73 Amateur Radio

November 1963
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ANNUAL NOVEMBER ISSUE

featuring

Tool and Workshop Practices For the Ham

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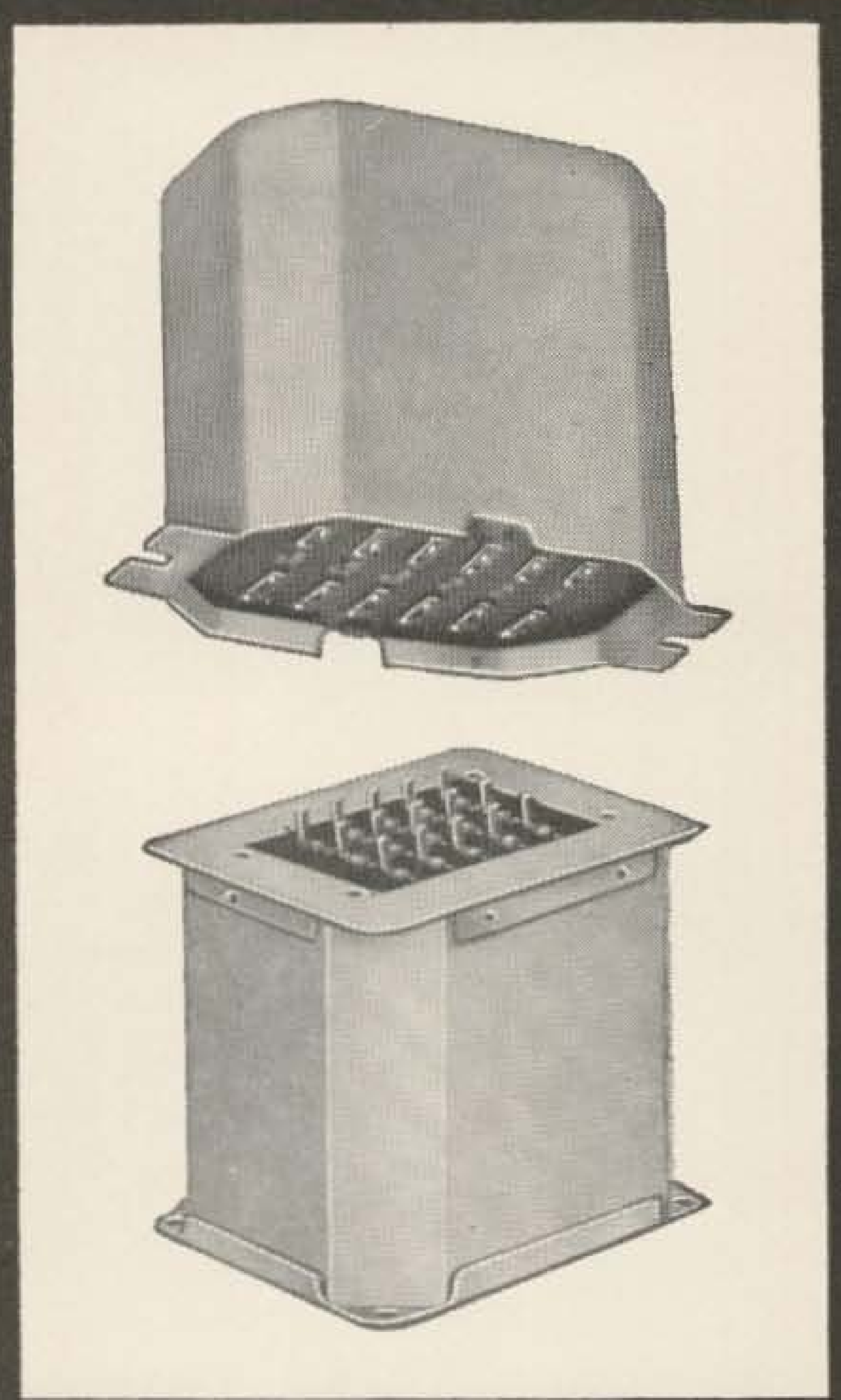
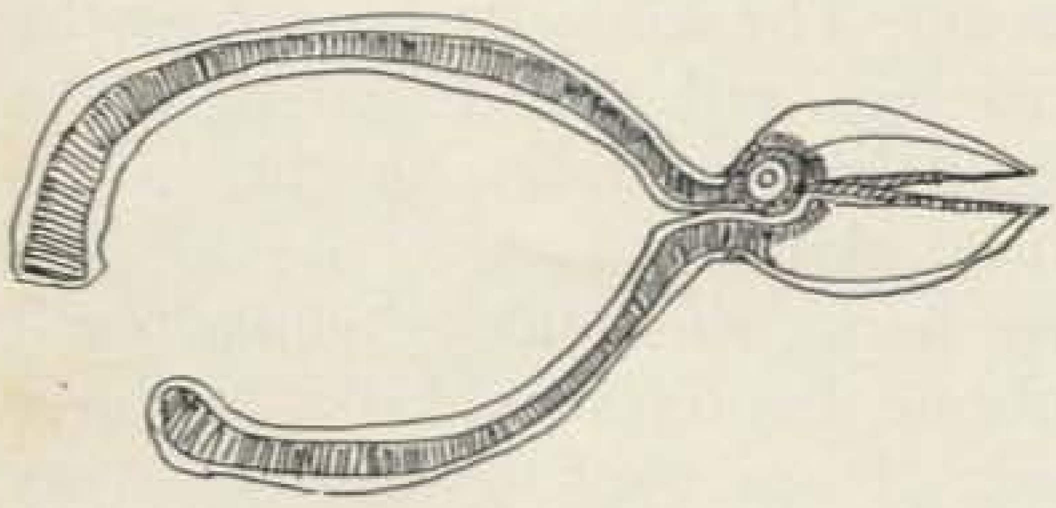


