73

NOVEMBER 1966

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REPLACEMENT TYPE TRANSFORMERS & REACTORS

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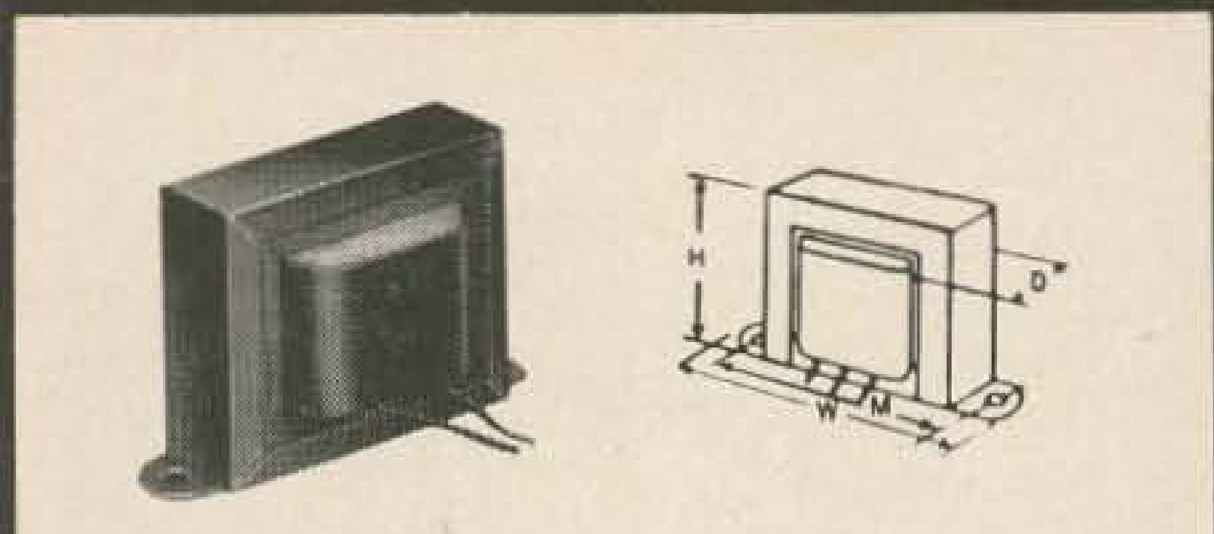
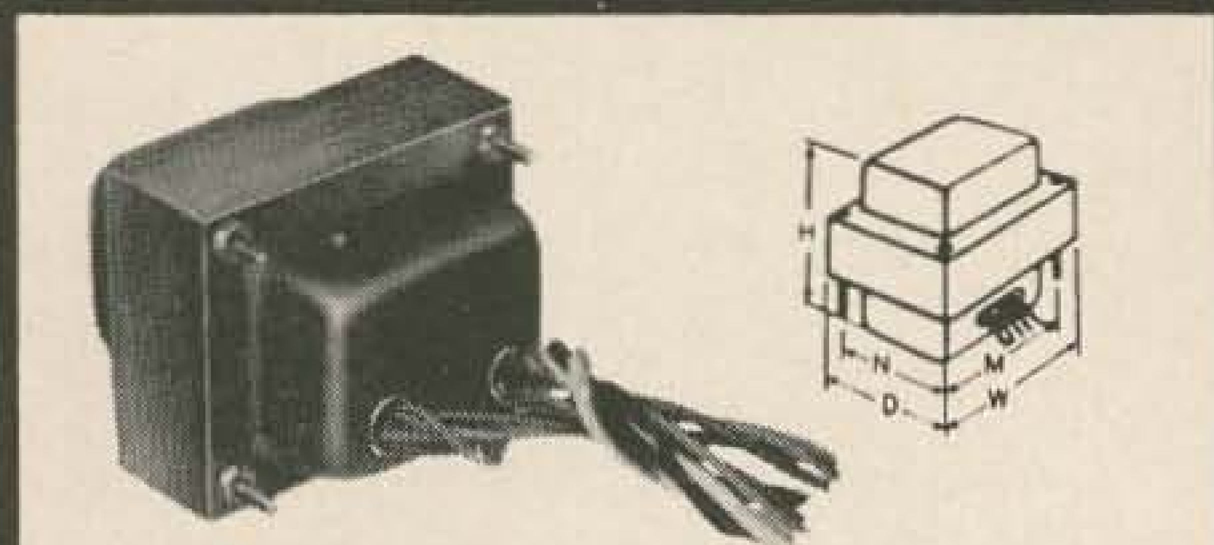
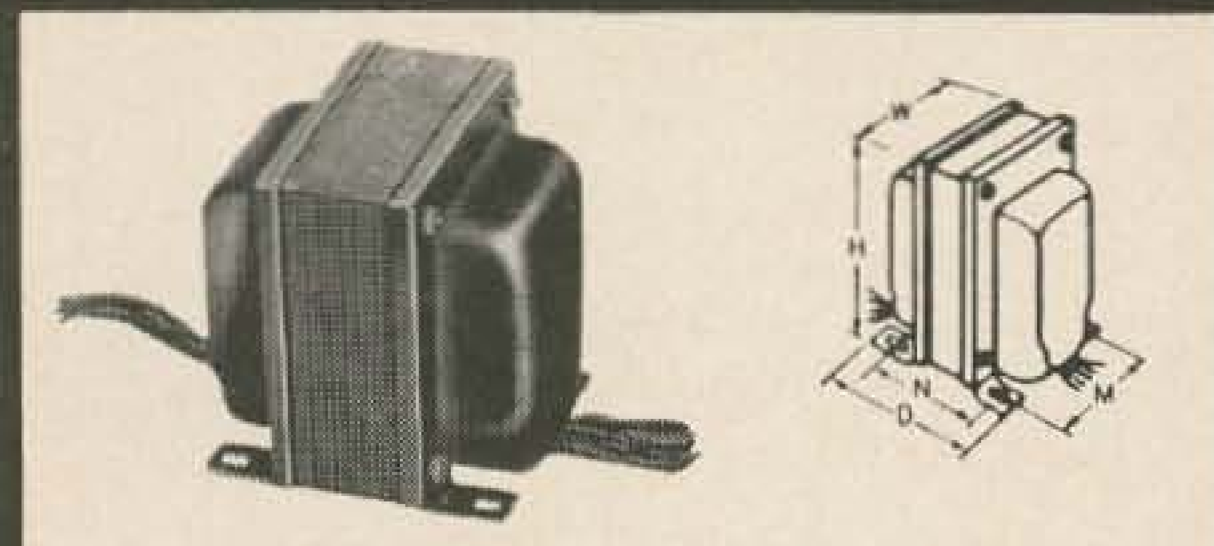
UTC replacement type transformers, here described, (Pri. 117 V. 50/60 cycles) provide the highest reliability in this field. All units are low temperature rise, vacuum sealed against humidity with special impregnating materials to prevent corrosion and electrolysis. Shells are finished in attractive high lustre black enamel.



CHANNEL TYPE



DOUBLE SHELL TYPE



VERTICAL SHELL TYPE

CHANNEL FRAME FILAMENT/TRANSISTOR TRANSFS.

Pri. 115 V 50/60 Cycles—Test Volts RMS: 1500

Type No.	Secondary	W	D	H	M	Lbs.
FT-1	2.5 VCT-3A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-2	6.3 VCT-1.2A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-3	2.5 VCT-6A	3 5/16	1 7/8	2	2 13/16	1
FT-4	6.3 VCT-3A	3 5/16	1 7/8	2	2 13/16	1
FT-5	2.5 VCT-10A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-6	5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-7	7.5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-8	6.3 VCT-8A	4	2 1/2	2 5/8	3 9/16	2 1/2
FT-10	24 VCT-2A or 12V-4A	4	2 5/8	2 5/8	3 9/16	2 1/2
FT-11	24 VCT-1A or 12V-2A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-12	36 VCT-1.3A or 18V-2.6A	4	2 5/8	2 5/8	3 9/16	2 1/2

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

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

DOUBLE SHELL POWER TRANSFORMERS

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

VERTICAL SHELL POWER TRANSFORMERS

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

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Type No.	Induct. Hys.	Current	Resistance Ohms	W	Dimensions, in. D	H	M	Wt. Lbs.
R-55	6	40ma	300	2 3/8	1 3/8	1 3/8	2	1/2
R-14	8	40ma	250	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-15	12	30ma	450	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-16	15	30ma	630	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-17	20	40ma	850	3 5/16	1 5/8	2	2 13/16	1
R-18	8	80ma	250	3 5/16	1 5/8	2	2 13/16	1
R-19	14	100ma	450	3 3/4	1 7/8	2 5/16	3 1/8	1 1/2
R-20	5	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-21	15/3	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-220	100/8 Mhy 25/2 Mhy	2.5A 5A	.6 .16	3 3/4	2	2 5/16	3 1/8	1 1/2

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73 Magazine

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November 1966

Vol. XLIV, No. 1

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73 Magazine is published monthly by 73, Inc., Peterborough, N. H. 03458. The phone is 603-924-3873. Subscription rates $4.00 per year, $7.00 two years, $10 three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in Bristol, Conn., U.S.A. Postmasters, please send form 3579 to 73 Magazine, Peterborough, New Hampshire. Why not make a DX friend of yours happy with a gift subscription to 73?

de W2NSD/1

never say die

Last month I wrote describing the first few weeks of my trip . .. the fun side, with hunting and safari in "darkest" Africa. This month I'd like to tell you about the more serious side of my trip . . . my visit to six African countries and eleven Asian countries.

Since the balance of power in the ITU has changed to the Afro-Asian countries and the survival of amateur radio through the next ITU frequency allocation conference is largely dependent on the support we will get from these countries. I wanted to find out as best I could what the amateur radio situation is in these countries and perhaps what might be done to improve it. I wanted to find out just how much amateur activity there was, how much of it was by Europeans and Americans, and how much by locals. I wanted to find out what the possibilities were of getting more local operators and what, if anything, could be done to help expand amateur radio in these countries. I wanted to find out what sort of support amateur radio is getting from the governments of these countries.

After visiting these seventeen countries and talking with the leading amateurs in these countries I think I see a fairly clear pattern. While the picture looks, on the surface, very black indeed and I found virtually no amateurs with any word of encouragement about our future, I believe that, even though the time is desperately short, we can accomplish enough in the time left to us to give us a chance at survival.

Our basic problem is not that the governments of these countries are against amateur radio . . . our difficulty is that they are almost completely ignorant about it. I don't know if I can get across to you the vacuum here. For instance, I was talking with the Minister of Communications for a country . . . this is the top man who is responsible only to the Prime Minister. This chap was under the impression that amateur radio had to do with taxi two way communications, ship-to-shore radio, doctor calling services and the $10 C-B handtalkies he had seen advertised in America.

Our strong point with all of these countries is that they need amateur radio . . . they need it badly . . . desperately. The weak point is that they don't know they need it. The job that has to be done then is twofold . . . first we must make them aware of the tremendous importance of amateur radio to their countries and secondly we must work with them to nurture it there.

You know, it's funny, but I've found that though most of us realize the value of amateur radio to our countries, few of us bring this point up when we have an opportunity to put in a good word in the right place. We tend to brag about the much less vital benefits of our hobby such as our ability to provide communications in time of emergency, our value as a training ground for military needs, our propaganda value in our contacts with other countries . . . tourism, etc. All these are undeniable benefits that a country derives from amateur radio . . . but the one single most important point is often missed.

One of the most fundamental and important needs of any country that is trying to develop is communications. A country can only develop as fast as its communications permit it. Communications is absolutely basic. Without communications you don't have business, you don't have government, you don't have a country. And without people to build, install, operate and repair the communications you don't have communications.

The key to providing the people for communications is obviously amateur radio. Our hobby provides the spark of interest which attracts fellows in their teens into communications and electronics. In practice we find that at least half of these who get interested in amateur radio eventually go into electronics and communications. We find that a country that encourages amateur radio automatically develops a generous supply of self-trained and interested men who are ready to help the country grow. When there is an adequate supply of amateurs in a country there is no need to bring in outside experts at high salaries or to set up expensive state-run technical training courses which produce men with book learning and no practical experience. Further, the amateur does not turn out to be the technical graduate who will never sully himself by actually working with equipment. He knows the gear . . . he has worked with it and he jumps in when something has to be done.

It is no wonder that the countries, without

(Continued on page 108)

Editor's Ramblings

Paul Franson WA1CCH

Zip

We have completed the work of adding zip codes to all of our U.S. address stencils. It cost quite a bit, but we're happy to do this if it means that we'll get better mail service and that postage rates won't go up.

All of our stencils are now arranged by zip codes, so whenever you write us about your subscription, we *must* have your zip code. Please don't forget this very important part of your address.

We'd also appreciate your checking your address label to make sure that the zip code on it is correct. It's very difficult for us to check them here, and the Post Office may not deliver your magazines after the first of the year unless the zip code is correct.

We are also installing an IBM data processing system to improve mail deliveries, our handling of subscriptions, and our bookkeeping. We expect it to speed up all of these things after it's working properly. The first issue of the magazine we will mail with this equipment will probably be the February issue, the first mailing in 1967. We're hoping that the change from our present system, which we've outgrown, to the new one will be smooth and orderly. Realistically, we imagine some problems will probably pop up and hope that they won't be too rough.

Changes in 73?

73 readers often ask us "when" we're going to change to the square-back "perfect" binding used by QST and CQ. The obvious implication of their question is that perfect binding is superior to the binding we now use, which is called saddle stitching. I'm not so sure that they're right. Maybe this is a good time to discuss the two bindings and point out the advantages and disadvantages of each.

Saddle stitching offers a number of advantages: The major two are that it's cheaper and faster to bind this way than to perfect bind. These two considerations alone have made saddle stitching very popular with weeklies and other timely magazines such as Newsweek, Saturday Review and Business Week. Saddle stitching seems more up-to-date than perfect binding, probably because so many very popular, "in" magazines such as Playboy, Scientific American, Car and Driver and the New Yorker, use it.

Saddle stitching offers two big advantages to advertisers. Saddle-stitched magazines tend to fall open at their center, giving the advertiser who takes the two center pages of the magazine extra reader attention. That's only good for one advertiser per month, though. But all advertisers who take facing pages (called a spread) find that their ads are more impressive in a saddle-stitched magazine than in a perfect-bound one.

But the advantages listed above mean little to the average readers of a magazine. They help advertisers and publishers, not readers. The big appeal to readers of a saddle-stitched magazine is that it permits the magazine to open flat. 73 stays open when you're trying to build a project from it without the traditional two transformers. If this seems a minor item to you, you must not do much building. For that matter, many people have devised gadgets to hold QST open in the workshop.

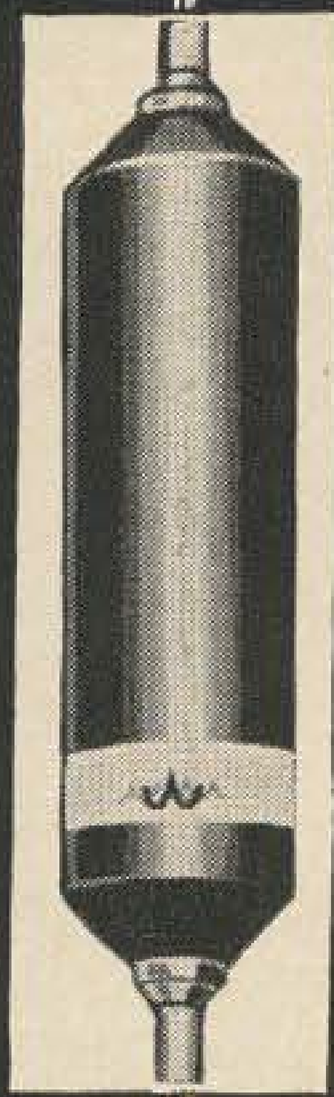
Various advantages of the square back (perfect) binding, like those of saddle stitching, are important to different people. For the person planning a magazine (in this case, me), perfect binding is much more versatile. It's far easier to handle booklets and other inserts and special color arrangements with perfect binding since a perfect-bound book is made of a number of smaller booklets bound together. A square-back magazine looks thicker and more substantial than a saddle-stitched one of the same size, as you can see if you compare a recent CQ (112 pages) with a 73 (128 pages). The smaller CQ *looks* thicker. The square back also makes a convenient surface for printing the issue number, so that it's easy to find a particular copy in a random stack. However, most people who keep old magazines for reference keep them in binders, so that this doesn't seem to be very important.

I think that the main reason so many hams (especially older ones) prefer the square back is that they're used to it. After all, QST and CQ have always been that way, so all ham magazines should be the same. We've run into that attitude about many other things as

(Continued on page 120)

Look at it this way Penelope...

When a mobile ham wants out . . . he wants way out!



So . . . what he really wants is a *Waters* AUTO-MATCH®

(for Christmas, that is)

. . . which is to say he wants an antenna engineered to polish off the job of getting all the RF power generated in today's peppier SSB tranceivers out . . . way out! And Waters AUTO-MATCH® does just that! It excels on any band with only a coil change . . structurally it's built to outlast rig after rig . . . car after car. Santa is pretty well stocked with the Auto-Match right now — but play it safe and get an order in early.

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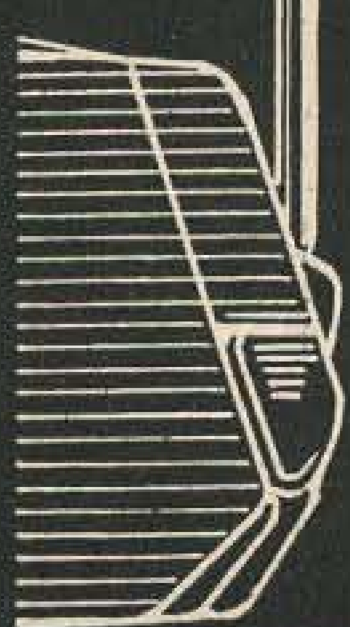

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Bill Hoisington K1CLL
Peterborough, N.H.

80 Watts on Two Meters for $80

Here's the two meter version of Bill's very popular 50 watts on 50 MHz for $50 in the June 73.

We all know superhet receivers—well, here's a superhet transmitter, in fact three of them. Two work poorly, but one works very well. It uses a rock-bound VFO! It's easy to build and low in cost. You too can build it, but just pay attention to all the little details.

The problems facing the superhet transmitter designer are much the same as those that bedevil the multi-conversion superhet receiver man, but in reverse!

1. We have transmitting images instead of receiving images, licked by moving the oscillator further away from the desired frequency.
2. We also have oscillator instability and oscillator hum modulation, to be cured by putting the variable oscillator down on a low enough frequency, which means not higher than ten meters, and preferably much lower, like 3 to 5 MHz, and then *adding* it in, not multiplying it.
3. This last remedy demands more than one conversion to get on two meters for a no-compromise job. Sounds familiar?

If you try to do it with only one conversion, you have to accept compromises and be careful in your crystal and frequency choices. Or use more tubes. Or think about new circuits such as the tripler-mixer. It can be done, but you may not like some of the results. The first two transmitters are interesting, but partially unsatisfactory, but the third described is almost perfect!

Difficulties met on two meters

The two meter designer meets many more difficulties on two than on six. These stem mainly from the higher frequency. If you use the same type of crystals (that is, no higher than 40 to 60 MHz) you have to use a stage of frequency multiplication. The reduced circuit gain experienced at two meters requires more amplification (more tubes) to reach a given power. And this is more trouble on two as tubes begin to show their transit-time losses and lower input impedances.

In spite of this, or you might say because of this, I spent considerable time and effort in developing this circuit to keep the number of tubes at a minimum. I developed a brand new circuit (at least to the best of my knowledge) but its rf output was too low.

Details are important on two meters: the amount of gain per stage, how to conserve this gain, grid tuning, practical low cost construction, and so forth. So pay careful attention.

One tube, two meters

Here's my one compaction, crystal oscillator, VFO, tripler-mixer, with two meter output. (Do *not* build this one. A better circuit is de-

---

Bill Hoisington K1CLL, former W2BAV and 2BAV is well-known to all 73 readers for his many construction articles on VHF and UHF gear. Bill has been licensed since 1923.

scribed later.) But believe me, this was *not* done for a stunt! I decided to keep the VFO feature at all cost for two meters. It's not yet an absolute necessity at all times for getting a QSO on two, but there are lots of times when you cannot make a desired contact without the VFO. If you set up the rig in a different location, or on a hill-top, and hear some local lads chatting away, where are you without VFO? This occurs plenty at home also.

The 6AF11 works fine as two separate oscillators and a mixer, with its two triodes and one pentode. Where oscillators on separate frequencies are deliberately coupled to a mixer, there is no nuisance reaction between sections. I say nuisance advisedly because when used for certain other purposes there can be nuisance reaction, such as, for example, when trying to use one of the triodes as a low level audio stage and one of the others as an oscillator.

Every time I use the "video" type pentode of the 6AF11 as a mixer with crystal controlled energy on the grid and low-frequency variable addition frequency on the screen it works like a charm.

However, in going to two meters using the same tube layout as on six, plenty of difficulties showed up right away.

I did not want to go to a crystal of over 100 MHz (too expensive and too touchy) so had to frequency multiply. But that used up the two triodes right away! After spending some time on the bench with an external mixer, with much poorer results, I suddenly hit on the idea of using the tripler as a mixer also.

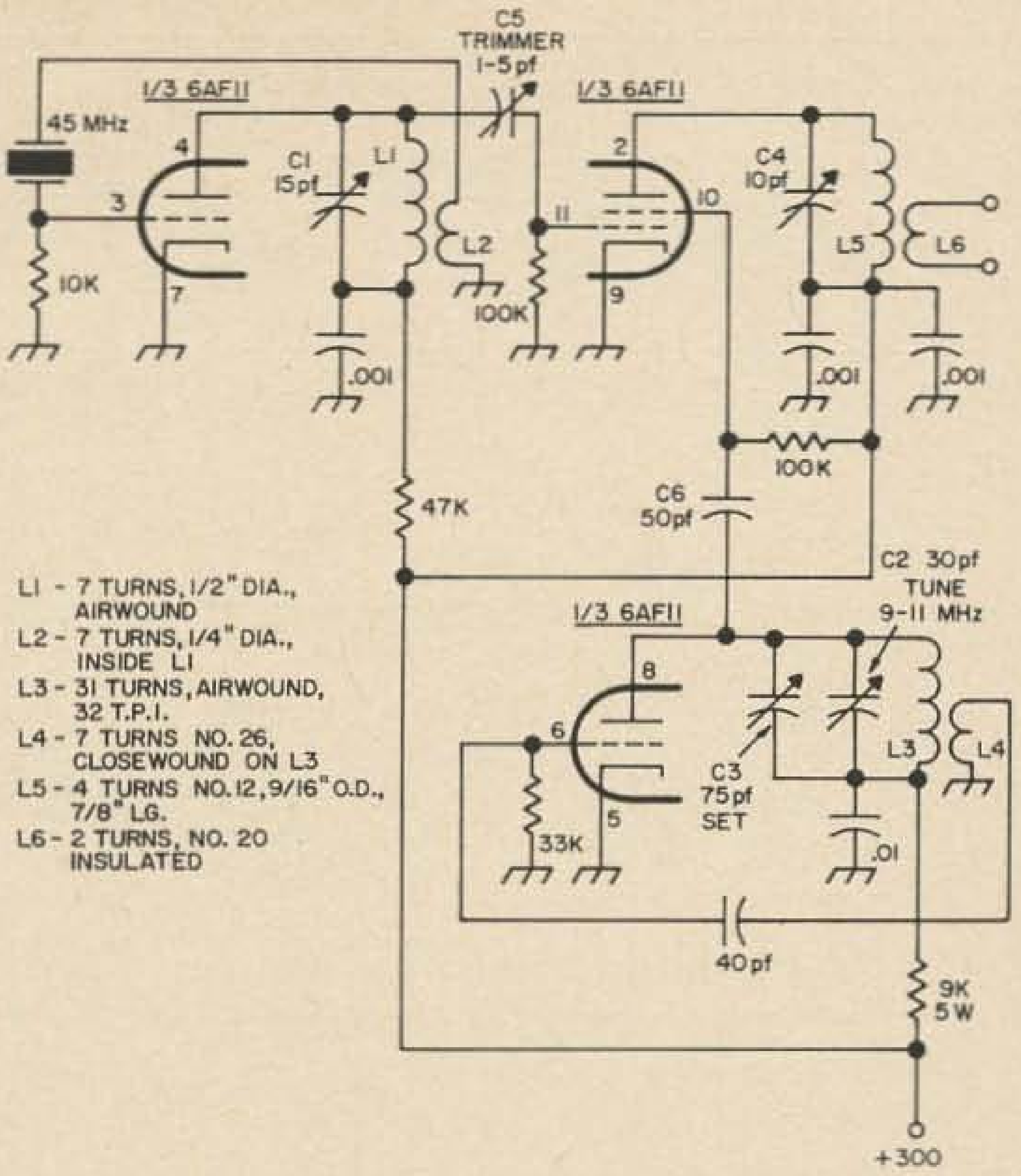

Fig. 1. Compactron crystal oscillator, tripler-mixer, and heterodyne VFO with two meter output, from one tube. This circuit is not recommended. It gives enough drive for a 5763 amplifier, but not for an 80-watt final.

Well, why not? Plenty of triplers on VHF-UHF have been modulated by voice (and other things!). So, I fed 45 MHz into the grid and modulated the screen with low frequency from the other triode used as a 9 to 11 MHz oscillator, and lo and behold, just as theory predicted (this time theory worked) out came one of the "side-bands," none other than 144 MHz. It was nice and stable to adjust from

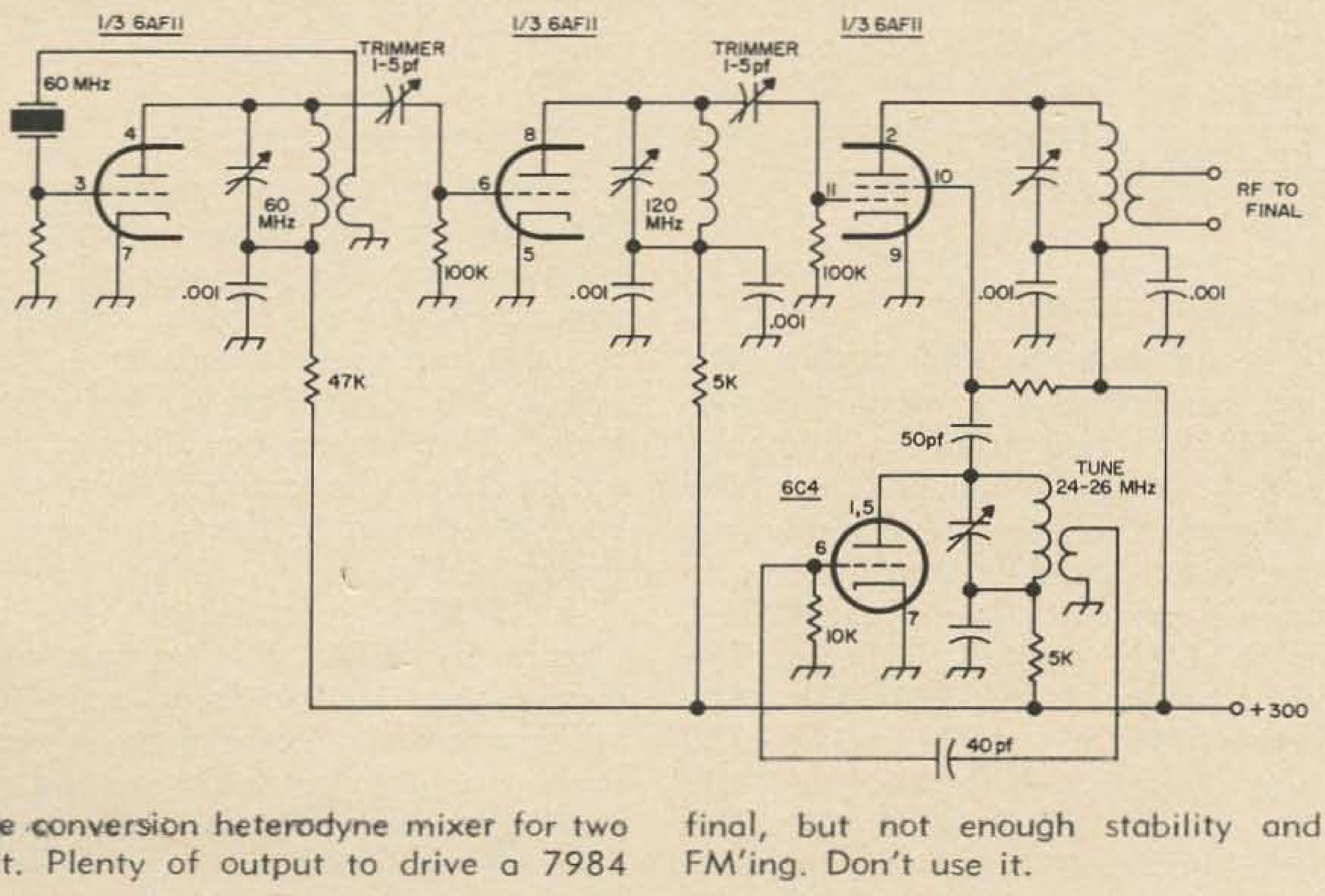

Fig. 2. Single conversion heterodyne mixer for two meter output. Plenty of output to drive a 7984 final, but not enough stability and too much FM'ing. Don't use it.

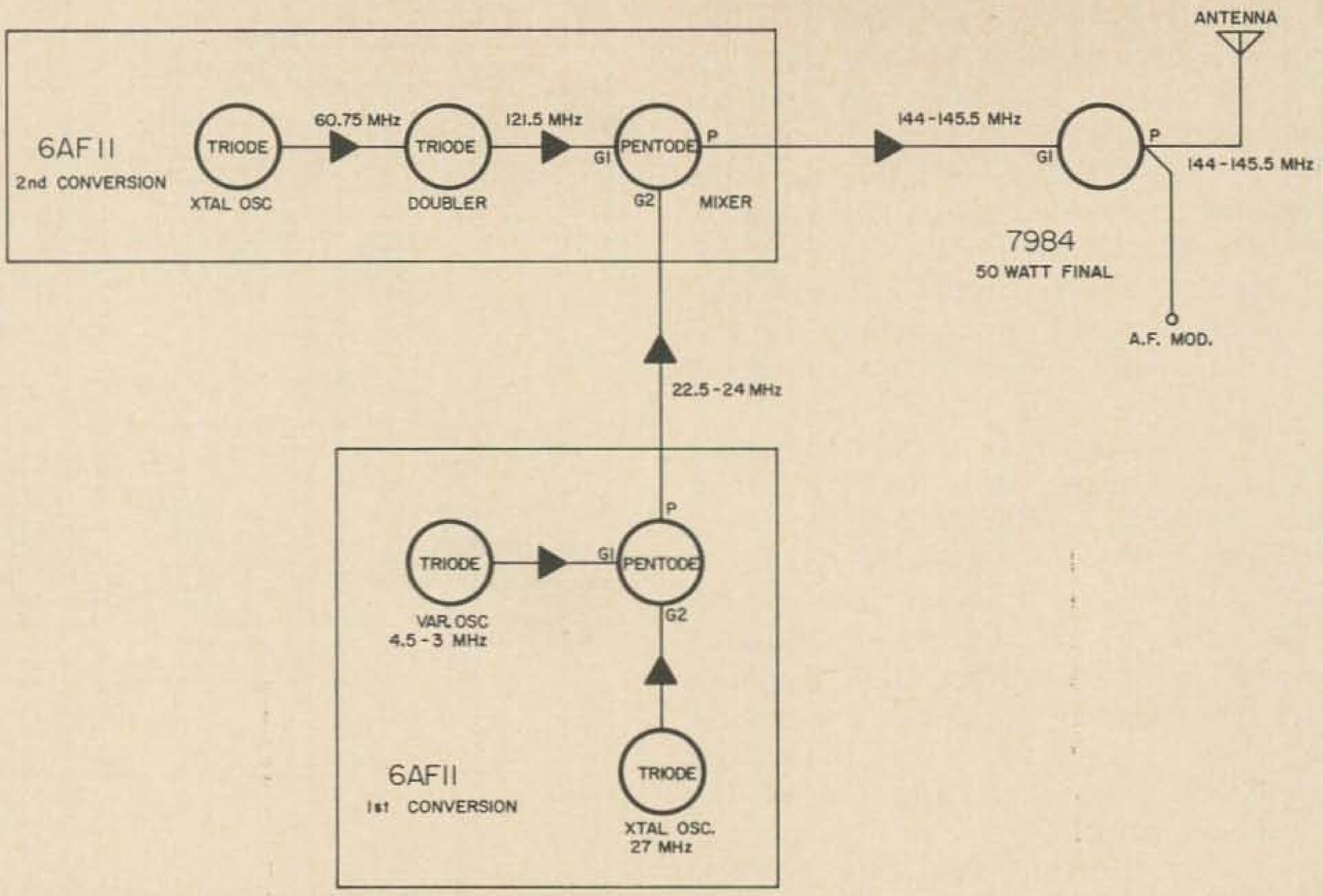

Fig. 3. Block diagram of the "perfect" two meter, superhet, double conversion transmitter. The first conversion is given in Fig. 4, the second conversion in Fig. 5, and the final in Fig. 6.

144 to 146, but had less than 100 mW output.

The circuit is shown in **Fig. 1.** It is really quite clear if you simply follow through one "tube" at a time. The 6AF11 is actually just three complete tubes in one glass bottle, so it isn't hard. You can dimly light a number 48 bulb on the output terminals with about 280 to 300 volts B plus.

However, while the two meter output was enough to operate a 5763 amplifier, it only gave marginal drive for the 80 watter. I have followed one principle above all others in my articles. NO MARGINAL CIRCUITS! It's bad enough for lads with not too much experience as yet to get a *good* circuit going. If a circuit causes *me* trouble after 40 years experience it must be marginal. Anyway, don't build the above circuit, unless you really like to play around.

Second superhet transmitter

This also is an *intermediate* design. It's good, but not perfect. If you want a stable VFO transmitter with two tubes for a total of $3, which will drive an 80 watt final amplifier with only one conversion, you can use this one. But it's intermediate: good, but not perfect.

Fig. 2 shows the circuit. One of the 6AF11 triodes is a 60 MHz crystal oscillator. The second triode is a doubler to 120 MHz. The pentode section of the 6AF11 mixes 120 MHz from the doubler with the 6C4 24 MHz VFO.

That's just about it. The pentode plate is tuned to 120 plus 24 MHz and there you are on 144 MHz. With a single 300 volt supply from an old radio you can burn out that number 48 bulb (120 mW) on two meters, but when I put it on the air, I met the Gremlins! Everything *looked* fine: Plenty of drive to the final, tuned fine, image 24 MHz away, (couldn't even find it), modulation great, first contacts fine. But, as soon as some sharp receivers were encountered drift and FM were noticed. There's no getting around it, you should use more than one conversion on two meters—both on receive and transmit. So, enough of that, let's get on into the "perfect" job.

Third try—and success

This is the one. No compromise here. You throw on the exciter and Plonk! Right in the middle of the sharp pass-band receiver (both yours and his) each time. No drift, no FM, and you can operate anywhere you like from 144 to 146 MHz. **Fig. 3** shows the block diagram. The conversion circuit of **Fig. 2** is retained but the external 6C4 variable oscillator is replaced by the first conversion 6AF11 shown in **Fig. 4.**

A 27 MHz crystal starts the ball rolling. Cheap 27 MHz CB crystals are fine. Of course, you can use frequencies to suit, with other crystals, if you have them. The important point to get is the *general* range of frequencies you *can* use. It's a good rule not to go over ten times in frequency, when converting,

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Illustrated above is a complete Swan station for SSB, AM, AND CW. You can transmit and receive on all 5 bands with your 350 transceiver, and when used with the Mark I linear amplifier, you're at the legal power limit. Switch in the Model 410 outboard VFO and you're all set for separate transmit and receive operation. Yet this complete home station, with proven Swan performance, reliability, and craftsmanship is yours for substantially less than any other comparable equipment.

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5 BANDS—400 WATTS

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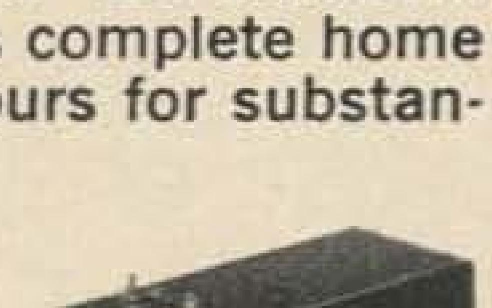
MODEL 14-117 . . . . . . $130



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CRYSTAL CALIBRATOR KIT $19.50
SIDEBAND SELECTOR KIT $18.00

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either on transmission or on reception. This also holds for frequency division, subtraction, or addition. You *can* do it if you *have* to but then you have to get quite fussy and use elaborate filters, etc.

Note carefully that the first conversion uses *subtraction* instead of addition. If you have a rock 3 to 5 MHz *lower* than 22.5 or use a different second conversion frequency you can *add*. Just don't stray too far from the indicated frequency. Say 110 to 125 MHz for the second conversion and 19 to 34 MHz for the first.

The second triode is the low frequency oscillator. Note that with subtraction instead of addition you tune to 4.6 for 144, and to 3.6 for 145 MHz. Learning these tricks will be useful for you in years to come, if SSB takes over completely.

No special precautions are needed on the VFO when using double conversion. Haven't used a voltage regulator yet.

This low frequency oscillator feeds into the pentode screen and there you are out on 22.5 over to the second conversion. I used a link, L5, over to the second conversion stage because while L4 on 22.5 does tune nice and sharp, there are other frequencies in there to keep down. Such as the crystal on 27 and the plus frequency on 31 MHz. Also I'm using at present an untuned grid on the final. Use a number 48 bulb link coupled to L4 to tune up, also use a wave meter. Check for 22.5 to 24 MHz and you'll be doing fine. If you use different crystals than I did you will check for

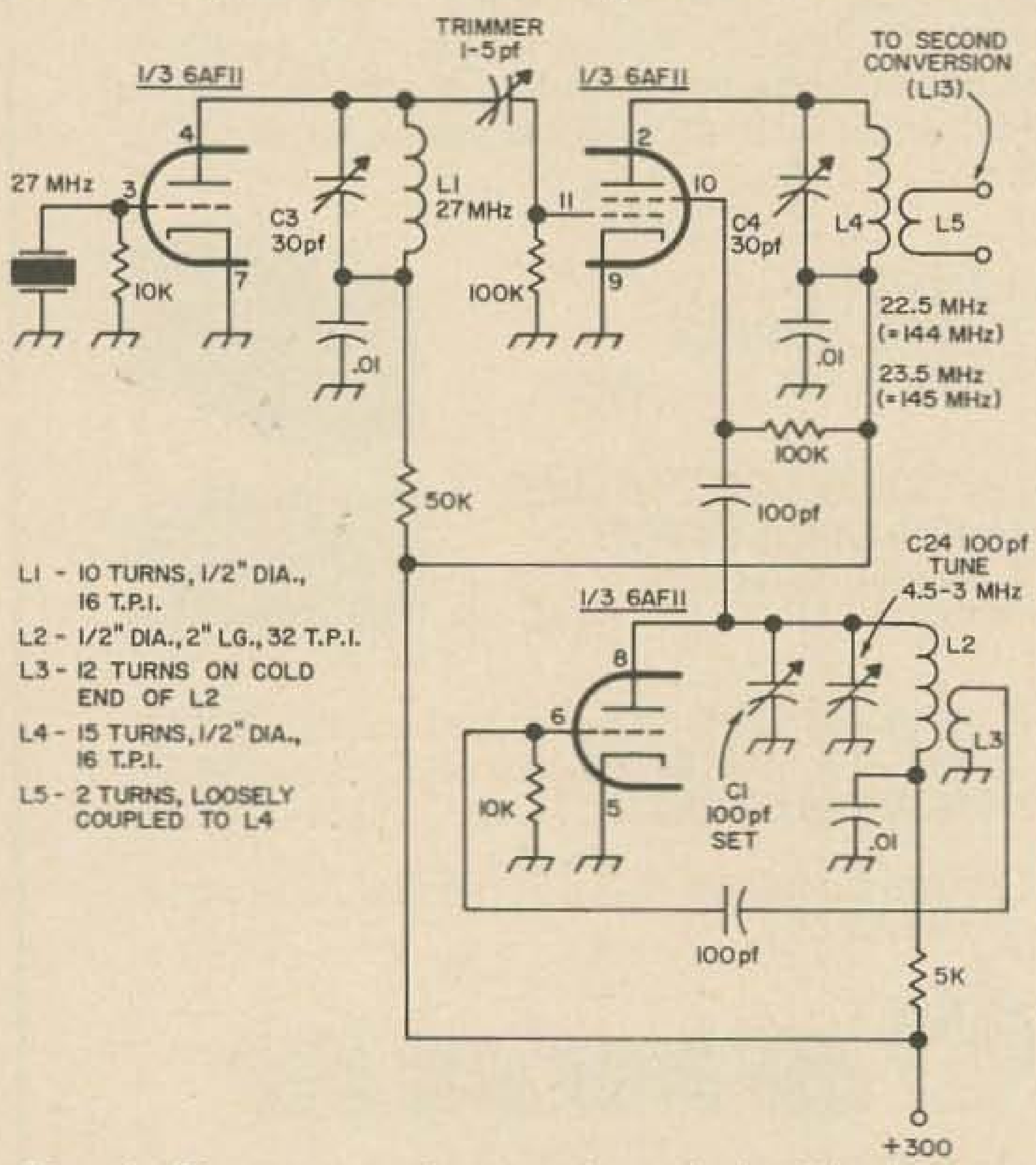


Fig. 4. First conversion section of the ideal transmitter. It puts out a stable signal on 22.5 to 23.5 MHz.

the corresponding points of course. The bulb should *almost* burn out. A brown head .9 watt or a blue bead 1.5 watt bulb can also be used.

The second conversion is shown in **Fig. 5.** I used a 60.75 MHz crystal because it was in the junk box. And it worked fine. As mentioned above, you can use others but I would advise staying in the 55 to 65 MHz range for doubling to 110 to 130. With a little regeneration from L11 the 60.75 rock takes off every time and the circuit has plenty of output and handles just as well as any lower frequency crystal. You will need a regenerative connection in the crystal grid circuit, the plate on one end of L10 and grid on the other end of L11. Use a tuned diode to check for 60 MHz output from L10.* C5 should be coupled lightly at first to the doubler grid, then advance C5 for more drive to the doubler. You will find that C5 at maximum will overlead the crystal oscillator. Be sure to adjust C1 so that the oscillator starts every time. This condition does not occur at maximum rf output but backed off a little.

This 60 MHz output goes to the doubler grid, whose plate is tuned to 121.5 by L12 and C12. The pentode input capacitance is sufficient for parallel resonance without any capacitance across L12. I did have one there but removed it.

The 22.5 MHz variable frequency input from the first conversion is link coupled by L13 to L14 and applied to the pentode screen by C14. Vary the coupling of this link for full drive to the screen with the least possible coupling. Just in passing, everything went smoothly in this circuit. This has almost always proved true. Try to *cut down* on components and you run into trouble. Put in the stuff necessary, and it goes good.

So, after tune-up, the 121.5 and the 22.5 add in this pentode and come out on the plate as 144 MHz. Be sure to peak up on *144*, not 121.5 MHz. You can also find the 121.5 minus 22.5 MHz, if you look for it, but it will be no trouble.

You should have about 85 to 90 volts on the plate coil of L10 in the operating condition. Do not go over this voltage as those VHF crystals are nice and stable as long as you keep *under* 100 volts on the triode plate.

You will find about a half watt or so out on 144, enough for that big final. Well, it is big for Two'er or Gonset lads.

The 80 watt final

A previous model of this one was described in the July '66 73, so we'll just touch on the improvements here. **Fig. 6** shows the circuit.

* See p. 20 in June '63 73.

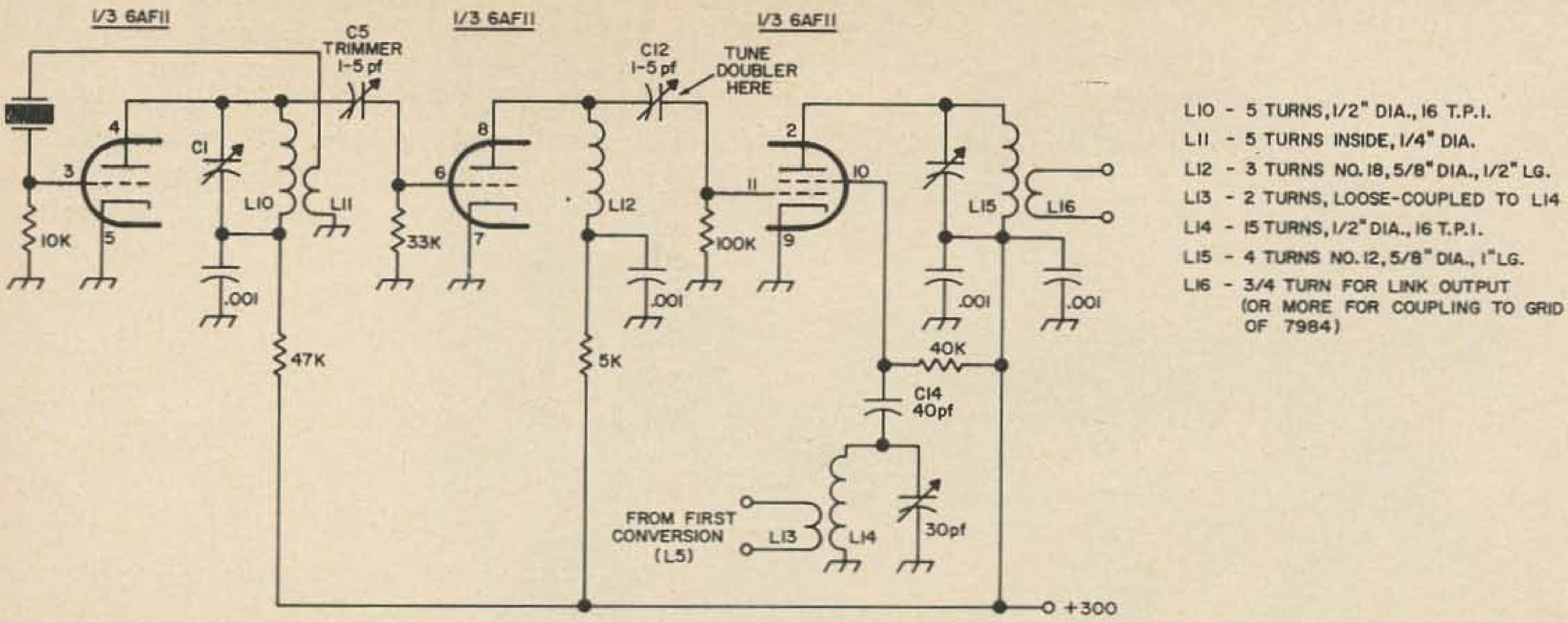


Fig. 5. Second conversion of the two meter transmitter. An input of 23 MHz from the first section gives output on two meters. The crystal used is 60.75 MHz. Output is about half a watt.

The grid circuit is simplicity itself but does warrant some discussion. The input capacitance (and some usually unmentioned inductance) reduces the size of any ordinary lumped inductance you might wish to put in as a "grid circuit." The choice for now is a quarter wave fixed tuned tank as shown in **Fig. 6.** A full wave circuit was tried but so far was not any great improvement, other than to allow link coupling, which you cannot use with the quarter wave circuit shown. It tuned nicely but showed signs of self-oscillation. If you remember, neutralization had to be used in the six meter unit. Note that the amplifier must be next to the exciter.

By simple cut and try the grid coil was worked out. This puts the grid on 144 MHz, fairly broadbanded, and works like a charm. Through the 25 kΩ grid resistor, there is about 1½ mA of grid current. Try for 2 mA

A real good plate dip is obtained along with a zippy noisy arc from a pencil test on the plate while dipped from 200 mA to 50 mA or so. This not quite the roaring flame you get. with the switching six and two 200 watt final with the 4X250 (see 73, April 66) but it does light a 50 watt bulb to dazzling brilliance.

And reports on the air are all good. Modulation was provided by the old standby with a pair of 6L6GC's. See June 73, page 20.

Reports were "At least 100% modulation", "Clear", "Excellent", etc. Stability was checked with a number of QSO's, one with a receiver (with 2 kHz bandwidth) receiver 40 miles away. Anyway, on selective receivers it comes right on at the same frequency every time. And last night I had the opportunity of checking with a Collins 75S1 and over some ten minutes he had not touched the receiver dial.

No FM either. This can be nasty. Sometimes VFO's can get some final rf on their grids. The result is a slight amount of FM which shows up as unsymmetrical modulation. That is, the modulation is not the same on each side of the carrier, and maybe the middle is mushy. If you get this condition (you *won't* with *this* rig), you're in for trouble as it is real hard to get rid of, unless you build a new and *different* rig.

So, what more do you want from $1 per watt?

Conclusions

If you build this rig as shown you will get a real feel for a genuine "professional type" transmitter.

Take the time to tune up the various coils and frequencies and you will be rewarded with a rock-stable fully modulated 80 watt VFO rig for two meters. You'll enjoy building and using it.

. . . K1CLL

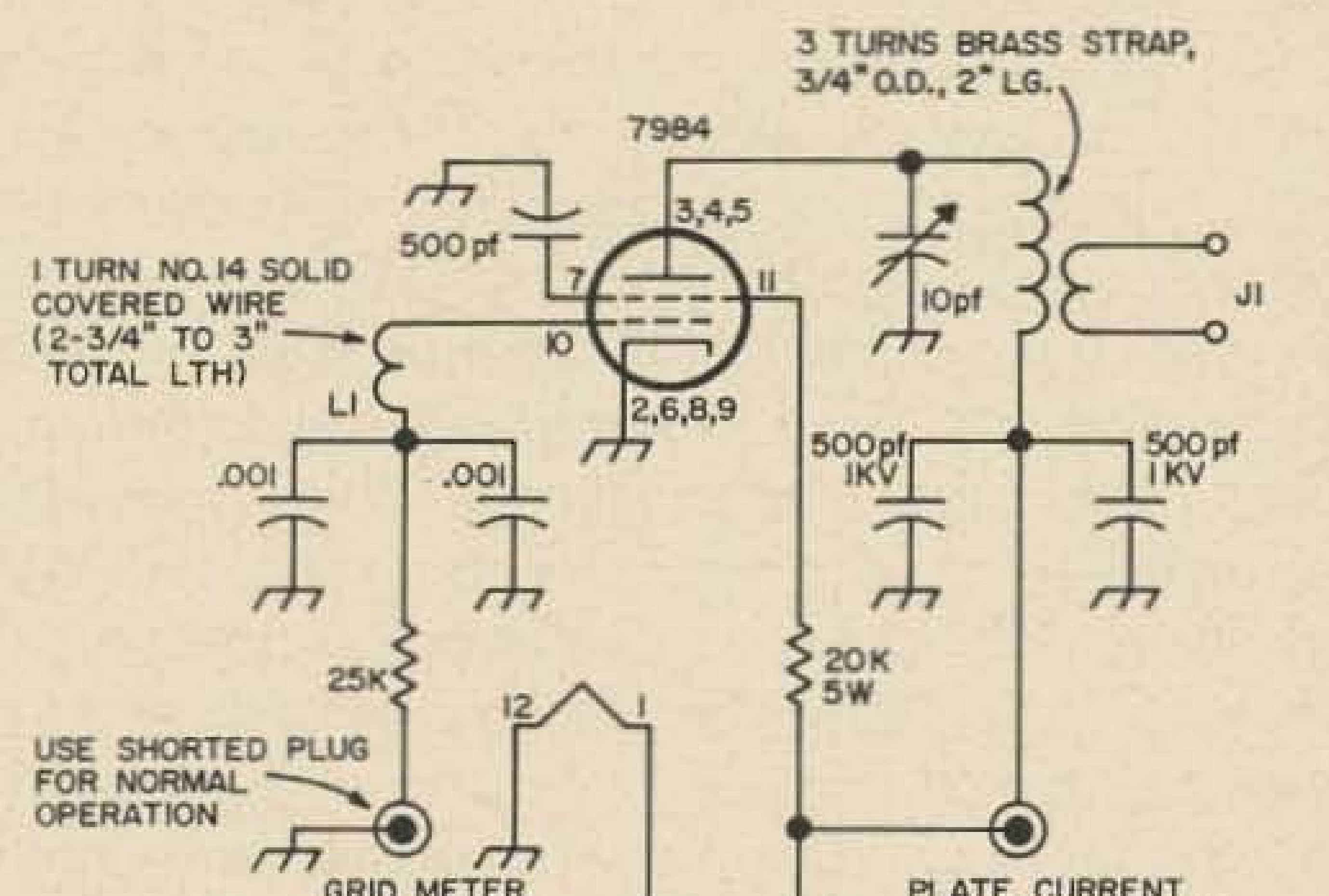
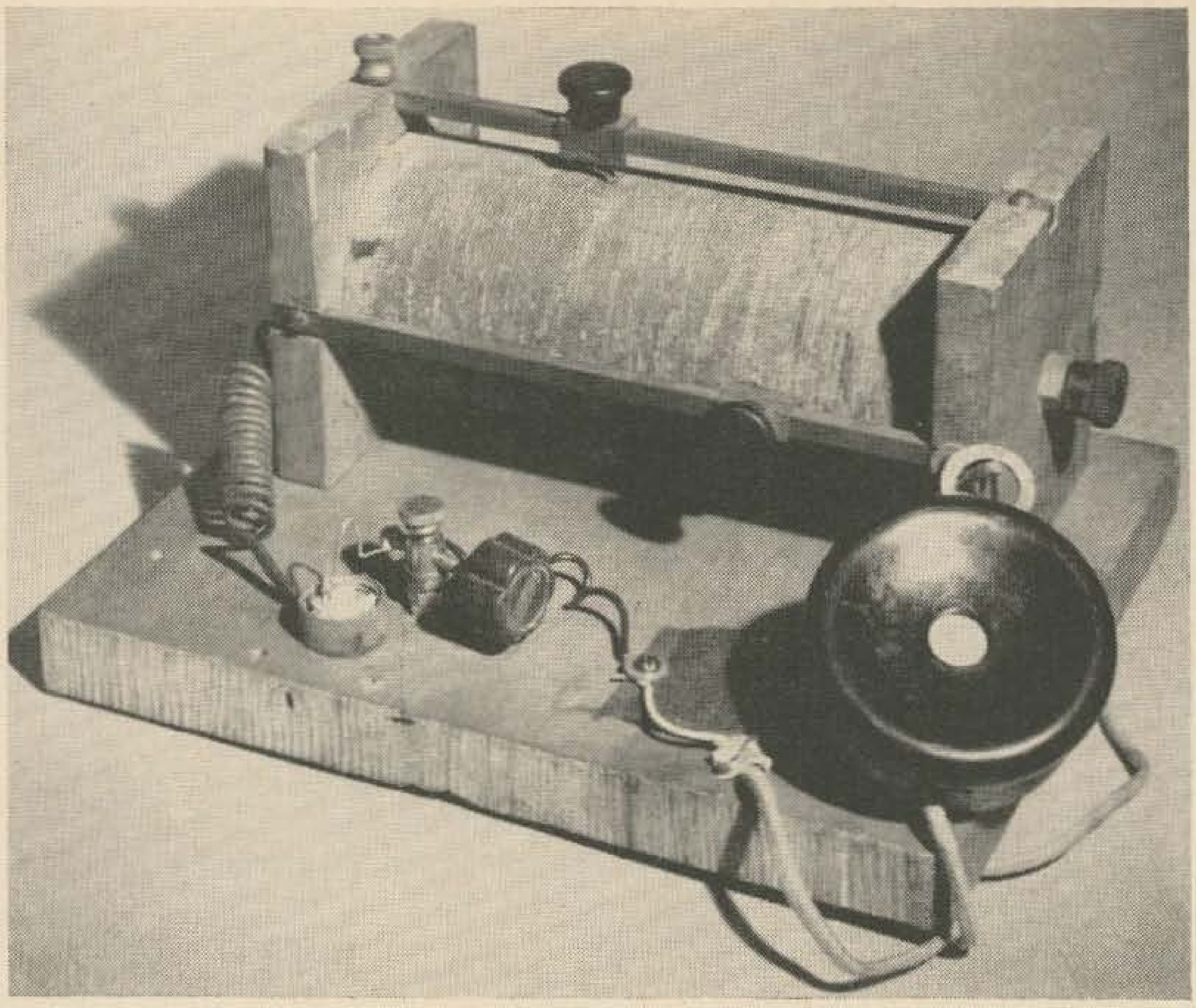


Fig. 6. 80 watt input 7984 final for two meters. See the July 73, page 67, for layout of the final amplifier, which is very similar to the linear shown there.



Yesterday's ham receivers were much simpler than the ones used today. Here's a crystal set that still works well and receives local stations.

Howard Pyle W7OE
3434 74th Avenue, S.E.
Mercer Island, Washington

The Novice Class

. . . then and now

Although the amateur Novice license has been established for only a relatively few years, amateur radio has *always* had a novice class even from its' earliest pioneer days. Webster defines a 'novice' as " . . . a person new to a particular activity; a beginner . . .". Obviously, at the turn of the century when "wireless" telegraphy first electrified the world, even the early scientists and operators were little more than 'beginners' in a new art. Newspapers and magazines devoted much space to the new miracle of communication without wires or other connecting medium other than the space around us, then popularly referred to as the ether. Numerous published pictures of wireless telegraph installations seemed to indicate that the equipment required was relatively simple . . . a coil of copper tubing, a few glass jars or plates and a conventional telegraph key formed the nucleus of transmitting equipment. A receiver was even simpler; a spoonful of iron and nickle filings, a pill bottle, a telephone receiver and an electric door bell put the budding 'novice' in wireless telegraphy in business! From there on out it was then, as it is today, simply a matter of experimenting, reading all the related literature he could lay his hands on (it was woefully scarce in early days), sending for the few rather skimpy catalogs then available and drawing on his own initiative and imagination.

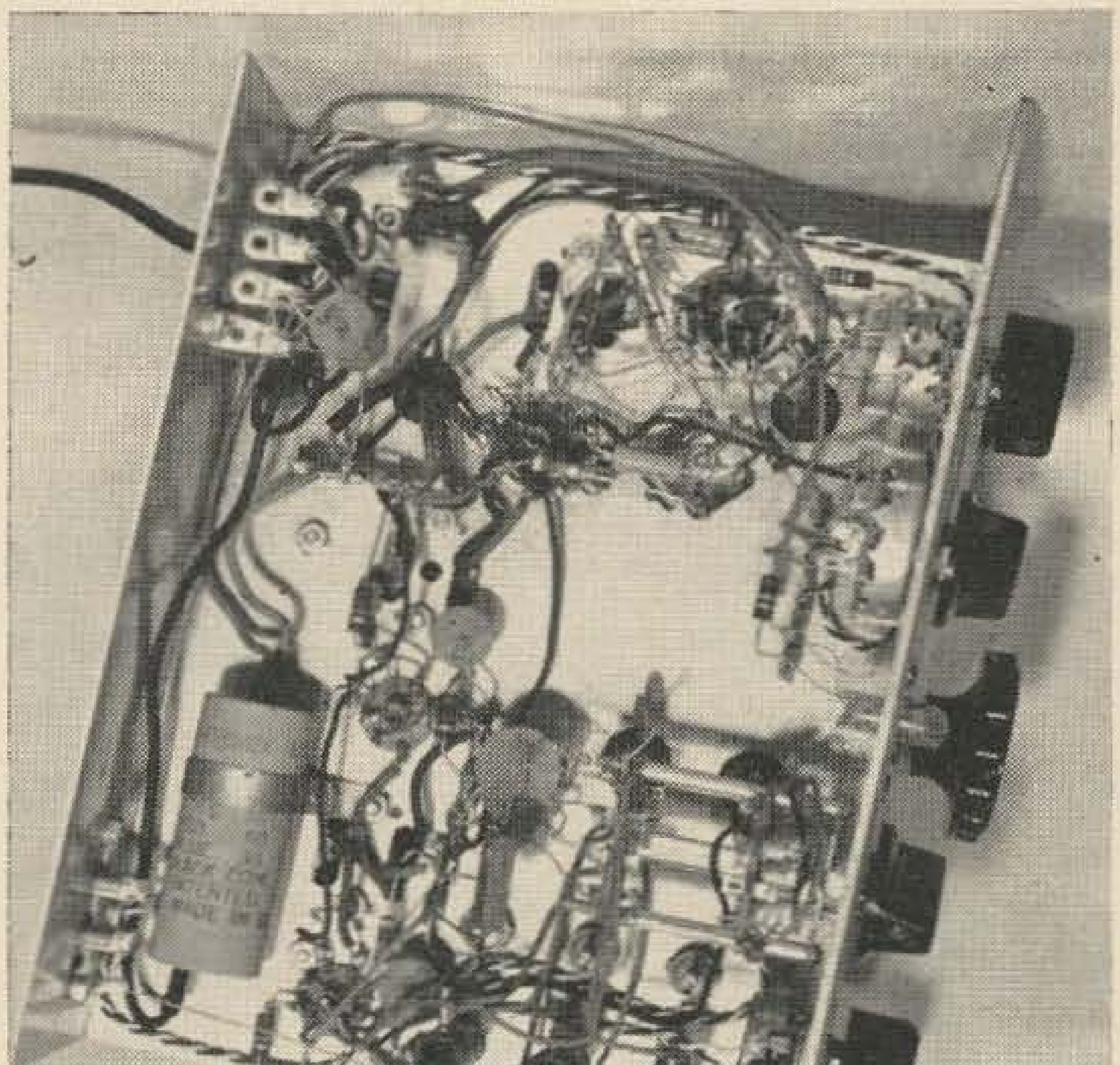
In the early 1900's a rather considerable number of lads (and yes, even a few lassies) as well as a more mature class, were seriously experimenting with various electrical devices. A battery of dry cells filched from pioneer garages (outgrowth of the village backsmith shop) where they had been cast aside after short service in the horseless carriages of the day, could be made to produce intriguing results. Bells could be made to ring, buzzers to buzz, both surreptitiously removed from the kitchen wall! Tiny lamps could be made to glow and could be turned on and off at will by switches fashioned from tacks and pieces of tin. Through reptition, these limited experiments were becoming a bit boresome; the embryo Edisons were casting about for broader outlets for their inventive imaginations. And then came "wireless"; a whole new field with unlimited possibilities! What more natural than that the young devotees of the electrical Genie turn to this new science? And they did . . . literally by the scores! Our first novices were thus born; they knew little and had much to learn. That they *did* learn is overwhelmingly attested by the status of the several hundred thousand members of the amateur fraternity today. They are skilled not only in actual communication but are continuing to contribute awesomely to the development of continually improving apparatus with which to accomplish such communication through space.That is the "then" of the novice, as used in our title . . . . how about the "now" ? Let's see.

The amateur radio novice of today is an acknowledged beginner in a field which offers unlimited opportunity for exciting adventure both in communicating with others of his class and in fabricating relatively simple equipment with which to do so. We use the term "relatively simple" guardedly; by no stretch of the imagination are the transmitters and receivers of the present-day amateur as simple and free of complication as the spark coils from a Model 'T' Ford, a few used glass photographic plates or quart fruit jars and a spool of wire painstakingly wound on an oatmeal box, all forming the nucleus of the pioneer amateur 'wireless' station. International law has long ago ruled out the spark coil and his big brother, the 'spark' transformer. Vacuum tube transmitters sounded the death knell of the crystal receiver . . . the continuous waves generated by tubes are impossible to receive on a 'crystal set'. The one exception is amateur radio telephones; a nearby, relatively powerful amateur radiophone can still be heard using a crystal detector but it is a pretty sorry substitute for a modern vacuum tube receiver; now the tiny 'transistor' is even beginning to replace vacuum tubes in recent ultra-modern amateur equipment!

So, what does the now legally recognized novice class of radio amateur do about it? He has entered the amateur rank of his own volition; he has been attracted to it through acquaintance with one or more others who have entered this charmed land; perhaps he has been a short-wave listener, intrigued by the many and varied conversations he hears on the ham bands . . . possibly he has even been engaged in Citizen's Band communication or has done a bit of playing around with walkie-talkies. Regardless of the magnet which drew him, his interest has been sufficiently fired to warrant his initial attendance at a meeting of the local ham radio club at the invitation of an enthusiastic neighborhood ham.

The fateful evening arrives and they set out to join a motley group assembled in a spacious basement room at the local church. Neat but comfortable clothed are doctors, lawyers, beggarmen and . . . well let's leave thieves out of it, shall we? Nevertheless, all walks of life represented and all age groups . . . teen-agers on up through the more mature and the senior citizens; even perhaps an octogenarian or two . . very likely a few of the charming sex as well! Folding chairs provide generous seating area, a desk up front for the club officers and a table at one side plentifully loaded with a heterogenous assortment of, to our newest novice, a 'wierd' collection of electronic odds and ends; objects for a raffle or auction at the close of the session.

Our novice . . . shall we call him Joe? . . . is casually introduced to several of those present and is almost at once mystified by unfamiliar words lightly bandied about. Yagi . . . 7 meg band . . . ZL's . . . per-selector . . . notch filter ! ! Bewildered at the outset, his confusion continues to mount but at the sound of the gavel Joe finds a seat next to his sponsor, determined to stick it out. The business session of the meeting is conventional . . . this he has been through many times



The underside of this modern noice receiver from Conar is far more complex than the crystal set. The complexity pays off in far better performance, of course.

either in school or through membership in other organizations. Finally a rap of the gavel ends the formalities and the president introduces the speaker of the evening. A good talker, he has chosen "Coax Cable vs. Twin Lead" for his subject. It's a good presentation making some valuable points for many but to Joe . . . well this mysterious thing called 'ham radio' looks pretty remote if he is going to have to absorb this kind of stuff!

A welcome respite is next provided with a round of coffee and doughnuts on a self-service table, in exchange for a nickel or a dime dropped in an old shield can serving as a cash box. Then the auction follows; happily the auctioneer has a keen sense of humor and Joe rather enjoys the horse-play although much of the gear which changes hands is totally unfamiliar to him. Disposal of most of the equipment winds up the evening and amid a chorus of "CUL", "73" and similar monkey chatter the gang high-tails it for the home "QTH" and a bit of "DX"! To his pal's query on the way home, "How'd you like it Joe . . . think you still wanna be a ham?" . . Joe replies, "Well, it sounds like it might be fun all right once a guy catches on but all those crazy terms; right now they throw me . . . hey, what does "QSO" mean anyway?" There you have it . . . a ham is born! In the next two weeks until the club meets again, Joe mulls it over . . . maybe thumbs through with a more than casual interest, the few electronic magazines at the local drug store. "It might be fun at that but gee, can I ever learn to talk their language?" he ponders. Conquering the mystifying jargon of hamdom seems to form an almost impossible barrier but it's a safe bet to say that Joe will be on hand for the next and many more club meetings!

Here's the front of the Conar novice receiver. Conar kits are distributed by the National Radio Institute of Washington, D.C.

Next month we'll start a new series of articles for 73 on the adventures of a new ham as he becomes interested in ham radio, progresses and learns. The series, which will appear monthly, will be written by Howard Pyle W7OE, one of the best known and most prolific of ham radio authors. Be sure to be with us each month!

All right, we've taken our embryo ham over the first hurdle; rubbing elbows with kindred souls. The next few weeks only contribute more to his confusion but gradually a few feeble glimmers of light break through the electronic fog. He has even progressed to the point where on meeting one of his club acquaintances, he casually greets him with, "Hi, how's DX?" and leaves with ". . . so long and '73' " . . . definitely Joe is on his way!

The preceding paragraphs are of course, simply a hypothetical exposure to the early stages of a disease known among the fraternity as 'hamitis'. It is the first timid pointing of the feet down the pathway to a glorious and richly rewarding hobby which can, and often does, lead to a profitable lifetime career in electronics as well. The next step of course is serious entry into this mystic realm by acquiring the popular ham magazines, perhaps one of the several handbook familiarly termed the "ham's Bible" and a manual or two dealing with amateur radio construction practice. Catalogs from the numerous electronic mail order houses are sent for and, on arrival, carefully pored through . . . in each reading a little more familiarity with heretofore strange words and phrases is acquired; Joe has his feet wet now and is eager to learn to swim!

I'd like to take you through Joe's subsequent adventures in the marvelous realm of ham radio. His initial efforts to master the code . . . build a simple piece of gear . . . study for his novice examination and eventually pass it. Carry him right on through building his first transmitter and joining the gang in that wonderful world of hamdom. If you'd like to pursue Joe's adventures in the trials and tribulations besetting the newcomer to ham radio, watch for the series starting in next month's 73. We'll lead Joe by the hand through the electronic maze which will eventually put him in line for a shack full of gear and walls plastered with world-wide QSL cards.

Next month: Joe tackles the code.

. . . W7OE

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Tuning the RTTY Signal

Use a simple adapter to simplify tuning RTTY.

If we wish to get the best possible operation from our RTTY gear, it is important that our receiver be correctly tuned to the incoming signal and that the shift on our FSK be correct. This article will discuss the proper tuning procedure for use with audio type RTTY converters and will describe a simple easily-constructed tuning indicator.

Fig. 1 illustrates graphically the proper relations between the receiver tuning and BFO setting that we need for best results. In the correctly tuned illustration, an optimum *if* selectivity curve is shown, with a bandwidth just wide enough to pass the entire FSK spectrum. Obviously, the tuning is most critical for this bandwidth. Note that the BFO should be set 2550 Hz away from the *center* of the *if* passband. It doesn't make any difference whether the BFO is above or below the *if* frequency—this will only swap the MARK and SPACE tones. The incorrectly tuned example shows the BFO set too close to the *if* frequency. Here, the SPACE frequency will "fall off" the edge of the *if* curve causing it to be weaker than the MARK signal. This will result in errors, particularly when noise or fading is present. If your receiver has a wider passband than 1200 cps, the tuning will not be as critical. However, it is very desirable to have the FSK signal *centered* in the passband. We then have the maximum tolerance for drifts, mistuning, etc.

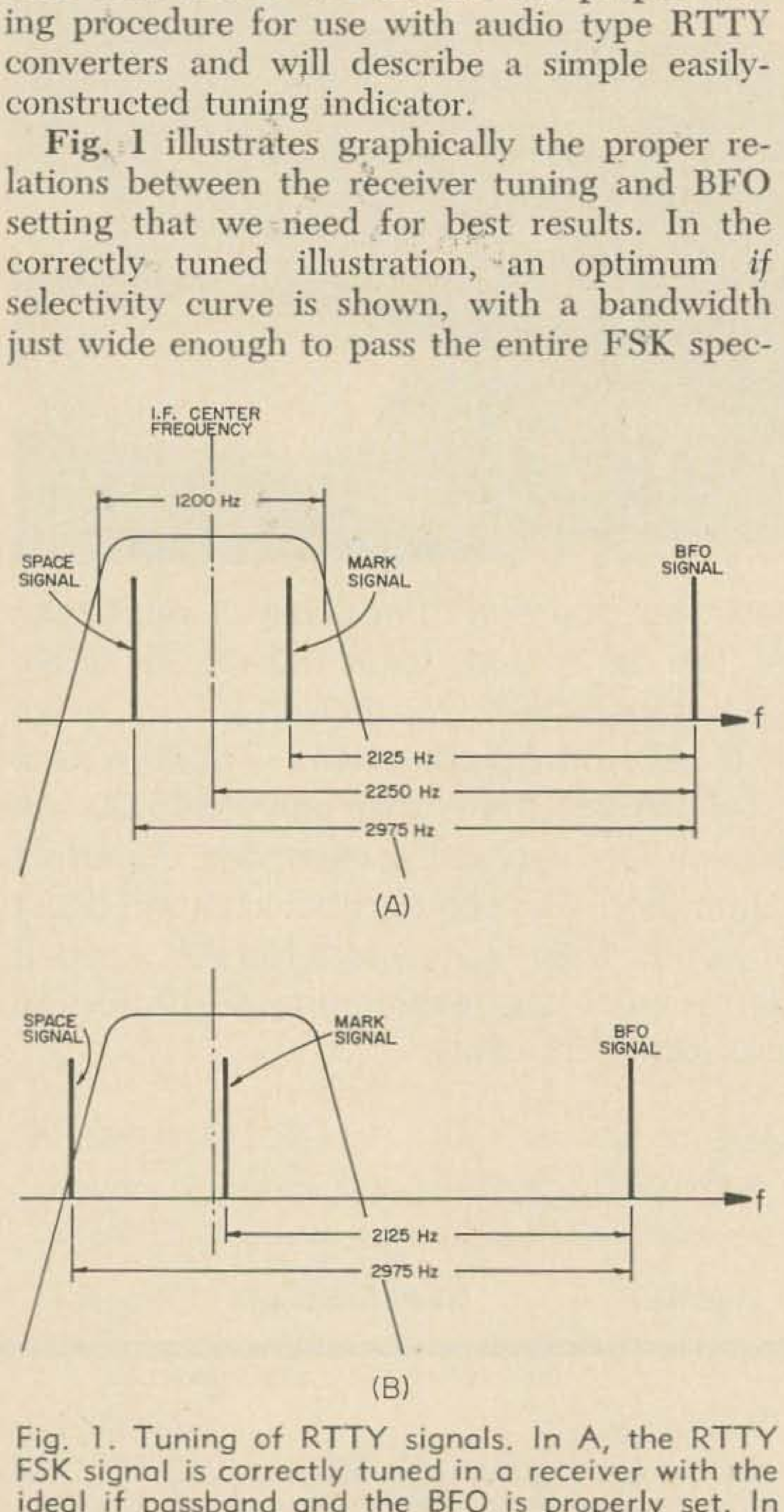


Fig. 1. Tuning of RTTY signals. In A, the RTTY FSK signal is correctly tuned in a receiver with the ideal if passband and the BFO is properly set. In B, the BFO is improperly set with the mark signal in the if passband and the space signal out of it. The distance from the BFO to the if center should be 2550 instead of 2250 Hz.

