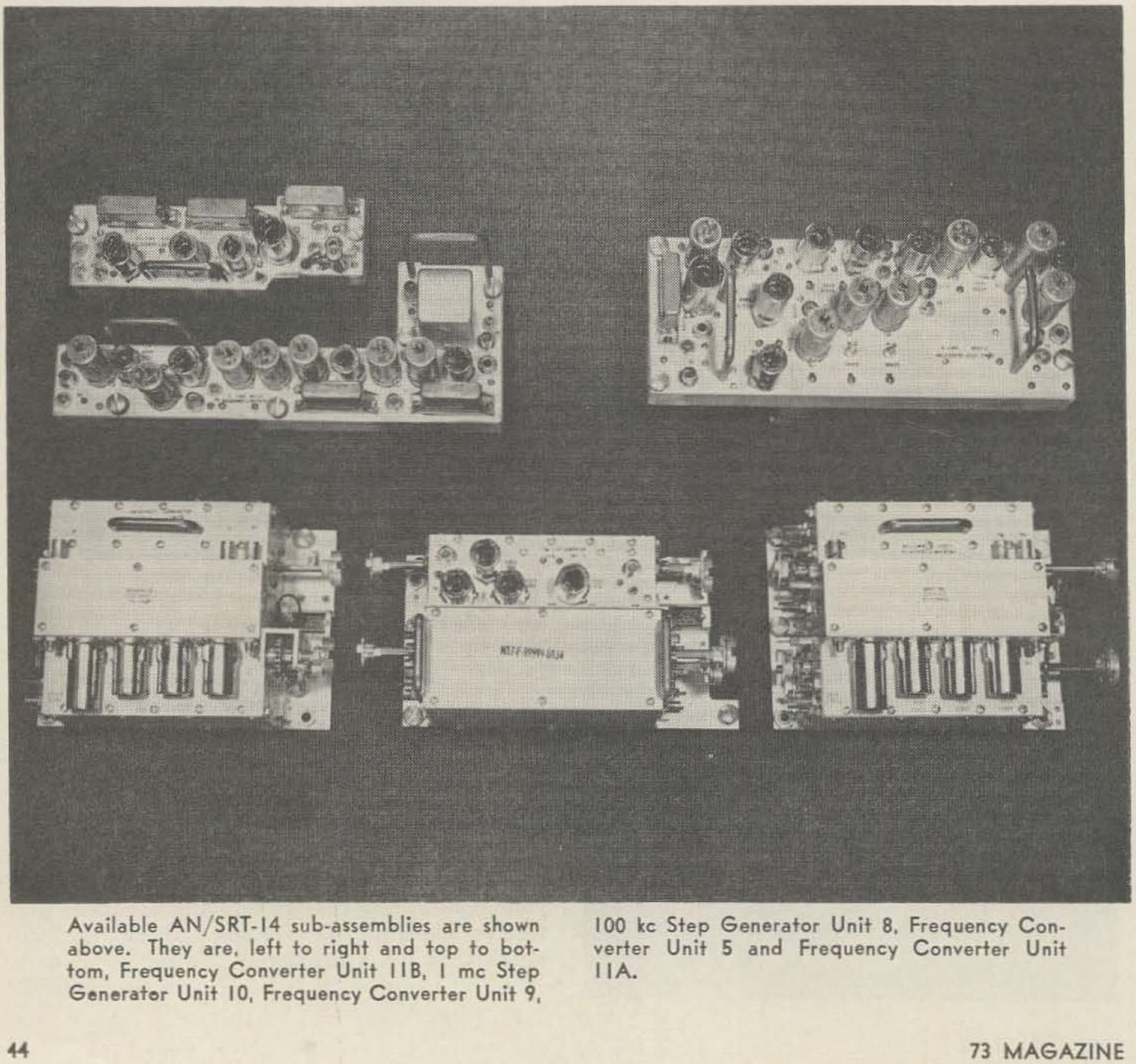
Surplus Frequency Synthesizer

Newly Released Components of AN/SRT-14 Transmitter Permit Economical Amateur Use of Frequency Synthesizer Techniques.

Roy E. Pafenberg
709 North Oakland Street
Arlington, Virginia

Photo Credit: Morgan S. Gassman, Jr.

SOME of the most appealing items of electronic surplus to reach the market in many a day are now available in sufficient quantities to be interesting. The equipment under discussion consists of a series of six replacement subassemblies from the Radio Transmitter, AN/SRT-14. The end equipment is a modern shipboard, 100 watt CW, FSK RTT and AM transmitter covering the frequency range of 300 kilocycles to 26 megacycles.



Available AN/SRT-14 sub-assemblies are shown above. They are, left to right and top to bottom, Frequency Converter Unit 11B, 1 mc Step Generator Unit 10, Frequency Converter Unit 9, 100 kc Step Generator Unit 8, Frequency Converter Unit 5 and Frequency Converter Unit 11A.

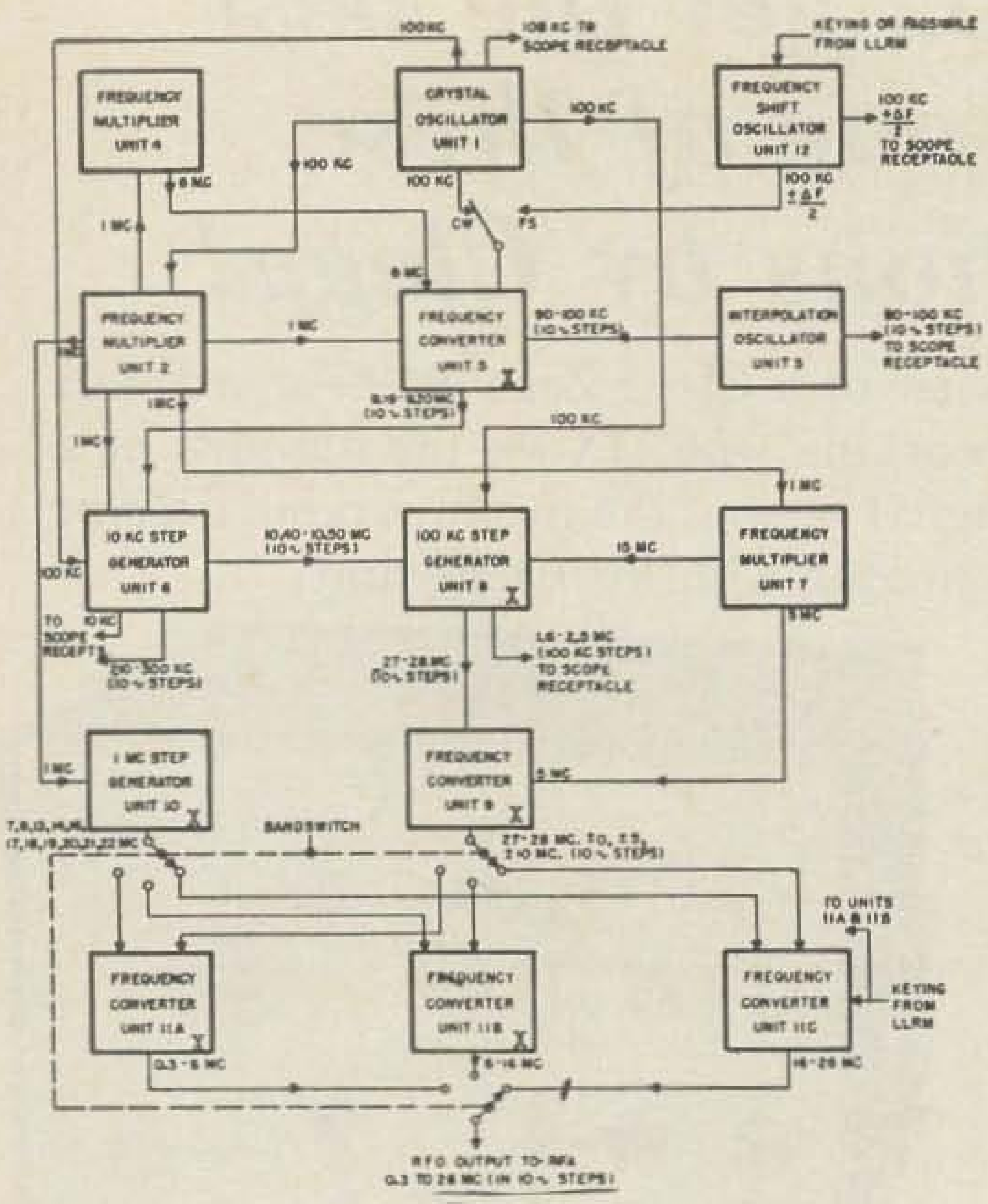


Fig. 1

To my knowledge this is the first item of frequency synthesizing transmitting equipment to reach the surplus market. The frequency synthesizer method of frequency control is becoming more and more popular, especially in high stability military and commercial transmitting equipment. This design concept employs a secondary frequency standard as a base frequency oscillator. While any frequency might be used for this standard, 100 or 1,000 kc is the logical choice. From this single frequency, by a series of manipulations involving multipliers, mixers, regenerative dividers and/or phase locked oscillators, the final air frequency is derived. This locked frequency control may be carried through to the air frequency or may be stopped at any point in the frequency generating chain and reliance placed on the stability and calibration of a limited tuning range, low frequency interpolation oscillator to "fill in the holes" in the spectrum. If this locked frequency control is carried through to the air frequency, the coverage will not be truly continuous. Highly stable output will be available only on the so called "detent" frequencies of the equipment. The separation of these discrete frequencies varies with the complexity of the equipment and may be 1,000, 100 or 10 cycles. There is nothing magic in these figures and any other logical interval may be used. The point is that, at some point in the design, operational flexibility must be sacrified to avoid undue complexity and cost.

The frequencies generated and used in the various conversions required to afford the wide frequency coverage of the AN/SRT-14 are numerous and the combinations vary for each of the bands covered. The following discussion has been simplified to the point that it does not describe the exact means used to arrive at any particular output frequency. However, this over-simplification leads to an easier understanding of the basic circuitry.

In the AN/SRT-14, the frequency standard is a 100 kc crystal oscillator, accurate to within 1.5 parts per million. From this highly stable source, three separate blocks of frequencies, spaced at 1 mc, 100 kc and 10 kc intervals are generated. Each of these frequencies is locked to and of the same order of stability as the 100 kc standard. By means of switched, selective circuits, the desired frequencies are chosen and combined in mixers to arrive at a frequency 90 kc lower than the desired air frequency. This frequency is mixed with the output of a highly stable oscillator, tunable from 90 to 100 kc. This oscillator is not synchronized with the equipment standard, but is of such an order of stability that the air frequency is known within 20 cycles. The interpolation oscillator is tuned by three decade switches which are used to change the frequency in increments of 1,000, 100 and 10 cycles.

Since all stages of the exciter are switch tuned, it becomes a relatively simple matter to gang the various assemblies and arrive at an exciter that is completely tuned by the setting of detented selector switches. Putting this exciter on any frequency is simply a matter of setting the basic frequency band and positioning the 1,000 kc, 100 kc, 10 kc, 1 kc, 100 cycle and 10 cycle selector switches so that the desired air frequency is read out on the decade calibrated scales.

The over-simplifications employed in the above discussion are apparent when the block diagram of the exciter, shown in Fig. 1, is studied. Signal path and derivation of the various frequencies for each frequency band are shown. While an exciter such as this is admittedly complex, the superior performance justifies use of the techniques employed. Those who desire to pursue the subject of frequency synthesis further are referred to the excellent treatment contained in Collins publication, "Fundamentals of Single Sideband." This book is available from Collins Radio Company, Technical Publications Department, Cedar Rapids, Iowa, at a cost of $5.00.

Of the 14 units shown in Fig. 1, 6 are available through surplus channels. These units are identified by an "X" in the lower right hand corner of the block. The photograph shows these 6 assemblies laid out in their approximate mechanical relationship. It is unfortunate that all of the assemblies are not available, but that is the luck of the surplus market. The units are available, in substantial quantities, from RITCO Electronics, Post Office Box 156, Annandale, Virginia. The assemblies are brand new, in sealed cartons, and are priced at between $5.00 and $10.00 each, less tubes. Mr.

Ritter, of RITCO, advises that a discount will be made if a complete set is purchased.

These units are a good buy, if only for parts. Unit 11 B, for example, has 40, $\frac{5}{16}$", stud mounted, slug turned coil forms and 43 coaxial, stud mounted, trimmer capacitors. All parts are military grade and suited to the compact construction employed. However, their primary application should be as originally designed, with such modifications as required to adapt them to amateur practice and provide all band coverage. Units which are not available are such that any constructing amateur can provide, at nominal cost, the required fill in units.

Preliminary work has been performed on all band, CW, AM and SSB exciter using these components arranged as shown in Figure 8. The un-numbered blocks represent circuit functions not available in the surplus units. These units are conventional and should pose no problems to the experienced constructor. Use of a crystal calibrator, kit or manufactured, is suggested for the 100 kc oscillator.

Despite a sincere effort on the part of the editor, schematic diagrams of the available units, Figures 2 through 7, are too large for inclusion in this article. These drawings are so detailed, showing frequency relationships, power requirements and connections, rf terminations and control identification, that they would not satisfactorily reduce to the publishers format. Therefore, these schematics, Chart I, a complete frequency plan of the proposed exciter and Fig. 9, a diagram of one of the missing units to serve as a guide in the design of the frequency multiplier and cathode follower stages, have been withdrawn. The writer has arranged these drawings to use a minimum of paper, had a reproducible master made and turned this over to RITCO Electronics. A yard square, white print containing the chart and drawings will be supplied, at no cost, with the purchase of a set of the units and individual units will be furnished with the appropriate schematic. For those who wish only the drawings, RITCO will supply these at the cost price of 75 cents.

The following discussion covers work, in progress or proposed, on this exciter. While not tested, except for the fact that the units perform identical functions in the AN/SRT-14 Transmitter, no difficulty is anticipated. Coil and capacitor data given is based on extrapolation of existing LC circuits in the equipment which use the same coil form and core. Be that as it may, good luck and a grid-dip meter will resolve all argument.

In line with this plan, work in Unit 5 is limited to alignment. The following procedure is designed for use with a 455 kc SSB generator. Once aligned for this mode of operation, CW or AM operation may be obtained by introduction of carrier. If the SSB generator is not available, the VFO frequency range may

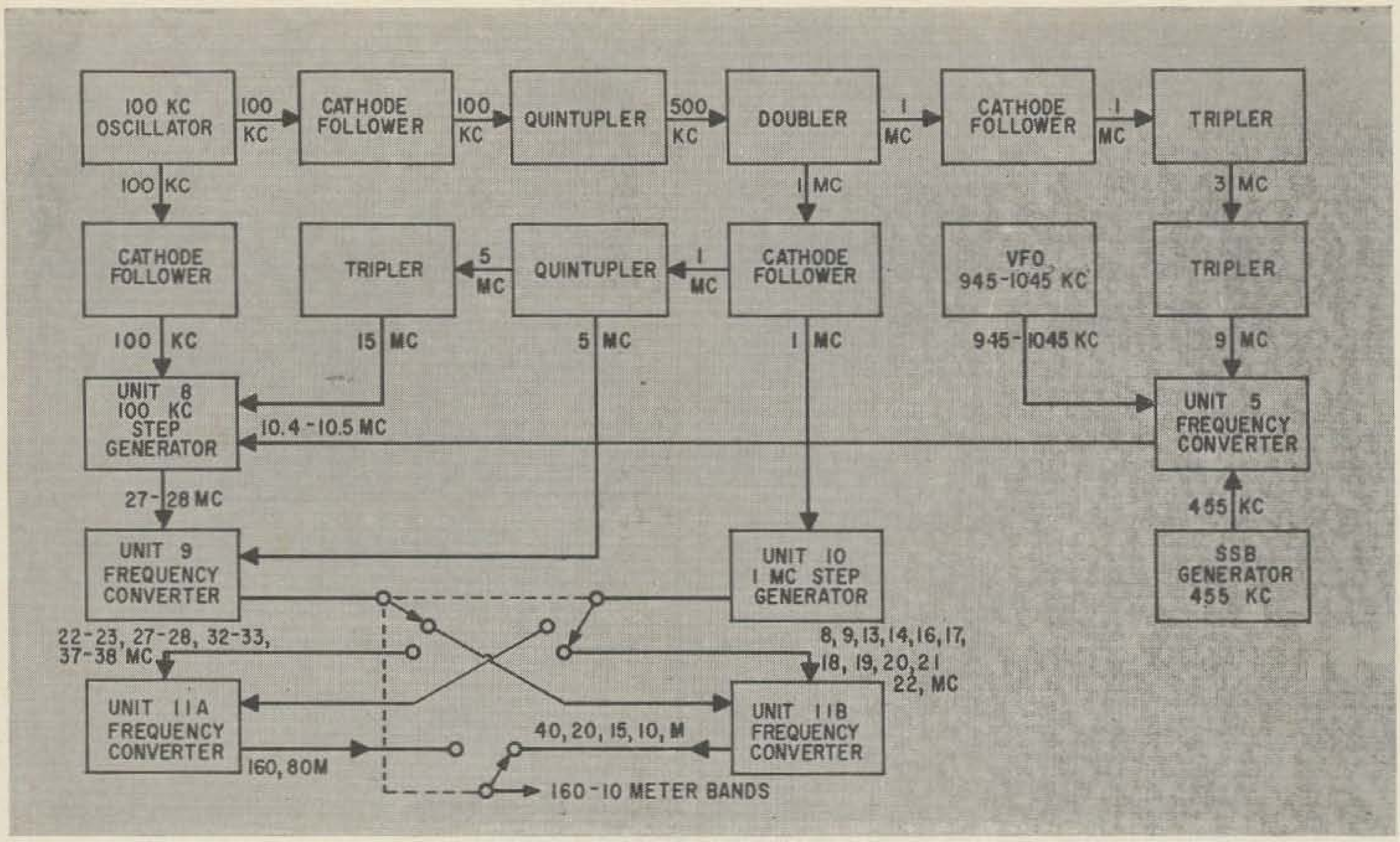


Fig. 8

be changed and it connected to another input. Connect a VFO covering the range of 945 to 1,045 kc to J-2152. Output should be about 1.2 volts into the 1,000 ohm load. Jacks J-2153 and J-2154 are not used in this arrangement. Apply power to the unit and connect a VTVM rf probe to pin 7 of V-2152. Adjust the primary and secondary slugs of Z-2151 and Z-2152 for uniform response over the VFO frequency range. It may be necessary to add a small capacitor across the transformer windings to resonate them to the desired frequencies. Conventional stagger tuned alignment techniques apply in this and the following steps.

Connect the SSB exciter to Jack, J-2155, and introduce carrier to produce about 1.2 volts across the 150 ohm input resistor. Move the VTVM probe to pin 1 of V-2153 and adjust the primary and secondary slugs of Z-2153, Z-2154 and Z-2157 for uniform response through the 1.4 to 1.5 mc range. This band is the sum of the VFO and SSB generator carrier frequencies. While improbable, it may be necessary to reduce the value of the capacitors shunting the transformer windings.

Apply the 9 mc input, at about 1.3 volts, to J-2151. Terminate J-2156 with a 51 ohm resistor and connect the VTVM to this point. Sweep the VFO through its range and adjust the primary and secondary slugs of Z-2155 and Z-215 to provide uniform output over the 10.4 to 10.5 mc band. Output should be about 1.3 volts. If SSB operation is not contemplated, change the frequency range of the VFO to 1.4 to 1.5 mc and connect to J-2153. Align as above, ignoring the adjustments of Z-2153, Z-2154 and Z-2157. The other input jacks are not used in this mode. Remove the terminating resistor and VTVM probe and Unit 5 is ready for inter-connection as shown in Figure 8.

To provide full amateur band coverage, one frequency is missing from the range of the Unit 10 harmonic generator. A 9 mc injection frequency is required for output on the 28-29 mc band. Since the 7 mc frequency is not used for amateur band coverage, these circuits are readjusted to 9 mc. The existing 7 mc coils, L-2526, L-2537, L-2548, L-2559 and L-2570 are adjustable over the range of 3.3-6 μh. Since the inductance required for these circuits at 9 mc is something on the order of 2.5 μh, turns must be removed. Removing about 7 of the existing 22 turns should be about right. Connect power, switch the band switch to position 0 and apply the 1 mc input at about 8.6 volts. Loosely couple the output of the unit to a receiver tuned to 9 mc. Adjust for maximum output and then peak, using an rf probe and VTVM.

Last of the modifications involves Unit 11B. Three of the unused 1 mc range positions must be altered to resonate in the 21-22, 28-29 and 29-30 mc bands. Positions 5, the former 15-16 mc range is selected for the 21.22 mc band. The 4 tuned circuits involved use .56-1.0 μh inductors, parallel with 91 mmfd capacitors to achieve resonance with about 32 mmfd additional capacity. Reducing the value of capacitors C-6, C-33, C-56 and C-83 to approximately 18 mmfd should enable alignment to the 21-22 mc band. Position 2, the former 12-13 mc range is selected for the 28-29 mc band and position 3, the former 13-14 mc range is selected for the 29-30 mc band. Inductors for both bands, L-3, L-4, L-13, L-14, L-27, L-28, L-37 and L-38, should be trimmed to 5 turns each.

The existing shunting capacitors should be removed. 27 mmfd capacitors should be installed in shunt with position 2 inductors and 24 mmfd capacitors installed in shunt with position 3 inductors.

Alignment of Unit 11B should be postponed until the completed exciter is available. Adjustment involves sweeping each of the three altered bands in 100 kc increments. Rock the 100 kc selector switch and maximum output should occur at the respective 100 kc switch position. If not, adjust the inductances appropriate to the band until this is true. Do NOT adjust the 100 kc step trimmer capacitors since this will destroy the correct alignment for the other bands. As a last resort, the capacitors shunting the inductors may have to be changed to obtain the proper LC ratio. If all goes well, the exciter should deliver an output of approximately 2 volts into a 50 ohm load on all bands.

The completed exciter should be connected and tested with the various units unmounted and accessible. RF connectors are the BNC type and 50 ohm cable should be used. Power connections to each of the 6 AN/SRT-14 units are made through identical Winchester Electronics, MRE-14P-G connectors. The receptacle to mate with this plug is Winchester Electronics part MRE-14S-G. A cable hood is available as part MRE-14H.

Mechanical design of this exciter has not been finalized. The proposed arrangement consists of a 10½" relay rack panel with a standard 12 x 17 x 3 inch aluminum chassis mounted at the bottom of the panel. A ⅛ x 17 x 10¼ inch aluminum plate will be attached to the rear of the chassis and the top of the plate braced to the front panel by ⅜ inch aluminum rods. The power supply, SSB exciter and the other fabricated circuitry will be contained on the chassis and the surplus units bolted to the front and back of the aluminum plate.

The switches in the surplus units will be actuated by Oak or Leadex rotary switch solenoids mounted directly to the external detent assemblies. These actuators are controlled by remote switches and operate on the "open circuit homing" principle so dear to the hearts of airborne military radio equipment designers. In this concept, the only front panel, frequency determining controls will be the linearly calibrated, 100 kc range VFO dial, the 1 mc or band selector switch and the 100 kc selector switch.