73

Magazine

Wayne Green W2NSD/1

Editor, etcetera



November, 1963

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de W2NSD/1

never say die

When someone called up the other day to let me know that the ARRL was indeed going to send in their restricted bands petition to the FCC, we both marveled that they would go ahead with this in the face of the violent opposition of such a large proportion of the amateurs and the disinterest shown by the FCC.

The petition, as I understand it, calls for the segregation of our phone bands on a three year schedule. First to go would be the favorite, 20 meters, which would be for Class A only (Advanced Class) starting in 1965. Then 40 and 15, and finally 75 meters. The full grim details are supposed to be in the November QST.

Since the ARRL has not yet been able to come up with any reasonable excuse for this attempt to step backwards, we wonder what they have up their sleeves. They certainly must have something, for otherwise their attempt is bound to fail and they surely must know this.

As you may have surmised from reading my editorials for the last few months, I have been following this situation closely and watching for the League to present an explanation that doesn't insult the intelligence of the average ham.

If all goes as planned by the ARRL the General and Conditional Class hams will have only two little shreds of 160 meters and from ten meters up if they want to operate on phone in three years.

I think this is lousy.

I'm not alone in this opinion. We are in the midst of preparing a booklet of the letters received on the subject of incentive licensing. It has been my past experience that an editor normally hears mostly from people who disagree with him, while those who agree nod their heads and let it go at that. I have been rather outspoken against this move and never before have I been so firmly backed up by my mail. In addition to the many agreeable letters I also received a considerable number of copies of letters sent to QST and their officials. A few negative letters came in also and they will be included in the booklet. If you are interested in reading a close approximation of what the League probably received in answer to their editorials then send in a SASE, or $1 for this plus the next few IoAR Bulletins. Good reading.

So what *is* the reason behind the ARRL petition? No one really knows. Some suggest that this is a pet project of the one or two old timers who seem to be running the League these days. Those of us who are still around remember what a good deal the handful of kilowatt ops had in pre-war times. The Class A bands were only 100 kc wide and held about eight or ten roundtables. It was no place for the low power op. The kilowatt boys had the bands to themselves and they loved it. I can easily understand how nostalgia might dictate a return to those glorious days.

On the other hand, since one obvious result of Class A phone bands would be to force many thousands of ops back onto CW, many fellows are pretty well convinced that this move is just another in a long line of pro-CW actions by the League. Back in the pre-war days, when about 70% of the amateurs operated CW and about 50% didn't even have a modulator, the shortage of phone bands for Class B was of little moment. But today we have to look far and wide to find fellows who can't go on phone. What with SSB transceivers and thousands of mobile stations, the restriction of phone bands would create a great hardship.

One of the ARRL Hq staff told me in confidence that the whole purpose of this "incentive licensing" escapade was to create controversy. The idea behind this was to make the League more talked about so that more amateurs would subscribe to QST. They certainly have succeeded in getting the ARRL talked about, but unless there are an awful lot of liars writing to me saying that they have not renewed their subscriptions to QST this scheme has backfired. Suppose the QST boys are able to put their bill through? What then?

As an Advanced Class licensee I would find 20 meters a lot easier to use for about 75% of the operators wouldn't be able to use it. This would make DX'ing simpler, but it would also prevent me from contacting a lot of friends that I've been talking to for years. Eventually I suppose 75% of them would get their Advanced Class license and be back on. But a percentage of them either through anger at what had happened to them, laziness, or too much other busines would never be heard from again.

Another great advantage would be the bargains in both new and used equipment that I would find. With thousands of amateurs dropping out of radio the prices would plummet and I could pick up incredible bargains.

As more and more manufacturers went out of business I could build up a fantastic hamshack at fractions of the old prices. This would have its disadvantages too for there certainly would be little new coming out into such a depressed market and it would probably be many years before any company came out with anything really remarkably new.