So we see that we need to do two things. First, get our BFO settings correct and, second, be able to accurately tune in the RTTY signal so that it is in just the right place in the *if* passband. The answer to both these requirements is a good tuning indicator. An additional advantage of a good indicator is that we can set the shift on our transmitter correctly.

Types of indicators

Many different devices have been used for RTTY tuning indicators. A list might include:

- Zero-center meter across discriminator load
- Neon bulbs on keyer output
- Electron-eye tubes on the MARK–SPACE detector output
- Variable-angle scope display
- Flipping-line scope display
- Detected-pulse scope display
- Scope cross-pattern.

Most RTTY'ers have their favorite indicator. However, the display which seems the easiest and fastest for the newcomer to learn to use is the cross-pattern oscilloscope. This method was originated by Merrill Swan W6AEE, one

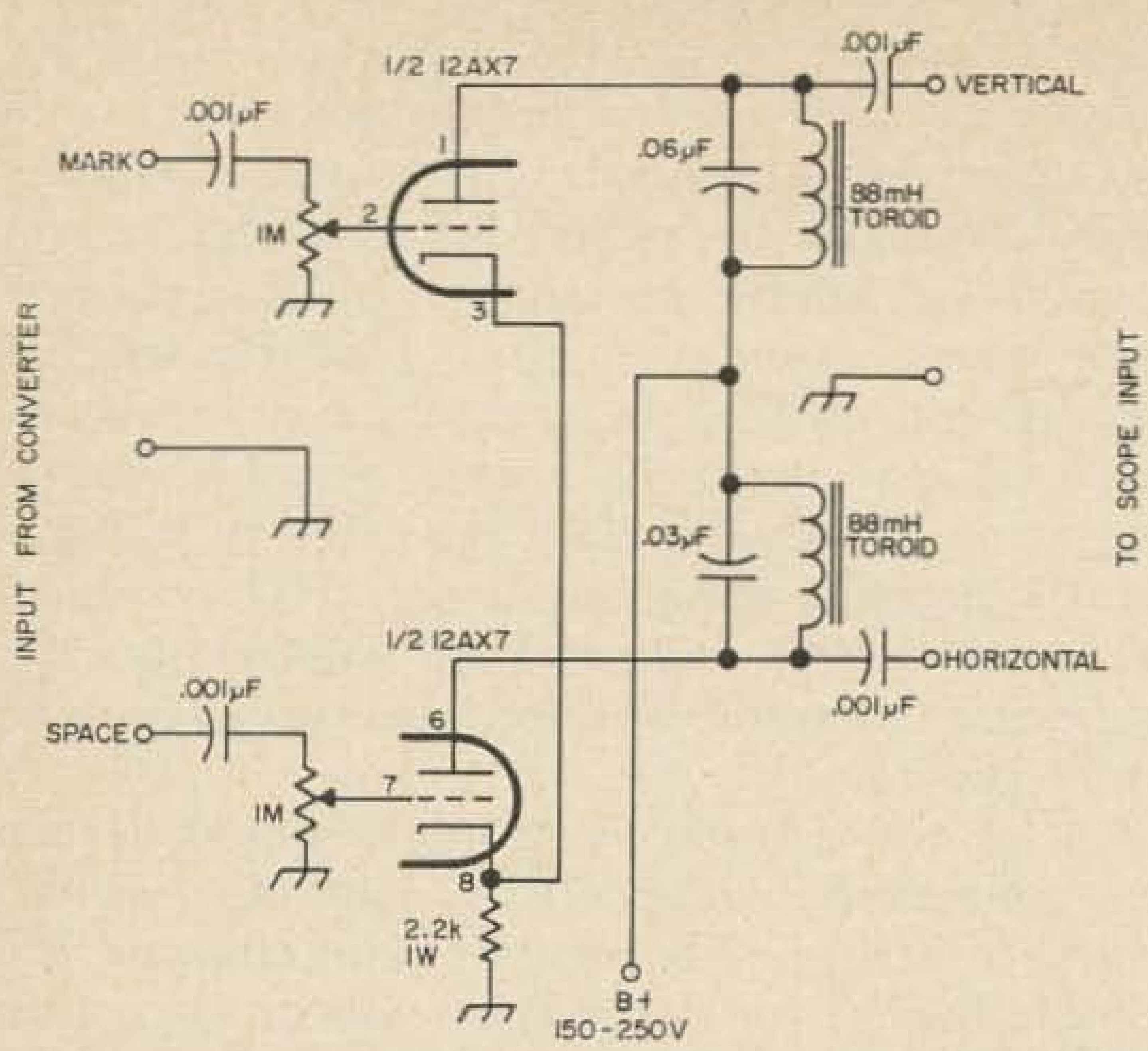


Fig. 2. Circuit of a scope tuning adapter for RTTY.

of the pioneers in ham RTTY. In this type of indicator, a correctly tuned signal with correct shift will produce a perfect cross on the scope face. As you tune through an RTTY signal with the receiver dial, the cross will first be small and will attain its maximum size when the signal is correctly tuned and then will get small again as we detune. If the frequency shift of the received station is incorrect, then one arm of the cross will be shorter than the other. You can experiment with your converter to determine if a signal with the wrong shift prints best when tuned for maximum MARK, maximum SPACE or "in between."

Cross-pattern tuning adapter

Either a standard oscilloscope can be used as a cross-pattern tuning indicator or a scope tube added to the RTTY converter. The simplest way of driving the scope is to feed the horizontal input from one set of the tuned circuits in the converter and the vertical input from the other set. However, most RTTY converters have relatively low-Q circuits for separating the MARK and SPACE tones. The result is that we get crossed ellipses instead of crossed lines as shown in **Fig. 5A.** Accurate tuning is thus more difficult. The solution is to build a simple adapter whose circuit is shown in **Fig. 2.** This adapter can be used with almost any audio-type converter and can drive a standard oscilloscope. It has sufficient gain to drive the deflection plates of a 2" or 3" cathode ray tube directly. The adapter is very simple, consisting of two highly-selective circuits and a dual triode amplifier.

High-Q toroids are tuned to the two audio tones, which are normally 2125 and 2975 Hz These are driven by the two sections of a 12AX7 which has a high plate resistance. The grids of the 12AX7 are fed from the two tuned circuits in the RTTY converter.

It is rather difficult to give exact instructions on connecting the tuning adapter to the many different types of converter circuits in use. The best procedure is to experiment with your particular unit until you find the points which produce the cleanest pattern on the scope indicator. However, we can give some general suggestions. **Fig. 3** shows a block diagram of a typical audio converter consisting of a limiter followed by the audio tone filters. Two amplifiers feed the detectors whose outputs are combined to drive the keyer circuit. Points which may be suitable for connecting the adapter are indicated. Note that the MARK and SPACE adapter inputs are tied together when connecting to the limiter output but are separated when connected beyond the converter filters.

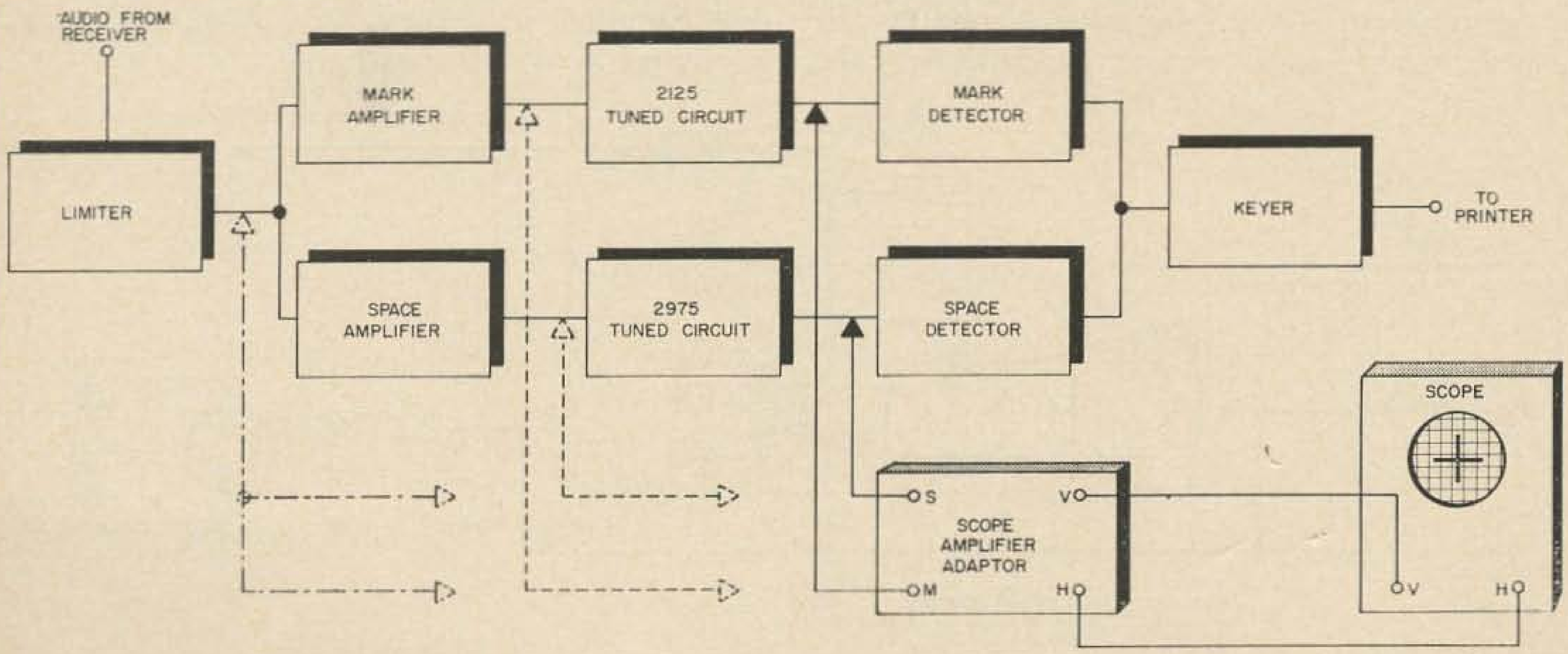


Fig. 3. Possible scope adapter connections for a typical audio-type RTTY converter. Typical scope and scope amplifier adapters are shown in Figs. 2 and 4, but a regular oscilloscope can be used.

Scope indicator

As mentioned earlier, a conventional oscilloscope can be used in conjunction with the cross-pattern adapter as the indicator. However, for a few dollars, a separate scope indicator can be easily built. **Fig. 4** is a basic circuit which uses the power supply in the RTTY converter or other existing supply for the scope high voltage. The scope tube can be a 2AP1 or similar type which are available surplus for two or three dollars. A separate filament transformer should be used since the cathode is several hundred volts above ground. The anode voltage is obtained by deriving a negative voltage from one side of the high voltage transformer in the converter power supply. This voltage will be approximately equal to the peak a-c and may give sufficient brightness depending on the particular scope tube and the transformer in your power supply. If the pattern is not bright enough, then disconnect the ground from the voltage divider network and return to the B+ voltage from the power supply as shown in the dotted lines. This will put the negative supply in series with the positive supply. Be careful not to ground the various pots and use insulated shafts for safety.

No centering controls are shown since most scope tubes will have adequate deflection plate alignment for this use. However, if the pattern is too much off center, it can be corrected by use of a small permanent magnet. The magnet is moved around near the scope tube and taped to the chassis or panel at a spot which gives proper centering.

Aligning the adapter

With the adapter connected to the scope indicator, the two toroids in the adapter can be trimmed to exact frequency. Probably the easiest and cheapest toroids available are the 88mH loading coils which can be bought for less than $1.00 each, although any toroid from 50 to several hundred millihenries is suitable. The approximate values of capacitance required for 88mH are shown. With an accurate source of audio tuned to 2125 Hz and fed to the grid of V_{1a}, the capacitance is trimmed across L_1 to obtain the longest possible line on the scope. Similarly, 2975 Hz is fed to the grid of V_{1b} and the capacitance across L_2 is varied to produce the longest line. Alternately, the capacitances could be fixed and turns removed from the toroids.

After the adapter is properly tuned, it can be connected to the RTTY converter, as described earlier. The scope gain controls are then adjusted for the desired size cross-pattern and the unit is ready to use. Tuning in an RTTY station is extremely simple. Just tune for maximum cross size and that's it! **Fig. 5** shows the patterns obtained for various conditions.

Receiver tuning hints

We mentioned earlier that it is important to have the BFO correctly set. We would like to get our receiver set up so that the BFO is in the proper relationship to the selectivity curve of the *if* as illustrated in **Fig. 1.** Once this is done, we should then tune in RTTY signals using the main tuning dial, leaving the BFO fixed. The following procedure is suggested to get your receiver set in this manner. Once this is done, then tuning RTTY signals with the tuning indicator is easier and faster than CW or SSB!

1. Turn on your VFO to provide a steady carrier.

2. With AGC on and BFO off tune in your VFO signal and carefully peak the signal with the S-meter. You now have the VFO signal centered in your *if* passband.

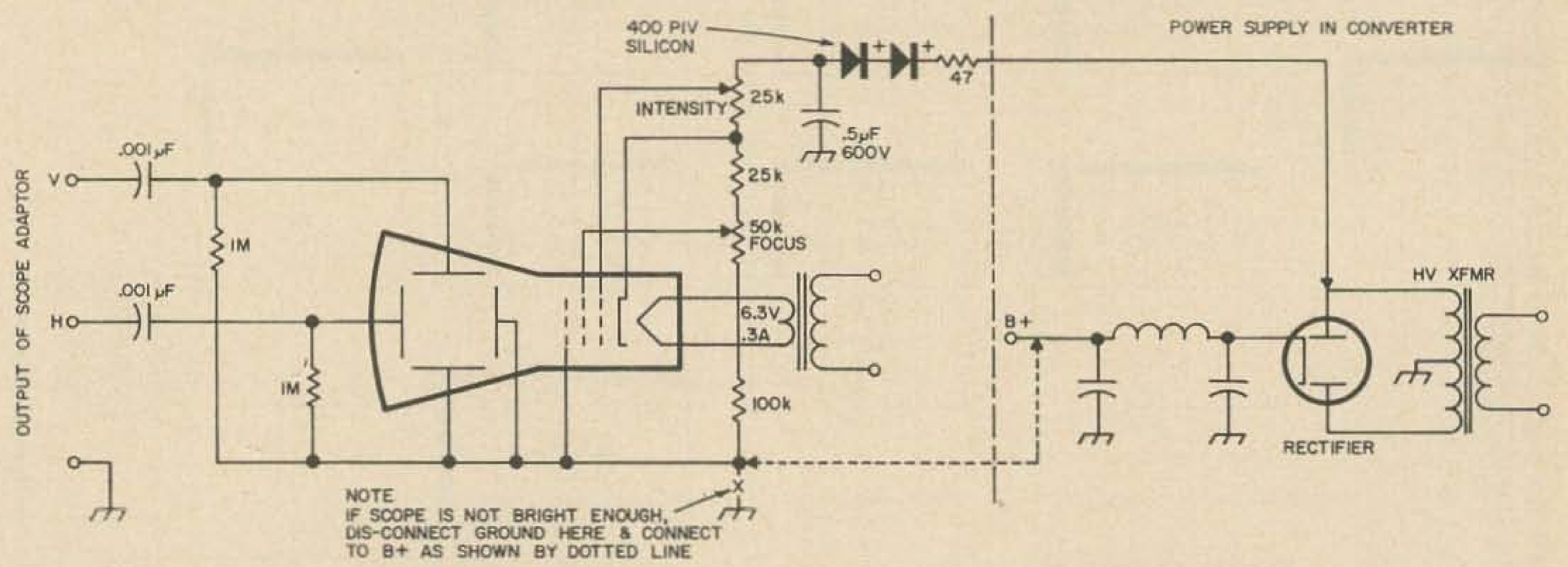


Fig. 4. Simple scope indicator for RTTY tuning unit. A transistorized oscilloscope for this use was described by K8ERV in the June 1966 issue of 73. It can be used as discussed in this article.

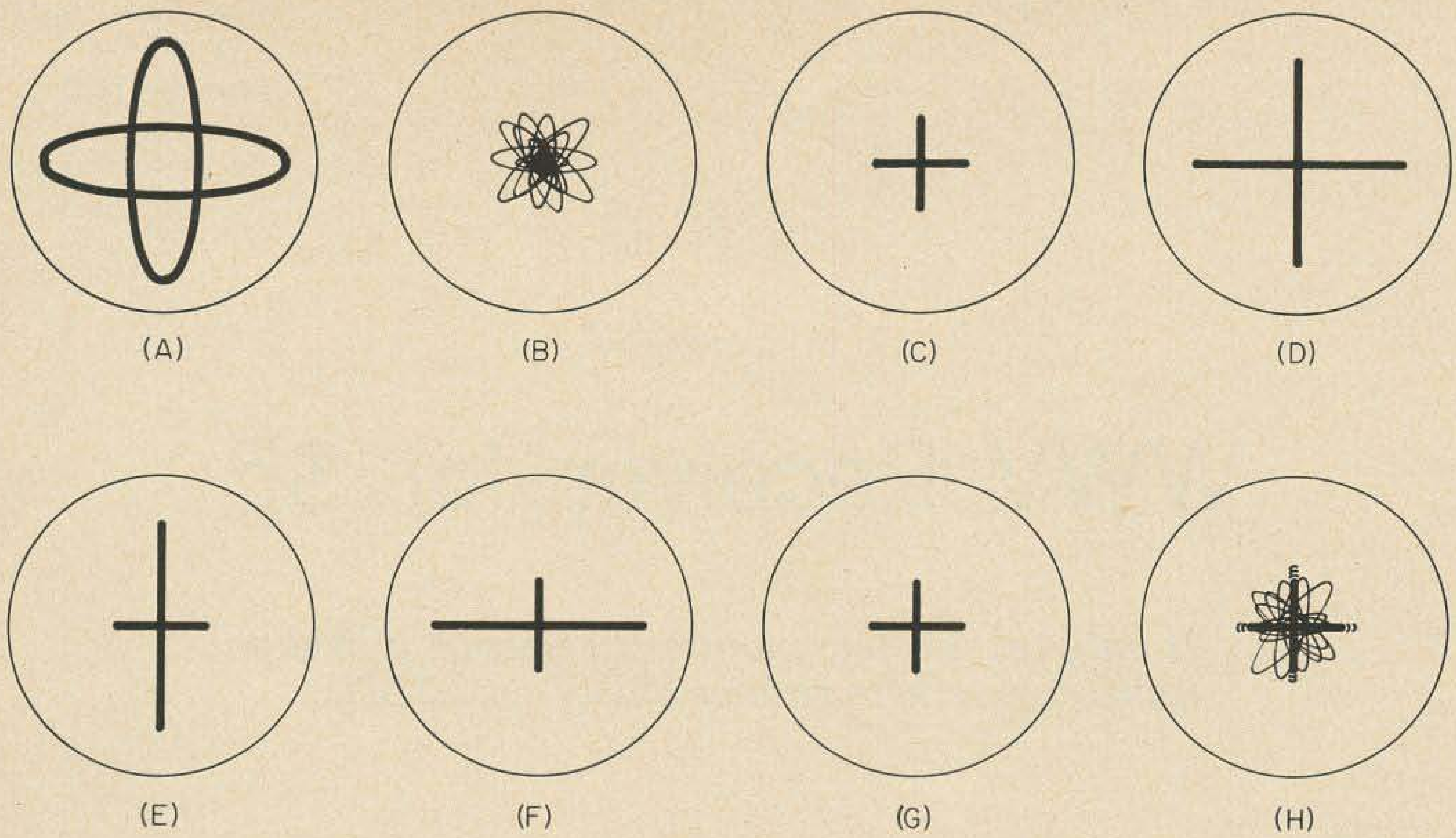


Fig. 5. Examples of RTTY tuning scope patterns for various signal conditions. All patterns except A are obtained using the scope tuning adapter. A Cross pattern from converter using low-Q tuned circuits. B. Pattern with no FSK signal, noise and speech only. C. Correct shift FSK, improperly tuned. D. Correct shift FSK, correctly tuned. E. FSK signal with incorrect shift, peaked on mark. F. FSK signal with incorrect shift, peaked on space. G. narrow shift FSK correctly tuned. H. Weak FSK signal with noise (signal not limiting) correctly tuned. The text discusses the easiest method.

3. Now, turn on the BFO and zero-beat the VFO signal with the BFO pitch control. The BFO is now tuned to the center of the *if* passband.

4. Detune your VFO 425 Hz higher in frequency. This will produce a 425 Hz beat note with the BFO. You can set this accurately by operating your FSK (switching between MARK and SPACE) and carefully tuning the VFO so you get the *same* 425 Hz tone from MARK condition as from SPACE condition. This is true since the BFO is in the center, while the space frequency is 425 Hz lower and the mark frequency is 425 Hz higher.

5. Now, retune the BFO pitch control to produce a 2125 Hz beat against one frequency and 2975 Hz beat against the other frequency. This setting can be made most accurately by operating your FSK and adjusting the BFO pitch control for the maximum size cross on the tuning indicator scope. Some BFO controls may not have quite enough range to get the 2975 Hz beat, but this can usually be corrected by a slight adjustment of the trimmer on the BFO coil.

6. When the proper BFO setting is found, make a mark on the receiver panel of some kind so that you can always set the BFO pitch control to this position. *Always* tune in FSK signals with the main tuning dial and not with the BFO control.

Setting transmitter shift

By using our cross-patterns tuning adapter, our transmitter frequency shift can be quickly set to the correct value. With the transmitter exciter ON and in the MARK condition (keyboard closed), tune in your signal with the receiver until the scope line representing MARK has its maximum length. Then simply depress the break key on the teletype machine and adjust the shift control to obtain the maximum length line on the scope representing SPACE. That's it! Also, zero-beating another RTTY station is very fast and easy with the tuning indicator. When calling another station, you zero-beat his MARK signal by tuning your VFO in the "spotting" mode to produce the same line on the scope. You can also operate your break key for a quick check on your shift.

Conclusions

In order to get the best possible results from his receiving set-up, the RTTY'er should understand how to set his BFO and how to tune in the FSK signal. Some form of tuning indicator is almost essential. The simple-to-use cross-patterns scope type has been a favorite with many and the adapter described provides an ideal pattern. . . . W4EHU

James Ashe W2DXH
R.D. 1
Freeville, N.Y.

WWV Receiver for $5

It only takes a few minutes to convert a cheap transistor radio to receive WWV on 2.5 MHz.

Something quite remarkable has happened recently. The combined effects of engineering research and industrial competition have resulted in really workable radio receivers appearing on the consumer market at prices of around five dollars. These inexpensive radios are designed to tune over the broadcast band of 550 to 1600 kHz are battery operated, have a good powdered-iron core antenna coil, and contain five or more working transistors. The circuit is installed in a thermoplastic case of generally attractive design, and comes with a real or simulated leather cover. Discount stores, dime stores, and most of the larger consumer electronics supply houses offer a wide variety of basically similar receivers in this class.

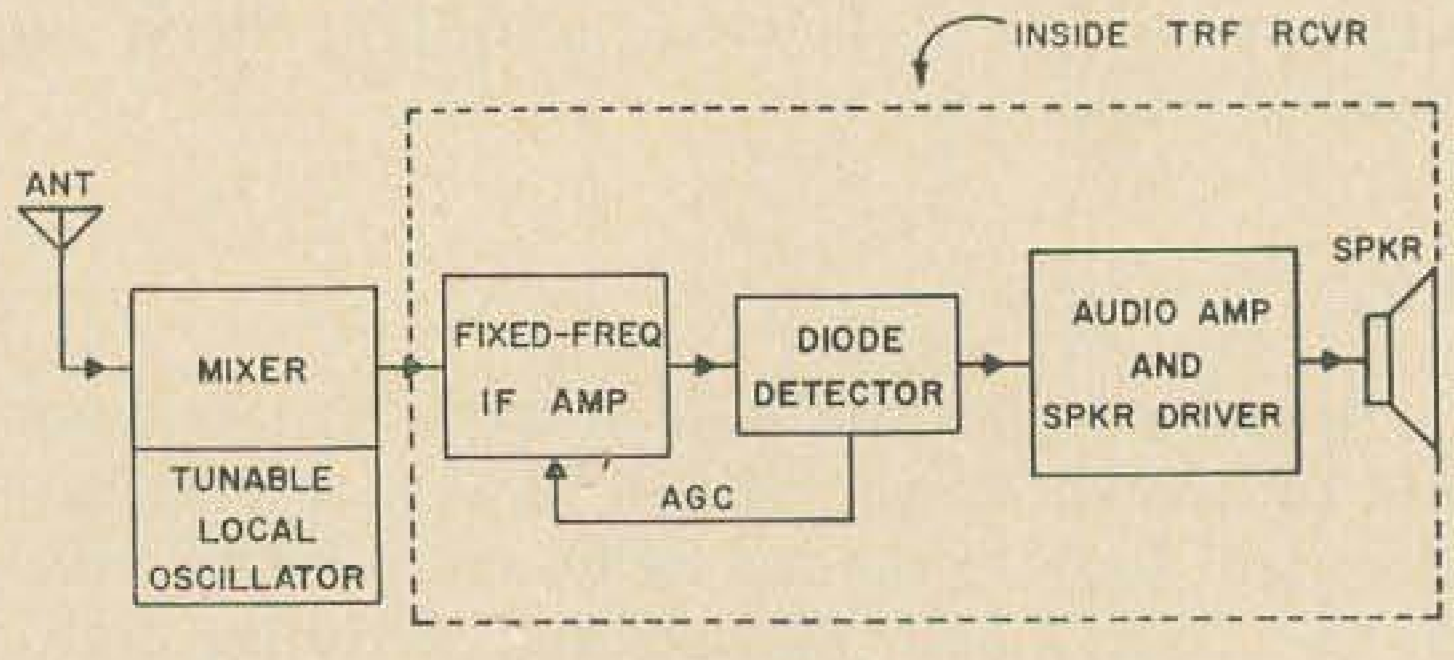


Fig. 1. Block diagram of a typical small superhet receiver without an rf stage. Most five-dollar transistor superhets closely follow this scheme.

These receivers are commonly supplied with a schematic diagram. In a typical model (most of them are about the same; avoid reflex circuits) the first transistor serves as a common-emitter mixer and a collector-feedback tunable local oscillator. The next two transistors are *if* amplifiers at the usual near-455 kHz frequency. There is even an AGC circuit! A diode detector provides the AGC control voltage and the audio to a one-transistor gain stage. A transformer-coupled two transistor push-pull audio output stage, which may include a thermistor for compensation of temperature effects, feeds the small loudspeaker. A small phone jack may be wired to disconnect the loudspeaker when using the low-impedance earphone. The usual arrangement is shown in block-diagram form in **Fig. 1.**

At the low price of $5.00, a receiver should be satisfactory if it works at all! Observation is more encouraging than that: most of these receivers are considerably better than 'usable'. And they commonly show distinct indications of good engineering, such as electrical stability, and a clean, relatively open layout. Maintenance is not difficult and replacement parts or substitutes are easily obtained. Their style of construction, although well under MIL specs, is far from flimsy. Most of these receivers are not toys: they are real, usable electronic devices.

But what are they good for? How their

manufacturers must gnash their teeth over the usual broadcast fare! It neither informs nor impels to action; white noise is more pleasing and useful. Some other application must be found for one of these attractive devices. A few ideas have appeared in ham magazines from time to time: a fix-tuned *if* for a VHF receiver, or a conversion to a simple service instrument. A recent QST article suggests stripping out most of the circuit to build up something almost entirely different. Such drastic revision is not proposed here. It's a remarkably simple job to convert one of these receivers to a usable WWV receiver.

A little history

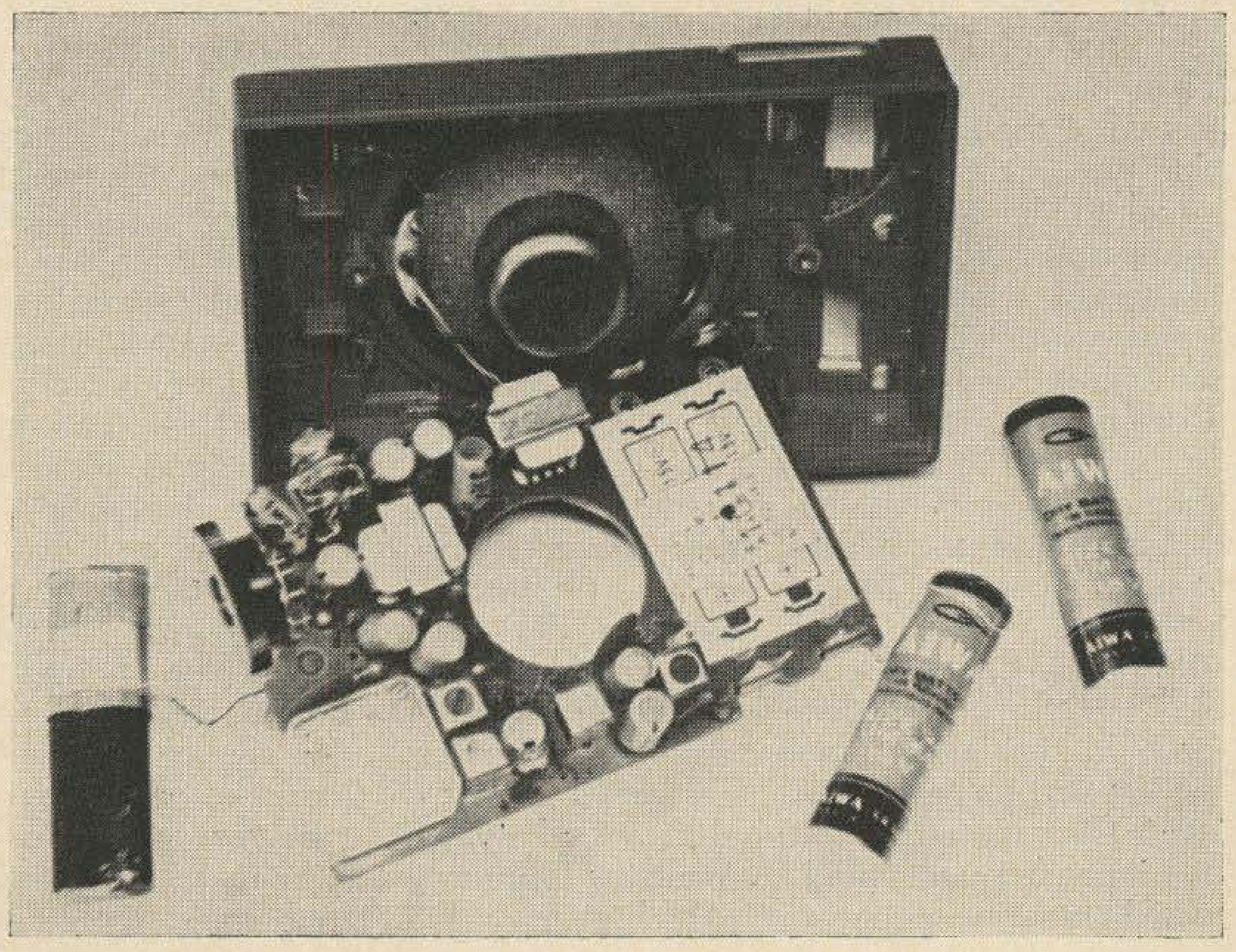
Almost any radio receiving system contains an amplifier of some kind. Only the simplest ones do not: the crystal receivers built in the early days of radio, and still built for some purposes, utilize only the incoming energy from the antenna. These receivers are insensitive and no longer serve for normal communications work.

The history of radio is largely the story of years of research upon a very central problem: how can a smaller signal be made to yield a usable result? And the smallest usable signal has become very small indeed. Imagine a 1-watt lamp and its general illumination of the surrounding territory. This represents roughly what Hertz had achieved by 1889. Nowadays a millionth part of this 1-watt illumination, or 10^{-6} watts, is regarded as a huge signal which is likely to overload the receiver. A further reduction by another million times brings the signal to a workable level, about 10^{-12} watts. Most amateurs would regard a signal as fairly weak at another hundred times smaller: 10^{-14} watts, or about 0.7 microvolts across 50 ohms.

What did the old-timers do about small signals? At first they had to get along with no amplifiers at all. Hertz's spark gap soon yielded to improved detectors such as the coherer and later the electrolytic, the crystal, and some other varieties. There was great emphasis on making the most effective use of the signal. Much of the early literature is devoted to better coupling devices, and there were even such things as push-pull crystal receivers. Later arrangements used primitive thermionic triodes as RF amplifiers at the received frequency, and these developed into the TRF or Tuned Radio Frequency receivers which have lasted almost up to the present.

Something really new happened in 1918. Edwin Armstrong, then in Paris as an officer in the Signal Corps, built a strikingly improved kind of radio receiver. A year and a half later, in 1920, he received his patent on one of the most popular circuit ideas in history: the superheterodyne circuit.

He used an amplifying and detecting system that always operated at the same frequency. The designer, engineer, and builder could exert their full skill and knowledge against the problem of making something uncompromisingly intended to do the best possible job. Troublesome tuning, tracking, and feedback difficulties were greatly eased by this simplification. Then he made his fix-tuned receiver respond to frequencies other than its own by adding a converter circuit: any given frequency fed into the converter could be made



The WWV receiver just before assembling back into its case. The antenna leads are very fragile!

to come out as the right frequency for the fix-tuned receiver. The converter could be designed to feed any frequency within a wide range into the fix-tuned receiver. This was the basic principle that has become one of the key ideas of radio electronics.

His converter circuit is now called the mixer, and it is often arranged to perform a second function as a local oscillator. It's easy to forget that the *if* amplifier is really a complete receiver in itself: a TRF receiver often fix-tuned to about 455 kHz. This basically simple and highly workable idea (the number built so far must be in the tens of millions!) does have some peculiarities, or depending on your point of view, a few shortcomings. This simple conversion of a tunable broadcast to a fix-tuned shortwave receiver depends on one of them.

Superheterodyne operation

About 1800, a French mathematician was working on a difficult problem. He was trying to develop a mathematical description of the actual events occurring when a stretched cord is pulled away from its resting position and abruptly released. He solved his problem in a way that some mathematicians of his day refused to accept as mathematics. His name was Fourier; many modern eletronics handbooks have tables and collections of equations based on his results.

The question of how a superheterodyne mixer works can be studied by Fourier analysis. The engineer writes down a simple equation to represent the two frequencies applied to the mixer input, and then he writes a longer, rather hairy looking thing to represent the output. He writes a Fourier series. Then he may red-pencil a circle around one or two of the terms and simply ignore the rest. The two important terms are (1) a frequency equal to the numerical sum of the two input frequencies and (2) a frequency equal to the numerical difference between the two input frequencies. The sum frequency is interesting to transmitter builders, and is the basis of Hoisington's one-tube 50MHz. VFO described in the June 1966 issue of 73. The difference frequency interests us and receiver builders in general. And the terms ignored aren't really gone; they come back sometimes to produce unwanted birdies. Fisk's article in the April 1966 issue of 73 discusses that problem.

The little superhet we are about to modify probably has an *if* frequency of 455 kHz. This means that its inside TRF receiver (see **Fig. 1** again) is responding to the difference between the input frequency and an oscillator frequency which must be either 455 kHz higher or 455 kHz lower than that input frequency. The manufacturer practically always chooses an oscillator frequency above the received frequency in these little receivers; it simplifies necessary adjustments.

Let us suppose the receiver is tuned to 1590 kHz. This is still within the broadcast band, but very near its upper edge. Its local oscillator must be operating 455 kHz higher, at 2045 kHz. Adding 455 kHz to this known oscillator frequency, we come to 2.5 MHz as the other value which differs by the *if* frequency from the oscillator frequency. If we can make a small revision in the input circuit to emphasize the 2.5 MHz, we will have a WWV receiver!

The conversion

The appropriate instruments for this conversion are a grid dip oscillator and an RF signal generator. It is not a difficult conversion and with care you may be successful without the instruments. In either case, try to find a short-wave receiver capable of picking up WWV before going ahead. Sometimes it sounds quite weird. The one-per-second ticks are distinctive, and there is a time announcement each five minutes.

Check the receiver for normal operation before starting the conversion. If it is working properly, tune to just under 1600 kHz, remove the battery, and dismantle the circuit board from the case without disturbing the tuning capacitor. Remove the knob from the capacitor, and fill in the remaining hole in the case with a piece of cardboard. A coat of clear fingernail polish will improve the cardboard, and it may be held in place with some glue or epoxy cement.

Free the loop antenna structure from the printed circuit board, but do not disconnect any wires. Be gentle! And then trace backwards from the mixer transistor to the link coupling from the loop antenna. This circuit must be opened since the grid dip oscillator may be powerful enough to destroy the mixer transistor. The base circuit is best opened at the end opposite ground: the connection to the mixer base terminal. Don't worry about possible detuning.

Use the grid dip oscillator to find the resonant frequency of the antenna coil. It should be very near 1590 kHz, because it was set to that value before dismantling and events should not have disturbed it. If it is not near this frequency, you must find out why! Perhaps the oscillator frequency is off also, making eventual success very hard to achieve.

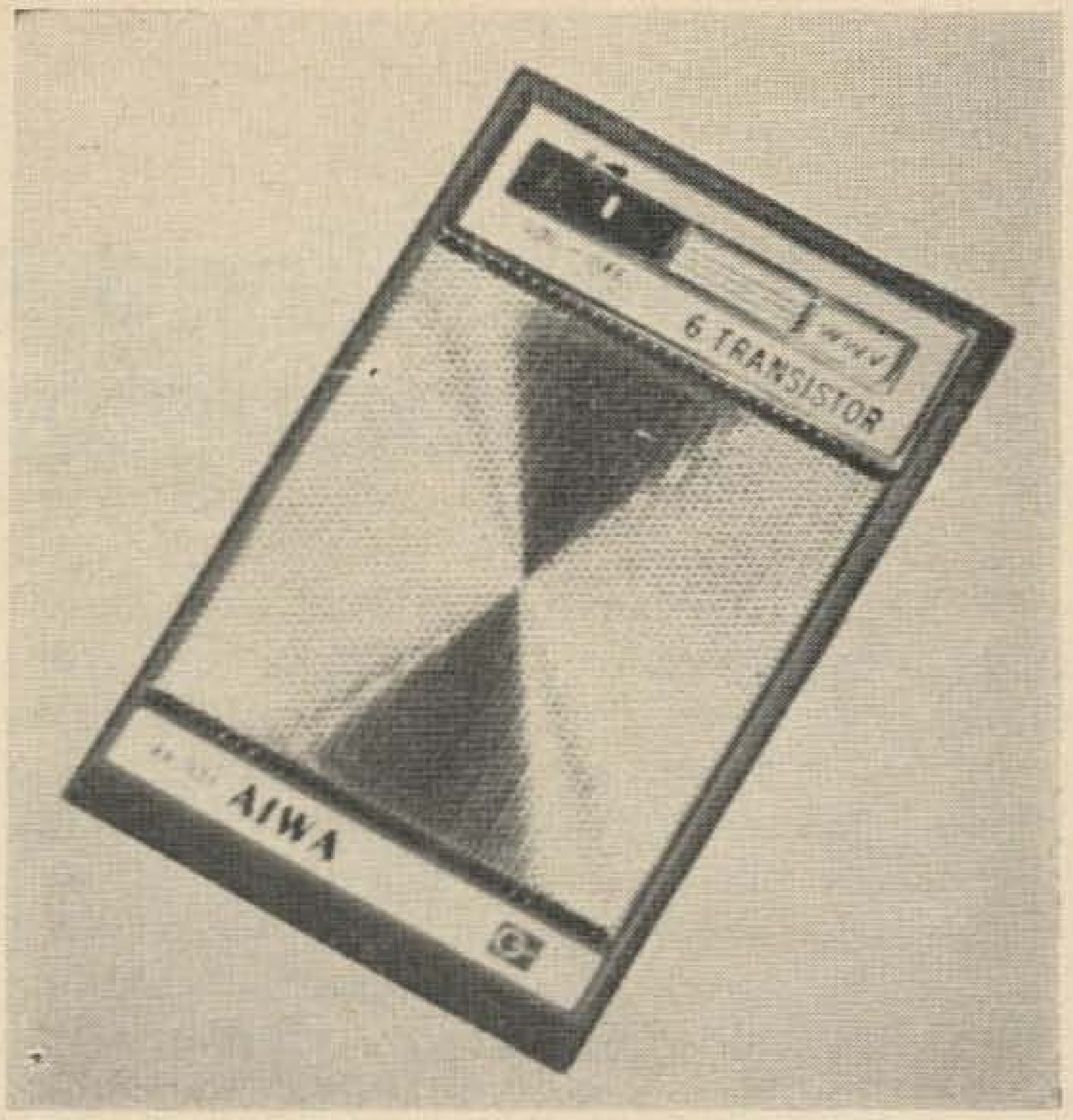
When the antenna coil dips at the right frequency, and perhaps after checking the oscillator frequency at 2.045 MHz, start taking turns off the antenna coil. Do not adjust the capacitor! Remove a few turns of wire and check the resonant frequency. Take off another few turns and dip again. Try to come up on the required 2.5 MHz by easy degrees so that you certainly do not overshoot.

After the antenna coil is modified to dip at 2.5 MHz, take a few turns off the link coupling to the mixer. The antenna coil and the link should be reduced by the same percentage: it should have worked out to a little over 30% reduction. Then remake the open mixer base terminal connection, and remount the receiver in its case. The modification is complete; only adjustment remains.

Warm up the signal generator, set it to internal modulation, and bring an unshielded lead from its output near the receiver. If its output is too strong, the following does not work very well; distance or a weaker signal is indicated. Tune the generator around the vicinity of 2.5 MHz to find what frequency the receiver is responding to. Having found it, retune the generator slightly nearer the desired 2.5 MHz but not quite out of the receiver passband. There are two tiny trimmers in the tuning capacitor; a small adjustment to one of these will center the receiver on the generator frequency. Readjust the generator still closer to 2.5 MHz and trim the receiver to frequency again. The little trimmers are capable of a surprisingly wide range of adjustment; it should not be necessary to adjust the main capacitor. Continue until the receiver is zeroed on the signal generator's 2.5 MHz.

The other trimmer is now known to be the antenna coil trimmer. Adjust it for maximum response to the generator signal. This nearly completes the job; only an on-the-air test is required. Early morning or evening is the best time for this, when signal propagation conditions are good but not so terrific the receiver's broad selectivity is overwhelmed by powerful transmitters adiacent to WWV. An external antenna should not be needed in central USA. If required, it can be coupled to the receiver by two or three turns of wire, large enough to slip the receiver inside.

Shortwave transmitters should be quite audible. Tune the oscillator trimmer up and down from its starting setting (check its position before making adjustments). When you have located WWV, peak it up with the antenna trimmer, and then zero in for strongest reception by adjusting the *if* slugs. No harm in this! Fixing the antenna and oscillator circuits to a single frequency has eliminated the strict conditions that must be met for correct



This receiver is fix-tuned to WWV at 2.5 MHz. Two small pieces of cardboard fill in the holes left by removal of the tuning dial.

tracking; you can now tune the *if* to any frequency you like. Vernier tuning in this way is very easy. When the receiver is zeroed in, the job is done. Replace the receiver's back—and it'll last for years.

Loose ends

As they are used in *if* circuits, transistors tend to cause regeneration. A close look at the schematic may show a tiny capacitor from the end of the tuned *if* winding opposite the collector connection right back to the base of the transistor. This capacitor feeds a small signal into the base circuit opposing the signal which leaks back through the transistor. If this capacitor is removed, the receiver may not quite go into oscillation. A very perceptible improvement in sensitivity results. Don't wreck the capacitor, you may want to put it back.

In some regions an external antenna may be required at any time to hear WWV. Sorry, I do not know how sensitive this receiver really is. If you are far from the transmitter, located in Greenbelt, Maryland and moving to Colorado, a more elaborate conversion to a large external loop may be in order.

I purchased a pair of these receivers. I haven't converted the other one yet; maybe it will make a good first and second *if* for an inexpensive tuner following a VHF converter. This should require one or two additional transistors, so that perhaps the tuner could be completed for $10 to $20. Look for this in a future article.

. . . W2DXH

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Streamlined Modulators for Transistor Transmitters

Presented here are two unusual methods of modulating transistor transmitters that rival the commonly used transformer coupled collector modulation technique in performance. While neither circuit is really new (they both have basic vacuum tube histories), the implementation to transistor circuitry is unique. Both of the techniques discussed streamline the modulator by eliminating the bulky modulation transformer and its attendant matching problems. Hence, the primary advantages of reduced size, weight, and power consumption gain by utilizing transistors are further enhanced by streamlining the modulation amplifier.

DC-series modulation

The compact, high quality modulation technique shown in **Fig. 1**, is termed dc-series modulation because the modulating transistor is in series with the final dc supply voltage. In this circuit, the modulating transistor is shown in the emitter leg; however, it is effectively varying the collector supply voltage. The emitter is used because proper voltage polarities are available for coupling the low cost pnp germanium audio transistor to the NPN silicon rf power device.

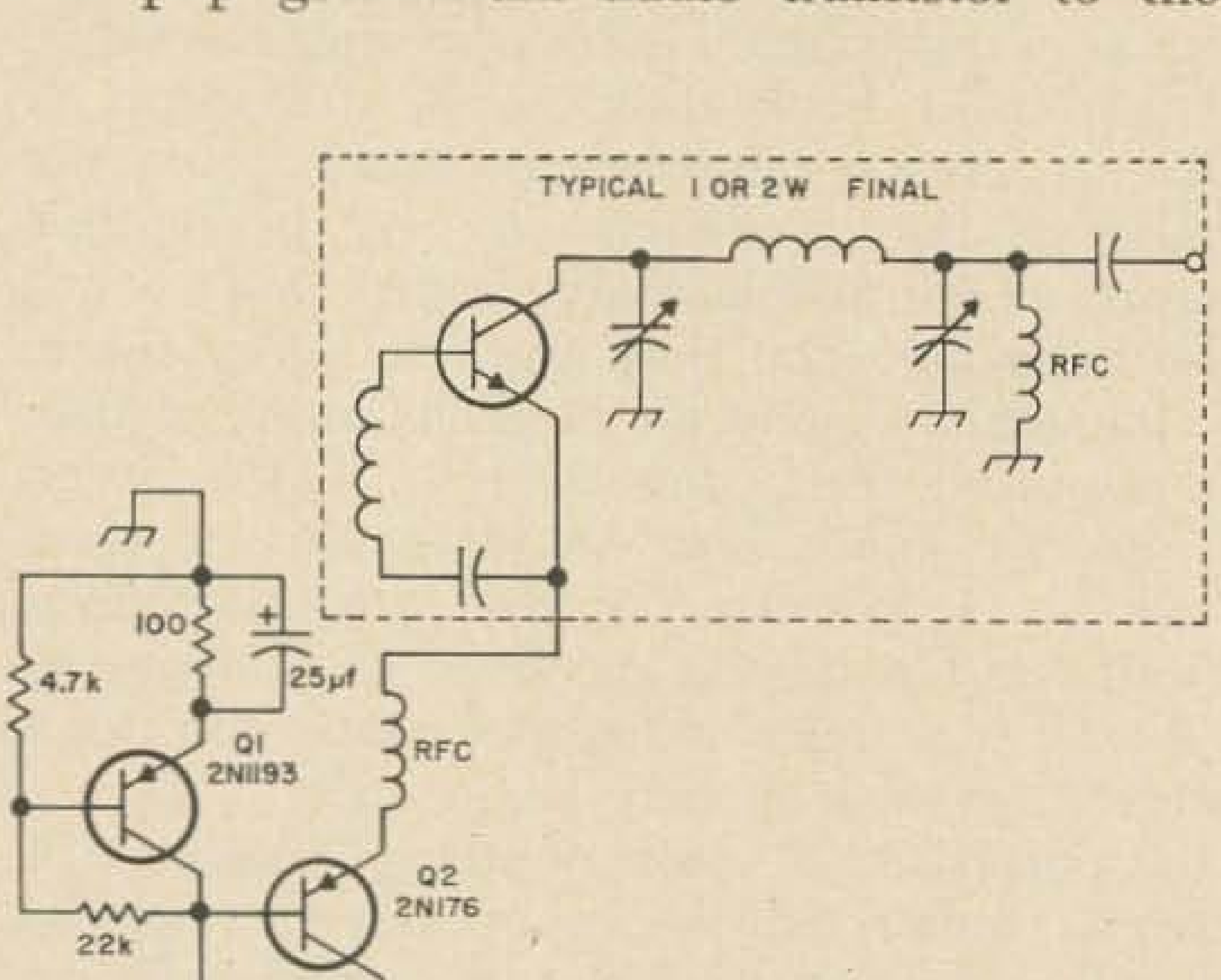


Fig. 1. DC series modulation of a transistor amplifier.

The components shown in **Fig. 1**, and, in particular the 2N176 power transistor, are intended for use with a low-power (1 or 2-watt) final; however, a power transistor with a higher current handling capability could be used in place of the 2N176 to modulate higher power transmitters. In which case, select a transistor with a high current gain so that it can be easily driven by the audio driver transistor.

The circuit works somewhat like a controlled carrier circuit. With no audio drive, the 2N176 modulating transistor is biased to furnish about ½ of the supply voltage to the modulated stage. Then, audio peaks drive Q2 to full conduction furnishing the entire supply voltage to the final. Likewise, the audio valleys cutoff Q2 reducing the voltage to the final to zero. Hence, the carrier power output is being controlled by the modulating signal and is varied at an audio rate.

There is one minor disadvantage of this modulation technique. As indicated on **Fig. 1**, twice the normal supply voltage is needed. The reason for this comes to light, when the standard transformer coupled collector modulation circuit is examined. Here, the audio peak-to-peak voltage supplied by the modulation transformer effectively changes the instantaneous collector voltage from zero to twice the supply voltage at 100% modulation. However, in **Fig. 1**, the modulator is not supplying any additional audio voltage, it is only controlling the supply voltage. Therefore, to get the necessary voltage swing, the supply voltage must be double that normally used for transformer coupled collector modulation. Like transformer coupled collector modulation, the dc-series modulating technique is also plagued with driver feedthrough. That is, due to capacitance effects, the drive signal feeds through on downward modulation; hence, preventing full down modulation. Thus, it is difficult to obtain 100% modulation unless the driver is also modulated.

The audio driver Q_1 is a conventional common emitter amplifier that provides about 20 dB of gain. Approximately 0.14 volt applied to the base of Q_1 gives full modulation. This drive can be obtained from one or two stages of common emitter amplification depending upon the microphone used. Q_1 can be almost any type of good quality pnp transistor.

Performance wise, the dc-series technique is superior to the conventional method since it yields a greater modulated power output, lower distortion, and overall transmitter current is lower. Moreover, in a comparison test a larger detected audio voltage was achieved (with a diode demodulator) from the dc-series modulated transmitter than from the same final when it was transformer coupled collector modulated. This is an important criteria considering that what really counts, in an AM system, is the detected audio.

RC-coupled base modulation

A second circuit, RC-coupled base modulation, shown in **Fig. 2**, also has performance capabilities that are competitive with the usual collector modulation technique.

In this circuit, the modulation is injected to the base of the RF transistor using two resistors, R1 and R2. The effect of R1 is to linearize the waveform which is excellent for values of R1 between 10 and 20 ohms. Negligible improvement in linearity is achieved for larger values of R1. Also, R1 should not be bypassed for audio because bypassing introduces negative current feedback in the final RF stage at audio frequencies. Resistor R2 can range between 100 and 2,000 ohms. Ultimately, the upper value of both R1 and R2 is determined by the available rf drive power because greater drive power is needed for larger values of resistance.

The effective load resistance, presented to Q_1, is essentially equal to R2. Therefore, to reduce modulation power requirements it is desirable to make R2 large. Thus, with these conflicting requirements some type of a compromise is necessary. Hence, the values given in **Fig. 2** represent a good compromise between linearity, rf drive power and modulation power requirements.

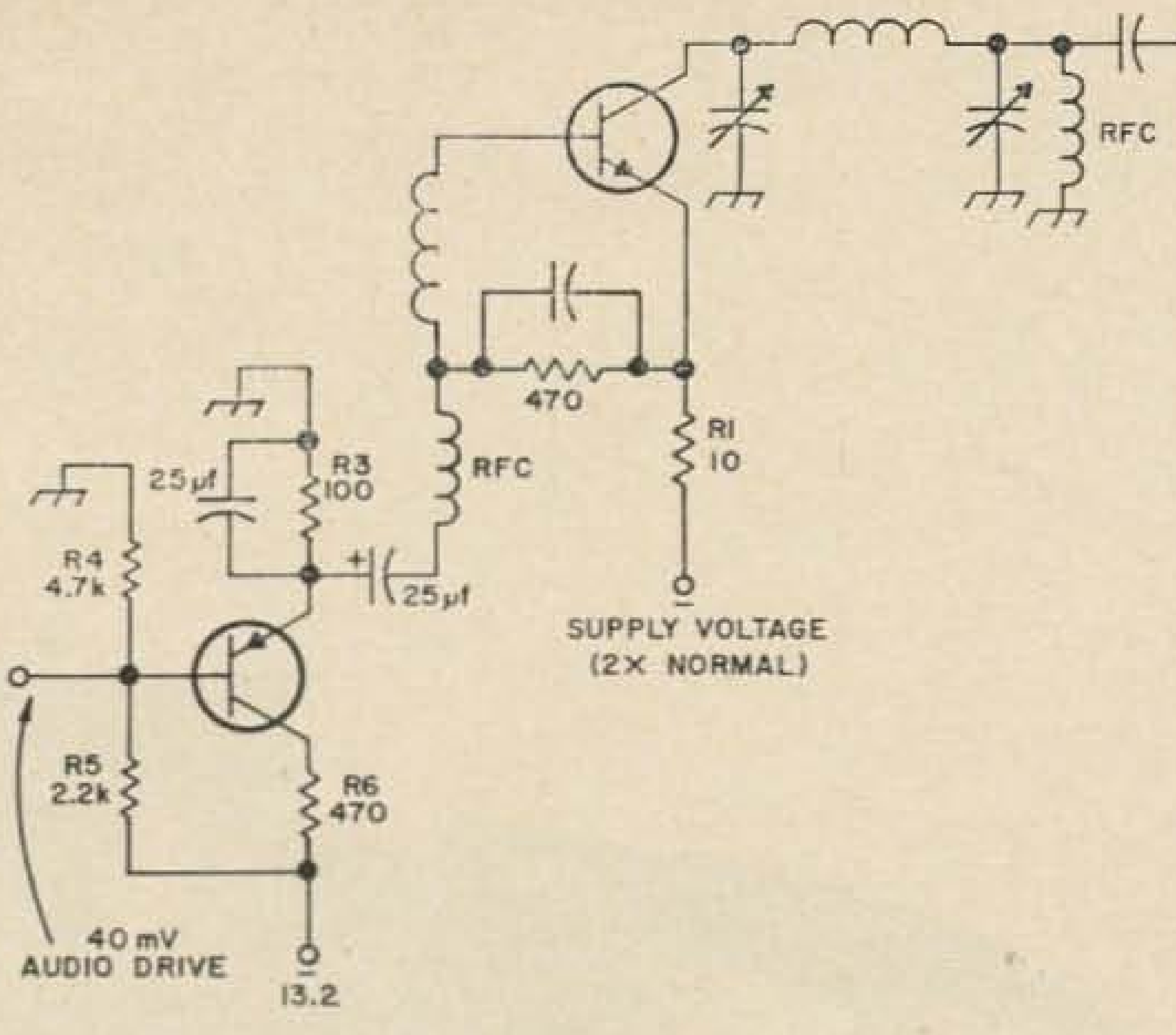


Fig. 2. RC coupled base modulation.

This rc-coupled base circuit yields excellent modulation characteristics because it has built-in feedback, and, it also prevents feedthrough which in turn permits 100% modulation to be easily achieved. A disadvantage is the higher power dissipation in the rf stage due to the extra drive discussed previously. Therefore, you may want to add a little additional heat sinking to take care of the additional power dissipation.

The audio stage Q_1 uses a small-signal, general purpose audio transistor in a common emitter stage. From the circuit components shown, an undistorted output of about 2 volts can be supplied to the base of the final with 40 mV of audio drive signal. This is sufficient to provide 100% modulation for a transmitter in the 1 to 2 watt range. For higher power finals, an audio stage capable of supplying a greater voltage swing should be used. Since the audio signal is being applied to the base of the rf stage, it functions as a common emitter amplifier for both the RF and audio.

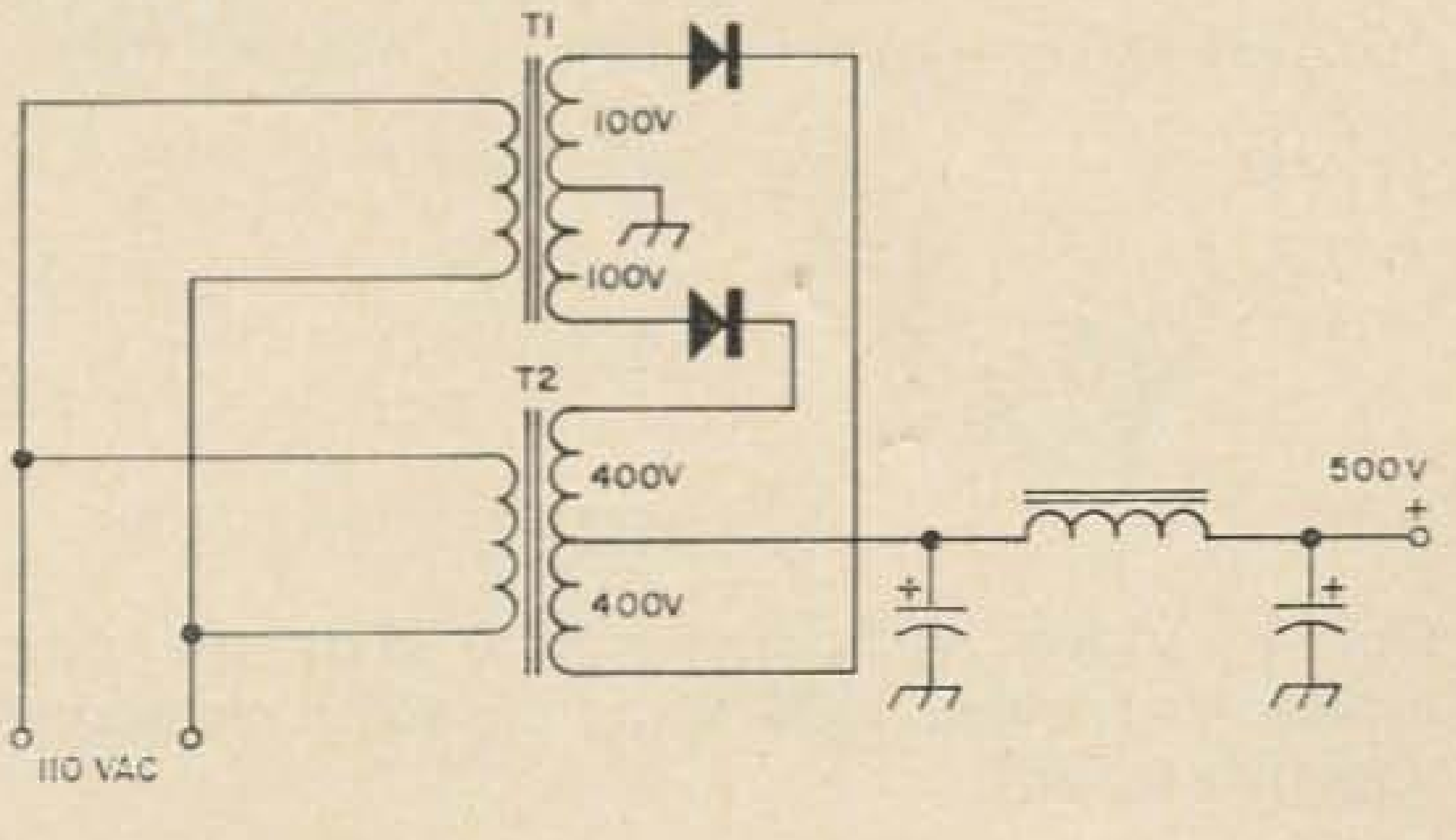
Why not try dc-series modulation or rc-coupled base modulation next time—they both perform well and do away with the bulky, expensive transformer that is difficult to match.

. . . Thorpe

Unlike CT Transformers

Usually unlike power transformers cannot be connected in series to obtain higher dc output voltages because no center tap is then available. This circuit illustrates a method of accomplishing this. The transformer on the positive side must have sufficient insulation to withstand the combined voltages. The primaries of course must be correctly polarized—if little or no output is obtained reverse the connections to either primary.

. . . Robert Kuhn WØHKF



Larry Will K3ADS
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Amateur Television— Let's Get Started: Part II

This article continues on with an introduction to setting up your ham TV station. It covers transmitters, modulators and antennas.

Now that the camera and receiving gear are working, it is necessary to assemble some sort of transmitter. While it is possible to use television on any amateur band above 420 MHz, as a practical matter most transmissions are in the 420 band. The 420 band provides the greatest coverage per watt and enables those already on the band with CW and phone equipment to utilize this equipment.

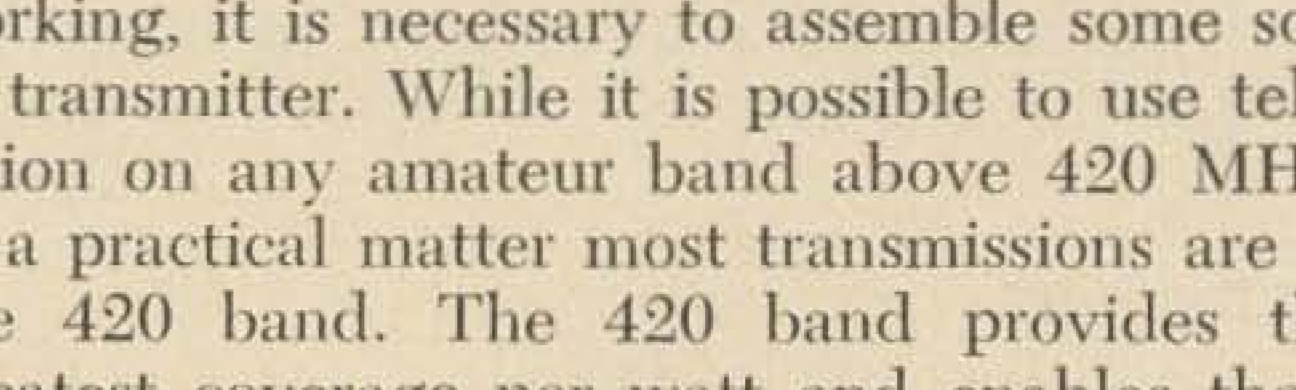

Fig. 1. Video modulation. Note that the sync modulates positive 15% while the video modulates negative to 88%.

The band is divided per a gentleman's agreement:

420-432 MHz	wideband audio stable
432-436 MHz	CW and audio
436-450 MHz	television

Thus the TV minded amateur has 14 MHz to use up.

The television modulator

In order to put the wideband TV signal on the carrier, a video modulator is necessary. The commercial standard is to use a bandwidth of 4.2 MHz for the picture information. This equals a horizontal resolution of about

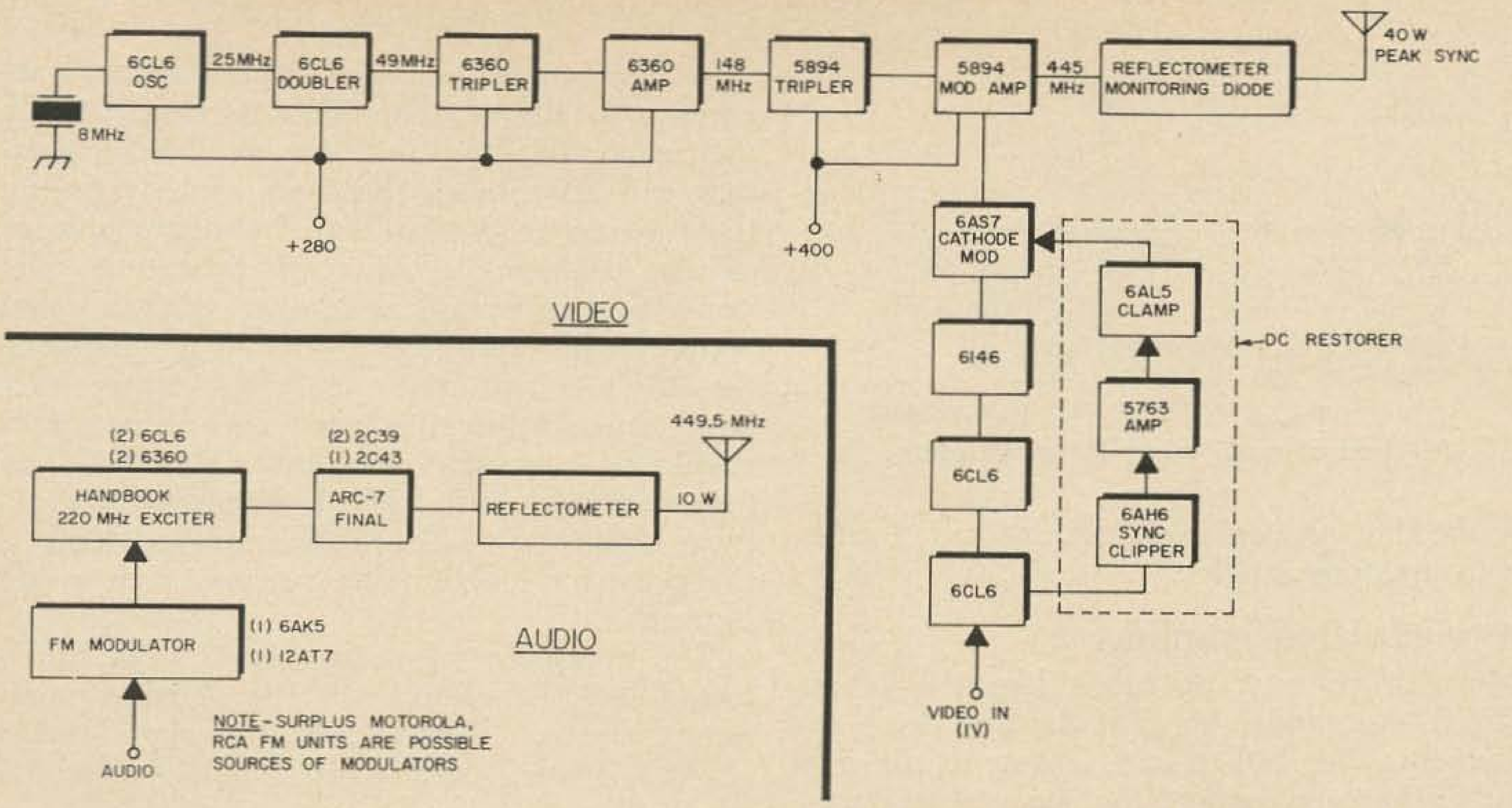

Fig. 2. Block diagram of the television transmitter used at K3ADS.

336 lines. This is an excellent picture capable of very fine detail. The average TV receiver, considering ghosting and other problems, normally will give a 250 line picture with a 200 line picture being entirely satisfactory.

Therefore to obtain a 200 line picture, the video amplifiers and modulator must have a bandwidth of at least 2.5 MHz. As a practical matter, a 2.5 MHz bandwidth is really easy to obtain. This wide bandwidth, however, results in amplifiers with low gain so several stages of video amplification are necessary. One of the most popular surplus modulators is the CRV series, originally used in a 250 MHz TV transmitter. This can be used to grid modulate tubes such as 5894 or 6939.

Most modulators for TV use grid or a combination of grid and cathode modulation. In AM work, this would be a poor modulating scheme, but in TV the modulation is essentially negative as per **Fig. 1** and therefore even though grid modulation is used, the tubes may be run at full CW inputs. Notice that sync modulates positive about 15% and that video modulates negative about 88%. More on this depth of modulation later. When using cathode modulation, the cathode must be grounded well for rf but not for video. Use good button bypasses of 10-40 pF.

The rf exciter

Fig. 2 shows a block diagram of the K3ADS television exciter. Two things are evident. First, the transmitter is a combination of units that have appeared in print. The low level exciters are the 220 units appearing in the older editions of the ARRL Handbook.[1] The visual exciter was moved to 144 MHz. In the visual transmitter, the last 6360 drives a surplus[2] Link 450 MHz FM final.