All in all, this is a very worth-while construction project. Performance should equal or exceed that of the best commercial amateur exciters and the cost negligible in comparison to that of manufactured equipment. In addition, the experience gained in the newer techniques of frequency generation will prove invaluable to any serious constructing amateur, particularly if he is engaged in allied commercial endeavor. . . . Pafenberg

Convert the URC-4 Walkie Talkie for Two Meters

Chuck Saylor K7ILP
528 N. Delaware
Chandler, Arizona

THE URC-4 is a fairly new item to the surplus market in limited number, however, it is known that MARS and CAP personnel have some of these in their possession. Description of the unit is as follows: It was originally operated on the two following frequencies of 121.5 and 243.0 megacycles. The complete set consists of the transceiver, battery, and connecting cable. Battery required is 135 volts B-Plus and 1.3 volts for filaments. The receiver is a superregen. The transmitter has three stages for 121.5 and a doubler stage for 243 mc.

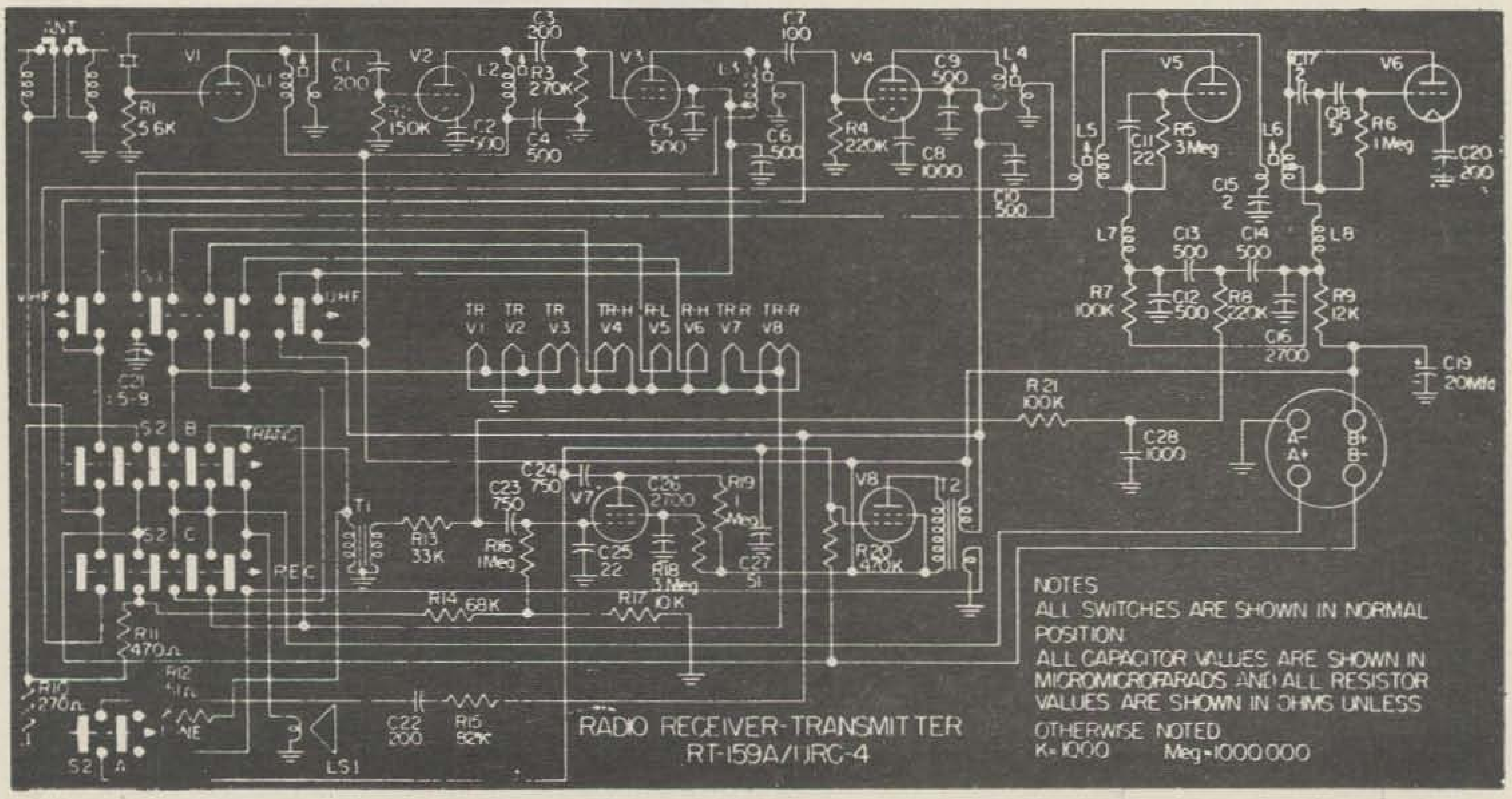
Receiver

The first item is to remove the cover which may be clipped on or held with screws. After you have the cover removed you will find in the set on the chassis three red screws. Loosen these screws all the way and carefully remove the set from the case. You will notice there are some wires connected to the case. It is not necessary to unsolder these wires, but you may do so. Now, referring to the schematic which is on the reverse side of the case cover, find coil L-5. Unsolder the wire from the plate of V-5 and carefully remove one turn and resolder to the plate pin of V-5. Remove tube V-6 which is on the underside of the chassis and save for spare. This tube could be left in and used to listen to a 220 mc signal if desired.

Transmitter

The transmitter conversion is about as simple as they come. The first thing to do is to decide what two meter frequency you desire to use. The International Crystal Company can supply crystals that will operate in this set for less than $5.00. The style of crystal is a HC6/U series with .050" pins. The crystal used operates at series resonance, in the 36 and 37 mc range for two meters. Remove the barrel type crystal if it still happens to be in the set and bend spring clip back and forth until it breaks off. I do not recommend drilling of the securing rivet as disastrous results could happen. Now solder a crystal socket for the above crystal to the two crystal contact posts on the chassis in a horizontal position. Remove tubes V-1, V-2, V-3, and V-4. Save Tube V-4 for spare. Remove the yellow plastic cover which protects the coils, there are two screws that secure it, just loosen and lift up.

Unsolder the wire that connects to the plate pin of V-1, this is the wire to coil L-1. Carefully remove three turns from this coil and resolder to the plate pin of tube V-1. Be careful not to get too much solder on the pin as it may run onto an adjoining pin. Coil L-2 is modified in the same manner with the removal of two turns. Coil L-3 gets one turn removed on the plate side of tube V-3 and is resoldered. Reinstall the plastic coil protector with the two screws. Insert tubes V-1, V-2, and V-3 in their sockets and make sure the red index marks on tubes match that of the tube socket. At this time it would be a good idea to check



the continuity of all slide wafer switches .o make sure they are making good contact, also the antenna contact spring on the underside of the chassis. Now carefully install the chassis in the case and secure with the three red screws.

It should be brought up at this time that a battery supply must be decided upon. This we leave up to your ingenuity. Some may solder direct to the plug pins and others may want to convert to a Jones plug or other type of connections. Batteries used are two 67½ volt batt.; and a 1.3 volt filament batt. Connections are shown on the diagram. The two 67½ batt. are connected in series. We now modify the case cover lid to facilitate easier tuning of the transmitter. A ¼" hole is to be drilled in the lid so that coil L-1 may be tuned with the cover installed, this is due to the detuning of the oscillator by the capacitance of the lid. Do not install cover lid at this time as the initial tuning is accomplished with the cover off.

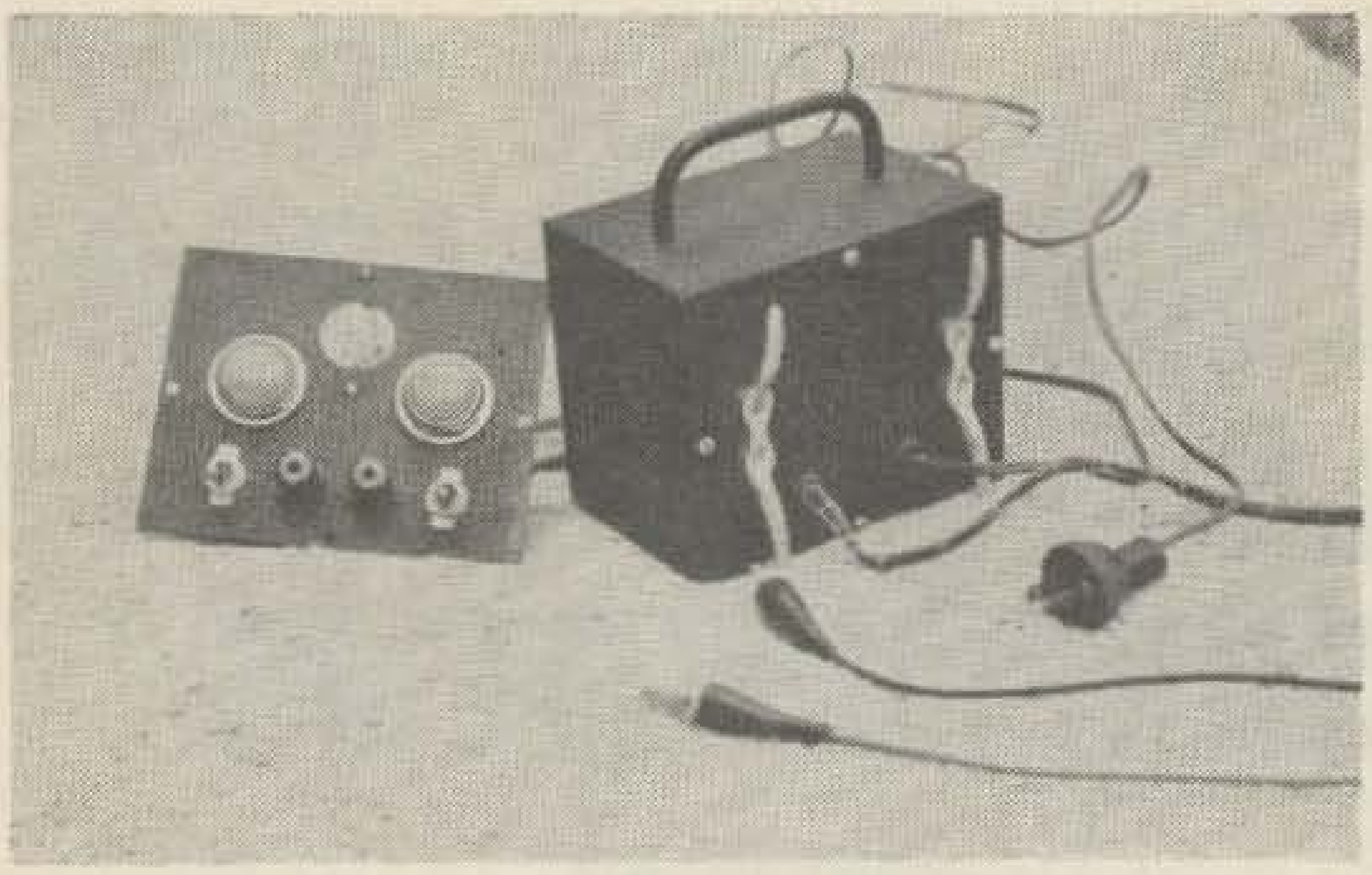
Tuning

If you have access to a Gonset Communicator it will make tuning easier, otherwise you will need a VHF signal generator with modulation and a VHF sensitive frequency meter, or receiver. First let's go through the operating procedure on this set in case the instructions have been removed from the front. There is a large slide switch on the left side of the set, this should be in the VHF position. On the right side we have three buttons at the bottom of the set marked; receiver, transmit, and tone. These buttons have a lock which is a tab located at the lower part of the receiver buttons; to unlock pull tab down. Any button may be locked in the actuated position by holding the desired button in and at the same time pushing lock tab in. These buttons also have an adjustment for travel which is an Allen adjusting screw located in the end of the individual button. The disappearing dipole antenna is unlocked by moving the thumb lock slide and pulling carefully up on the plastic top until it is fully extended. Then take the antenna elements and extend them horizontally and lock into the clips. The tuning of the receiver is next, so get yourself a non-metallic screw driver. Tune the signal generator to the frequency you want the receiver to work on. With the battery supply hooked up press in the receiver button and tune slug in coil L-5 until maximum reception is heard. If the above instructions do not produce results check your work or use that spare tube. Also the button travel adjustment may be out of adjustment.

To tune the transmitter we need a frequency meter or a VHF receiver tuned to the output of the walkie-talkie. Press the transmit button in, tune slugs L-1, L-2, and L-3 for maximum output. There may be more than one place where oscillations may occur when tuning the slugs; use the strongest. Tune with a non-metallic screwdriver, and be careful with slugs as they will break very easily. If they do, remove and replace with a slug from coil L-4 or L-6. Now we install the case cover lid with the ¼" hole drilled for access to coil L-1. Press transmit button and peak up coil L-1 for maximum output. No doubt there will or can be various changes to this for use in the 220 mc band, but it is not too popular here and the output would be much less. Tests have been made up to one mile to my QTH which uses a Gonset two with 100% results both ways, however, this is not in a city with skyscrapers. But I do believe this is one of the best two meter walkie-talkies to hit the surplus market.

. . . K7ILP

Xtal from American Crystal Co., see ad index, abt. $4.00.



Carl C. Drumeller W5EHC
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Oklahoma City 12, Oklahoma

Continuity and Power Transformer Checker

Power transformers with unmarked terminals or leads are always a challenge to the experimenter. The process of finding out which is the primary, the low-voltage secondary, and the high-voltage secondary has resulted in many a blown fuse or tripped circuit-breaker.

Most experimenters are familiar with the method of using a light bulb in series with the 117-volt line to check continuity. Many, however, use a carelessly-constructed device that in itself is a source of danger, not to mention blown fuses. After using just such an arrangement for a matter of over 25 years, the author decided it was high time to build a device that would accomplish the desired purpose with less element of danger to the operator.

First an analysis was made of the desired characteristics. It should be fused for safe operation and protection of house circuits. It should be self-checking, so that full trust may be given to its indications. It should be capable of being stored away compactly, with no dangling leads. And, finally, it should give not only a positive indication of circuit continuity but also a relative indication of circuit impedance.

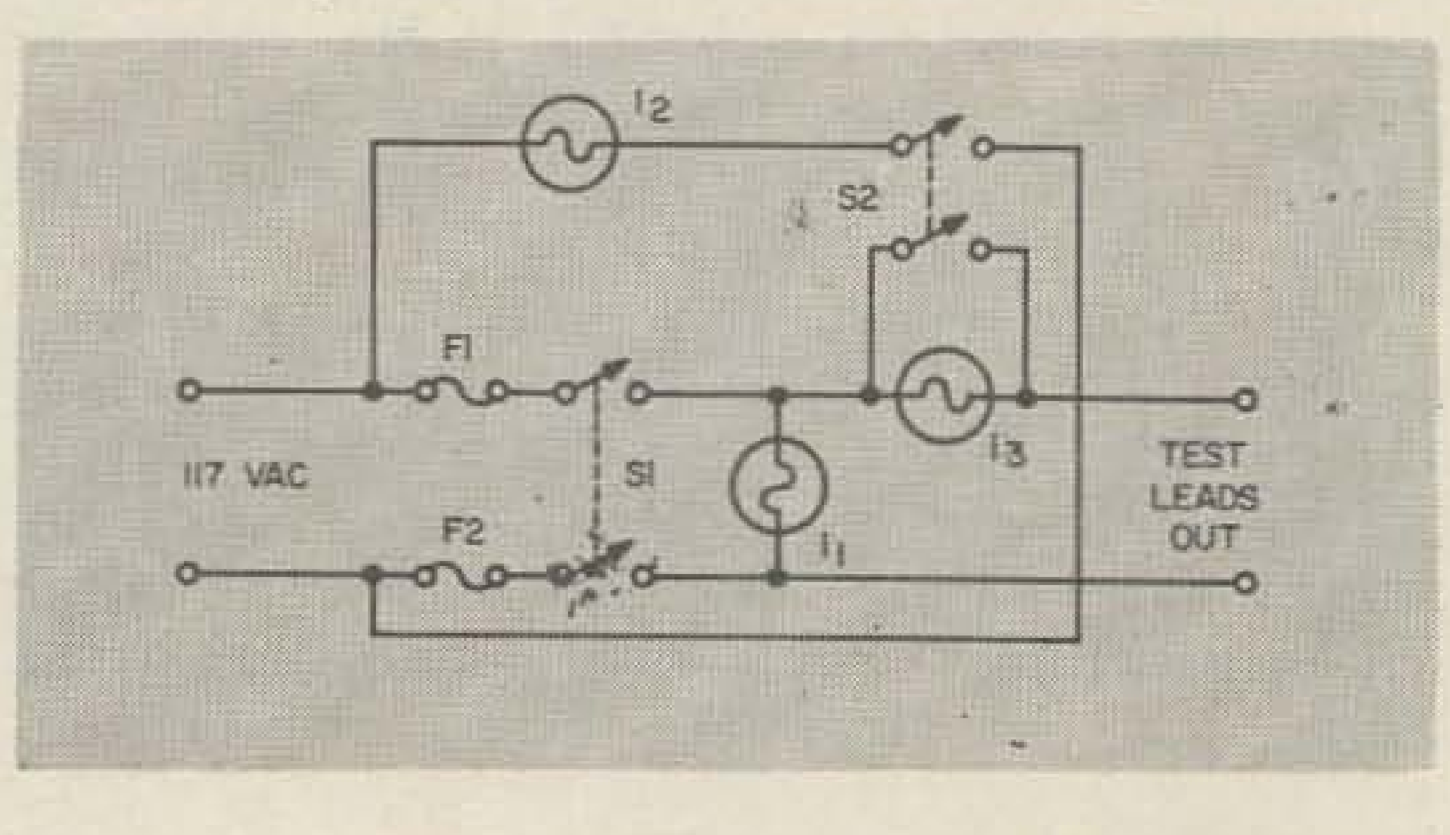
All of these operational requirements are met by the simple circuit shown in Fig. 1. No special skill is needed for any of its many uses or for its construction. A utility box 6" wide, 5" high, and 4" deep houses the few components. No chassis is used, but all parts are mounted upon the front panel, with the exception of the two line cleats attached to the rear face of the cabinet and used for storing the line cord and the output leads. Across the bottom of the panel, from left to right, are S1, F1, F2, and S2. Above them, again from left to right, are I1 and I2. At the top center is a 1-¼" hole through which I3 is viewed. The socket for I3 is mounted by means of tapped metal spacers. The spacing is adjusted so that I3 is flush against the panel. This ensures greatest visibility of its filament. Switch plates are used on S1 and S2 to indicate when the respective circuits are closed. If it is so desired, decals or other means may be used to label S1 as "Line Voltage" and S2 as "Full Voltage."

The circuit itself is so simple no wiring instructions are needed. All wiring is from a component terminal to a component terminal, with no tie points required.

Line cord input and test leads output are brought out through the rear panel and are protected by rubber grommets. A small carrying handle was mounted on top of the cabinet for added convenience.

A few simple precautions should be observed whenever the checker is used. The first steps are to separate the two output leads, making certain that their clips are not shorting and are not touching any grounded object including you. Snap on Switch S1, Lamp I1 should light up, indicating the unit is ready for the next step. Experimentally touch the two output lead clips together. Lamp I3 should light to full brilliancy. If there is too much light from the other bulbs it may be necessary to shield them from I3. Make careful mental note of the brilliancy of I3 with leads shorted for it will be used as a standard of comparison for further tests. Unshort the leads and snap off S1. This last is a very important step and should never be omitted, no matter how hurried the operator may be. Now you are ready to make tests with the checker.

If the experimenter is ambitious, he may want to add an isolating transformer to the input circuit. This has much merit as a safety measure but adds to the cost of construction, which otherwise can be kept to a very modest figure. Another possible refinement would be to mount permanently a female appliance socket on the panel and wire it across the output circuit. For a more objective indication of circuit impedance than relative lamp brillian-



cy, an alternating-current voltmeter of 0 to 150 volt range may be connected across the output terminals. Its deflection will vary inversely with the impedance of the circuit under test.

It is hoped the experimenter will find this little device a convenient and safe tool for testing not only transformer windings but a multitude of other circuits.

. . . W5EHC

Parts List

F1—2-ampere fuse, with panel mount
F2—2-ampere fuse, with panel mount
I1—6-watt, 117 volt, S-6 bulb, with red panel light socket
I2—6-watt, 117-volt, S-6 bulb, with red panel light socket
I3—10-watt, 117-volt, clear glass bulb, with socket
S1—Double-pole single-throw toggle switch, with "On-Off" plate
S2—Double-pole single-throw toggle switch, with "On-Off" plate
1 Cabinet, 6" wide, 5" high, 4" deep, with front and rear panels
2 Line cleats
2 Rubber grommets for ⅜" hole
1 Line cord, with male appliance plug
2 Test leads, with insulated clip
1 Carrying handle

S_1	I_1	S_2	I_2	I_3	Leads	Indication
Closed	Lighted	Open	Dark	Dark	Unknown winding of transformer	1. Open circuit 2. High-voltage secondary
Closed	Lighted	Open	Dark	Dim	Unknown winding of transformer	1. Primary of 60-cycle transformer 2. High-voltage secondary of 400-cycle transformer
Closed	Lighted	Open	Dark	Fully Lighted	Unknown winding of transformer	1. Low-voltage secondary of 60-cycle xfmr 2. Primary of 400-cycle xfmr 3. Any winding of a xfmr having a shorted turn 4. Short circuit
Closed	Lighted	Open	Dark	Dim	Primary of unknown xfmr	Ready for ac volt-meter check of other windings to determine approximate values.
Closed	Lighted	Closed	Lighted	Dark	Primary of unknown xfmr	Ready for ac volt-meter check to determine exact voltage of other windings

Modifying the Lafayette HE-35

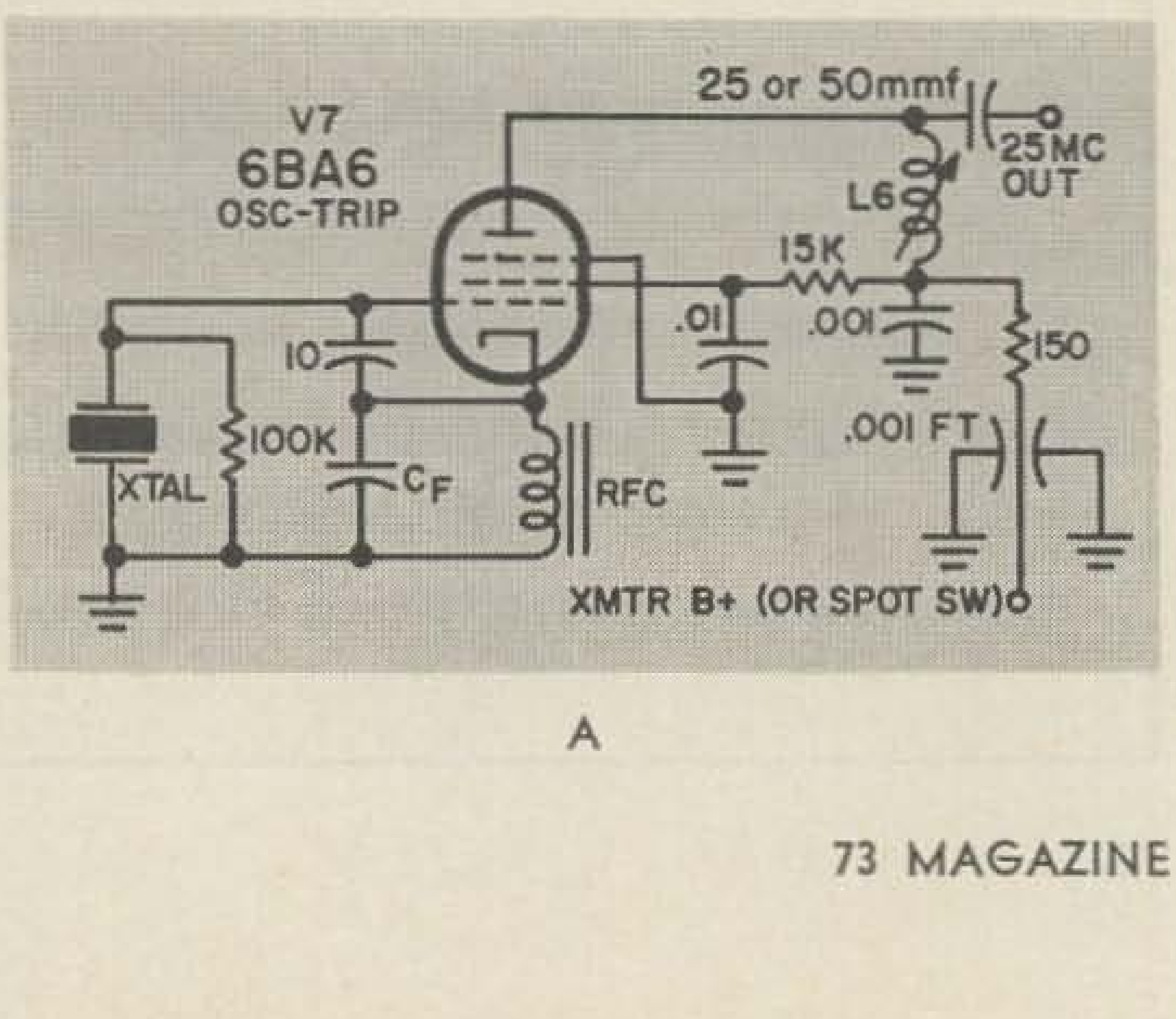
Larry Levy WA2INM

THE Lafayette HE-35 is a versatile 6 meter transceiver and is quite a bargain since it comes completely equipped and wired for only $57.50. As soon as it is unpacked it can be plugged in and put on the air, as it has a crystal and a microphone included. The only thing that is not included is an antenna. Incidentally, the rig will work with just a piece of hook-up wire, although a better antenna will naturally increase the range. In addition to this, the transceiver can be used in the car with a 6 or 12 volt mobile power supply. It is a very compact unit and can be set up almost anywhere.