Though a return to Class A licensing would probably help 73 at first through the sales of thousands of copies of an Advanced Class Study Manual and increased advertising by frantic manufacturers and distributors, in the long run it would hurt.

In summary: as things look now I don't see how the League can possibly hope to succeed with their petition. The FCC doesn't hoodwink easily. Neither do most hams. I believe that I can safely say that unless there is some development that is not even forseen right now that the ARRL hasn't got a chance of getting our regulations set back 25 years. There is no denying that they have gotten a lot of publicity out of this though, so perhaps they will achieve their main goal even if they lose the battle.

Technical Improvement

While the ARRL is trying to decide what laws to try to jam through to force you to learn more of the technical end of ham radio, why not show them up by setting up a little self-improvement plan of your own? Perhaps I am wrong and it is necessary to throw most of the hams off the air for a while to get them to learn a little more theory. I don't think so.

Let's take you, for instance. How about you doing something about technicalizing yourself? Forget all those excuses about not having time, beding too old to learn, and all that rot. You can, at home, in your spare time, become quite an expert on radio and it won't cost you much either. It really needn't cost anything extra unless you want to invest in some reference books.

What is my magic answer to this great problem? It is so simple I hesitate to tell you. You'll just laugh it off and there we'll be. If you were to take the time each month to read every technical article in 73 and make sure that you understand it you would soon find yourself with an impressive understanding of radio. You don't have to invest in a bunch of text books, license manuals, and like that.

Sure, you'll run across parts of the article that you just don't understand. This is an important part of the learning process. By the time you've talked these problems out with fellows on the air or at your own ham club you will really

(Turn to page 96)

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Another Approach to TVI

Harmonic Reduction

Jim Kyle K5JKX
1236 N.E. 44th Street
Oklahoma City 11, Okla.

TVI giving you trouble? Does your peanut whistle wipe out local channels just as if it were a kilowatt? Or are you maybe in the process of planning that next rig, and want to avoid any problems with the Tennessee Valley Indians?

Hundreds of thousand of words have been written on the subject of TVI—but very few of them have really brought out one point which is of special interest to the VHF-minded ham who happens to live in a semi-weak-signal area (and this includes almost every place in the world, when you stop to think of those almost-out-of-range stations which a few people enjoy watching!).

This almost-neglected point is simply that unwanted multiples of the original frequency are one of the most prolific causes of TVI from VHF transmitters! Almost any design will be sufficiently free from 50 mc harmonics to stay out of trouble; most will be safe when it comes to 25 mc harmonics as well. But the design practices commonly followed in VHF gear almost insure that plenty of harmonic energy still makes it to the feedline from the oscillator!

Consider, for example, a 6-meter rig operating on 50.250 mc, from an 8375 kc crystal. The oscillator produces some output at 8.375 mc, 16.75 mc, 25.125 mc, 33.5 mc, 41.875 mc, 50.250 mc, 58.625 mc, 67.0 mc, 75.375 mc, etc. on up the scale. That harmonic at 58.625 is right in the middle of Channel 2. The one at 67.0 is only 250 kc away from the video carrier of Channel 4. The 75.375 mc harmonic is just 625 kc away from Channel 5—and many TV-set front ends will let it right on in!

But, you may say, the tuned circuits between the oscillator and the final keep these harmonics down.

And that is where, in all too many cases, you're dead wrong!