The other feature of this transmitter is the inclusion of an FM sound transmitter 4.5 MHz above the picture carrier. By sending audio along with video, the receiving station copies the entire signal directly on the TV set. Because of the narrow bandwidth of the audio channel, a power of only about 10 or 20 per cent of the visual power is needed, and the second 220 exciter drives an old surplus ARC 27 final to about 10 watts output.[3]

The video modulator used at K3ADS is a convertered commercial unit and due to the inavailability of many of the parts, I will not

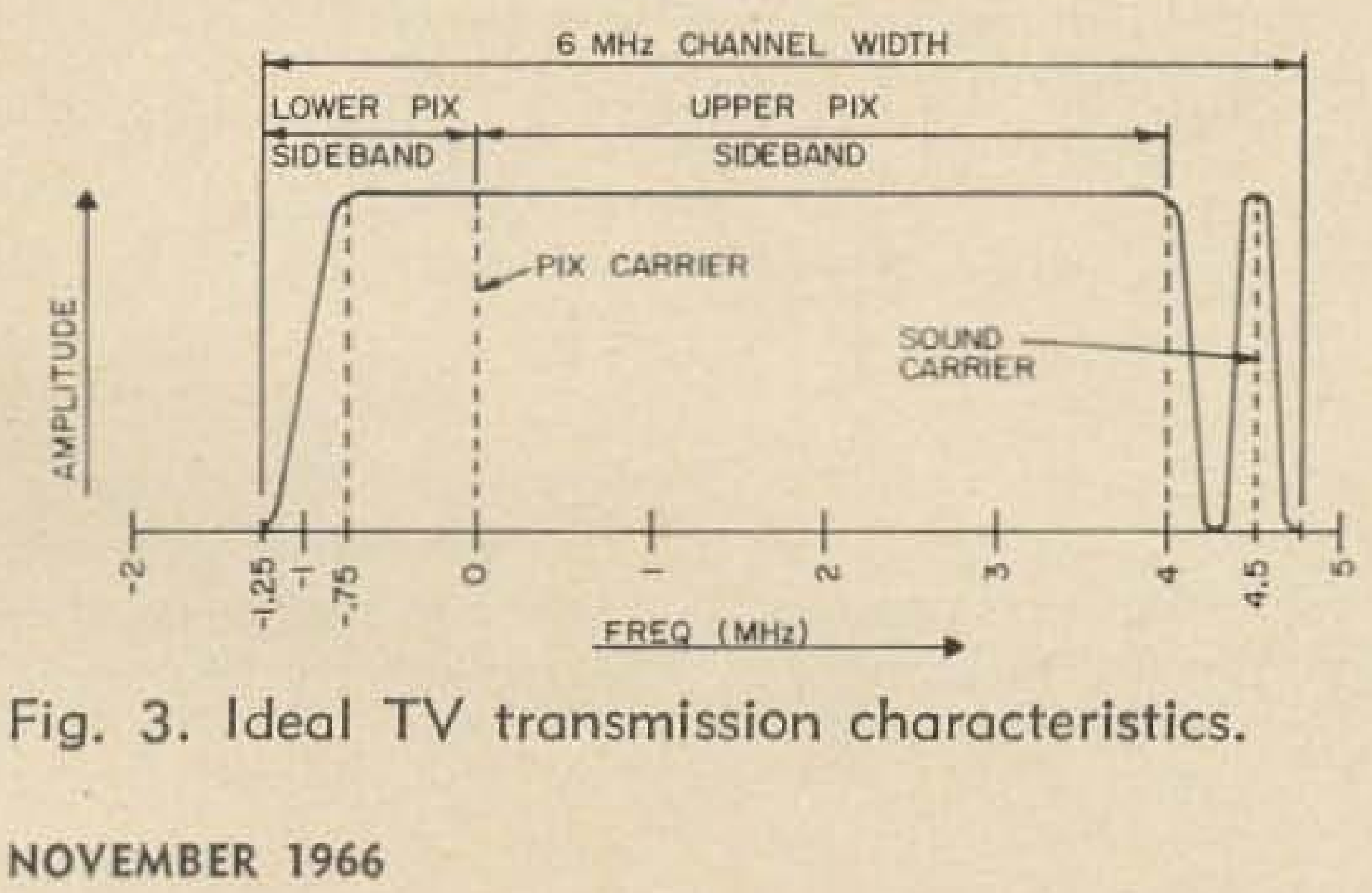

Fig. 3. Ideal TV transmission characteristics.

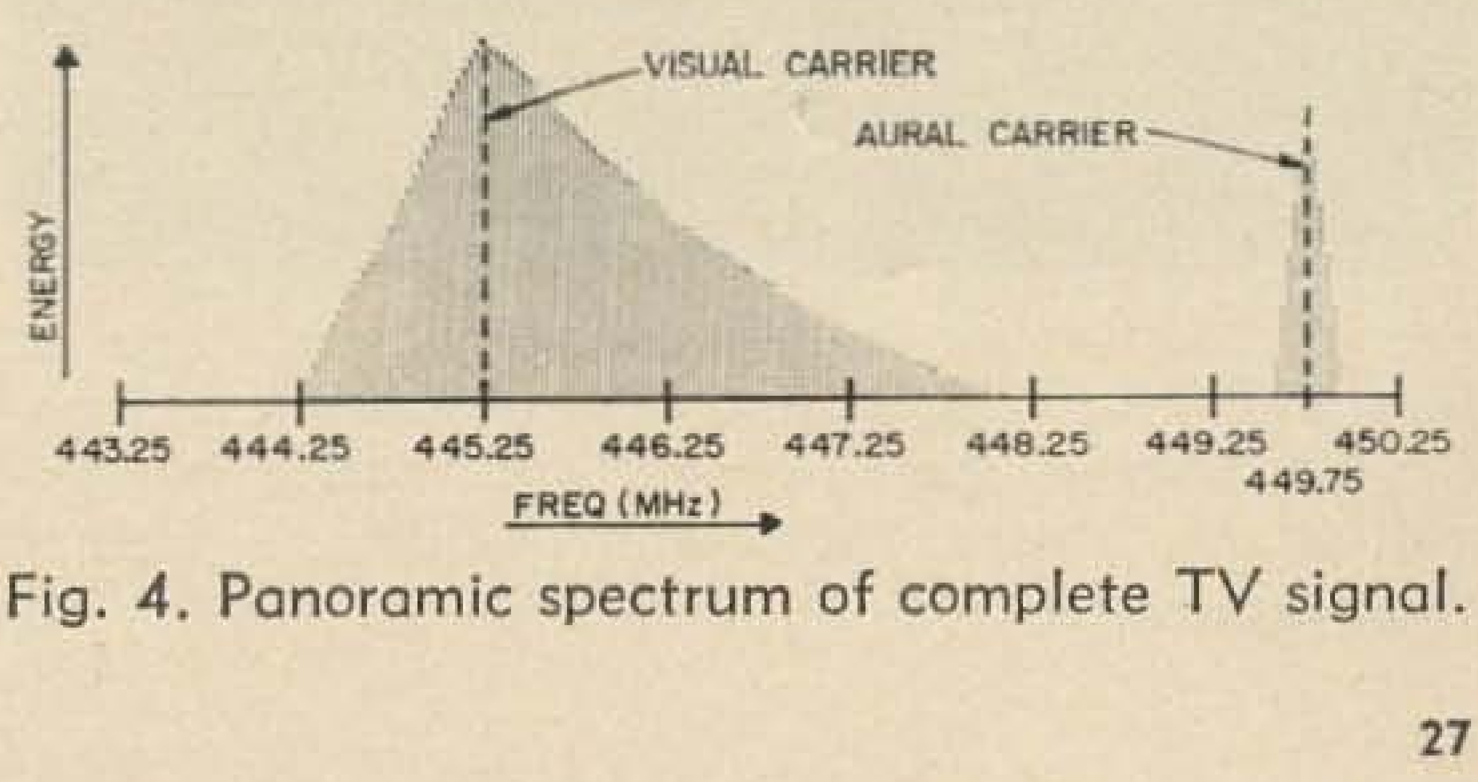

Fig. 4. Panoramic spectrum of complete TV signal.

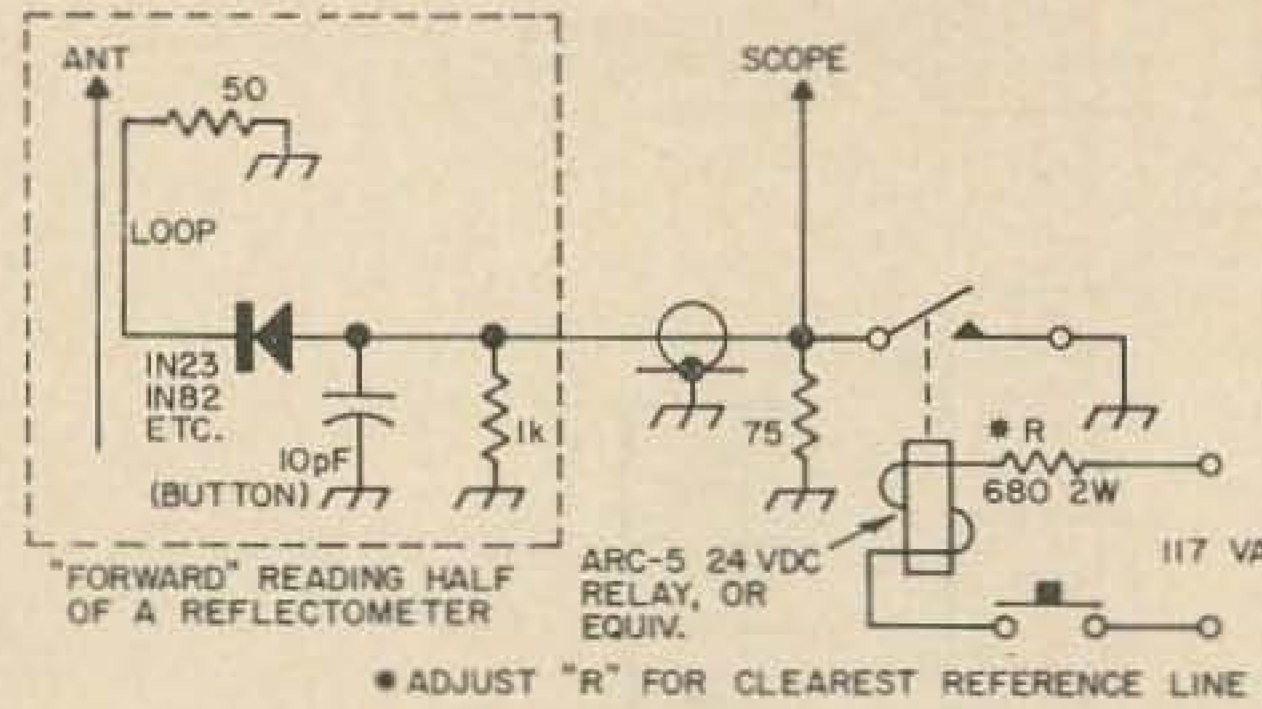

Fig. 5. Method of monitoring TV modulation.

describe that particular circuit. Instead, I refer you to previous articles.[4]

The modulated amplifier

Most of us look at tubes like the 5894, 4X250B, etc., and marvel at the low drive requirements. We fail to look closely at the fine print in the tube manual that says 'at frequencies above 175 MHz.' Looking there, one finds that the 5894 takes 13 watts of drive, and the 4X250B, 18 watts, at 500 MHz. In order to meet these requirements, the final amplifier should be driven by a tube of the same type. For example, do not try to drive a 4X250B with a 2C39A. The latter just doesn't have enough steam. As a rule of thumb, the driver stage should have a power *output* of *twice* the power drive requirements of the final to account for circuit losses. Be sure the tube operates properly as a CW amplifier before attempting to apply video. An rf wattmeter is useful here.

Bandwidth and vestigal sideband transmission

The AM modulation of the final with a video signal of 2.5 MHz bandwidth would result in an rf signal 5 MHz wide. In order to conserve spectrum, vestigal sideband transmission is used which attenuates the lower sideband according to **Fig. 4.** The filter necessary to do this is complicated and fortunately the amateur can accomplish the same end by tuning the transmitter on the high frequency side of carrier resonance. This will accentuate the upper and attenuate the lower sideband and actually will improve the received picture since the TV receiver uses mainly the upper sideband. In addition, the input and output links should be overcoupled to lower circuit Q and improve bandwidth. All these procedures reduce efficiency of the final amplifier. This is the price for high quality pictures. Use a big blower!

The complete television signal with audio would look something like **Fig. 4** on a panoramic receiver. Notice that the signal takes about 5.5 MHz with a small 'hole' below the sound carrier.

Modulation monitoring

Fig. 5 shows a video 'chopper,' the gadget used to measure modulation. It is simply a DC relay connected through a pushbutton to an ac source. The contacts alternately close and open across the video from a sampling diode producing a jagged line on a scope at 112 IRE* units as in **Fig. 6.** This line corresponds to 100% negative modulation. The positive modulation is of no problem as the transmitter only goes to plus 15%. The problem usually is overmodulation negatively as in **Fig. 8.** Note the clipped whites. On the screen, these clipped whites appear as indistinct bright areas, exactly as is the case when the beam control is too low on the camera.

The procedure in adjustment of the modulated amplifier is to adjust the video level, dc bias, value of the grid resistor, and drive to the final to obtain a trace similar to **Figs. 6 and 7.** A compromise must be reached between power and video. Too much power to the final (too little bias) results in overmodulation and distorted sync. Too little power input results in

*Actually, IEEE units, now, of course.

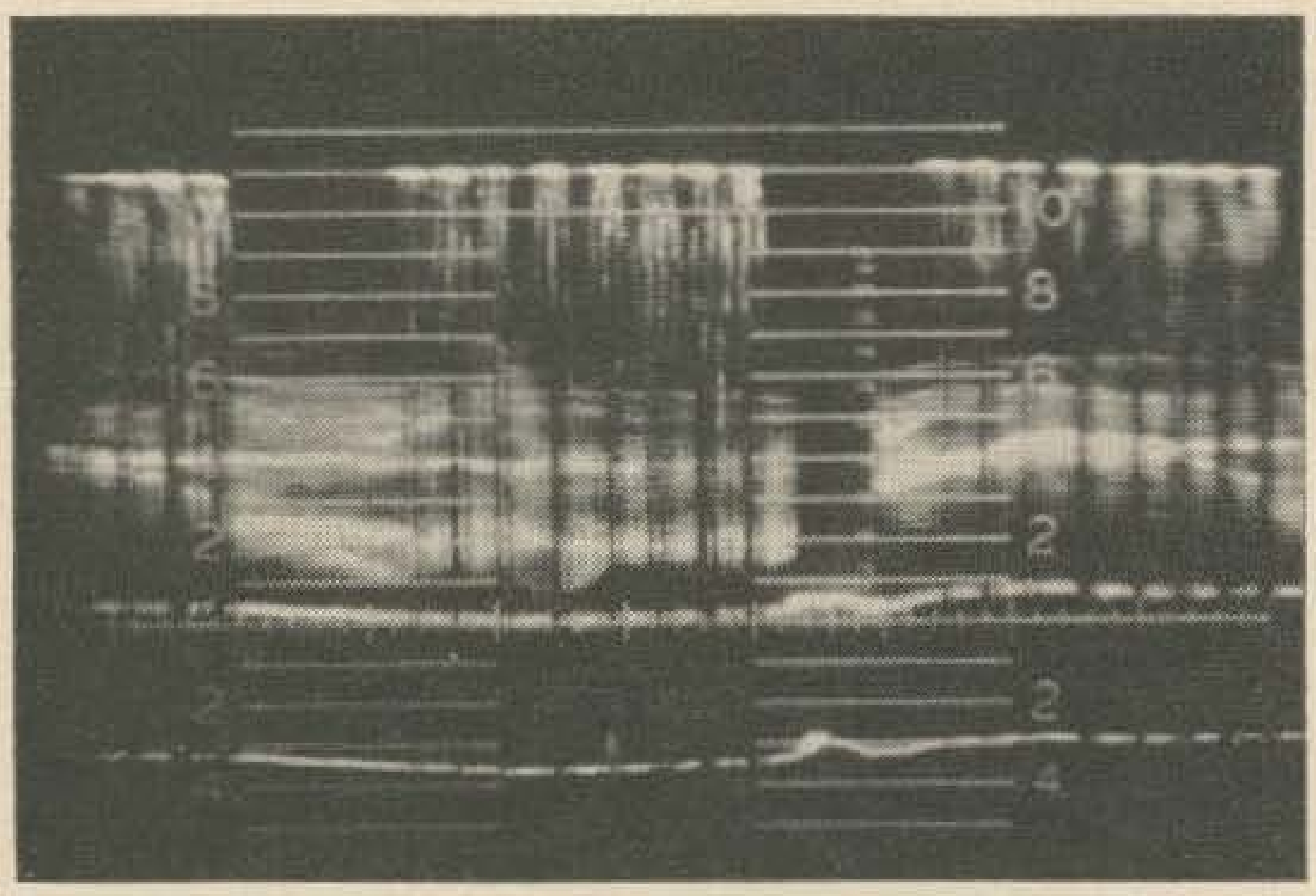
Fig. 6. Modulation monitoring. The white line at plus 112 IRE (IEEE) units is the chopper reference. On this picture, the percent of modulation is difficult to see. In use, the pattern is normally clearer than shown here.

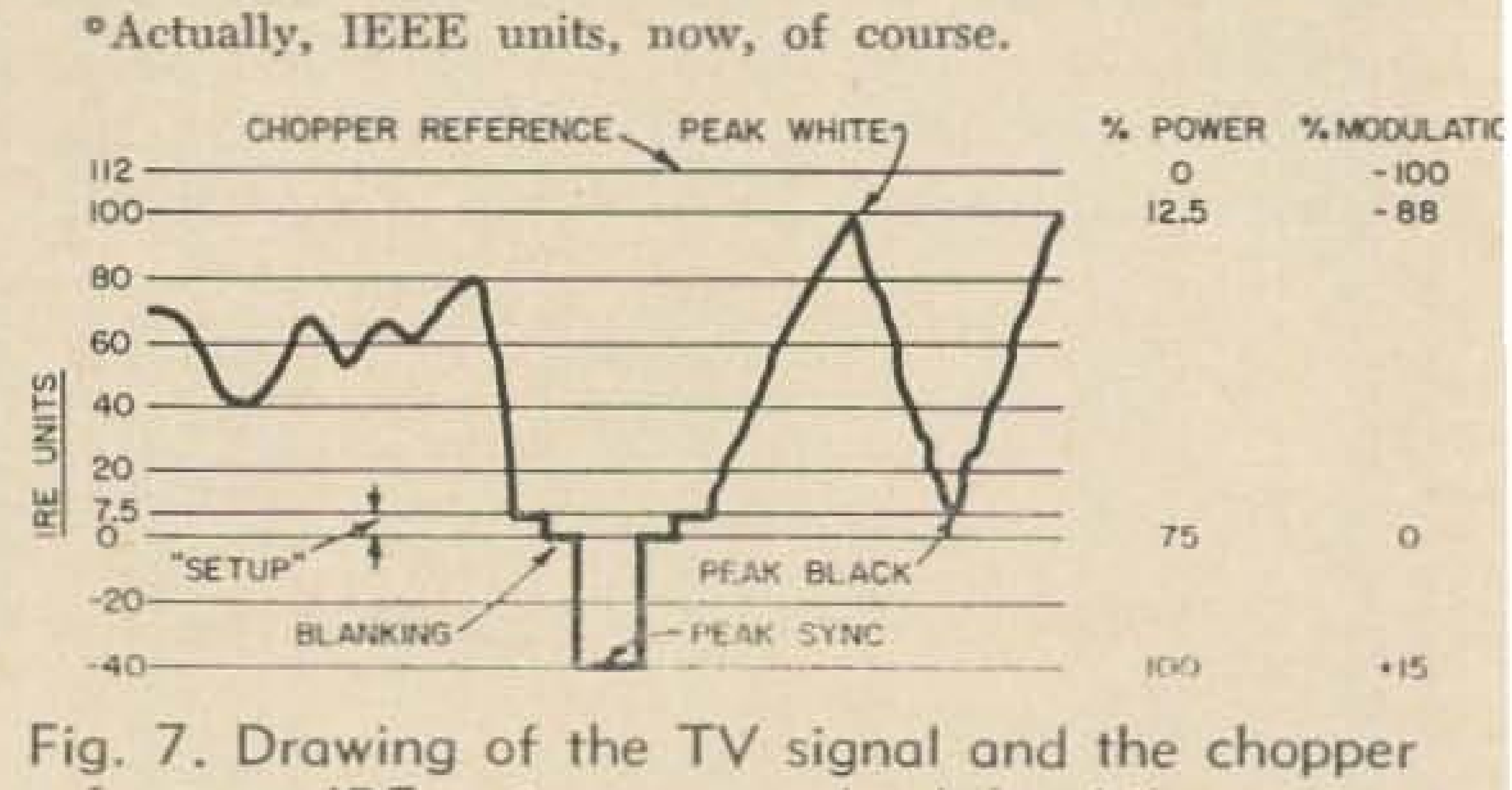

Fig. 7. Drawing of the TV signal and the chopper reference. IRE units are on the left while percent modulation and percent of power are shown on the right. In TV transmitters, power is referred to peak sync, not carrier level.

low modulation and a pale 'washed out' picture.

Problems

In the tuneup procedure, the scope should be moved alternately from the modulator plate to the monitoring diode. (**Fig. 5**) The video waveform should be identical at these two points. If the video at the modulator plate is not like **Fig. 7** (less chopper reference), the modulator should be checked for the same problems described under camera adjustment last month. If all is in order on the modulator, but the monitoring diode shows distortion such as clipped whites or loss of sync,) the power amplifier operating controls must be readjusted to obtain a good scope presentation.

One of the problems occurring in the amplifier is the loss of sync. This can be caused by low drive or too low a fixed bias on the amplifier. If bias is near zero, the video will invert and sync will go 'negative.' This condition is characterized by a violently jittering picture with white sync bars as opposed to the customary black when viewed on the picture monitor.

The most important trouble is clipped whites as in **Fig. 8.** We all have a tendency to overmodulate. I emphasize the need to limit negative video to −88 per cent. The teletail clue is the waveform of **Fig. 8** as seen at the monitoring diode.

rf in the shack

Some cameras are sensitive to 440 MHz energy. Rf feedback into the video amplifiers is possible at any stage but usually finds itself in the low level video amplifiers in the camera. It is characterized by a change in the picture as seen on the direct (not the off-the-air) monitor when the video level is brought up on the modulator. The picture can be completely wiped out if the feedback is great enough. The solution is to locate the camera away from the transmitter or to remove video amplifiers one by one starting at the preamp to isolate the defective stage. Small (10 pF or less) capacitors on the grid and plate of the culprit stage should remove the interference. An rf sniffer should be constructed to find hot leads. **Fig. 9** shows the one used at K3ADS. It is amazing how many leads that are not supposed to have rf, actually do. Adjust the pot till the bulb just lights when away from rf. When the bulb is placed near a source of rf it will become brighter usually turning purple instead of orange. Install filter networks of small 432 rf chokes and 100 pF capacitors on power leads showing rf. On coax cables between units, the match should be adjusted for minimum SWR

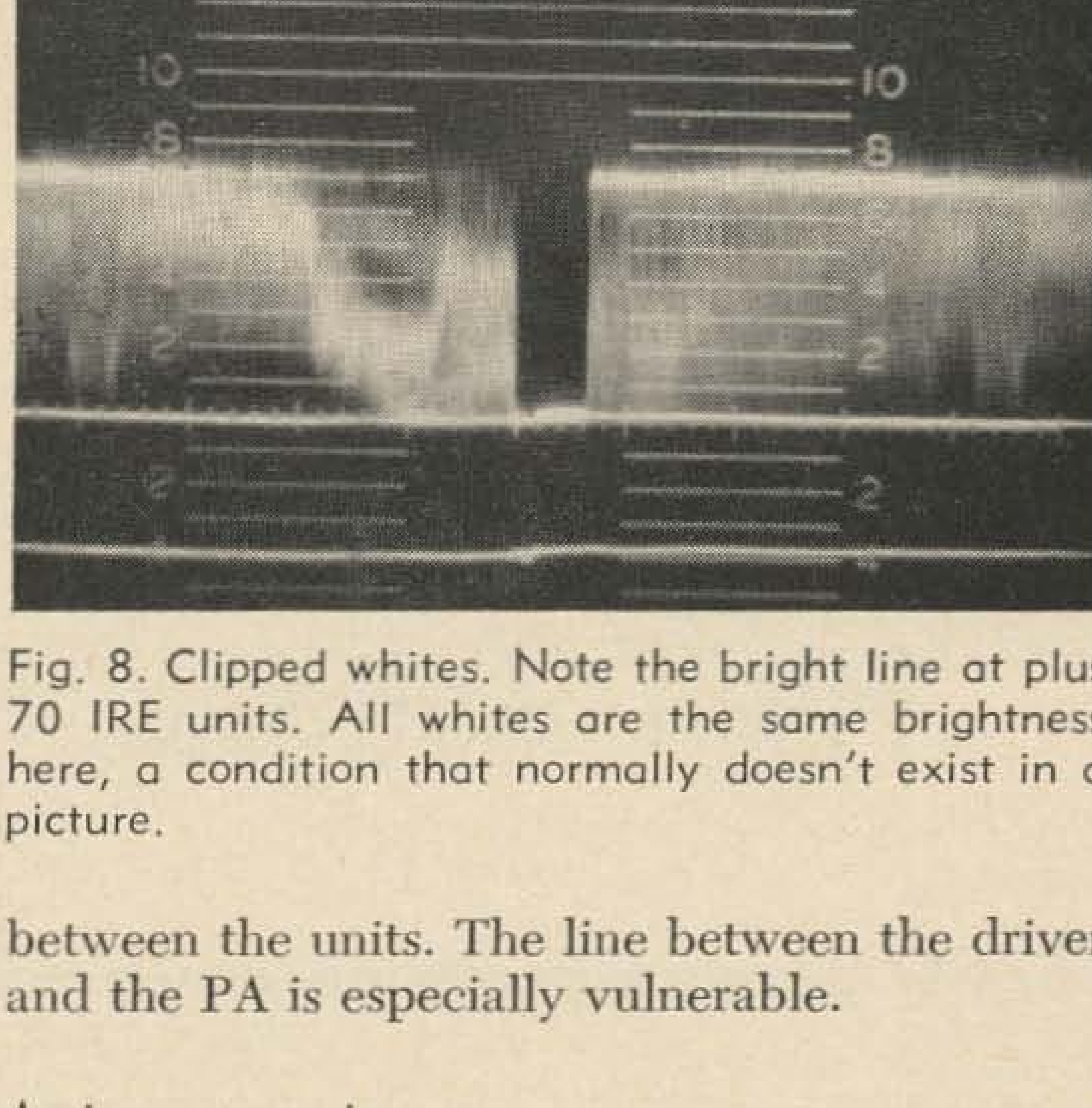

Fig. 8. Clipped whites. Note the bright line at plus 70 IRE units. All whites are the same brightness here, a condition that normally doesn't exist in a picture.

between the units. The line between the driver and the PA is especially vulnerable.

Antenna systems.

All that need be said is that all the rules for UHF antennas apply doubly for TV. Build 'em big and high. For a good TV picture, an S9 signal is needed. Most important is the match. A high SWR results in reflections that produce ghosts on the picture which cannot be eliminated at the receiving end. A UHF SWR bridge is a must.

Conclusion

I hope these articles will encourage those who have started a TV system to dig it out and get it working. Perhaps a few newcomers might get started. To paraphrase a familiar statement, "Come on down . . . to three quarter meters, there's lots of fun a waitin'." I wish to thank Larry, K3MKK, and Barry Cruise and Ross Kauffman, W3ZKU, for photographic help of these articles. . . . K3ADS

1. Exciter-Transmitter for 220 Mc.; 1958 ARRL Handbook p. 432.
2. Available from "Selectronics" Philadelphia, Pennsylvania.
3. W5AJF, Putting the ARC-27 on 432. December 1963, 73.
4. W8VCO, Video Modulator. October 1963, 73.

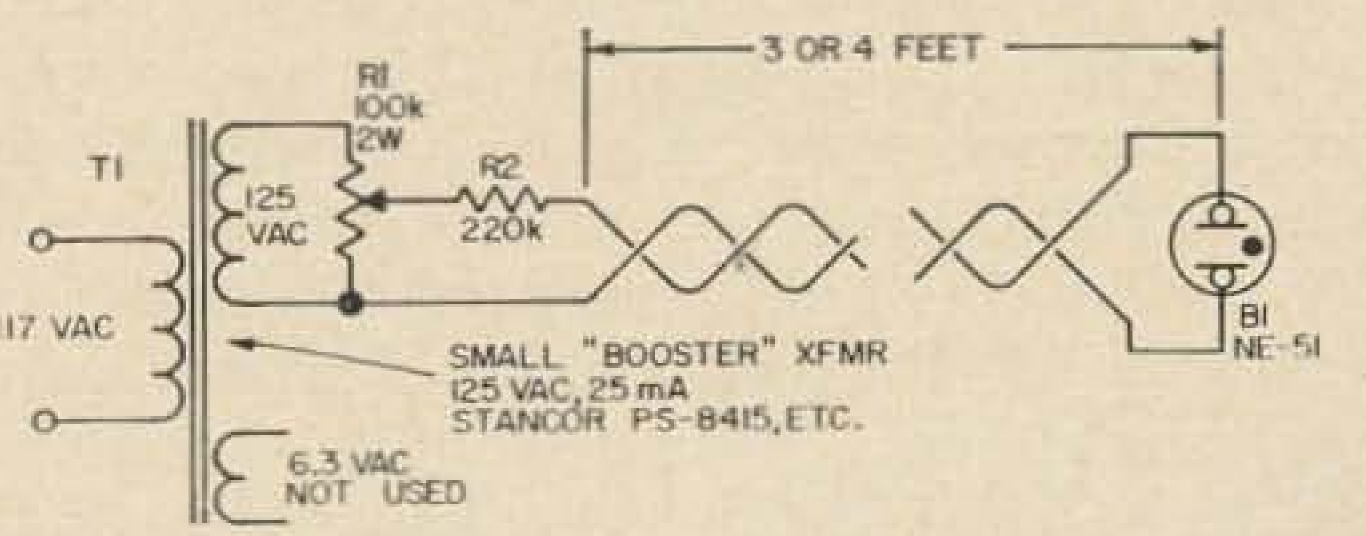

Fig. 9. Rf sniffer for cooling down a transmitter assembly. Shield the sniffer and be sure to insulate the bulb from high voltage.

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Some Thoughts on Designing High-Voltage Power Supplies

K6ZGQ takes a different approach to a power supply for an SSB transceiver.

A few months ago a new transmitter of commercial manufacture was acquired at K6ZGQ. This was a high quality unit, but came without a power supply, as do many medium-power transmitters today. As a consequence, the first order of business was to build up a source of the various voltages required for the rig.

The first thought was to build a power supply like most of those being used today; that is, pack all the power capability possible into a very small size, using every trick to reduce the size, weight and cost. After all, that seemed to be the newest trend in transmitter power supply design today, so why not follow the herd? But the writer being a conservative chap, it was decided to pursue a different line of design philosophy.

A few years ago most transmitter power supplies were heavy, bulky things. This meant that if you were a kilowatt class operator, you hired a separate truck for the power supplies when moving day came around. But those supplies did have one big advantage; they were much more reliable than the featherweight types seen doing the same jobs today. As a result, most users of this type supply didn't have to worry about an essential component going west just at the minute a rare DX station was finally snagged through a big pileup on 20. Further, the problem of replacing transformers, chokes and filter capacitors had to be coped with a lot less often. And a conservatively designed supply is a lot more forgiving of design errors than is the smaller variety.

So it came about that the author's 200-watt transmitter acquired a 100-pound monster for a power supply. To be fair, the expense, using surplus components from the pages of this magazine, was about twice what could have been accomplished using lightweight techniques. But this supply will still be operating long after a smaller supply would have been repaired, or even rebuilt, several times. And after all, why put a 20 dollar power supply on a transmitter that cost several hundred dollars?

This is really an idea article, not a construction piece. Let's face it, your components won't be exactly like the writer's, nor will your voltage and current requirements likely be the same. However, the schematic of the author's supply is shown in **Fig. 1** to illustrate two points. First, note that every component is operating with a large safety factor. Second, the choke in the high-voltage section is operating in a resonant circuit in conjunction with C_1. These two features are what make this supply different from most, and will be discussed below.

The resonant choke

Good voltage regulation is a prime requisite in a power supply to be used with linear amplifiers. For developing this good regulation, it is difficult to equal the choke-input filter circuit. Furthermore, the choke-input filter has other advantages. It tends to limit the peak current in the rectifier diodes, an important consideration when using high-voltage silicon rectifiers. And it allows the transformer to operate cooler than it would in a capacitor-input type circuit.

But there is one big problem when using a choke-input circuit in a medium- or high-voltage supply. That problem is that the bleed current necessary is usually quite high, unless you have lots of money to spend on high-inductance, high-current chokes. This means that bleeder resistors with a high wattage rating are necessary, and these cost money. Furthermore, and more important from a reliability standpoint, the large quantities of heat being generated by the bleeders tend to raise the operating temperature of the supply, and this in turn will reduce the life of the components.

For example, let's take a look at an 850 volt supply. The formula given in the handbooks for bleed current is (assuming a full-wave rectifier and a 60 Hz line frequency):

$$I_b = \frac{E_{dc}}{L} \qquad (1)$$

I_b = bleed current, mA
E_{dc} = dc output voltage
L = Choke inductance, henries

With a 10 henry choke the necessary bleed current would be 850/10 = 85 milliamps. This means there is 0.085 x 850 = 72.3 watts of heat being dissipated by the bleeder. That is a lot of heat! This constant current flow also tends to heat the transformers, rectifiers, and choke.

Some designs get around this problem by using a swinging choke; that is, a choke which has a lot of inductance at low (bleed) currents, and a much smaller inductance when the heavy load current flows. Unfortunately, this approach is usually not a good one for the amateur because swinging chokes are expensive, and not readily available on the surplus market. And, then again, most swinging chokes available commercially (at less than outrageous prices) still don't have sufficient inductance to cut the necessary bleed current down as far as is desirable. Still another problem with swinging chokes is their DC resistance, which is usually large enough to contribute detrimentally to the overall voltage regulation.

Fortunately, there is a technique (not original with the author) that gets around all these problems at the same time, although it adds some new ones of its own, of course. This technique is the addition of a capacitor across the filter choke to form a parallel resonant circuit. With a full-wave rectifier circuit and 60 Hz line frequency, we resonate the choke at 120 Hz, the first and most important ripple component frequency. The idea is to use a choke with a low-inductance, high-current rating. This will guarantee a low dc resistance. Then the capacitor is properly chosen to resonate the choke. The lower limit on the choke inductance is reached when the capacitor value required begins to approach the value of the output capacitor (C_2 in **Fig. 1**). Usually a choke of about 2 henries is used, although other values are fine, depending on what you have on hand. The required bleed current with the resonant filter then is:

$$I_b = \frac{E_{dc} \times R_l}{852L^2} \qquad (2)$$

E_{dc} = dc output voltage
R_l = Choke resistance at 120 Hz
L = Inductance of choke, henries
I_b = Bleed current, mA

Now, looking at this equation, it would seem a simple enough matter to measure the resistance of the choke and then, knowing the choke's inductance and the DC output voltage, to calculate the required bleed current. But here's the hooker (remember we promised you new problems): the value of R_l can be measured, but it isn't simply a matter of putting an ohmmeter across the choke. This is because the resistance of the choke at 120 Hz won't be the same as the dc resistance, the resistance that would be measured by the ohmmeter. Furthermore, the value of the choke's inductance tends to change, depending on the current through the choke. This variance makes it difficult, if not impossible, to calculate the best value of capacitance to be used in parallel with the choke.

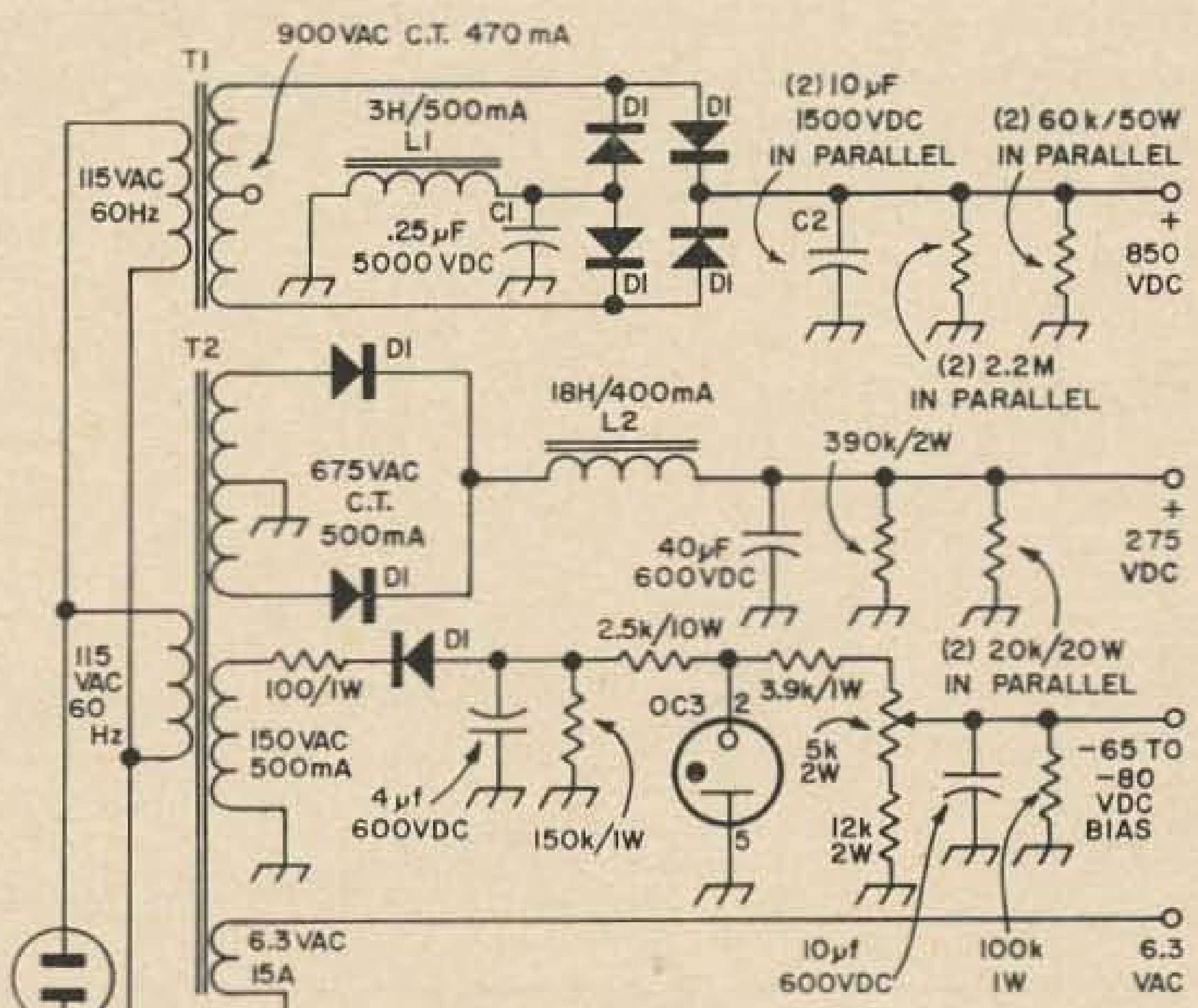


Fig. 1. Schematic of K6ZGQ's heavy duty transceiver power supply.

Once again, though, there is an answer to the problem. This time it involves what engineers call an iterative process (about the same thing amateurs call cut-and-try). Having selected the choke you will use, you want to know the proper bleed current and the proper size of capacitor to be used in parallel with the choke. Simply follow this four step method and you will come out with the right values:

1. Take a guess at what I_b should be, say 20 milliamps for each 500 volts of dc output voltage. Then calculate the size of the bleeder resistor, R_b. From Ohm's Law: $R_b = E_{dc}/I_b$. For E_{dc} use 0.9 times the total transformer rms secondary voltage if using a bridge rectifier or half this amount if using a conventional full-wave circuit.

2. Now haywire the circuit together, using R_b as calculated above. With reduced voltage on the primary of the plate transformer, say 40 volts, substitute different values of C_1, finally selecting that value that gives the *least* DC output voltage. With a 2 henry choke this will be about 0.5 microfarad. The right value of C_1 will probably be far from critical. Be sure to keep the primary voltage constant.

3. Now disconnect the bleeder resistor and measure the output voltage (continue using reduced primary voltage). Then gradually load the supply, measuring the output voltage and current at several points as the loading is increased. These points can then be used to plot a curve like that in **Fig. 2.** A good way to provide this variable load is by varying the bias on a spare transmitting tube hooked up as in **Fig. 3.** The plate dissipation rating of the tube may be exceeded as each reading is made, but if the supply is turned off between readings while the bias is reset, the tube will not be damaged.

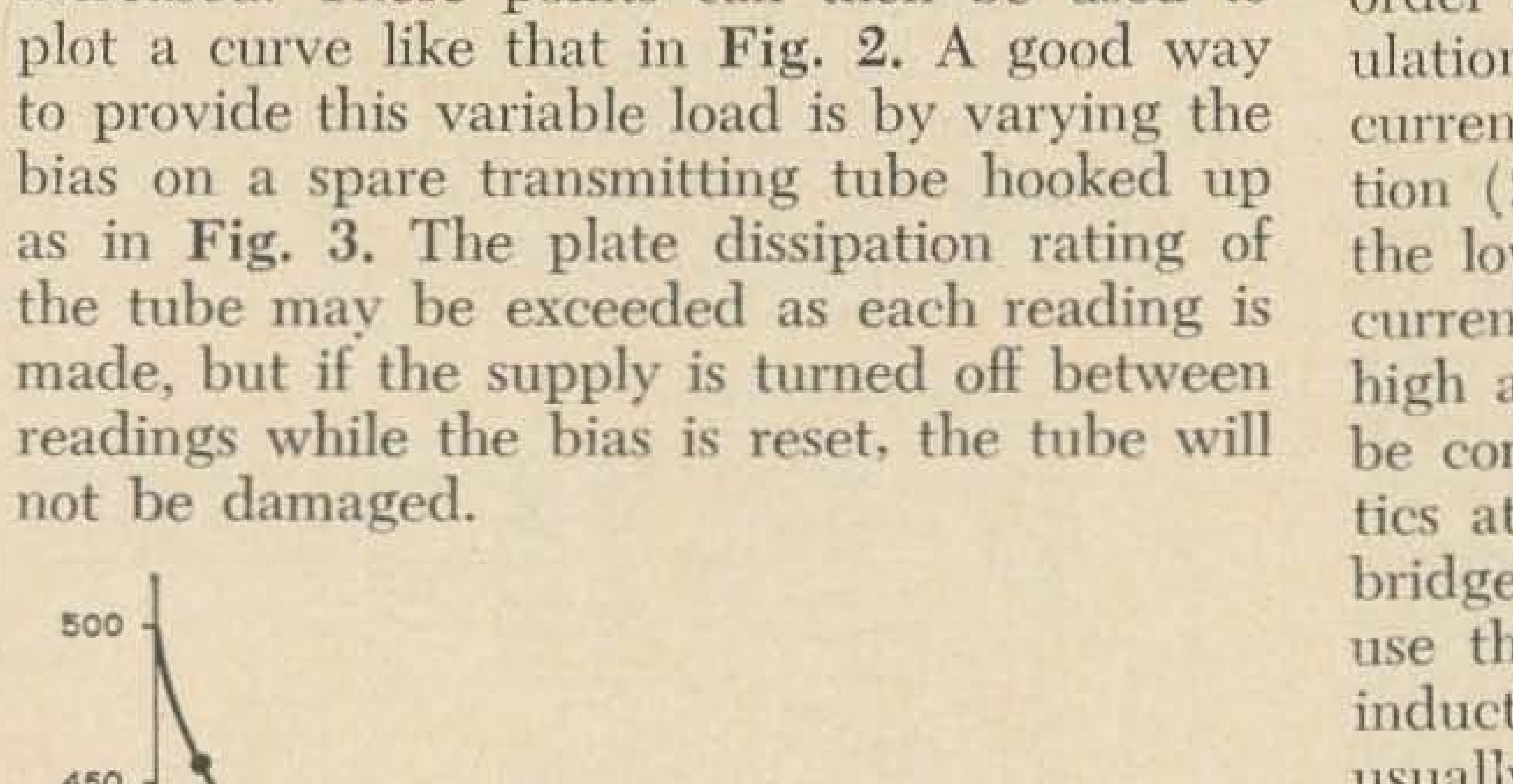


Fig. 2. Typical shape of curve that will result from technique given in step three in the text. Point X gives minimum allowable bleeder current.

4. The lowest allowable bleed current is that corresponding to point X on the curve in **Fig. 2**, that is, the point where the curve flattens out. Add about 30% safety factor to this value to get the proper bleed current, I_b. If the value obtained is very much different from that used in Step 1, use this new value and go back to Step 1, repeating the procedure. You will probably find it unnecessary to change C_1, if you do repeat the steps. And you shouldn't have to repeat the procedure more than once.

All this may sound quite involved and complicated, but it takes much less time to do than to tell about it. Be sure to observe sensible safety measures when performing your measurements. When substituting different capacitors for C_1 the working voltage rating can be any value greater than the output voltage, but don't use electrolytics. After the final selection is made be sure to use a high quality oil capacitor for this component, since the strain on it is great. The working voltage rating should be at least twice the dc output voltage.

The above process has assumed that you have already chosen the choke you will use beforehand. If a choice between two or more chokes is available, these facts should be kept in mind. First, it is desirable that the choke have as low a dc resistance as possible, in order to help provide good static voltage regulation. Second, it is desirable that the bleed current be as low as possible, and from Equation (2) it is obvious that the higher L is and the lower R_l is, the lower the necessary bleed current is. Thus, the ratio L^2/R_l should be as high as possible. If necessary two chokes can be compared by measuring their characteristics at 120 Hz on an inductance bridge. If a bridge is not available, the only recourse is to use the choke with the higher ratio of rated inductance to rated dc resistance. This will usually provide the proper choice between two chokes, and it has the advantage of pro-

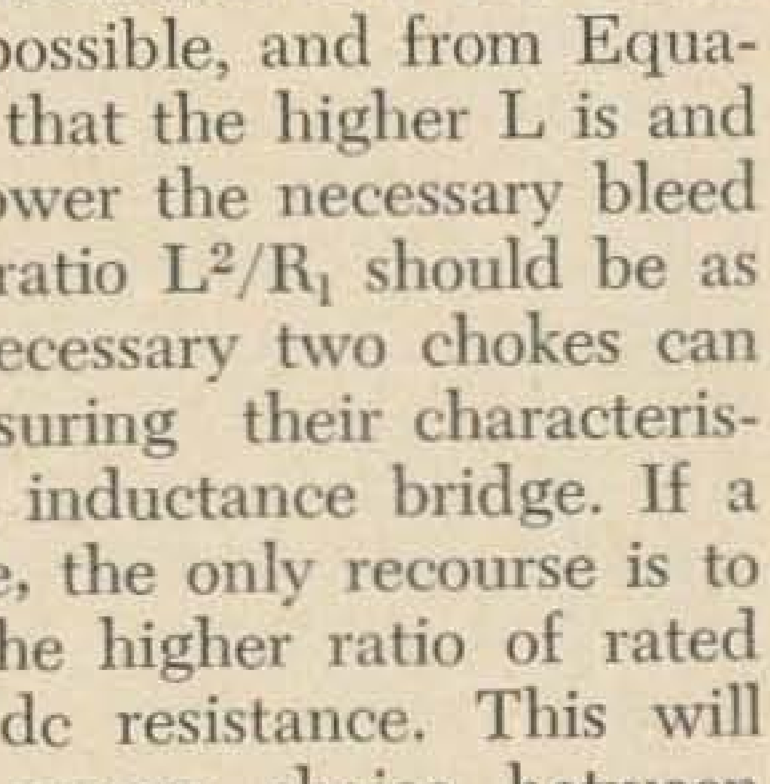


Fig. 3. This circuit shows a simple approach to providing a variable resistor for testing a power supply. Tetrodes can also be used by connecting the screen to the plate through a 10,000 ohm 10 watt resistor.

viding a choice between chokes you don't have yet—the ones in the magazine advertisements.

The reduction in bleed current that can be achieved by this method of parallel resonant filters is truly amazing. In the writer's supply the bleed current in the high-voltage section is only 28 milliamps, and this with only a 3 henry choke. And with a choke this small, it is a simple enough matter to find one with a very low DC resistance.

So now we have licked the only big problem in a choke-input design. Let's look now at this business of conservative design.

Reliability

To provide reliability in an electronic design, each and every component must be operating well within it's ratings. This means using components that have higher ratings than might seem necessary at first thought. Why do you suppose the military surplus components you buy are larger and heftier than their commercial counterpart? Because the military *must* have reliability and this requires components with a fat safety factor. (This helps make military surplus today still a big bargain in electronic components, too.)

Let's look at each type component individually and how it is selected for reliability:

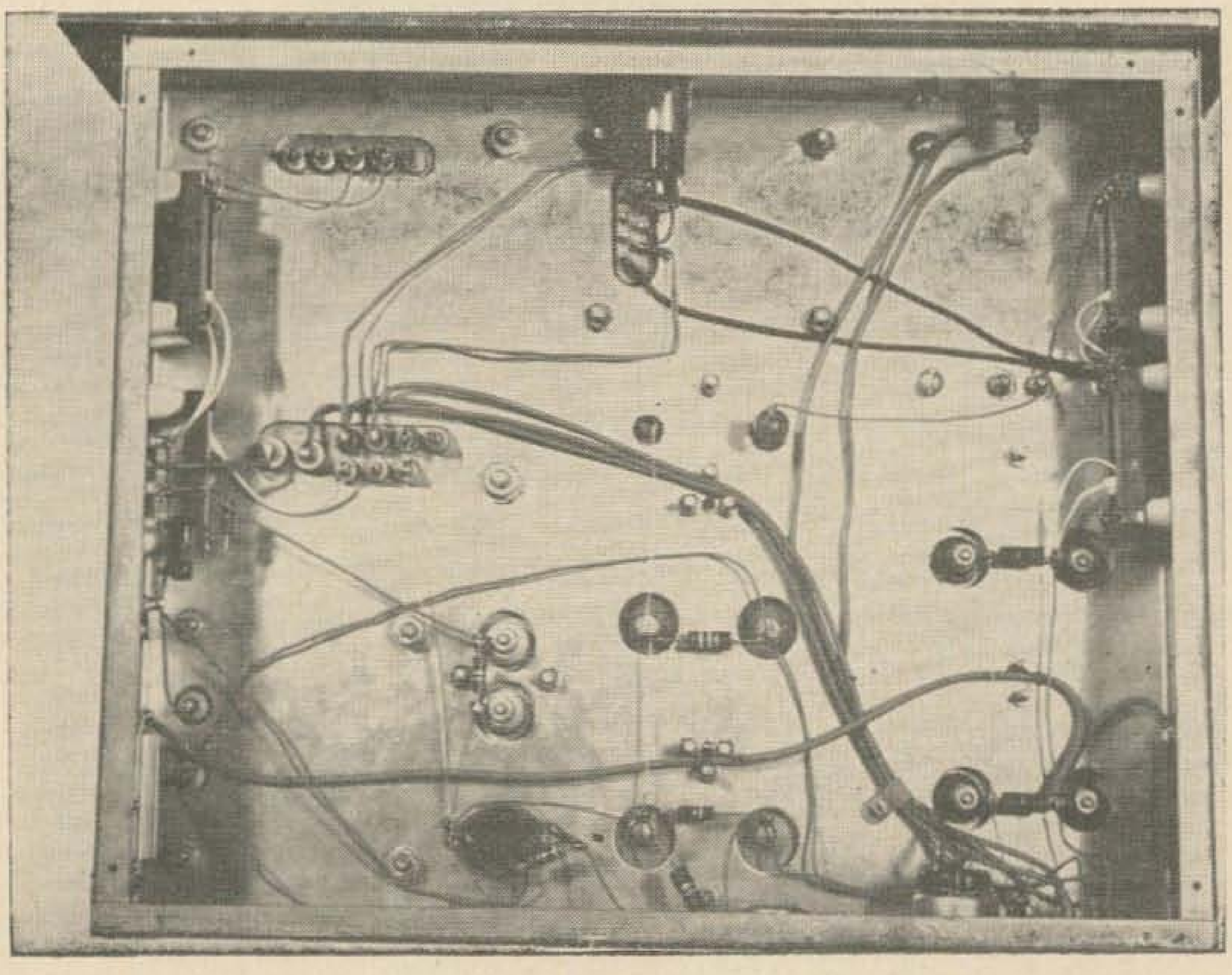
1. Transformers and chokes. These are fairly simple, it's just a matter of using components with a higher current rating than the minimum necessary. In the author's supply all the chokes and transformers have a current rating 50% higher than normal.

2. Rectifiers. Silicon diodes are the thing today. Read up on their use in back issues of this magazine. Then choose units with at least 50% higher peak inverse voltage rating than the minimum necessary. The current rating isn't quite as critical, but a hefty rating in this department is a good idea, too. The author's supply uses some beautiful military surplus units rated at 3000 piv, 200 milliamps. These are a genuine bargain available from a recent advertiser in these pages.[1] Be sure to mention 73 when writing to surplus dealers.

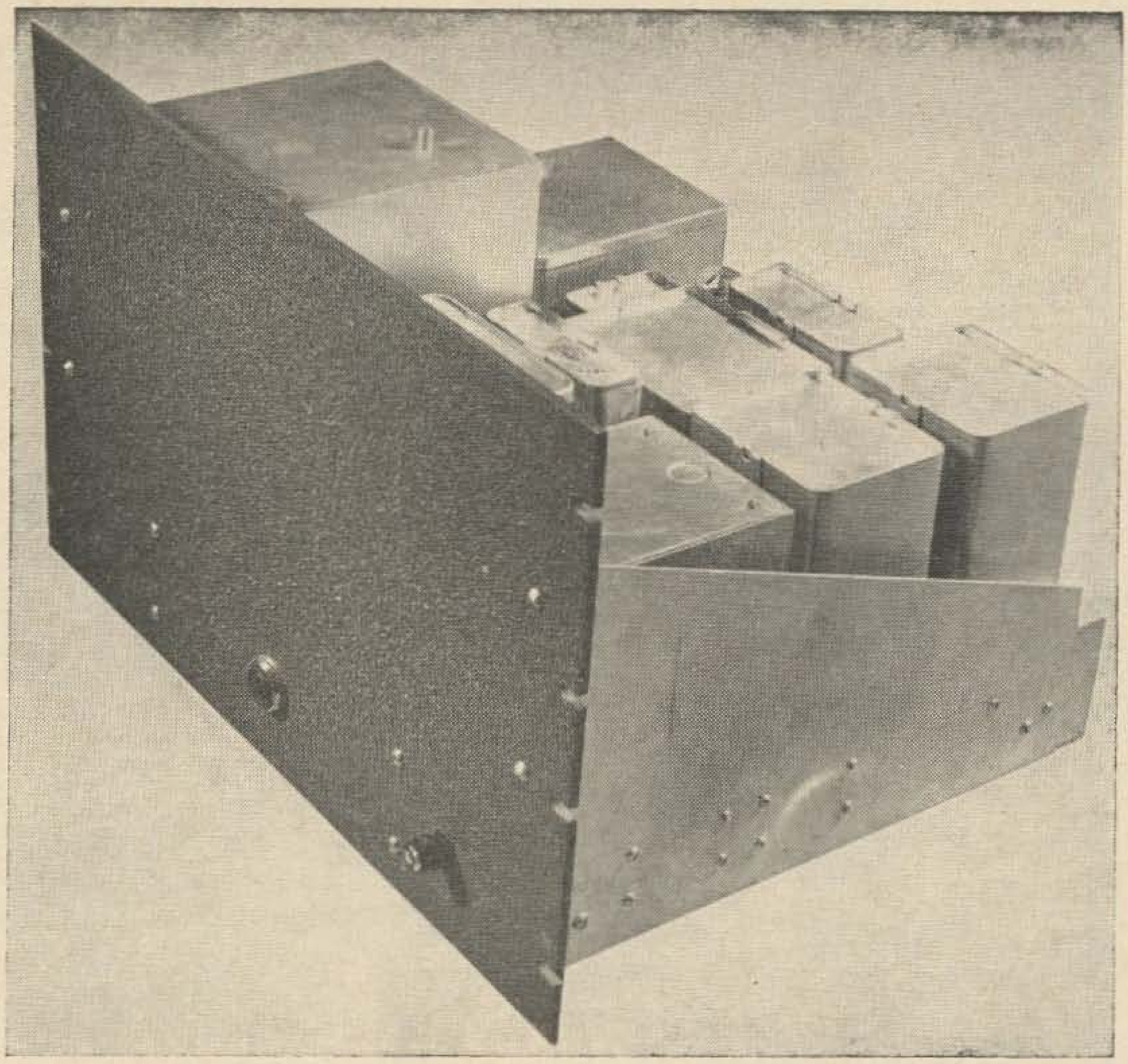
3. Capacitors. If you want reliability it is absolutely necessary that you use oil capacitors in your supply. Electrolytics just don't have very long lives. Follow the lead of the military and use oil capacitors with at least a 50% safety factor in working voltage rating. Oils are available in surplus at very reasonable prices these days.

4. Resistors. Heat and high temperatures are major gremlins in electronic equipment. In resistors, high operating temperatures limit component life severely. Consequently, resistors should have at least 3 times more wattage rating than the amount of heat they will be called upon to dissipate. This will reduce their operating temperatures considerably, and greatly increase their life. Also, note that in the writer's supply two bleeders are used in parallel, rather than a single one. This is so that if one fails in operation, there will still be some bleed to keep the output voltage from increasing sharply and causing components in

[1] Electronics Components Co. Box 2902D, Baton Rouge, Louisiana, 70821.



Underside of K6ZGQ's power supply. Components mounted on ceramic pillars on the chassis sides are the silicon rectifiers. The thick wire near the rear of the chassis connects the two high-voltage bleeders.



K6ZGQ's power supply. The transformers, chokes and capacitors have been brushed with aluminum paint for appearance.

the transmitter to fail. Also, it allows the bleeder to be divided into two parts. The two resistors are physically as far apart as possible, further reducing the operating temperature. Note that small resistors are used directly across the terminals of all filter capacitors. This is a safety precaution.

5. Fusing. To protect the rectifiers and other components a fuse with medium-blow characteristics should be used, with a current rating that is only slightly greater than that required for operation under normal conditions. Start with a small fuse and if it fails under the normal load, use the next higher current rating.

6. Note that in the high-voltage section, **Fig. 1,** the choke and parallel capacitor are in the negative lead, between the rectifiers and ground. This is to avoid having the high voltage on the choke, reducing the chance of insulation breakdown in this component.

Conclusion

This article was written for the amateur who prefers to "roll his own" in power supplies. The attempt has been to point out some facts about reliability in design that seem to have been avoided in current amateur practice. Building reliability into a design may cost a little more but it will pay off in the long run due to greatly increased life and reduced maintenance expense.

Although resonant chokes aren't new (the Henry 2-K and some Collins supplies use the idea), to the author's knowledge this article marks the first time that a fool-proof method for their use in homebrew equipment has appeared in an amateur journal.

Try the techniques outlined in this article in that new supply you're planning and gain for yourself the advantages of the choke input filter coupled with reliability.

. . . K6ZGQ/6

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VHF Antennas

Some hints gained from years of roof scrambling

About 42 years ago, the writer built a 1¼ meter parabolic beam antenna on the roof of an engineering building at college and has been climbing roofs ever since that time. There is a great fascination in building and testing VHF antennas and I suppose, or hope it will continue for a few more years. Nowadays it always means a sore back and legs for a week after each antenna test and pole raising effort, plus some scolding by my wife. At the moment I'm recovering from some stiff muscles after putting up a new 24 element 220 MHz antenna without assistance. Some thoughts pass rapidly through my mind that I'm too old to be roof scrambling, but as usual I bury that with some new ideas for repairing my even larger 432 MHz beam antenna next month, or as soon as I can obtain a couple of feet of Teflon rod for phasing line insulation. Teflon insulators are wonderful dampness-effect eliminators. I should really be making some changes or improvements in my three 144 MHz beams, some of which have been up far too long, perhaps 2 or 3 years. That is a long, long time for a dyed in the wool experimenter to leave a VHF antenna without a few changes.

Perhaps a summary of a few of the countless antenna tests that I've made, would help clarify some of the problems for others. The problem of which is better, yagi or curtain-type beams, always comes up. Curtain, or broadside, arrays always have a wider frequency coverage than arrays of yagi antennas and are generally easier to get into proper operation. Yagi arrays can be made with fewer elements for up to about 15 dB gain. Above that figure, large broadside antennas may have actually less antenna elements than equivalent arrays of yagis. When a person wants as much as 18 or 20 dB gain a large broadside array of from 64 to 128 elements may be easier to build and adjust than equivalent yagi arrays.

In terms of signal capture area or actual antenna gain, a great number of long yagi antennas will have no more gain than big broadside array. As the area spreads out for signal capture, the array depth becomes less and less important. The big broadside with thin depth may often wind up with more signal gain than long yagi arrays with great depth and "optimum" spacing. That word "optimum" is awfully hard to obtain in practice since director elements in a beam generally react unfavorably with adjacent broadside directors in other yagis.

Several years ago the writer made some tests on 1296 and later checked out again on 432 MHz. Various lengths of yagi antennas, adjusted for best forward gain into a field strength device with very low SWR on the transmission line were set up. The power into the transmission line and SWR were kept at a constant value by readjusting the matching stub and feeder taps whenever one or more directors were placed in the field broadside to the yagi. It is a time consuming job and took many days of work to check out some results. Even a single director element spaced out to the side (or sides for two) of from $\lambda/2$ to λ, produced a drop in forward gain. On the other hand, reflector elements spaced out about $\lambda/2$ always added to the forward gain when in the plane of the antenna element. Reflector elements can "work together" without losing gain whereas director elements usually do not. This occurs because a short element (director) tends to pull the field out in a direction away from the driven element more or less in a forward direction with respect to the director position. It means that any directors off to the sides, such as in two yagis, causes some loss in the desired forward gain. The expected 3 dB power gain for two yagis or 6 dB for four yagis is very difficult to realize. If the yagis are spaced far enough apart to pick up 3 dB forward lobe gain, the minor lobes become very large and the forward lobe begins to look like a cigar shape. The array may not be held in correct position in a strong wind.

It is better to have a fairly broad forward lobe for this reason. Strong side lobes mean undesirable noise and undesired signal pickup. "Noise" means all sources other than receiver internal noise.

Any two or more driven elements in a broadside beam (reflector and driven elements only) tend to produce objectionable "side" lobes as the spacing is increased much over $\lambda/2$. At λ or greater spacings the side lobes are horrible. Yagi arrays are usually spaced from λ to 3λ to avoid director interference effects and the side lobes are apt to be objectionable. If the spacing is reduced to about ⅝ λ, the side lobes are small but the forward gain may only be increased one or two decibels as the number of yagis are doubled. A good beam antenna should always increase 3 dB in gain as the number of elements is doubled, without increasing the side lobe problem.

One way of getting the desired 3 dB added gain for double the number of elements or rather double the area of beam dimensions, is to use closer spaced, short yagi antennas. The final end result in very high gain arrays, is that a driven element and a reflector will equal the results with a short yagi for each antenna unit. The short yagis of 8 to 16 in number can be used to advantage in fairly high gain arrays. Often four long yagis can be used to advantage for antennas with gains as high as 15 to 17 dB.

Scaling down proven long yagi designs from 144 to 432 MHz usually doesn't work out very well. The directors cannot be made ⅓ as small in length and diameter, spacing and boom support material. A variation in any of these items can make a 432 MHz yagi with low gain. Lots of work goes into the design and construction of a good 432 MHz yagi. The excellent one designed by Ed Tilton (*QST*, April 1966) with eleven elements checked out at about 12 dB gain on west coast antenna measurements. Four of these could be expected to produce around 17 dB gain. This is about the same as could be had with 32 extended length and spacings in a broadside array or 64 elements in a standard $\lambda/2$ length and spacings. The 44 elements in the four long yagis are intermediate in number as compared to the two broadside arrays.

Short or medium length yagi antennas can be made without reflectors and with a gain of about one decibel more than a standard yagi on the same mounting boom length. These yagi antennas are known as director beams since no reflector element is needed. The front to back ratio of lobes is similar to that of a standard yagi and may often be superior. The forward side lobes are quite similar to the standard yagi. The spacings for maximum gain between yagis is about equal to the boom length or higher, whereas the standard yagi spacing is usually from ¾ to 1 times the boom length. **Fig. 1** shows the forward gain which can be obtained from a single yagi of both designs. These are about maximum values which can be obtained in practical designs and it is very easy to get much less gain. It can be seen that the two curves begin to approach each other for long yagis.

Stacking two yagis in broadside will give from 2 to 3 dB more gain, with the smaller gain values occurring for smaller broadside spacing. The forward side lobes are always less for smaller spacings and usually a spacing of ⅝ to ¾ of the boom lengths, with only about 2 dB added forward gain, is worthwhile since the undesired lobes are much smaller and the forward lobe is broader. End stacking of yagis does not seem to be as critical, and close to 3 dB gain is obtainable with ¾ or greater length spacing. This holds true for any yagi design. Four yagis in a square configuration normally will add about 5 dB gain over a single yagi.

Broadside arrays generally use $\lambda/2$ lengths and spacings with a set of reflectors spaced .2 to .25 λ behind each driven element. The curves of **Fig. 2** indicate the approximate gain for the usual 4, 8, 16 and 32 driven element arrays with two sets of lengths and spacings. The ¾ λ spacing curve shows higher gain but it has greater forward side lobes and a sharper front lobe. For a given number of driven elements (and similar number of reflectors), the wider spacing and greater lengths add up to more capture area, and higher gain. Values from the curves show about 12 dB for an 8 driven element array of 16 elements for the usual lengths and spacings. The extended version has about 15 dB gain in a forward direction. Both arrays would use 8 reflectors of the same length in either design. The driven $\lambda/2$ elements are actually about 5% less length than the reflectors. In any case equal length phasing lines to all driven elements, can be

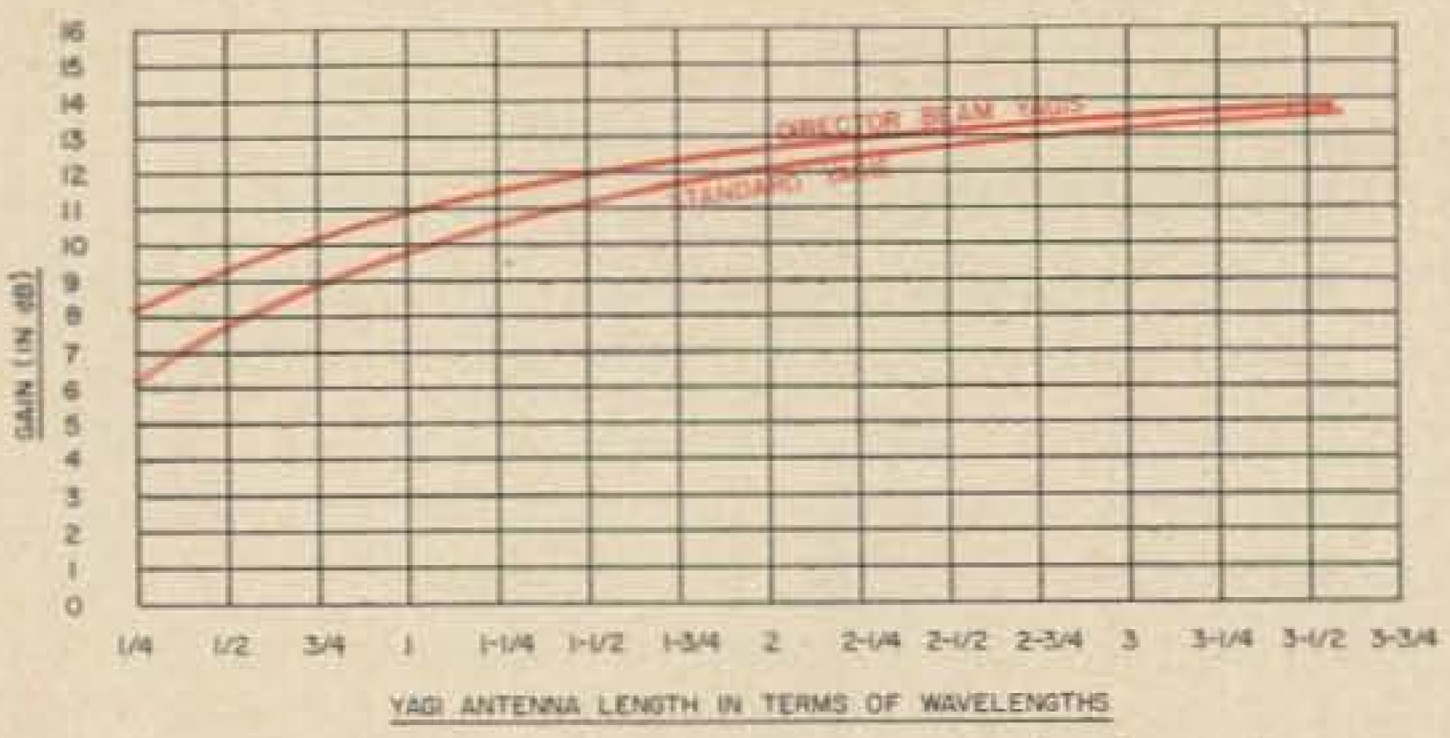

Fig. 1. Forward gain versus length for director beam and standard yagis.

made resonant and the whole array tuned to the desired band of frequencies with a quarter or half wave tuning stub at the common junction of these lines.

Three examples of practical beam antennas are shown in **Figs. 3, 4,** and **5.** These antennas have been in use at W6AJF for several years. The relatively small director beam of two yagis in **Fig. 3** is actually half of a larger beam which was cut in two in order to have a vertical and a horizontal 144 MHz beam on the same pole. The original square configuration had about 15 dB gain. Now each beam has about 12 dB gain but both polarizations are used in this area, so two beams are needed. This is a director beam with no reflectors and each yagi has about 10 dB gain. Two in broadside with relatively small spacing provides between 12 and 13 dB forward gain. An advantage of this beam is the simple feeder system, one phasing line and one tuning stub which can be either an open stub roughly 20 inches long or a shorted stub about 40 inches long. The latter is desirable as it can be grounded to the tower at the center of the shorting wire for added lightning protection. A 27 inch λ/2 balun and coax line connection can be made at point "C" in **Fig. 3** or a few inches above the shorted tuning stub for the λ/2 design. In any case the tuning stub is used to resonate the whole array to about 145 MHz with an accurate GDO while the antenna is a few feet above ground and pointing upward. The balun taps at "C" are also made at this time by using an SWR meter and transmitter. When the tuning stub is the right length and the balun taps are at the correct points, the SWR will be near unity at the desired frequency. Putting the antenna up in the air on a tower or TV mast will then probably raise the SWR reading to perhaps 1.2 which is within reasonable limits. This method saves a lot of mast climbing. The writer often uses TV push-up masts and makes these adjustments with the antennas in place but within reach from the roof of the radio shack. This requires considerable roof scrambling—an old story to this radio ham.

The antenna dimensions are all given in **Fig. 3** for the 144 MHz beam. Similarly, the values are shown for the 220 MHz beam in **Fig. 4** and 432 MHz in **Fig. 5.** All phasing lines and tuning stubs were made with number 14 wire spaced from ½ to 1 inch with poly insulators or Teflon insulators spaced 8 or 10 inches apart. Number 14 wire can be melted into the center of a short poly rod by holding a 150 or 200 watt soldering iron on the wire adjacent to the insulator. Teflon insulators require a hole smaller than number 14 wire and the wires forced thru these holes. Teflon is far better for foggy or rainy weather. The writer has no snow problem.

The 220 MHz beam of **Fig. 4** is a standard yagi design except that the rf feed is a little unusual and very simple. The driver elements of all four yagis are extended out to about ⅝ λ in length and end fed with a single phasing line and shorted tuning stub. The latter is a little over λ/4 in order to resonate the whole system to 222 MHz. The end spacing is limited to about 40 inches because of the ⅝ λ driven element lengths. For convenience the broadside spacing was also made about 40 inches. The antenna gain with four 4 ft. yagis (6 elements each) is approximately 14 dB which is about 2 dB more than could be obtained with a standard 16 element broadside beam. The latter requires more area space on a pole. Either two or four short or medium long yagis usually require less area space and provide more gain than a standard 16 element broadside of λ/2 design (see **Fig. 2** for eight driven elements).