Circuitwise, the transmitter has an overtone oscillator using one half of a 6CX8 driving the other half as a final. It is plate modulated by a 6V6, which is also the audio output for the receiver. The receiver is a single conversion superheterodyne with one stage of rf and one stage of *if*. It uses two tubes before the detector which perform all the functions of a superhet. The triode half of a 6EA8 is used as a mixer and the pentode half as an rf amplifier. The pentode half of a second 6EA8 is used as the *if* amplifier and the triode half as the oscillator. The set also includes a 6AL5 noise limiter. While it may appear that a receiver with so few tubes will be greatly lacking in sensitivity, I was amazed to find that it could receive weak signals quite well. Even from the car it is possible to receive stations running moderate power as much as 50 miles away. The overall performance of the transceiver is very good, and the quality of the modulation is excellent. As with any unit, there are a number of modifications which can be made that will improve the performance or the operating convenience. I made several modifications in the unit and the result was a transceiver that had all the features that I wanted. It should be noted that these modifications, with the exception of the first two, are independent of each other and any combination can be used, depending upon the preferences of each owner.

One disadvantage of the transceiver is its use of expensive overtone crystals. In Brooklyn it is almost impossible to remain on one frequency and have many QSO's completed without QRM. The problem is critical because there are so many HE-35's in use, all with the same frequency crystal. The cost of third overtone crystals makes it prohibitive to acquire a large collection of frequencies. A practical solution is to use 8 mc crystals, many of which are available surplus for less than a dollar. Another reason for the use of 8 mc crystals is the increased grid drive. Because of their construction, third overtone crystals cannot be used at high power levels and still have stability. For this reason the output of the overtone oscillator is limited and the grid drive on the final is low. This results in less efficiency than it is possible to get out of the stage. Although the drive is low, there is enough to have reasonably good modulation without splattering. With the increased drive available from the 8 mc crystals, the efficiency is greatly improved, as is the quality of the modulation.

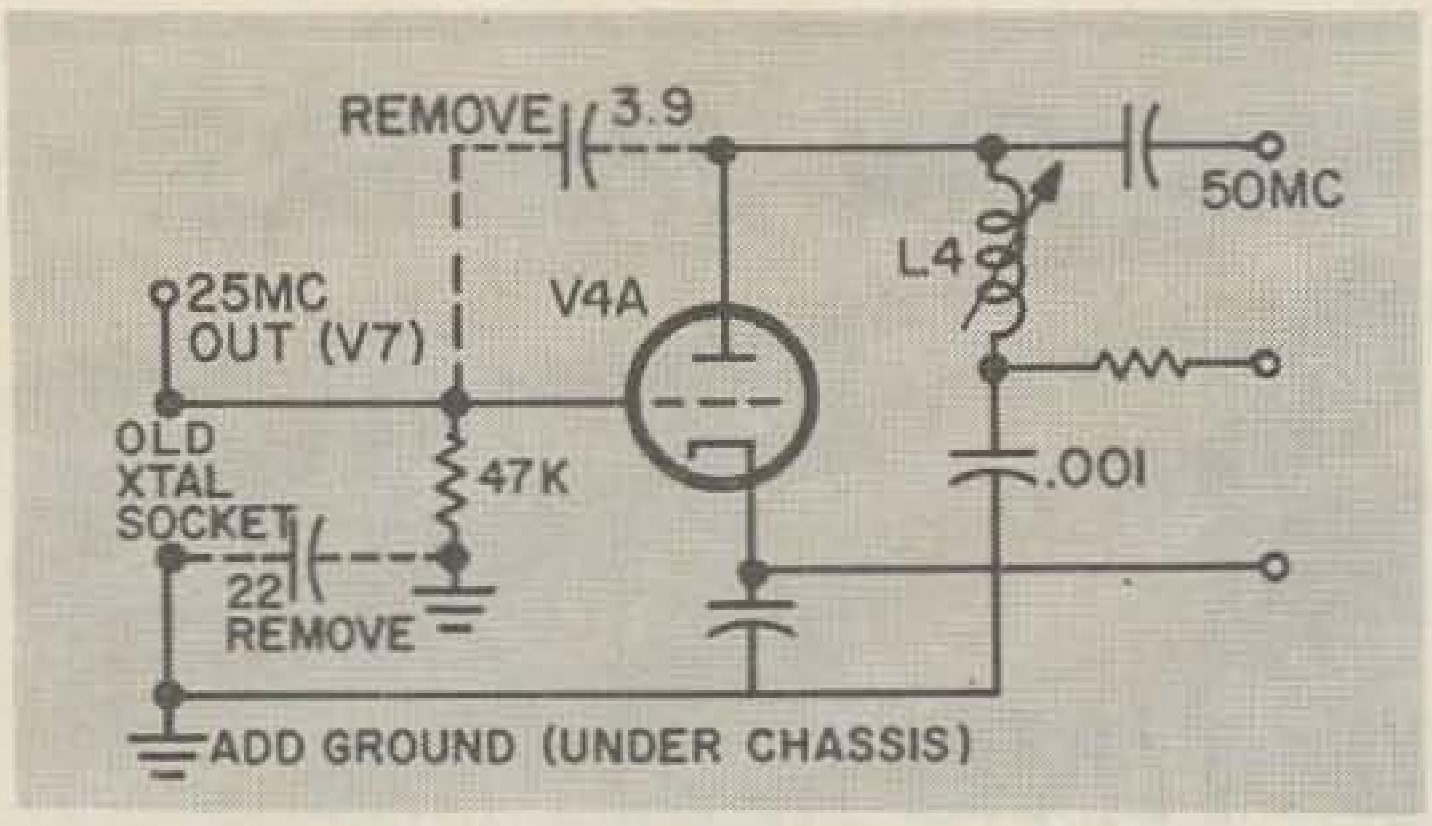
The use of 8 mc crystals requires an extra oscillator stage. I used a 6BA6 which has fairly low power requirements but has sufficient output when used as an oscillator-tripler to adequately drive the triode half of the 6CX8, now functioning as a doubler. When it is properly driven, the doubler will give more than sufficient drive for the final. A 6AU6 can be susbstituted for the 6BA6 if one is available. The oscillator is built on a piece of scrap aluminum about 2 X 2 inches. The assembly is bolted to the front panel. It is lo-



A

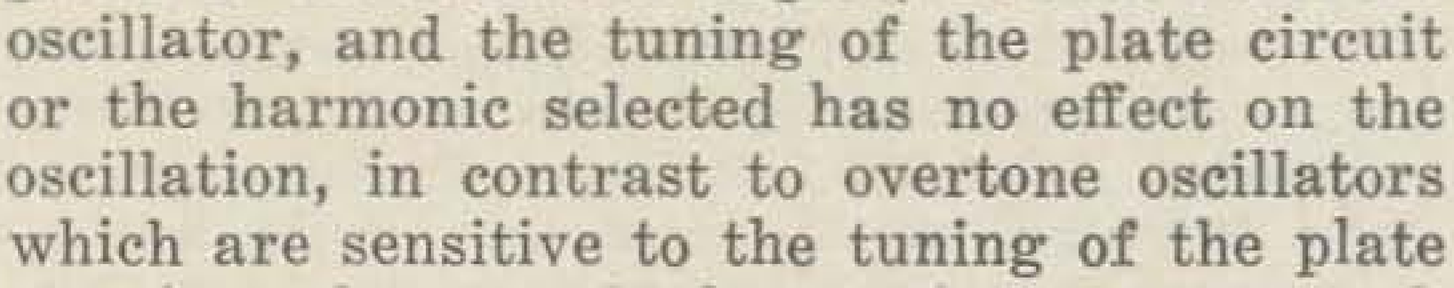
cated under the word "Band" at the top of the panel. It should be mounted far enough down so that the tube has a ¼ inch clearance from the top, about 2½ inches from the upper edge being sufficient.

The circuit is shown in "A." The value of "Cf" depends upon the inductance of "RFC." if "RFC" is 2½ mh, "Cf" should be about 150 mmfd. If the inductance of "RFC" is less, the value of "Cf" should be decreased proportionately. With a given inductance, the amount of feed-back depends on the ratio of "Cf" to the 10 mmfd condenser, so that decreasing the value of "Cf" increases the feed-back. If you desire to experiment, "Cf" can be a small ceramic trimmer adjusted so that a further decrease in capacitance will not result in an increase in output. Such adjustment is really unnecessary as the oscillator has sufficient output if a fixed condenser of approximately correct value is used. Coil L6 consists of 10 turns of #34 enameled wire, close wound on a Lafayette CO-310 coil form. Be sure that the coil is tuned to the correct frequency, as *any* harmonic of 8 mc will give grid drive. If the wrong one is chosen, either the drive will be low or the final will give no output. As an example, if the coil is tuned to 16 mc, the rig will work, although the drive will be less on the final because the triode will function as a tripler, with a resulting decrease in output. If the coil is tuned to 32 mc, the triode will not multiply, with no output from the final



B

as a result. It should be noted that the circuit given is an oscillator-tripler, not an overtone oscillator, and the tuning of the plate circuit or the harmonic selected has no effect on the oscillation, in contrast to overtone oscillators which are sensitive to the tuning of the plate circuit and only odd harmonics can be used. Diagram "B" shows how the new oscillator is connected into the circuit. The feed-back circuit from the original oscillator is removed by clipping the 3.9 mmfd condenser between the plate and grid of V4-A. The 22 mmfd feed-back condenser is removed and the .001 condenser from the cold end of L4 is connected to the chassis with short leads. The wires are disconnected from the crystal socket. The output from V7 is connected directly to the grid of V4-A. The original crystal socket was removed and one that accepted FT-243 type crystals was substituted. As a matter of courtesy and convenience, I felt it necessary to add a spot switch. It is extremely simple to install and the results are worth while. The connections are shown in Diagram "F."

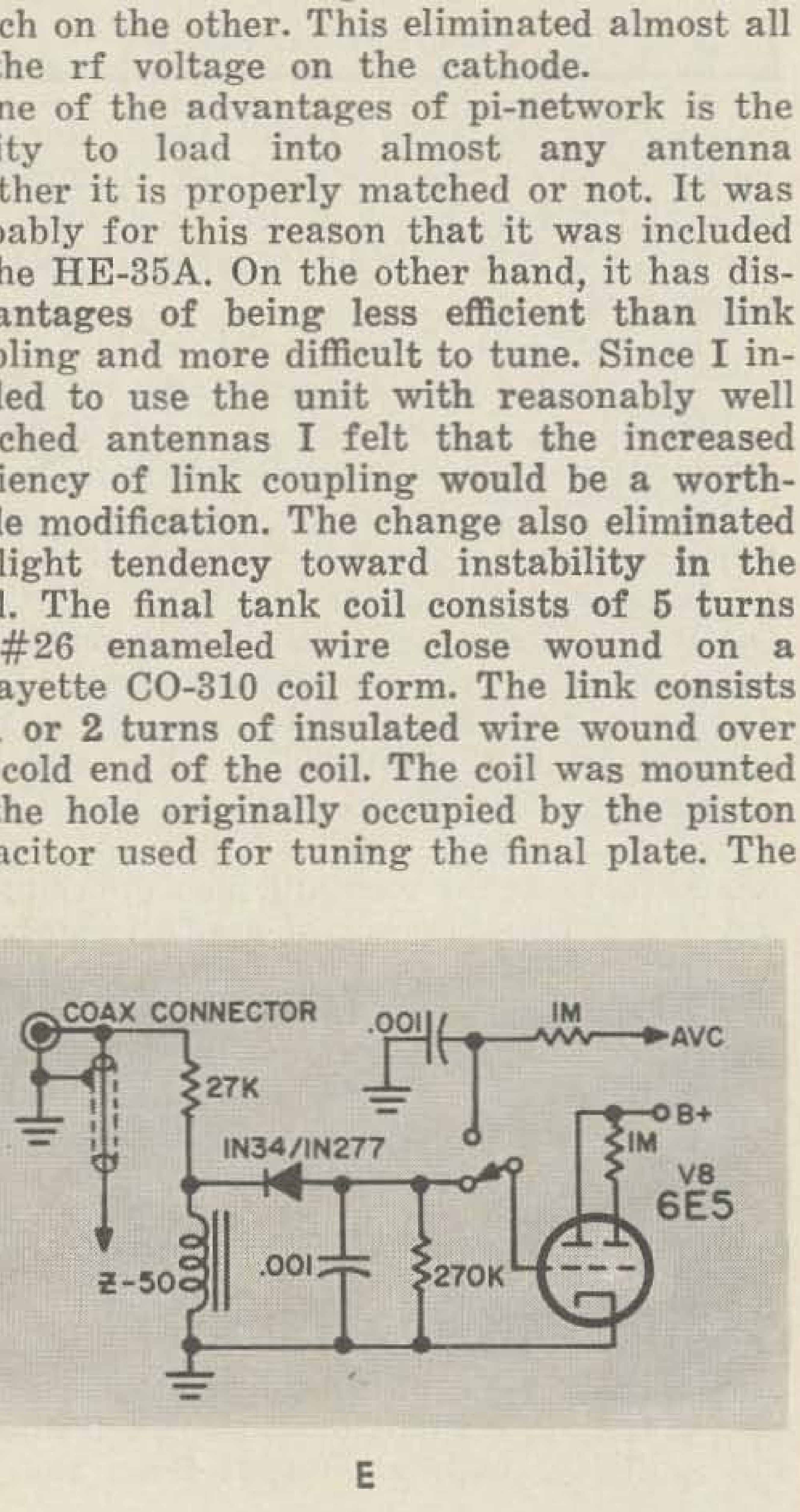


F

Inspection of the schematic revealed that when the unit is used on 12 volts the heaters are connected in a series parallel configuration. In order to maintain the balance in the heater circuit, it would be necessary to add a second tube that has the same heater current as the oscillator tube to the unit. A logical choice would be a tuning eye, which could be used to measure the strength of received signals as well as power output from the transmitter. An excellent choice for an eye tube is a 6E5 as it has the correct heater requirements and is quite sensitive. The tube is mounted on the front panel in an Amphenol tuning eye assembly. It is centered about 2 inches down from the top under the letter "i" in the word "Tranceiver." I mounted the assembly upside down because the rig is used most of the time with the operator looking down at the indicator and if it is mounted conventionally, it is necessary to tilt the transceiver as the shade obstructs the eye. As a tuning indicator for the receiver it is only necessary to connect the grid of the eye tube to the AVC through a 1 meg resistor. Better results can be obtained if it is connected on the detector side of the 2.2 meg isolating resistor. To use the eye tube to measure transmitter output, an *rf* detector is required to provide a few volts of negative bias. The grid of the eye tube is switched between the transmitter and receiver sections by the use of a miniature switch such as the Lafayette SW-76. Incidentally, this switch is a good choice for the spot switch and a pair of them can be used to preserve the appearance of the unit. The schematic for the eye and detector is shown in Diagram "E." To add the tubes into the circuit, connect the heater of V7 in parallel with V6 and connect the heater of V8 between pin 2 of V6 and ground.

One possible source of instability in the transmitter is the rf voltage present on the cathode of the final amplifier as well as on the leads to the transmit switch. The .01 by-pass condensers used appear to be too inductive to act as an effective by-pass at 50 mc. I by-passed the cathodes with a .001 button condenser and connected the leads from the cathodes to the switch through a .001 feed-through condenser, the cathodes being on one side of the feed-through and the leads to the switch on the other. This eliminated almost all of the rf voltage on the cathode.

One of the advantages of pi-network is the ability to load into almost any antenna whether it is properly matched or not. It was probably for this reason that it was included in the HE-35A. On the other hand, it has disadvantages of being less efficient than link coupling and more difficult to tune. Since I intended to use the unit with reasonably well matched antennas I felt that the increased efficiency of link coupling would be a worthwhile modification. The change also eliminated a slight tendency toward instability in the final. The final tank coil consists of 5 turns of #26 enameled wire close wound on a Lafayette CO-310 coil form. The link consists of 1 or 2 turns of insulated wire wound over the cold end of the coil. The coil was mounted in the hole originally occupied by the piston capacitor used for tuning the final plate. The

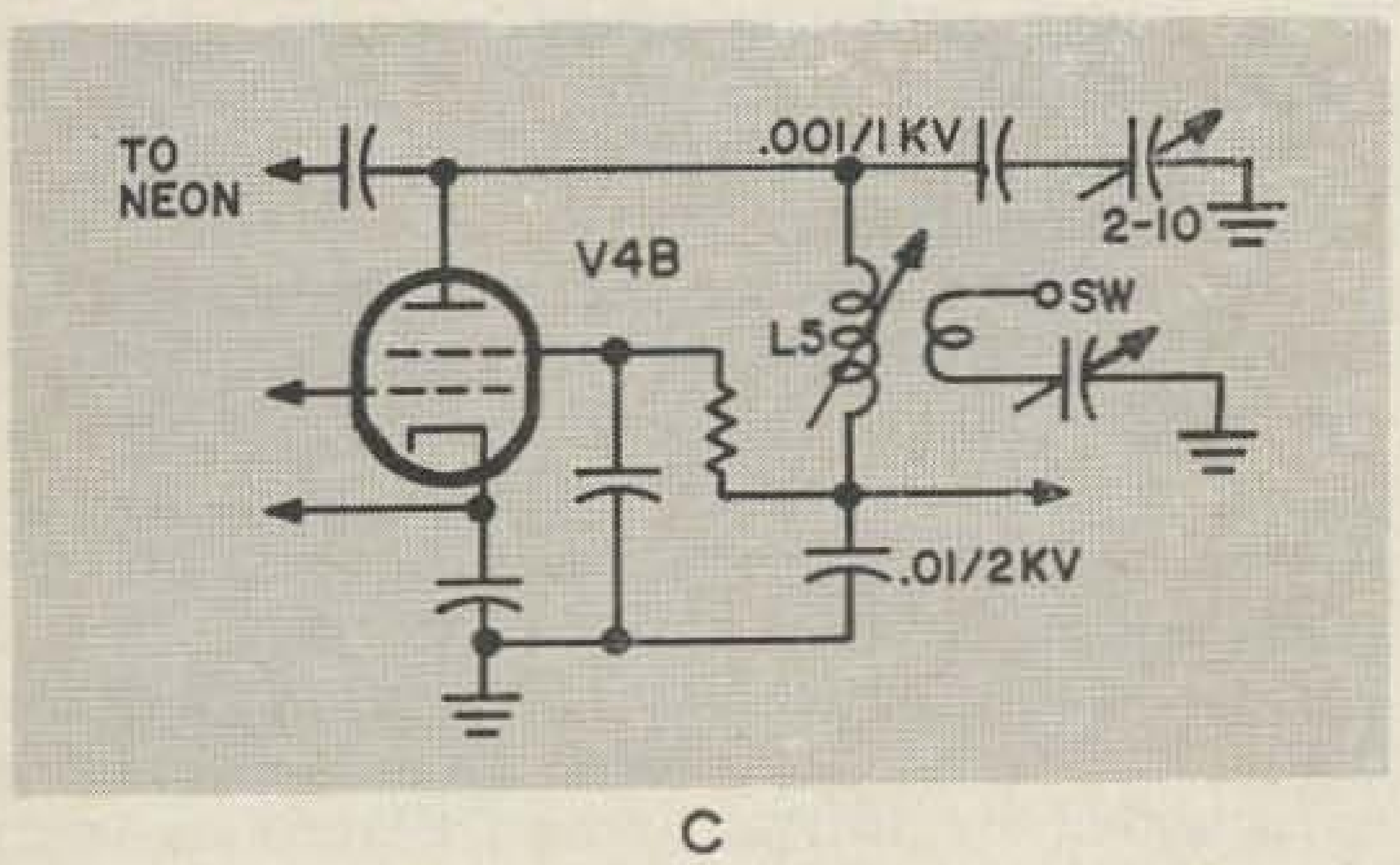


E

link is tuned by a 7-45 mmfd ceramic trimmer. If there is not enough capacity with the trimmer at maximum, a 50 mmfd ceramic disc can be added in parallel so that the tuning range is from 57-95 mmfd. It is usually not necessary as I found that maximum loading for most antennas is approximately 35 mmfd.

One inconvenience noticed in the operation is tuning the slug with a screwdriver inserted through a hole in the top. This can be frustrating, especially when trying to find the slot in the car at night. I decided to add a small tuning condenser on the front panel to eliminate this situation. A 2-10 mmfd miniature variable worked fine. It is connected through a .001 ceramic disc to the tank circuit to isolate it from the high dc and audio voltages present. In this manner a much smaller condenser can be used since it requires a lower break-down voltage rating and therefore smaller spacing between the plates. The condenser has enough range to tune the entire 6 meter band.