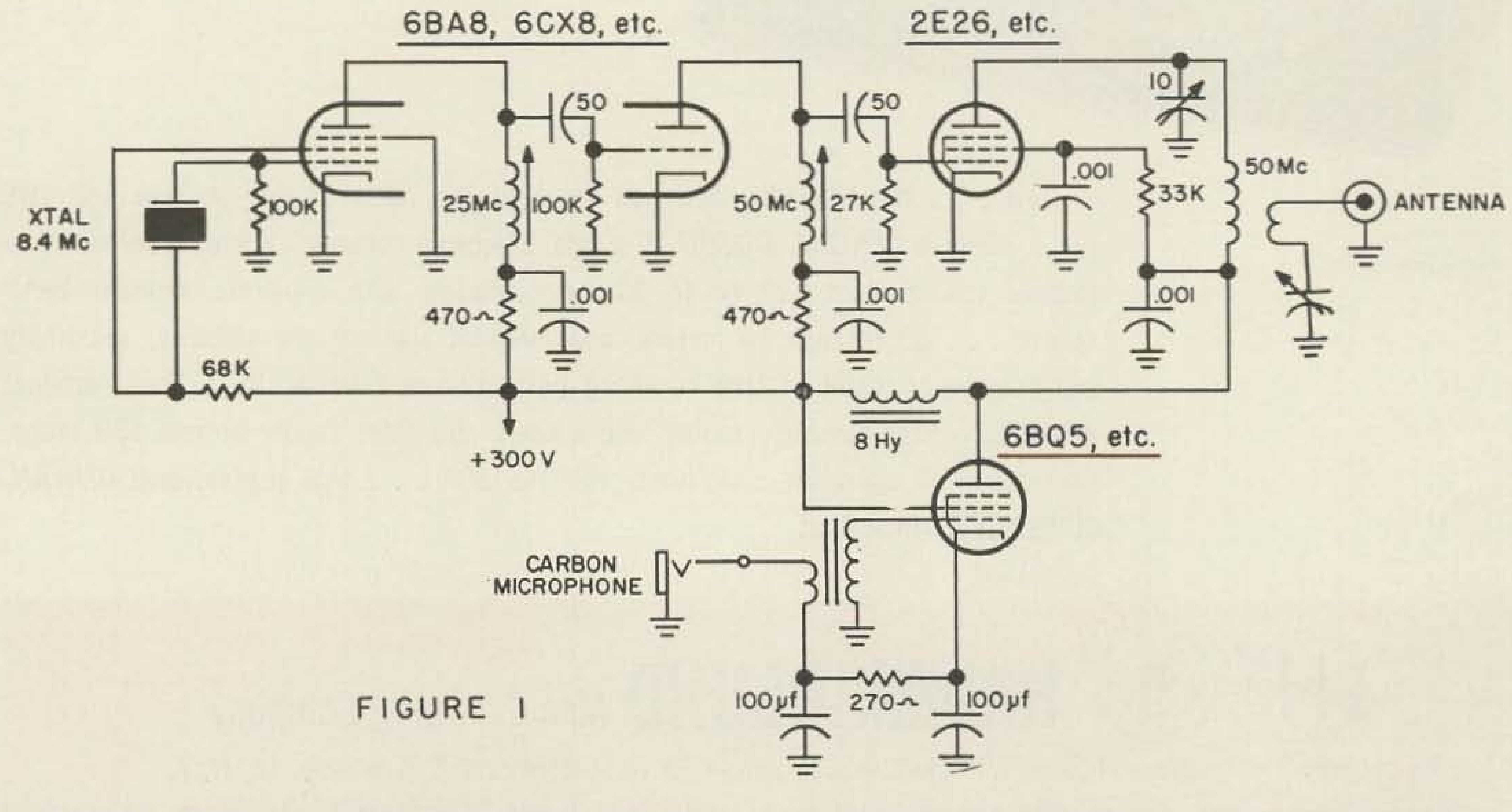
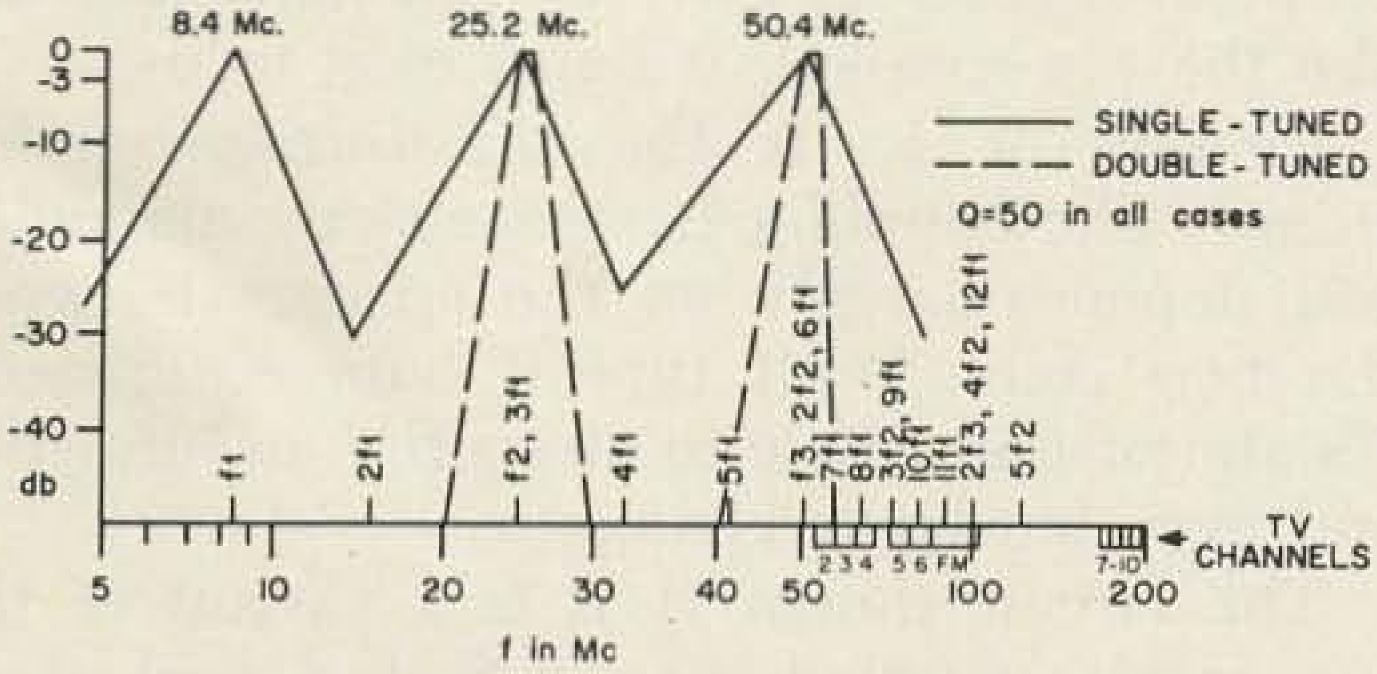