Getting into high gain beams, such as needed on 432 MHz, the broadside beams come into preference usually. The one shown in **Fig. 5** was up for several years at W6AJF until poly insulator crazing, wind and bird collision damages forced its temporary retirement. It is due for an overhauling and substitution of Teflon insulators. It has an approximate gain of 18 dB when new and shiny. All

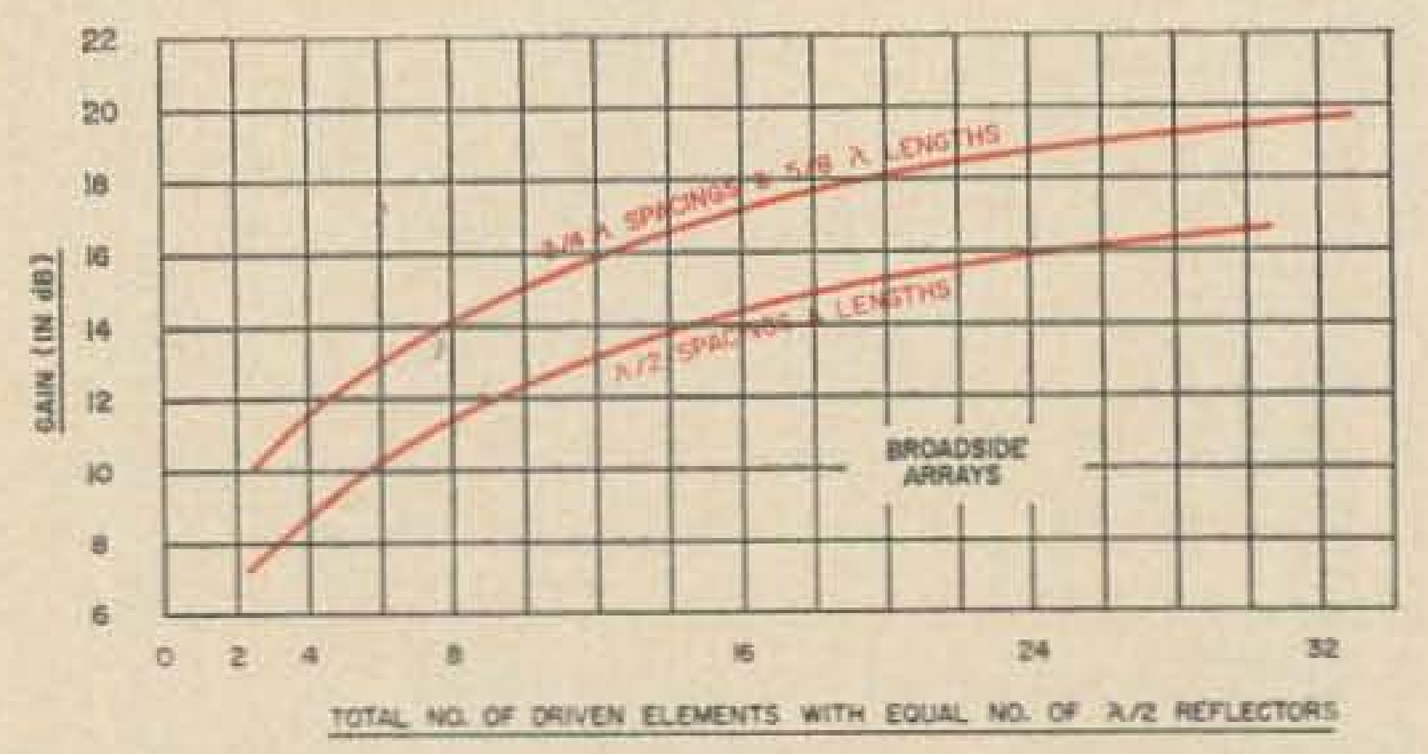

Fig. 2. Gain of broadside arrays for various numbers of elements.

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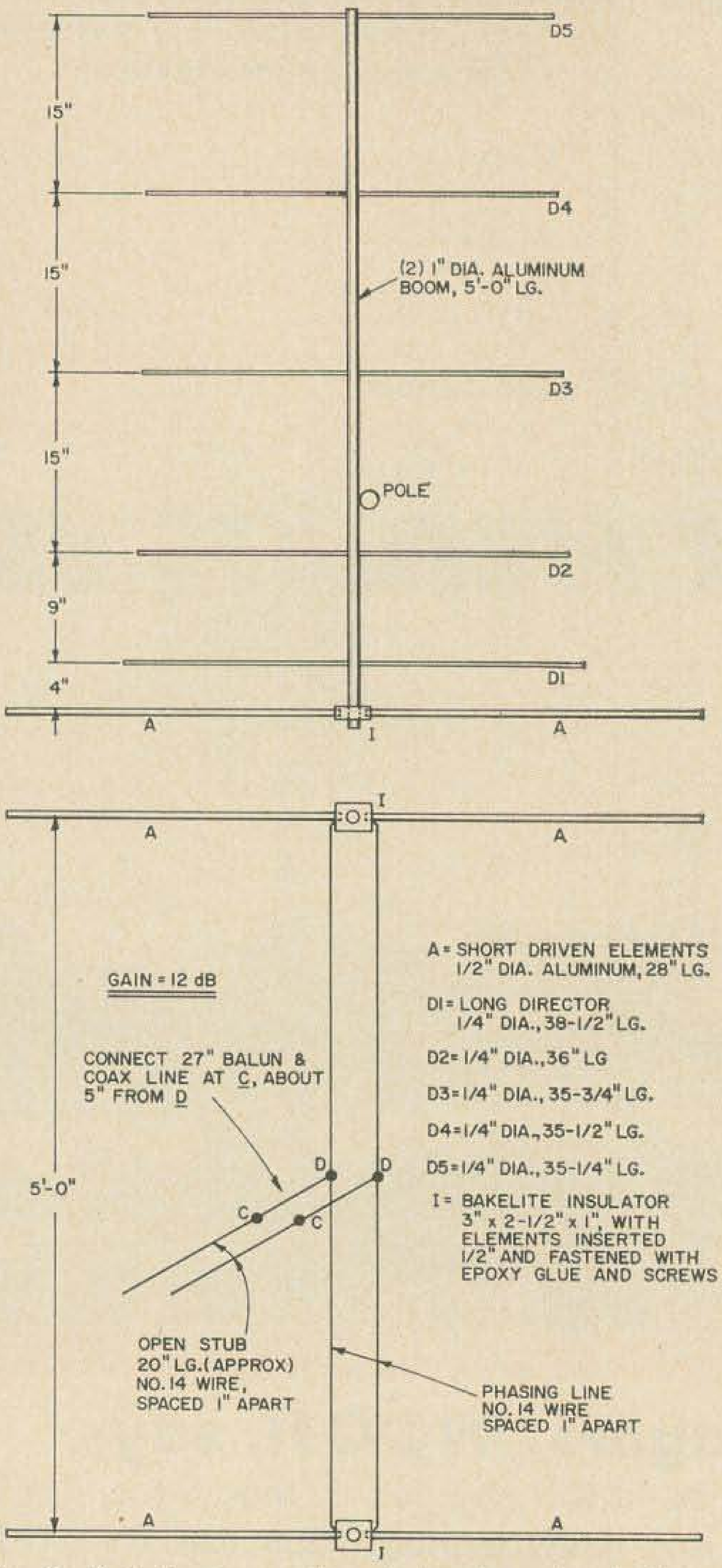


Fig. 3. Relatively small and simple pair of director beam yagis giving about 12 dB gain on two meters. Notice that this antenna uses no reflectors.

432 MHz beams tend to deteriorate from 1 to 3 dB with weathering, and corrosion of elements, so should be rebuilt and shined up occasionally.

The **Fig. 5** beam uses extended elements ⅝ λ long in the driven elements and λ/2 reflectors. The broadside spacing between driven elements is ¾ λ and the rear elements (reflectors) are about λ/4 behind the top portions of each driven element. The writer is not convinced that ⅝ λ broadside spacing is not better than ¾ λ because of less spurious lobe amplitudes. ⅝ λ spacing requires a different length of tuning stub and has about 1 dB less forward gain but the forward pattern is broader. The latter is an advantage in heavy winds, since horizontal directivity can be too great for average ease of operation. An antenna much over two wavelengths wide can be a real problem to hold on a correct bearing for weak signal reception in windy locations.

The writer has a 64 element "curtain" beam on 432 MHz but with so much vertical stacking (32 over 32) the top of the beam moves several inches with respect to the bottom portion and a stiff wind adds considerable QSB to weak signals. The 64 element job uses ⅝ λ element spacing and its forward pattern is fine, better than the **Fig. 5** beam in practice. However, the top sway is a problem and the 32 element job is going back up soon in place of the 64 element beam. The wind blows most of the time here and small beams seem to be preferable for everyday operation.

The three beams described in this article are all-metal construction which seem to stand wind and rainstorms better than wooden boom construction. Because of the metal booms sup-

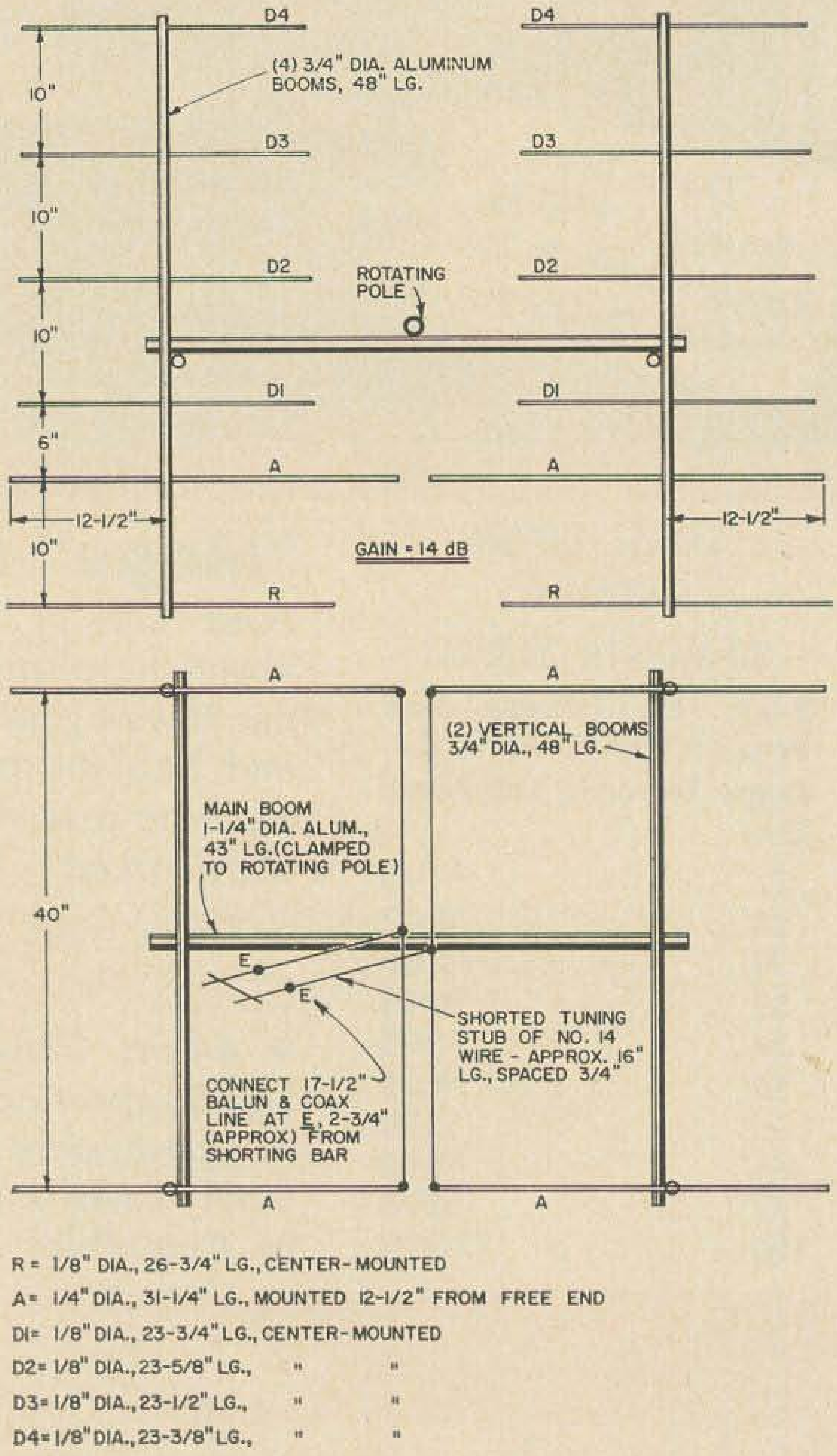


Fig. 4. 220 MHz quad of conventional yagis giving about 14 dB gain.

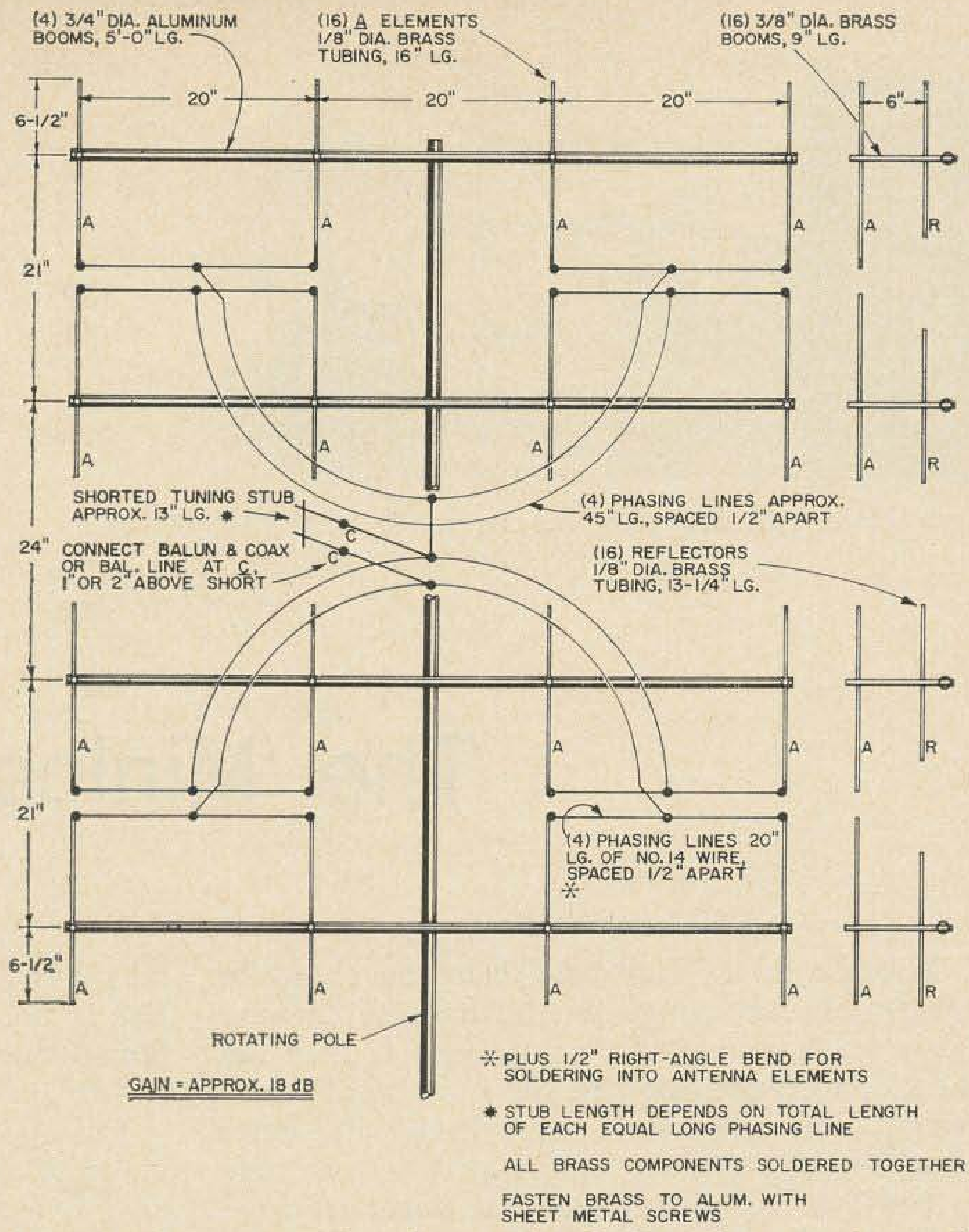
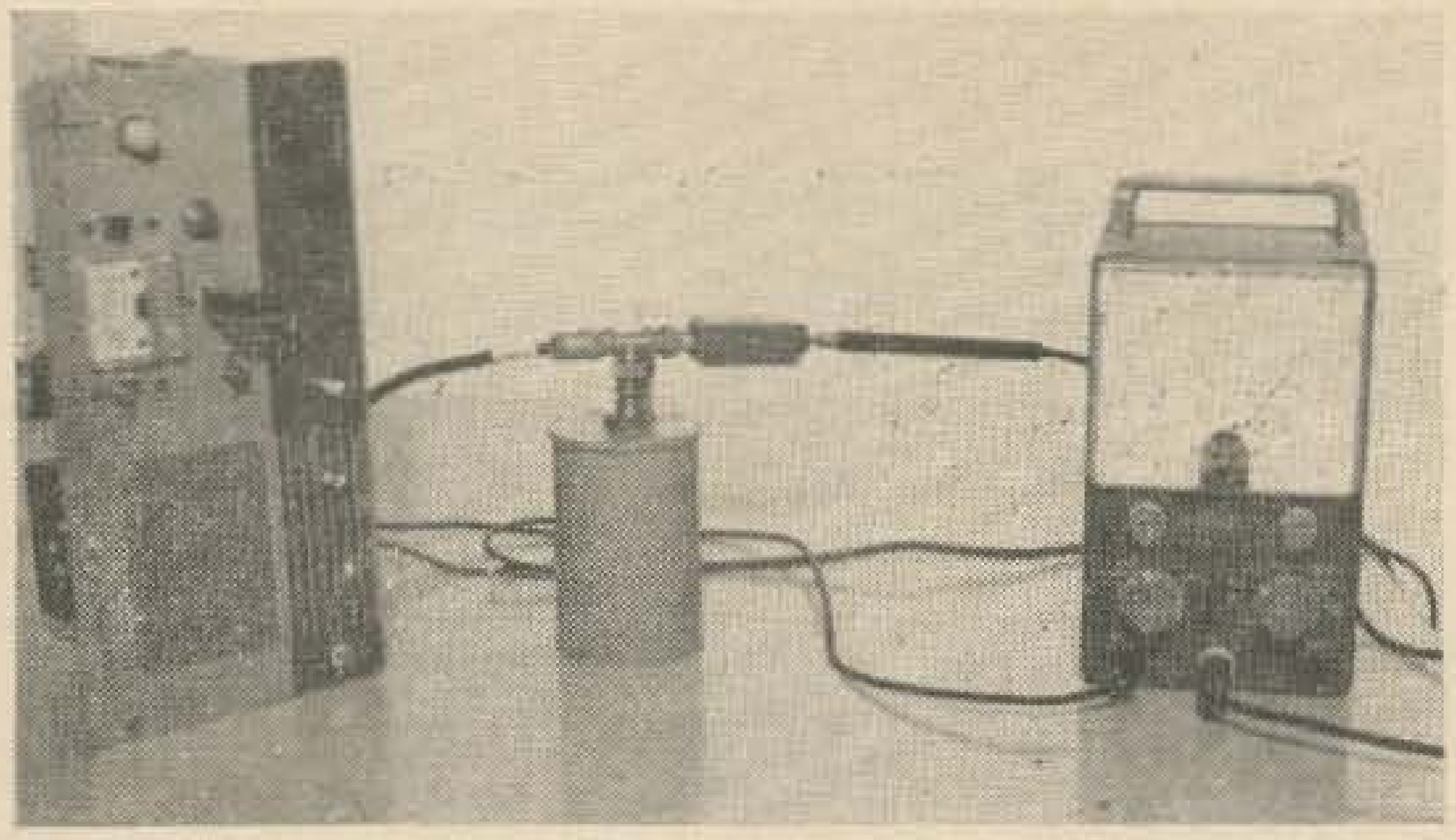


Fig. 5. High gain (18 dB) broadside beam for 432 MHz.

porting all radiating elements, the length of each element is slightly longer than for the case of wooden supports, especially in yagi antennas. The parasitic elements in all yagi beams have to be lengthened by about ⅔ of the metal boom diameter. If wooden booms are used, subtract this half inch or so from all parasitic elements (directors particularly) from the values shown. Don't expect other diameter elements than those shown to work correctly without some changes in lengths.

. . . W6AJF



The Minican in use with the companion detector.

Sam Kelly W6JTT
12811 Owen Street
Garden Grove, California

The 'Minican'

The Heathkit "Cantenna" has proven to be a major breakthrough in the field of dummy loads for ham use. Unfortunately, it isn't the most convenient thing to use on a small work bench with low power rigs! Borrowing their idea, I built this load for use with transmitters in the 5 to 15 watt range. The parts are few: a Campbell soup tin can, four one watt resistors, a UG-254-A connector, a short piece of 5/16 inch brass tubing and transformer oil.

Fig. 1 is a sketch of the assembled unit. The 50 ohm resistance was made up of three 15 ohm and one 5 ohm one watt carbon resistors.

First sand a can lid from a larger size can until it is free of paint. Drill a ½ inch hole through the center of the lid, and a ¼ inch hole on the perimiter. Mount the coaxial connector through the center hole. Solder a 1 inch length of 5/16 in. brass tubing over the ¼ inch hole. Solder the resistors as shown. Center the lid on the can and solder the lid to the can. Use a file to remove all rough edges. Mask the connector with masking tape and paint the can to prevent rusting.

Fill the can with transformer oil. A good grade of automatic transmission fluid was used in one load with no degredation in performance. However, it probably is not advisable as the fluid has a relatively low ignition temperature and might create a fire hazard.

The load was tested by running it for five hours with an input of 15 watts of 50 MHz rf. The can became warm, but the resistors showed no signs of overheating.

A maximum VSWR of 1.5:1 was obtained at 234 MHz. The measurement was made at this frequency because an automatic test set was available.

A companion rf detector unit shown in **Fig. 2** was built in a two inch section of ¾ inch square extruded brass stock. A Dage 394-1 BNC connector is mounted on one end for connecting to the RF circuit, while the DC output to the VTVM is a tip jack.

. . . W6JTT

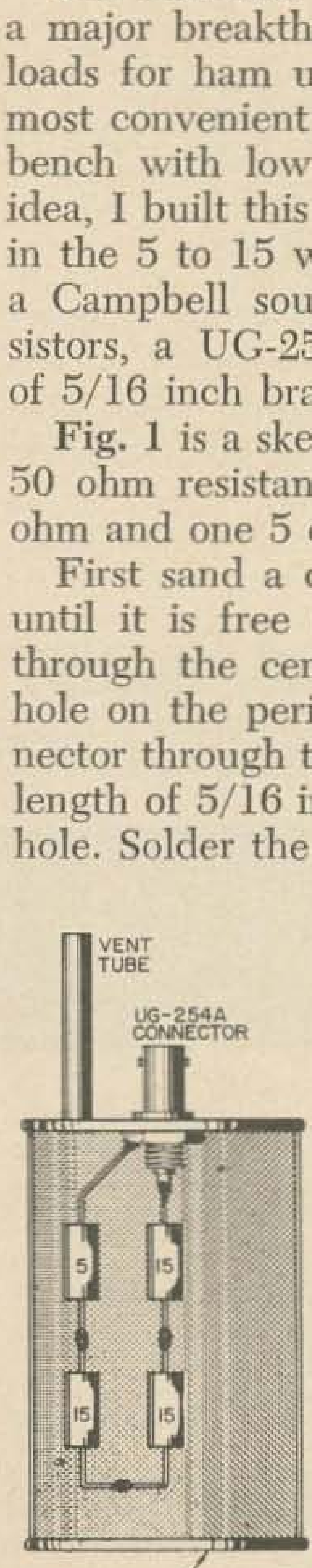


Fig. 1. Construction of the Minican. Main parts are a soup can, coax connector and resistors.

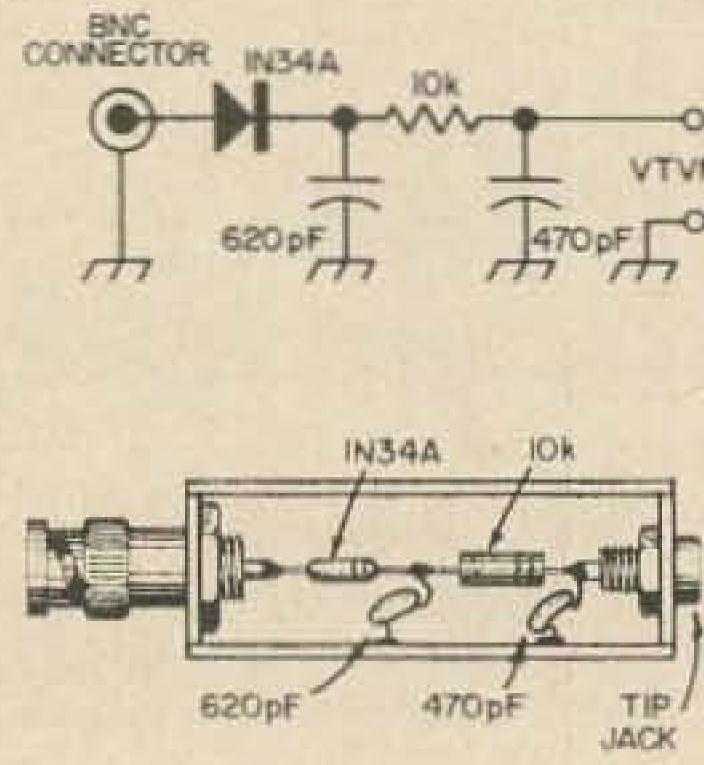


Fig. 2. Rf detector for use with the Minican.

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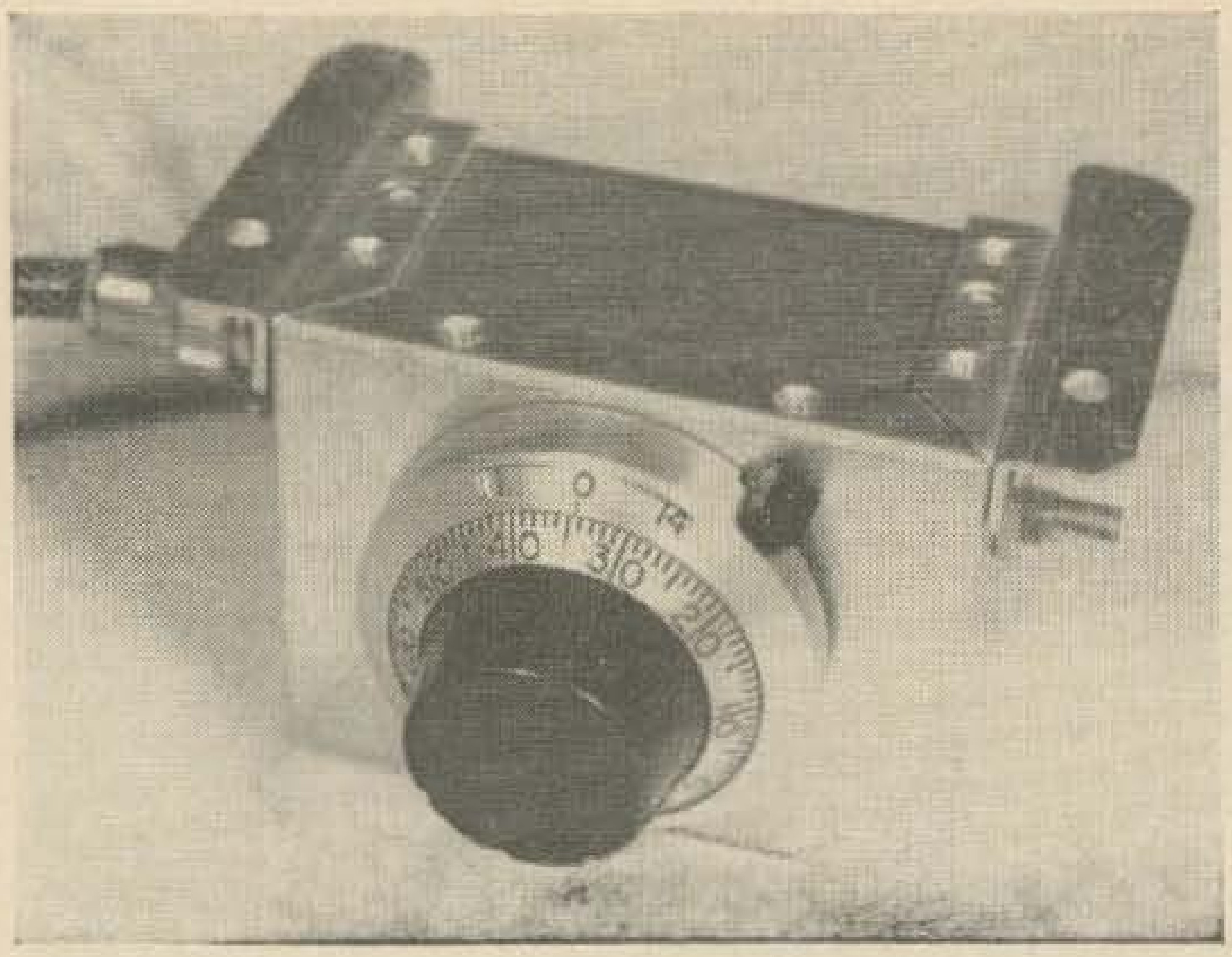


Front view of the six or two meter VFO using a piston tuning capacitor as shown in Fig. 3.

Del Crowell K6RIL
1674 Morgan Street
Mountain View, California

A Stable VFO for VHF or HF

These simple VFO's are inexpensive, small, easy-to-build—and provide excellent stability.

Like to build a small, simple, inexpensive, stable VFO for VHF or HF use? If you would, this article tells you how. The basic VFO described here drifts less than 80 Hz total in three hours, yet can be built very easily. The VHF model of the VFO is shown in **Fig. 1.** It can be used on six or two meters as it furnishes 24 or 25 MHz output with an oscillator in the 8 MHz range. The high frequency model shown in **Fig. 2** is designed for use with an SSB mixer and operates at 5-6 MHz. Two methods of tuning are shown. One uses a conventional air variable capacitor. The other uses a piston trimmer capacitor which offers very small size, excellent stability and easy tuning.

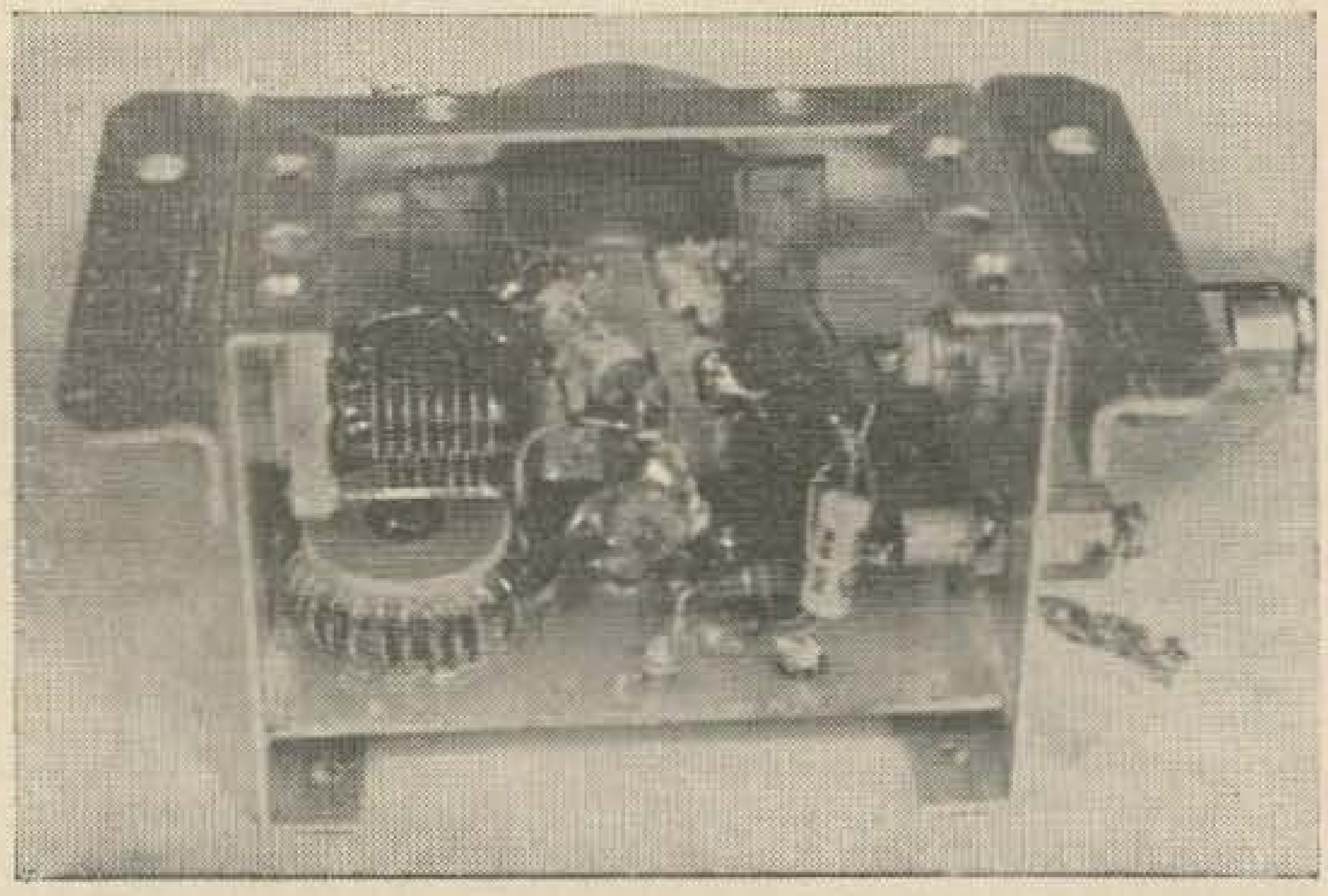
Circuit description

The circuits of the two models are similar. Each starts with a modified high capacitance Clapp oscillator using a toroidal coil. The coil (L1 in each case) is wound on a small toroidal form and features a very high Q (around 250) on a Boonton Q Meter. The coil and the capacitors C1 through C6 form a resonant frequency at the VFO frequency. Series tuning is done with C1 through C4. C1 is used to set the basic frequency range, C2 is for temperature compensation, C3 is the calibration trimmer and C4 is the tuning capacitor. The range of C4 is determinded by the frequency coverage desired. On two meters, 10 pF is more than adequate, but this value only gives 1.8 MHz range on six. For the 5-6 MHz range, 70 pF of range is needed to cover 1 MHz. This means that the capacitor must have a maximum value of about 75 pF.

C5 and C6 form a capacitive divider for feedback voltage. Using the same value for both capacitors insures that the feedback circuit is balanced. Changing the supply voltage affects the VFO frequency very little so a voltage regulator is not required.

Output is coupled from the emitter of the oscillator with a 100 pF capacitor. Don't use more than 100 pF because of loading effects on the oscillator circuit. The lowest value that can be used is best.

The second stage of the circuit (Q2 and its circuitry) is used as an untuned buffer at the same frequency as the oscillator in the 5-6 MHz VFO. Its output is low impedance from the emitter. In the two or six meter model, the second stage is a tripler to about 24 MHz with an rf choke in a broadband collector



Inside of the portable VFO for six or two showing the construction.

circuit. The output is high impedance and used to drive a vacuum tube grid at this station.

The circuits in **Figs. 1** and **2** both perform well. I've built the two meter and 5-6 MHz versions, but it should be easy to cover six with the two meter model by reducing the value of C1.

Construction details

The VFO's shown in the photos are the results of using the same basic ciruit but using different construction techniques. The toroidal coil L1 used in both models is constructed by winding heavy gauge wire on the proper toroidal core. A good stable core with high permeability is a neccesity. Several manufacturers make suitable cores. I used a Micrometals core, which can be obtained from Micrometals, 72 E. Montecito Ave., Sierra Madre, California, or from one of their representatives. They have a minimum charge of $10 per order, but for $10, I was able to obtain a life-time supply of cores as each is very inexpensive when you buy a large number. I'd recommend that you write for their catalog and then order the cores.

If you'd rather not buy so many cores, Ami-Tron Associates, 12033 Otsego St., North Hollywood, California, will sell you an individual core for only 60¢ postpaid. You can also make up the proper coil inductance with the Ami-Tron RF Toroid Balun Kit available at many radio distributors.

After winding the wire on the core, the coil should be given a heavy coat of Hi-Q varnish or dope to prevent the wire from moving. All the capacitors in the circuit must be of good quality. A temperature-compensating capacitor is used to correct the minor drift in the circuit. All frequency-determining components must be securely mounted to prevent change in frequency due to movement of parts and wires.

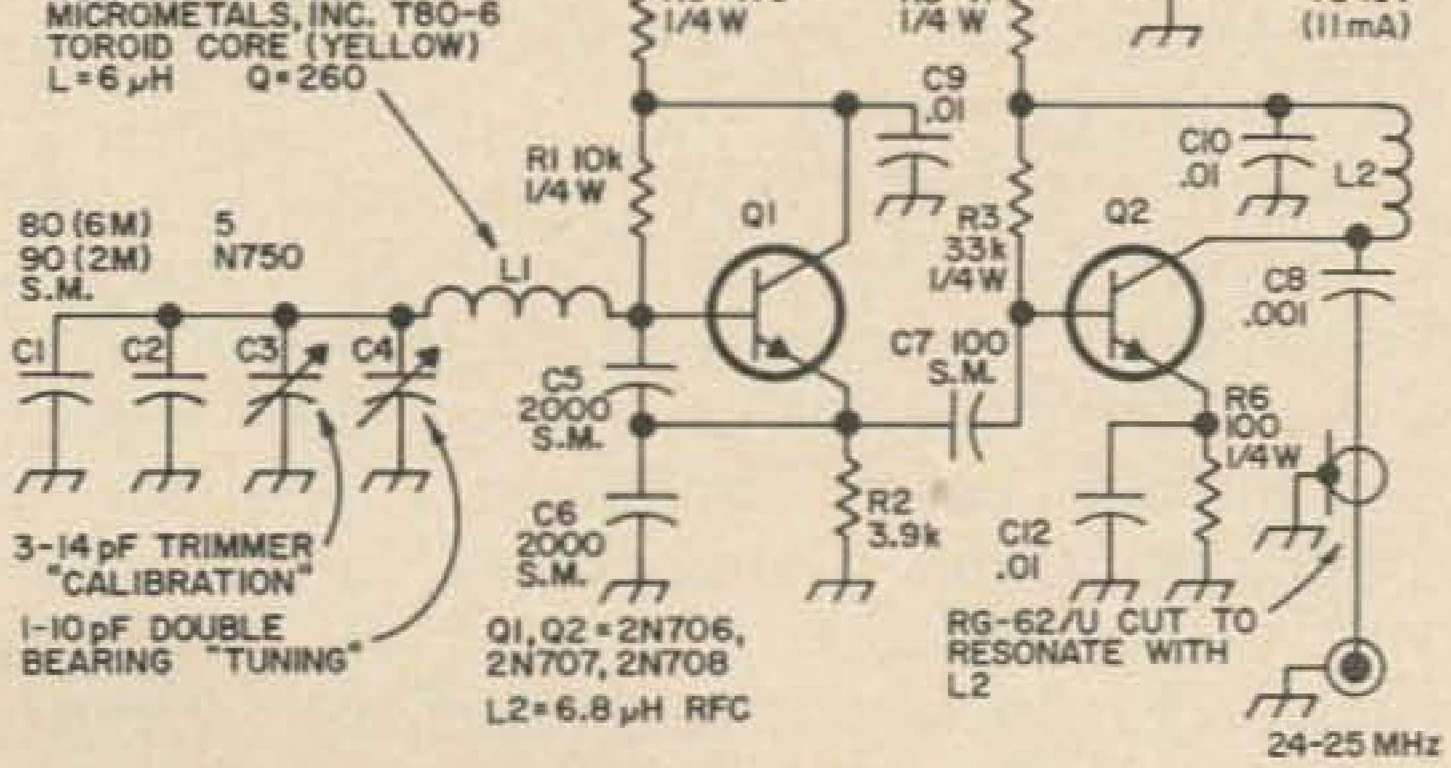
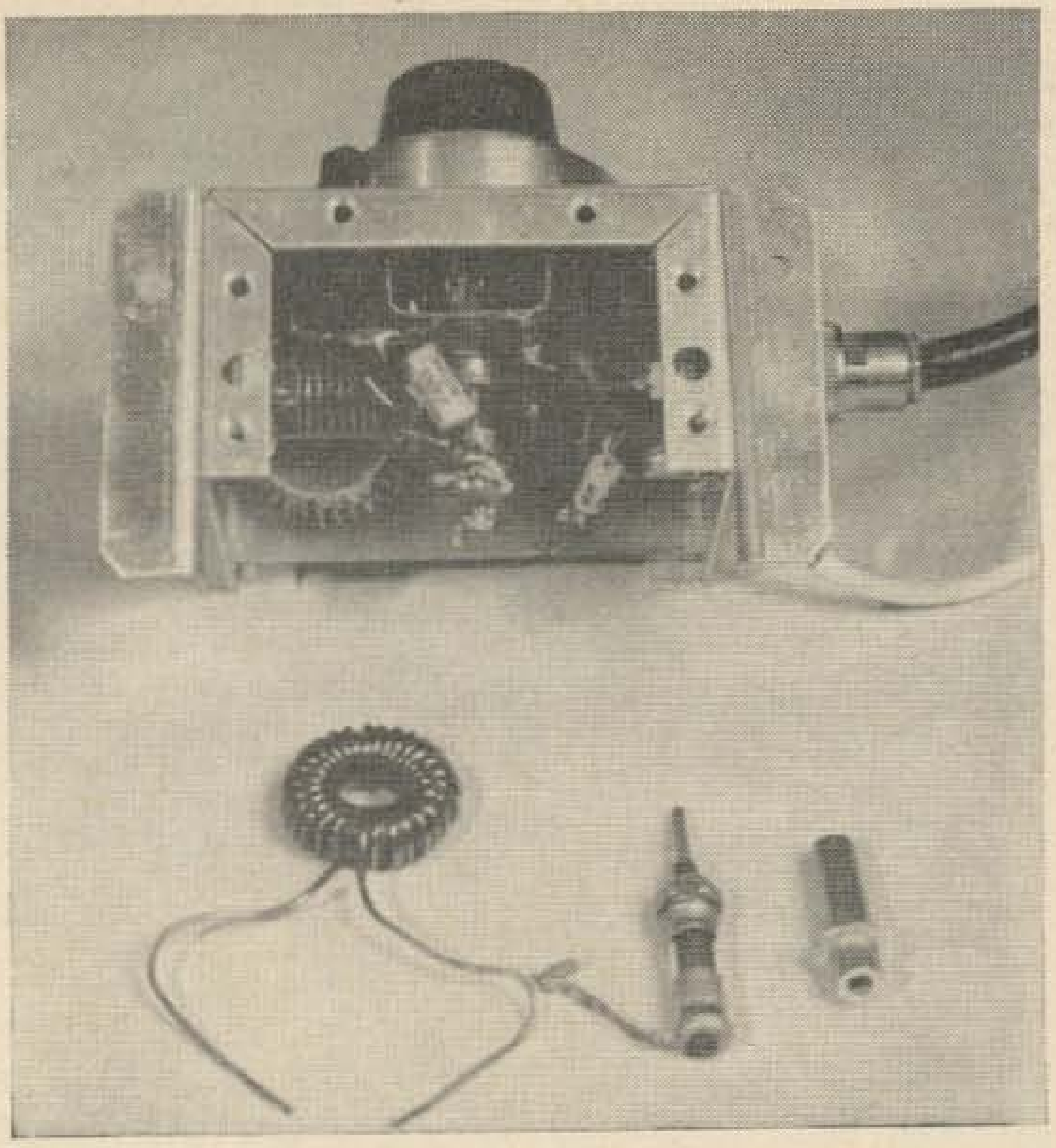


Fig. 1. Six or two meter transistor VFO with output on 24-25 MHz. The oscillator operates on 8-8.3 MHz.



Parts for the portable VFO. This VFO was made for two, but can be used on six with minor changes, or on 5-6 MHz.

Mobile VFO for two or six

The two meter VFO shown in the photos was built in a small package for mobile use. This VFO used a piston capacitor. Oscillator parts, transistors and the toroidal coil were mounted on a section of insulated board and cemented to the box with epoxy. This unit was built in a hurry for use during a trip so a few short cuts were taken. The box used was an LMB tight fit chassis box with self-tapping screws to fasten down the edges, but a sturdier box would be better. The tuning capacitor (C4, 1-10 pF) used in the two meter model came from surplus. This capacitor was mounted on a U-shaped bracket with its shaft moved by a stationary bushing (see **Fig. 3**). A hollow shaft was drilled out for a very tight fit over the bushing. This allows the capacitor to be turned with practically no backlash. A turn-count dial was fastened to the front of

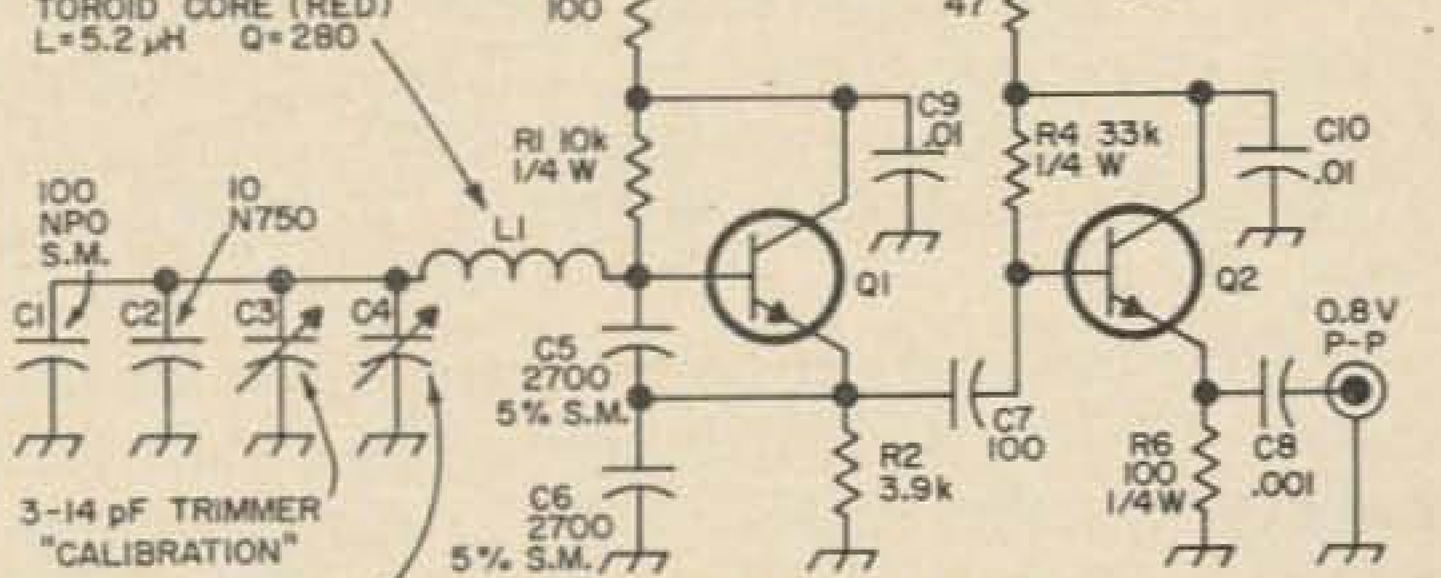
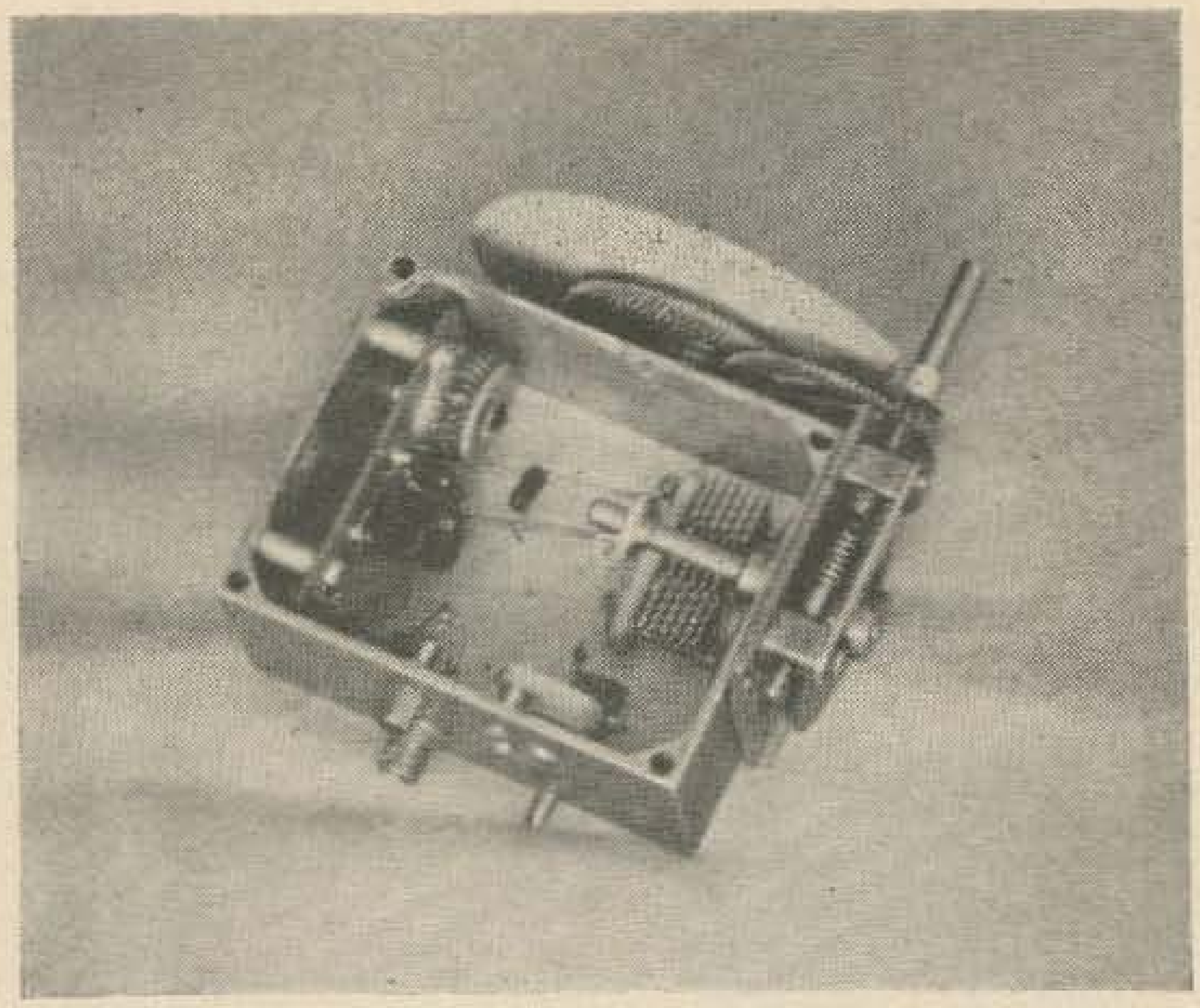


Fig. 2. Transistor VFO for 5-6 MHz for SSB mixing service.



Construction of VFO using parts from a command set transmitter dial.

the VFO box and a calibration chart was made. With 22 turns, the capacitor has about 9 pF of travel, or from 8.0-8.3 MHz on the VFO. This resulted in a very stable VFO which could be tuned to zero beat while driving.

5-6 MHz VFO

This VFO used different construction than the two meter one. The VFO parts were mounted on the insulated board as described before, but the box and tuning mechanism use a different technique. The box used was made from heavy cast aluminum found in a surplus store, with a cover fabricated from ⅛ inch aluminum. A sturdy double bearing capacitor was used for tuning. A gear drive and dial assembly from an ARC 5 transmitter was adapted to the VFO. This gear assembly gives plenty of bandspread with smooth tuning and very little backlash, though the mechanical work was a bit tedious. 48 turns are required to cover the 1 MHz range from 5-6 MHz, which is very nice for SSB tuning. A round plastic dial was cut out and installed in place of the original dial.

Both VFO's have given very good results. The two meter model in particular has provided much better stability reports than commercial VFO's.

. . . K6RIL

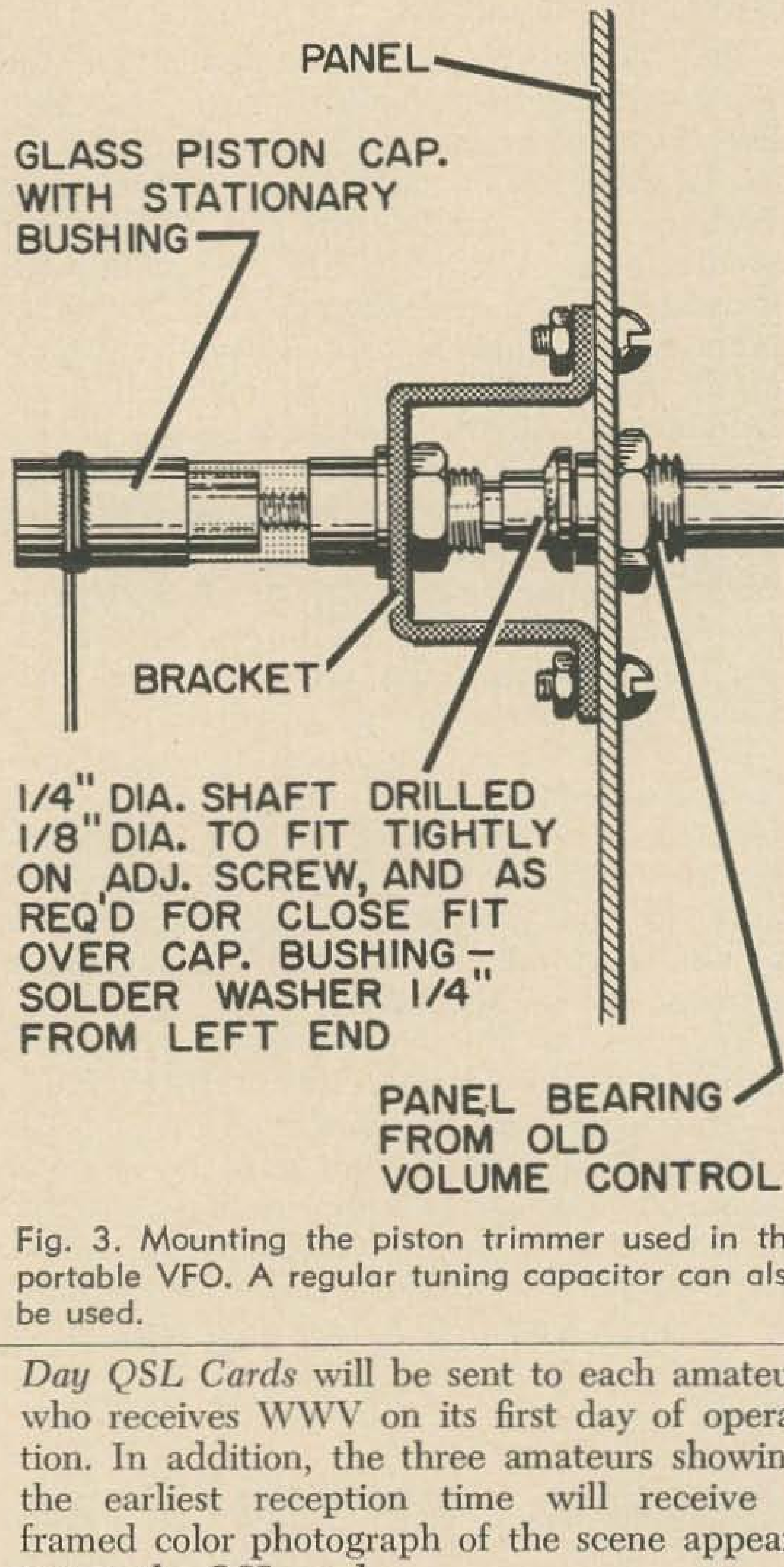


Fig. 3. Mounting the piston trimmer used in the portable VFO. A regular tuning capacitor can also be used.

WWV Moves

The National Bureau of Standards radio station WWV is moving from its present location in Maryland to Fort Collins, Colorado where it will commence operations at 0000 hours Universal Time on 1 December 1966. This is equivalent to 1900 EST, 1800 CST, 1700 MST and 1600 PST—all on November 30th.

WWV is very important to amateurs because of its standard frequency and time broadcasts; thousands of QSL cards are annually mailed to amateurs all over the world. To commemorate the opening of the new WWV station at Fort Collins, special *First Day QSL Cards* will be sent to each amateur who receives WWV on its first day of operation. In addition, the three amateurs showing the earliest reception time will receive a framed color photograph of the scene appearing on the QSL card.

Recipients of the WWV broadcast who wish to qualify for the First Day QSL Card will be required to correctly quote the new WWV voice announcement and have their reports postmarked before midnight December 2, 1966, local time. Cards should be addressed and mailed directly to David H. Andrews, Chief, Frequency-Time Broadcast Services Section, Radio Standards Physics Division, National Bureau of Standards, Boulder, Colorado, 80302.

Ray Hoffman W4TDI
5619 Sedgwich Lane
Springfield, Va.

The X Beam

A simple antenna with a pattern similar to a rhombic.

In the never ending effort to put a good signal on the ham bands—despite the limitations of the average location, available real estate and the pocketbook—the subject of new, better, and smaller versions of antennas holds a certain fascination. There are loaded whips, short beams, quads, multiband dipoles, short verticals, and even the big wheel.

Through all of this, the rhombic has remained aloof and serene in its plush surroundings of several acres of land and stately masts. The size requirements are usually enough to scare off even the most hardy souls, its direction is fixed and its use limited as an amateur antenna.

A recent "antenna" development, used in semi-fixed transportable installations stirred my imagination. With a little adaptation, it shows great promise as a ham antenna. Since the major part of the adaptation was cutting it down to suburban lot size, it became quite practical. If you have a space 75 feet square, you too can have antenna with characteristics similar to a rhombic.

Perhaps the most difficult part of a rhombic is four poles or trees in just the right place. On the other hand just about anyone can find a single pole or mast, approximately 40 feet high. A tree is completely acceptable and even two trees with a rope between them to put the antenna in just the right place may be used.

Fig. 1A shows a typical unterminated rhombic antenna with the major lobes of radiation. **Fig. 1B** is an antenna, that gives the same pattern, but in a different physical form. Although the appearance has been changed, it still has the same phase relationships, and therefore, directional characteristics and gain.

At first glance, there is no apparent structural improvement—five supports instead of four. Not so. The four outer wire terminations are made near ground level. Sloping the legs provides more gain at the desired wave angles and increases the capture area but best of all it eliminates a structural problem.

Figs. 1A and **2B** show bi-directional patterns. For unidirectional applications, the antenna is terminated by an impedance slightly higher than its characteristic impedance, thus greatly attentuating one lobe. However, in this adaptation no termination is desired because the bi-directional characteristics can be used to advantage.

A normal sized rhombic antenna usually has three or more wavelengths of wire on a leg, is about twice as long as it is wide and requires some pretty tall masts. Under these near ideal conditions, it may show 12-18 dB gain over a half wave dipole. Leg length, shape, and height above ground are interrelated and all affect gain.

Leg length and height are quite evident and have the same meaning as in any antenna. The shape is derived from a factor called tilt angle whose value is one half of the angle between two adjacent side legs, which in turn comes from the angle at which maximum radiation from the leg occurred. This is shown in **Fig. 2**.

Rhombic antenna design tables have been worked out in many forms and are available in several handbooks. If the reasoning in the foregoing paragraphs is correct, the data should also generally apply to our antenna, which I call an X-beam. In checking these sources, an interesting case was noted. If the legs are one wavelength long, then the tilt angle becomes 45-50° and the height is about .5 wavelength.

This, then, is the basis for the design of the X-beam—four wires one wavelength long, suspended or attached to a mast or tree some 40 or 50 feet high and sloping down to convenient trees or stub poles near the ground. The angle between each pair of adjacent wires is 90° giving a tilt angle of 45°. **Fig. 3** shows a 14 MHz version of the antenna, which has a 3-5 dB gain over a half wave dipole.

Based on the 14 MHz dimensions, the antenna will occupy a square area of about 75 feet between the legs if the center is 40 feet high.

How is the thing fed? The original version feeds the ends of two of the Vee wires and terminates the other two to produce unidirectional characteristics. For amateur work this feed system is neither practical nor desirable since bidirectional results are desired. True, the frequency range over which the antenna operates will be greatly reduced. However, since the amateur bands are narrow and in harmonic relationship, this is no serious drawback. A convenient feed point would be the center of the antenna. Further, in order to perform properly a rhombic antenna should have out of phase currents in its adjacent legs. A tuned feeder system would be ideal for this application and is recommended if the antenna center is convenient to the shack.

Where the antenna is some distance from the transmitter it is more convenient to use coaxial line. Assuming the feed point impedance to be comparatively high, the quarter wave matching section shown in **Fig. 4** was fabricated and tried. This combination resulted in a reasonable SWR and since all items are readily obtainable, no further refinement was made at this time. Further work will be done in the future to reduce the SWR.

At this point the antenna was loaded up with the Collins 30L-1 and several preliminary tests were made. It performed well, and several comparisons made with a local ham using a three element beam showed that the X beam did indeed have some gain in the desired direction.

The next development, as one might surmise from the drawings, was to determine if the directional pattern could be switched 90° in some way. Of course, one could play may-pole with the legs and do it, but there is another and more subtle way—switch the feed points and antenna configuration with a relay. A DPDT antenna type relay, mounted in a polyethylene box and placed adjacent to the center point does the job nicely and is connected as shown in **Fig. 5.**

Legs a and d are permanently connected to the feedline and to the cross connected fixed poles of the relay. Legs b and c are connected to the moving arms of the relay. For one direction legs a and b are connected and legs c and d are connected. When the relay is actuated legs a and c are connected and legs b and d are connected which switches the directive pattern 90°.

Now as to results—the X beam is oriented E-W and N-S on my lot. There are a great many trees in the yard—the main reason for not putting up my beam in the first place. The antenna is hung right in among them. Apparently the trees have less influence on the antenna than one would expect since the directional pattern is well defined. Switching the beam on a station in Florida shows a dif-

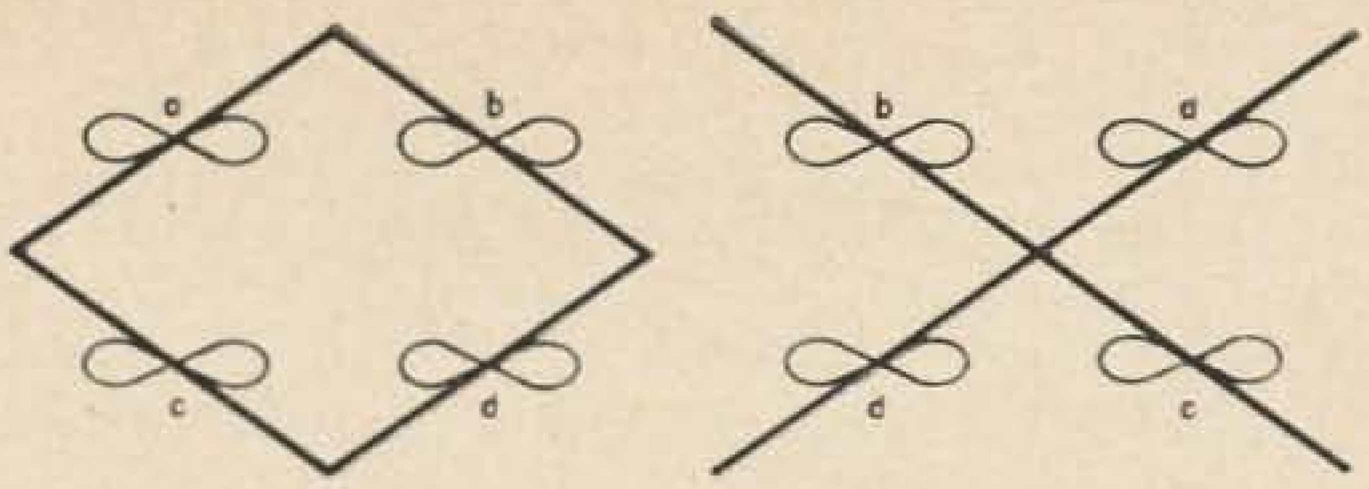


Fig. 1A, left. Rhombic and its pattern. 1B, right. X beam with characteristics similar to a rhombic.

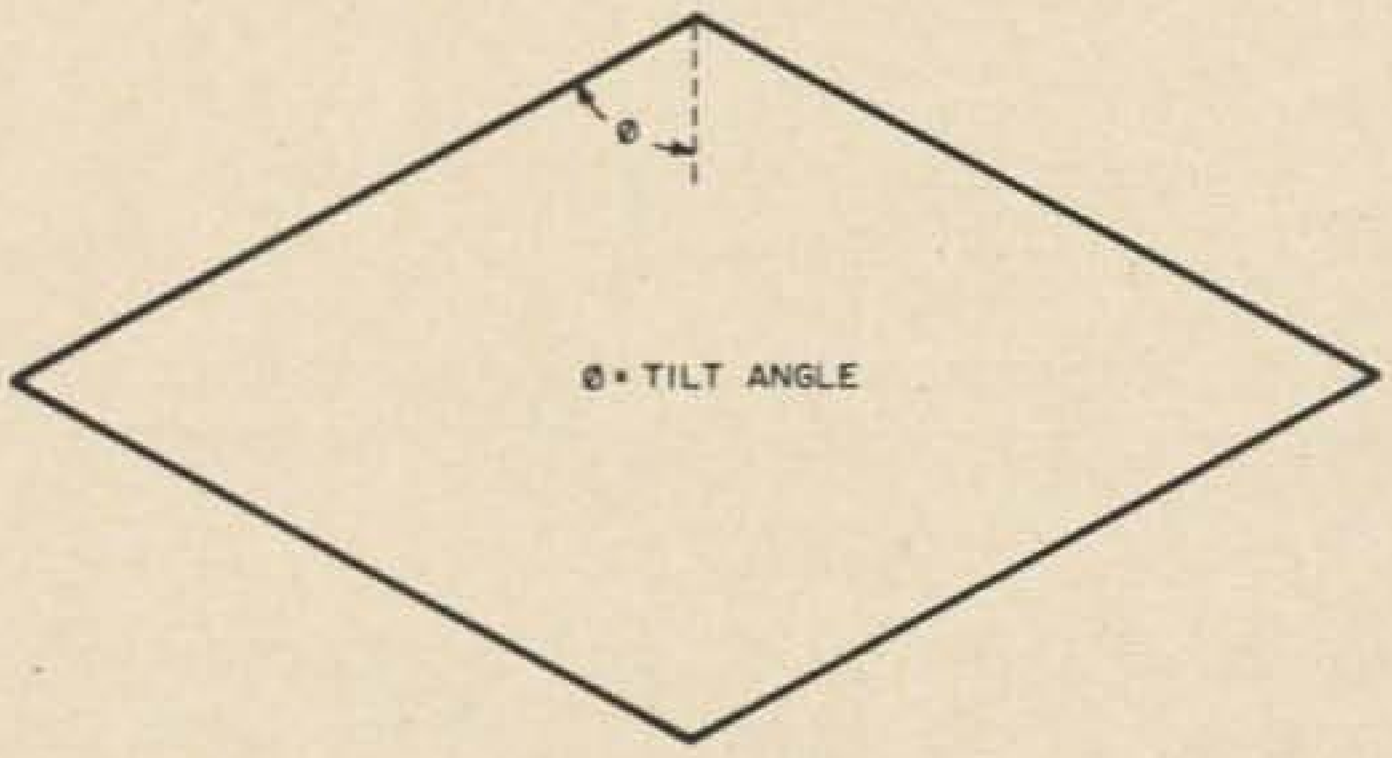


Fig. 2. Tilt angle of a rhombic.

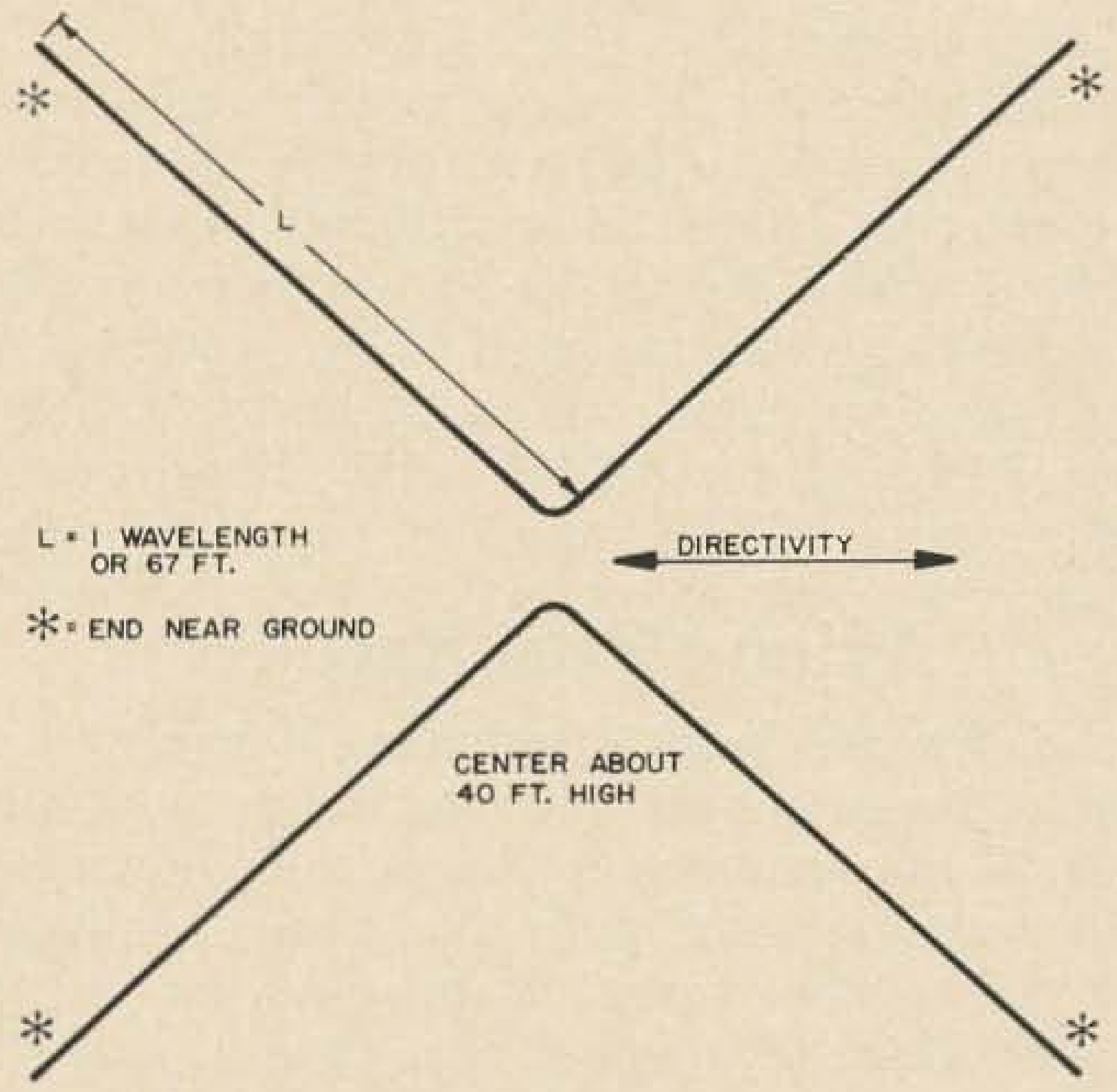


Fig. 3. Configuration of the X beam.