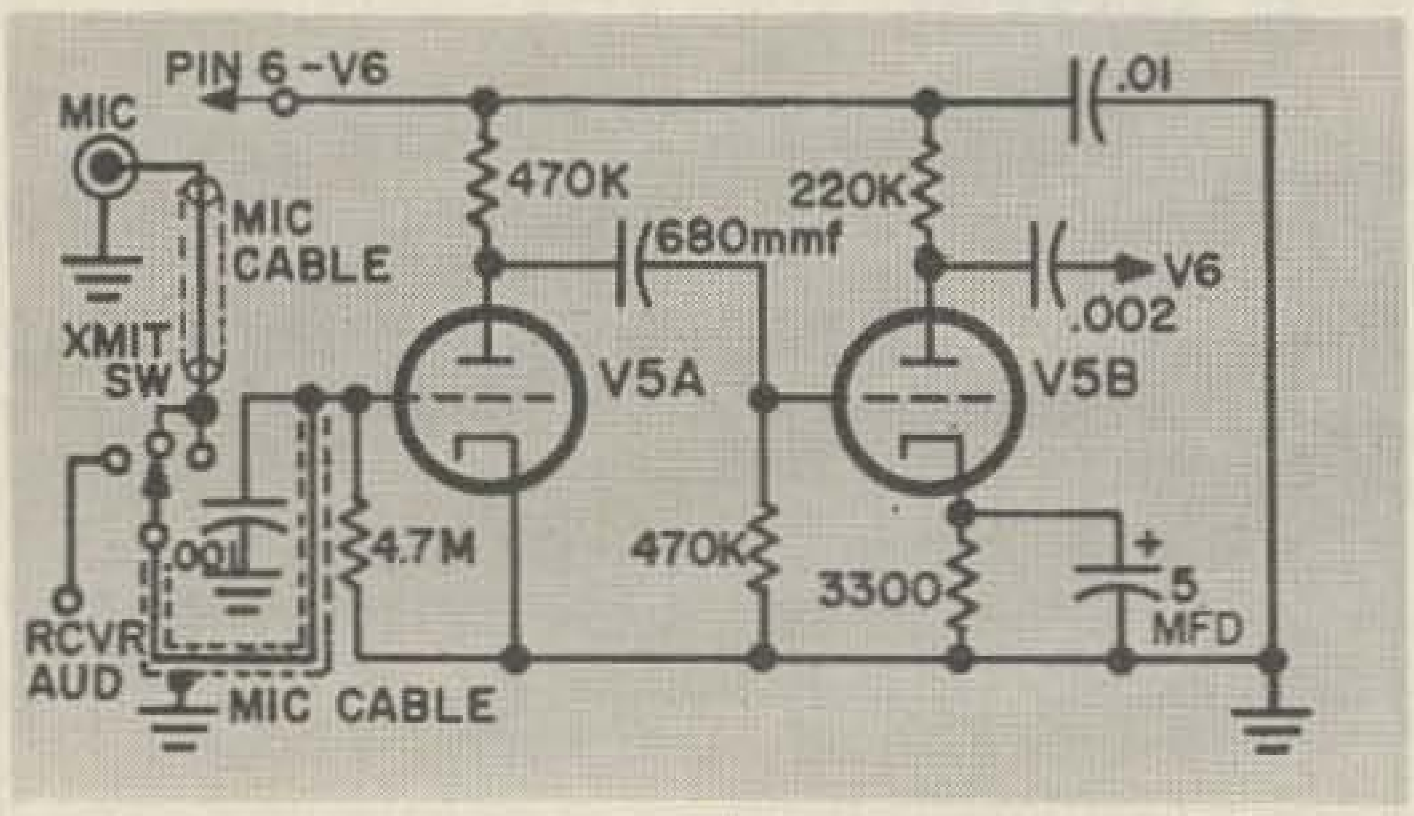
A front panel loading condenser is not really necessary, as the setting is not critical and usually does not have to be reset when changing frequency. One could be included if it is desired. The tuning condenser for this should be mounted so that the shortest leads possible are used. A good place is on the front panel between the rf indicator and the noise limiter control. The schematic for the changes are shown in Diagram "C."



C

The receiver section can be improved with a little rewiring and the changing of a few values. Although it has amazing sensitivity for the number of stages, its sensitivity can be increased further by the use of carefully controlled regeneration. The transceiver was very well designed from the viewpoint of stable operation. With the values originally used, there are no traces of regeneration. Almost any change in value that increased the gain introduced regeneration. If the amount of regeneration is carefully controlled, a stage is capable of a considerable increase in gain without any ill effects. Because the local activity is concentrated in the lower mc of the band, I decided to omit the 4700 ohm loading resistor across L1, which was originally used to broaden the response of the coil to 4 mc. This resulted in an increase in sensitivity. Removing the resistor across L2 resulted in instability, so it was left connected. The plate load of V1A was changed from 4700 ohms to 15K. Regeneration was added to the *if* stage by shorting pin 7 to ground and lowering the value of the plate supply resistor to 1K. This caused too much regeneration, so the amount of regeneration was reduced by shunting the primary of T2 with a 150K resistor. I also shunted the secondary of T1 with a 470K resistor. This achieved the desired amount of regeneration. The amount is controllable by the value of the shunt resistor across T2. Reducing the value of the resistor lowers regeneration. After repeaking the coils, the overall gain of the receiver was considerably higher.

Another modification that might be of interest involves the local oscillator. Since the local activity is concentrated in the first half mc of the band I did not see any need for having the receiver tune the full 4 mc. By changing the L to C ratio of the oscillator circuit I modified it to tune just 1 mc.

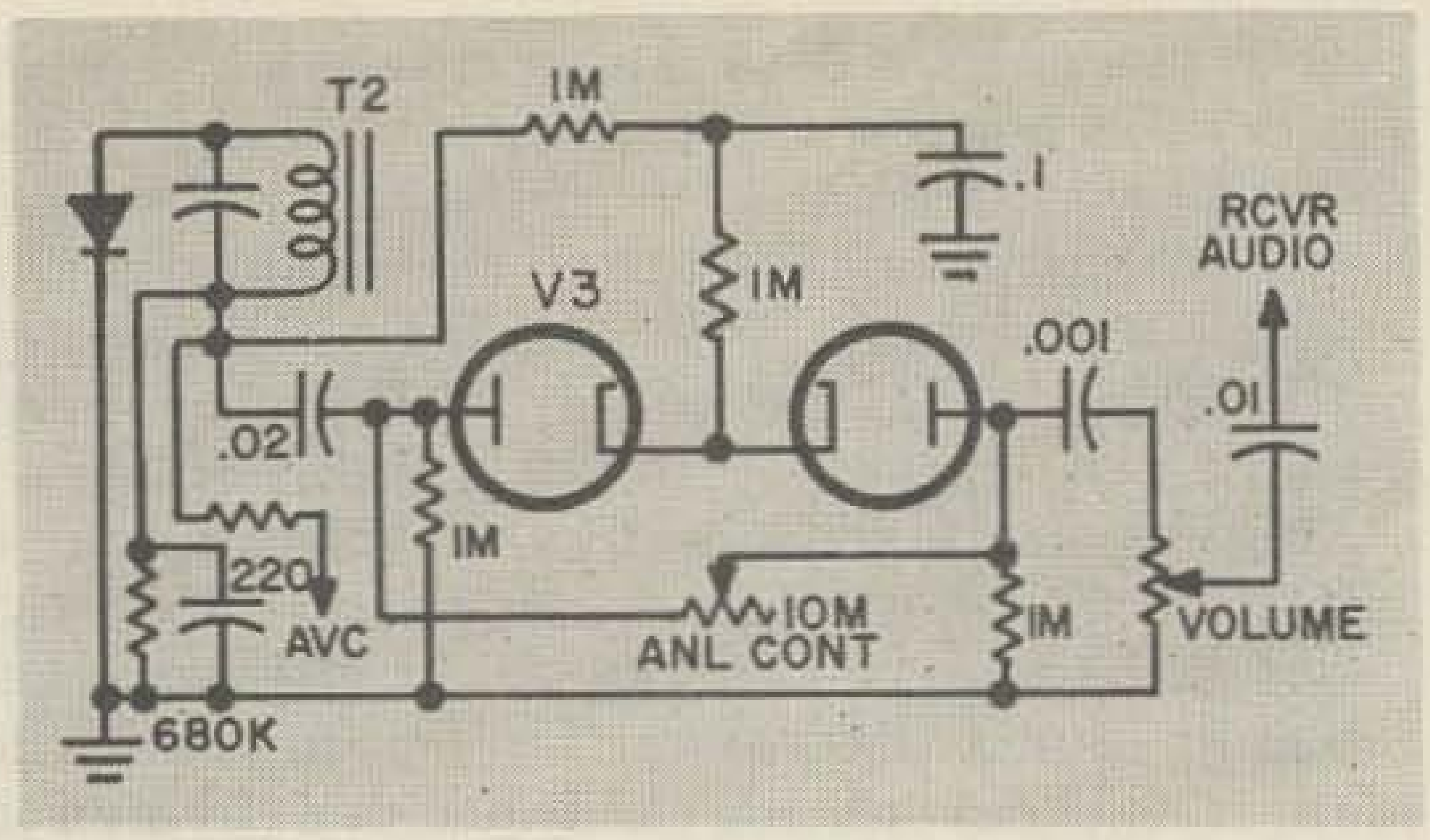


D

A slight drift was noticed on strong signals after the other changes were made in the *if*. This seemed to be a result of the voltage variation caused by the varying drop across a resistor as the plate current of the *if* tube changes with the AVC. The trouble was corrected by connecting the oscillator, through a decoupling resistor and filter, directly to the cathode of the rectifier. The changes are shown in "H."

When operating mobile, the need for additional audio is greatly increased since the rig has to compete with much higher background noise, the noise of the motor, wind, other traffic, etc. The noise limiter reduces the audio level further. It is difficult to receive a weak station under these conditions. One solution is to add another stage of audio amplification. A careful inspection of the schematic revealed that one-half of the 12AX7 wasn't doing anything in "receive." With a little rewiring of the switching circuits I added the extra stage of audio to the receiver. On "transmit," the stage still functions as a speech amplifier. The revised audio section is shown in "D."

I improved the noise limiter slightly so that it limits more effectively, though the original limiter was quite good. If it is desired, the modified limiter does not have to be variable



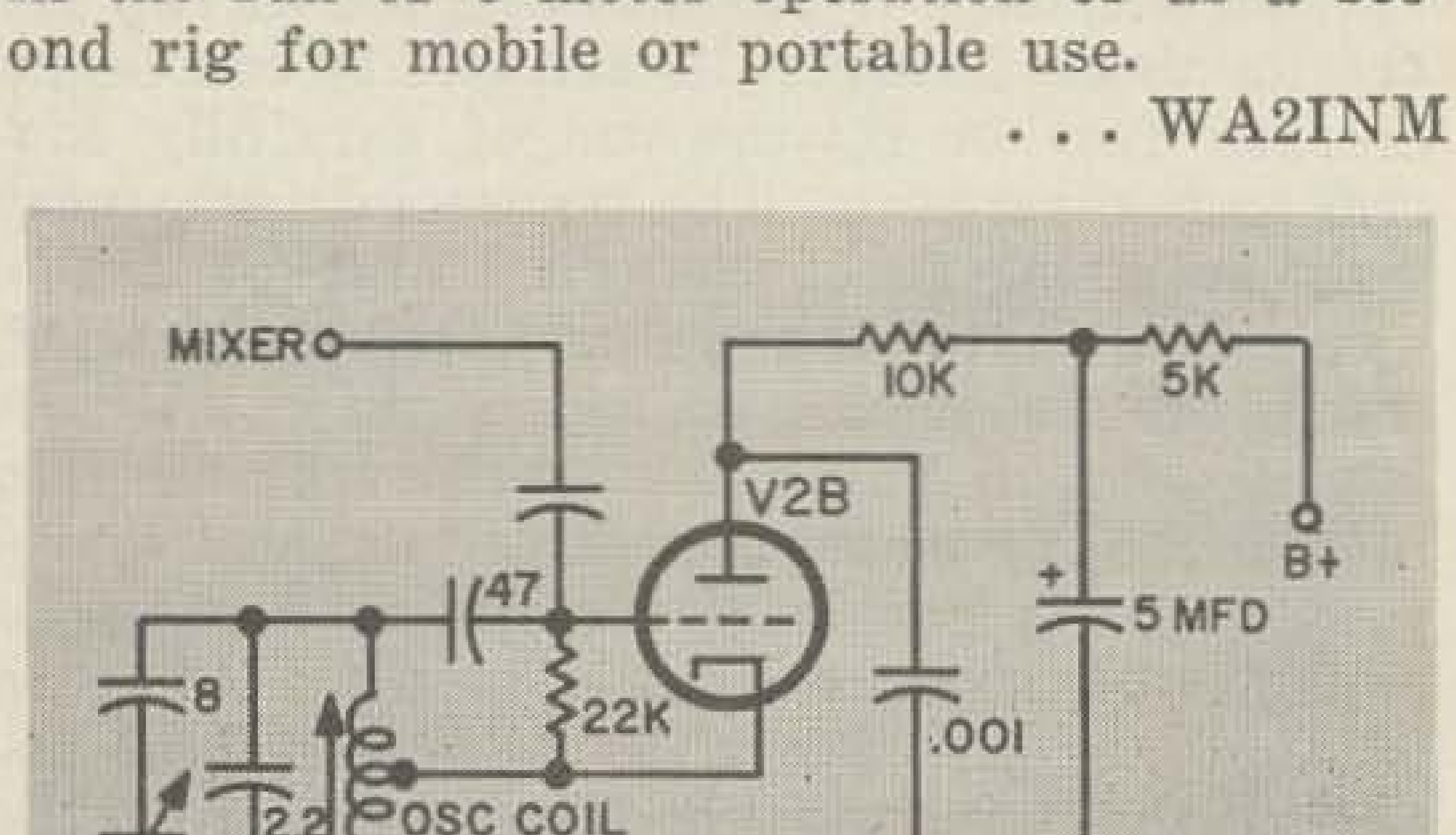
G

and the 10 meg limiter control could be replaced with a switch. I personally prefer the variable limiting feature, so I did not change mine. The modified circuit is shown in "G."

One attractive addition is a pair of indicator lights for transmit and receive. I used a pair of Lafayette MS-478 neon assemblies, one red and one yellow. The neons are connected through a 250K resistor to the switch B-plus contacts on the transmit switch. These pilots are very attractive and are a worth-while addition to almost any rig, especially because they are so inexpensive. Another convenience is a modulation indicator which is especially useful when operating at night. One can be made quite easily from an additional neon. It is connected through a .01 mfd 1000 v condenser to the modulated B plus lead of the modulation transformer. One side of the neon is grounded and the other goes to the condenser. While it will not indicate the exact percentage of modulation, it will indicate if there is modulation.

The modified transceiver has given excellent results both at home and in the car. At times the performance has been nothing short of amazing. An example of this is that I have worked several skip stations in excess of 1000 miles while driving in Brooklyn, using just a halo for an antenna. One of these contacts was made in heavy tarffic and almost completely surrounded by tall buildings. I received very good reports. The HE-35 is an excellent choice for those who are interested in participating in the fun of 6 meter operation or as a second rig for mobile or portable use.

. . . WA2INM



H

Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Dress it up

Photo Credit: Morgan S. Gassman, Jr.

ONE problem that plagues the amateur constructor is the shortage of trim hardware and other mechanical components that spell the difference between functional, but obviously "home grown," equipment and a smart "custom-commercial" product. Fortunately, the packaging problem has been fairly well solved by the various manufacturers of metal cabinets. The wide variety of types, sizes, materials and finishes available provide the amateur constructor with a selection that will meet the requirements of most construction projects.

With modern component parts and the handsome enclosures available, there is apparently no reason why every creation should not have that commercial finish. This, however, is not the case. Aside from downright sloppy workmanship, three factors are to blame for this condition. These deficiencies are poor panel layout, inadequate marking of controls and the lack of distinctive trim hardware.

Two of the problems, panel layout and marking, are usually easily solved. The control panel should be laid out to provide a balanced appearance and maximum operating convenience without reducing the efficiency of the equipment by poor electrical arrangement. Labeling and marking of the controls and control panel is not difficult. The complete and attractive decal sets, when applied in accordance with instructions, give professional results. A light coat of clear, spray lacquer will insure permanence of the markings.

The desirability of trim on amateur equipment is a controversial subject. The word "trim" brings forth a vision of gleaming chrome and this falls in the same category as caviar; some like it and some don't.

For those who do, a visit to the local hardware store will be profitable. Many new items of decorative cabinet hardware have entered the market and much of this has electronic equipment application.

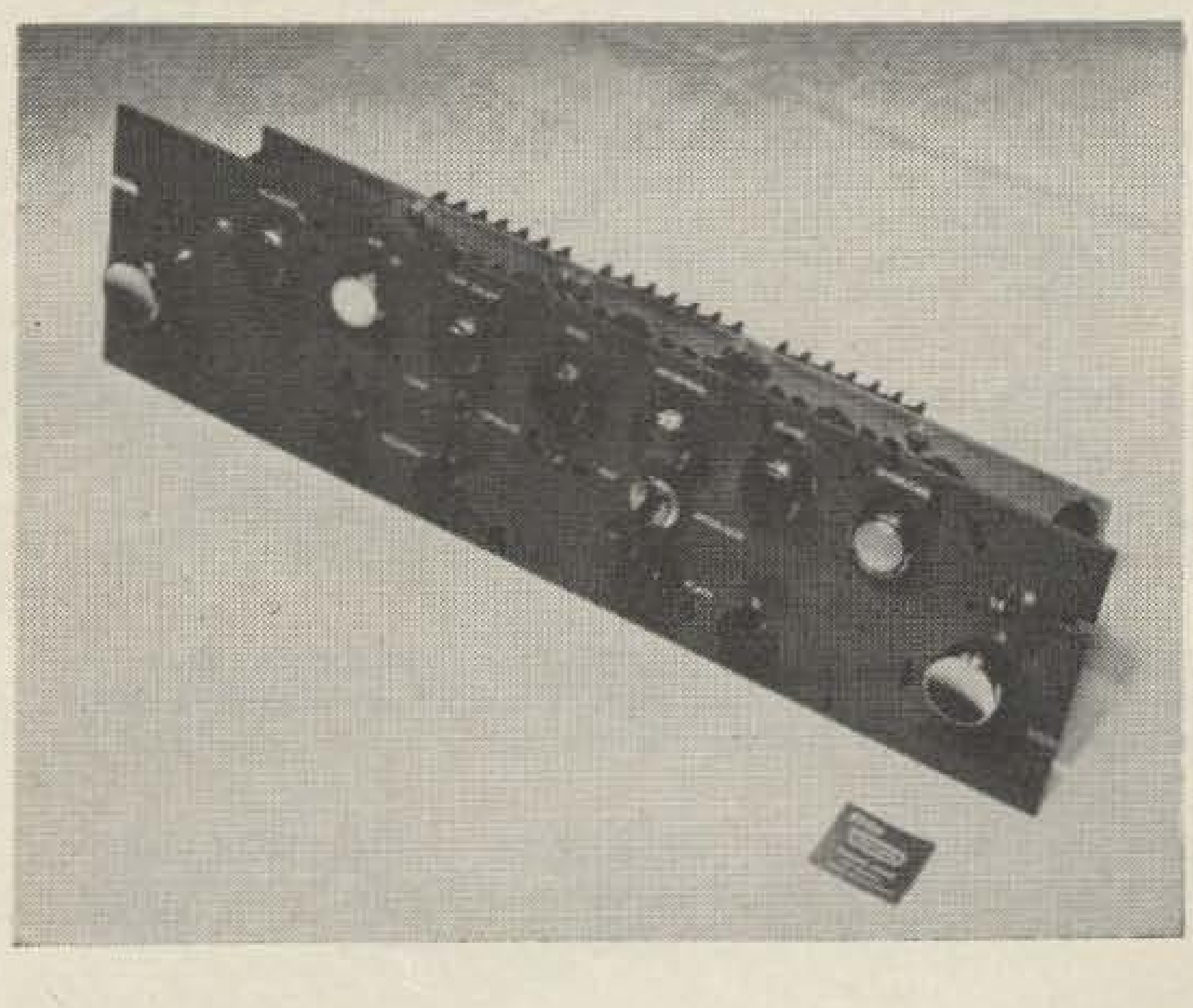
Panel handles for rack mounted equipment have long been on the market. However, these handles require two mounting holes and may not be immediately available. Sturdy, chrome plated kitchen cabinet knobs may be found in many hardware stores. These heavy, die cast units are quite attractive and are budget priced. The photograph shows two Sears, Roebuck and Company #5905 "Craftsman" cabinet knobs mounted on a rack panel. The bright chrome and the modernistic styling of these 1¼" diameter knobs provide a custom touch to the equipment.

Chrome plated cabinet knob back plates also have amateur equipment application. They are available in a variety of sizes, in both round and square types, and make ideal trim for various components. The photograph shows a Sears, Roebuck and Company #5907 "Craftsman" plate used as a mounting for a miniature meter. A 1" hole is punched in the center of the 2⅜" square plate and the assembly mounted by the meter mounting nut. Other components may be mounted in the same way and the chrome adds flash to any equipment.

Surplus BC-191 and BC-375 transmitters have supplied the variable inductors for many amateur transmitters. This unit is a fine component and, complete with counter dial, provides a low cost answer to the pi-network circuitry of medium and high power transmitters. However, regardless of how it is mounted, the existing dial is decidedly antique in appearance.

The photograph shows an up-dated installation of this dial. A Sears, Roebuck and Company, 2½", #6021 "Craftsman" cabinet knob is sawed off just back of the largest diameter. The back side is dressed smooth with a file and two holes are drilled in the knob. The hole in the center is used to secure the plate to the old dial and the second hole mounts the spinner crank. Credit for this one goes to W4SYJ. The modernistic result will be a credit to the finest equipment.