FIGURE 1

Typical circuit for simple 3-tube 50 mc rig: similar coupling circuits are to be found in many units now operating although oscillator arrangement is unusual as is modulator.

Fig. 1 shows the schematic of a typical three tube 50 mc peanut whistle (it's not taken from any particular design, but the basics are there). Note that only *two* tuned circuits separate the oscillator and the final output circuit. The 25 mc tank between the oscillator and the driver makes sure that the wanted third harmonic of the crystal gets the most boost—but the second, fourth, and fifth do pretty well also. Even the seventh and ninth get through to some degree. Then when these harmonics from the fifth up (40 mc to around 90 mc) hit the 50 mc tank in the driver plate circuit, they get another boost. They're too close to the 50 mc desired output frequency to be held down very much in the final tank, and boom!—out the feedline they go. The result? Galloping TVI.

If you're interested in seeing how this works, Fig. 2 is an approximate graph of the selectivity curves of single-tuned circuits (solid lines) against frequency. You can see that the unwanted harmonics are attenuated some 20 db or more—but this isn't enough to get rid of the TVI problems.



Selectivity curves of single-tuned and double tuned circuits in typical VHF transmitter. F1 is crystal frequency, F2 is tripler output, and F3 is final output frequency. Note how oscillator harmonics hit TV channels if allowed to get out; note also difference in skirt selectivity between single-tuned and double-tuned circuits.

So what can we do about it?

The simplest answer is to switch from the single-tuned circuits used in Fig. 1 to double-tuned circuits, coupled in such a way that the unwanted harmonics are reduced enough to be considered eliminated. But unless you do a little planning, you'll end up with circuits so selective that you have to completely retune the rig from the oscillator on, every time you change frequency as much as 100 kc. This may be fine for fixed-frequency mobile rigs, but it's one big pain in everyday operation!

The lazy man's answer to this is to make all the circuits bandpass (with a wide enough passband to allow QSY up to a megacycle or so at the output frequency. And before you run away, let's hasten to add that making the circuits bandpass isn't near so difficult as you may have been led to believe in the past!

The absolute bandwidth in cycles per second of any tuned circuit depends on just three factors—and you can control two of them easily. In fact, if you happen to have a commercially-built transceiver using single-tuned circuits a la Fig. 1, you will find it a relatively simple job to make it bandpass! And if you're starting a new rig, you'll find it no trouble at all to add the bandpass feature from the beginning.

Before we get into the how-to-do-it, though, let's take a look at some of the theory behind this whole business of selectivity. It will help immensely when you get around to designing your own application of these ideas.

As mentioned a couple of paragraphs ago, the absolute selectivity in cycles per second of any tuned circuit depends on just three factors: the frequency at which it operates, the Q of the circuit, and (in the case of double-tuned circuits) the coupling between tanks.

If *any one* of these factors is varied, the bandwidth will also vary. Bandwidth increases as frequency goes higher, and decreases as the Q is increased. The effect of changing the coupling varies, depending on the level at which the bandwidth is measured.

In a transmitter, the frequency is usually fixed rather firmly and you can't do much about it. Q, however, is a design choice which you can change; and coupling between the tanks is relatively easy to vary.

In selecting the Q at which you want to operate the circuit, several factors must be considered. The most important is that Q must not be too high if you want a relatively broad-band circuit. Since this is the opposite of usual procedure, it bears repeating: for maximum bandwidth, keep the Q low!

Air-core coils such as B&W Miniductor and Illumitronics Air-Dux have Q values of around 200 at the frequencies we'll be dealing with mostly. The Q of slug-tuned coils varies with the slug material, the position of the slug in the coil, and the frequency. Since tuning the coil will change its Q, these coils are not recommended for bandpass circuits—but if you want to use them, you'll find Q ranges from about 40 to nearly 100.