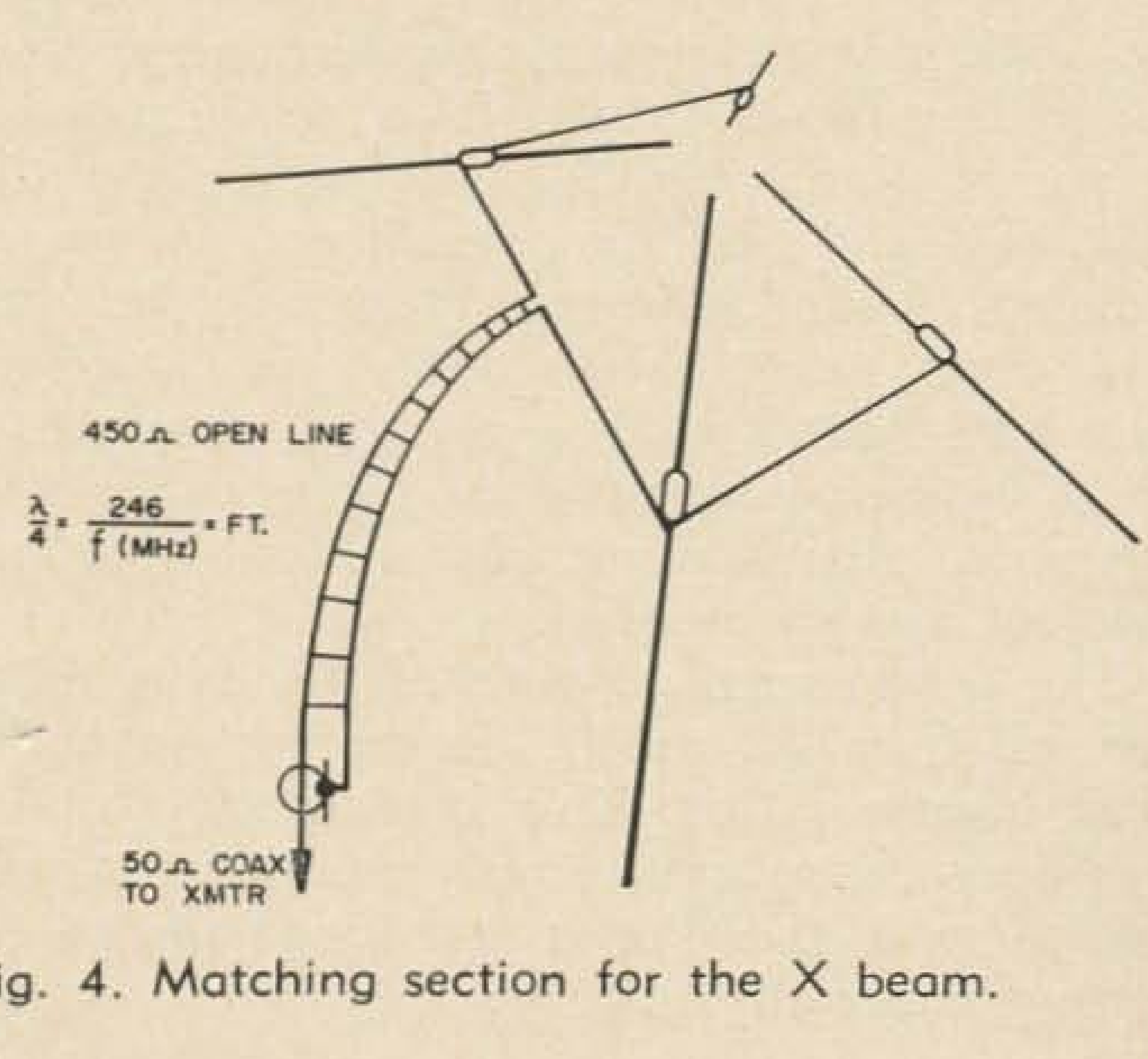


Fig. 4. Matching section for the X beam.

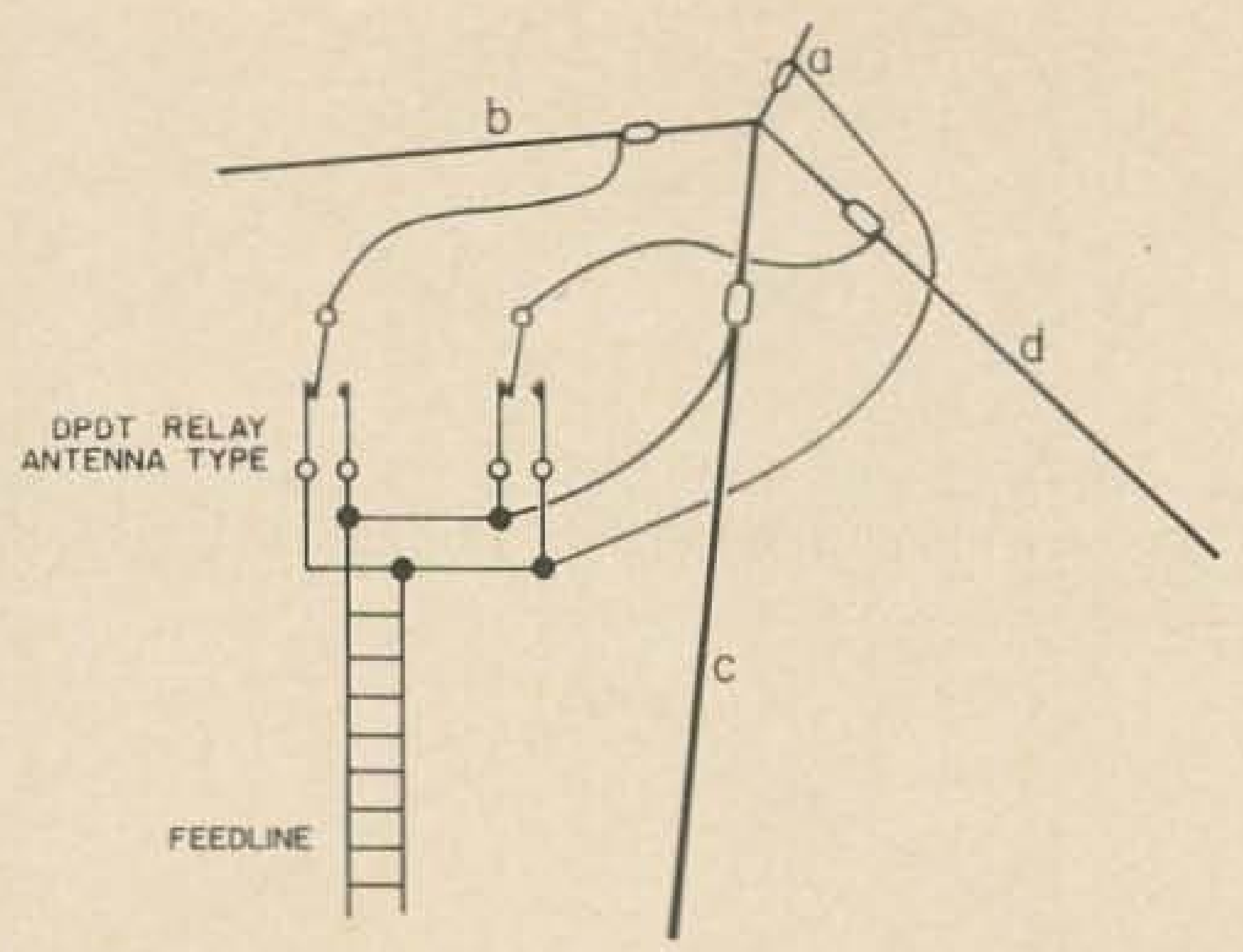


Fig. 5. X beam with switchable pattern, which gives an effect similar to rotating the antenna.

ference of about 20 dB and the Europeans go up some 15 dB when the pattern is in their favor. Some stations do not change at all, due to their being between the major lobes. Reports have been excellent and the percentage of calls answered is quite flattering.

The 20 meter X beam might well be expected to perform to some degree on most of the amateur bands. In an attempt to ascertain what it would do, an SB-33 was borrowed for a week-end and connected to the feedline. No change of any kind was made in the feed system designed for 14,300 kHz. Results were interesting and although not conclusive, they do present an area for further experimentation.

4.0 MHz operation—several stations contacted with good reports. No significant change when relay activated.

7.0 MHz operation—several stations worked within 800 mile radius with excellent results. A noticeable change when directivity was switched. Not enough data was collected to determine exact characteristics.

21.0 MHZ operation—performance very similar to 14 MHz. Unfortunately the population of this band at this time is too sparse to completely evaluate performance.

As a final test, one kW of rf was pumped into the feedline. Since nothing smoked, melted or made funny noises, it can be concluded that the SWR that exists on the line is not a serious drawback to all-band operation!

Another antenna of this type was constructed in the area. It uses tuned feeders and all band operation is indeed quite interesting—it does very well on all of the popular frequencies. The builder noted about the same performance as the original but was able to match the system much better using the tuned feeders.

My thanks to the gang on 20, whose many reports helped the cause. The Northern Virginia group were most kind—putting up with my many breakins to obtain comparative readings. . . . W4TDI

A Home Brew Rectifier

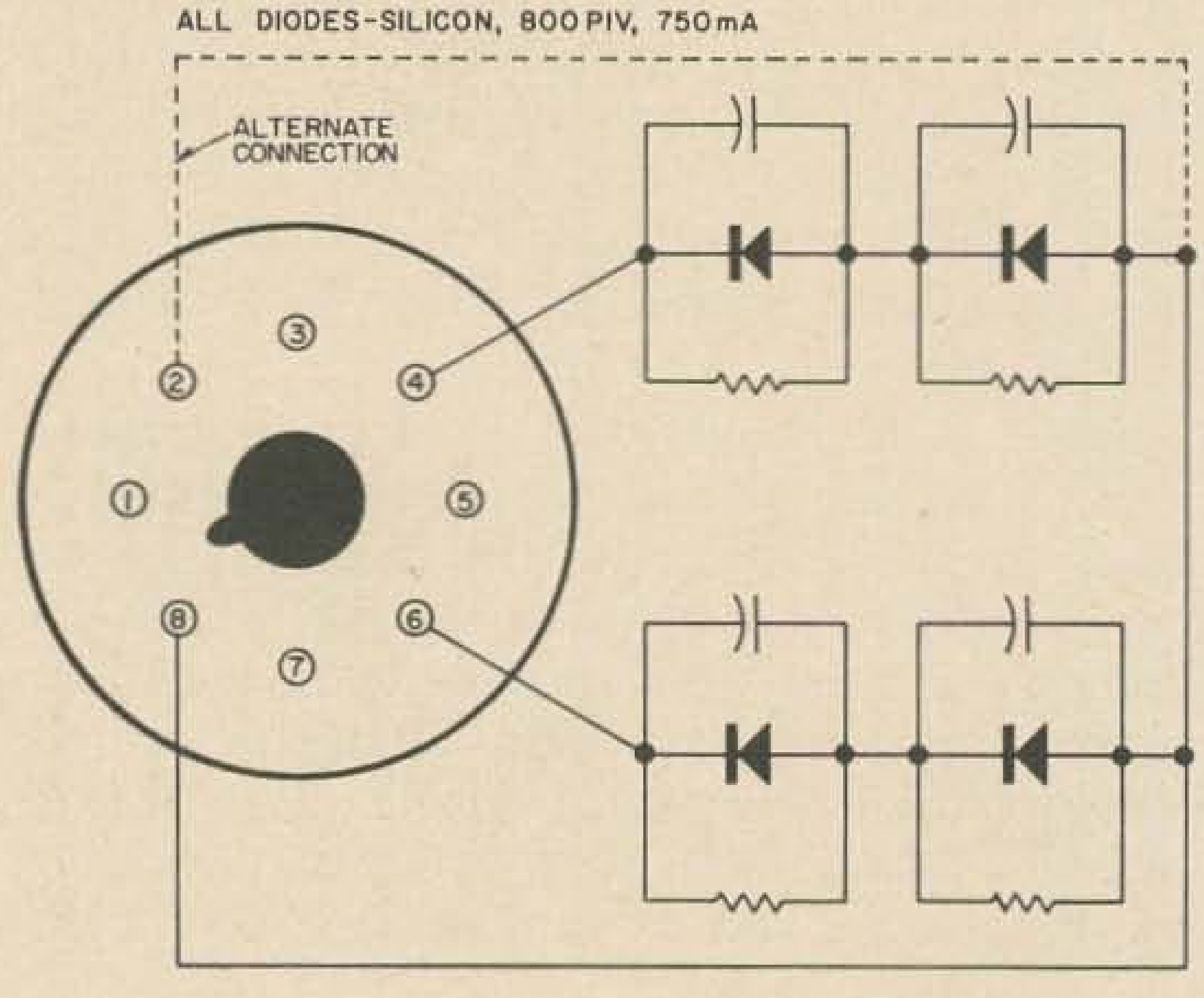
Diodes are being used more frequently in the replacement of vacuum tubes and offer several improvements. The circuit shown is a full wave rectifier with the diodes replacing the tube. The capacitors prevent the voltage spikes from damaging the diodes and the parallel resistors equalize voltage drops across the diodes. No surge resistors were needed as the resistance of the transformer secondary was high enough to limit the charging current below the diode rating. This rectifier, with proper diodes, may be used to replace the 5Y3, 5U4 and 5R4 tube rectifiers.

Some of the advantages that may be utilized upon using this rectifier are: compact size, little heat, long life, no glass envelope to break, higher output voltage (amount depending upon capacitor), or choke input filter, no filament voltage needed.

The commercial versions of this type rectifier sell from \$2 to \$5, depending upon the peak inverse rating. This home brew rectifier was very cheap as the only components purchased were the diodes and diode prices are getting lower all the time.

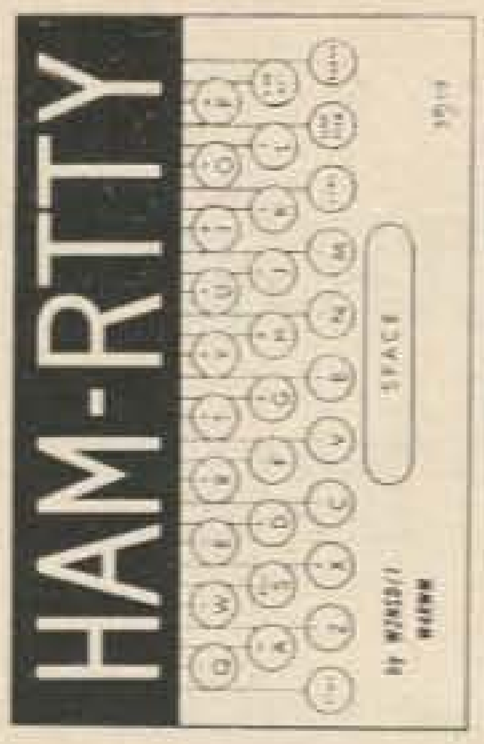
This rectifier has been used in an SX-100 receiver as a plug-in replacement for the 5Y3 for over the past year with fine results. The B+ voltage, under load, increased about 30 volts which was still below the maximum for the tubes involved. A plastic pill bottle may be slipped over the diodes to prevent any shock hazard.

. . . Carl Pleasant W5MPX



73 BOOKS FOR CHRISTMAS

HAM RTTY



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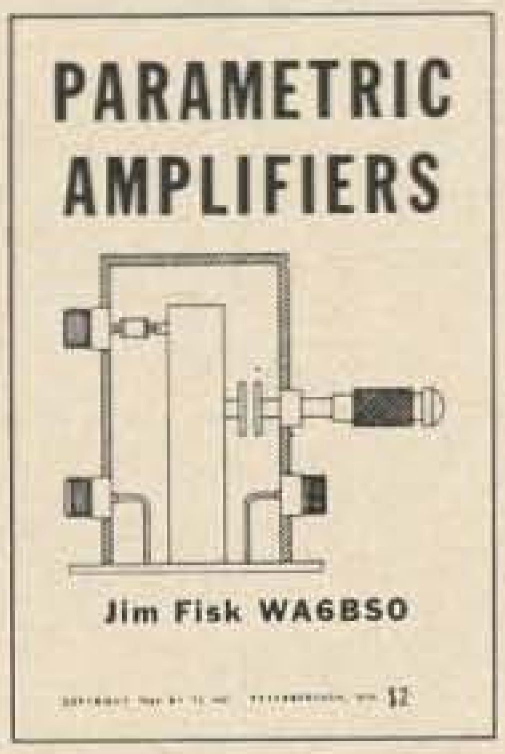

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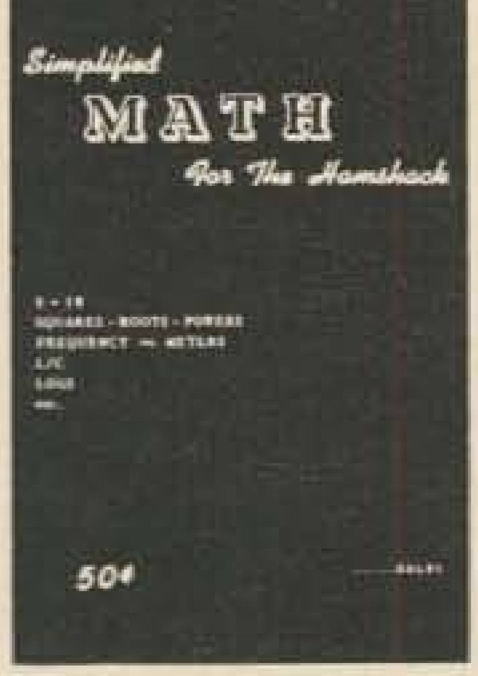

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73 Magazine

Peterborough, N. H. 03458

Richard Factor WA2IKL
Joseph Shapiro WA2ZCH
115 Central Park West
New York, New York

Remove the Drudgery from Ham Radio

Don't let the FCC close your station for altercations.

Are you sick of CW? Does RTTY break your nails? Do your gums bleed when you chew the rag? The authors, plagued with these perennial problems, have taken their cue from tape cartridges. These heretofore relatively unknown contrivances were spawned at the nation's broadcast stations where they are used to relieve the announcers of the incomparable drudgery of announcing, and the engineer, of engineering. The thought of a union engineer actually having to thread a tape (horrors) or an announcer having to read a live commercial endistraughtifies those concerned. After all, it's just their job!

Photo by Ira Fuchs WB2CLL.

The purpose of this article, Mr. Radio Amateur, is to show you how you too can avoid the daily drudgery of going on the air and talking to your contact. If your neighbor hams don't read 73, you can be the first in your town to have a real broadcast station! What we're getting at is that, with a tape cartridge setup as described below, you will never again have to talk with anyone. All you need to do is to record several cartridges with ham-type talk and then play them in sequence.

A typical QSO might go as follows: Play CQ tape until someone answers (the cartridge conveniently repeats itself every minute.) It must, of course, be used with a VOX for unattended operation. In time someone will answer you and a QSO is born. The next step is to put in the "Handle, QTH, RIG" tape, which can be individualized for each band. This can be done simply by switching tape tracks—instructions will follow. Eventually, the tape will finish and your contact will return with some similarly uninspiring information about himself. At this juncture you have a choice: if you have been listening to the QSO (you are, of course, under no obligation to do so) and you find that the other chap is interesting, you might want to go to the trouble of speaking to him. In this case, just stop the cartridge machine and come back to him personally at the end of his transmission. If you don't, (a vast majority of cases), you need only insert the "Assorted 73's and Closings" tape and walk away. Your contact will respond in kind and you are rid of him. If he is one of those who insists on emitting a string of "final finals," the tape will really put him down.

If you are in an interesting QSO and "nature calls," just start your "General Comments" tape and make the necessary pilgrimage. This not only obviates the necessity of embarrassing yourself on the air by saying where you are going, but also saves your license from official embarrassment if you inadvertently utter an illegal synonym.

At this point you are no doubt wondering what has withheld the cartridge revolution from the amateur market. Sure you are. The basic problem has been the high cost of the cartridge players. Most broadcast units cost upwards of $500. However, mass production, the American Way, has come to the rescue. Some of the tape cartridge units for automobiles use this exact cartridge, known as the Fidelipac. These units cost less than $100. However, also in the American Way, these units have already become obsolete with the advent of the 8-track Lear Jet-R.C.A. system which has been adopted by G.M., Ford, anl Chrysler. This naturally means that the price of the automobile Fidelipac units will fall. The authors feel confident in making this prediction because, in fact, it already has. We have seen ads for one unit, the Portatape, for as little as $45. This unit includes an oscillator which converts the audio from the tape head to a broadcast band rf signal which can be fed to any standard radio. It is likely that the hams in the audience would prefer to take the output directly from the head. If you don't want the oscillator, you can buy the unit for $36. The name of the supplier for the $36 unit can be obtained from, of all places, Popular Science Magazine. Saying you saw it in 73 will undoubtedly confuse them greviously.

The Fidelipac cartridges are relatively simple gadgets (see photograph). They basically consist of an "endless loop" of especially lubricated tape in a plastic box. When they are placed in a cartridge player, a removable idler wheel pops up through a hole in the bottom and presses the tape against the capstan. The pressure pads, also in the cartridge, press the tape against the head or heads. The length of the tape can be varied so that any time interval from several seconds to a half hour can be obtained. The advantages are obvious: no rewinding and no threading.

Now for the mechanics of the system. To the basic cartridge machine you must add a dc power supply for twelve volts. Since the motors have speed governors, regulation isn't important. If your player has only tape head output, you must furnish a NAB equalized preamplifier. Since most of the units will already contain an amplifier of one sort or another, just build an attenuator pad and connect it between the output and your transmitter microphone input.

There remains one problem; that of recording the cartridges. None of the machines has a record preamp. There are three ways of solving this problem. The first is to homebrew a record preamp. This is not recommended since special components are required. The second is to use the record preamp from an old tape recorder. This will work quite well even though the heads aren't designed for recording. Besides, cannibalizing an old tape recorder is in the best traditions of scrounging. Using either of these methods will yield four discrete tracks on the tape. Thus you can tailor the comment to the band, season, weather, etc. just be selecting the proper track. If neither of the above methods is appealing (that is, if they're appalling) you can buy empty cartridges and a reel of lubricated tape such as Scotch type 151. Don't try to use unlubricated tape because you'll find (*very* much to your dismay) that it will not work. You can then use a standard tape recorder to put your message on the tape which is then wound on the cartridge. If you are unfamiliar with the winding process, it is suggested that you obtain one already wound so that you can see how it is done. It should be noted that if you use a standard tape recorder you can only record one track on the cartridge. If you use a so-called four track stereo model you can record two tracks. This is because a standard machine records alternate tracks in opposite directions while all four tracks run in the same direction on the cartridge. Although this disability can be circumvented, methods of doing so are beyond the scope of this article.

The uses of cartridges in ham radio are legion. For instance, they could be used for mobile work. We feel that this would be the ultimate in keeping the amateur's mind on the road. You can even buy or make music tape cartridges for use when the band is dead. A myriad of other uses suggest themselves. Since they suggest themselves, we won't bother.

Your friendly authors can envision the day following the universal acceptance of this grand scheme when it will no longer be necessary for hams to waste their valuable time calling CQ, and, even worse, talking on the air. Instead, they can spend their time winding tape cartridges and improving their on-the-air voices and personalities. Hams could start correspondence clubs to exchange ideas for recording cartridges, and many new technical developments could ensue, such as automatic tones recorded on the cartridges to turn on your contact's transmitter when your tape is finished. Eventually, we will reach nirvana, when all hams will have tape recordings running their stations, and perhaps even use automatic QSL printers and mailers. Then the amateur will be freed from the drudgery of personally operating his equipment and he can devote his energies to more nearly useful pursuits. . . . WA2IKL, WA2ZCH

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	401-12	15-16	.6-1.6
	401-M	2-3	.6-1.6
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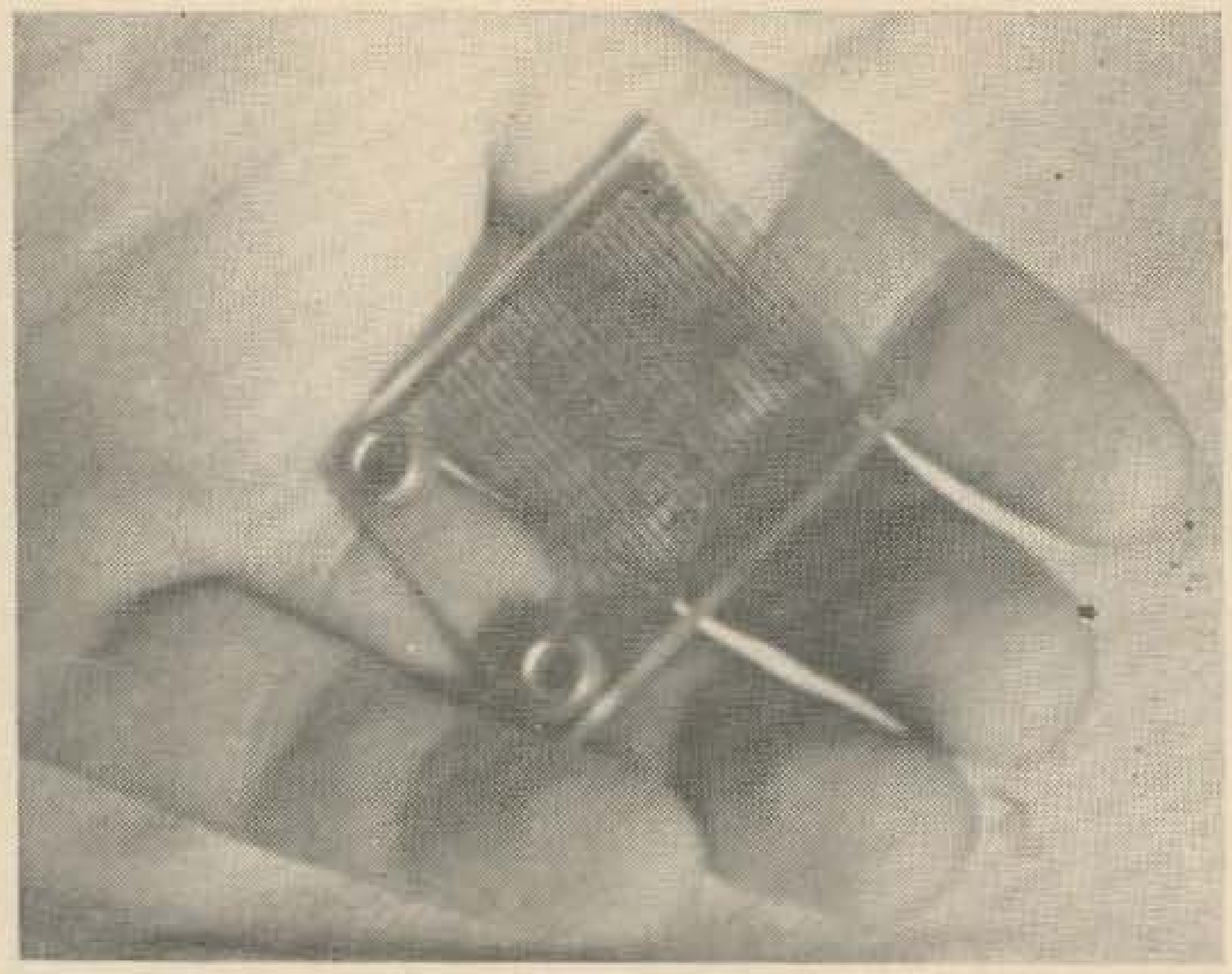

Honeywell humidity sensor used in the Humidivox.

Richard Factor WA2IKL
115 Central Park West
New York, N.Y. 10023

The Humidivox

One of the penalties we pay for switchless SSB operation is that we sometimes forget to turn the switch when it should be turned; i.e., when we get up from the rig to do something else. All too often the VOX is left on and any noise made by an unwary or unwitting occupant of the room goes over the air. While it is only embarrassing to have others listening to family arguments, it can become downright illegal if the argument is sufficiently suffused with vindictive invective. Judging from the things I've heard on the air, this happens rather frequently.

An unfortunate characteristic of microphones is that they do not have the intelligence to know when they're being spoken to. An ideal solution to our problem is to make the microphone realize that it is only to transmit a signal when it is spoken into, even though a signal just as loud from across the room should not be transmitted. While an artificial intelligence for microphones may seem ridiculous, we can construct an electronic circuit which will "tell" the microphone when to work.

Let us examine some of the alternative circuits available: The most elementary is the push-to-talk circuit. This is quite practical, but of course it completely negates the advantages of the VOX. There are more exotic circuits, such as capacitance operated proximity relays, but these are difficult to build and adjust, and

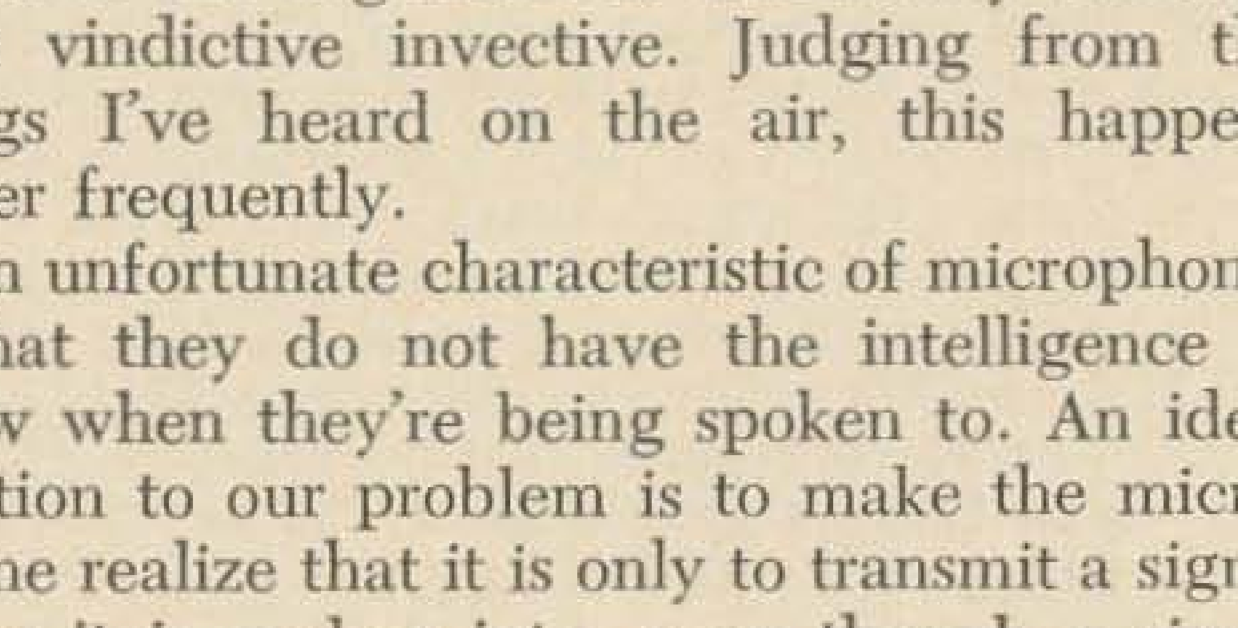

Fig. 1. Simplest version of the Humidivox. This circuit uses a humidity detector (HS-1) on your microphone to make sure that your VOX is triggered only by a person speaking into the mike.

are unreliable at best in large RF fields. A photocell detector could be used to show when someone is in front of the microphone, but these are physically unwieldy and microphones (and people) have a habit of moving around. By now it might seem that the only solution is to hire someone to sit by the T-R switch, but by remembering a universally known but totally ignored characteristic of the human organism, it is possible to construct a practical solution for a few dollars in about as many minutes.

The characteristic I am talking about is that when people talk, their breath contains moisture which can easily be detected by a number of devices on the market known variously as electric hygrometers or humidity indicators. Most of these are made with a fine grid of printed wiring on a moisture sensitive plastic surface which changes its resistance when the moisture content of the air changes. The unit I used is a Honeywell type Q229A6X1 which has a resistance in the 50 megohm range in a fairly low humidity room which decreases to less than 1 meg after a few seconds of talking at about six inches. The circuit is quite simple, using two cheap transistors in a DC amplifier. There is no particular reason why the transistors specified need be used; as long as Q1 has fairly low leakage the circuit will work. The relay you use will depend on the supply voltage. I used a sensitive reed relay which has a resistance of 690 ohms and a pull in voltage of 6V. The supply is 12V. A battery supply can be used and will last quite a while since the non-operating current is less than 1 mA, but with the prices of batteries being as high as they are, a voltage doubler connected to the rig's filament supply will be cheaper.

Fig. 1 is the most basic circuit for satisfactory operation in a constant humidity environment such as an air conditioned room. If your roof leaks or you live in an area with changeable weather, it would be a good idea to use

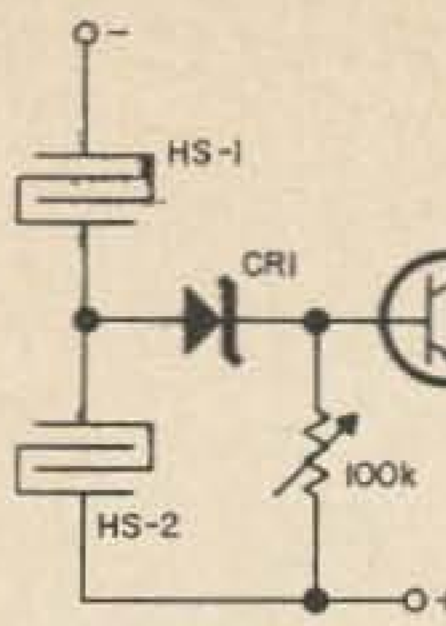

Fig. 2. This input circuit is recommended if you operate in a humid atmosphere.

the alternate input circuit in **Fig. 2.** In this circuit, HS1 is placed on the microphone and HS2 near the microphone but in a place where it won't be breathed on. CR1 is a zener diode whose value is approximately ½ the supply voltage. If the two sensors are of the same type, the junction voltage will be ½ the supply voltage regardless of the relative humidity; but if HS1 is breathed on, the voltage will become more negative and the diode will conduct and activate the relay.

There is one problem (actually more of a nuisance) involved with this system; that is the time lapse in the operation of the sensor. It will take one or two seconds to activate the relay after talking begins and about five seconds to drop out when you are through. Obviously, then, this relay can not control the transmitter directly. The author customarily uses a compression amplifier between the microphone and the transmitter. If the Humidivox is used to control the gain of the compressor, the problem is solved. The non-compressed gain is set so that nothing (short of a chorus of indignant mothers-in-law) could activate the VOX unless it is very close to the microphone. This makes it necessary to speak the first few words loudly, but when the Humidivox relay closes, the compressor gain increases and only a natural voice is necessary. When you are through talking, the system reverts to the state where it is impossible to activate accidentally. Note that it is not necessary to shout every time the VOX drops out, but only when you start a new transmission. If you don't use a compressor, just connect the normally open contacts of the relay in parallel with a resistor which is in series with the microphone and equal to about five times the input impedance of the transmitter.

The Humidivox is a simple gadget which can save a lot of embarrassment and costs little to build. There are many opportunities for experimentation: for instance, you could discover how to make it *not* respond to alcohol. This could save further embarrassment! If at any time you decide to go back to PTT or even CW, you can always use it to lower the roof of your convertible. . . . WA2IKL

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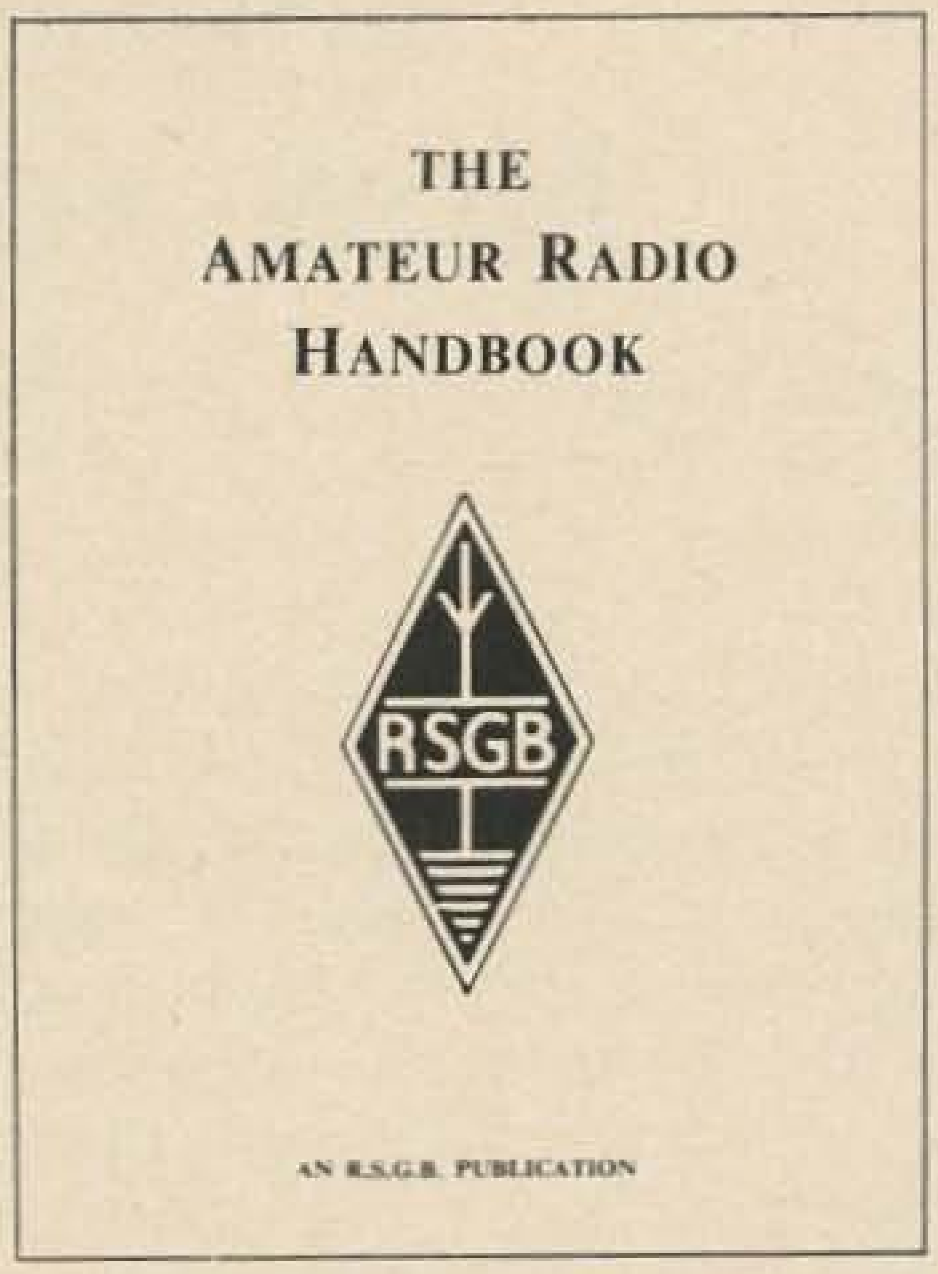

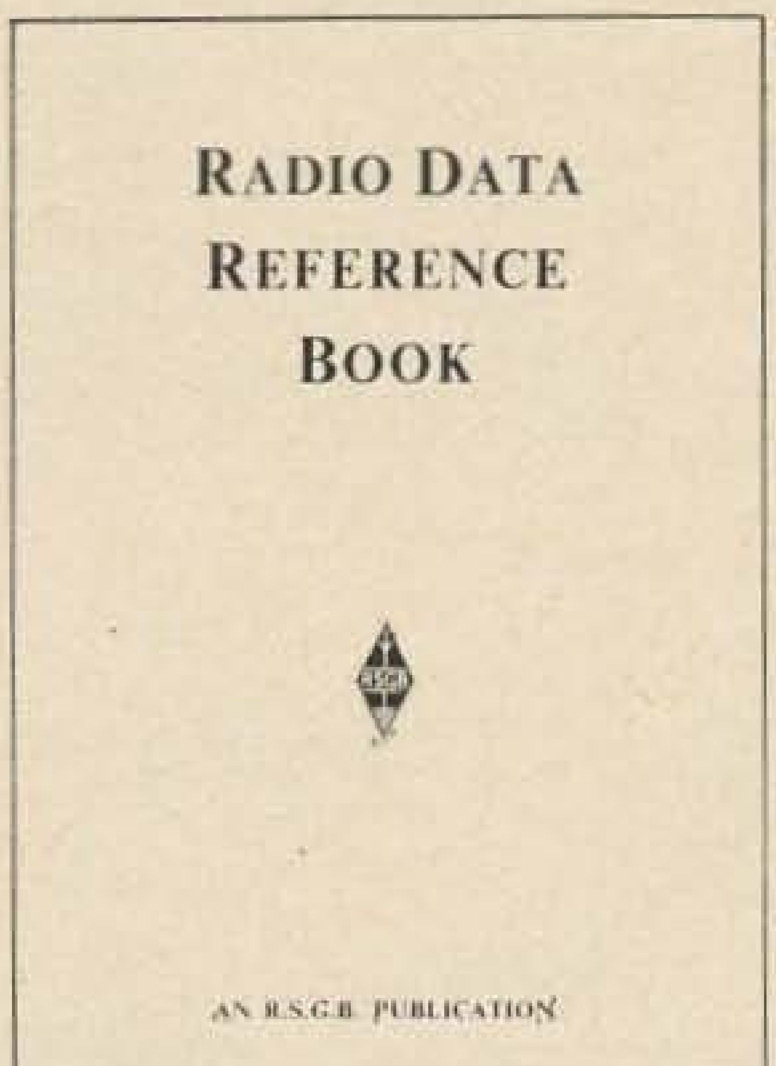

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Ron Wren W6DFT
1264 Idylberry Road
San Rafael, Calif.

The Now-You-See-It, Now-You-Don't Antenna

My wife looked at the brand new house and sighed, "It's beautiful. And look, there aren't any wires or telephone poles to mar the scenery."

I choked. No poles, ac lines or TV antennas meant only one thing: the builder had spent a small fortune burying the utility wires and installing a master cable TV system. No half-wit ham was going to move in and spoil the view with an outrageous antenna farm.

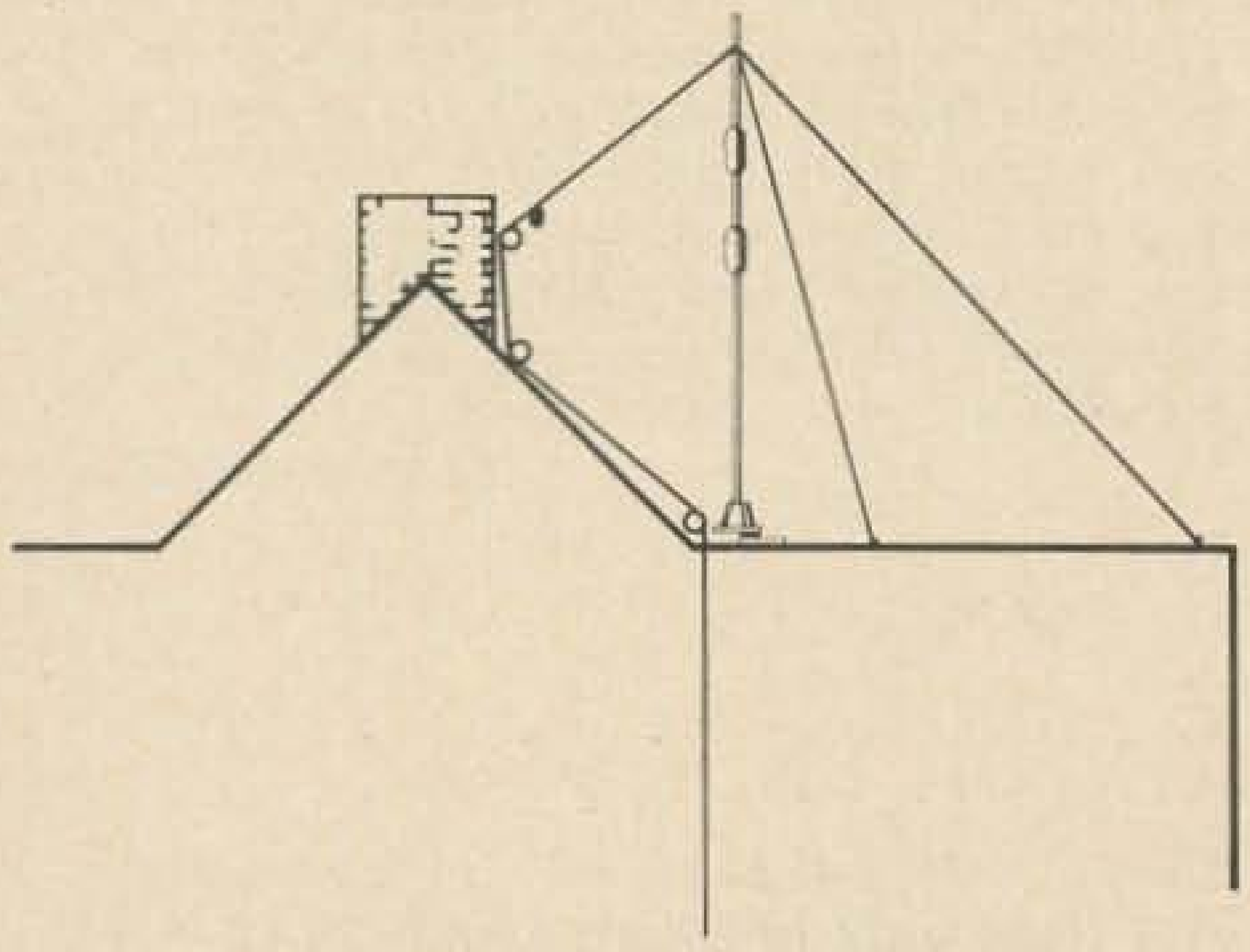
Here was my wife's dream home . . . and it happened to be a ham's nightmare. At least, I thought, it didn't have a built-in intercom set like every home in the last tract we saw. I shuddered as I thought of the probable mass "I I" (intercom interference) we would have experienced: "Who's that on the intercom, dear?" "I don't know, but I think he said he's in Guatemala."

As my wife toured the models I checked with the builder's salesman and found, as many hams are discovering in new developments, "no antennas without approval."

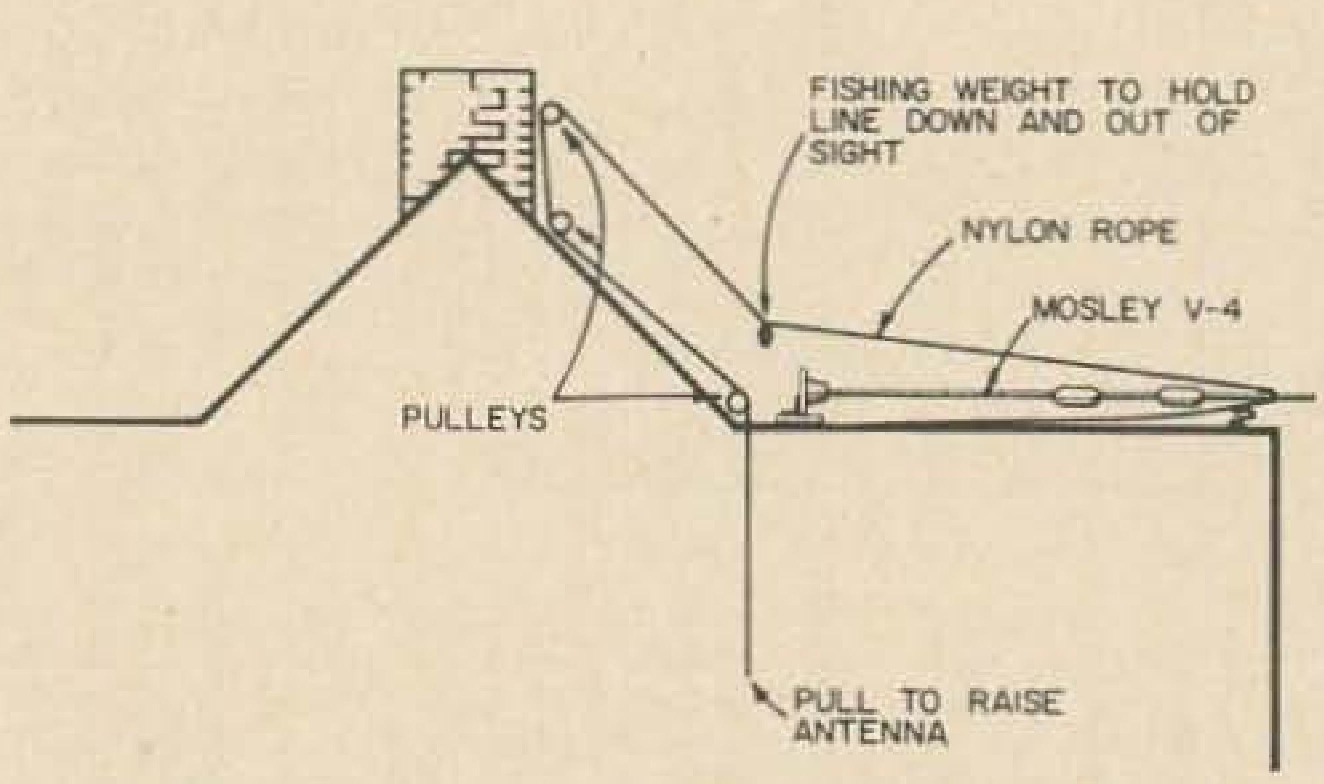
Suddenly, a thought flashed across my mind. I recalled those old World War II B movies . . . you know, the kind where the secret agent raises a mysterious antenna up from an underground hideout and transmits the coded messages home to his sinister government.

I had the answer! What I constructed, with the approval of the builder, may help other hams faced with the dilemma of esthetics over electronics.

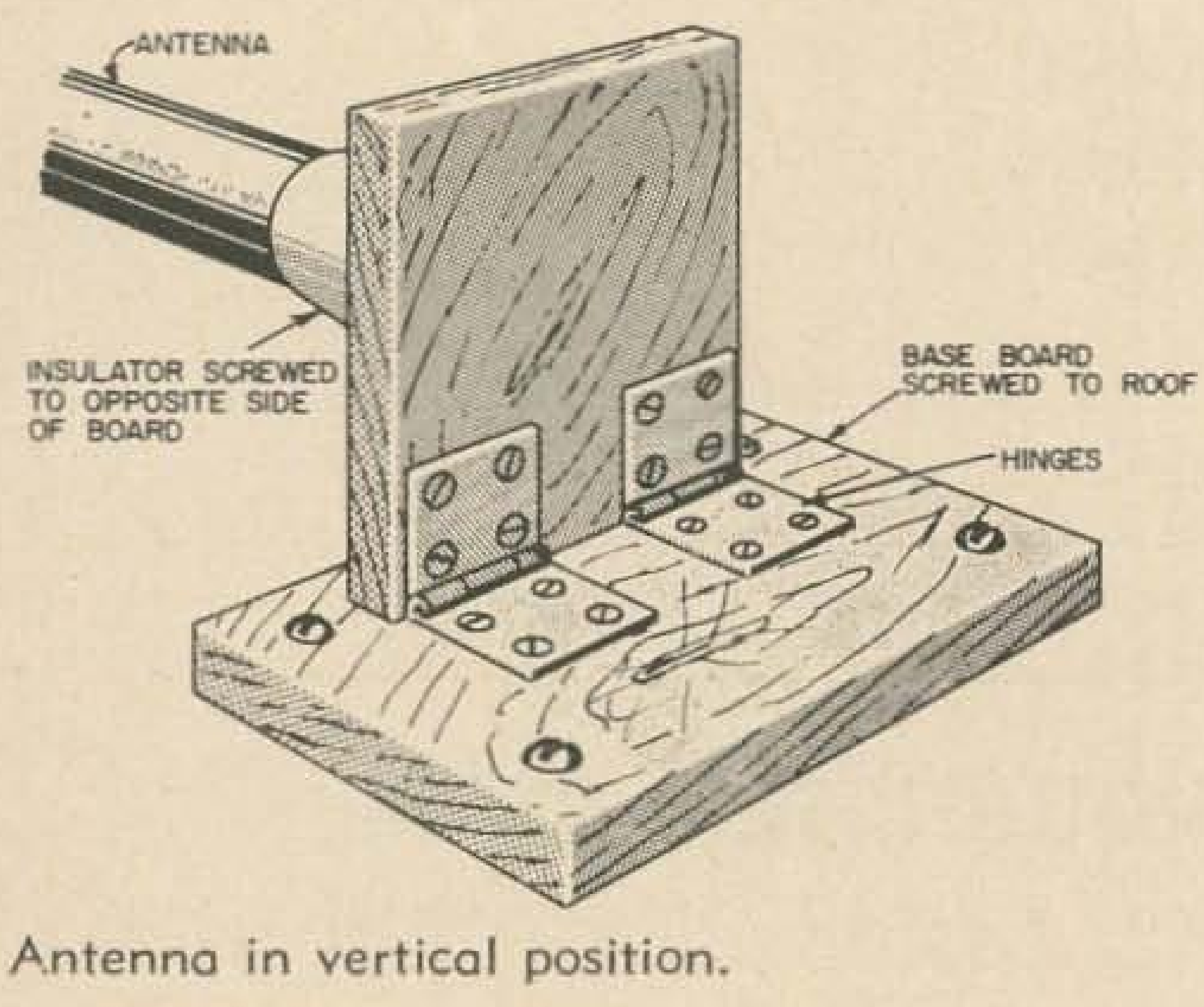
Ron is a partner in an ad agency. He's written articles for ham magazines and other magazines. He has an AB in Radio-TV Broadcasting from San Jose State College.



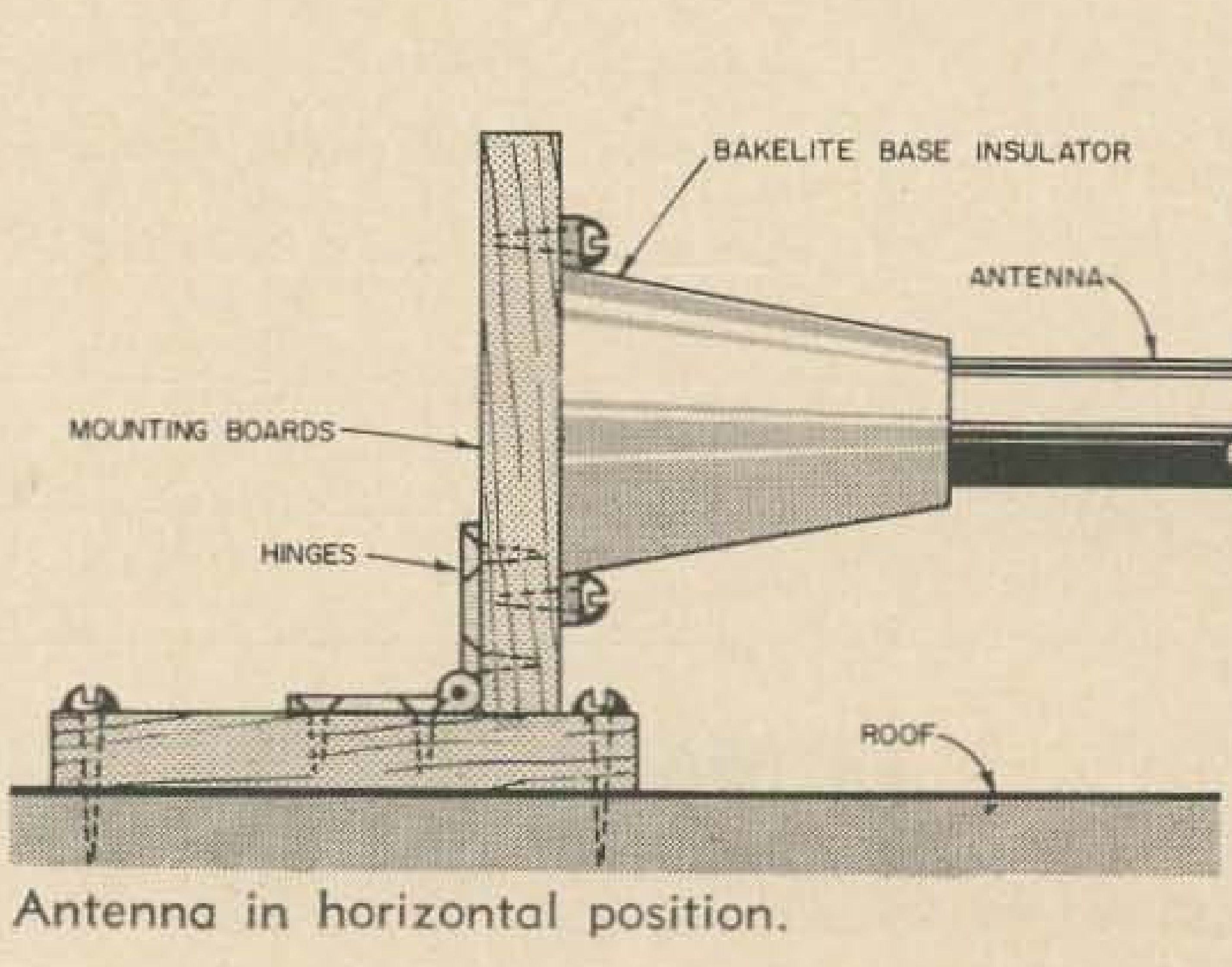
PULLING GUY ROPE PULLS ANTENNA INTO VERTICAL POSITION



VERTICAL ANTENNA IN HORIZONTAL POSITION



Antenna in vertical position.



Antenna in horizontal position.

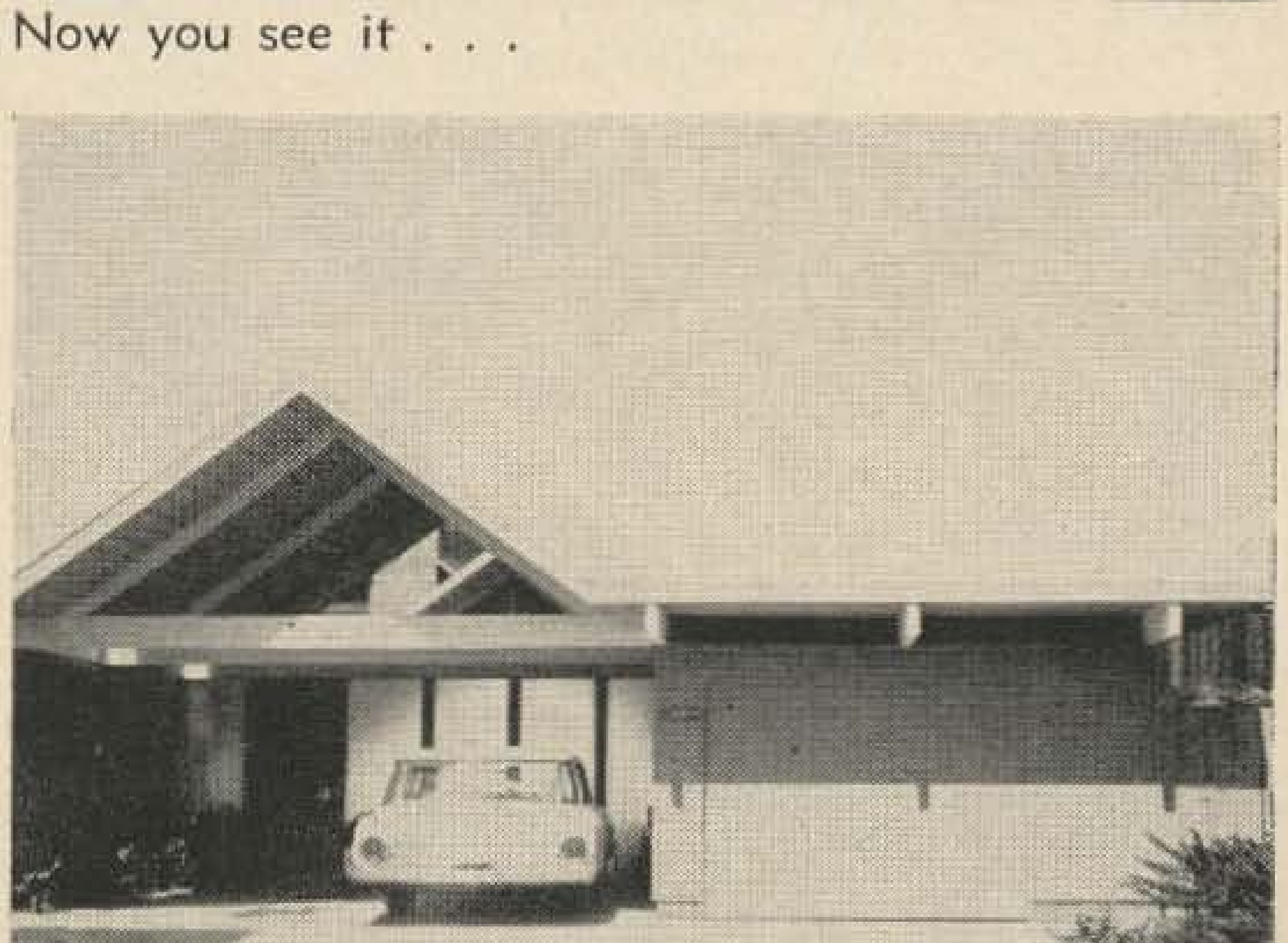
I took my Mosley V-4 vertical (any vertical antenna will do) and fastened its plastic base to a piece of board—about an inch thick by 8 by 10. On the other side of the board I screwed a pair of ordinary door hinges. They, in turn, were screwed to another 1 x 8 x 10 board securely bolted to the flat part of my roof.

Next, I fastened two nylon guy ropes to the antenna and anchored them to the roof. But for the third guy, I took an extra long length of nylon and ran it first to a pulley hooked to my chimney, then across the roof to a second pulley, then down the side of the house.

The action is simple, esthetically pleasing 99% of the time and only slightly suspicious-looking the 1% of the time when the antenna is being used. The vertical, you see, is normally horizontal—flat on the roof and completely out of sight. When I'm ready to transmit, I pull on the third guy rope, smile cunningly, and watch as my antenna slowly rises to a vertical position. The guy rope is tied to the house to hold the antenna up while I'm on the air, and released to lower it to the roof.

Since most of my operating is done at night, few of my neighbors know of the antenna's existence. And those who do simply think I'm a spy. It's better than being a ham in a "no-antenna" neighborhood. . . . W6DFT

Now you see it . . .



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Home Made Custom Decals

I am sure that most hams who like to build equipment are familiar with decals. Decals give that commercial look to home constructed equipment.

Many times in the past, I have needed a special title or design that was not in my commercial package. I imagine other do-it-yourselfers have also been faced with this problem.

Perhaps your projects only require standard titles such as: KVA, Gauss, De-emphasis, Hot Water, Tilt, etc., whereby a commercial set of decals will do the job. Should you require a special title, however, here's how you can make it at home by a method that is easy, cheap, and fun.

See if you can find the following material in your junkbox: a sheet of decals, a rubber stamp, and a piece of glass or plastic that will provide a smooth surface onto which you can roll some thick paint. Apply a small dab of paint to the glass or plastic and roll it out into a thin layer. Gently mash the rubber stamp down into the paint to ink it. Now firmly stamp the impression onto the border of the decal sheet, being careful not to press too hard or slide the stamp sideways. If you goofed on that one, try another. A little practice will probably be needed to get the desired results. When the paint is dry, the decal can be applied in the usual manner.

Commercial decal paper and other supplies can be obtained from art suppliers. A sheet of "Klear Kote," 20"x25", decal paper, that sells for about 32 cents, will make many decals. Special inks and paints can also be purchased, but some success can be achieved with ordinary enamels.

A variety of rubber stamps can be obtained from mail-order houses, or office supply stores. One, familiar to hams, is the "Name, Call, and Address" stamp. This is available for about a dollar, and it makes fine decals for identifying your equipment. The small set of individual character stamps shown in the photograph is handy and allows setting type for about any title that you might need. These and other types are usually available in several sizes and styles.

No matter which type of rubber stamp you use, you're likely to have some trouble on your first few tries. These suggestions may help you achieve better results: First, roll the

The upper left decal was made with a silk screen. The upper right decal was made by cutting a stencil from poster board and spraying through it with an aerosol type spray can. The lower left of the photo shows several decals made with the familiar "call, name, and address" rubber stamp. In the lower right is pictured a small transistor project with lettering done in decals made by the author. The "KK" was made with a stencil cut from poster board as explained above. The "W9SLM" was made from the rubber stamp. The balance of the lettering was from commercial decal packs.

Several types of rubber stamps available at low cost that can be used by do-it-yourselfers. Also shown is a tube of stamping ink.

paint into a thin film and do not press too hard on the stamp. Thick layers of paint or too much pressure will fill in the letters and make them smear on the decal sheet. This is the most important step, as it will make the difference between a clean, sharp impression and a smeary one. Second, after the decals are stamped, clean the rubber stamps with a thinner or solvent that will not dissolve the rubber. Pay special attention to removing the paint from inside the characters, as once it dries it is difficult to get out. Third, the consistency of the paint should be thick so it will not run or leave a dim impression on the decal sheet. Fourth, the stamp itself should be sharp, as it will print only as clearly as its letters are sharp.

I have also had some success in making designs for decals by cutting stencils, placing them on the decal paper, and spraying through them with a spray paint can.

Should you desire to produce a large quantity of the same decal, such as for a club project, a stencil cut on a mimeograph master sheet will serve the purpose, and it can be run off at home. And, if you're really enterprising, you can devise other jazzed up gimmicks for making truly unique decals.

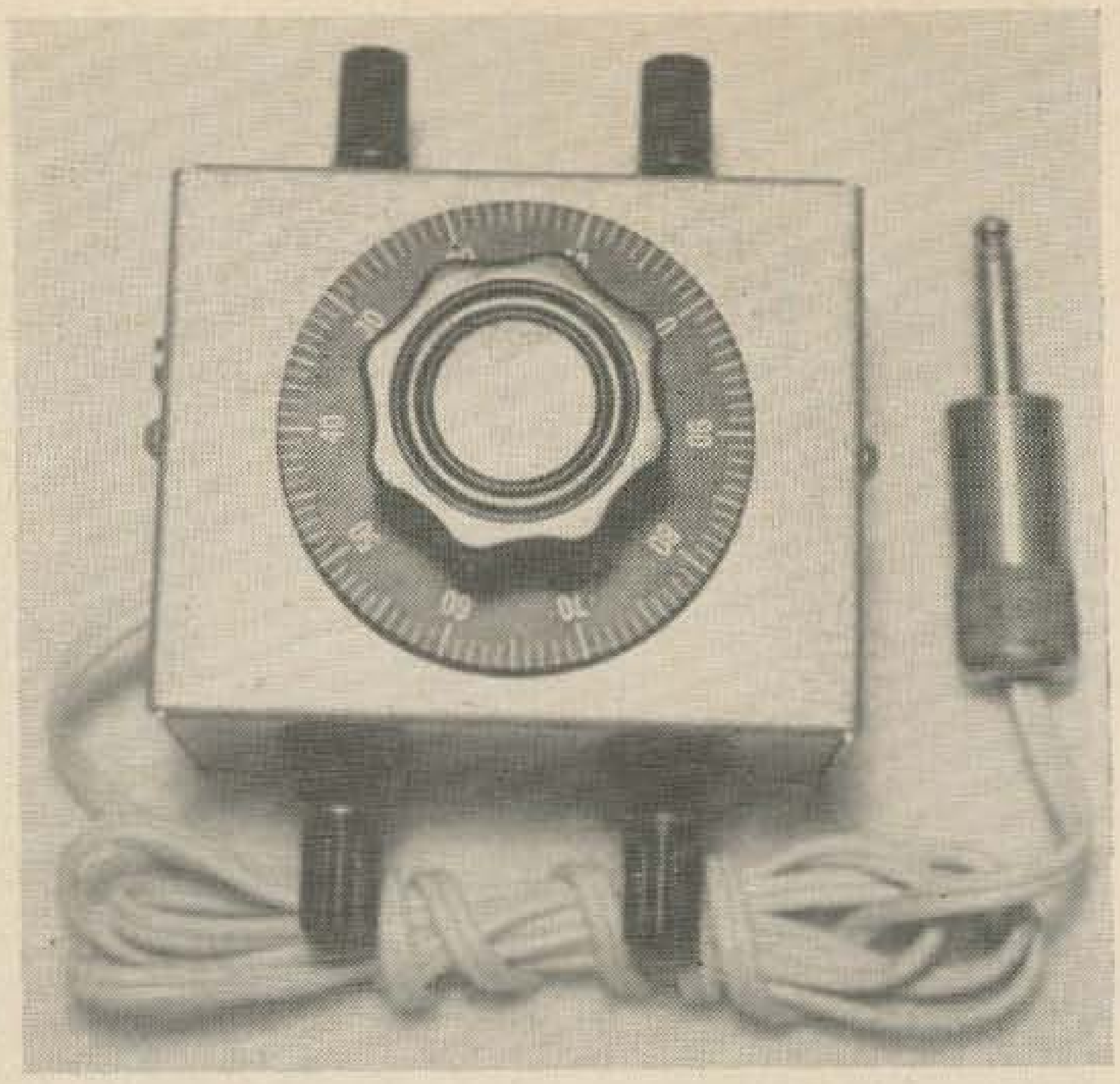
That's it men. If you've been looking for a special title or design in a decal that isn't in your commercial package, try my method, and it will give your latest creation that custom appearance.

. . . W9SLM

A quick sample impression that can be readily made to try out this method of making decals.

Houston Gene Dewey WB6AFN
314 East G Street
Ontario, California
Photo by Robert Rathburn.

A Simple C-R Bridge



WB6AFN's simple capacitance-resistance bridge.

Are you looking for a simple gadget to match resistors, and to measure accurately the values of those unmarked surplus capacitors? Your problem is solved. This little instrument is not only simple, but also cheap, versatile, and accurate.

Note on the schematic that the ac source and null indicator are not included. Inclusion of these would only increase the building cost. Most hams have an ac source readily available. You can use a 6.3 Vac transformer, an audio generator, code practice oscillator, or your ham receiver. (Turn on the Xtal Calibrator on the receiver; tune to loudest beat note; plug the bridge into the phone jack. Simple.) The null indicator may be a VOM, VTVM, or a pair of headphones.

Calibration is accomplished in two parts. First, find the median resistance. Second, calibrate the bridge to measure capacitance.

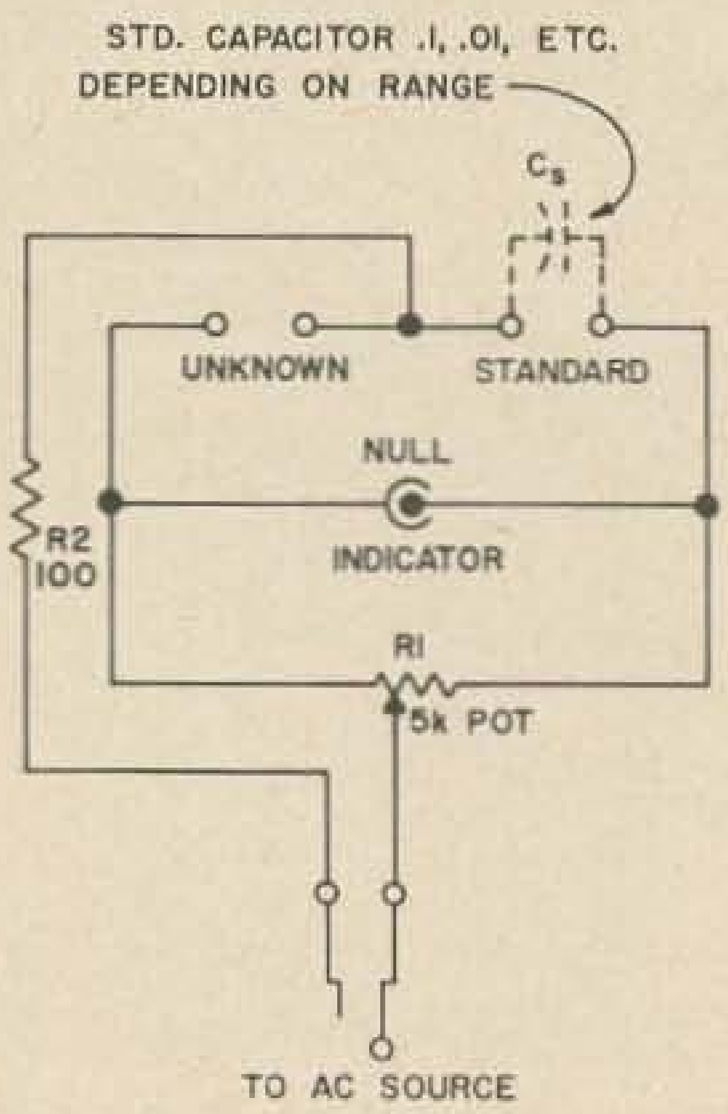
Finding the median resistance

Using two resistors of approximately the same value, attach each resistor to each set of terminals. Find null and record dial reading. Exchange resistors. Find null and record dial reading. Add the readings together and divide by two. The answer should correspond to the midscale reading on the dial. If the answer is not the same, adjust the dial and repeat until satisfactory results are achieved.