The ideas shown in the photographs and described above just scratch the surface. Visit your local department store and give your imagination a chance. Ingenious application of items designed for other purposes can save you money and provide a custom touch to your equipment. . . . W4WKM



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A PNP-NPN CPO

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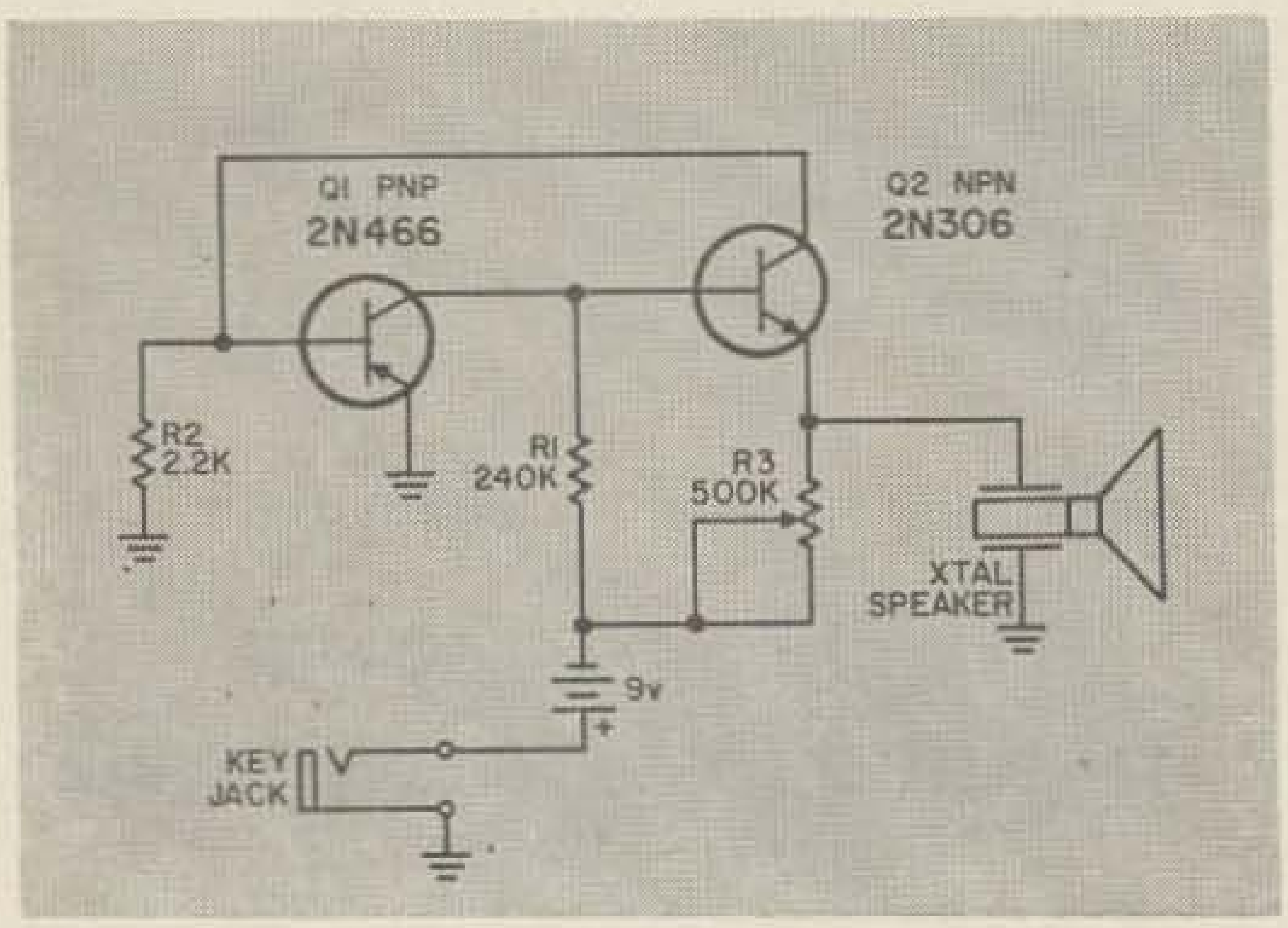
VARIOUS classes of amateurs, or amateurs-to-be, build code practice oscillators for numerous individual reasons. Among these are the desire to learn the code or to improve their proficiency, or to just plain build one for the fun and self-satisfaction of doing something or learning something. This oscillator circuit was intended along the latter lines, but it is very useful in keeping the old fist from getting too rusty.

The circuit uses the old PNP-NPN transistor arrangement which is commonly used to explain the PNPN type of transistor. Three resistors (actually two fixed resistors and a potentiometer) plus a crystal type pillow speaker complete the oscillator. Power is furnished by a 9 volt transistor radio battery, with a current drain of less than 100 microamperes. A crystal diode could be used to rectify a little RF from the rig for monitoring of your keying while transmitting, but the battery supply should be used until the oscillator is working satisfactorily alone.

The tone produced is quite pleasing, being very rich in harmonics. The actual waveshape across the speaker is nearly the same as that of a normal RC type relaxation oscillator. Sound pressure build-up in the piezo-electric crystal speaker does cause some distortion and flattening of the normal curve, and in fact the oscillator can be frequency modulated by blowing or talking into the speaker.

By now the reader has probably guessed the secret of operation of the circuit, in that the inherent capacity of the speaker is the hidden circuit component. The one used measured about .003 mfd. Incidentally, a number of pillow speakers have various low impedance coils, rather than a piezo-electric crystal—so be sure before you buy it. Lower tones than the range of the tone control can be produced by simply shunting the speaker with a fixed capacitor. Or omit the speaker, using only a capacitor, and about 9 volts of signal is available to drive an audio power amplifier. In this case the oscillator may work over a range of from a few cycles to 10 kc, depending on the size of the fixed capacitor.



The circuit is essentially a form of an astable multivibrator, in which both Q1 and Q2 are cut off until the emitter voltage of Q2 rises to about the same voltage as is on its base, which is applied through R1. The emitter voltage on Q2 rises at the rate at which the speaker capacitance is charged through the potentiometer, R3. Q2 is cross coupled to Q1, so they amplify regeneratively, causing complete conduction of both, thereby rapidly discharging the capacity. The cycle then repeats itself indefinitely or until power is removed by opening the key.

One peculiarity of the circuit should not be overlooked. The PNP transistor must be conducting slightly in order to amplify and enable the circuit to trigger. Therefore at very low temperatures where Ico of the transistors is low and the base to emitter voltage is increased, R2 may have to be increased in value, or omitted. At high temperatures the reverse is true. The values specified gave good operation with a number of similar transistors at normal room temperature. Incidentally, the crystal speaker could easily be ruined by leaving it in a closed car on a hot day, or exposing it to other sources of heat.

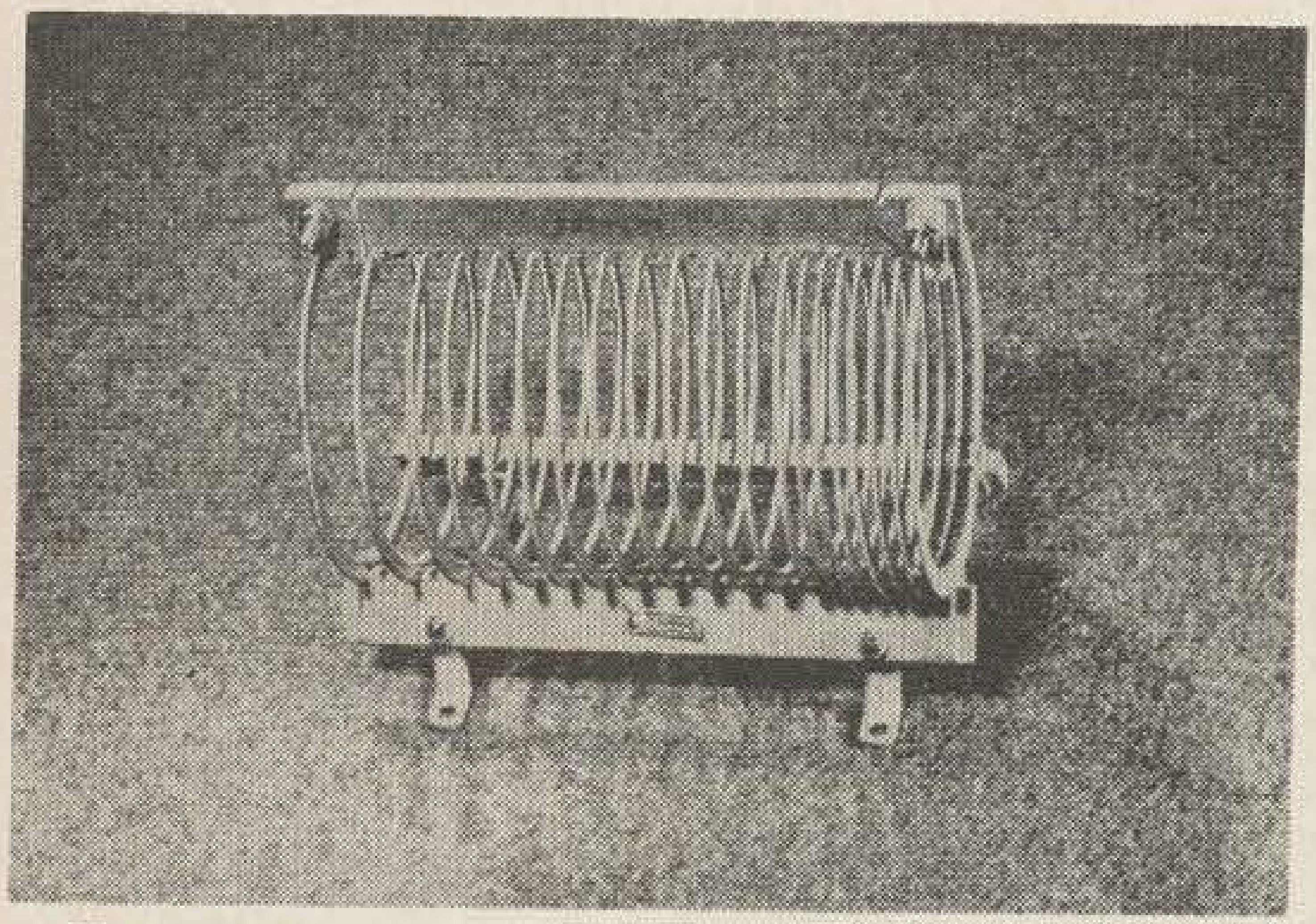
Construction is non-critical—a finished circuit works as well as the breadboard—which is unusual in present day electronics. If you use transistor sockets and find it a bit difficult to make solder stick to them a tiny drop of acid flux makes a world of difference. Needless to say, the acid flux must be carefully washed off with alcohol immediately after soldering, else stray leakage paths and corrosion will set in.

While the output is low, due to the low current drain, it is more than sufficient for code practice in the normal quiet ham shack. A major advantage is that it keeps the code practice in the ham shack, and not on the already cluttered up CW bands. . . . K6EAW

Variable Pitch Pi-Network Inductor

EDGEWOUND, copper ribbon inductors, similar to the E. F. Johnson Company 200 and 232 series coils, are frequently available on the surplus market at very reasonable prices. These inductors will handle substantial power levels and would be ideal for use in high power, tapped pi-network tank circuits except that constant pitch winding is employed. This complicates their use in band-switching circuitry since the required form factor may not be achieved at the higher frequencies.

Modification of these inductors for band-switching, pi-network use is a simple task. The edgewound copper ribbon is supported by three notched Micalex bars and mounting feet are attached to two of these. The clips securing one end of the insulators are removed and the end turns pulled out of the coil. The spacing of the remaining turns is progressively increased by inserting the turns in every notch for the low frequency section, every second notch for the medium frequency section and every third notch for the high frequency section. The photograph shows one of these inductors modified in this fashion. Addition of ceramic post, mounting insulators complete the coil.

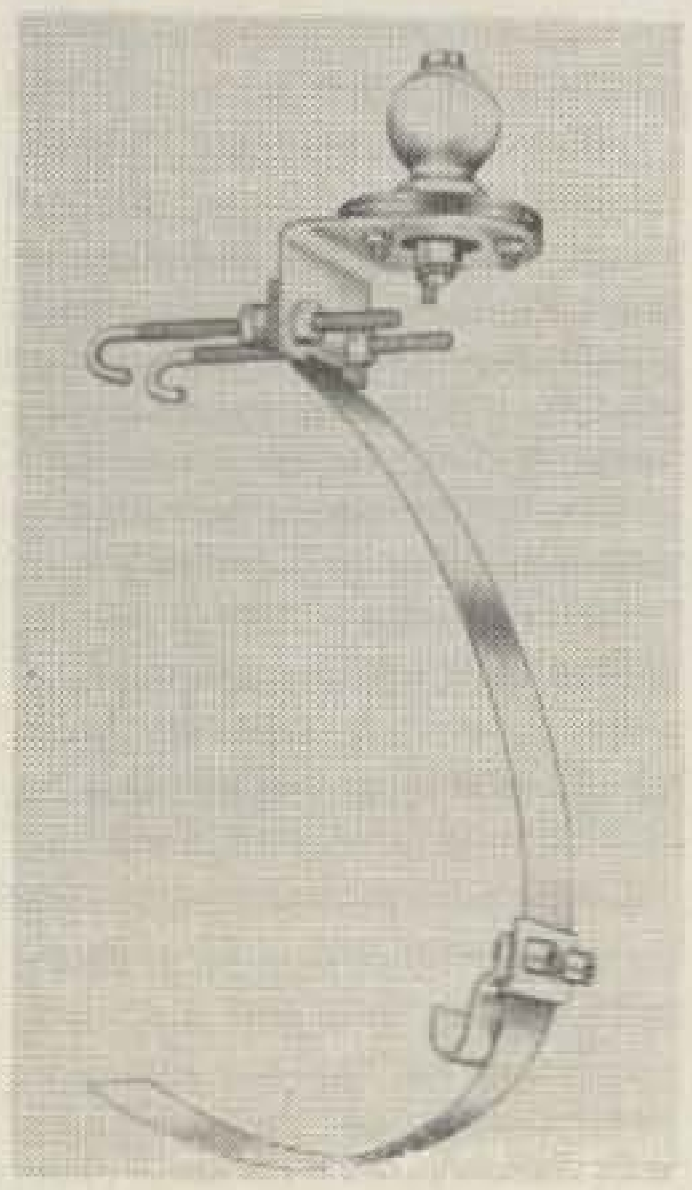


Total inductance and the positions of the taps will be determined by the desired LC ratio and circuit "Q" and these are fixed by the operating parameters of the final stage. After the tap locations are determined, copper strap leads are sweat soldered to the inductor and connected to the tap switch.

Suitable tap switches may also be found on the surplus market. Since military equipment is required to work into a wide variety of antennas, tank circuit voltages and currents are often extremely high. As a consequence, very heavy duty ceramic switches are used in relatively low power equipment. Use of these switches and the modified inductors will go a long way toward reducing the cost of high power amplifier construction. . . .W4WKM

Photo Credit: Morgan S. Gassman, Jr.

New Products

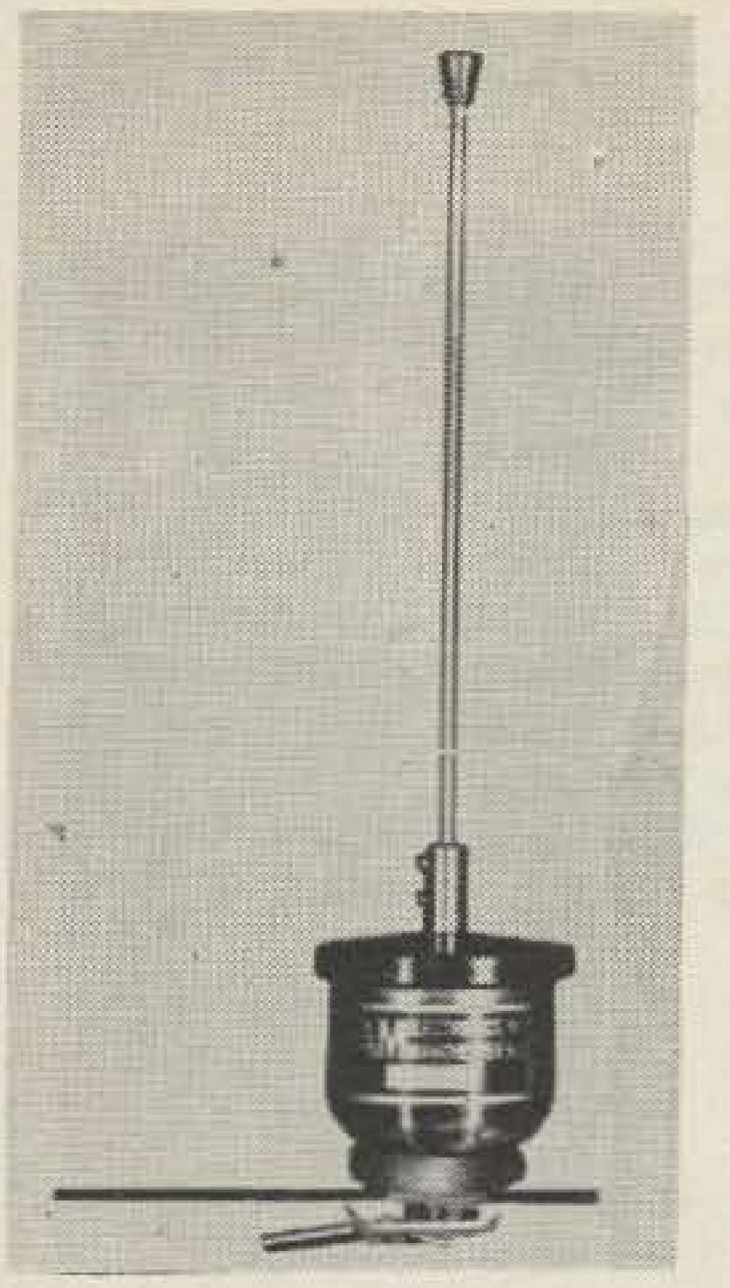


Bumper Mount

One of the major problems in bumper mounts has been the wide variety of shapes to be fitted. New-Tronics has come up with a clever solution to this puzzler: a flat alloy steel strap which fits tightly against any shape bumper, large or small. The whip receptical has a standard ⅜-24 thread and adjusts for vertical position of the whip. Wanna know more? Drop New-Tronics a card at 3455 Vega Avenue, Cleveland 13, Ohio.

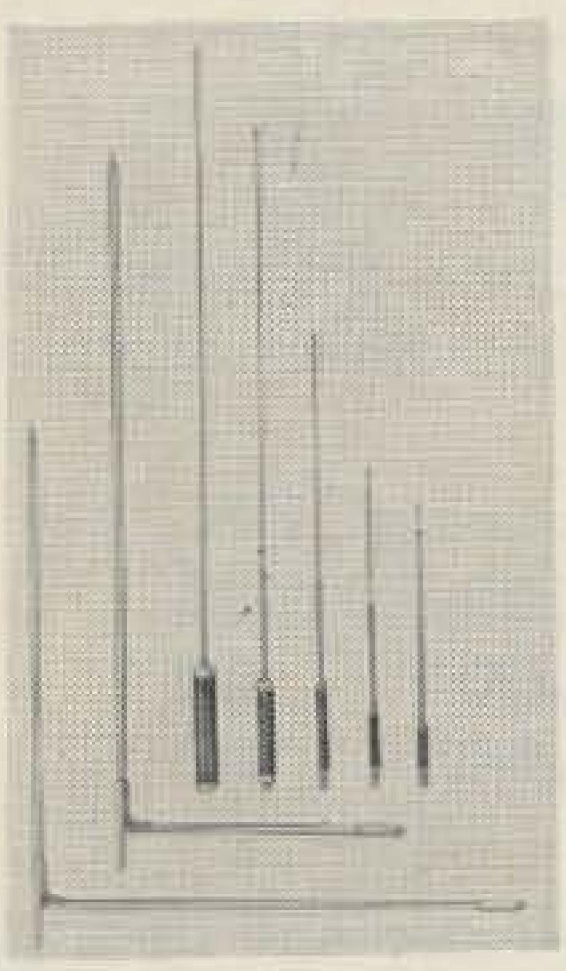
Index To Surplus

Roy Pafenberg W4WKM has come up with a really valuable idea. He has taken the time to check back through all of the past issues of 73, QST, Electronics World, Radio-Electronics, and . . . er, CQ, and has made a complete list of all of the articles that have appeared about surplus. Since this ran to over 100 manuscript pages it was obvious that we couldn't publish this in 73. Thus another book was born. We've gotten this set up in book form and had it printed for you. It lists all pieces of surplus equipment alphabetically and gives a listing of all articles on it and a digest of the content of each article. This should be invaluable to anyone interested in converting or buying surplus equipment. It also lists all of the surplus conversion books and their content. $1.50.



Car Roof Antenna

GAM Electronics has a new mobile antenna for roof-top mounting. This one only sticks ⅜" through the roof, leaving no bulge in the inside upholstery. Roof-top mounting provides a much better signal, eliminates dead spots and picket-fence effect. The TG-2-R has a half wave whip and a built-in matching transformer. It tunes from 144-160 mc. Brochure? Write GAM, 138 Lincoln Street, Manchester, New Hampshire.



All-Band Mobile Antenna

The engineers at New-Tronics have been extra busy of late and have come up with a fine arrangement for all-banding the mobile antenna. All kinds of coil tapping arrangements have been tried in the past and most of them lead to almost complete frustration on the part of the poor operator. N-T has a good practical system: separate resonators for each band. The base whip has a hinge arrangement so it can fold over for resonator changing or garaging. Each resonator can be matched to your particular car by tuning it with the stainless steel adjustable rod. There are two masts available, one for bumper mounting and the other for fender or deck use. New-Tronics will be pleased to send you further information is you'll card them at 3455 Vega Ave., Cleveland 13, Ohio.

LETTERS

Dear Mr. Green:

I was very interested in the article by your contributor, Roy Pafenberg, W4WKM, on the grid dip oscillator, in your January 1962 issue. Roy seemed to be very enthusiastic about the product, as well he should be. This Japanese import, at $36.95, is an almost exact copy of a wired version of the Knight-Kit G-30 Grid Dip Oscillator, which has been built by many hams all over the country. The price of the Knight-Kit is $22.95. As a ham I would prefer to spend only $22.95 and a pleasant evening building a grid dip oscillator. The Knight-Kit uses all American parts, but this is only a passing observation.

Lou Dezettel W9SFW

Dear Sir:

We will train you at home to operate Heavy Construction Machinery. If you answer immediately you will get the FREE Railroad Telegraphers Course. Would you like to be a Federal Postal Clerk in the club car of the Santa Fe Chief? Mix with Movie Stars?

First you have to do something for me. That's the American Way.

Last year I managed to buy a gift subscription to Batman on Sideband, or whatever you call your magazine, for a friend and I don't know when it expires but I would like to renew it for 2 years. However, I suspect I may be a little late and perhaps he lost faith and renewed it hisself. In other words I don't want to give you the money if you're just going to slip it in the beer kitty because he already came thru. If he did I'll still get him 2 yrs additional—he's only 40 or so—will you handle this please? Bill me or ask me for the money and fix his stencil.

Ken Cole W7IDF

WAYNE GREEN LOSES SHIRT

I have now proven positively that it is not possible to keep subscription prices at $3 per year and at the same time put out a larger magazine . . .even with the most rigorous economy measures.

	One Year	Two Years	Three Years	LIFE
Present subscription rates	$3.00	$5.00	$7.00	$30
New rates, effective March 1, 1962	3.50	6.50	9.00	40
New, new rate, sometime in the fall	4.00	7.00	10.00	50

All $3.00 subscriptions received after March first will receive 10 issues.
CLUB RATES: Club secretaries may send in subscriptions in groups of five or more and deduct 50¢ per subscription for the club.