At this point you may be puzzled. How, you may ask, do I get that low Q without using a slug-tuned coil? The answer is to invest in a few composition resistors and shunt them across the circuit. This will knock the Q down to any value you want. Then you can use the air-core coils, which also make the coupling situation easier.

Here we've been talking about coupling, but just what does it amount to? Actually, there are many ways of coupling a pair of tuned

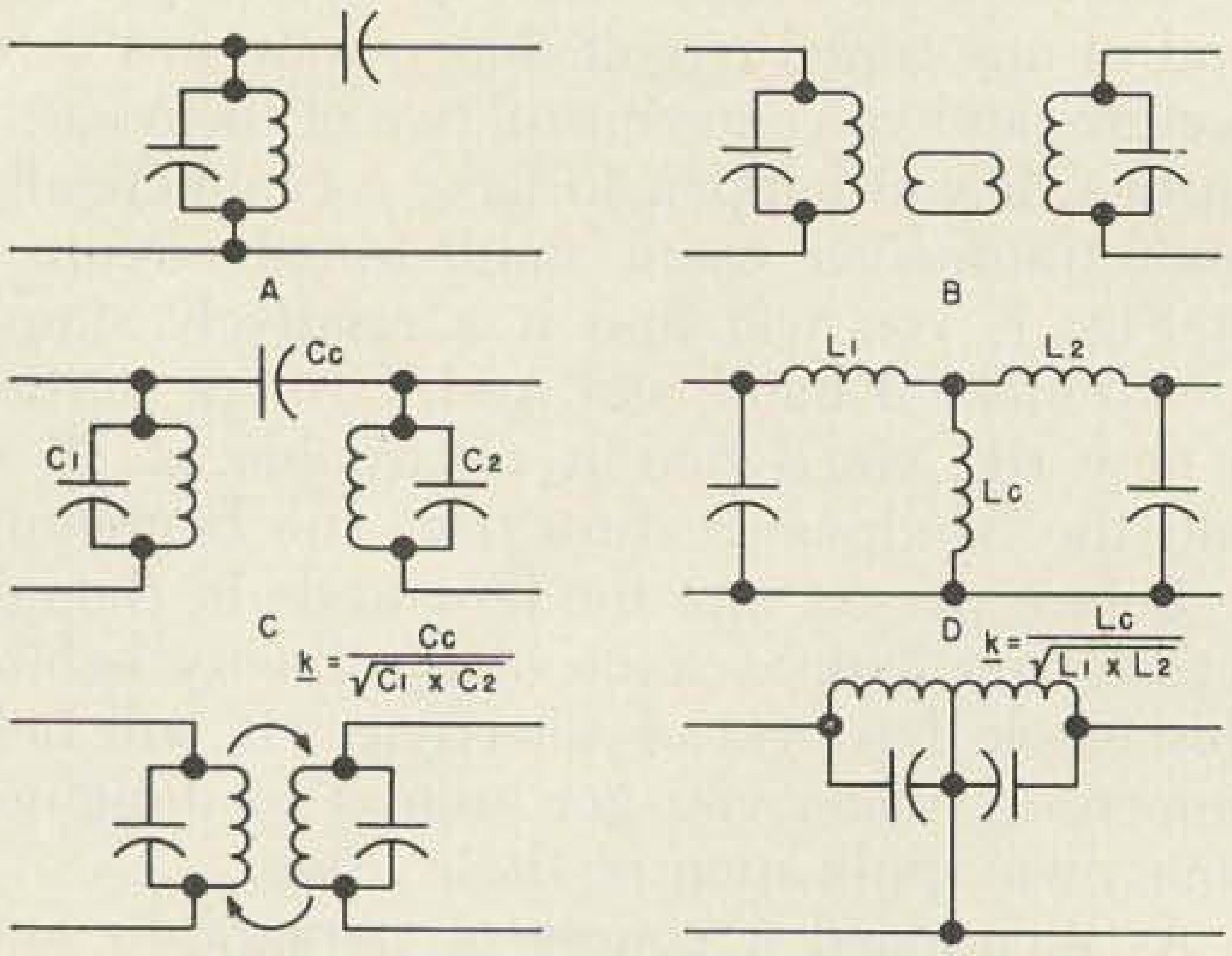


FIGURE 3

Six of the most practical forms of coupling with tuned circuits A) Single tuned circuit B) Link coupled. k varies from 0.16 to 0.4 C) Top coupled k D) Inductive bottom coupled E) Transformer coupled. k varies widely, depending on placement of coils F) "GE Ham News" coupler; special case of circuit E.

circuits—but of these, only a few are really practical. Most of these practical methods are shown in Fig. 3.

The simplest of all, of course, is the single tuned circuit as shown at A—but this is what we're getting away from.