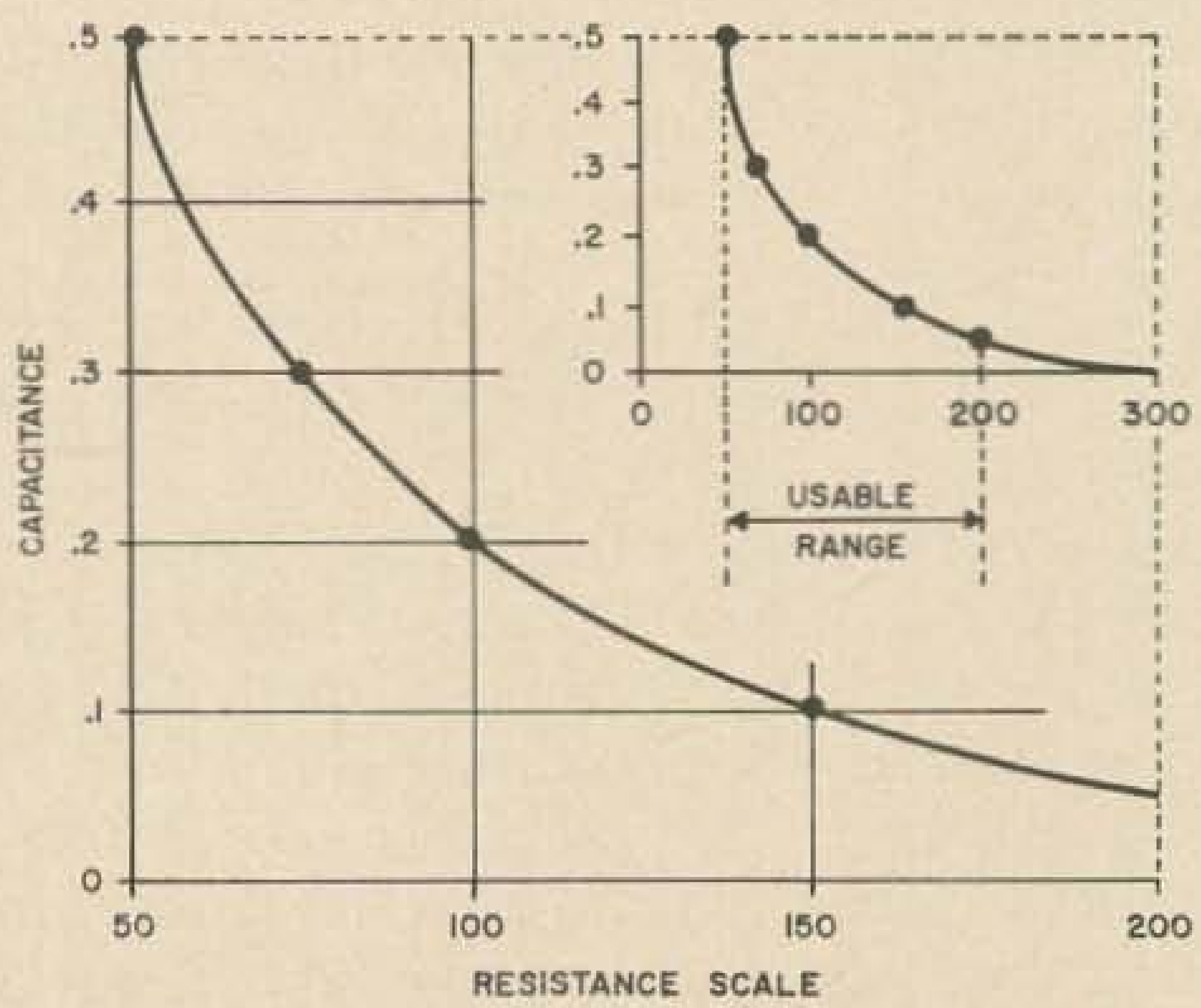
Capacitance measuring

You will need three "standard" capacitors, .1 μF, .01 μF, and .001 μF. Label one set of terminals STANDARD. Always attach the standard capacitors to the STANDARD terminals only. Label the other set of terminals UNKNOWN. Using the .1 μF capacitor, attach capacitors of known value to the UNKNOWN terminals. Find the null of each, and record the dial reading. Do this with a wide range of capacities. Graph the data. It should have a form similar to the author's graph. If each of the standard capacitors is exactly ten times greater than the other this one graph can be used with all standard capacitors by moving the decimal point to the appropriate place.

. . . WB6AFN



Schematic of the simple C-R bridge.



Calibration chart for the bridge.

Bob Renfro WA4NXC
RCA Missile Test Project
Grand Bahama Island
P. O. Box 4036
P. A. F. B., Florida

Down Range—AFETR

The Air Force Eastern Test Range was established as a testing round for the development of missiles and launching of satellites. Several tracking stations located on islands and ships in the South Atlantic acquire data on missiles and satellites and send this information to Cape Kennedy for analysis.

This data is obtained by telemetry, pulse and CW radar, optics, and receiving soundings. Some data is used to predict an impact point if power should fail in the missile. Some tracking stations are used to generate navigational signals used by ships and planes.

The location of the tracking stations are shown on the map. It is assumed a missile is fired from Cape Kennedy and flies in such a path to take it near the tracking stations.

The prime contractor for the ETR is PAA (Pan American Airways). The sub-contractor is RCA (Radio Corporation of America!).

PAA provides construction and operating of the station. They provide food, maintenance of quarters, laundry, etc.

WA4NXC in his shack. Note the QSL's over the rig.

RCA provides the technical people to operate and maintain the electronic equipment. The equipment is owned by the Air Force and manufactured by several companies.

Items necessary for sustaining human life are supplied by PAA. A military-type dining room is operated and the food is excellent. A typical breakfast consists of several juices and fruits, fried potatoes, eggs any style cooked to order, bacon, ham, toast, cooked cereal, hot cakes, French toast, etc. Take your pick of as much as you want.

Dinner and supper offer several types of meats and vegetables. There is no charge for eating in the mess hall.

Free laundry is provided as well as free movies. Modern films with plenty of good Mr. Magoo and Roadrunner cartoons are shown at dusk at an outdoor movie theater.

In addition to 2 weeks normal vacation per year, Downrangers receive an additional 30 days vacation. Free transportation between the station and Florida is provided.

Salary is attractive, Downrangers receiving an additional 30% to 40% depending on location. The salary is also tax free since the stations are foreign.

Mail service is provided by the Air Force. I count on a mail delivery once a week even though they are planned more often.

Tracking stations are on tropical islands close to the water and boats and fishing gear are supplied.

The working hours are arranged for plenty of time to enjoy the local sports and climate. However, the dining room does not conform. It always wants to serve meals in the middle of a ball game or diving expedition.

Most stations have a club with snack bar where you can buy hamburgers and other snacks. If you prefer to take your meals in liquid form, attractive prices prevail. For instance—Martini for a quarter!

Getting a license to operate at a Downrange tracking station is not impossible. Inspection of the R. O. I. (Range Operating Instructions) will indicate the procedure for each station. Downrangers can usually obtain a license easier than a native by going through the Air Force.

Out of all the technical people working at the tracking stations, there are very few active hams, one out of two hundred I would say. However, take a commercial vessel that does no technical work, just hauls grain and chemicals around the world, and you will find one out of three or four a ham. For instance, the "Marine Shipper" merchant ship, crew of ten. Out of this are three hams, W4WYI, K2OOR, and W3WVE. Take the RCA missile tracking ship, "American Marriner" 300 scientists and engineers on board, only one active ham, W5CAZ.

On a tracking station near the U. S. fringe area, TV reception is possible from Miami. This brings back the TVI problem. Also BCI, where thirty men live in one building, all playing their transistor radios. All we need is Mr. Ham to fire up a 100 watt rig down the hall and these transistor radios pump up and down with his keying or modulation.

The ham that does operate will use earphones, have his room light out, and use a disguised antenna. Could be there are more hams and they just don't let it be known.

Of these so-called active hams down range, why don't you work them? My investigation shows this:

The typical ham getting off work checks out scuba tanks, does a bit of spear fishing in the crystal-clear, shark-infested waters of the South Atlantic, makes it back for supper, and thoroughly gorges himself.

Then to the club for a few after-dinner drinks to aid digestion. Then it's time for the outdoor movie theater and become food for the mosquitos and sand fleas for three hours. After that some liquid refreshments, game of darts and pool, then bedtime.

Who wants to turn on the rig? Because downrangers have exotic prefixes of VQ9, ZD8, ZD7, etc., it's impossible to have a leisurely QSO with an old friend. The pile up is enough to burn out your receiver.

So you want to join up and operate from exotic DX spots, and really get your fill of DX operating? Chances are you will soon find skin diving, playing pool, and girl chasing in the native village more appealing than sweating over your rig. . . . WA4NXC

Byron Weaver WB2HAL
87 Cottage Place, Apt. 22
Long Branch, New Jersey

The Second Requirement

Get maximum power from your link coupled transmitter.

Although the pi-network is the most popular output coupling circuit, there are still many who use untuned inductive coupling to transfer power from their transmitter to the antenna. This type of coupling is probably most widely used in portable or mobile equipment where the power is low. It appears to be a simple, inexpensive, and space-saving method but the question arises, "Are you really getting the most from it?" Chances are, you are not!

Recently, I built a battery operated low power transmitter and decided to use this type of coupling.

Fig. 1 illustrates a typical circuit, where R represents the load resistance. Assuming that the antenna and transmission line have been properly matched (in which case R is equal to the line impedance), maximum transfer of power will occur if:

1. The tank circuit (C1 and L1) has a loaded Q of 10 or less,
2. The pick-up or link coil (L2) has a reactance equal to R at the operating frequency, and
3. Coupling is very tight between coils.

Little difficulty arises in meeting the first and third requirements, but if your transmitter fulfills the second requirement, either you are very lucky, or you have taken time to make the worthwhile adjustments!

The object here is to enable you to meet the second requirement! Theoretically, it is possible to compute the approximate inductance, but the approximate is not nearly enough! Most articles state a certain number of turns for L2. This may have been optimum for the author but most likely you will not have a replica of his transmitter. Then too, he may not have adjusted his link properly either.

Trial and error is the method I have found to work most satisfactorily to meet the second requirement. It requires only time and patience. Once finished, you know the status of your power.

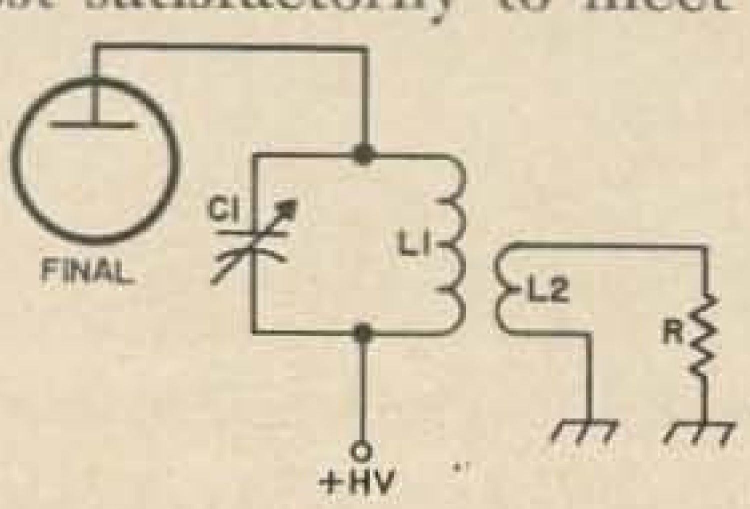


Fig. 1. Typical rf output amplifier showing the output coil, L1, the link, L2, and the load resistor, R.

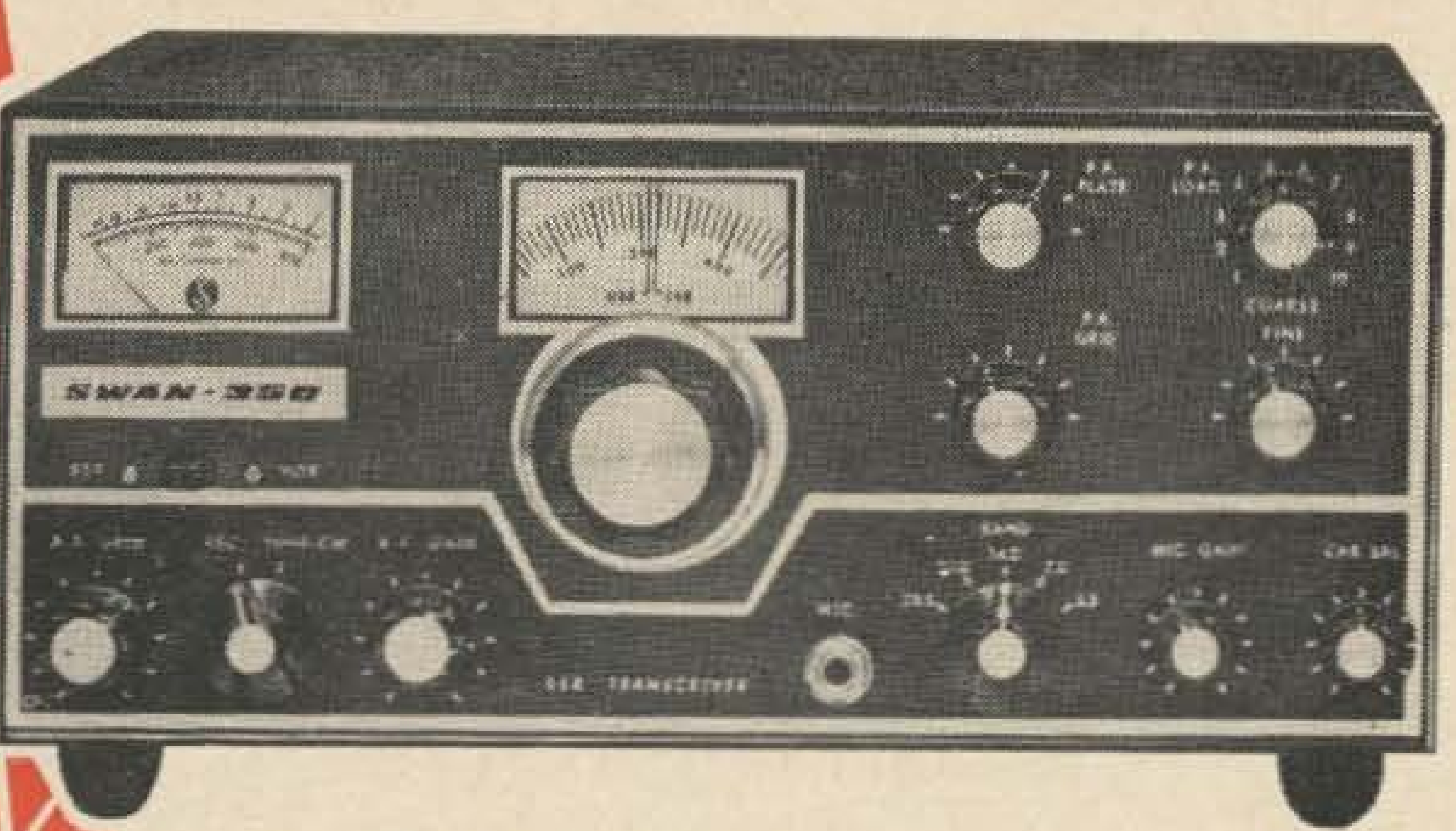
Following is the procedure I used to increase my output voltage from 0.15 volts peak-to-peak to 13.5 volts peak-to-peak across a 50 ohm load. The dB meter on the receiver went from 35 dB to well past the 100 dB mark!

Since my coaxial cable was about 50 ohms, I connected a 50 ohm, 2 watt resistor directly across the transmitter output connector, keeping the resistor leads as short as possible. The resistor was the composition type and not of the inductive variety. Connecting an oscilloscope across the resistor I found the voltage to be 0.15 volts peak-to-peak with 3 turns on the link of the 40 meter transmitter. The turns in both L1 and L2 were close wound on a 1 inch diameter form. By spreading the turns on L2, the voltage increased to about 3 volts. This indicated that I had lowered the inductance and/or got closer coupling since there was now no space separating L1 and L2. By taking a turn off the link, the voltage increased to about 6 volts for 2 tight wound turns. Opening the turns decreased the voltage. Moving the link closer to, and away from L1 varied the voltage tremendously, although moved only an eighth of an inch or less at a time. Finally, a point was wound where I had a maximum of 13.5 volts peak-to-peak for my little rig and I applied a little cement glue on the pick-up to hold it in place. The results of the adjustment were obvious on the receiver's meter when the rig was reconnected to the antenna line for it pegged!

Many amateurs don't have a scope available as I do, but can possibly find a friend who has one. Pilot lamps of the proper impedance could be used in place of the resistor by observing the brilliance and adjusting for maximum. An AC voltmeter suitable for the frequency might be a substitute for the scope. everal resistors can be paralleled to obtain the wattage and resistance required for your rig. Make sure the leads are as short as physically possible in any case.

After all, if you have given time to build a rig, you shouldn't short-change yourself by keeping the power in the rig rather than the antenna, unless you are in need of a heater rather than a contact! . . . WB2HAL

NEW SWAN-350 TRANSCEIVER



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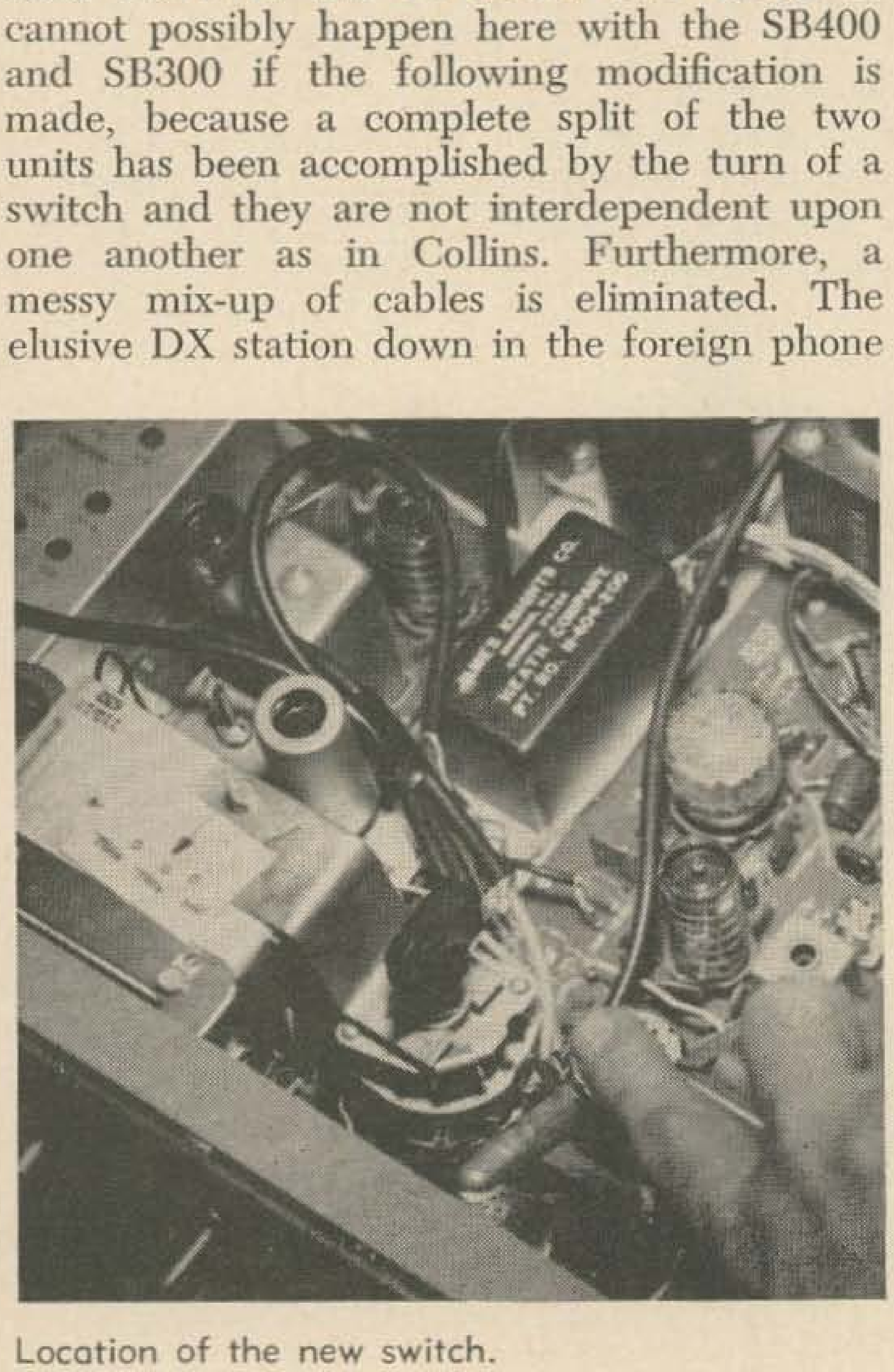
Cdr. Gay Milius W4NJF
Robert Webb K4ASU
421 Saddle Rock Road
Norfolk, Va.

Heath SB400 Modification

The Heath SB400 and SB300 work well together in tranceive but there are times, usually working DX, when it is necessary to operate them apart from each other. It then becomes a chore and takes time to shift plugs and cables in the SB400. The Collins S Line makes a similar change by simply throwing a switch on the front panel of the exciter when the receiver and exciter have been cabled together for tranceive operation. However, at times, this can cause havoc, and pink tickets, should the operator neglect to check the band segment in which the exciter was set. This is what has happened when the CW operator suddenly hears SSB signals from American stations down in the 20 meter CW band. It cannot possibly happen here with the SB400 and SB300 if the following modification is made, because a complete split of the two units has been accomplished by the turn of a switch and they are not interdependent upon one another as in Collins. Furthermore, a messy mix-up of cables is eliminated. The elusive DX station down in the foreign phone band can be heard while he is called, up in the American phone section without delay.



Location of the new switch.

The entire affair is done by the installation of a double throw, 2, 3 or 4 pole rotary switch with two wafers. A common surplus item was used here but others are readily available in the market. The poles of the rotary switch are attached to the lead from the mixer and are thrown to the lead to the receiver LMO or to the lead to the transmitter LMO. At the same time, using the second wafer, when in split operation, the dial lights of the SB400 are energized to indicate that the transmitter is being operated separately and the receiver LMO is grounded out.

This is quite cheap, easy and simple because beside the rotary switch all that is required is a length of RG-58A/U coax, a small piece of aluminum, three phono-plugs, a piece of hookup wire and a 100 ohm ½ watt resistor. Most of the wiring can be done before the rotary switch is installed. The only modification to the original SB400 is a minor change in the wiring of the two dial lights which are fed normally from two different sources. To control them with one switch, the dial lights, of course, must be fed from one source and wired in parallel.

The accompanying photograph clearly shows the placement of the rotary switch for which a small bracket is constructed from the piece of aluminum. The screw which holds the bracket is already in the LMO cover of the SB400. It is loosened and run through a hole or slot in the bracket and put back into its original hole. The bracket is bent sufficiently to permit the rotary switch being used to fit comfortably in the space to the right of the LMO.

The wiring is relatively simple after the cables have been prepared. All of them can be soldered to the rotary switch before installation. Lay aside the two cables which came with the SB400 and which were used to make the transformation to transceive. Save them, as they may come in handy at a later

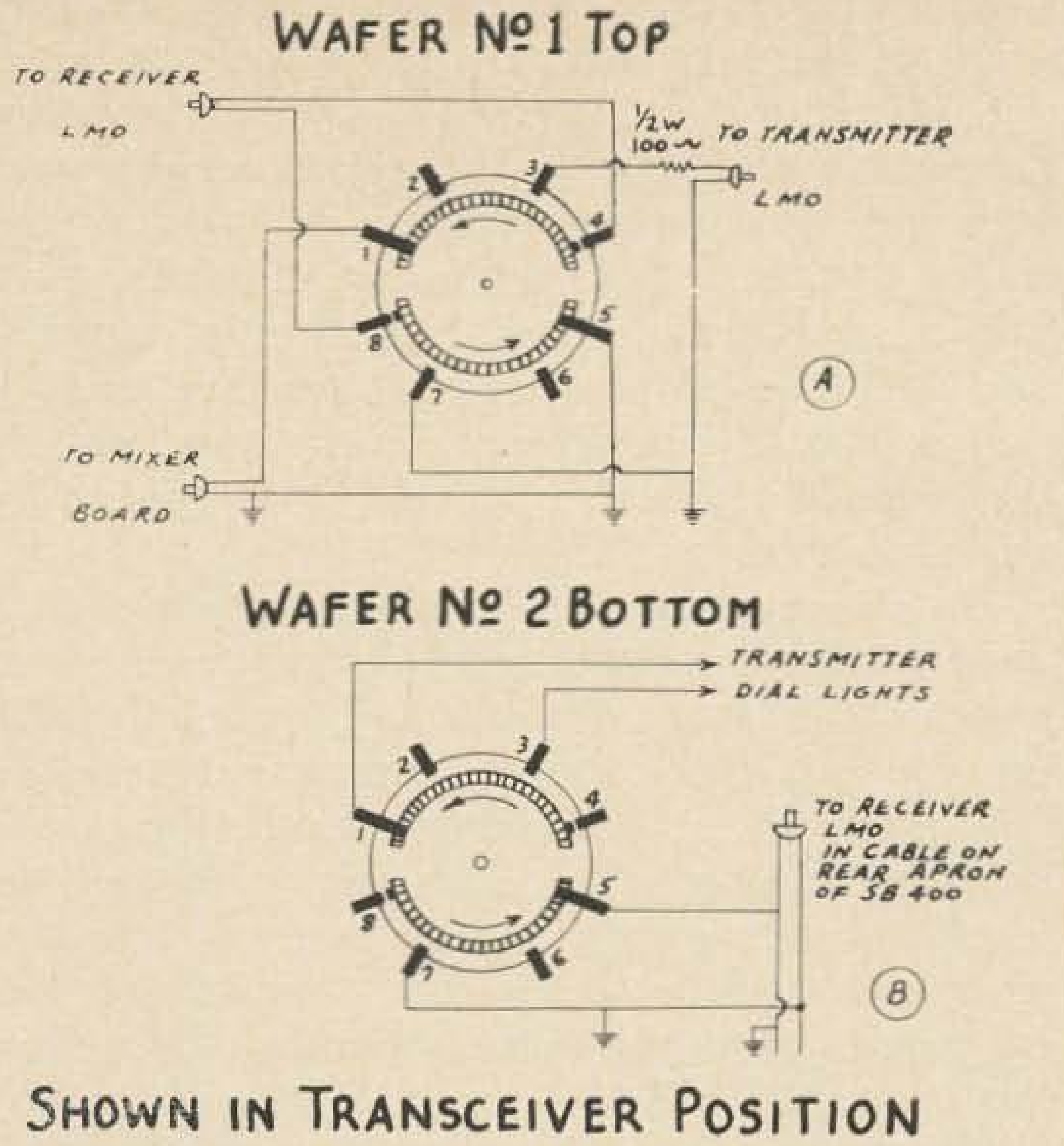


Fig. 1. Wiring of the new switch for the SB-line.

date. Cut four cables from the RG-58A/U. It is suggested that, prior to cutting the coax, you determine the lengths required by using a piece of solid wire which can be threaded between the components and thereby obtain fairly accurate dimensions. Enough cable should be used to be dressed professionally around the components on the chassis. Length is not critical. In the photograph the cables appear to be rather long; but they were shortened for neatness after the picture was snapped.

Two of the cables just cut are fitted with phono-plugs at one end while the remaining end of each of the two is stripped to solder to the lugs on the rotary switch. One cable, which will go between the rotary switch and the transmitter LMO has the 100 ohm resistor inserted in series with its center lead and a phono-lug is fitted immediately after the resistor. (This is the same arrangement as on one of the original cables which came with the SB400.) The other end is also stripped for attachment to a lug on the rotary switch. The fourth cable is rather long and has both ends stripped. One end of that cable will be soldered to a lug on the second wafer of the rotary switch. The other end will be fed through the rear of the cabinet and joined in and at the phono-plug already on the cable which comes from the receiver LMO. There is a small hole in the back of the SB400 cabinet which requires only a little enlarging to admit RG-58A/U. This concludes the preparation of the cables and they should be soldered to the proper lugs on the rotary switch as set out in **Fig. 1.**

At first glance it will appear as if one segment of the top wafer on the rotary switch is not necessary because all the connections thereto go to ground. However, nothing will be saved by connecting the shields of all the cables together. Nothing but an unwieldy mess results, and there will be saved only one segment of the rotary switch—two sections or wafers are still necessary. The rotary switch, therefore, becomes an excellent tie point for all cable shields.

On the lower wafer of the rotary switch a discerning eye might be led to believe that in place of the long cable which goes out through the rear of the cabinet, connections can be made directly at the rotary switch, thus eliminating the long cable. This was tried and the results were quite unsatisfactory. Spurious emissions appeared. As the purpose of this cable is to ground out the receiver LMO when the transmitter LMO is in use and hereby eliminate or prevent beat notes from the combination of both LMOs, it is logical that the grounding should be made away from the transmitter and outside of the receiver.

As for the dial light modification, view the lights from the front of the SB400. Disconnect the brown lead coming from the base of the mixer band-pass circuit board at the left-hand dial light. Lengthen this wire so that it will reach pin #1 on lower wafer of the rotary switch and solder it to pin #1. (See **Fig. 1B.**) Disconnect all the leads on the right dial light. There are a good number attached thereto because it has been used as a tie point. Solder all those leads together and tape them well. They can hang free. Run a lead from the left dial light to the right dial light. Run another lead from the left dial light to pin #4 on the lower wafer of the rotary switch. You now have placed both lights in parallel from one source of power and the switch will complete the circuit only when it places the transmitter LMO into operation. The connections to the switch can be made after the cables have been attached and before the rotary switch is attached to the bracket on the LMO cover.

To embellish the job you can make a little diagram as seen in the photograph to tell you where the pointer lies. This, of course, is not too necessary because if everything is working correctly your dial lights will light when your transmitter LMO is taking over.

Anyone who has the two pieces of gear can immediately discern the inconvenience which this modification removes. Now, all you have to do to leave transceive operation is to lift the transmitter cabinet cover and switch to split operation!

. . . K4ASU, W4NJF

MORE ON COLLINS

COLLINS R391 SIMILAR TO R390

In the June issue we published an advertisement on Collins Communications Receivers. Many of you have written in asking for specifications and prices and many have been sold. Because of the questions asked, I feel that I have left out information which might otherwise have enabled other sets to be sold; so here goes:

The Collins 388, 389, 390, 390A, and 391 are the best communications receivers available in the world today. When modified with a product detector, they actually out-perform most of the sets made which sell at two to five times as much money but which were designed to be light-weight versions. These models of which I write are rugged, reliable, trustworthy, and impressive in the job they do. Looking at what the dollar buys today in terms of 1966 products, you can actually feel the superior value in these sets. There are those of you who want a communications receiver which can be used in conjunction with converters for tuning 2 meters, 6 meters, and higher frequencies. How can you impress the 5-megacycle wide 220 MC band on a .5 MC band? In other words, how can you display properly these VHF ham frequencies on the HF frequencies such as 80, 40, 20, or even 10. It can't be done. When you use the S line, you have to keep on cranking in 200 KC chunks and then retune all over again and even this is limited to four such consecutive spots. The superiority of the Collins 390 or 388 series is thus clearly established for the VHFer. Consider the need for stability in teletype. Here we want to preserve our 850 cycle frequency shift and a set which has a drifting VFO or BFO will mean poor results.

Once the Collins has been tuned, it is going to stay put. For those of you who want to know frequency exactly, these sets will permit you to tune to a frequency while the power is off and then by merely turning the set on you will be on the nose within 300 cycles. A side by side comparison of the specifications of these three types of receivers is given for your consideration. The prices shown are for receivers meeting these specifications and which have been painstakingly restored in all respects to that provided by the manufacturer. We guarantee what we sell and so if you want the satisfaction of having the very, very best in high frequency general purpose communications receivers—whether for ham, commercial, or laboratory purpose—do not hesitate, for if you divide the cost of this merchandise by the number of years of satisfaction that you will have, these sets will cost the least and yet provide you the most. The product detector modification for each set is $255.00 additional. Goods are subject to prior sale and f.o.b. Harvard, packed for shipment anywhere in the world at no extra charge. See our ad in the June issue for more detail.

SPECIFICATIONS

	388	390-391	390A
Frequency Range	540KC-30.5MC	.5-32MC	.5-32MC
Mode of Reception	MCW-CW-AM	MCW-CW-AM	MCW-CW-AM
Calibration	Direct every 100KC	Every 100KC	Every 100KC
Tuning	Linear with frequency slide rule dial	Digital readout	Digital readout
Stability	±1KC within its range	±300 cycles	±300 cycles
Temperature Range	−20° to +60°C	−40° to +65°C	−40° to +65°C
Sensitivity	3mv = 500mw, ±6db S to N	3mv on AM, 1mv on CW	3mv on AM, 1mv on CW
Selectivity	200cps-6KC, ±6db	100cps-16KC in 6 steps	100cps-16KC in 6 steps
Spurious Freq. Response	Down 50db	Down 55db	Down 55db
Power Source	115/230V 60 cps	115/230V 60 cps	115/230V 60 cps
Wattage	85	225	225
Input Impedance	Bal or unbal 300-ohm	125-ohm terminated matches 50-ohm with adapter	125-ohm terminated with adapter to 50- or 70-ohm
Output Impedance	3.2 or 600-ohm	3.2 or 600, and 600	3.2 or 600 and 600Ω
Dimensions	10½hx19wx14 deep	10½hx19wx14 deep	10½hx19wx14 deep
Weight	35 lbs.	80 lbs.	75 lbs.
Price	$775.00	$1350.00	$1495.00

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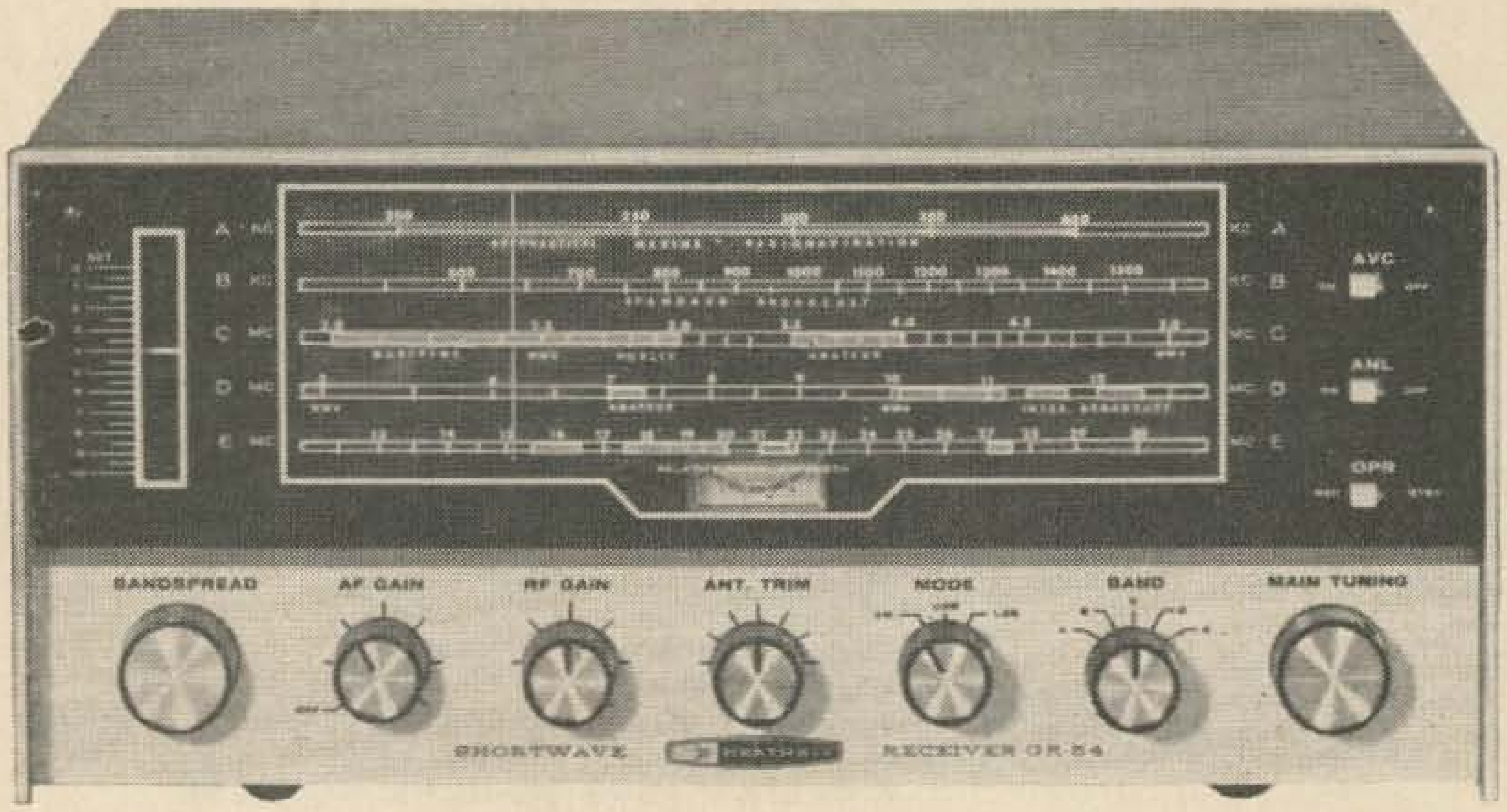


Testing the Heath GR 54

Here's an inexpensive general coverage receiver for the ham or SWL.

"Get a $150 SWL Receiver for $84.95," the ad read.

"Well, they'll have to show me," I thought as I sent off a check for the receiver. An ad can and often does say anything, but knowing Heath's reputation I figured I'd get more than $85 worth anyway. After building the receiver, I've found that they're right.

The GR-54 covers 2 to 30 MHz in three bands, plus 180 to 420 kHz and the broadcast band. It contains a power transformer with a full-wave, silicon diode power supply. A tuned rf amplifier stage is used, with two *if* amplifier stages. A diode detector is used for AM detection and a separate product detector for SSB. Two diodes provide the ANL. One stage of audio amplification feeds the output stage. A built-in speaker is provided with an output connection of 8 ohms for external speaker if desired.

A number of multipurpose tubes are used, keeping the count down to six tubes. In addition, six diodes are used, plus the power supply silicon diodes. An "S" meter is used to indicate relative strength of signals. The *if* frequency is 1682 kHz.

Most unique in a receiver (not to mention one under 100 dollars), is the use of two crystals, one at 1680.1 kHz and the other at 1682.4 kHz, providing a half-lattice crystal filter! This crystal filter is placed in the secondary winding of the mixer to first *if* transformer, providing a narrow bandpass through the *if* amplifiers. By using these crystals, selectivity is 3.0 kHz at 6 dB and 7.5 kHz at 20 dB! This is quite remarkable for a low priced receiver.

Sensitivity is very good. Best sensitivity (on SSB), was on the 2.5 to 5 MHz band and was .4 μV average, with lowest sensitivity of 4 μV on the highest band. The relatively low sensitivity on the highest band is rather typical and expected.

I wondered how they could maintain such a high average sensitivity in a kit, with the receiver being built by quite a range of electronic talent. When I built the receiver, this became self-evident. The kit uses five separate, heavy printed circuit boards! As a matter of fact, no wiring is done on the steel chassis, except for inter-board wiring and the power supply.

Three boards are used for the front-end coils. The first one has all of the antenna coils, the second the rf amplifier plate coils and the third the oscillator coils. Even the coils are different on this receiver. They use a very strong coil form with four strong mountings. This prevents the inexperienced from finding it easy to break one of them, or burn them up with a soldering gun.

The rf, oscillator and mixer stages are located on another circuit board, with their associated parts. The last and largest board contains *if* stages, detector, product detector and audio stages. Coaxial cable is used for inter-board connections where required. Layout is good. A long shaft is used with the antenna trimmer capacitor, so that it can be located close to the rf amplifier stage. A rod antenna is used on the broadcast band, acting as antenna and also the antenna coil for that band. The antenna input impedance is a nominal 50 ohms.

Using printed circuit boards for the various coils and circuits, Heath has made alignment very easy. In addition, the coils are pre-tuned, and I do mean *pre-tuned!* I used a lab signal generator to align my kit, and not one of the coil slugs had to be turned more than half a turn. If the kit builder did not have equipment, but followed the directions given in the manual, he couldn't go wrong. (As a matter of fact, I aligned a student's GR-54 by this method and it came off fine.)

Check out of the receiver on the air came off without a hitch. Electrical bandspread is provided, and with the half-lattice filter, selectivity and tuning was very good. The low frequency band (180 to 420 kHz), was somewhat dead at this location, which is normal here. The sensitivity on this band is approximately 1.5 μV, however. The receiver does not have a tendency to overload on strong signals and the antenna trimmer, unlike some receivers checked out here, really makes a difference.

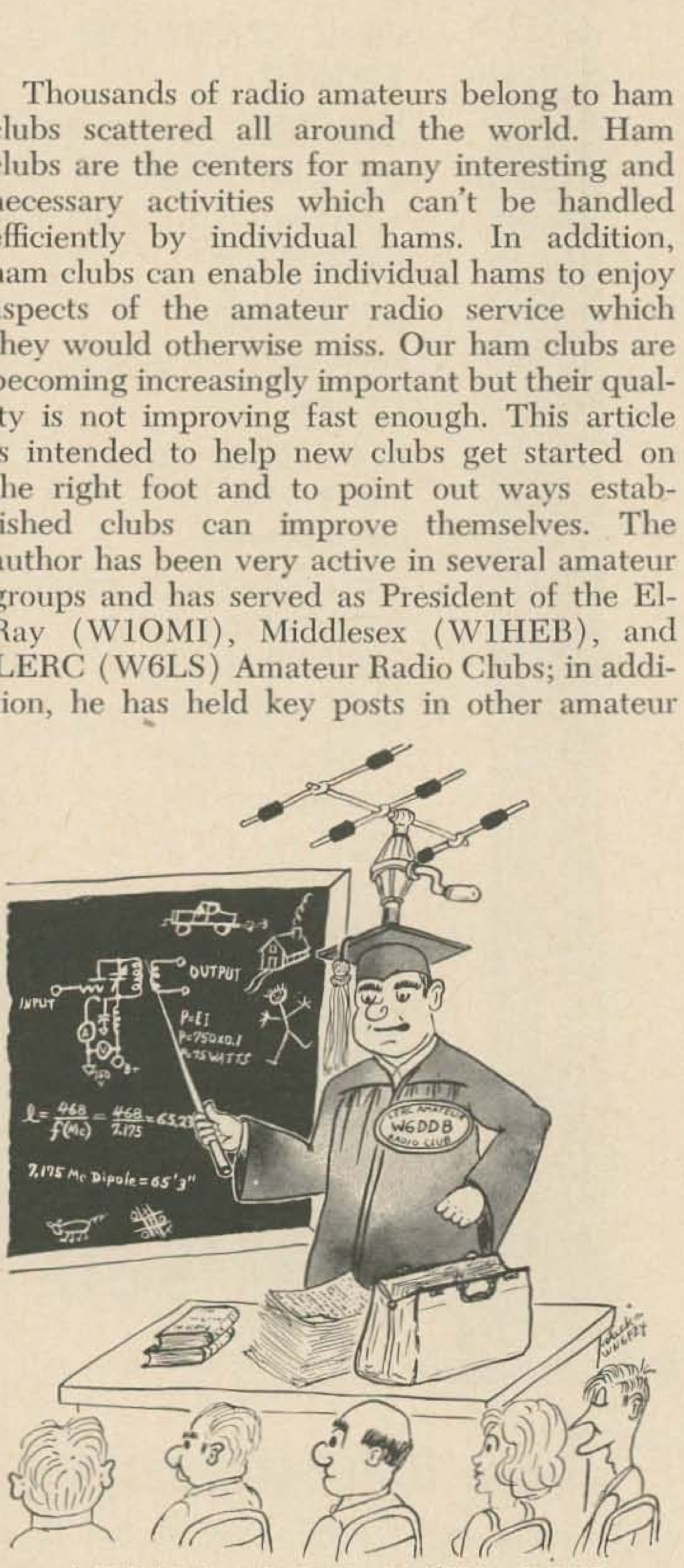
VHF and UHF is of great interest to me, so the receiver was tried out with three different converters for 6, 2 and 1¼ meters, one of which was a tunable type. The receiver is excellent for shortwave listening, and generally ham work, but I think its greatest value to the Amateur is as a fixed or tunable *if* for converters. A receiver used for this purpose must have good stability, sensitivity, selectivity and what is so often lacking, a very stable BFO and product detector for SSB. The GR-54 can deliver this kind of operation, and for this purpose I found it to be great. At $84.95, the GR-54 is a good receiver buy.

. . . W3UZN

Bill Welsh W6DDB
2814 Empire Avenue
Burbank, California 91504

Prescription for Healthy Ham Clubs

Thousands of radio amateurs belong to ham clubs scattered all around the world. Ham clubs are the centers for many interesting and necessary activities which can't be handled efficiently by individual hams. In addition, ham clubs can enable individual hams to enjoy aspects of the amateur radio service which they would otherwise miss. Our ham clubs are becoming increasingly important but their quality is not improving fast enough. This article is intended to help new clubs get started on the right foot and to point out ways established clubs can improve themselves. The author has been very active in several amateur groups and has served as President of the El-Ray (W1OMI), Middlesex (W1HEB), and LERC (W6LS) Amateur Radio Clubs; in addition, he has held key posts in other amateur radio organizations. The same basic questions are asked by those who want to upgrade their clubs and the answers are included in this article. Each category of subject has a heading to make it easier to locate desired material.



A CLUB SHOULD CONDUCT REGULAR LICENSING CLASSES

Board of directors

Purpose: This board determines whether the club will be an asset to the amateur radio service or whether it will be just another mediocre group which stumbles through one boring meeting after another. In short, this board sets the pace and its actions result in a club which is either a failure or a success.

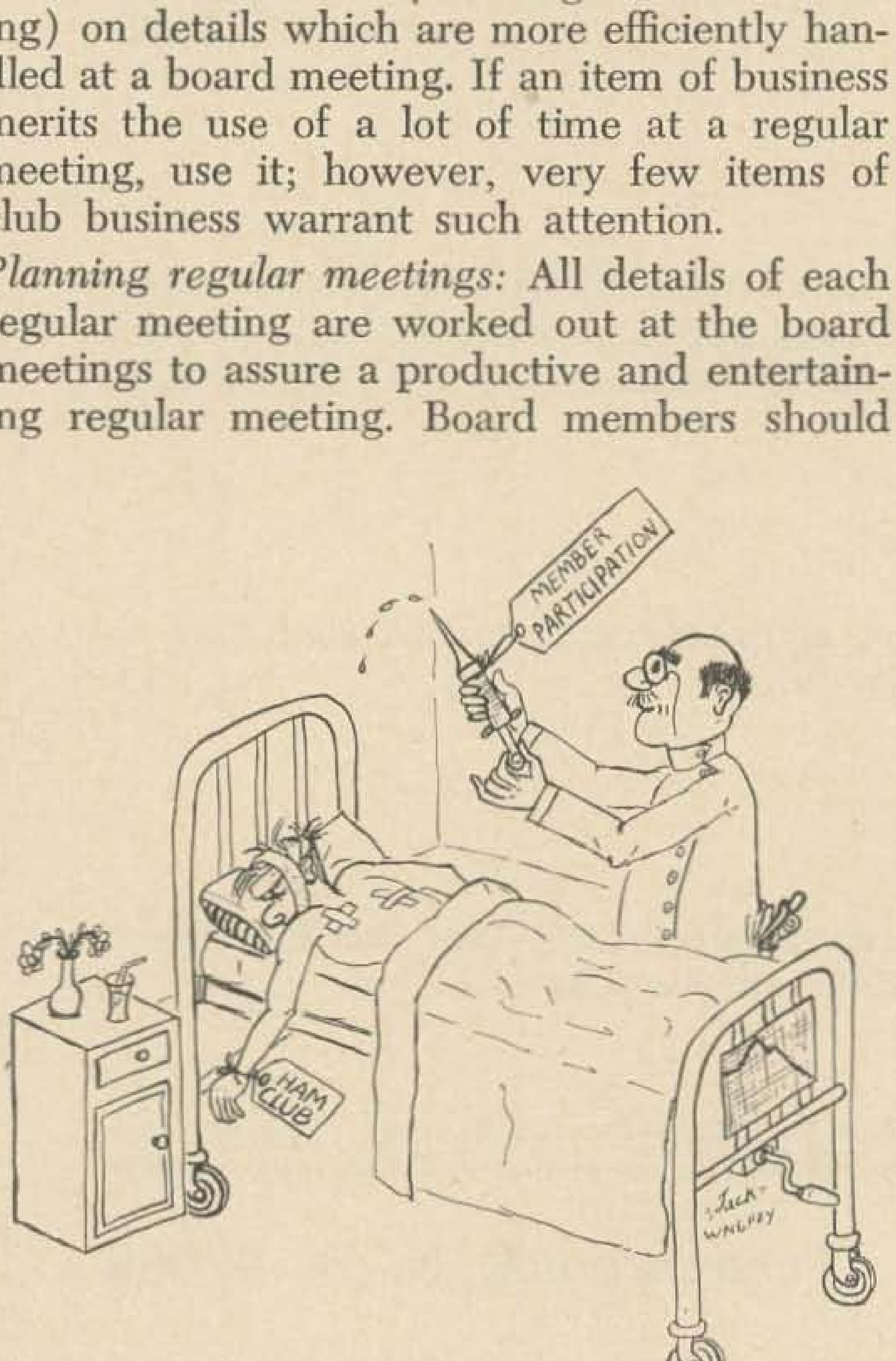
Members: The Chairman of the Board of Directors should be the immediate past president because he is the one person who knows precisely what the objectives of the past administration were. As Chairman, the ex-president can provide desired continuity between administrations to continue long-term efforts toward worthwhile club objectives. If the ex-president is not available, any officer from the previous administration can be elected to chair the board. All officers from the previous administration should be requested to serve on the board along with all the present elected and appointed club officials. Each coordinator (committee chairman) should be invited to serve on the board along with the club's Trustee and Editor (if applicable).

Meeting conduct: The Chairman establishes the agenda prior to each board meeting to make sure that each item will be covered. The board meetings must be started promptly and should be terminated as close as possible to a predetermined regular ending time. The Chairman must conduct board meetings in a pleasant but efficient manner, making sure that each item of business receives no more than its fair share of time and discussion. Board

meetings are not a social affair and board members must be made to realize that board meetings have got to be conducted in a business-like manner. Take care that minor items of business and personal chit-chat do not waste valuable meeting time which should be spent on important club matters.

Business items and motions: Each item of new business should be discussed in detail at a board meeting before it is presented at a regular meeting. All interested parties should be invited to attend board meetings at which items will be discussed which are of prime importance to them. Board meetings must be open to all members and it must be made known that every club member is welcome to attend them, although only the regular board members can vote. Invite interested members to present their views and ideas at board meetings; do not wait for them to ask permission to attend board meetings. The fine details must be hammered out at board meetings before any item is brought up at a regular meeting for discussion and possible action. If a motion will be needed, its wording should be finalized at the board meeting and members should be designated to make and second any such motion. It is ridiculous to waste the time of all club members (at a regular club meeting) on details which are more efficiently handled at a board meeting. If an item of business merits the use of a lot of time at a regular meeting, use it; however, very few items of club business warrant such attention.

Planning regular meetings: All details of each regular meeting are worked out at the board meetings to assure a productive and entertaining regular meeting. Board members should



"A SHOT OF THIS STUFF WILL FIX HIM UP RIGHT AWAY"

include each club coordinator (committee chairman) who spearheads a specific club activity such as:

- Auctions
- Bulletin
- Contests
- Conventions & Hamfests
- Council Federation Activity
- Donation Prizes
- Elections
- Entertainment
- Library
- Membership
- Officer Installations
- Outings & Field Trips
- Publicity & Public Relations
- Refreshments
- Silent Key
- Station Equipment & Operation
- Training Programs
- TVI & BCI

Coordinators: Why go along with the old committee chairman routine when most club functions are actually performed by one person who either does the job himself or coordinates the actions and responsibilities of others to make sure the job is done? Past and present club officers should take on any of these specific coordinator duties which can't be filled by appointees. Most of these coordinator posts should be filled by the President, using members who are prospective club officers.

Selecting Nominees: One of the most important functions of the board is to secure a good selection of capable and willing nominees prior to the nomination meeting. A strong slate is mandatory if the club is to progress and the club's progress is affected by the officers elected. When selecting a slate of nominees, remember that proven willingness to work (plus regular participation in club activities) is more important than technical know-how, operating ability, length of time licensed, speech-making ability, or personal appearance. Desire, long-term interest, and dependability are the prime assets of good officers. It is wise to limit tenure in each elected office to a maximum of two consecutive years to maintain a healthy atmosphere of new blood and fresh ideas in the club. The previous elected officers can strengthen their club greatly by selecting one of the coordinator's posts and concentrating on improving the one facet of the club's activities in which they are most interested. The tenure of club coordinators should not be limited. Ex-officers are the backbone of the club when they accept appointed posts which are not filled with prospective new officers; this frees the newly-elected officers to do the jobs they were elected to do.

Regular meetings

Conduct: Start and end each meeting on time. Retain a business-like atmosphere until all club business is completed and then ease off and make sure everyone enjoys the entertainment portion of the program. Do not permit time-consuming discussions of business items which should be handled at board meetings. Do not discuss any item of new business until it has been discussed at a board meeting, unless it is of such a nature that there can be no doubt of its ready approval or defeat. The overall conduct of your entire regular club meeting determines whether or not visiting hams will return to future meetings and subsequently decide to join your club. It is easy to get hams to attend a meeting as a visitor but it takes a good meeting (plus a cordial welcome) to get them to return to subsequent meetings. Recognize your visitors without putting them ill-at-ease. It is best to have each visitor seated beside the club member who knows him best and to have your club member rise with your visitor to introduce him. It is a poor practice to have your visitors stand up alone to introduce themselves. Remember that the overall conduct of your regular meetings also determine whether or not you will retain your present members.

Reports: Recognize each officer and coordinator for any reports they may wish to make and allow each to use any rostrum and microphone/amplifier facilities which are available. Make sure you provide regular reports from the Treasurer, Secretary, and Chairman of the Board. If your club publishes a bulletin, such reports can be included in it and they can be routinely accepted at the regular meeting if no member requests any corrections or additions to them. The printed reports give your members a chance to read them as carefully as they desire prior to the regular meeting at which they are to be accepted or amended.

By-laws: Remember that by-laws are just intended to serve as a guide to help expedite the conduct of business in an orderly fashion. Do not allow clubhouse lawyers to tie up a meeting by using the by-laws as a weapon. Have it clearly stated in your by-laws themselves that your presiding officer has the authority to take any reasonable action he deems necessary to assure proper conduct of the meeting in accordance with the desires of the majority of the members. Make it a practice to give each prospective member a set of up-to-date by-laws at the time you give him a membership application.

Entertainment: Your entertainment program is of prime importance at each regular meeting. Club members have a wide range of interests, experience, equipment, and education. No meeting is likely to satisfy all your members from start to finish but careful planning can produce meetings which cover such a wide scope that all of your members do enjoy some parts of them. Keep training, building, and operating sessions separate from your regular meetings but encourage special sessions for all such specialized purposes. Since your club members do vary so widely in their interests and backgrounds, it is necessary to provide a wide variety of entertainment programs. Occasional short contests (DX prefixes, code runs, FCC rules, TVI, etc.) can add fun and interest to meetings. Use a wide variety of speakers, films, slides, tapes, and displays to appeal to as many members as possible. Vary the entertainment approach often and aim it at a different ham interest group each month.

Use general interest programs on special occasions (such as at the installation of officers) but retain the amateur radio flavor at all times. If your members just want entertainment, they can go to the movies or a sports event—or perhaps just stay home and be mesmerized by the boob-tube. Real hams join amateur radio clubs to participate in worthwhile ham activities.

Excellent films are available from:

USAF Film Library, 8900 S. Broadway, St. Louis, Missouri
Bell Telephone Company (Science series)
Local Civil Defense Groups
Local Army/Navy/Air Force MARS Groups
ARRL Film Library
Local Colleges
Local Lending Libraries
Electronic/Electrical Industries

One or more members can be used to supplement a film or similar light program. Members are often willing to stage an excellent program in conjunction with another program whereas they seldem feel at ease if they are featured as the sole entertainment program.

Each entertainment program should be investigated by the entertainment coordinator and discussed at a board meeting before it is used. Entertainment programming should be shared by as many members as possible to get the benefit of several different viewpoints.

Donation prizes: These prizes can provide a lot of interest at the regular meetings and can help swell the club treasury at the same time. Do not make the mistake of pestering local distributors for free donation prizes. Clubs and individual hams need distributors as much as ham distributors need us and we should do what we can to support local distributors who are making a sincere effort to supply the equipment and components we need. Accept a reasonable discount for club donation prize purchases but pay for everything you get. Try to be impartial and use items from as many distributors as possible.

Major prizes sell most of the donation prize tickets and about 70% of the available donation prize funds should be spent on one major prize. Members purchase tickets with the hope that they will win the big prize. The little prizes don't attract large ticket sales but they do send a few more members home appeased despite the fact that the big one did get away. Plan to retain some fixed amount of the donation prize revenue (10%?) and use the rest to purchase the donation prizes for the next regular meeting. If your members know that 90% of their donation prize money is being spent to purchase donation prizes (at a good discount), they realize they are getting full value for their money and they are willing to put out their cash. It does not pay to be greedy in any club matters and never make the mistake of assuming that your members are unaware of what the score is; there are plenty of lazy club members but darned few stupid ones!

Do not assume that you know the financial circumstances or personal feelings of your members. You'll have members who do not purchase donation prize tickets and they should not be made to feel unwelcome because they don't purchase them. Some people object to gambling even in its mildest forms and you'll very likely have members who honestly do not wish to participate in this club activity. As long as your members know that the small profit from the sale of donation prize tickets is used to support necessary club expenditures, your ticket sales will remain high.

The donation prize coordinator should report results at each board meeting. He should discuss his choice of donation prizes for future meetings. Small prizes can be judiciously selected to meet current club needs and objectives. It is wise to use such small prizes as:

Club QSL Card Orders
Club Dues
73 Subscriptions
QST Subscriptions
CQ Subscriptions.

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Eico 753 (factory wired)	249.00
Galaxy III (demo)	229.00
National NCX-3	229.00
Transcom SBT-3 (demo)	199.00
Transcom AC P/S (demo)	69.00
SBE SB-34 (demo)	349.00
Sonar 40 40 mtr. SSB xcvr	149.00
Sonar 12VDC Supply	69.00
Swan SW-175 (75 Mtr)	139.00
Swan SW-12DC (800 Volt)	69.00

RECEIVERS

Collins 75S-1	$369.00
Collins R-388	459.00
Collins R-390A/URR	649.00
Collins 75A-1	159.00
Collins 75A-3	239.00
Collins 75A-4	359.00
Drake 2A	169.00
Drake 2B (like new)	209.00
Hammarlund HQ-140X	129.00
Hammarlund SP-600JX-17	359.00
Hammarlund HQ-170C	209.00
Hammarlund HQ-180C	269.00
Hallicrafters SX-111	159.00
Hallicrafters S-120	49.00
Hallicrafters S-76	79.00
Hallicrafters SX-96	159.00
Hallicrafters SX-110	119.00
Heath HR-20	99.00
National NC88	49.00
National NC98	59.00
National NC270	139.00
National HR050T (4 Coils)	189.00
National NC155 (demo)	139.00
RME 4350	119.00
RME 6900	179.00

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Clegg 22'er	189.00
Gonset Comm. II 6 mtr.	89.00
Gonset Comm. III 6 mtr.	129.00
Gonset III 2 mtr.	179.00
Gonset IV Comm. 6 mtr.	169.00
Gonset IV Comm. 2 mtr.	249.00
Gonset G-50	229.00
Gonset Comm. IV 220 MHz. (new)	229.00
Heath HA-20 6 mtr. linear	95.00
Heath "Shawnee" 6 mtr.	159.00
Irving 6 mtr. SSB mixer kit (new)	39.00
Lafayette HE-45B w/vfo	99.00
Polycom PC-6 (6 mtr.)	179.00
P & H 600A SSB Mixer	35.00
P & H PR600A Reg. P/S for 600A	29.00
Telco SB-50 6 mtr. SSB mixer (new)	59.00

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B & W 5100	$129.00
Collins 30L-1 (near new)	365.00
Collins 30S-1	795.00
Collins 32V-1	119.00
Central Elect. 20A with vox and anti-trip	119.00
Central Elect. 100V	369.00
Globe "Champion" 300W	99.00
Gonset 500 W. Linear	129.00
Gonset GSB-100	199.00
Gonset GSB-201	239.00
Heath "Apache"	109.00
Heath DX-35	29.00
Heath DX-40	37.00
Heath HG-10 VFO	29.00
Heath DX-100	75.00
Halicrafters HT-40	39.00
Hammarlund HX-50	249.00
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Johnson Viking II	69.00
Johnson "Ranger"	89.00
Johnson "Valiant"	169.00

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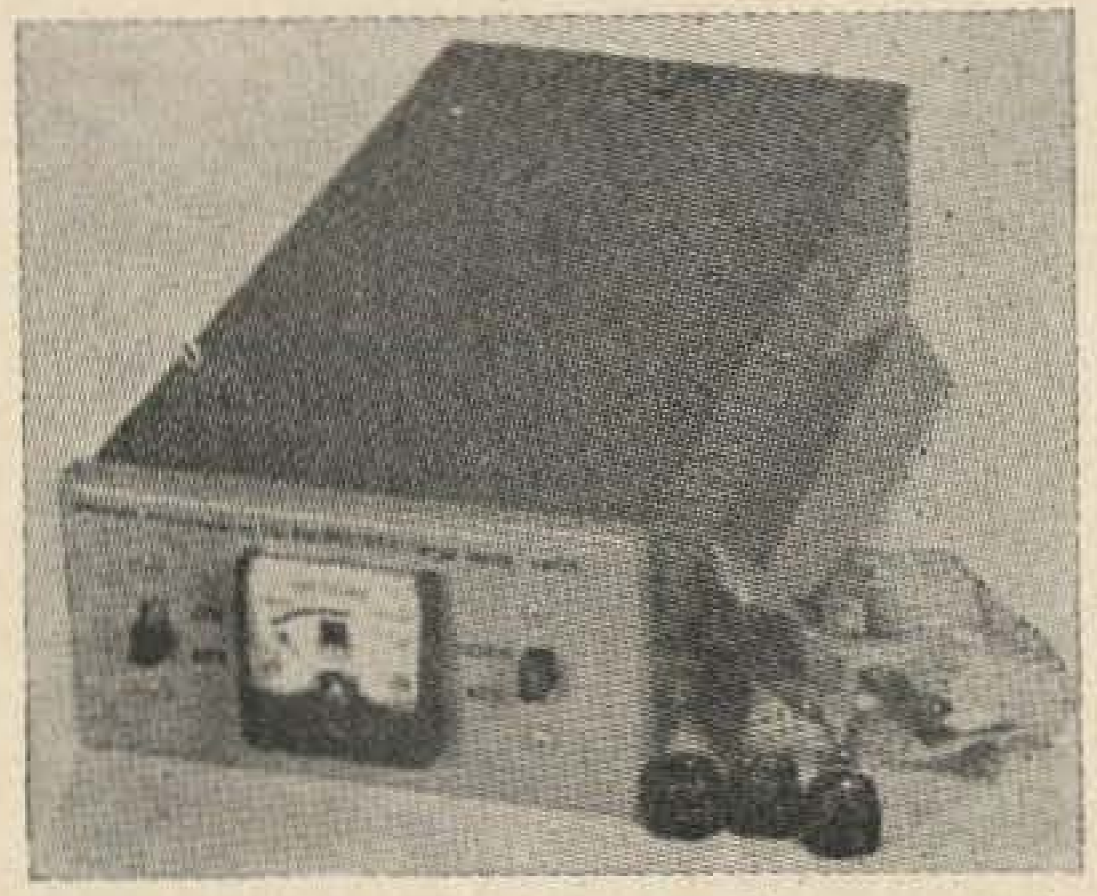

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Rest Break: It is wise to have a 10-15 minute rest break at any convenient mid-point in your meeting. When announcing the rest break, state the time at which the meeting will be reconvened. Prior to the rest break, restate what the donation prizes are for the evening and point out whom members and visitors can approach to purchase donation prize tickets during the rest break. Resume your meeting at the stated time and your members will be more alert and better able to enjoy the remainder of your program. Do not have refreshments available during the rest break.

Coffee Break: Don't hold your coffee break in the middle of your meeting because you rush everyone and cut short discussions which are vital to the club's progress. Hold your coffee break at the end of the meeting when your officers and coordinators will have ample opportunity to complete discussions with other members, speakers, and prospective members.

Rotate coffee break duty among as many members as possible. Provide a fixed maximum amount for refreshments (to your refreshment coordinator) and use a wide variety to get away from the dull monotony of coffee and doughnuts. Mud and sinkers aren't particularly appealing at the end of a long day. Do not allow speakers or visitors to contribute to any refreshment kitty you may have.

Conventions, hamfests, shows

Conducting Conventions and Hamfests: Unless excellent club membership participation is assured, do not attempt to conduct a hamfest or convention. These are major projects which require excellent cooperation from the majority of your members and both can involve large sums of cash which could overtax your treasury. It is wise to participate in local hobby shows and demonstrations whenever possible to keep ham radio in the public eye; this is good public relations.

Advertising your club at radio affairs: Whenever your club members attend conventions, hamfests, radio club council (federation) meetings, meetings of other radio clubs, C-D exercises, etc., have them wear club badges.

Special meetings: It is a good practice to expand your December meeting to include a general interest Christmas Party type program which is aimed at the families of your club members. Several clubs offer their top donation prizes for the year at this meeting and use this meeting to install their newly-elected officers. If your officers are installed at a different time of the year, it is best to hold a formal installation ceremony and to include official recognition for the work accomplished by the out-going officers.

Field trips

Make sure all your members have advance notice of each field trip and that they know whom to contact for additional details. Make every member know he is welcome on all field trips. Conduct field trips to:

- Tower & antenna raisings
- Hamfests & conventions
- Local AM/TV/FM broadcast stations & transmitting sites
- Local radio stations of other radio services
- Member's stations
- Local distributors
- Local manufacturers

Operation

Club station: If you have a permanent site available, set up the best club station your club can afford. Try to have better equipment and antennas than most of your members have themselves. Set up a top-notch Novice station to give your new licensees a taste of the Novice code bands under the best possible conditions.

Use your club station to conduct club nets and to advertise club activities during on-the-air contacts with other active hams. The best place to recruit new members is on the air; who wants hams who don't operate? Make it a practice to have the operators QSL each contact with each station which is worked for the first time. If you print a bulletin, send a recent issue with your club QSL and invite the ham to attend a future meeting, providing him with a couple of specific future meeting dates.

Make it a practice to have the club station operated strictly by the book. Have each operator sign the log book, complete the log in a uniform legal manner, operate in the best possible manner. QSL each QSO, and just plain do the best possible salesmanship job. Remind each member he must have his operator's license with him when he operates any station, including the club station.

Contests: Have your club station active in as many contests as possible, even if it is just token participation. Encourage maximum at-home activity by all your member stations in each contest throughout the year and make special log sheets, check sheets, and reporting forms available for your members. Several clubs offer prizes to their top scorers to encourage increased activity in major national and international contests.

Field day: The annual field day exercise provides an excellent opportunity to test your club's ability to operate under adverse conditions. FD also provides a once-per-year chance to get some excellent public relations work done on behalf of the amateur radio service and your own club. Local newspapers, radio stations, and TV stations are usually glad to provide coverage of your field day activities. If you are sending written articles to newspapers, double or triple space your typed copy and submit it well in advance of the FD date. If you want radio and TV coverage, send them a typed announcement letting them know what FD is, where your group will be operating, and whom they can contact for full particulars. Do not permit untrue or exaggerated statements and stick to known facts at all times. Amateur radio is truly the best radio service and truthful statements of facts are more than enough to remind John Q. Public that we are doing a good job for him. Emphasize the usefulness of the amateur radio service rather than the names and calls of a few club wheels. One's name in print (plus a dime) still just buys one a cup of coffee. Support our amateur radio service and your radio club and forego petty personal agrandizement.

Training

Every club should conduct regular licensing classes to help produce the best possible new operators and to help upgrade present hams. Classes provide an excellent source of new members and your instructors quickly learn which students are the best prospective club members. The newer hams are usually more active than the long-licensed ones and a constant supply of new members (from your classes) insures continued high interest and activity.

Sample examinations & handouts: The author of this article has taught general licensing classes for several years and he's willing to send a sample set of examinations and handouts to any club instructor who requests them. Just send a self-addressed 10 x 12 inch manila envelope and $1.50 in postage stamps and the sample set will be sent as quickly as possible. All clubs are welcome to copy, modify, and duplicate these sheets to use them as they see fit in their licensing classes.

Licensing classes booklet: The ARRL Communications Department has a free brochure available to licensing class instructors in league-affiliated clubs; simply request a copy of "Licensing Classes" to pick up a lot of useful tips on just how one should conduct club classes. This brochure tells you the do's and don't learned the hard way in working with several thousand licensing class students. The training aids, film sources, film contests, hand-out sources, ham manufacturers, code practice stations, typical examinations, etc., are all gathered together in this one booklet to make your job easier and to help make your classes better.

Class conduct: Conduct formal classes and provide your training coordinator with the classroom space, budget, storage area, training aids, and help he needs to run your training program. It is best to keep building programs separate from licensing programs or neither one will prove as successful as it should be. Make extensive use of the excellent films detailed in the "Licensing Classes" brochure.

Code practice: Next to on-the-air contacts, the best way to have your students build up their code speeds is to use pre-recorded tapes. The author of this article has produced a set of seven 1800-foot monaural tape recordings which have been used successfully to take thousands of students from no knowledge of the code up through 13 WPM. A printed break-down of this series of tapes is available to anyone who requests one and sends a self-addressed, stamped envelope. It takes a lot of time and effort to produce good code training tapes but they are extremely effective and you'll quickly agree that it is worth the trouble. A series of seven 1800-foot tapes, recorded monaurally at 3¾ IPS, provide 21 hours of instruction which will do the job.

Extra class course: When the present incentive licensing docket is untangled (and that could be anytime) the higher grade licenses will probably carry operating privileges which will not be available to holders of lower class licenses. Since this is an accepted assumption with most hams, there is a great demand for amateur extra class licensing courses and ham clubs are in the best position to provide the desired training. It is best not to assume knowledge on the part of your applicants; a simple general-class theory test will quickly determine which applicants are qualified to directly enter your extra class course and which ones should be sent through your general course for a refresher before they take your extra class course. If you don't establish a minimum knowledge level for those entering your extra class course, you will be so busy reviewing general class theory that you won't be able to give proper coverage to the advanced theory which should be covered in the extra class course.

Bulletin

Regardless of size, paper, ink, professional appearance, or anything else, a club bulletin is a prime ingredient in any successful club. Your bulletin coordinator (editor) should be provided with a regular budget, reporters, and all the help he needs to get your bulletin out on time. Send each member a bulletin prior to the regular meeting to remind him to attend the meeting. All information should be submitted to the editor (in writing) at least a week prior to the regular printing date. The editor must be kept up-to-date as members are added or dropped and as their addresses and/or call signs change.

Head sheets: Your bulletin head sheets should include:

Club name, address, and call sign

Location, date, and time of your next regular meeting

Name, address, telephone number, and call sign of each officer

Reports and articles: Each club officer, coordinator, and member should be urged to submit full articles and small news items for the bulletin. References to hams and clubs should include their names and call signs. Standard reports from club officers can be printed in the bulletin to preclude the necessity for having them read during regular meetings.

Your editor should print all articles submitted as long as they are not an attack against any person or group. Print items which are of interest to as many of your members as possible. The bulletin must reflect club news and not just be the ramblings and opinions of one member, the editor. Use your bulletin to recognize the effort each member expends on behalf of the club; this is the right place to give credit to those who are doing the work to make your club more successful. Do not print negative comments about any of your members or officers who fail to perform satisfactorily.

Educational articles should be included to help your newcomers and to jog the memory cells of your experienced hams. Get these articles from as many different members and readers as possible. Correct poor spelling but leave the technical content of the writer's article alone.