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name call

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address (QTH)

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city zone state

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☐ $5.00 two years ☐ Renewal (I think)
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Start with: current issue ☐ next issue ☐

73 Magazine 1379 EAST 15th STREET, BROOKLYN 30, N. Y.

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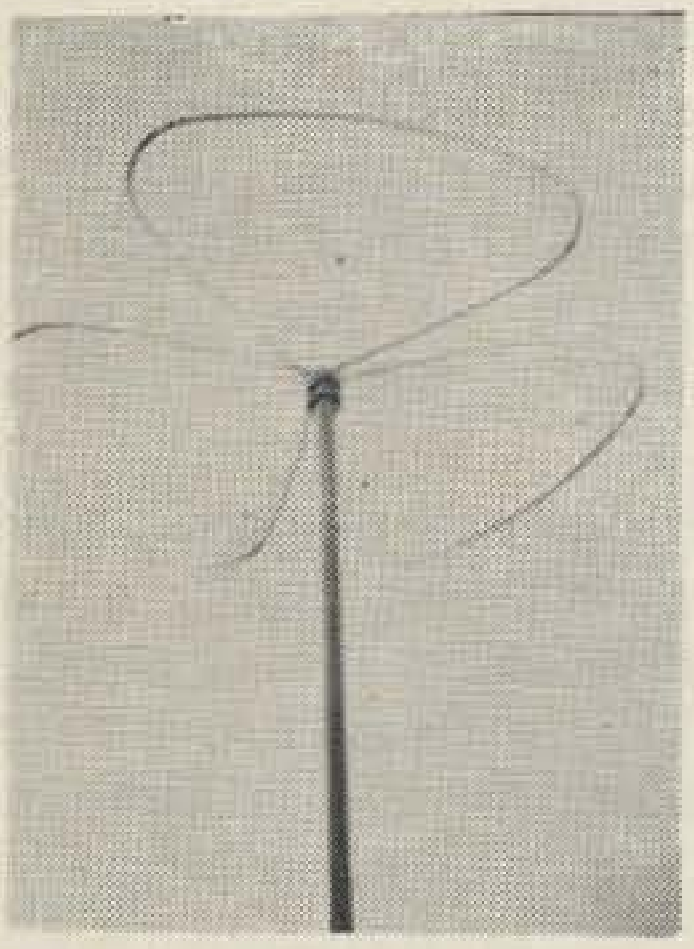
☐ $7.00 three years ☐ New subscription (I think)
Start with: current issue ☐ next issue ☐

73 Magazine 1379 EAST 15th STREET, BROOKLYN 30, N. Y.

New Products

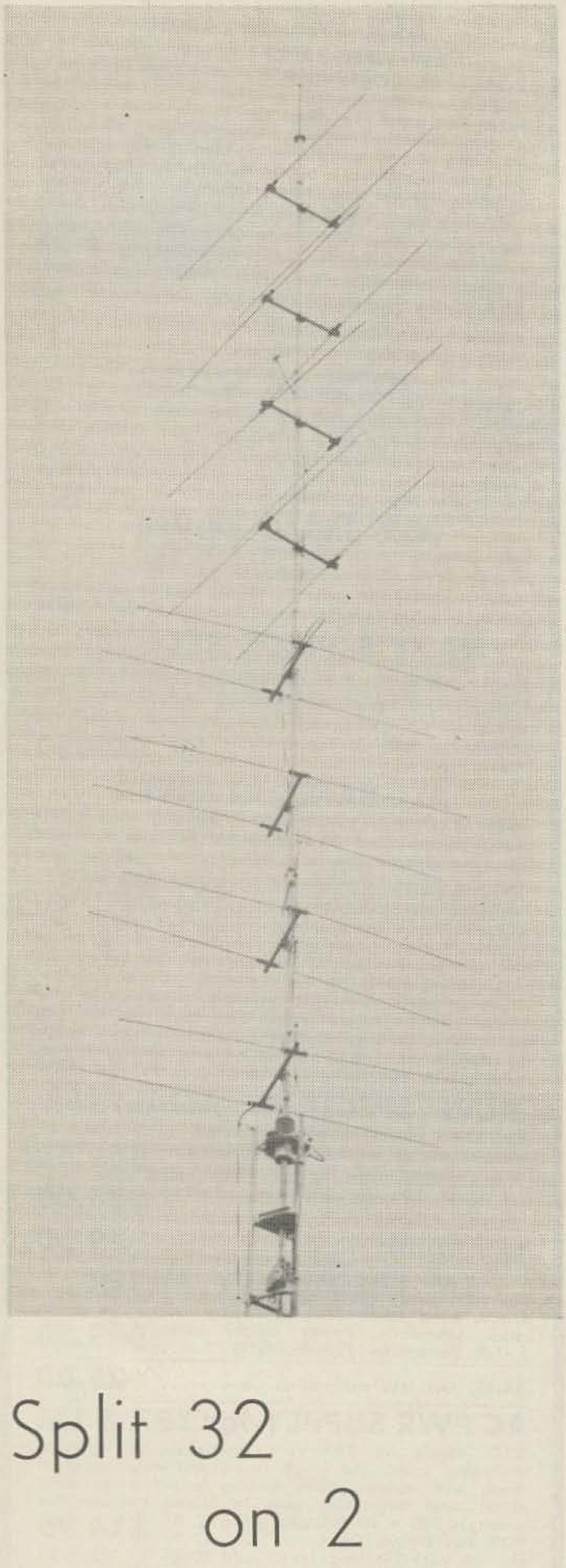
EICO VTVM

The EICO model 222 is available in kit form for $27.95 and wired for $42.95. This unit provides direct reading measurements of ac and dc voltages up to 1500 volts in 5 ranges and resistance from 0.2 ohms to 1000 megohms in five ranges. Handles ac from 30 cps to 3 mc, and up to 250 mc can be read using the HVP probe. Peak-to-peak readings are possible with the PTP probe. The regular probe has a clever switching arrangement for ac volts, dc volts and ohms.



Big Wheel

Cush-Craft is justifiably proud of the new clover-leaf VHF antenna which they claim will provide a gain in all directions (360°) which compares favorably with a seven element yagi in its favorable direction when dual stacked! This new design looks sure to be popular. It provides an SWR of 1.2:1 or less over a 4 mc bandwidth and a gain of 5 db over a halo. A card to Cush-Craft, 621 Hayward Street, Manchester, N.H. will bring you the details.



Split 32 on 2

Tom Lamb K8ERV
1066 Larchwood Road
Mansfield, Ohio

BEING naturally curious (nosy) I like to hear what's going on in the area on 2 meters. The standard 16 element collinear is an ideal monitoring antenna due to its very broad horizontal pattern, but it will still operate in only one general direction. The Split 32 is a set of two collinears mounted on the same tower using two independent rotors. When properly connected together, it permits nearly independent operation in any two directions with 32 elements available for one direction when required.

The graph shows that the actual performance is just what might be expected. Curve A is the pattern of the 32 element antenna rotated as a unit. The F/B ratio is about 9 db, and the beam width 55 degrees. This is an unusually broad pattern for 32 elements because they are stacked *up* rather than side by side. The vertical pattern will be extremely sharp.

Now if only one of the sets is rotated, curve B results. Notice that when the sections are at right angles the response in the original direction drops only 4 db, or 1 db less signal than would be received with a plain collinear in the first place. This proves negligible interaction. But any signal in the new 90° direction is increased about *34 db*. When the two sets are phased for maximum foreward gain there is a slight cancellation when they are placed back to back. This is due to the 180° phase difference between the small back pickup and the main lobe signals.

Fig. 2 shows the feed system used. I brought both feedlines into the shack for versatility. The SWR of each antenna on the coax side of the balun read less than 1.2:1. Since the true impedance is thus very nearly 52 ohms, the common feed point would be 26 ohms. A quarter wave section of 36 ohm line (two pieces RG-59U in parallel) restores the line to 52 ohms. By keeping all lines at 52, a transmitter can be connected to one, or both sections of the antenna with only minor retuning.

Exact construction details are not available since the antenna just grew. The inner mast is two 12′ sections of very heavy 1¼″ aluminum tube. The outer mast (lower beam) is a 12′ section of 1⅝″ aluminum tube. Nylon or Teflon spacers are used in the space between these to prevent binding as the antenna bends in the wind. The entire antenna weighs about 40 lbs. Two alliance automatic rotors are used. Anyone attempting to build a similar antenna should consider a heavier outer mast, as the present assembly sways vigorously in a strong wind.

The results of using the Split 32 for several months have been most interesting. Both sides of a QSO can be easily monitored or you can join into otherwise impossible three-ways. One section can be used for experiments while the other remains on duty. And last but not least, such an antenna could be invaluable for emergency operation.

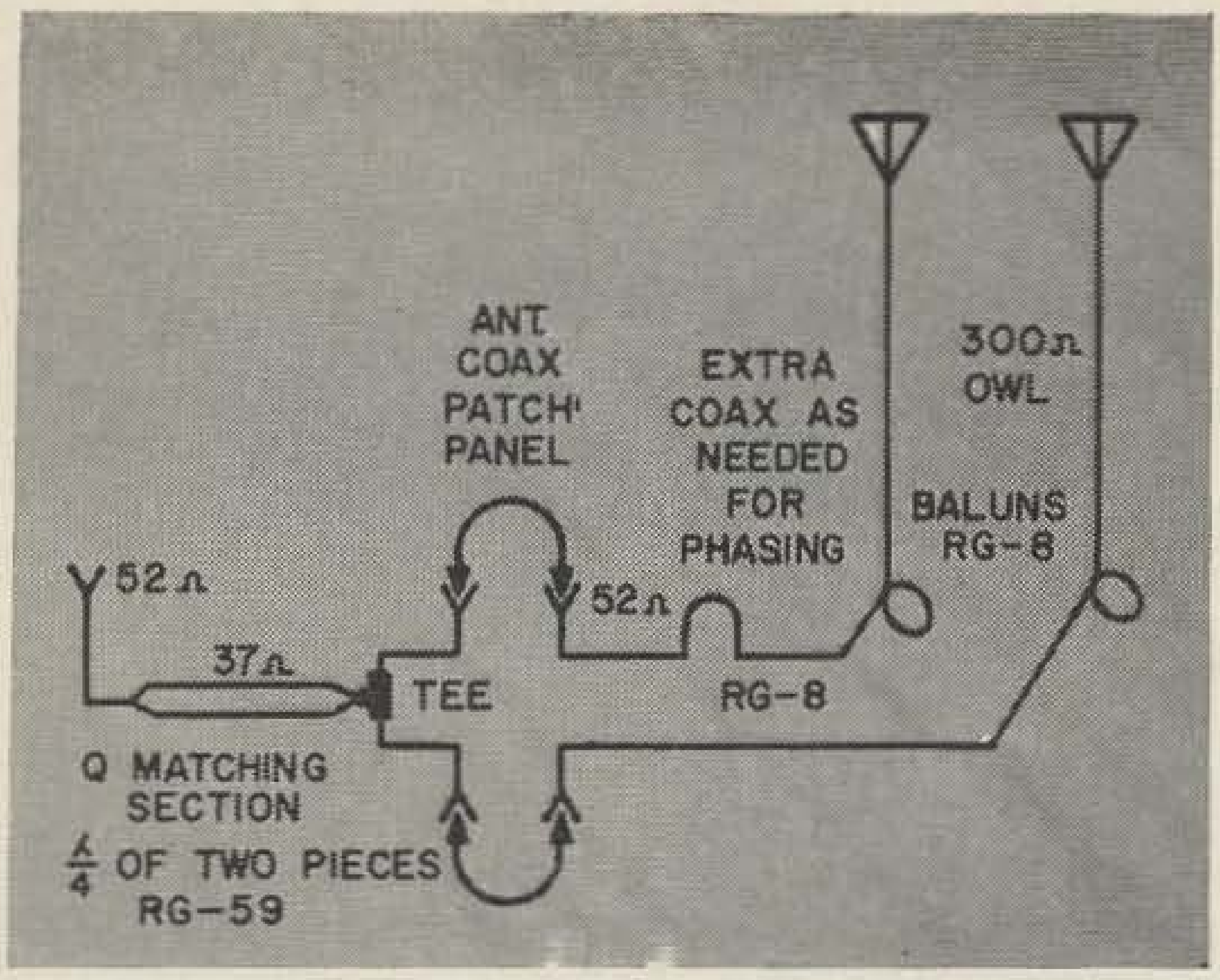
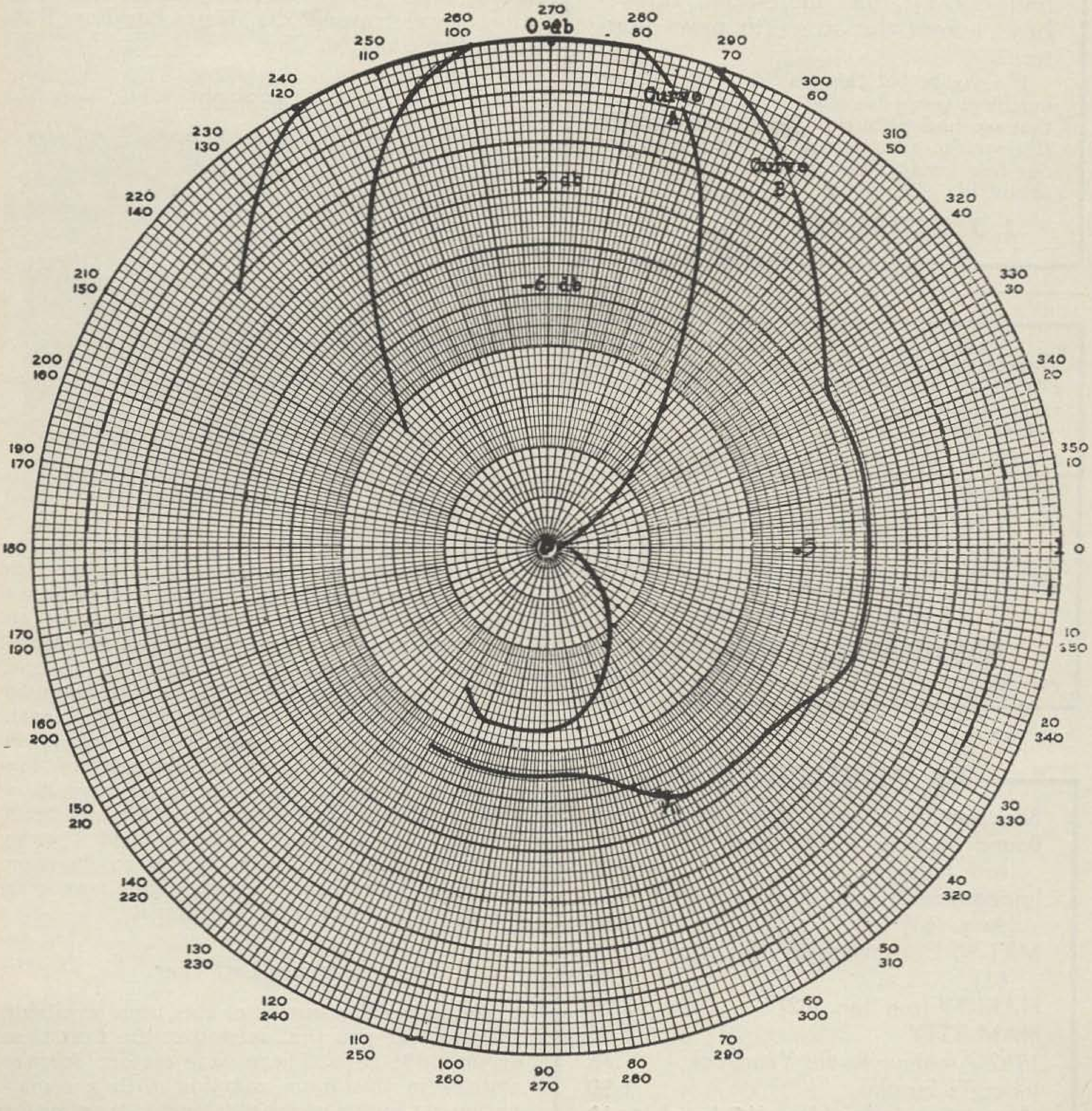


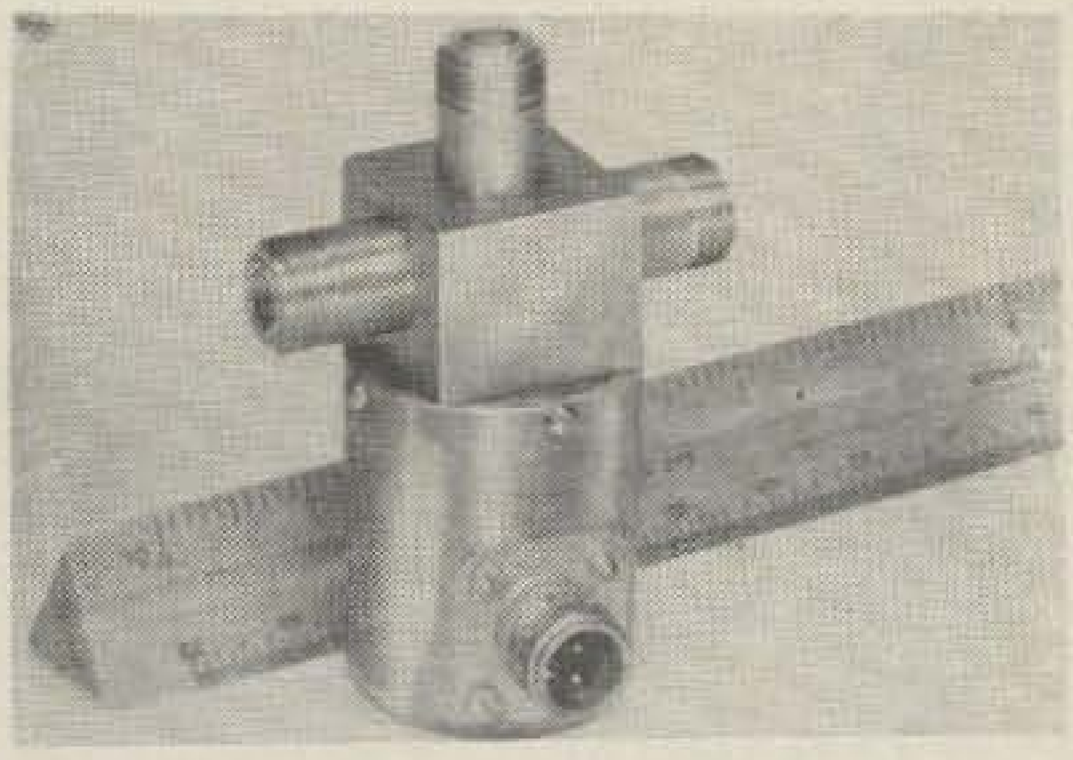
Fig. 2



Curve A: Rotating 32 elements. Curve B: Rotating upper 16 elements, lower 16 elements fixed.

More New Products

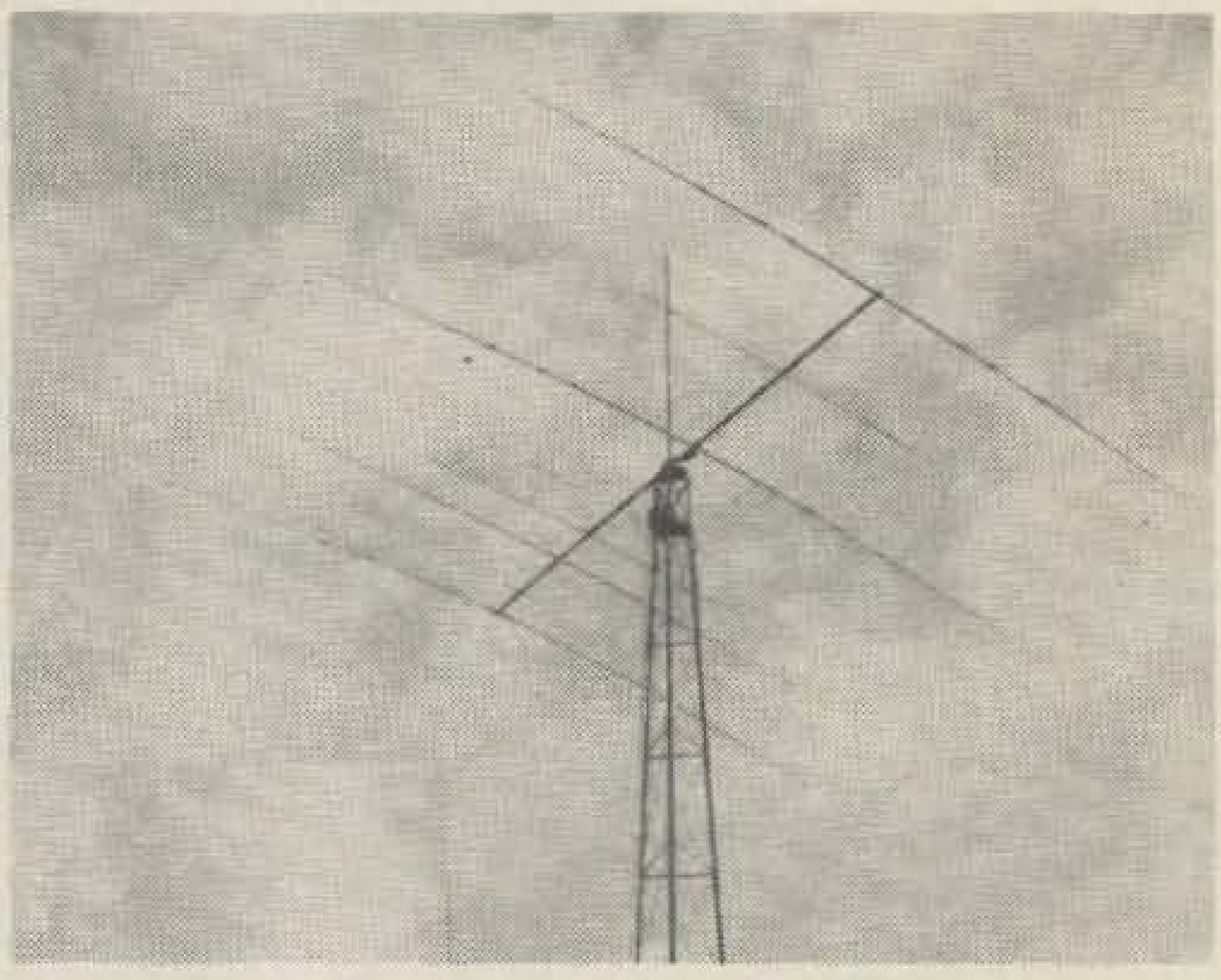
→



Coax Switch

Bay-Roy has a new one: One pole double throw, with built-in connectors for your choice of BNC-UHF-TNC, etc. The coil uses 115 vac. Works up to 1200 mc. and is rated at 75 watts, making it ideal for receivers and medium power transmitters. Write Bay-Roy, Box 7503, Cleveland 30, Ohio.

Only $985.00!



Telrex seems to be out in front in the announcement of expensive antennas. This monster four bander is fed with a single coax feeder and gives you a whopping signal on 10, 15, 20 and 40 meters. This gives you three elements on 20 and 40, and four on 15 and 10. The boom length is 33' and the beam is designed to operate best at the 61' level. Weighs only (?) 175 pounds. There is some question as to how many distributors are stocking this model and even fewer have it on display. Maybe you'd better send for info from Telrex, Asbury Park, New Jersey. If you mention it they will also throw in dope on their Duo-Band Kit Antennas. They may even throw it in if you don't mention it.