Most widely used in transmitters is the link-coupled version shown at B. This consists of two separate tuned circuits, with a small link wound around the cold end of each and the two links connected together. This has the advantage that the two circuits may be physically separated; in addition, coupling can be varied by the size and position of the link, and since both links can be changed, a wide range of control is possible. The amount of coupling between circuits is usually denoted by the "coefficient of coupling" which is abbreviated k; values of k for typical single links range from 0.40 (small link at end of coil) to 0.63 (large link wound over center of coil). To obtain the over-all figure for two coils, the individual values of k must be multiplied, giving a range from 0.16 to 0.39. Smaller values may be obtained by spacing the link farther from the main coil.

The top-coupled circuit shown at C is easy to calculate in theory, but proves a bit difficult to realize in practice. Its k can be calculated as shown in the illustration, but don't forget to include all stray capacitance in the values of C2 and C3. These strays are what make the top-coupled circuit difficult to use.

Shown at D is the inductive bottom-coupled circuit, which has been popular in past years for VHF converter applications but which has seen little use in transmitters. Like the top-coupled circuit, it's easy to calculate—and unlike the top-coupled, it's also easy to use.

Finally, at E, is the transformer-coupled circuit. The coupling here is strictly magnetic, and depends largely on the spacing between the two coils. With typical ham equipment, it's almost impossible to measure k accurately—and even harder to change it.

The circuit shown at E is a variant of the transformer-coupled circuit first described in "G-E Ham News" several years ago. It has a k value depending almost entirely on the size of the coil, since it consists of a single length of coil center-tapped.

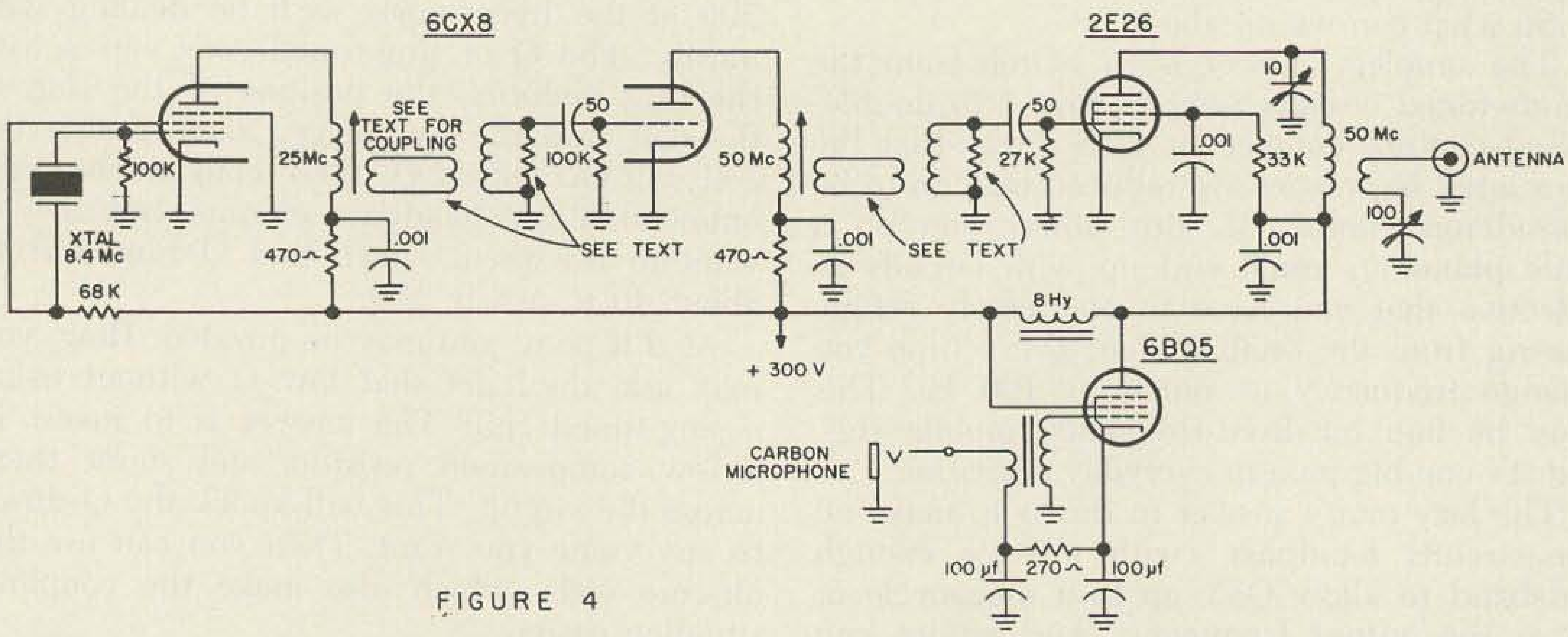


FIGURE 4

Circuit of Fig. 1 modified for bandpass double-tuned coupling between rf stages to eliminate TVI. Note only changes are addition of two grid tanks and coupling links. Resistors across grid tanks are for control of Q as described in text; this modification may be made to any rig, or this circuit may be used for an economy 10 watter.