Articles can be printed which are related to the subject of the coming entertainment program. Such articles give your members a chance to get acquainted with the program

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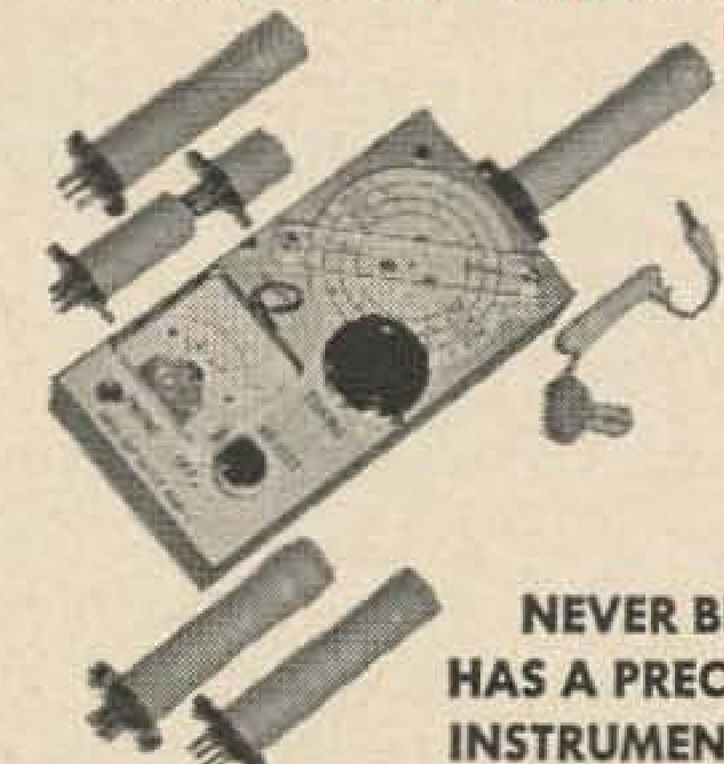

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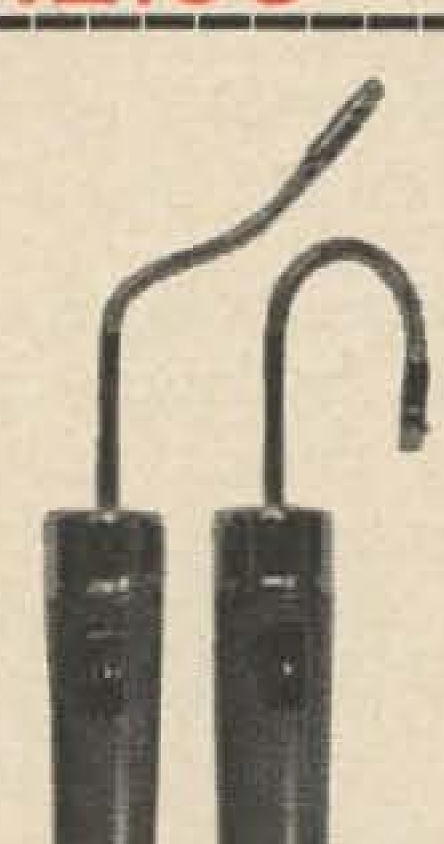

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QUEMENT ELECTRONICS

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"Northern California's Most Complete Ham Store" subject and this assures a more attentive audience at the regular meeting.

Your better licensing class handouts often make an appreciated addition to your bulletins. It is a good practice to publish a list of your members names, addresses, call signs, and telephone numbers at least once each year.

Exchange bulletins with other clubs on a swap basis and improve your bulletin by critically comparing it with those you receive. The author of this article would be pleased to exchange club bulletins with any other club.

Encourage club members to send a bulletin to each local ham they contact to help promote prospective new members. Print extra bulletins to be distributed wherever they'll do the most good.

Special club items

QSL cards: Design and print a top-quality distinctive basic club card to be overprinted and used by your club members; print as many as possible to obtain the best possible price. Do not permit variations in the basic card. Take care to produce the best possible card and end up with a QSL which all your members will want to use. Sell cards to members in a wide range of quantities and have the club clear a small profit on each sale.

Badges: Design a unique club badge and urge all members to obtain one and to wear it to all ham activities, especially to your own club meetings.

Membership cards: Design a wallet-size membership card and issue one to each member every year. Some clubs prefer to indicate membership class and longevity of club association on these cards. Honorary members should receive lifetime membership cards plus appropriate certificates, if possible. Each ex-president who completed an elected term in office should be an honorary member.

Supplies: Produce the club membership applications, by-laws, class applications, attendance record forms, class completion certificates, log forms, check sheets, honorary membership certificates, and all other printed matter required for club operation. If the club has a fixed location, store all club materials there and use the club address for all club correspondence.

Money: If your club collects dues, save your treasurer a lot of trouble by making them payable yearly; weekly and monthly dues collections are time-consuming and an unnecessary bother. It takes money to operate a club and you are wasting your time if you're continually forced to operate on a shoe-string and you are faced with constant fund-raising drives. Donation prizes, club QSL sales, magazine/organization subscriptions, initiation fees, refreshment kitties, auctions, dues, and other sources of revenue can all be tapped to pay your club's operating expenses. A moderate initiation fee and reasonably high dues rates are the best way to obtain your basic operating funds. Association with a good club is worth money to a ham so don't be hesitant about requesting the funds you need to operate. If prospective or current members do not feel the club is worth the price to them, let them stay out; just make sure it is actually worth its cost. If special hardship cases arise, initiation fees and dues requirements can easily be waived by your board. Make sure your club is a good investment and your members will pay the tab.

Value: Remember that a club's value is not judged by its total membership, the size of its quarters, or its bank account; many of the best clubs are quite small in these respects. If the club serves the needs of the amateur radio service, the general public, the various levels of government, and its own members, it is an excellent organization.

Silent keys: Each club should establish a silent key committee under the direction of a silent key coordinator. It's the least we can do for a deceased member to make sure his family gets the professional help they need to disassemble his station and to market it at the best possible price.

Summary: Doo-dads such as club decals, jackets, shirts, emblems, stationery, etc. all have proven popular with some clubs. These items are just so much frosting on the cake, though; make sure you bake a good cake before you try to ice it.

It is hoped that this article has provided some new ideas on how to run a ham club. It is understood that clubs must be tailored to meet the specific needs and interests of the members. Some subjects have been mentioned in a few words despite the fact that they are of such great importance that articles could be written on them alone. The purpose of this article is just to hit the high spots and it is hoped that this has been accomplished. Your added suggestions and comments would be appreciated.

Remember that a ham club is supposed to be an association of people who are in the amateur radio service; make sure your club's long-range objective is to be of service.

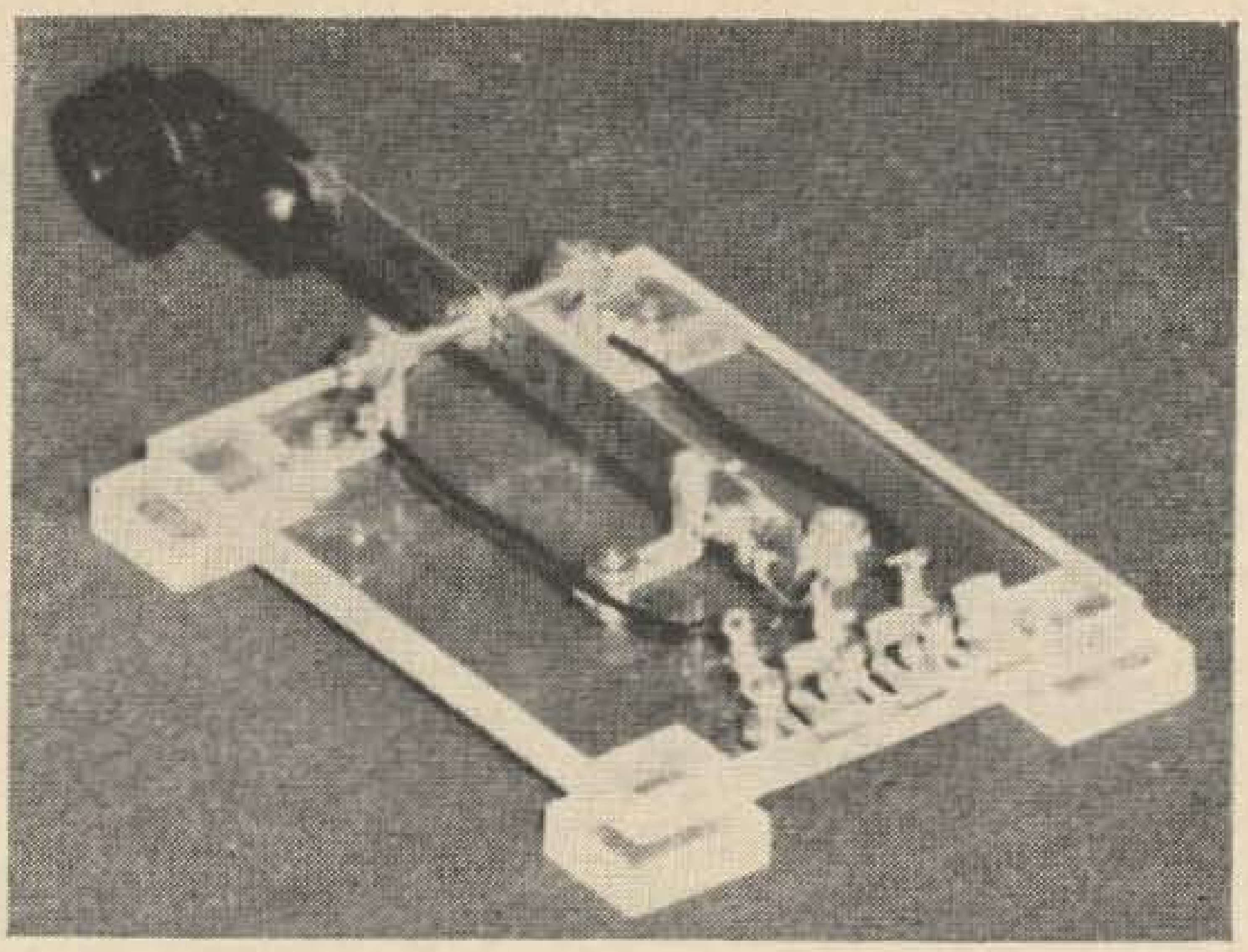
. . . W6DDB

Inexpensive Key

Marvin McConkey K1MAL

We here at the VA Hospital, Northampton, Massachusetts, have built several Electronic Keyers as described by W4UWA/K3KMO in the June 1962 issue of 73 Magazine as a patient project in our Manual Arts Therapy Radio Clinic. After taxing our pocketbooks to buy a relay and other components not found in our parts box, very little money was left to buy the key. Anxious to go on the air with our radio club call of K1OXT, we decided to use Yankee ingenuity and see if we could fabricate a unit. The Instructors in the other Manual Arts Therapy Clinics cooperated and we came up with a couple of hacksaw blades, some 6-32 nuts, machine screws, and a scrap piece of ¼" plexiglass (wood could have been used). We put our heads together back at the Radio Clinic, assembled all these parts and came up with the key. This key has worked out very well for us and we thought we would share the information with your readers and our Amateur Radio Fraternity. This can be fabricated with a very small outlay of cash, a minimum number of tools; such as, a drill, an old hacksaw (hope you don't have to use the blade from the hacksaw which was used for the key arm), and a screw driver.

. . . K1MAL



This photo of the inexpensive key shows the construction.

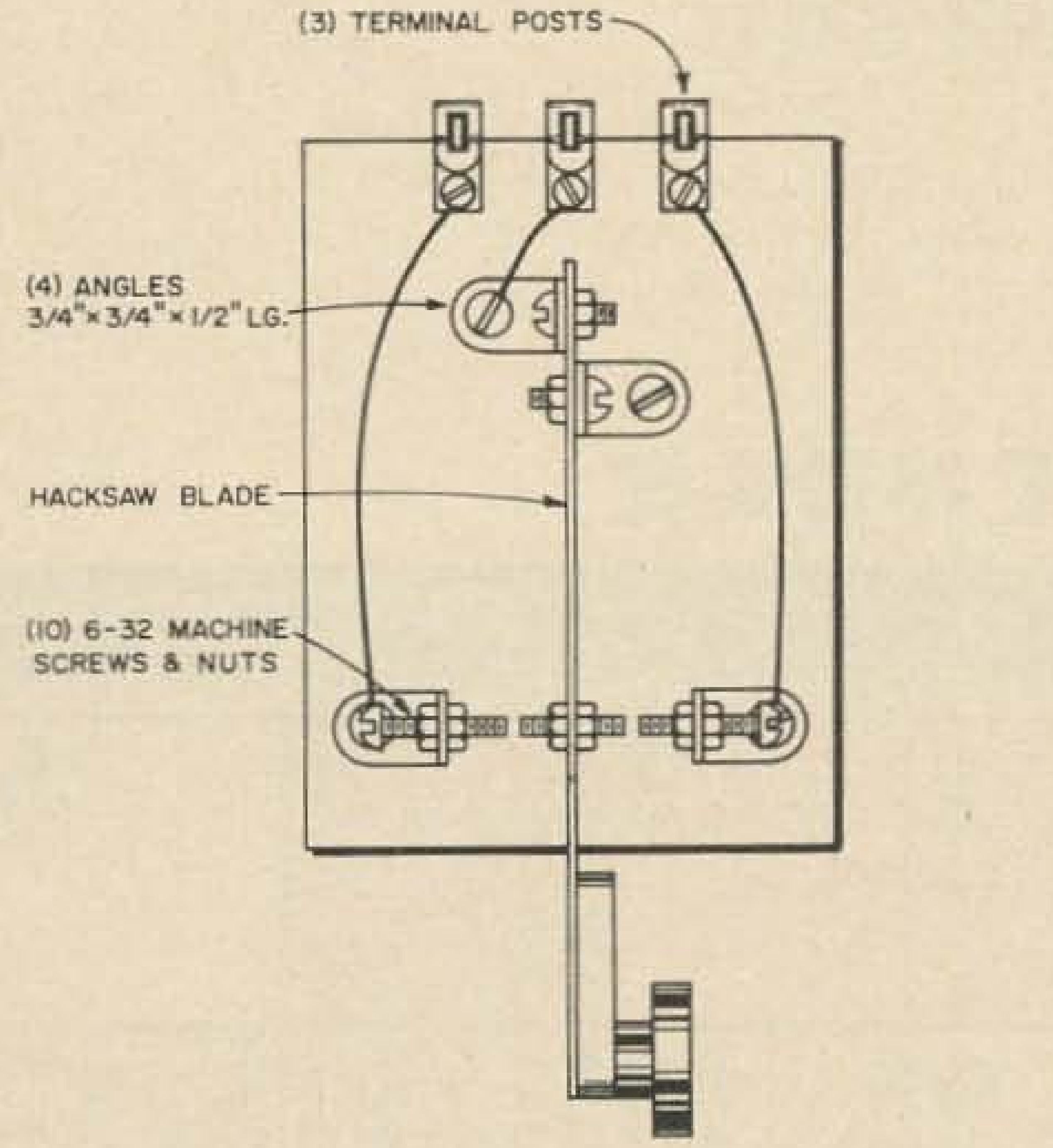


Fig. 1. Inexpensive key knob made from ¼" stock with 1" disc glued to ½" disc and these two discs glued to piece 1" × ⅝". Base is plastic or wood 4¾" × 3½" × ¼".

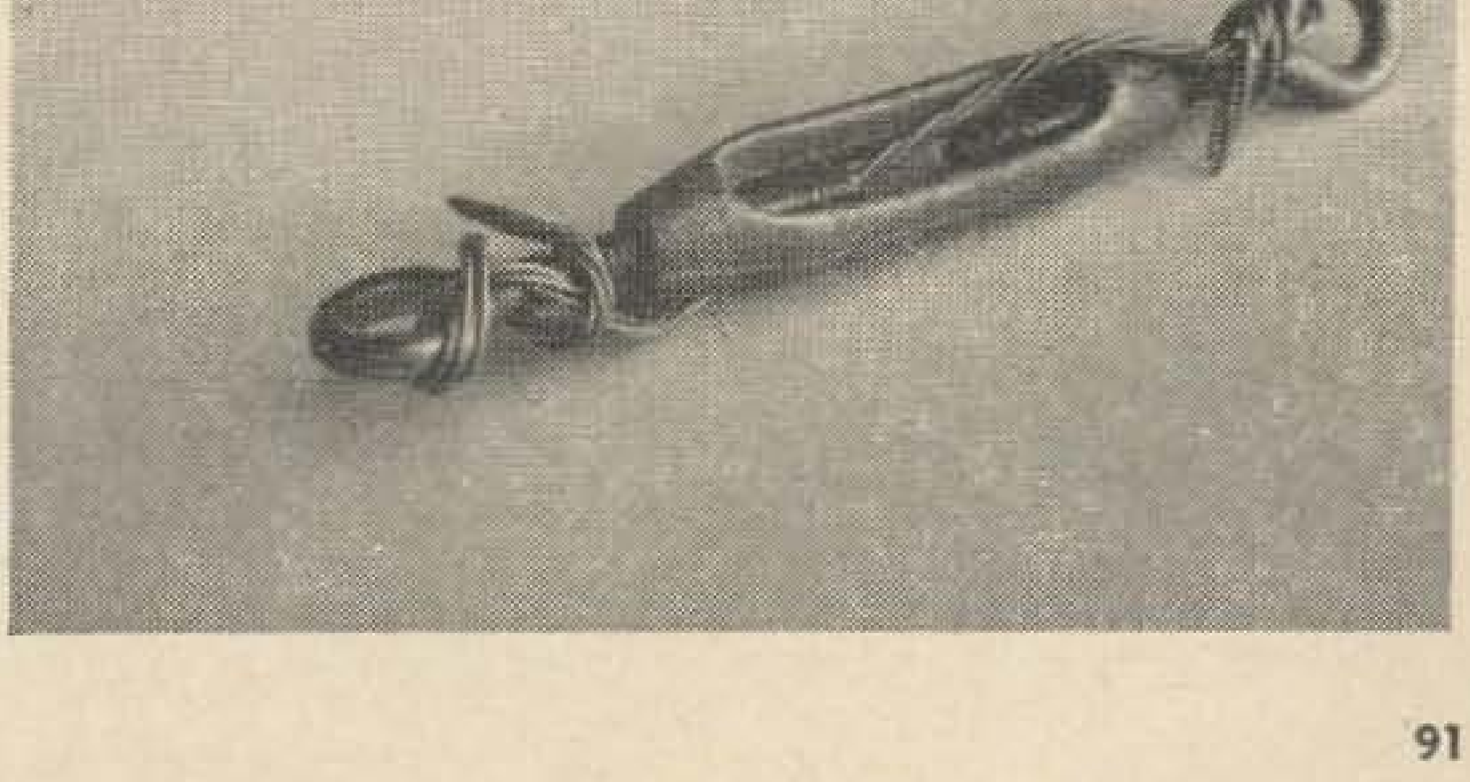
Turnbuckle Safety

Turnbuckles are very commonly used in antenna installations to allow tightening of guy guy wires, and also to provide a break point in the guy when antenna masts are to be lowered. It is not very well known, however, that under certain conditions of vibration in windy weather, that a turnbuckle will unscrew, and therefore open the guy just as destructively as if it had broken!

This is particularly true with new turnbuckles, which have nice, clean, smooth threads.

The use of a nut to lock the threads in the desired position is made difficult by the fact that one half of a turnbuckle uses a left-handed thread, and left-hand nuts are hard to find.

A simple, effective means of preventing a turnbuckle from loosening is shown in the photo. A short piece of common guy wire is fed through the body of the turnbuckle and then through each end, and then twisted to prevent unraveling. This keeps either end from turning with respect to the body. . . . K6UGT

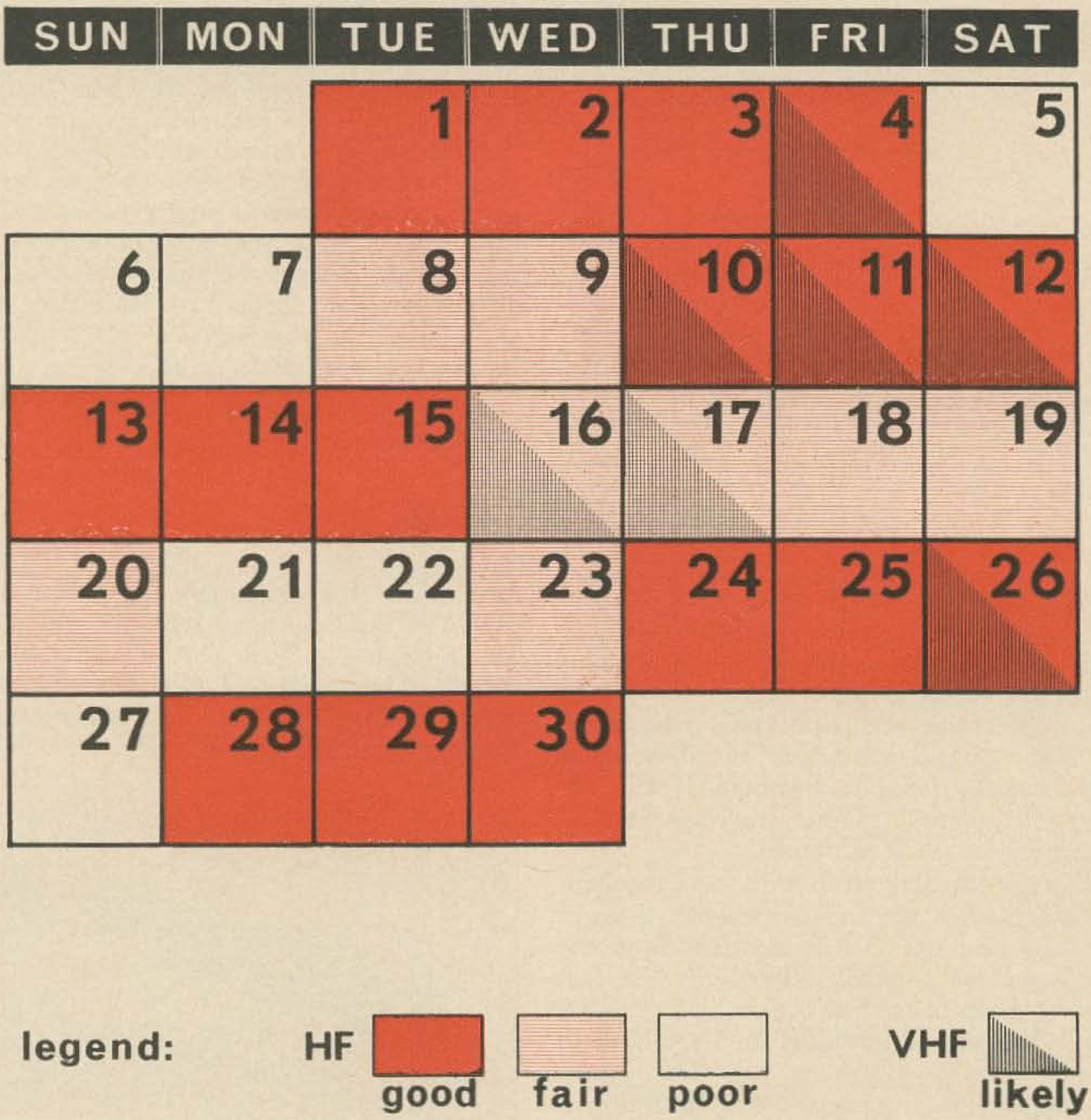


PROPAGATION

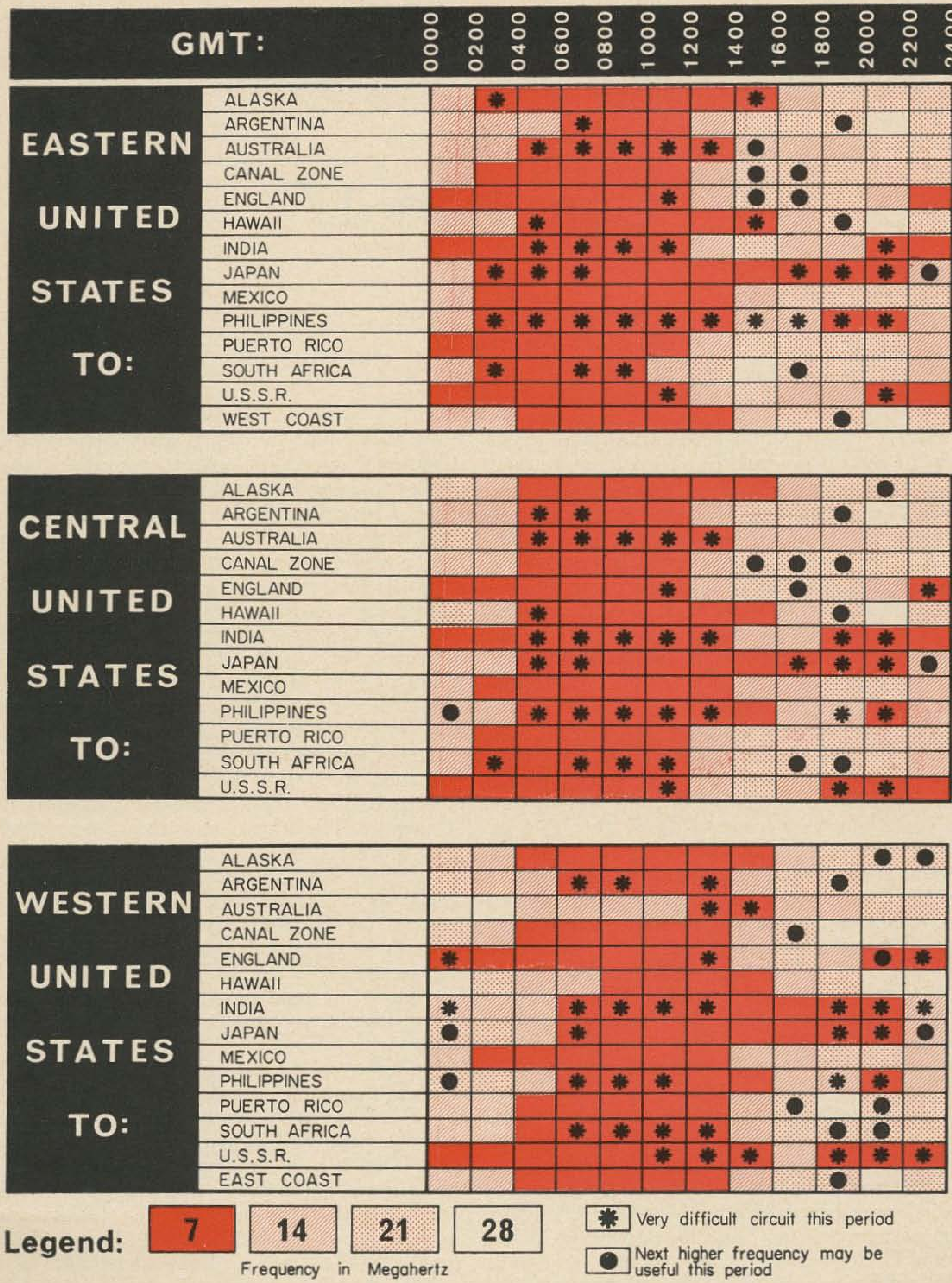
NOVEMBER 1966

J. H. Nelson

DX CALENDAR



OPTIMUM FREQUENCIES HOURLY



Gus: Part 17

Here I was on Mahe, trying to arrange some way to get to some of the rare islands in that general area. I nearly lived down around the docks, cornering any and all ship owners. I had plenty of time to observe the way of life on the Seychelles. These people know how to take it real easy; they don't worry about the various troubles throughout the world; in fact, most of them aren't aware of what's happening beyond Mahe. They are too busy enjoying life to worry about anything else. With the YL population a lot higher than the OM population, the fellows I guess have quite an interesting life. Some of the carrying on that I have heard about would shock some people, I'm sure. The people here do what they want to do, when they want to do it; the least of their worries is what other people think of them. One day as I was operating in my little thatched hut, I saw an old man setting under a coconut tree right out in front of my ham shack. I walked out and had a talk with this old fellow. I asked him where did he work. His answer was, that he did not work at all; I then asked him if he had retired, but he replied he could not retire because he had not ever really worked. About this time three or four porpoises were passing by a few hundred feet out in the ocean; he pointed at them and asked if I ever heard of any fish working. I had to admit I never did. Then he pointed up at some sea gulls and then he asked me if I had ever heard of any bird working; again the answer was no. Then he said to me, "You know God made the birds, and fish, and then made man as His own chosen people. The Good Lord takes care of the birds and fishes, so since man was His own chosen people, I know that God would take care of me." After thinking it over and looking around the Seychelles, I know it's possible for someone to live there a long time and never go hungry. The only clothing you really need is a pair of shorts; you can sleep under a coconut tree on a few leaves or maybe out on the beach. So maybe the old fellow has something there. I still think he was telling the truth about his not ever working. So there you are fellows—scram over to VQ9 land. You'll have it made —but their immigration department says you have to have a reasonable income if you want to stay there. No working allowed!

I even went to a few native dances there, and listened to their home-brew musical instruments. They have a native dance that's very much like the old square dance that we occasionally have in South Carolina. Their version lasts one solid hour. They call out the instructions to their dancers in their native tongue, singing the instructions along with the musicians. This was one time I wished I had along my tape recorder. This would have been something unusual to listen to back here right now.

Things were very cheap when I was there. A good carpenter could be hired for $.25 per day. Now, according to what I hear, the same carpenter wants $.75 per day, if you can get him! This inflation is blamed on the few USA technicians working there on a satellite tracking project! How such a few fellows can bring inflation to an island with about 45,000 population I myself cannot understand.

You soon become a part of the scene and everyone takes you for one of them after a few weeks on Mahe. You are invited out to dinners almost every night and soon everyone is calling you by your first name. You soon come to know many people there and you begin to see how they enjoy life. I don't think there is anyone on Mahe who has ulcers, unless they had them before they arrived there. The color of the population is anywhere from jet black to blonde, and there seems to be no sign of a color bar there.

After hanging around the docks for a number of weeks, I was invited by a captain of a boat to go with them to what they call Bird Island to gather eggs laid there by various sea birds. When we arrived at the island, which was only a short distance from Mahe, everyone picked up an umbrella before he boarded the small boat that was taking them ashore. I asked the captain if he thought it was going to rain. He looked at the sky and said he did not think there would be any rain from up there, and sort of smiled. I almost got on the boat without an umbrella, but giving it a second thought decided there must be some reason why everyone else was taking an umbrella, so I grabbed one myself, just in case. Away the little boat went for shore. When it arrived on the sandy beach, the sky darkened with squawking birds. I mean the sun actually went out. Then it started to rain, but this rain did not come from any clouds. Back we went to the big boat; we spent the night there and the next day went back. A total of some 900,000 eggs were gathered. Back on Mahe for the next few weeks plenty of eggs were served usually scrambled, and very cheap, too. Usually they are only allowed to gather these eggs during July, and only one trip to the island is allowed. There must have been a several million birds on this island. If you ever go, boys—take your umbrella.

Finally after sticking around the docks all the time I got word that a ship was taking off for the Chagoes Islands. I had been having daily schedules with France, VQ8AM, trying to get a license for the VQ8 islands. It was sort of touch and go regarding issuing a license. When I got word that there was a ship leaving for the Chagoes I immediately got in touch with France, telling him of the situation. He went down this time I think with Leny's brother, Gilbert, who still lives on Mauritius; Gilbert told the head man of their FCC the situation I was in, and he informed them that I should not miss this chance of getting to Chagoes. Telling them that if there was any trouble due to my operation there, he would come to my assistance. The story I got after I finally arrived on Mauritius was something more or less like that. I got in touch with the owner of Chagoes, and got the all important letter of introduction for me to hand to his island manager in Chagoes. Then I located the owner of the ship that was going there, got his approval to go, then went to the captain and got his approval to go on his ship. I was all set.

I still say I had a perfectly legal right to go there and operate. It was a clean operation as far as I am concerned and even to this day I think it should count as a new one for the fellows that I worked when I was there. Nothing anyone says or tells me will make me change my mind on this operation. Incidentally, I think the same of my BY operation. I wonder how many BY licenses the APRL has ever seen? What proof have they that every BY station is not a pirate? Did Chiang or Mao issue the licenses? If Mao, do they consider this legal? I am under the impression that from the USA viewpoint Chiang is the legal government of China. If the present BY stations are using licenses issued by Mao–are they not pirates from our legal viewpoint? Kinda interesting, all this, eh fellows? I have not ever heard any answers to all this myself. While I am on the subject I am still not 100% sure what is and what is not a country either. Maybe there is no real good answer to this one. I guess there are some good solid rules but there also seems to be so many exceptions to these rules. Russia in their country list says that the Soviet stations down in Antarctica are separate from the rest of them and they call it another country. How about those other countries that are represented down there? Let's not get involved in this country business–it seems to be an endless debate, never quite coming to any definite conclusion. But it is something to think about when you are sitting there tuning your receiver for a new one.

Back to my story again. Here I was with a boat about to depart for Chagoes with only a verbal understanding; the trip was only costing a very small sum of money. I went, since there was no time to monkey around. All the way it was up wind, which meant a lot of tacking back and forth all the way; this added quite a number of days to the trip. Remember, most all boats in these parts are made for sailing, the diesel powered boats are used only to bring others up to the docks and take them away. As usual I did some/MM along the way.

About the third day out, around 10 a.m. one morning, I was operating when all of a sudden one of the deck hands ran into the dining room where I had the equipment mounted on the dining table and grabbed me by the arm saying something and pointing back to where my 14AVS Hy-Gain vertical ground plane antenna was mounted. I ran back with him to see what was wrong. On board a ship I had previously discovered that there usually was not room for all the ground radials, so I would connect a random length of 18 Copperweld to the ground plane and would keep the other end of the wire under the water. To do this, I had picked up from the engine room a bolt about 4 inches long and 1 inch in diameter; this big bolt was fastened to the end of my ground radial and tossed overboard to trail in the water. Incidentally, this makes a FB ground radial and the SWR is very close to 1:1. When I got to the antenna, believe it or not, a fish had swallowed this bolt and was really whipping back and forth in the water. I grabbed the wire and tried to pull the fish in. The Copperweld wire darn near cut thru my hands, so someone handed me a pair of greasy mechanics gloves. This time I managed to pull the fish up to the deck; it was a nice 17 pound tuna, and we ate him for supper that night. We had to cut him wide open to remove the bolt, for it had gone into the stomach of the fish.

Back to the shack I went and began operating. After operating about 30 minutes I noticed the SWR all of a sudden went up (I always operate with the SWR bridge in reflected power position). Out to the antenna I went again, expecting to find the ground wire broken off on account of the swishing back and forth of that tuna fish. As soon as the antenna came in view, I saw what was wrong –a flying fish about 10 inches long had gotten himself wedged in between the 20 meter stub and the rest of the antenna. You know the model 14 AVS Hy-Gain has a 20 meter section running up beside the other part of the antenna; the spacing in mine was about 2½ inches, just the right spacing for this flying fish to get caught between when he tried to fly in between the elements. I called this my "fish catching" antenna, and those two fish were the only ones I have ever accidentally caught in my life. The new 14ASQ Hy-Gain antenna has no 20 meter stub, so the flying fish catching feature is now gone. As fish were needed the deck crew would trail a hook with a piece of meat or fish on it; they always kept fresh fish on hand to eat when needed. A number of large boats passed us on their way to Aden, Mombasa, and tankers to the Persian Gulf; we saw a number of Japanese fishing ships also. Seemed to be plenty of traffic down there–Chagoes next month, boys.

. . . Gus

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2/$1.00
Similar to 2N2885 NPN and TMT8035 PNP microtransistors. 75 mw power at high frequencies. **Both units $1.00**
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Amateur Microwave Propagation

So, you want to go on amateur microwave? Fine! And, you have your equipment built? Excellent! And it tests out fine on the bench? Wonderful! But you can't communicate over a full sized path? Too bad! But don't feel lonesome. Many hams share the same Fresnel zone, to coin a phrase.

Almost without exception, articles dealing with amateur microwave communication have dealt solely with construction of the equipment. Relatively little, if anything, has been said about the path the beam must take in getting from transmitter to receiver. Just because you have a line of sight path does not mean you will be able to communicate via microwave.

Unlike on the amateur high frequency bands, (160-10 meters) where little consideration must be given to the path the signal takes, microwave communication takes something a little more than just putting together a pair of transmitters and receivers. Consideration must be given to such things as

1. Path Loss
2. Transmission Lines
3. Fade Margin
4. FM Improvement Threshold
5. Reflections, Refractions, Diffractions and Fresnel Zones
6. Antenna Gain
7. Antenna Orientation and Polarization
8. Passive Repeaters
9. Path Profiles

Singly, none of the items above are difficult to understand. And collectively they can save a lot of headaches trying to figure *why* a microwave system won't work.

Ray is a transmission engineer. He has thirteen years experience in commercial and military communications.

Path loss

Let's start at the head of the list with Path Loss. This is the calculated *free space* path loss that will occur to the beam going from transmitter to receiver. Path Loss *is not* attenuation (reduction) of signal strength due to the beam encountering any obstacle such as air, dust particles, clouds and the like (although these will cause attenuation). Path Loss *is* the result of the normal spreading of the beam that occurs to all radiations, including light.

In microwave work we must try to approach or achieve free space conditions, since trees, shrubs, buildings and the like can absorb from 12 to 46 dB per mile, or more, of the microwave signal. In most cases this would render microwave communication out of the question.

Free space path loss is easy to compute if you have a basic knowledge of logarithms. If you don't, a high school course in trigonometry with it's associated study of "logs" is recommended. Anyway, to compute path loss, use the following formula:

$$\text{Path Loss in dB} = 36.6 + 20 \log D + 20 \log f_{MHz}$$

where D = distance between antennas in miles,

f_{MHz} = the frequency in megahertz and

Path Loss is expressed as a logarithmic ratio, in dB.

As an example, assume a pair of transmitter/receiver terminals (let's call them a system), are operating on 1215 MHz and the distance between the terminals is 30.0 miles. Then we have a Path Loss equal to

$$36.6 + 20 \log 30 + 20 \log 1215 =$$
$$36.6 + 20 \times 1.477 + 20 \times 3.085 =$$
$$36.6 + 29.5 + 61.7 = 127.8 \text{ or about } 128 \text{ dB}$$

So, we have a Path Loss of 128 dB. Of course, if using the formula is too hard, you can always refer to the nomograph in **Fig. 1** and come just about as close.

Transmission lines

Well, 128 dB is a lot of loss and there is some additional "system loss" in the coaxial cable from transmitter to antenna and from antenna to receiver. For instance, RG-8/U, as used in our hypothetical system, has 3 dB loss for about 30 feet at 1215 MHz. This is the same as cutting your transmitter power in half. So, if you are going to the trouble of getting on microwave, it's recommended you use something better than RG-8/U, such as RG-17/U. It has only 1.3 dB loss at 1215 MHz for 30 feet. Remember, "It costs only a little more to go First Class."

Fade margin

In the design of your system, you will need to consider the degree of reliability you want. This will be a function of your Fade Margin. Fade Margin is the arbitrary signal margin established by the designer and is a function of Reliability. The fade margin establishes the amount of "cushion" you will have to fall back on, in case of a deep fade, before your receiver starts to be controlled by noise rather than signal. To determine your Fade Margin, first decide the amount of reliability you want by referring to **Fig. 3.**

If you have built your equipment, you should know your receiver FM Improvement Threshold (FMIT). If you don't know your FMIT it is easy to calculate.

$$\text{FMIT} = -104 + \text{NF} + \log B_{MHz}$$

where

-104 = a constant,

NF = receiver noise figure in dB and

B_{MHz} = Receiver *if* bandwidth at the 3 dB points.

In our example, assuming a noise figure of 13 dBm and a bandwidth of 3 MHz, we have an FMIT $= -104 + 13 + 10 \log 3 =$
$-104 + 13 + 10\ (.4775) =$
$-91 + 4.775 =$
-86.225 dBm

Rounding this off we have an FMIT of -86 dBm. This is the knee of the inherent thermal noise characteristic of your receiver, the "crossover" point where internal thermal noise of RF signal strength becomes the controlling factor of receiver usefulness.

Assuming we would like a 20 dB Fade Margin for 99% reliability with our FMIT at -86 dBm, our median received signal must be -66 dBm or more (by more, we mean going in a less negative direction; -65, -64, etc.). To get a signal of -66 dBm we have to

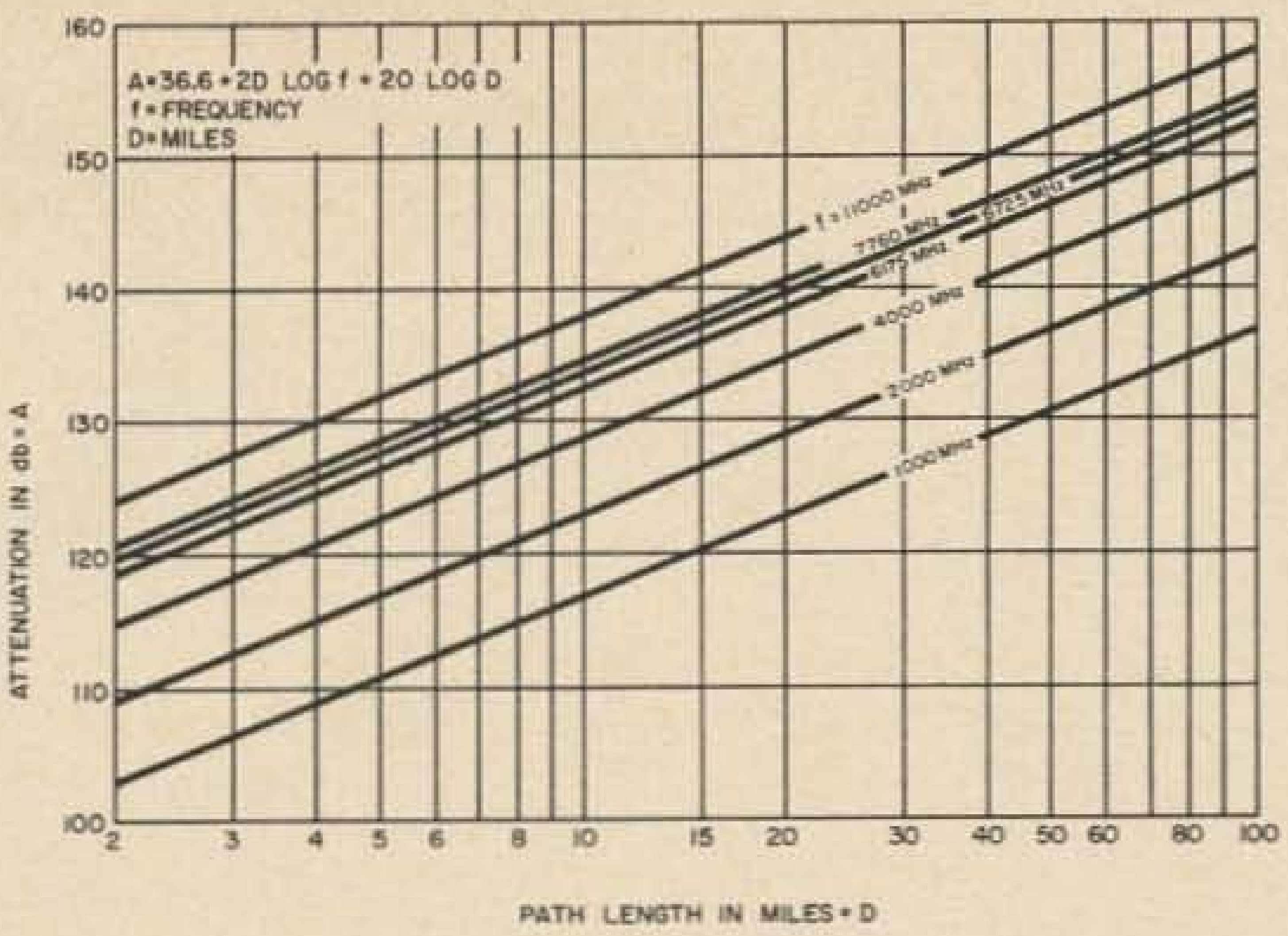


Fig. 1. To determine your path loss at a given frequency, enter the nomograph at the bottom (path length in miles). Assume 30 mile path and 1215 MHz. Read up to frequency of interest. Then read horizontally to the left and read path loss directly in dB (128). Graph courtesy Lenkurt Electric Co.

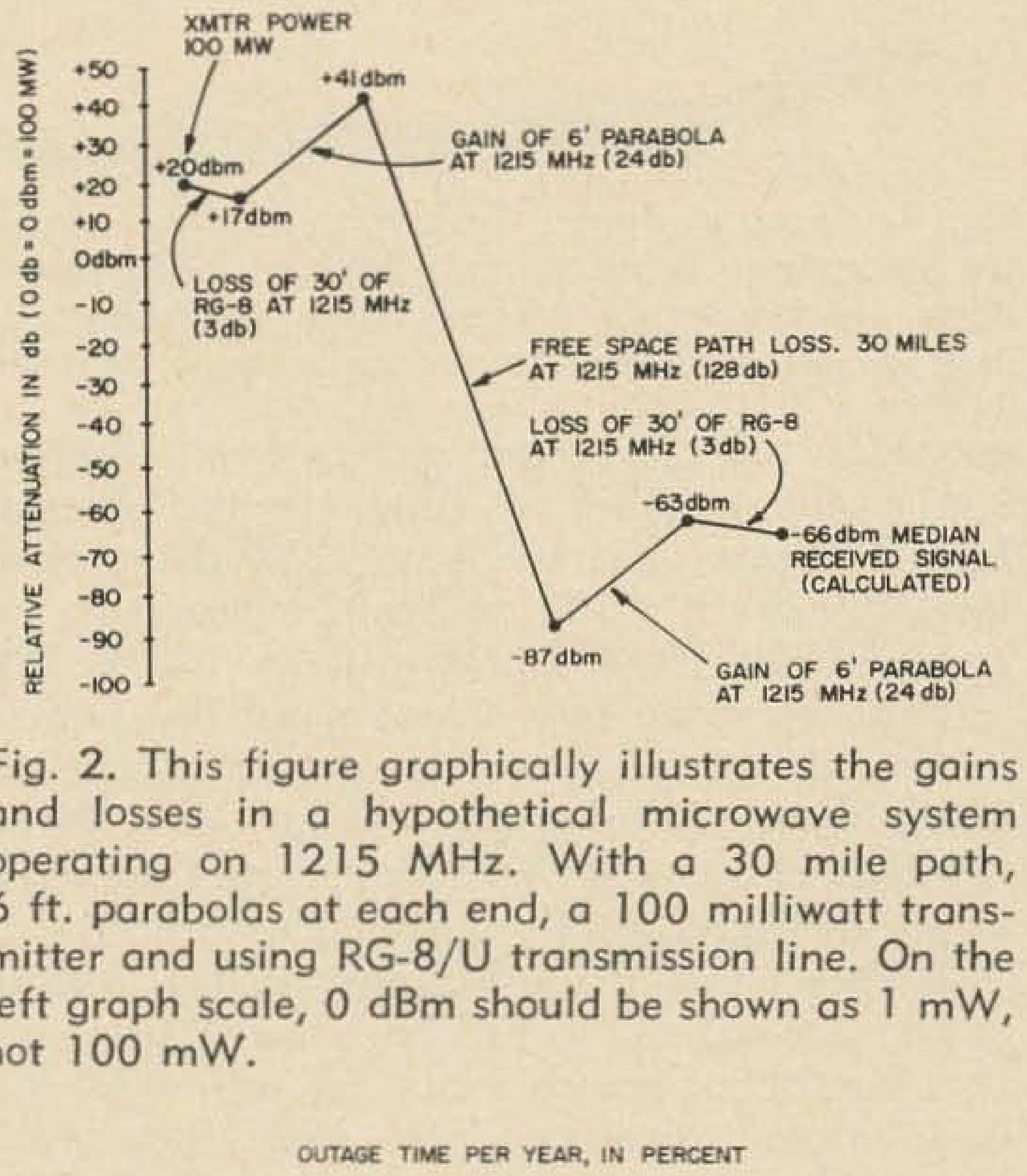


Fig. 2. This figure graphically illustrates the gains and losses in a hypothetical microwave system operating on 1215 MHz. With a 30 mile path, 6 ft. parabolas at each end, a 100 milliwatt transmitter and using RG-8/U transmission line. On the left graph scale, 0 dBm should be shown as 1 mW, not 100 mW.

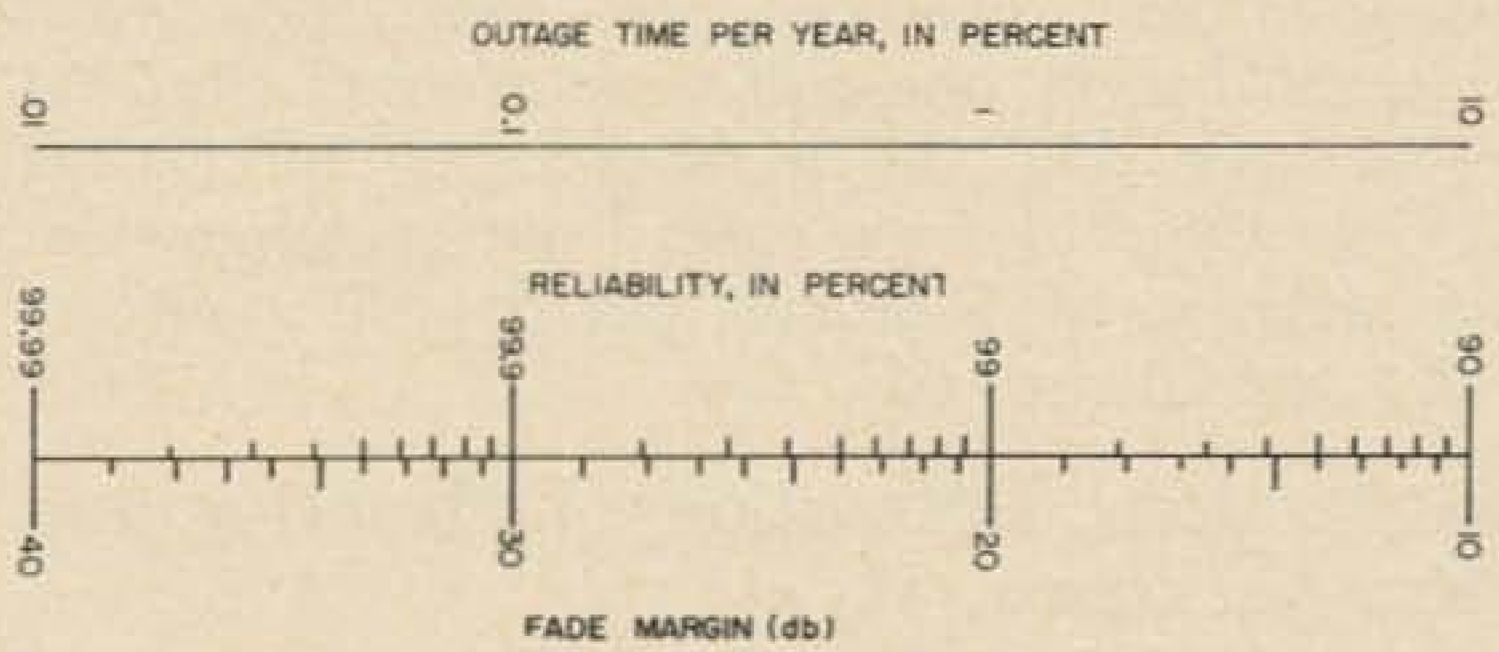


Fig. 3. With this nomograph you can find your percent of reliability of fade margin if you know one of the two. If you want 99% reliability, you must have a fade margin of at least 20 dB. If you have a 20 dB fade margin, you will have 99% reliability. This will give you a total outage time of 1%, less than 3¾ days per year, averaged out to less than 1 minute per day! Courtesy Lenkurt Electric Co.

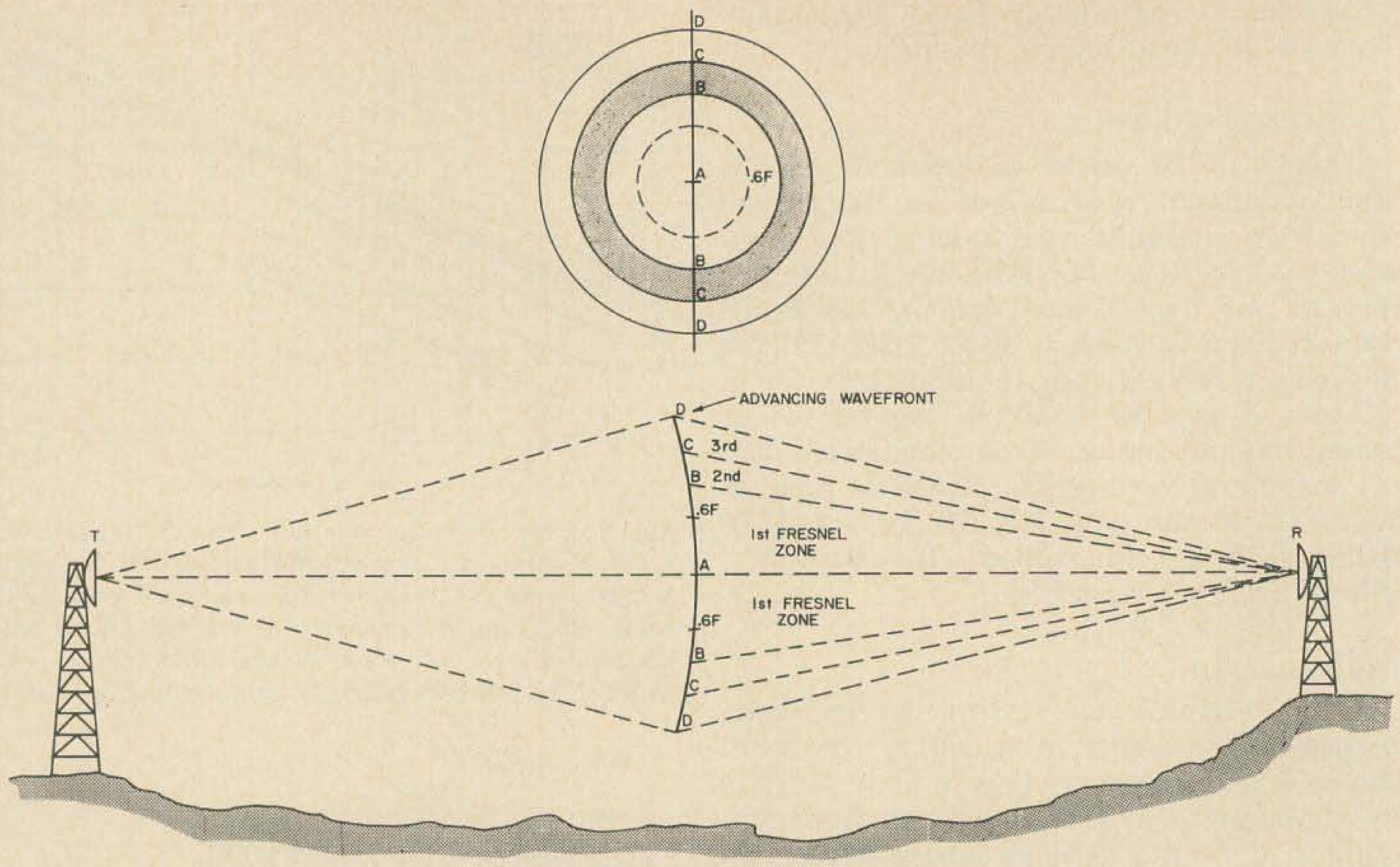


Fig. 4A. Fresnel Zones. Transmitted across space, the microwave beam spreads out, as do all radiations. In this figure the spreading is greatly exaggerated for clarity. At mid path, for a 30 mile path, at 1215 MHz, 6/10 first fresnel zone clearance would be equal to 75.9 feet, with full first fresnel zone radius extending to 126.54 feet.

get rid of 68 dB of our system loss. (System loss is the total of all losses in the system. **Fig. 2** shows that we have 134 dB system loss.) By using a 100 milliwatt transmitter we knock off 20 dB of this 68 dB, leaving 48 dB.

Then by using two 6 foot parabolas with a gain of 24 dB each, we can get rid of the remaining 48. To compute the gain of a given parabola at a specific frequency, use the nomograph in **Fig. 7**, or the formula with it.

With a 20 dB Fade Margin you will have a cushion of 20 dB to fall back on if propagation conditions cause freak fading. A 20 dB cushion will give you 99% reliability which means that in one full year of operation, 24 hours per day, the path will be out a total of less than 3¾ days, spread out over less than an average of 1 minute per day. Try getting that on 20 meters!

Reflections, Refractions, Diffraction and Fresnel Zones.

Much of the fading that will be experienced on microwave frequencies will be during the early morning and evening hours and particularly in spring and fall. Fading on microwave frequencies is frequency selective. That is, when a fade is occurring on one frequency, the likelihood of a fade occurring on an adjacent frequency with the same antenna heights and polarizations and located at the same point, will be very remote. But, if you are worried about reliability and fading you can always operate "frequency diversity," that is with two transmitters and receivers at each end, spaced 20 megahertz or more apart. Another alternate is to operate "space diversity" with two antennas serving one receiver or transmitter and spaced by at least 20 wavelengths. Surprisingly perhaps, fading will occur most frequently in flat areas such as in the wide mountain valleys and in coastal regions. Several good examples of the valleys are those that run North and South through Nevada and California. Some of these valleys are as narrow as 10 miles or so while others may be as wide as 100 miles or more. The Great Plains region, hundreds of miles wide and extending from the Llano Estacado region of West Texas, north to the Canadian Shield is another region having considerable fading. The reason for frequent fading in these areas is that they favor "layering" and columnaring of layers of air at certain times of the day and night, when the air is still and moisture is trapped in columns or layers of different temperature. These inversions cause reflections, refraction and diffraction or ducting of the microwave signal. Unfortunately, these are not readily predictable but they should be of minor consequence to ham operation.

Probably one of the more critical considerations of designing a microwave path is that of the Fresnel Zone. You might rightly ask, "What is a Fresnel Zone"?

Definitively speaking, Fresnel Zones are alternating zones of cancellation and reinforcement caused by interaction of the incident and reflected waves. Even numbered Fresnel Zones are destructive in nature while reinforcement is obtained with odd numbered Fresnel Zone reflections, as can be seen in **Fig. 4B.** There are an infinite number of Fresnel Zones but the first three are the most important since they contain most of the power of the beam. However destructive effects can be observed as high as the 12th Fresnel Zone and more. The First Fresnel Zone is that region of the microwave beam where, if a reflection occurs, the path will be between 0 and ½ wavelength longer than the incident beam. The path of the second Fresnel Zone will be between ½ and 1 wavelength longer and the path of the third Fresnel Zone will be between 1 and 1½ wavelength longer, etc.

Figs. 4A and **4B** show the Fresnel Zones to be a series of concentric circles. If you will imagine an obstruction rising through the beam, there will be a series of reinforcements and cancellations of the beam. Note that in **Fig. 4B,** at the outer limit of the first Fresnel Zone, it is possible to actually get "obstacle gain" of 6 dB from a smooth sphere obstacle such as a round mountain or hill without trees.

With a knife edge diffraction, such as a sharp ridge, gain is still possible, although somewhat reduced. The well designed microwave path should be so designed as to present free space conditions between transmitter and receiver. This condition (where obstruction loss is zero) occurs at approximately .6 first Fresnel Zone as well as at other points.

The radius of the Fresnel Zone may be

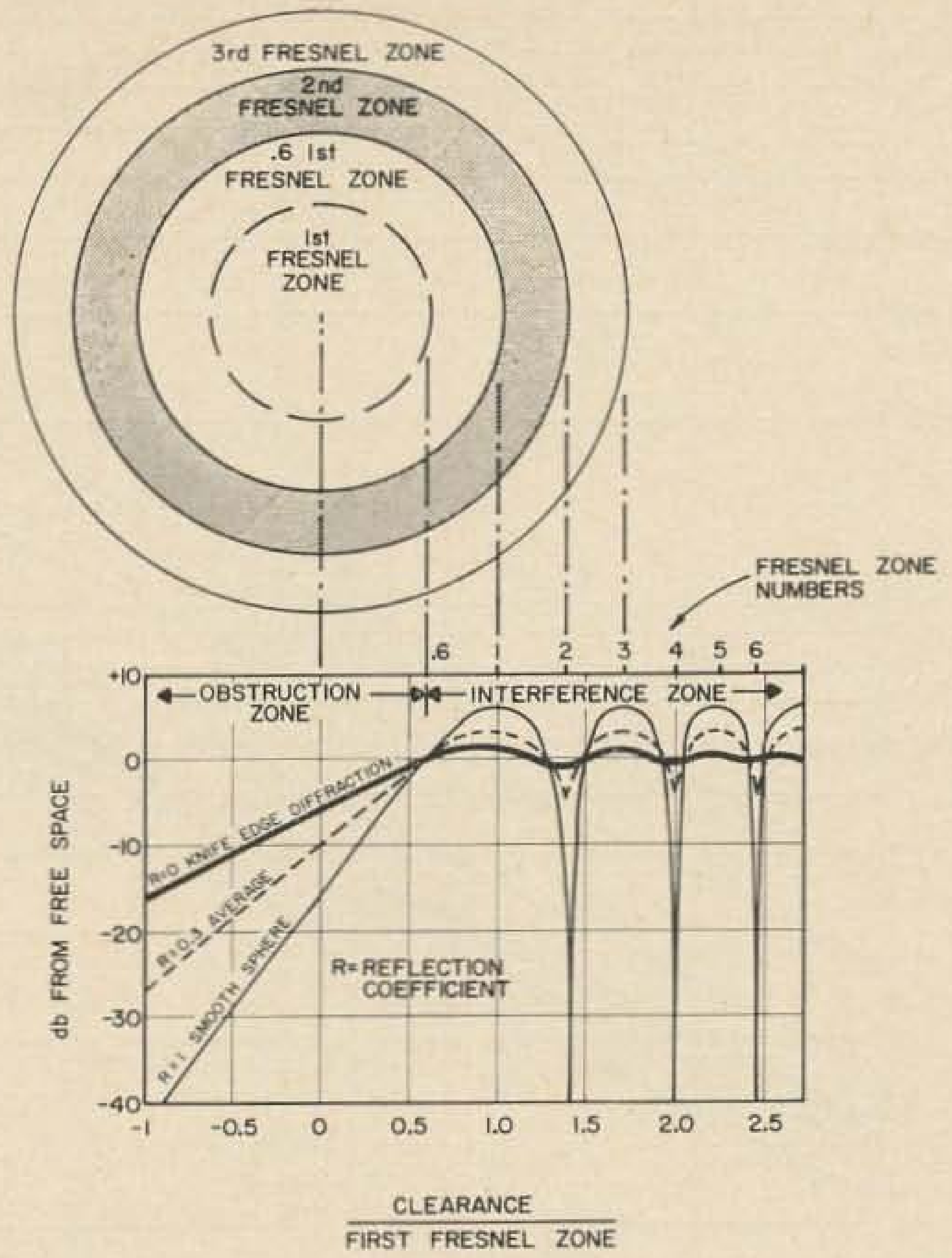


Fig. 4B. This figure shows the curve of the losses attendant to an obstruction rising through the microwave beam. If the obstruction is located so the center of the beam (Point A in 4A) is 75.9 feet (.6 first fresnel zone at 1215 MHz) above the obstruction, the equivalent of free space conditions are obtained and neither loss nor gain occurs. However, if the obstruction is located at the outer extremity of the first fresnel zone so that the very center of the beam is 126.54 feet above the obstruction, "obstacle gain" of 6 dB can occur. This would be the same as going from a 100 milliwatt transmitter to a 400 milliwatt transmitter. By the same token, if the very center of the beam grazes the top of the obstruction, shadowing occurs and obstruction losses will range from 6 dB to 16 dB, depending on the character of the terrain.

Propagation Conditions	Perfect	Ideal	Average	Difficult	Very Difficult
Weather	Standard Atmosphere	No Surface Layers or fog	Some Substandard Light Fog	Surface Layers Ground Fog	Surface Layers Fog Over Water
Location in U.S.A.		Rocky Mtns	Great Plains & East	Coastal	Coastal Water
Propagation Reliability					
60 to 85%			0.6 F K = 4/3	1.0 F K = 4/3	0.6 F K = 1
85 to 98%		0.6 F K = 4/3	1.0 F K = 4/3	0.6 F K = 1	0.3 F K = 2/3
98 to 99.9%	0.6 F K = 4/3	1.0 F K = 4/3	0.6 F K = 1	0.3 F K = 2/3	Grazing K = 1/2
99.9 to 99.99%	1.0 F K = 4/3	0.6 F K = 1	0.3 F K = 2/3	Grazing K = 1/2	Grazing K = 5/12

F = First Fresnel Zone Radius

Fig. 5. This chart gives some characteristic propagation reliability comparisons of various regions with varying propagation conditions and Fresnel Zone clearances for 30 mile paths. Courtesy Lenkurt Electric Co.

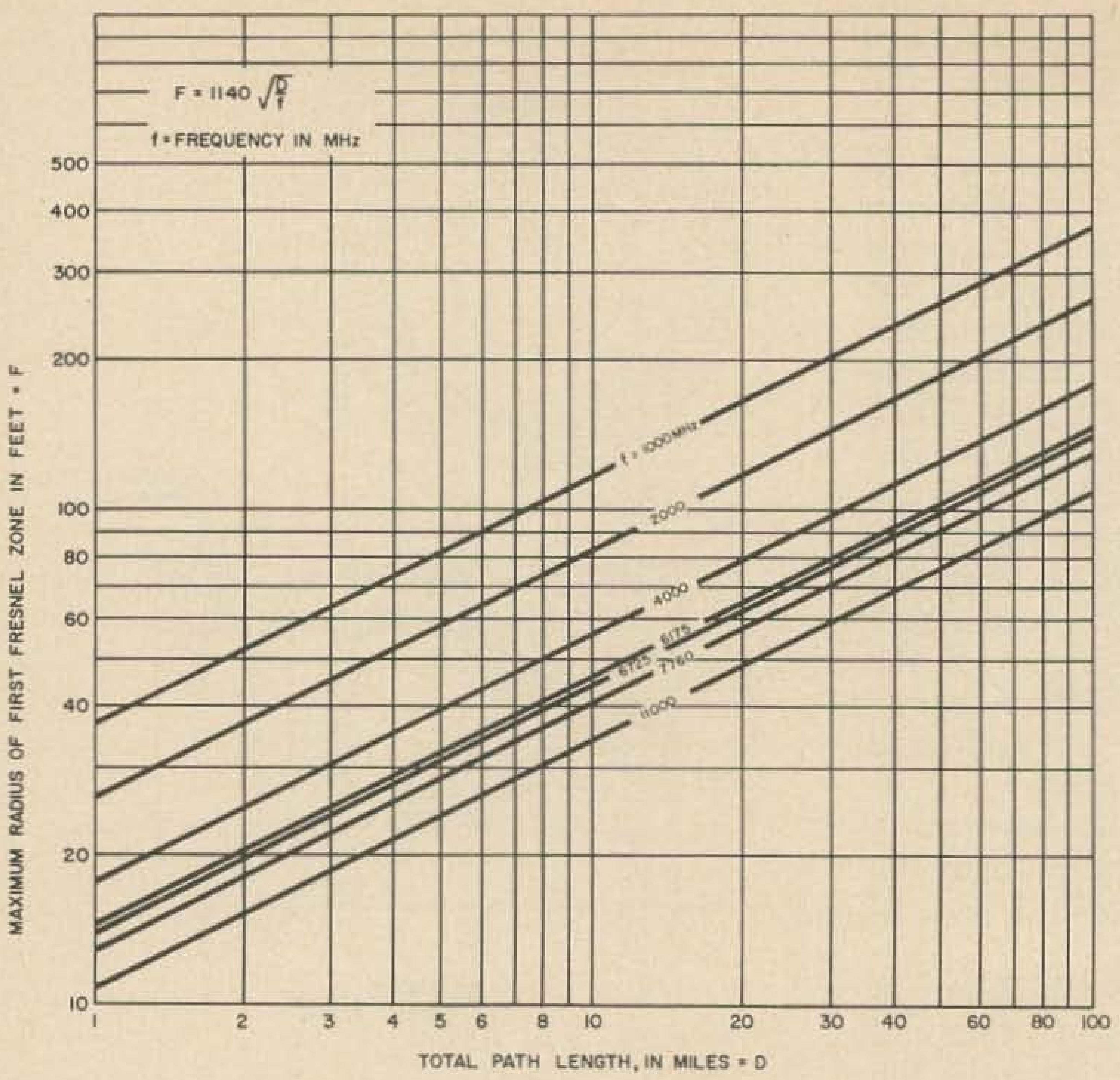


Fig. 6. First Fresnel Zone radius (1 to 11 GHz). To find the radius of the first Fresnel zone, enter the nomograph at the bottom (assuming a midpath of 15 miles and a frequency of 1215 MHz). Read up to the frequency of interest then, horizontally to the left to the radius of the first Fresnel Zone (approximately 125 feet). Courtesy Lenkurt Electric Co.

computed using the following formula:

$$F_n = 2280 \sqrt{\frac{n\, d_1\, d_2}{f\, D}}$$

where

F_n = the nth Fresnel Zone being considered,
n = zone number,
f = frequency of operation, in MHz,
D = total path length, in miles,
d_1 = distance from one terminal to the point in question
$d_2 = D - d_1$.

At midpath (where $d_1 = d_2$) the First Fresnel Zone radius is given by

$$F = 1140 \sqrt{\frac{D}{f}}$$

where

D = total path length, in miles and
f = frequency of operation in MHz.

For example, the radius of the first Fresnel Zone at 1215 MHz for a path of 30 miles, at midpath =

$$1140 \sqrt{\frac{15}{1215}} = 126 \text{ feet}$$

Six-tenths first Fresnel Zone clearance is equal to 75.9 feet. So the center of the microwave beam should be about 76 feet above any obstruction at midpath.

For practical purposes the radius for a given Fresnel Zone can be computed for the middle of the band in question and used with reasonable accuracy at all frequencies in that band. Preparing the path profile as suggested later, you will be able to see any areas that may pose potentially hazardous as far as Fresnel Zones go. And by computing the Fresnel Zone radius and comparing this to the clearance available with the path, frequency and tower heights of the system, you will be able to avoid some potentially serious reflection problems. If you plan microwave work in town, Fresnel Zone reflections can occur from and be computed for tall buildings that have flat sides that make excellent reflecting surfaces at microwave frequencies.

Antenna gain

It's not only of technical interest to be able to determine the size parabola needed for microwave work; it's also of economic interest. Why build or buy a 12 foot parabola when all you need is a 6 foot parabola. And a 6 foot parabola is a lot easier to transport than a 12 foot parabola.

So, we should know how to compute the gain of the various sizes of parabolas available to us.

Two things affect parabolic antenna gain. Frequency and size. The easy way to figure antenna gain is to use the nomograph in **Fig. 7.** If you prefer not to use the nomograph the formula is:

Gain = 20 log F_{MHz} + 20 log D −53
where F_{MHz} is the frequency in MHz
and D is the diameter of the parabola in feet

As an example, let us consider a 6 ft. parabola at 1215 MHz.

Gain = 20 log 1215 + 20 log 6 −53
= 20 × 3.085 + 20 × .778 −53
= 61.7 + 15.6 − 53 = 24.3 dB

Rounded off, 24.3 dB becomes 24 dB gain for a 6 ft. parabola at 1215 MHz.

Antenna orientation and Polarization

As radio waves are reflected from a surface they undergo a change in phase relationship with respect to the receiving antenna. This is dependent on the original polarization and the angle of incidence. Horizontally polarized waves suffer the most change being shifted in phase by about 180°. This in effect changes the electrical path length of the reflected wave by one half wavelength. For horizontally polarized waves, then, if the area of the reflecting surface is large enough to include the total area of any odd numbered Fresnel Zones, the resulting reflections will arrive at the receiving antenna out of phase with the incident wave and cause cancelling interference.

However, vertically polarized waves produce considerable variation in the phase angles reflected. Depending, as with horizontally polarized waves, on the angle of incidence and the reflection coefficient, vertically polarized waves will undergo changes in phase all the way from 0° to 180°. This means that for a given condition of reflection the vertically polarized wave will experience fewer destructive phase changes. So, the conclusion is to use vertical polarization in preference to horizontal, since the vertical is not always subject to 180° phase shifts, as are the horizontal waves.