February Last Year

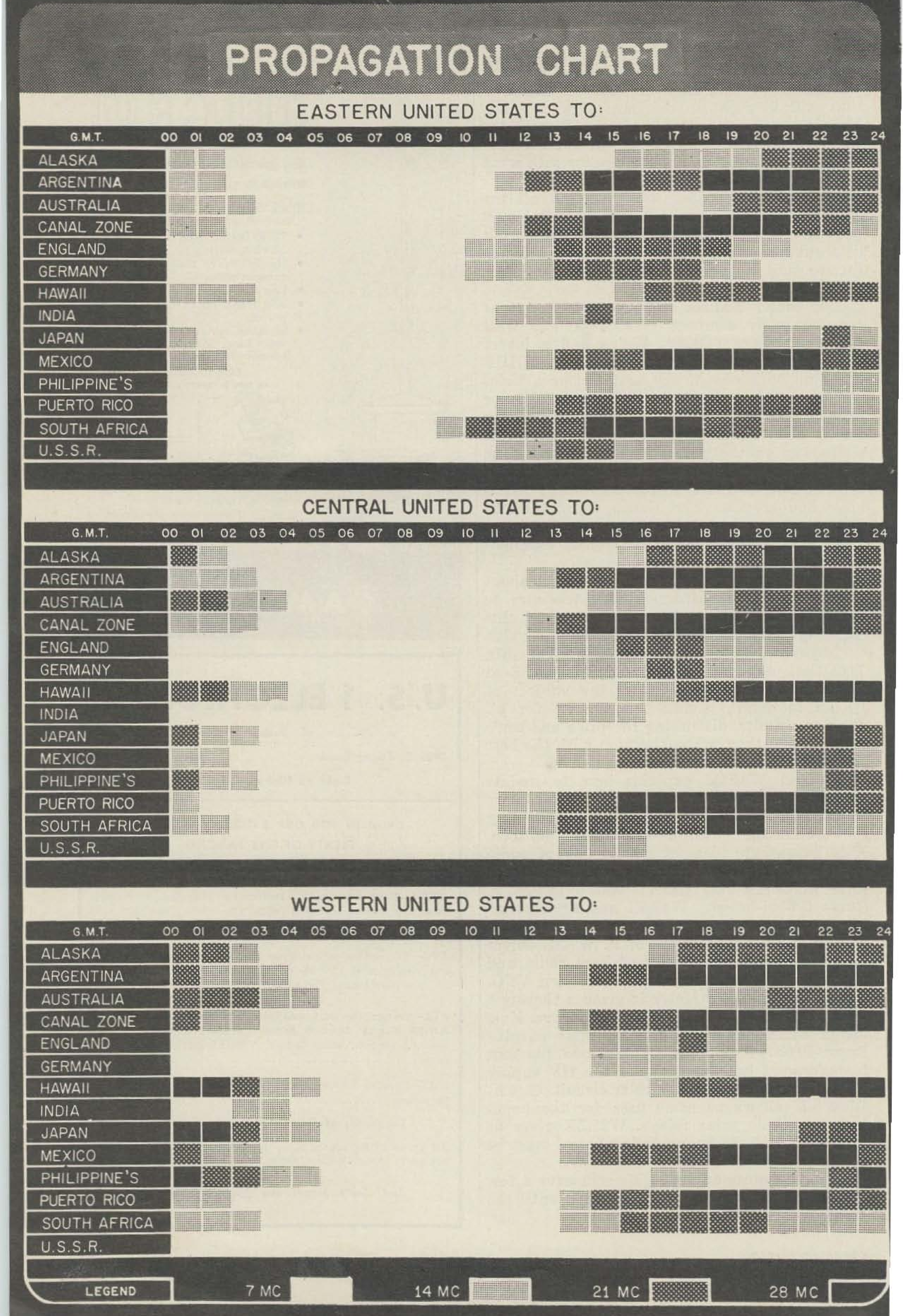
We have a few copies of this issue available for those of you that missed it the first time around. 50c each. There were sixteen feature articles in this issue, starting with a combination six meter and eighty meter transmitter (tuned up to the MARS 4.4 mc frequency), complete with power supply and modulator. 60 watts fully plate modulated. Next we have a simple two transistor microphone amplifier that will fit right in the base of your mike. This is particularly designed for use with the Varicap Modulator described in the October 1960 issue of 73. Jim Kyle comes up with what is billed as the "World's Simplest Phone Patch." While it does not give you all the features of the commercial units available, it does have the virtue of being able to be built in about ten minutes from an old power transformer and a potentiometer (100K to 2M), which is pretty virtuous.

Two meter addicts will get a kick out of the extremely compact three tube two watt rig using three 6CX8's. We've had a lot of compliments on this one. Ed Cole W7IDF came up with one of the best humor articles we've printed so far in his, "Squawk." You've probably heard someone read this over the air by now. The Kyle six meter car converter using 12v on the plates has met with mixed reviews. Several fellows have written in that they've built it and it works very well; others have had trouble. The Heath Hybrid Phone Patch was reviewed in this issue. As ever, Heath has a fine product and gives excellent dollar value.

One of the most discouraging things about working with transistors is their tendency to go pffft! K6EAW explains how to avoid this difficulty. This article is of considerable value to anyone who is transistorizing. The Big Technical Article for February is on Beat Generation wherein we cover the subject of BFO's in detail, giving the circuits for all popular circuits, discussing the pro's and con's of each, and then presenting you with the best known circ"it for the chore.

Ed Noll W3FQJ explains how to update the shack wavemeter and give it a lot more functions . . . like how to use it for providing the oscilloscope with a modulation pattern. Kyle has a cute idea for getting rid of audio interference: an adapter for the first audio tube which isolates the rf and bypasses it. Cures tvi-bci-hai-etc. W4API has an interesting dissertation on how to tune up that mobile whip and get the most out of it. W7OE delves into the remote antiquities of ham radio and shows us the beginnings of the modern VFO. The EICO Grid Dip Meter is given a thorough wringing out by W3UZN . . . we approve. Kyle has a small power supply for those surplus Super-Pro's. Simple unit, uses two filament transformers back to back for the HV supply with silicon diodes in a doubler circuit. Clever. W4WKM shows us some uses for the popularly available polar relays. W2LZX gives us a list of all of the known flying hams, must be a couple hundred at least.

That was quite an issue. We still have a few left which are available at 50c each until the supply is exhausted.


PROPAGATION CHART
EASTERN UNITED STATES TO:
CENTRAL UNITED STATES TO:
WESTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PUERTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

Propagation Charts

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

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

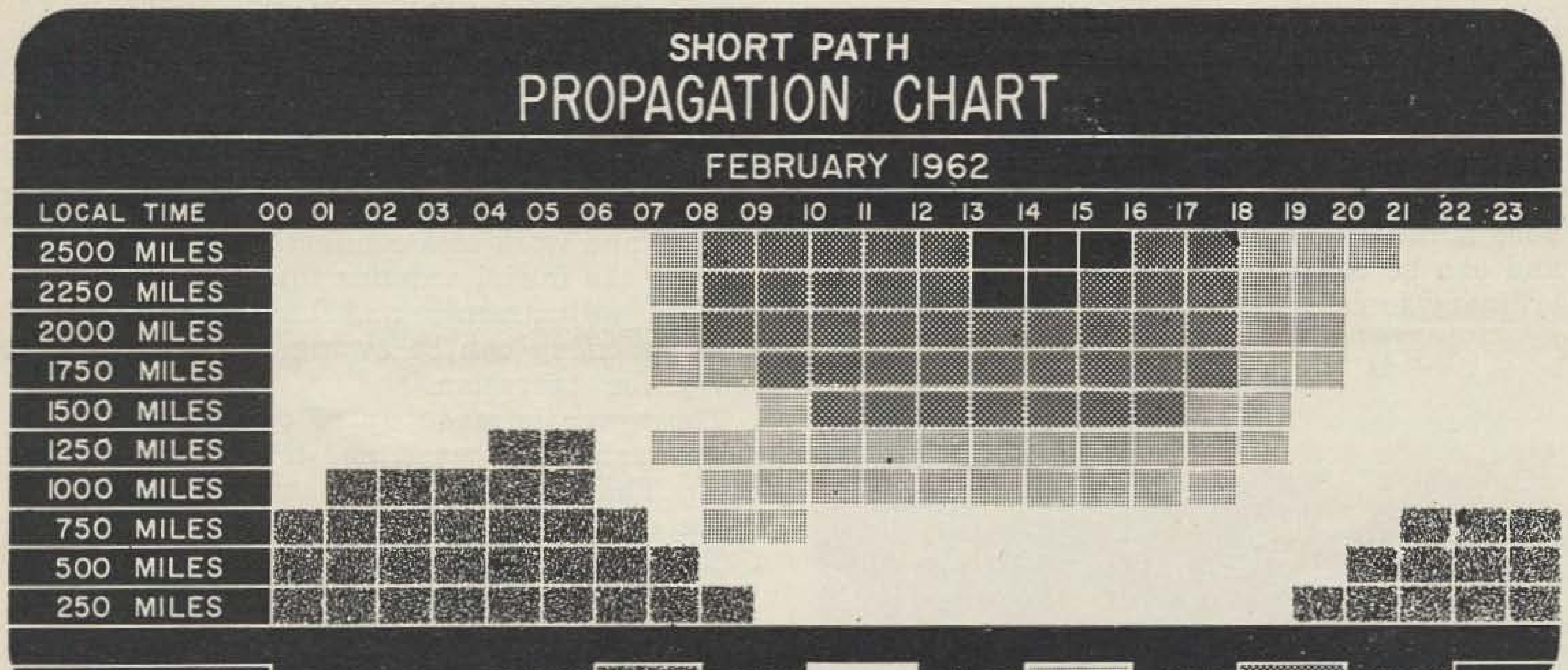
Advance Forecast: February 1962

Good: 1-3, 8-23, 27-28

Fair: 4-5, 7, 24-26

Bad: 6

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



An Economy Antenna Tower

Earl R. Murphy W8HOA
8891 Olentangy River Road
Powell, Ohio

ARE you one of those hams that, for lack of money or time or both, hangs his beam antenna on the nearest convenient high point and hopes for the best? If you are then get the beam off that chimney mount o rback porch roof and enjoy the advantages of good antenna performance that can be realized only by using an antenna tower. Towers cost too much you say? Well here is one that doesn't! The total cost for materials for the antenna tower described in this article should not be more than twelve dollars. This tower will put your beam twenty-five to thirty feet above ground, making this one of the lowest dollars-per-foot towers in existence. This tower is strong enough to support a rotor and one or more beam antennas and can be constructed with little effort using ordinary tools and readily available materials.

Fig. 2. Mast pivots over for work. 2" x 4" used as a prop.

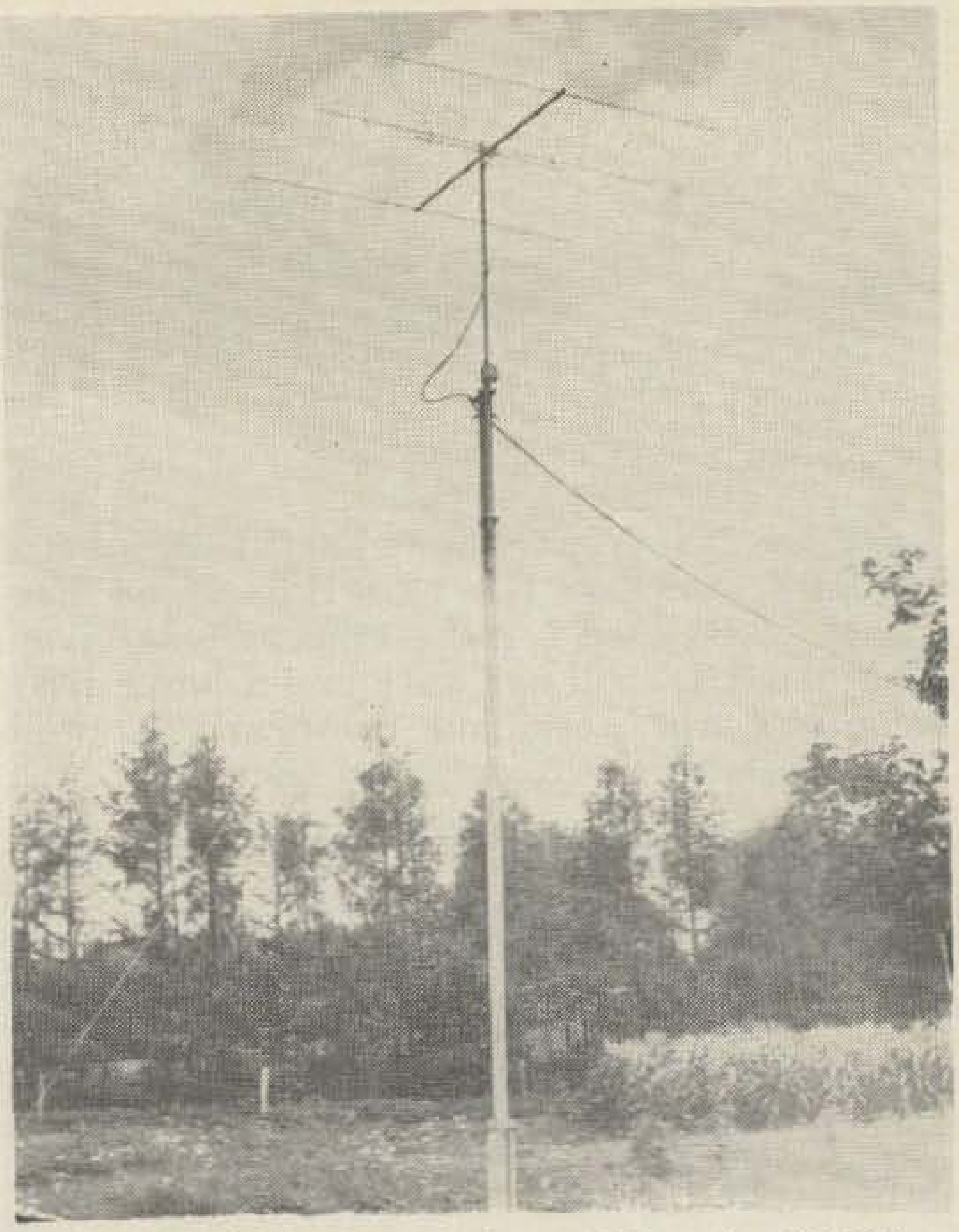


Fig. 1. This puts your beam 30' up for $12.00.

The tower, shown in Fig. 1, is of the semi-self supporting type, that is, the main strength is in the base and mast portions and the light guy ropes, which are optional when using light weight antennas, serve only as tethers to prevent excessive sway in high winds. Another desirable feature is a pivot arrangement which allows the mast portion of the tower to be raised or lowered while the antenna is in place. The lowered mast is shown in Fig. 2 where a 2" x 4" is used as a prop to keep the antenna from supporting the weight of the rotor and mast. This pivot arrangement is especially convenient as one can stand on the ground and work at a comfortable height while making the initial antenna installation or subsequent adjustments and then the antenna-mast assembly can be swung up into position ready for operation.

The tower is made up of two sections; the main upright, or mast, and a base to hold the mast. The following briefly outlines the steps to be used in construction of the tower.

The base is made of two eight foot 2" x 6"s joined by a five foot 2" x 4" as shown in Fig. 3. A half inch hole for the pivot bolt is drilled through both 2" x 6"s 28 inches from the top and the entire base is well painted to prevent deterioration. The base is buried to a depth of five feet in the ground. As the hole around the base is refilled, the dirt should be firmly packed and the base frequently checked with a level to be sure it remains vertical. As can be seen, the 2" x 4" provides a bearing surface in the narrow direction of the 2" x 6"s.

The mast is a good quality 24 foot 4" x 4". A half inch hole is drilled six inches from the

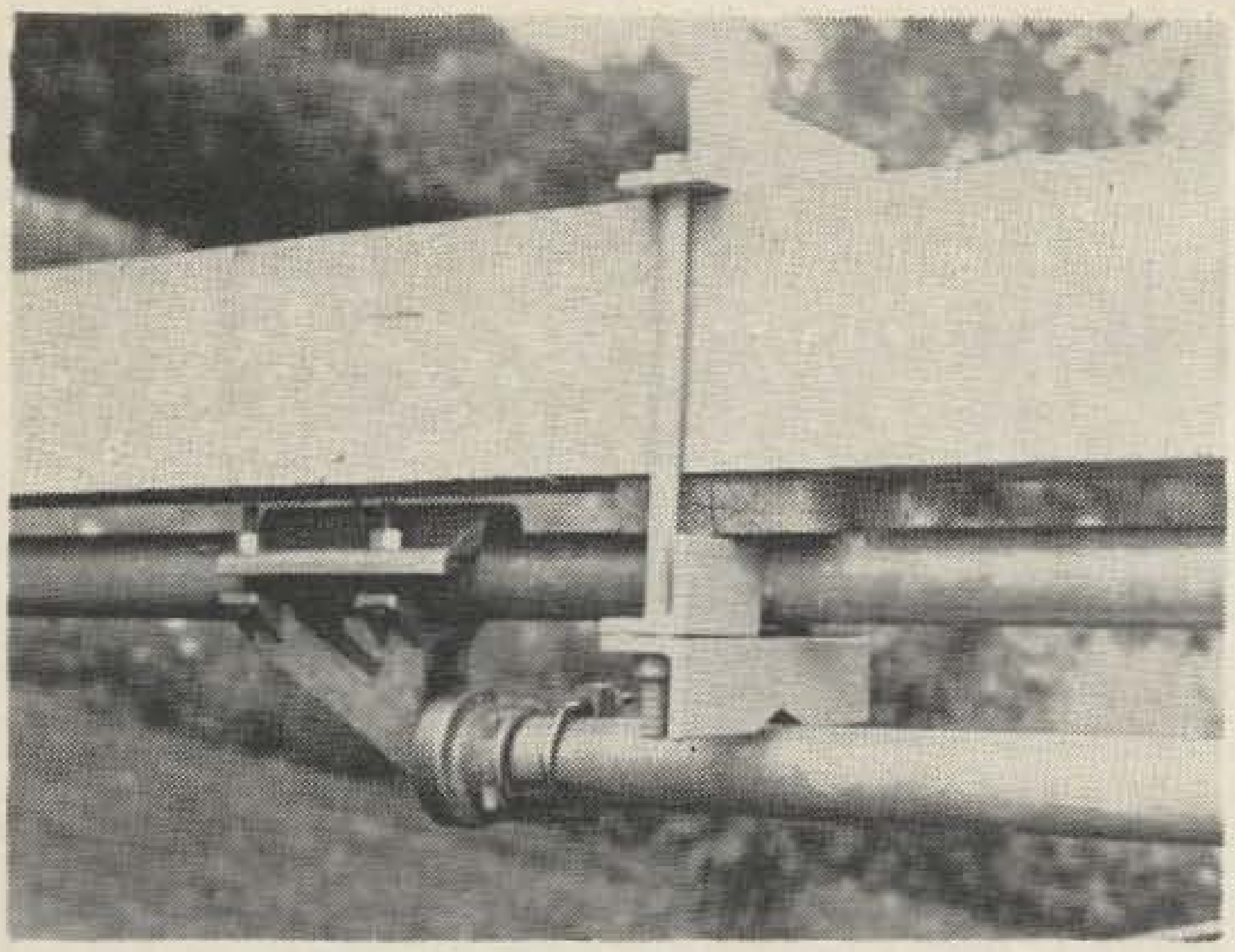


Fig. 5. Clamping arrangement detail.

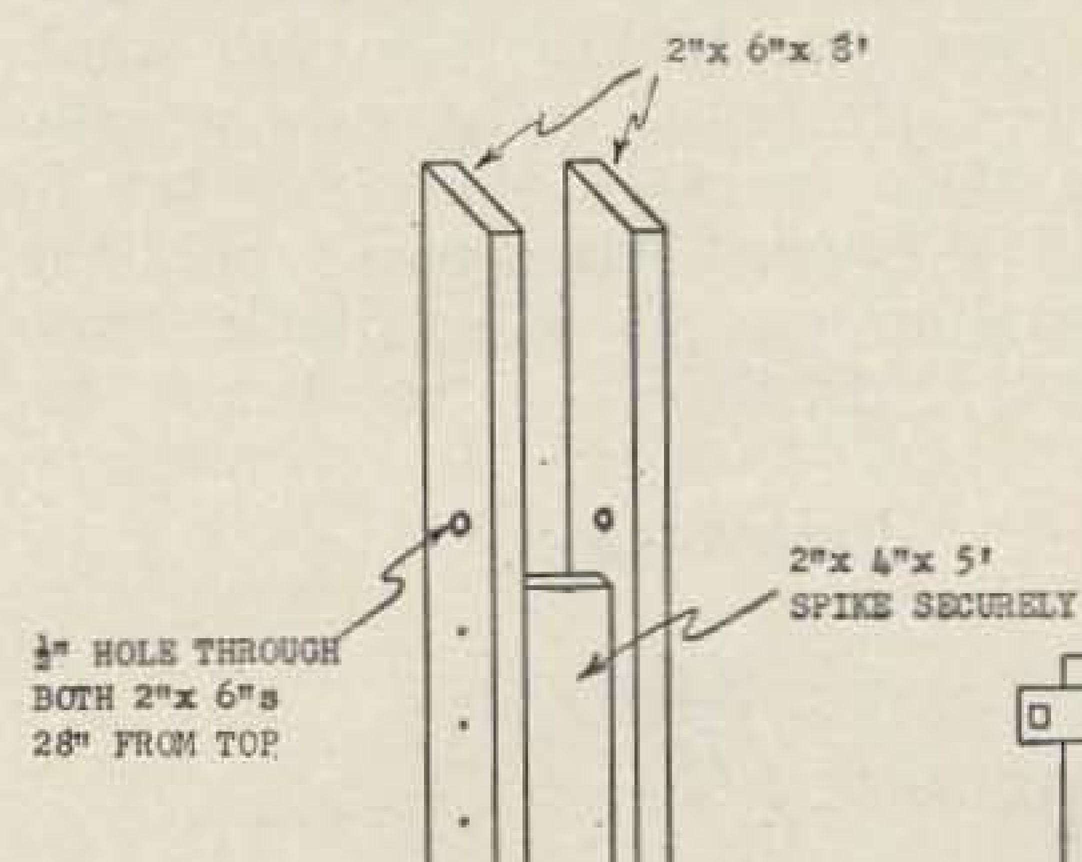
bottom end for the pivot bolt and the entire mast is well painted to prevent weathering. Screw in three eye bolts six inches from the top and attach the three tether ropes. The top of the base must be clamped to the mast when the mast is in an upright position and a good clamp can be made from two ½" x 8" machine bolts and two iron straps ⅜" x 2" x 8" or alternatively two pieces of angle iron 1½" x 8". The straps (or angle iron) are drilled one inch from either end with a half inch drill. This clamp is shown in position in Fig. 4. When this clamp is tightened the friction between the mast and the base holds the mast firmly upright. A word of caution here. Do not attempt to fasten the mast to the top of the base by using a bolt through the mast. The bolt hole will seriously weaken the mast at this critical point.

The antenna can be mounted at the top of the mast, or by using a standard 1¼" O.D. aluminum television mast the antenna can be extended as much as five or six feet above the top of the wooden mast. This aluminum television mast can be clamped directly to the wooden mast, or as shown in Fig. 2 a short section of television mast is used to provide a base for a rotor and thrust bearing. Fig. 5 shows a closeup of a clamping arrangement using three pieces of one inch angle iron five inches long and two ⅜" x 7" machine bolts. The wooden spacer allows clearance for mounting the rotor and thrust bearing. The antenna or aluminum mast can be attached to the wooden mast by any of a number of arrangements.

All that remains to be done is attached the antenna and transmission line and swing the mast up into position. Clamp the base to the mast and attach the guy ropes to their anchors. It should be re-emphasized that these guy ropes act as a tether and are not intended to support the tower, hence they should not be drawn up tight.

After a year of service at this QTH this tower needs no maintenance and appears as good as ever. Considering the investment, I believe this is one of the best towers available. So if you need an antenna tower of modest height and are long on "need" and short on cash, this is the tower for you.

. . . W8HOA



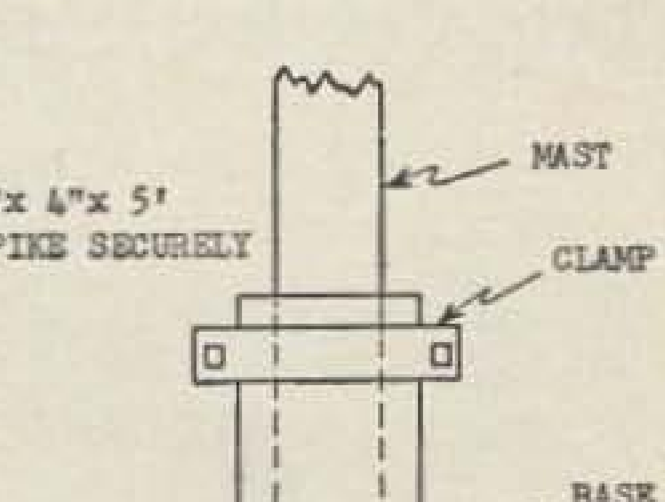
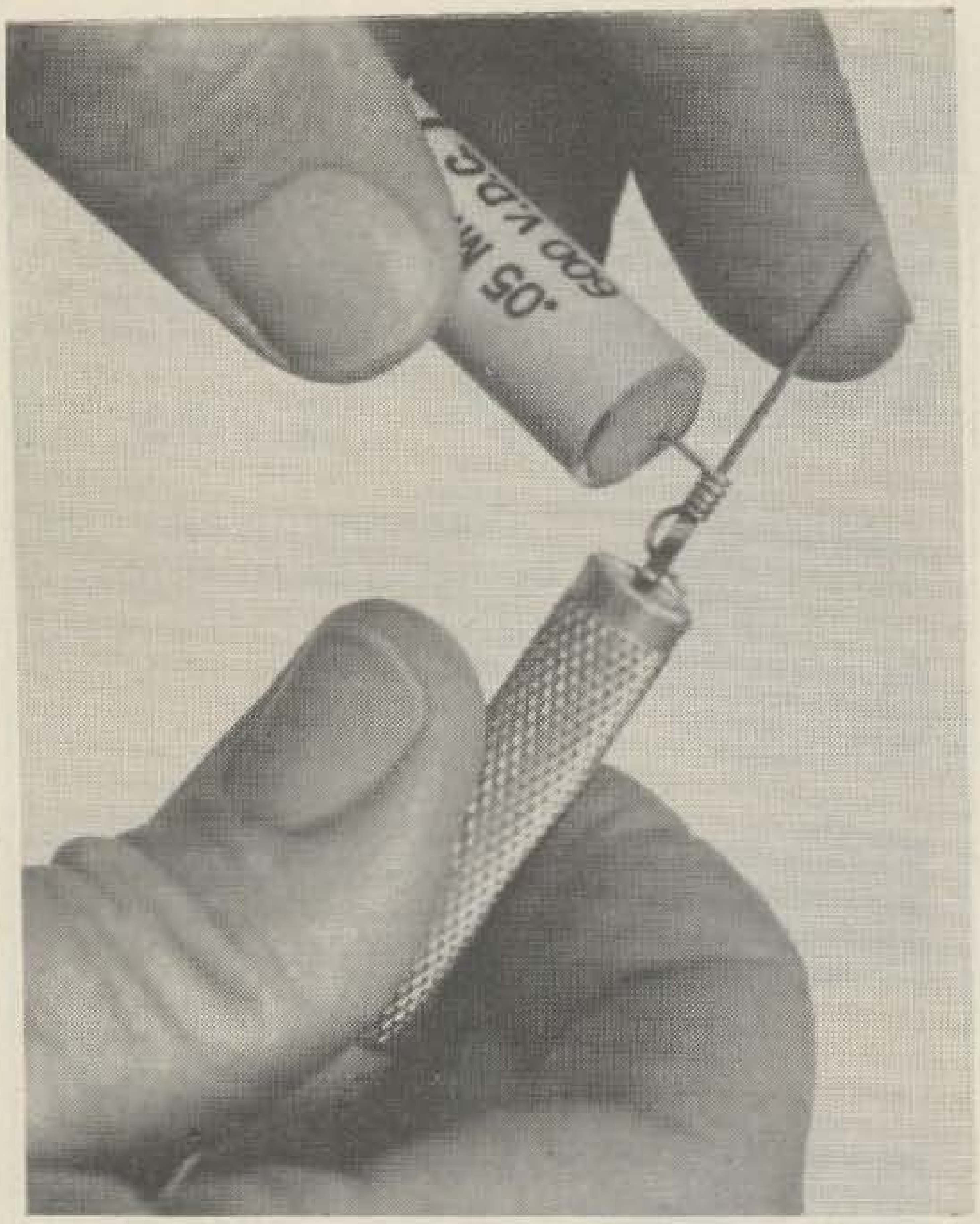


Fig. 3. Base. Fig. 4. Base clamp on base.

Parts List:

Quantity	
1	4" x 4" x 24' knot free wood for mast.
2	2" x 6" x 8' knot free wood for base.
1	2" x 4" x 5' knot free wood for base.
3	2" x 2" x 2' (wooden guy anchors).
1	½" x 7½" machine bolt (pivot bolt).
2	½" x 8" machine bolt for clamp.
2	⅜" x 2" x 8" iron strap for clamp.
3	metal eye screws.
100'	plastic covered nylon clothesline rope.



Wire Wrapper

Leave it to a ham to come up with a bright idea like this. Henry, W5IVU, has put a gadget on the market which makes it very simple to put a twirl on the end of a resistor or condenser lead. This sure makes it so you won't have any cold-solder joints or have to wrestle parts to hold them in place while you try to solder them. The twirled wires easily hold the part. The twirling gadget is available from Twirl-Con, 1101 N.E. Street, Edna, Texas. $2.

Lafayette

TE-18
G.D.C.

Tunes 360 kc to 220 mc in eight ranges. 117vac. Priced at $24.95. Every ham shack must have a grid dipper. See ad on page 3.

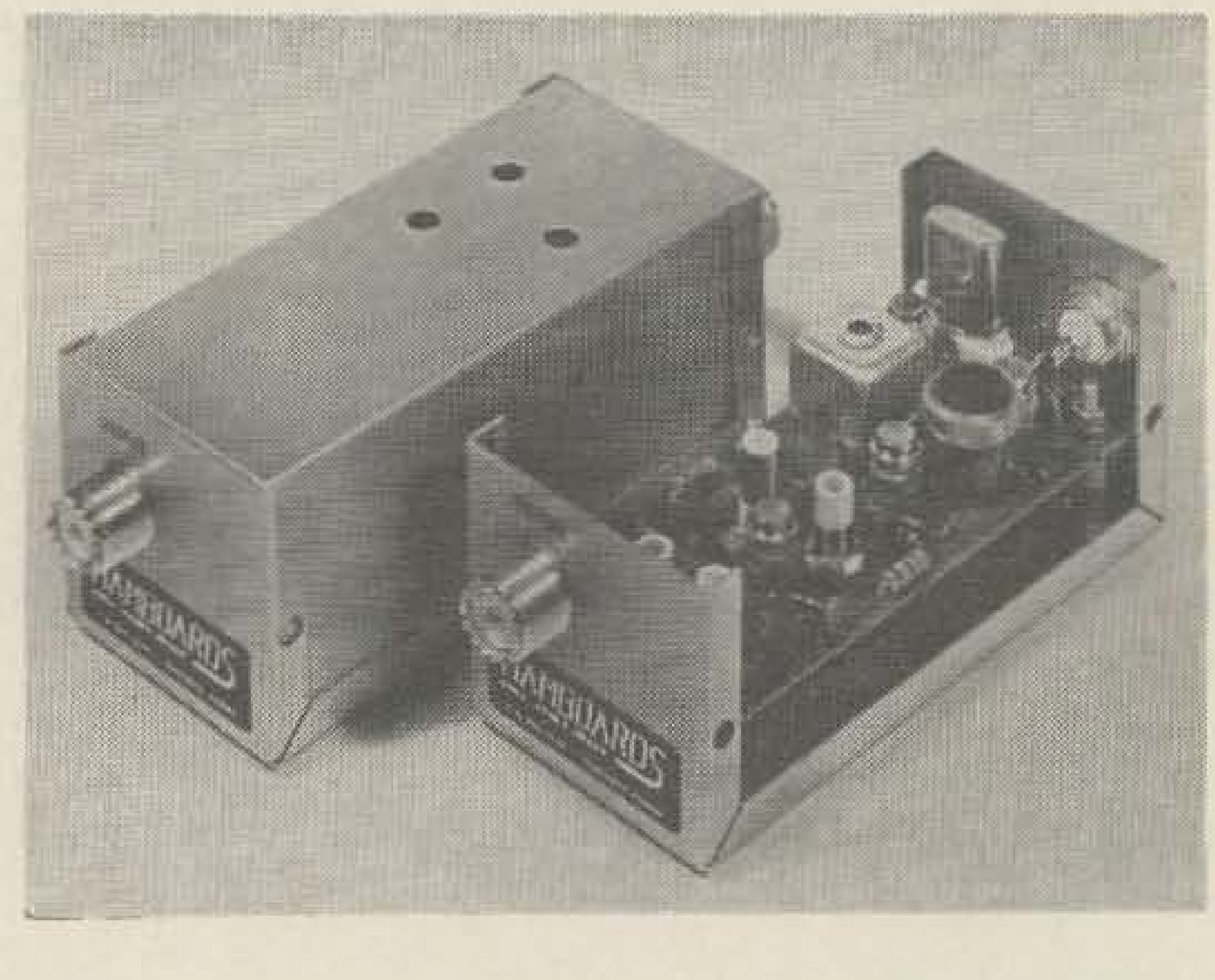
More New Products

Inductors

The Cambridge Thermionic Corporation (CTC) has something new for you: a set of five coils designed to hit the 3.5 to 28 mc bands and tune each band completely with 10 mmfd, making it possible to use band switching without extra shunt capacity. Clever these Bostonians, eh? Designated #2419. Then they also have a coil designed for bandswitching. This one tunes to 4 mc with 37 mmfd and then hits the high frequency end of each higher band as you short out sections of the coil. This is #2546. All coils are quite small, being less than 2" high. CTC will probably break loose with more data if you write: 445 Concord Ave., Cambridge 38, Mass.

12 Volt Converters

Hamboards have a nice deal for you. They have just announced a new line of converters for six and two meters. They are crystal controlled and completely transistorized. You can use flashlight batteries, the car battery, or borrow a few milliamperes from the cathode of an audio stage to power the converter, making them fine for mobile or fixed use. Noise figure is 4 db! The converters are complete and ready to use for $44.95 (six meters) and $49 95 (two meters). The printed circuit board and coil sets are available separately for do-it-yourselfers. Write Hamboards, Box 13158 Pine Castle, Florida for complete information.



(W2NSD from page 4)

You can find someone who collects almost anything. In this case it is K3HNP and he saves call letter license plates. He is still short plates from W7 states and VE1. He particularly likes old ones, the older the better, and wrong call area plates such as my W2NSD plate from New Hampshire. He'll pay the postage. Send 'em to David Heller, 14 Darkleaf Lane, Levittown, Penna. He'll take those call letter plates you've just taken off the car too.

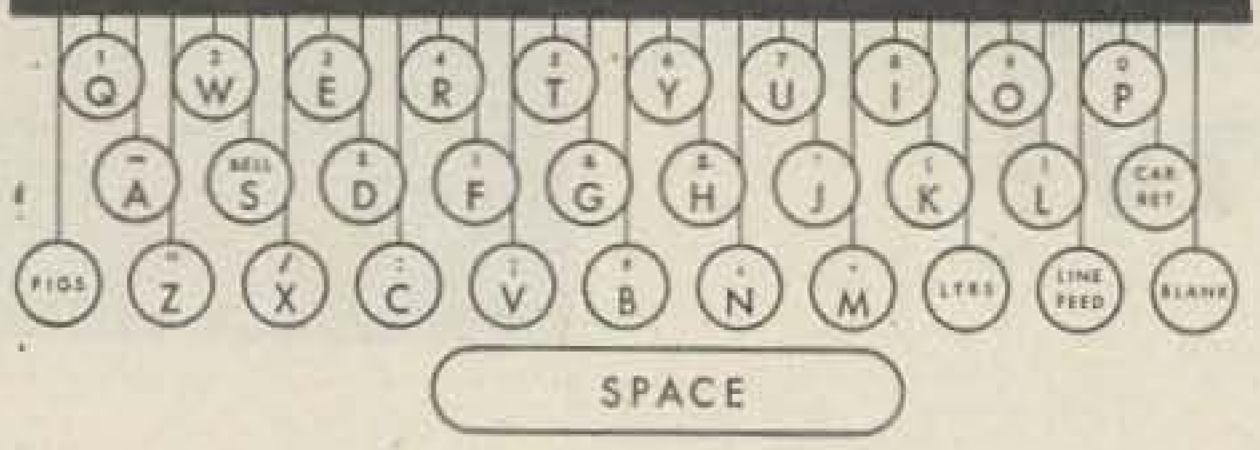
37¢

The other day I took time to sit down and calculate what it costs us to print copies of 73. Very distressing. It costs about 18¢ per copy! You think that is OK for a 37¢ magazine, eh? Well, first of all you should figure what we get per issue on subscriptions. On one year subs we get 25¢ per copy, which isn't too bad, unless you calculate in the cost of mailing out the twelve issues, the cost of the addressing stencil, and the cost of handling the subscription . . . all of which puts the deal in the red. A two year subscription works out to 20¢ per copy, which is even redder. Fellows sending in for three year subscripitions usually congratulate themselves on how much they are helping us. Ha! At 19½¢ per issue we are not doing very well. Postage varies with distance, but fortunately for the post office we have a huge following in California.

Perhaps this explains why we are still running around in rags. At any rate, it should be obvious that as the magazine grows larger it will be necessary for us to increase the subscription rates and the newsstand price. Advertising cannot grow to fill the gap because we are not going to let the magazine fill up beyond about ⅓ with advertising on the perhaps mistaken principle that most readers buy the magazine to read the articles. If you prefer an all-advertising magazine please let me know right away and we'll save thousands of dollars now being squandered in high living by our authors.

NEW!

HAM-RTTY



by Fred DeMotte W4RWM

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NOTE: *Beware of so-called handbooks which are primarily reprints of previously published articles.*

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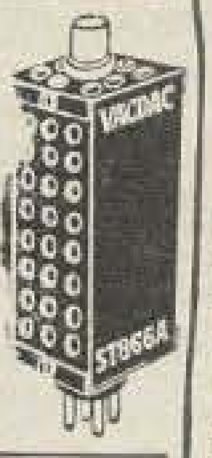

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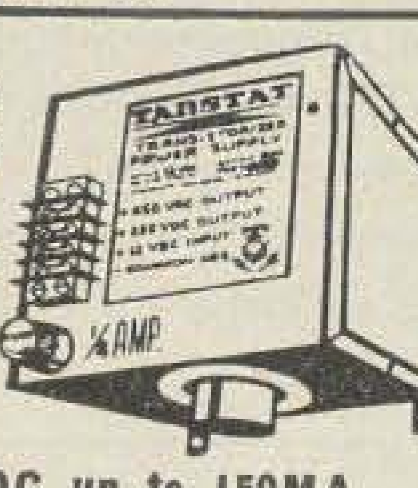

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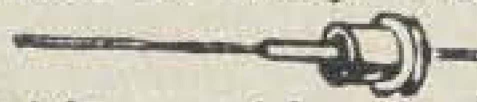

rms/piv	rms/piv	rms/piv	rms/piv
35/50	70/100	140/200	210/300
.09	.17	.22	.31
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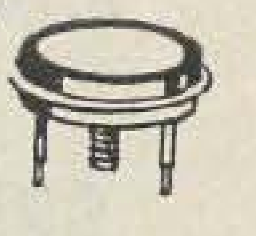

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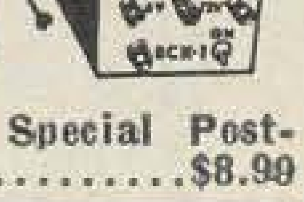

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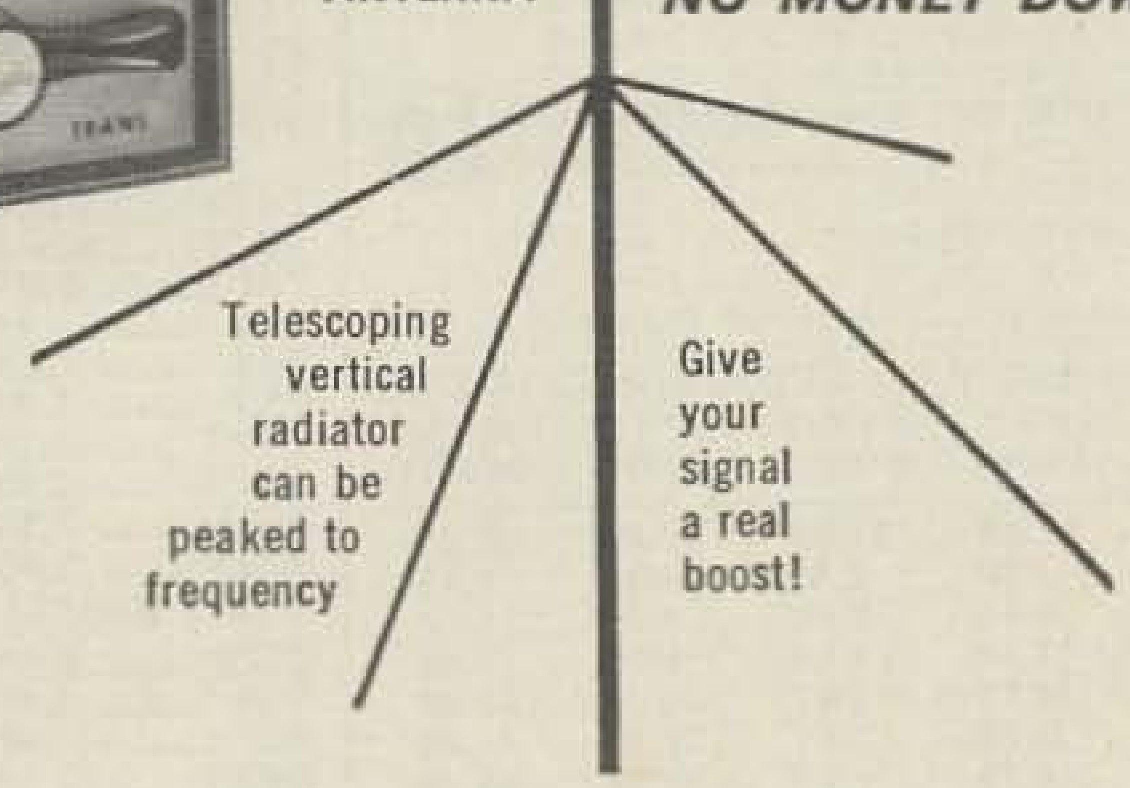

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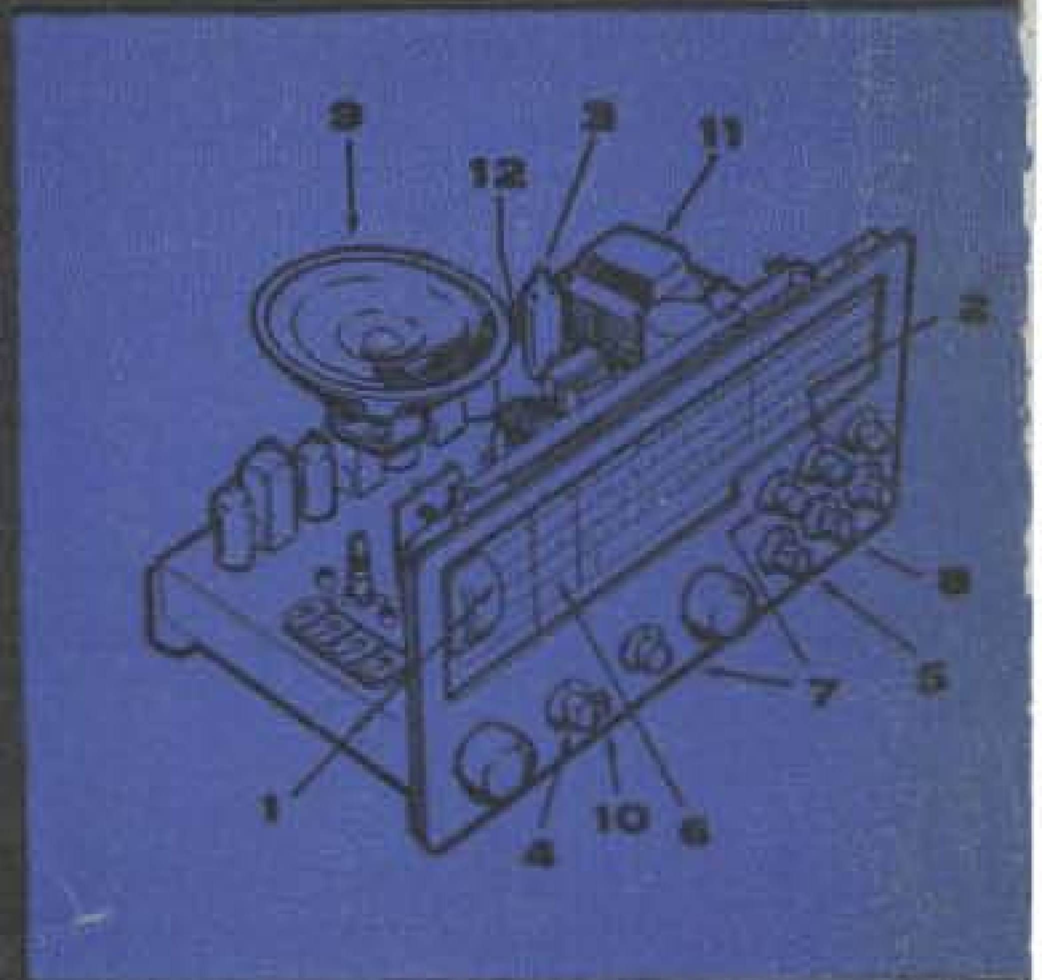

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