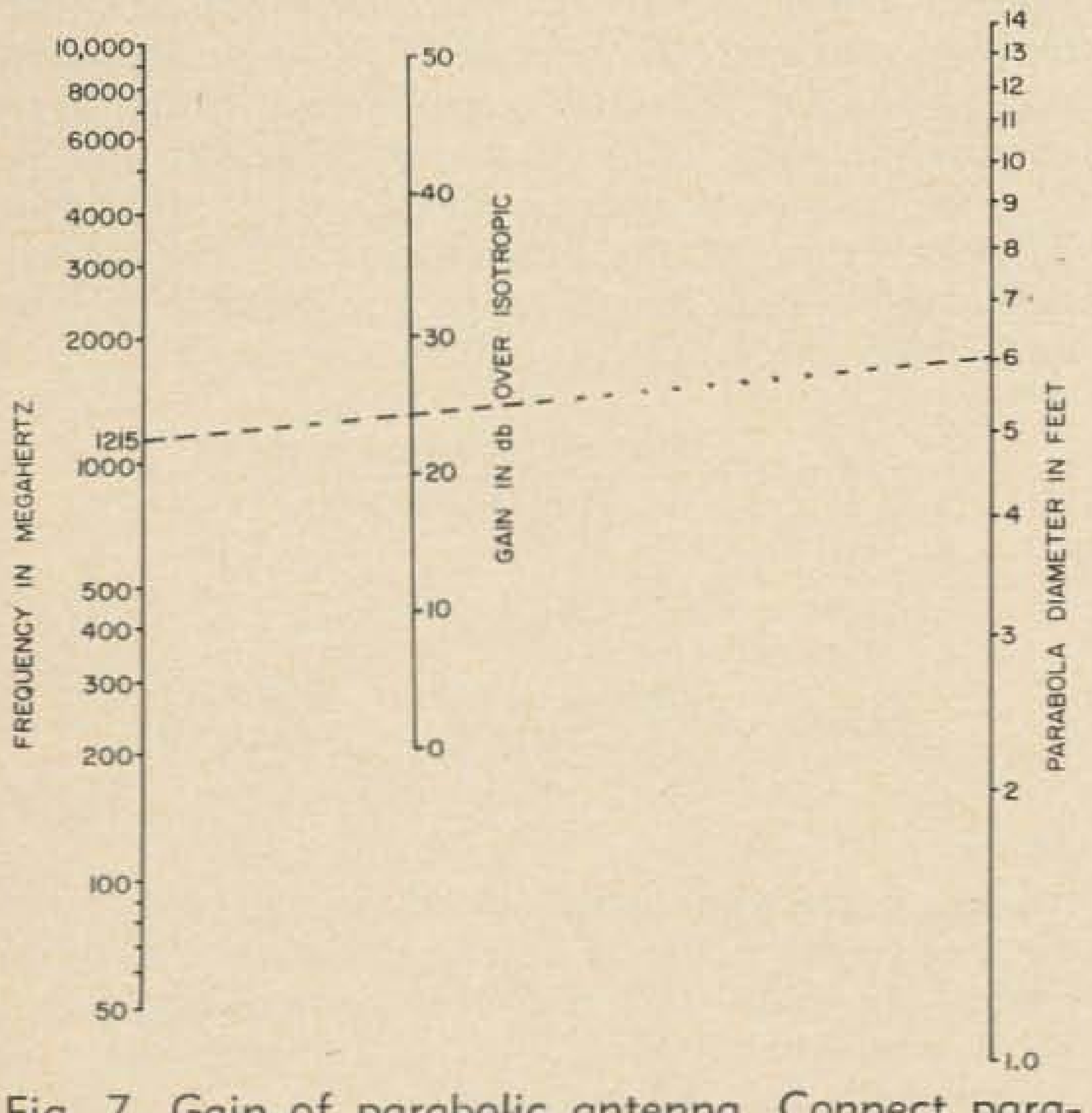


Fig. 7. Gain of parabolic antenna. Connect parabola diameter in feet to frequency with a straightedge. Where the straightedge crosses "gain" line, read gain of the parabola. Or compute by:
Gain (in db) = 20 Log_{10} f — 20 Log_{10} (D-52.6)
where f is the frequency in MHz and D is the diameter of the parabola in feet.

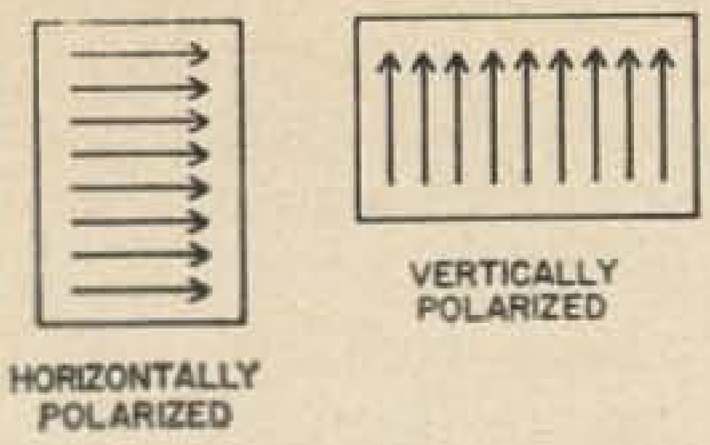


Fig. 8. Electric field polarization. Confusion frequently occurs on the polarization of waveguide and feedhorn openings in microwave work. The electric field is the field of reference and is, mechanically, 90° rotated from the longitudinal axis of the waveguide or feedhorn opening.

If you use waveguide feeds on the higher frequencies, the question of what is vertical and what is horizontal polarization, seems to be a popular one. **Fig. 8** shows the proper polarizations.

Passive Repeaters

If you are going to the trouble of going into microwave work, and on a serious basis, there may come a time that, no matter how high the tower supporting the parabola, a direct workable path may not be available. Then, either a passive or an active repeater becomes necessary. The passive requires no power and can be installed in a remote area, unattended. It effectively has gain, too, and should be considered if signals levels permit.

Commercial passive repeaters are designed so that the face of the reflector is flat within ⅜" for 2 GHz[1], ¼" for 6 GHz and ⅛" for 11 GHz. For 1215 MHz ham band operation, a flatness of 1" or so should be satisfactory and this is easily obtainable with a homemade reflector. The reflector must be made of a conductive material. 4' x 8' sheets of ¾" plywood, with the reflecting conductive material (heavy aluminum foil or sheeting) mounted to it makes a good passive reflector for 1215 MHz. A number of these 4 x 8's mounted on a two by four frame work will make a good passive repeater for temporary use.

When computing the path loss of a system using a passive repeater, you must compute path loss between transmitter and the passive

[1] GHz = gigahertz: 1,000,000,000 cycles per second (1 kMc).

and between the passive and the receiver, separately, rather than just between transmitter and receiver. The gain of the passive is the result of intercepting a part of the microwave energy transmitter and concentrating this energy into a narrow beam that is redirected in a concentrated beam toward the receiving antenna. The gain of the passive is found by

$$\text{Passive Gain in dB} = 20 \log \frac{4\pi A \cos \alpha}{\lambda^2}$$

where A is the effective area of the passive in square feet,

λ is the wavelength in feet, and

α is half the included horizontal angle.

The gain of the passive increases with an increase in area or frequency and with a decrease in the horizontal included angle. The most effective use of a passive is where it is located directly behind and above either the transmitting or receiving terminal location. It's impractical to use horizontal included angles greater than 140 degrees with the flat passive. Beyond that point the effective area becomes small and the passive becomes impractical and uneconomical.

The effective area is equal to the actual area multiplied by the cosine of one half the included angle and if the vertical angle is large, also by the cosine of one half the vertical included angle. Usually the vertical angle is small, only a few degrees, and is neglected.

In some cases, two parabolas connected back to back, with a short section of transmission line can make a very useful passive repeater. The transmission line should be kept as short as possible.

Path Profiles

When you have selected your tentative transmitter and receiver sites, a profile chart of the topography of the path should be prepared. With the profile you will be able to see areas that may present potential reflection points. A preferred method of illustrating the path profile is to use the "flat earth" with a curved microwave beam. The degree and direction of the bending of the beam can be defined by the equivalent earth radius factor K and multiplying this by the actual earth radius, R, gives the radius of a fictitious curve equal to the curvature of the earth minus the curvature of the microwave beam. Using the flat earth method you can compute, plot and

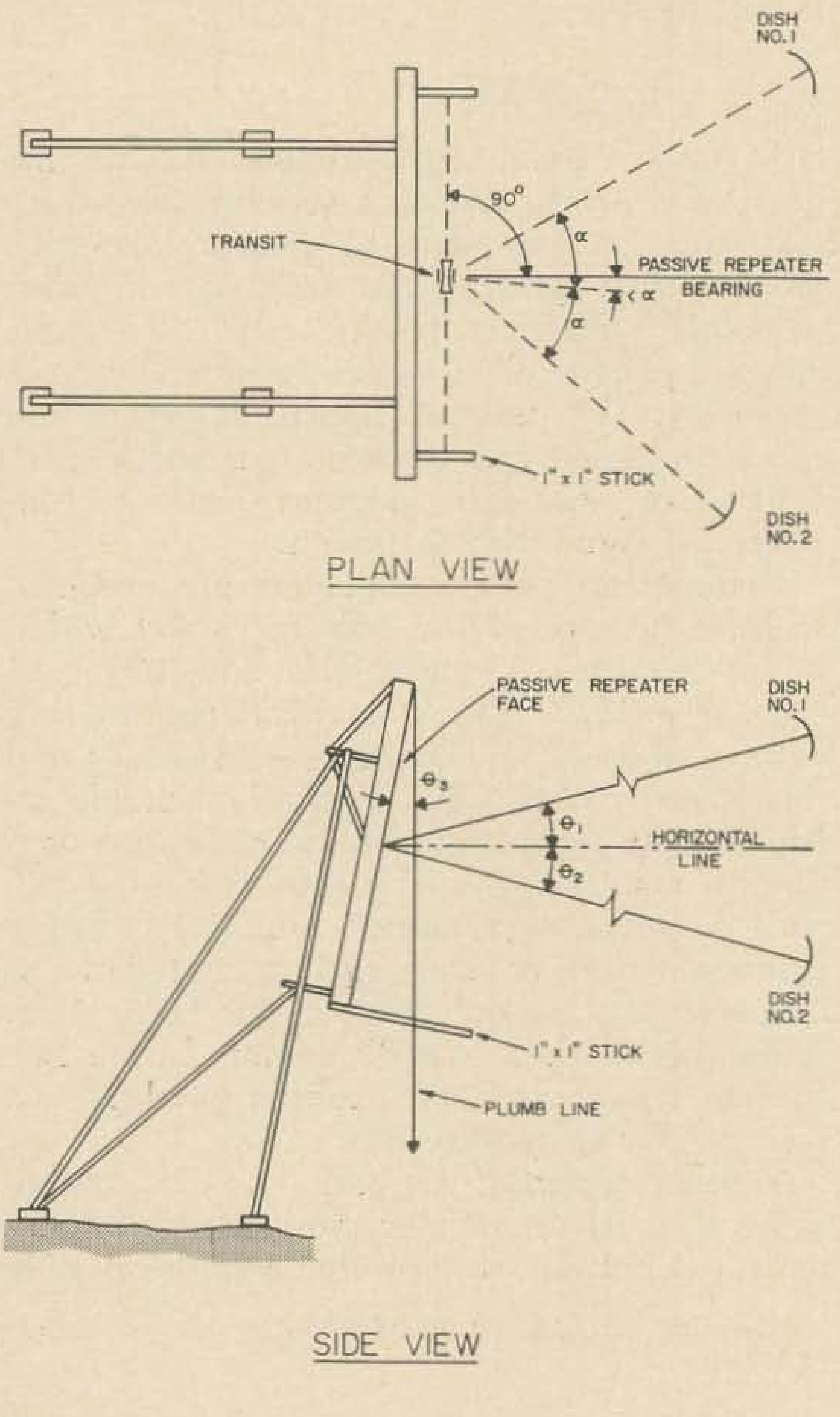


Fig. 9. For passive repeater installations, three angles must be measured and two angles must be calculated. The three to be measured are (1) the vertical angle between a horizontal line and the incoming beam, (2) the vertical angle between the horizontal included angle and (3) the horizontal included angle between the two paths. The two angles to be calculated are (1) the vertical face angle of the passive and (2) the correction angle which is added to the bisector of the horizontal angle. The equations are

$$\tan \Delta \alpha = \frac{(\tan \alpha)(\cos \theta - \cos \theta_2)}{(\cos \theta + \cos \theta_2)}$$

and

$$\tan \theta_3 = \frac{(\cos \Delta \alpha)(\sin \theta_1 + \sin \theta_2)}{(\cos \alpha)(\cos \theta_1 + \cos \theta_2)}$$

where

$\Delta\alpha$ = a correction angle added to the bisector of the horizontal angle to rotate the passive bearing toward the path with the least vertical angle,

θ_3 = the vertical face angle of the passive

2α = the horizontal included angle

θ_1 = vertical angle for path 1

θ_2 = vertical angle for path 2 and

(Conventions: sines are positive when the angle slopes downward and positive when the angle slopes up. Cosines and tangents are positive). Courtesy Microflect Co., Salem, Oregon.

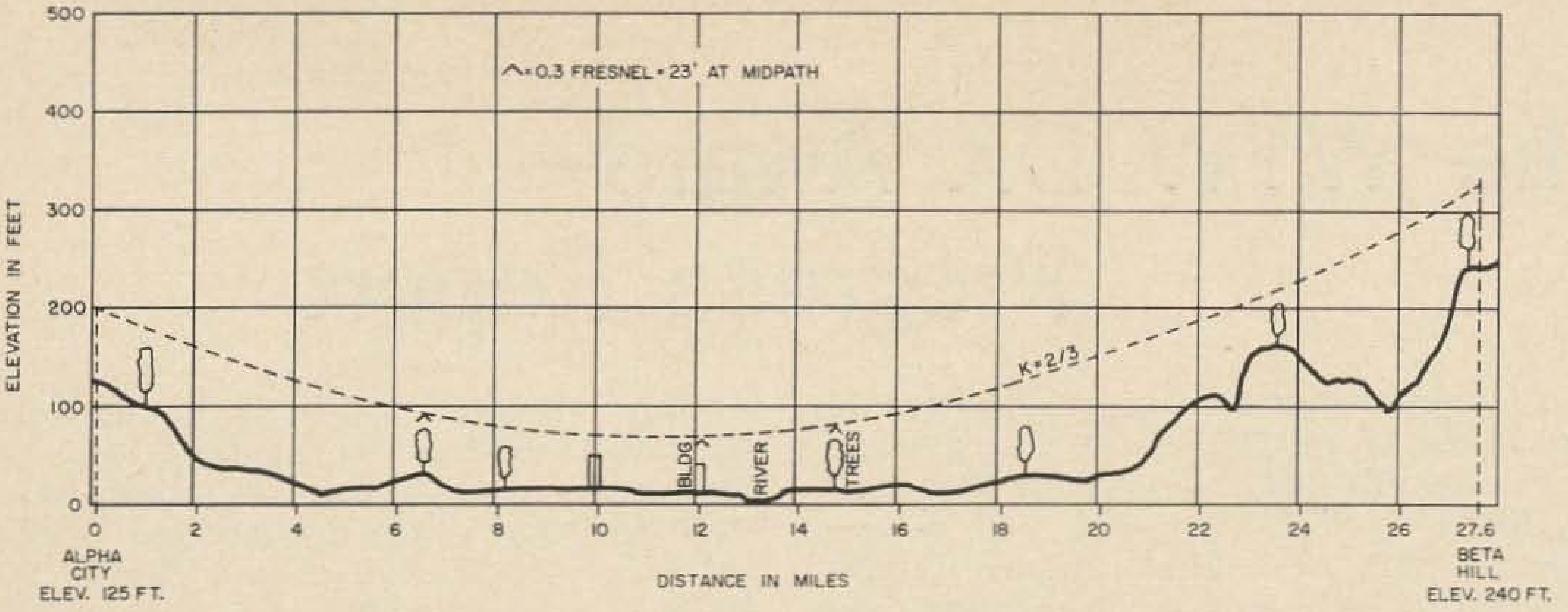


Fig. 10. Representative topographical path profile plotted with a ⅔ earth curvature. Courtesy Lenkurt Electric Co.

investigate the conditions for several values of K, to accommodate a changing propagation medium that might cause reflections. Normal atmospheric conditions prevail when K = 4/3.

Typical path clearance data and progagation reliability for a 30 mile path are given in **Fig. 5.**

The curvature for the various values of K at given points along the path may be found by

$$h = \frac{2d_1 \, d_2}{3 \, K}$$

where

h = the change in the vertical distance from a horizontal reference line, in feet,

d_1 = the distance from a point to one end of the path, in miles,

d_2 = the distance from the same point to the other end of the path, in miles and

K = the equivalent earth radius factor.

Fig. 10 shows a typical path profile using the flat earth method and **Fig. 11** is a nomograph designed to aid in determining the earth curvature for various values of K. When the propagation conditions are normal and K = 4/3, h is equal to one half the product of the two distances.

Well, we've come from Path Loss to Path Profile. You may have found some new ideas or some new slants to old ideas all for the purpose of making your microwave work more effective. Many of the considerations may be applied to VHF work as well, such as using two Yagi antennas back to back to make a VHF passive repeater.

Design of a microwave system, whether it contains only two terminals or many repeaters with spur terminals, must ultimately be a balance of all the elements and considerations of the system, including economics, reliability, flexibility and others, to accommodate the transmission of a signal from one terminal to another.

With more and more hams going into microwave spectrum, data such as that presented in this article will become more and more important. As the VHF frequencies become overcrowded in the metropolitan areas, other means will be required to circumvent interference on these bands. The establishment of ham microwave nets and systems across states for CD and emergency communication applications will require more sophisticated design of these future ham microwave systems.

. . . WA6PZR

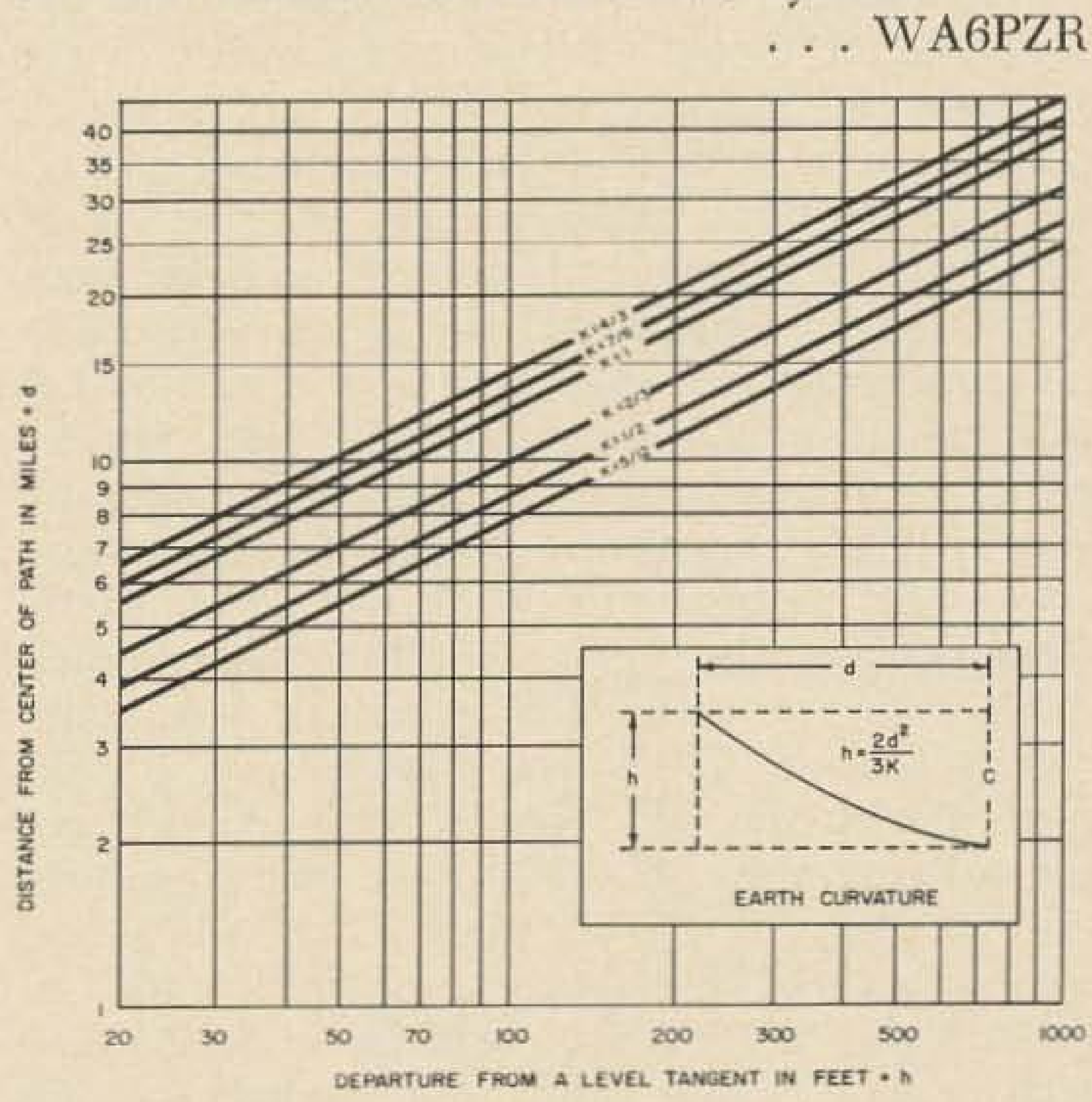


Fig. 11. Plotting the curvature of a microwave beam with a "flat earth" path profile. For a ⅔ earth radius factor, enter the nomograph at the point under investigation, say 10 miles. Read horizontally to the right to the ⅔ curve then read down to 100 feet, which is the departure of the curve from a level tangent to the flat earth. Courtesy Lenkurt Electric Company.

Gus Browning W4BPD
c/o 73 Magazine
Peterborough, N.H. 03458

The WTW DX Award—Progress Report

So far seven stations have qualified for the Worked the World DX Award. All have sent in at least 100 QSL's to qualify. They are: Gay Milius W4NJF (SSB #1), Bob Wagner W5KUC (SSB #2), "Hop" Hopple W3DJZ (SSB #3), Bob Gilson W4CCB (SSB #4), Jim Lawson WA2SFP (SSB #5), Joe Butler K6CAZ (SSB #6) and Vic Ulrich WA2DIG (CW #1). Bob Wagner W5KUC is the first 200 winner with SSB 200 #1.

The big trouble seems to be in getting those QSL cards. A number of fellows I have QSO'ed told me they had worked nearly 200 countries but have yet to receive the first 100 QSLs. Fellows, this is part of the game; but remember, if sending QSL cards is a real hardship on the DX station, they can send us a copy of their log and we will credit every applicant with QSOs that are shown on the log. We have card files for every applicant and it's easy to add to their list. In sending us your score please use standard size (3" by 5") file cards. Be sure your call sign is on each one of them, with your countries listed by their call signs alphabetically and numerically starting with file card number one. For any future tabulations please give us your signal report, number your cards, and be sure to indicate the band and the mode you used. All applications should be for a single band and a single mode; phone and CW may not be mixed or bands mixed. Include $1 or equivalent in IRC's and return postage for the cards.

Do not confuse our W T W award with other DX awards, this is something new, something everyone can enter, even the new comers to DXing. This award gives you a fair chance with the Old Timers; you all start out even. Remember all QSOs have to be on this side of May 1, 1966, 0001 GMT. We are anxiously QRX for some more applicants. In seeking the W T W you will be getting some activity and I am sure that's what we all want. Our bands need a lot of activity to show that we are in need of all the frequencies we have. Waiting for a "new one" in some of the "older" DX awards usually means waiting month after month for something to show up. Why lose all your time just setting around OM when you could be in there working a new one towards your W T W certificate? You fellows that are in the *honor roll* have just about worked yourself out of business and I strongly suggest you get into the W T W and have yourself a lot of fun. The W T W certificate is a real nice one to hang on your wall and will indicate to the boys that you are an *active* DXer. I know some fellows that are in DXCC who have not worked anything new (excepting maybe Don Miller) in the past 6 months. After you have worked those few you still need, what will you do? About all that's left now are places like Tunisia, Iraq, Albania, Sovereign Order of the Knights of Malta, Mount Althos and that's all. While you are QRX for these few that are still left, why not get in on all the fun with the W T W chasers? It will be difficult to get QSL cards for every contact, but at least you are doing something that every DXer likes to do—that's to work DX, even though some of it may be not of the variety known as "rare ones." You can still work those you need that I mentioned above when and *if* they show. You don't have to miss them by being in there getting a few new ones towards your W T W DX award. I admit that lots of fellows are getting tired of chasing DX, trying to work new ones, keeping all the records to know what you need, wanting to throw in the towel on DXing, wanting to see more TV programs such as "Gun Smoke," The Beverly Hillbillys," "Bonanza," wanting to "go fishing," play golf, look at football on TV, and many other things like that. Many of the Old Timers don't want to get up at 3AM to work VR4, VR6, VR3 etc. I myself have been like that the past few months, not because I am tired of working DX, but since I am stuck with a vertical ground plane and a little linear, I am not quite ready for the good, long haul stuff. I will soon have my new antenna up and am building a good linear. Oh yes, I still call myself a DXer, its in my blood. You other fellows I described above are not DXers any longer—you are ex-DXers and may as well face the facts.

The W T W DX Award is for fellows who are still DXers, the ones who like to get in a big pile up and work that rare one. You are the ones we want in the W T W. The W T W is here to stay fellows, let's face it, its a challenge we admit, but if you are a true DXer you will get with it and have yourself a lot of fun. I hope to see all you true DXers in the next pile up myself, working a few good ones.

Oh yes, my little magazine, "The *DXers* Magazine" is off and running; most of the *Big Guns* and many *Small Guns* are on my subscription list now. It looks good. I think it's filling a needed gap in the DX world, something that's needed and it's not in competition with anyone. Right now it's 16 pages; maybe more later on. . . . Gus

(Continued from page 2)
a single exception, that have led the way in electronics are those who have encouraged amateur radio as a hobby. And, on the other side, that those countries who are presently backward in electronics are, without exception, those that have been indifferent or restrictive to amateur radio.

Thus you can see, far from being just a fun hobby, amateur radio is of the greatest importance to any country. This is obviously recognized in the Soviet where we find amateur radio strongly supported by the government. They know what they are doing. France, on the other hand, has been most restrictive, and it comes as no surprise to us that while the electronics industries of Germany, Russia, Netherlands, England and Denmark are quite well known to us, we are totally unfamiliar with anything originating in France. A visit to France and a bout with their telephone system will tell you more than I can say without fear of reprisal from De Gaulle. France has less than one amateur for every 20,000 of their population (we have one for about 750 in the U.S.) and thus the development of electronics in France is virtually impossible . . . there are no people to draw from . . . they have euchred themselves out of the modern age of electronics by a backward and self-destroying policy toward amateur radio.

In case you think that the French amateurs will be angry with me for using their country as an object lesson, let me hasten to mention that it was they that made a point of this difficulty and they that requested me to bring this trouble to the light of day. France, if it would encourage amateur radio, could have over twenty times as many radio amateurs as it has today and could develop its electronics industry.

Larry Henn 5Z4JW came all the way down from Kitale for the dinner. This is a full day's drive over very rough roads. Larry is quite active on twenty sideband.

So, as you see, there are powerful reasons why amateur radio must be protected and encouraged in the growing countries of Africa and Asia. Our first task is to be sure that the leaders of these countries understand the importance of amateur radio. Our second task is to help them get ham radio started and growing in their countries.

Perhaps what we need at this time in our history is an amateur radio Ambassador to visit these countries and talk with the presidents, prime ministers, kings, etc., and acquaint them with the facts of our hobby and its importance to their country. I haven't tried to see the top men anywhere, so I don't know whether I could do much good along this line or not . . . I suspect that the best I would be able to do would be to see the top communications government official in most countries. I think we need to go higher than this. I think it would take someone like Barry Goldwater or Herb Hoover to get in at the top level.

This is being written in Sydney, Australia and I have no opportunity to call either of these men to find out their reaction to my ideas. I would like to point out though that Herb, as past president of the ARRL, could do amateur radio the best service it has ever had if he could take a bit of that $100,000 the ARRL Directors voted for just this type of purpose and spend it on a visit to see the heads of about twenty or thirty countries.

A lot can be done on the lower levels too, of course. I have been keeping a weather eye open for ways that we can help the growth of amateur radio, particularly among the local amateurs, in these Afro-Asian countries. Let me briefly touch on the situation I found. Kenya: one African amateur at present . . . no licenses being issued. If the license situation could be solved we might be able to encourage things to where we would have a slow but steady growth of African amateurs there, possibly five to ten a year as a starter. Ethiopia: no Africans licensed. Licenses are available and there are a number of Africans that would be interested in amateur radio if only equipment could be made available. The problem here, as in most of these countries, is unbelievable poverty. Sudan: no Africans licensed, no licenses. There are a few Africans ready for licensing if the government comes across . . . equipment is a major drawback here too. Egypt: two active amateurs . . . dozens or more interested, but equipment is prohibitive. Licenses are available. Lebanon: many local amateurs, equipment not difficult to get, licenses are easily available . . . look for continued growth here without much need for outside help. Syria: one licensee, no new licenses at present due to government problems. They've just had another change of government and it may be a while before they can start licensing again. Iraq is in a similar position. Iran is much stabler and there are several locals licensed and more coming along. Afghanistan has no locals and none in sight. Nepal ditto. Burma is in political turmoil: no ham radio in sight. I'll go into all of these countries and in more detail later.

India is a key country for here we find the largest number of licensed local amateurs, some 400. We now have reciprocal licensing with India, by the way. But 400 out of a population of 400 million is pitifully small even though it is way ahead of all the other Asian countries.

While in India I visited a number of the radio amateurs and had a chance to operate a little from their stations. I got together with many more amateurs and discussed their problems with them. The basic difficulty is poverty. It is difficult for us to understand their type of life. A skilled worker after 10 years at his job makes about $10 a month . . . an upper middle class (comparatively) makes $100 a month. Since there is virtually no radio equipment or parts available in the country the amateurs find it almost impossible to get on the air. One of the most modern pieces of equipment in India is the SX-28, left over from the last war.

The amateurs of India assure me that the only thing holding back more licenses is the lack of equipment. They tell me that they would be able to bring in thousands of men and boys for licenses if only some equipment was available.

That shouldn't be so difficult, now should it? I immediately thought of the mountains of ham gear that are stashed away in cellars, garages, attics, in closets and on shelves that we are no longer using. If some system could be worked out for gathering all this unused equipment and getting it shipped over to India . . . and then if it could be gotten into the country without the usual heavy duty payments and distributed equitably we might accomplish quite a lot. There are a lot of *if's* there. I don't think there will be any great difficulty in surmounting the U.S. end of the deal . . . but what about Indian duty and distribution . . . could these be solved?

I'll go into the blow-by-blow account of how everything was done later on. I did manage to get a verbal agreement from about as high as you can go to permit the entry of gift ham gear and parts into India duty free.

Special visitor at the Nairobi dinner was Ian Cable MP4BBW from Behrein, in town with his new XYL for the day. Ian is on the right. On the left is Steve Gibbs MP4BEQ who is now living in Nairobi and editor of the club bulletin, a surprisingly well-done paper for such a small group. Steve has been unable to manage a 5Z4 license as yet, but perhaps the lid will come off soon and we'll hear him on twenty. Ian is one of the old timers, of course, and anyone who has DXed much knows him well.

And the Institute of Telecommunications Engineers (the Indian counterpart of the IEEE) has volunteered to handle the distribution of equipment. Further, the Amateur Radio Society of India (ARSI) has volunteered to help the program by setting up study courses for the amateur license and classes in technical institutions.

The U.S. end is still open. It would be wonderful if the ARRL would, through its thousands of member clubs, take the responsibility for the collection and shipment of this equipment. If they will not handle this then we must find someone who can . . . I would like to hear from anyone with suggestions.

By helping India . . . and perhaps many other countries, we are helping the world as well as amateur radio. The basic truths that we must get through to the governments of new countries is that amateur radio is vital to the future of their country.

In 1959 India was one of the leading opponents to amateur radio. I believe I've seen a considerable change there and, if we can get gear to help them expand, that we will see an astounding change and find India a firm supporter of amateur radio.

Yes, I think I'm aware of most of the problems involved, if I may answer the usual volunteer group of negative thinkers. I've talked with the head ITE people in India and we have agreed on guidelines for the distribution of equipment and parts. Some will go to help deserving active amateurs, and a great deal will go for the establishment of amateur radio club projects in schools and institutions. On our end I would like to have the project handled by a non-profit organization so that donations to it can be taken off the income tax, thus helping ourselves a bit while we are helping others.

And please don't write to me about sending equipment or, for that matter, send me equipment for the project. I want you all to know what is going on as it is happening. If you have any suggestions or want to help, this is the time to write.

I believe that the present course of events can be changed. It is encouraging to me that a large number of our ham-owned equipment manufacturers are interested and active in the goal of perserving our hobby. It is unfortunate for us that some of the larger manufacturers seem completely indifferent to our future. It appears as if they view us coldly as a market and nothing more. If we fade away they will turn to other markets. I note, perhaps with perverse satisfaction, that few of these companies are advertising in 73 and that most of them are suffering considerable sales resistance to their products. Further note: though I am aware of the presence of the Bullmoose syndrome (what is good for 73 is good for amateur radio), I try not to let it become too obvious.

Fine, well and good for Wayne Green sticking his nose into things, but where, you ask, does IARU fit into all this? After all, isn't that the only international amateur radio organization? And what about the IARC there in Geneva? Gentlemen, those are two more kettles of fish and, as you have been subtly warned in QST, I have been meddling. I don't want to drag this piece on interminably this month so I'll put this can of worms to rest next month.

Robby 5Z4ERR at his shack in Nairobi, Kenya. Robby has for years been one of the top DX phone operators of the world. Just about every visiting amateur stops in to see Robby at the Robson Chemists shop right in the middle of Nairobi.

Ray 5Z4IR, one of the most active Kenya amateurs now that Robby has sort of "retired" from frantic DX chasing. Ray can be heard many afternoons on twenty rag chewing with his fine signal. Ray is the president of the East Africa amateur club and is shown here with Pete Bailey 5Z4KPB at the dinner held during my visit to Kenya.

So there you have it. I've tried to find out as best I could what is going on and figure out what might be done to improve matters. I'll have more details on my visits to those countries for you adventure fans.

ST2

There are periodic reports in the DX bulletins and columns of activity in the Sudan. Such reports are exaggerated. Back a few months ago ST2BSS was activated for a few days, but this was a special effort and no other activity has been permitted from this country since.

ST2BSS, the Boy Scouts of Sudan station, was set up by Jim Collins, who is in charge of transportation for the U.S. Embassy in Khartoum and is well known for his work in scouting. This station was licensed for operation in conjunction with a special Sudanese scout encampment.

The problem in Sudan is the usual one . . . politics. Just a couple days before my arrival there was another change of government, a coup that was virtually bloodless, with but about 25 lives lost.

Before the coup Jim had been working hard to get ST2BSS back on the air. He was having considerable success too. He had the backing of the Minister of Tourism and the Minister of Communications. All that was needed was the OK from the Minister of the Interior . . . and he had a verbal OK from this office. Then came the coup and none of the ministers knew what authority they had and no decisions could be made. At this time a subordinate rejected the amateur application with the result that Jim had to start all over again.

I went with him to see the new Minister of Tourism and we found him most enthusiastic about both amateur radio and scouting. He pointed out that, unfortunately, his support was not of much value at the moment because he really didn't know where he fit in the new scheme of things . . . he was sort of up in the air. I was glad to find that he has taken a strong interest in promoting tourism in Sudan and had just received a thorough report on the proposition from an American expert, one that has done much for other African countries. Though there isn't a lot for the tourist to do in Sudan right now, I can see where tourism could be greatly expanded and would be a relatively easy source of outside funds. Nigeria found that each visitor left about $120 behind. Sudan is right on the path from Europe to East Africa and some promotion might get tourists to that part of the world, some 10,000 a year, to stay for a day or so in Khartoum.

Jim's next hurdle was the new Minister of Communications. He tried through friends to set up a meeting with him so I could have a chance to shake hands, but he was busy until after my departure. Just by chance Jim met the Minister at the airport and had an opportunity to have coffee with him and found that he is quite enthusiastic about the scouts and the amateur radio station. The problem then is entirely the Minister of the Interior's department. Jim will be working on this and we may

Jim Collins ST2BSS. Jim is very interested in the boy scout movement and the BSS stands for Boy Scouts Sudan. His great project is to raise enough money to get twelve scouts to the jamboree in the U.S. next August. This would be the first time something like that ever happened, if he can manage it.

In Khartoum I visited Jim Collins ST2BSS, shown here with a copy of some magazine and two of the Sudan boy scouts that he is teaching about amateur radio. When the political situation in Sudan eases and licenses are again possible we will be looking for these two fine lads, Abdul Gayoum Mohammed and Abdul Aziz Awad.

just hear him on 20M one of these days if he succeeds.

The amateurs here have primarily been up against fear of the unknown in the past. The officials did not know much about amateur radio and were suspicious and afraid of it. They have troubles with the Shifta in the south and these forces use radio so their fears have been compounded.

Two of the Sudanese Scouts visited during my stay and I was interested to see that they are well on their way toward their amateur licenses. If the political problems can be overcome I think that, under Jim's tutorship, these scouts will soon be on the air. Jim did a wonderful job of this at his last assignment in Nigeria and is repeating it here.

The Minister of Tourism was quite interested when we pointed out that amateur radio would provide free advertising of Sudan and would encourage tourists to come and see this country. The country is low on money and is eager for any possible income. The income from tourists would be most welcome.

Jim has another project which would help with income to Sudan too. Sudanese scouts have never before been able to go to an international Jamboree. He is hoping that through amateur radio, donations can be received to help pay the way for a dozen Sudanese scouts to the Idaho Jamboree next year. I think that fellows contacting the station would be glad to send along a dollar or two for something like this. I might point out that this would have no bearing on the receipt of a QSL and that the donations would probably be requested to be sent to the Boy Scouts of America in New Brunswick, New Jersey to be held for the Sudanese Scouts.

If the new government holds together there is a good chance that we'll have some ST2's to work. There are a number of amateurs over here, some with gear, just waiting for things to break loose.

SU Report

By a lucky chance I managed to have a talk with Ibrahim SU1IM during my short stay in Cairo. He returned from a vacation just in time for us to get together.

The Callbook lists five amateurs in Egypt. Ibrahim explained that SU1AL is active a little, but on phone only. SU1AS is no longer active. SU1KG is not active. SU1KH has not been well and is inactive. Ibrahim gets on the air two or three hours a day and is the mainstay of this country for the DXers. He runs mostly to CW and gets on AM phone now and then. He runs 100 watts. There is one other chap licensed, but he is out of the country at present. . . . German fellow . . . SU1DL, the only foreigner with a license.

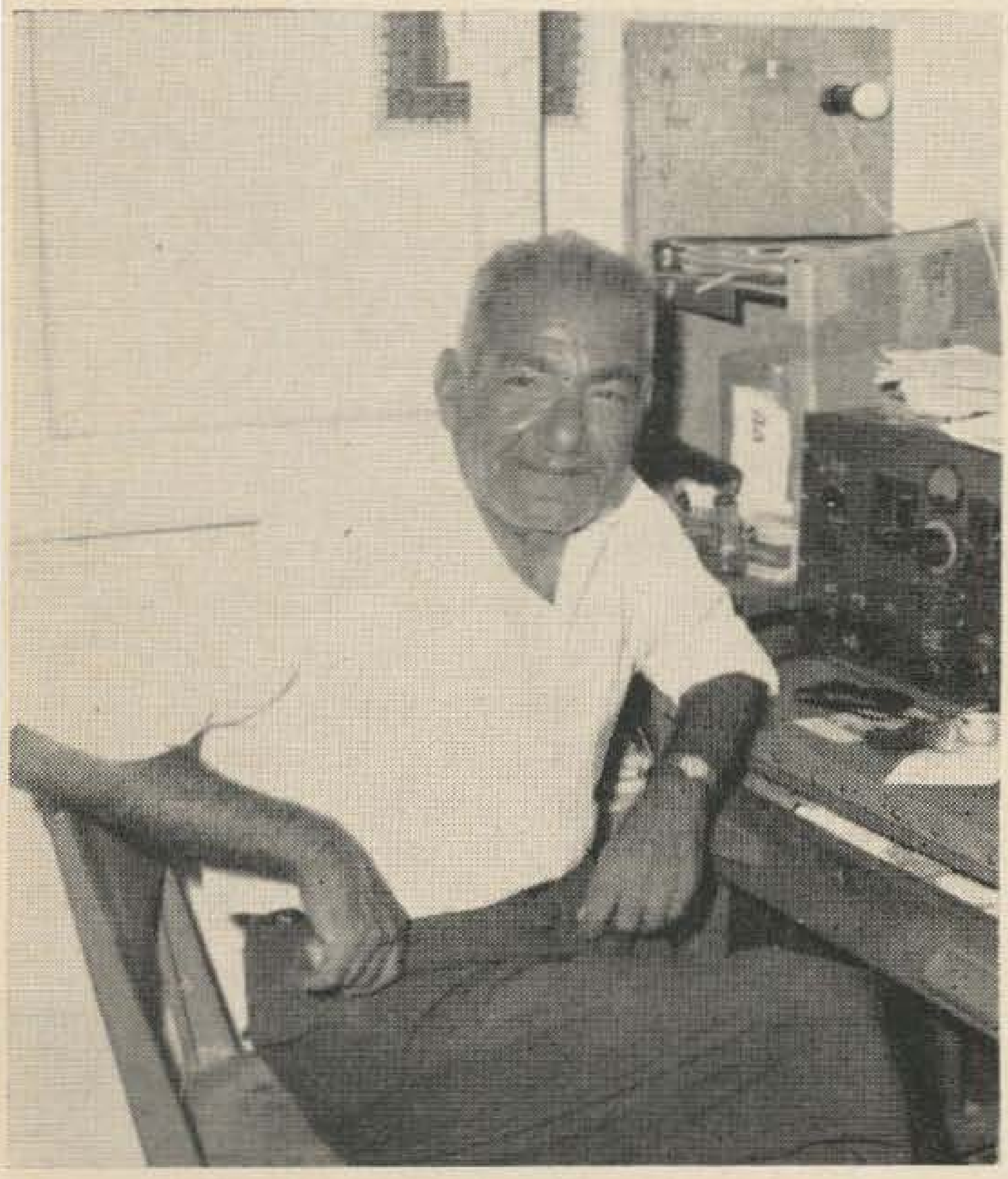
Ibrahim told me about W9DRS sending him his rig. Radio gear is completely impossible for locals to obtain and Jerry apparently got fed up with the rough CW note from SU1IM and shipped him a free rig. Ibrahim had to pay 90 pounds import duty on it . . . this is about $180. And when you consider that the normal wage around here runs about $30 a month you can see that even when the gear is free it is prohibitively expensive.

Ibrahim says that equipment is the big problem here. I told him that I could promise a sideband transceiver if he could get the government to permit it to be sent in duty free as a club station. He said he would see what he could do. He knew at least 50 fellows that would be interested in a project like that, if we could work it out.

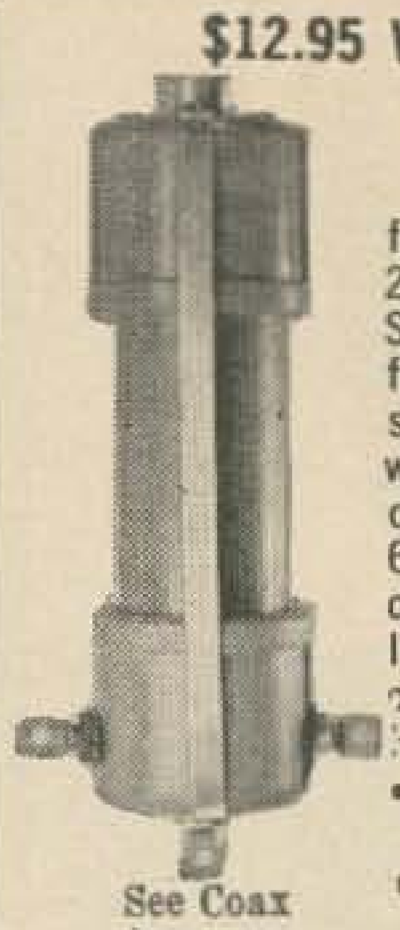
I went over the list of reasons why Egypt should do everything in its power to encourage amateur radio. Egypt needs radio experienced men very badly and they really can't afford to spend several thousand dollars training each one . . . with ham radio there is no cost to the government for the training. Egypt needs the tourists too and amateur radio is a wonderful and free means of public relations for the country. I pointed out that if Egypt would permit U.S. hams to operate during their visit here that they would get a lot of us to come over. Egypt has everything to gain and absolutely nothing to lose by encouraging amateur radio as much as they can. To my way of thinking any public official of any government that tried to stop amateur radio is working against his own country and should be immediately removed from office.

Egypt was giving a lot of trouble, particularly with their feud with Israel, but that is calming down now. I wondered why this was and it wasn't until I got here and talked with a chap at my hotel that I got the story. It seems that this high dam at Aswan that Russia is building for Egypt is not all peaches and cream. After it was well along someone got to thinking about it and asked what would happen if some country got mad at Egypt and put a bomb in the middle of the dam some night. Hmmm. The answer is simple, it would wipe out the entire country. You see, Egypt is desert except along the Nile and if the Aswan dam gave way it would send a wall of water about two hundred feet high right on down the river and would wash Cairo and Alexandria right out into the Mediterranean. And that would be the end of Egypt. Since it is only a few minutes by air from Israel to Aswan I think that there have been some serious doubts raised recently about the value of continuing the hassel with them. I know that I would have smiles for everyone if I found myself with something like that hanging over my head.

As if that isn't enough of a problem . . . seems that the engineers didn't think to make a silt survey before building the dam. Now I've seen that Nile down in Khartoum and Addis . . . and points south, and I'll tell you that it is a mighty muddy little creek. It is



Ibrahim SU1TM



CORRECTION

73 goofed in the September and October ads of Unadilla Radiation Products. The price of the all new, vinyl jacketed W2AU 10-15-20 meter element cubical quad should be $64.95, not $54.95 as shown.

dark brown where it starts up in Uganda and it is dark brown all the way along. It looks to me . . . and a number of others . . . as if they are going to have a silt dam there in short order. This not only cruds up the dam, but it has a longer reaching effect on the downstream end. The fields of the fertile valley watered by the Nile depend on the yearly overflow to deposit fresh silt. This is the fertilizer. Without the silt they will have to start buying and shipping in commercial fertilizer. Well, they haven't the money or shipping facilities for this and no one knows what the devil to do about it.

The tourist has some interesting things to see here. The pyramids, of course, are right on the edge of town . . . as is the great Sahara desert. A walk through the town is an experience you'll never forget, morning or evening. The casual tourist can sate himself in one very busy day or two leisurely ones. The more dedicated tourist can get advice from Ibrahim and spend a couple weeks investigating the town. I'm breezing through the world this trip so I quickly saw the pyramids, the Sphynx, a few tombs, rode a donkey, a camel and a horse through the desert. I walked the streets at night and in the day, covering a good deal of the town.

Those of you that are interested in my trip from the tourist angle should keep a weather eye peeled for an announcement of the availability of a complete booklet on my trip. This will cover my trip day by day in ridiculous detail . . . unexpurgated.

With money being as short as it is, QSL's are a problem for the fellows here. The postage on a package of ten cards is 3 piasters, which amounts to about 60¢ if you adjust for the difference in wage scales. Ibrahim mentioned that now and then some kindly fellows sent along a dollar bill, which was most gratefully accepted . . . this is worth about ten dollars here. I explained about the QSL manager system and Ibrahim is most anxious to set someone up as his manager. I'll see if Gus can find a volunteer for this.

Some help is badly needed over here. With a population of about 35 million people they have but three active amateurs. Perhaps we can get something started here. I talked with Ibrahim about the power and it is 180-200 volts at 50 cycles, so, if we can get him set up, a line transformer will be helpful to stabilize the voltage.

The more I travel in Africa the more that I see we can do to help out. Just a little effort on our part could make a big difference over here.

. . . Wayne

Letters

Dear 73:

During 1967, the Canadian Centennial Year, Canadian amateurs may use the prefix 3C- instead of the normal VE-. This is being done to call attention to Canada's Centennial and will undoubtably create a great deal of demand among foreign amateurs for QSL's.

Jack Beardall VE3MJ (3C3MJ)
Chatham, Ontario

Dear Sir:

Please knock off the "hertz" bit. Maybe I'm old fashioned, but cycles seemed so descriptive and to the point. The world is getting too complex the way it is without "hertzes" to contend with. I think that Mr. Hertz was a nice fellow, but don't you think he's satisfied being named after the number one automobile rental agency.

Gotta run and repair my motorhertz now. Keep up the good work.

Ryerson Gewalt K9LCJ
Racine, Wisconsin

Don't forget that "hertz" doesn't mean "cycles." It means "cycles per second." The fact that few people say "cycles per second" indicates that they think that expression is too complex. You ride a motorcycle per second? Ed.

Dear 73:

On WA6BSO's very good cable and connector articles, I might make these comments:

a. Fig. 2 on connectors omits the T, which has a male and two females like UG-107b/u. Mine is marked: 74868 49199 M-358.
b. Odd, but the PL-258 straight adapters I have checked with a signal generator show a loss and swr not present in all the other things hooked in series.
c. Some of the quick jobs are not the first—Hallett during WWII had a gadget for RG-18 cable with a spring-loaded ring, three steel balls. The inner conductor of the RG-18 became the plug. All you did was push until the three steel balls fell into a slot on the female end. To remove, put hand around it so the knurled ring pulled back to give the three balls room to get out of the slot, and off she came. Trouble: Contacts cut into copper inner conductor, made copper dust that later could accumulate and flash over with 1 kw of low-freq r.e.
d. RG-14 seems to be an attractive antenna cable for hams, but not included as popular.
e. The phono/uhf between-series I have is male phono to female UHF. Not in your photo on page 103. No numbers on it. Very useful without extra gadgets such as connecting antenna pad to signal generator or antenna coax that has male UHF.
f. Fig. 5 terminations may well be very useful at top of tower to go to antenna, etc., but no designations given, not shown in such as Fig. 2 and 3, etc., nor in table 2 which shows binding post but not this termination. I don't know if listed in the long Table 9 on index.

Bill Conklin K6KA
La Canada, Cal.

Dear 73:

Read with interest W2EEY/1's article, "A Curtain Going Up" in the August issue. Nice to see someone pointing out that it's possible to work DX without purchasing some particular brand of rotary beam or vertical, and have him call attention to the advantages of beefing up the lower radiation angles. To recommend 17'4" per element would seem to ignore end-effect and I would rather see a figure of around 16'8", but it's a broad band affair as he points out and I wouldn't quibble over a little inductive reactance. But he should have considered the velocity factor in figuring the phasing lines.

George Dery W6HG
Bellflower, Calif.

NEW PRODUCTS

VHF Antenna Mounts

Loren Parks has had some very nice, inexpensive antenna element mounts made up. They're made of iridite-treated Zamac and are very rugged. They hold 3/16 to 3/8 inch elements and mount on 1-¼ or 1-¼ inch booms. Four sets mount four elements and cost only $1 postpaid in the U.S.A. or Canada. Each additional mount is 25¢. Order from Parks Electronics Labs, Route 2, Box 35, Beaverton, Oregon 95118.

New Low-Priced 5-Band Transceiver from National

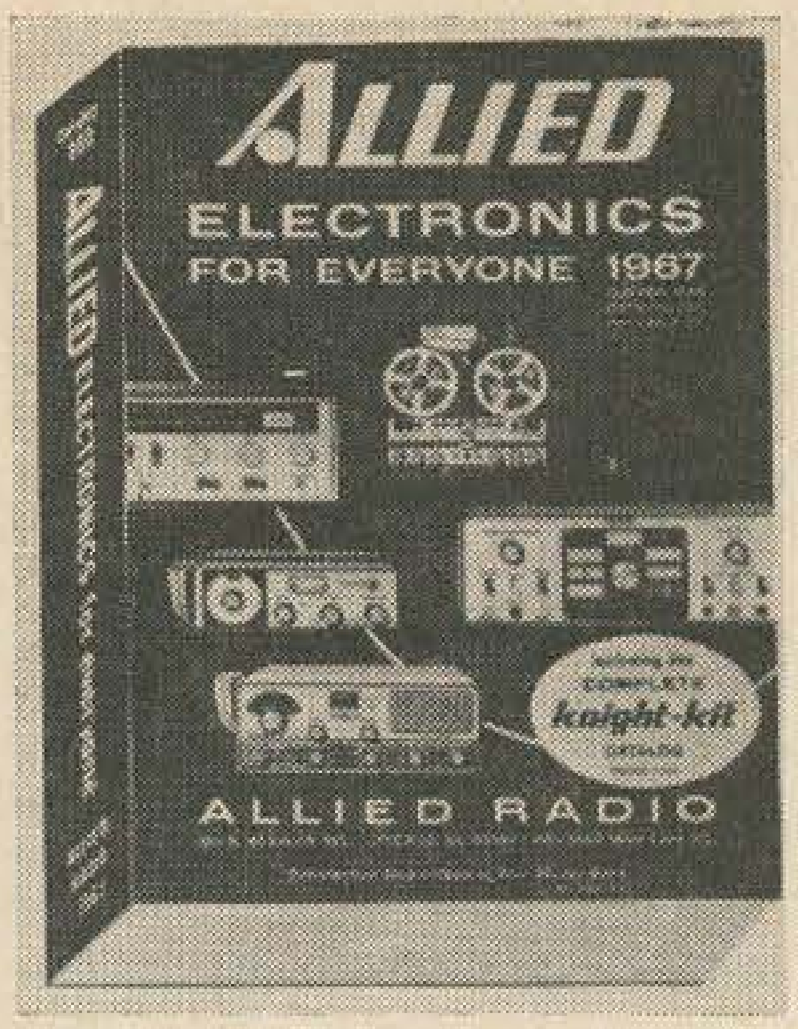
National Radio Company has just announced the introduction of the National 200, their new five band SSB/AM/CW transceiver features 200 watt PEP SSB input on all bands, 80 through 10 meters, and also provides CW operation plus compatible AM operation with separate AM detection in the receiver. The frequency of operation is determined by means of a pre-mixed crystal-controlled front end and a single VFO which tunes the same range on all five bands. This arrangement provides high stability as well as identical calibration and tuning rate from 80 through 10 meters. Other features of interest in this new transceiver are ALC, a solid state balanced modulator, choice of push-to-talk or front panel controlled operation, automatic carrier insertion in AM and CW modes, filter type sideband generation and receiver selectivity obtained with a high frequency crystal filter and a meter which automatically switches between the final amplifier cathode current on transmit to signal strength in S-units on receive. A mobile mount is included with the National 200 and the unit may be operated from National's NCX-A power supply or from the new National AC-200 117/234 Vac power supply. It may also be operated from any of the available DC supplies which supply the proper voltages and currents. Price: $359.00. For further information and specifications, write to National Radio Company, Inc., Equipment Division, Dept. P, 37 Washington Street, Melrose, Massachusetts 02176.

Knight-Kit 20,000 Ohms-Per-Volt VOM

A VOM is probably the most useful of electronics test instruments, and the new Knight-Kit KG-640 is designed for the greatest versatility in application, yet priced to meet the lowest of budgets. The Knight-Kit engineers have included the latest features in this instrument, including a taut-band meter movement which assures reliable and consistent readings. Another advantage with this new VOM, the meter is protected so that even a 1000 times overload will not damage the movement. The KG-640 has a total of 57 ranges starting at 0.8 Vdc (full scale), covered by a positive-action range/function switch and range-doubler switch that effectively doubles the number of ranges. This new unit is priced at $39.95 in kit form, or $59.95 fully assembled and ready to go. Watch for a complete review on this versatile new VOM in a future issue of 73. Complete details on the KG-640 are given in Allied's 1967 catalog number 240, available free from Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.

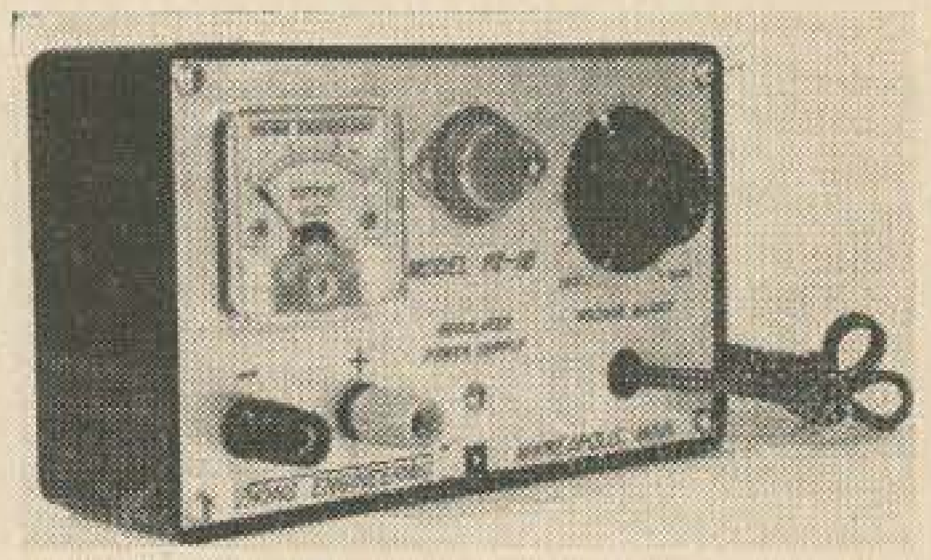
Lafayette HA-1200 2 Meter Transceiver

The new Lafayette HA-1200 two meter transceiver features a 25 watt DC input transmitter and a sensitive triple conversion receiver with crystal-controlled mixer. The HA-1200 uses 16 tubes, 4 transistors, 7 diodes and utilizes separate receiver and transmitter VFO's. The tuned nuvistor receiver front end provides better than 1μV sensitivity. A series gate noise limiter and squelch provide quiet standby operation. The transmitter uses high level push-pull transformer coupled modulation. The frequency may be controlled with standard 8 MHz crystals or by the VFO. A spot control is included. The meter indicates S units on receive and relative rf output on transmit. Internal solid state power supplies are for 117 Vac and 12 Vdc negative ground. A rugged push-to-talk ceramic microphone with coiled cord, AC and DC power cables, and mobile mounting bracket are included. Size: 11⅞" W x 12¾" D x 5⅞" H. Price is $189.95. You can order or obtain more information from Lafayette, 111 Jericho Turnpike, Syosset, New York 11791.



1967 Allied Catalog

Allied's new 514-page 1967 electronics catalog is now available and presents a wide selection of equipment of interest to the radio amateur. There are transmitters, new single sideband transceivers, VHF equipment for 6 and 2 meters, linear amplifiers, transmitting and receiving antennas, towers, mobile antennas and accessories, code practice aids, crystals, TVI filters, coaxial cable and every kind of accessory for the ham station. In addition to amateur oriented equipment, there are thousands of other products listed in this new catalog, including vacuum tubes, transistors, transformers, relays, switches, connectors, lamps, wire, cable, tools, hardware and technical books. This new 1967 catalog #260 is available free on request from Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.



Low Cost Regulated Power Supply

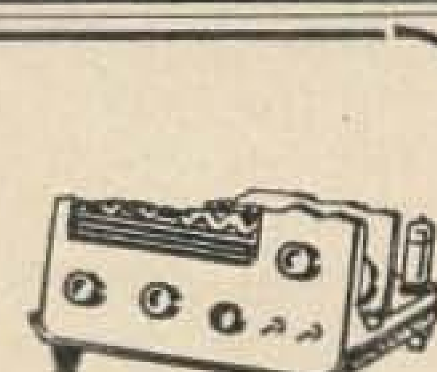
Viking Engineering of Minneapolis has introduced a low cost transistorized zener reference regulated power supply. Model PZ-121, available in factory assembled or simplified kit form, delivers stable, continuously variable output from 0-15 volts dc and useable currents to 250 mA. This compact, all solid-state unit provides regulation better than ±.2 volts and ac ripple of less than 5 mV for outputs to 100 mA. The PZ-121 features burn-out proof circuitry and transformer isolated output for maximum safety. The price is $13.95 in kit form or $19.95 assembled. For complete information contact Don Springer, National Sales Manager, Viking Engineering of Minneapolis, P.O. Box 9507, Minneapolis, Minnesota 55440.

1967 World Radio Labs Catalog

The new 1967 World Radio Labs Catalog is one of the best catalogs for hams that we have seen in a long, long time. In this new catalog, WRL more than lives up to its motto, "The house that hams built." Whereas many of the new electronic catalogs relegate the amateur equipment to two or three pages in the back, the new 1967 WRL catalog covers ham equipment in great detail. Almost every major amateur radio manufacturer is included between its covers. Entire pages of descriptions and specifications are included for major pieces of equipment of special interest, such as receivers, transceivers and linear amplifiers. Many items of equipment that are not normally found in your local electronics store are also available from WRL. All in all, this catalog offers the largest selection of ham equipment that we have ever seen in an electronics catalog. You may obtain a free copy by writing to World Radio Laboratories, 3415 West Broadway, Council Bluffs, Iowa 51501.

Principles of Electronic Oscillators

Beginning with the definition of an oscillator and ending with review questions of the material covered, the book *Principles of Electronic Oscillators* is definitely aimed at the hobbyist and technician. A logical sequence is followed in presenting the subject material to the reader. Oscillator theory is presented first, to prepare the reader for an explanation of the simplest type of oscillator circuit, the Armstrong oscillator, which is explained in the next section. Biasing and output-coupling techniques follow; and an explanation of the three basic types of oscillator circuits—the Hartley, Colpitts, and electron-coupled—completes the 81 page book. Questions and answers are found interspersed throughout the text, and 32 questions at the end of the book review the reader's newly gained knowledge. This book presents basic oscillator theory which every ham should be familiar with. Available for $1.95 from Techpress, Inc., Brownsburg, Ind. 46112 or your Techpress dealer.



(Continued from page 4)

well as bindings. "They've got a YL column. Why don't you?" "They've got a picture of my station on page 97. Why don't you?"

But I keep remembering a few other facts. 73's circulation has been rising 500 to 1500 per month for over a year, while as far as we know, both of our competitors are still in a decline. 73 is now running more pages of advertising than ever before, while both of the competition are at their lowest points in many years. CQ recently adopted a format of more articles and few columns, with ads spread throughout the magazine, as we've been doing since our first issue in October 1960. QST has made a few small steps in popularizing their format and content (even to using a few bad puns, which are always popular), while I'm sure that all will agree that 73 has tried to be popular and easy-to-read all along. I won't claim that either CQ or QST is copying us, but their changes are certainly in the same direction we've been traveling all along. I can't help wondering why people think we should copy them.

But to get back to the subject, neither binding seems to have overwhelming advantages. We aren't making any plans for changing, but may decide to someday. If you have any comments, we'd be glad to hear them.

Writing for 73

If you'd like a copy of our small booklet, "Writing for 73," which gives information on writing and submitting articles to 73, send us a self-addressed business envelope. We always need new articles and new authors, so don't be discouraged if you're inexperienced.

Ham Helpers

So far eight well-qualified hams have written in to offer to help newcomers or other hams with their problems. We've still got some details to straighten out, but expect to publish a list of the Ham Helpers next month.

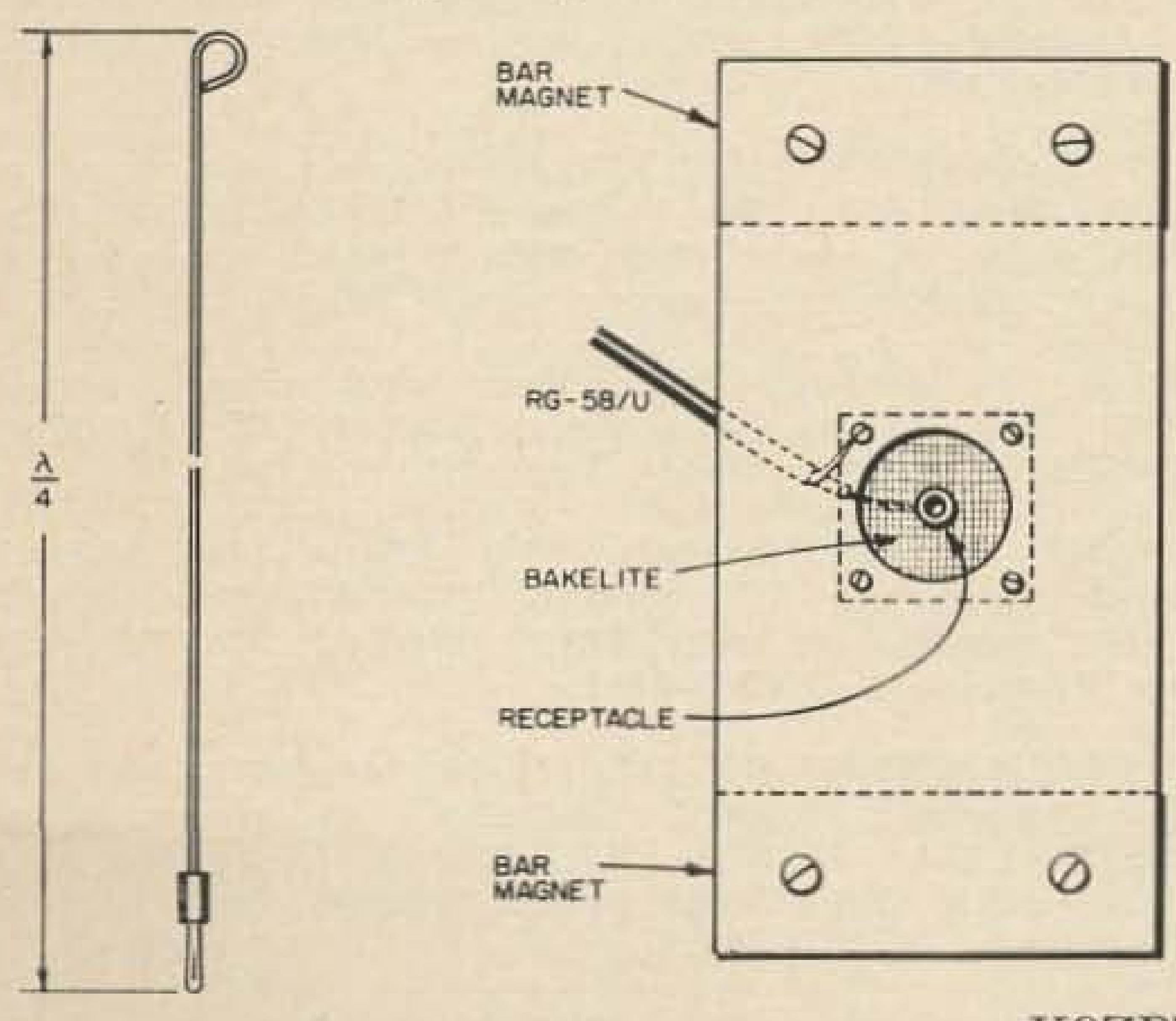
In addition to their direct help, we hope to publish a number of articles devoted to the questions most asked. These questions will probably be grouped by topic: "Questions Often Asked About Novice Receivers," ". . . Transmitters," ". . . Antennas," etc.

If you're qualified to help other hams, and have a little extra time to devote to helping them with their questions, we'd like to hear from you. Why not write today?

. . . Paul

Magnets and Coat Hangers on 2 Meters

Recently, I purchased a Heathkit "Twoer" and decided to go mobile. Because I do not own my own car, the problem of finding a suitable antenna came up. The antenna which I decided on was a quarter wave vertical whip, mounted on a piece of aluminum. Magnets are attached to the bottom which make the antenna temporary.



. . . K9ZPZ

Fig. 1. Temporary two meter mobile antenna.

The vertical whip is made out of coat hanger wire cut for the specific frequency I wished to operate. The "Twoer" is crystal controlled, and therefore I needed only to cut the antenna for the crystal frequency. The top of the antenna is bent into a loop and the bottom is soldered into a banana plug, as shown in **Fig. 1.**

The aluminum, which measured 3 inches by 6 inches, was punched with an inch diameter hole in the center. Bakelite, slightly bigger than the hole, was mounted completely covering the hole. Next two magnets were bolted to the aluminum, and covered with electrical tape to prevent scratching the top of the car.

In the center of the bakelite I mounted a banana plug receptacle. The center of the feed line was attached to the banana plug receptacle and the aluminum served as ground.

If you plan on working two or more different frequencies, different length whips can be cut. In each case solder a banana plug on the end and changing frequencies may be very easily accomplished.

The vertical whip antenna worked very well and will not fall in a strong wind. Its total cost is low and it is an excellent antenna for temporary mobile operation.

. . . Thomas Davis K8DOC

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TELREX TRIBANDER 10-15-20 antenna fraction present cost. Available for $165.00. Ham M Rotator $70.00. Both $225.00. Drake 1000 LP filter $12.00. 300' RG-9/U $15.00 new. Dow Key Relay $10.00. Ameco PV50 preamp $10.00. Two each 416B's $15.00. Two each 4X150's Navy pullouts $10.00. WA2FMC, 516-AN5-6137.

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DRAKE 2B, mint $180.00; Globe King 400B $125.00; Handbook keyer $15; Collins F250A85 filter, $10.00; IP-69C panadapter, new $20.00; K6ILM, 835 Valencia, San Francisco, 415-282-3201.

HALLICRAFTERS SX-146, HT-46 demonstrators, factory warranty $449.00. Johnson 500 reconditioned $275.00. Eldico SSB-100 MIL $189.00. Write for complete listing. Burghardt Radio Supply, Inc., Box 37, Watertown, S.D. 57201.

SB34, new with mike, Hustler antenna, 80, 40, 20 coils, $295.00. R. C. Dale K1UDI, 86 Westgate Road, Wellesley, Mass.

INVESTOR WANTED to promote the new and unique Bar'B Wire antenna, notify LeRoy Kerr WA6CTK, P.O. Box 444, Montebello, Cal. or page me at OX-4093.

KWS-1 serial number 238, two new final tubes (spares) $695.00. 75A4 serial number 2917, three filters, vernier knob $400.00. Ranger I $65, T60 $35, T50 and VFO $35, Poly-Comm 62B $175.00, NC98 $60, NCX3 with AC, DC supplies $325.00, new 304TL's $15.00, 4CX1000 with socket used $50. Jack Osbourne, 5636 Delmonte Ct., Santa Rosa, Calif.

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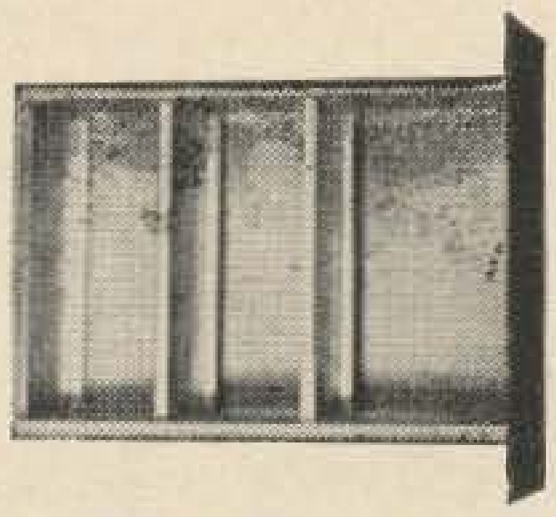

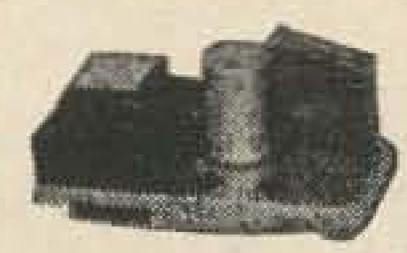

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CD307A/6Ft Ext Cord PL55 & JK26 .....$1
Carborundum Fine 6" Stone ....2/$1
Binding Posts 5Way/30Amp R&B .....5/$1
Tubes 6AG7 or 6AC7 ....3/$1

WANTED TUBES ALL TYPES
We Buy, Sell & Trade As Well!


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