For our purposes, the ease of adjustment and freedom from critical physical placement of parts make the link-coupled circuit of Fig. 3-B the easiest to work with. Keep in mind, though, that the same principles apply to all these circuits—there's nothing to keep you from using one of the others if you like.

Now let's look at the *purposes* of coupling the two circuits. There are two of these purposes, one the inverse of the other. The primary purpose, of course, is to transfer power at the desired frequency from one circuit to the other. The other purpose is to prevent power at undesired frequencies from being transferred.

The single-tuned circuit is probably the most efficient there is for plain power *transfer*, but it falls far short when it comes to rejecting undesired frequencies.

So we turn to double-tuned circuits. First let's assume that there is *no* coupling between our two circuits, but that power gets through anyway (this is what happens when we separate two single-tuned circuits by an amplifier stage). The selectivity is somewhat better than a single-tuned circuit, but the top of the curve is still pretty broad.

Now let's couple the two circuits, ever so lightly. At first, we find an extremely narrow selectivity curve—but also very little transfer of power from one to the other.

As we increase the coupling, more and more power is transferred. At some stage, we find that the power transfer rises to a peak, and as we increase the coupling still more we discover the power transfer drops off. However, if we now vary the frequency slightly, we will find that we have two peaks, spaced approximately equal distances above and below the original peak.

As the increase of coupling continues, the peaks move farther and farther apart. At the same time, the dip between them gets deeper and deeper. Finally, the dip is so deep and the spacing so wide that the arrangement becomes useless.

That point at which we discovered the single peak is known as "critical coupling," and strangely enough it always happens that this stage is reached when the product of the k and the coil Q is exactly 1.0. This gives us a relationship between k and Q which we can use to predict other circuit behavior.

For instance, if $kQ = 0.7$, the circuit will have the same bandwidth in the region of its peak as a single-tuned circuit. However, only some 70 percent of the power will be transferred.

With a kQ product of 1, maximum transfer of power will take place, but bandwidth in the nose region will rise to 1.4 times that of a single-tuned circuit.

Raising the kQ product to 2, we find that power transfer is still within a few percent of maximum, and bandwidth has risen to three times that of the single-tuned circuit.

All these bandwidth figures are applicable only in the region of the "nose" of the curve, near the desired frequency. How about down on the skirts of the curve? Say, some 30 db below the level of the desired frequency.

With a single tuned circuit, the 30 db bandwidth is some 50 times as great as the 3 db bandwidth. This is inadequate.

With double tuning and $kQ = 0.7$, 30 db bandwidth is only 7 times as great as that on the nose.

When $kQ = 1$, the 30 db bandwidth is 8 times the 3 db figure of a *single-tuned circuit*. Since the 3 db bandwidth of this circuit is 1.4 times as great as that of the single circuit, though, the 30 db bandwidth of this circuit is only about 5.7 times as wide as its nose.

With $kQ = 2$, 30 db bandwidth is 13 times the 3 db figure for single tuning, or 4.3 times as great as the nose of the single-tuned circuit.

The relationship between 3 db and 30 db bandwidths is important in that it tells us the *shape* of the curve; for this reason, it's called the "shape factor." Shape factor of a single-tuned circuit is approximately 50 to 1. That of a double-tuned circuit where $kQ = 0.7$ is about 7. If $kQ = 1$, shape factor is 5.7. If $kQ = 2$, shape factor is 4.3.

All this time, we've been talking in *relative* terms. Now let's find out how many cycles wide these bandwidths are.

The absolute width of the band, in the nose region, is determined only by the frequency and the Q. Though some engineers might quibble, the approximate relationship is that 3 db bandwidth for a single-tuned circuit or double-tuned circuit when $kQ=0.7$ is equal to the center frequency divided by the Q. Thus a single-tuned circuit at 25 mc with a Q of 50 would have a 3 db bandwidth of 500 kc. If the frequency remained the same but the Q were increased to 200, the bandwidth would drop to 125 kc.

This whole business of bandwidth can be summed up in a table such as that shown here (Table 1).

Table 1. Bandwidth as a Function of Frequency

Coupling	-3 db	-30 db	Shape Factor
Single-tuned	f_o/Q	$50f_o/Q$	50 to 1
$kQ = 0.7$	f_o/Q	$7f_o/Q$	7 to 1
$kQ = 1$	$1.4f_o/Q$	$8f_o/Q$	5.7 to 1
$kQ = 2$	$3f_o/Q$	$13f_o/Q$	4.3 to 1

Thus you can see that to obtain the narrowest skirts (smallest shape factor) the coupling should be larger, but this in turn will increase absolute bandwidth, requiring an increase in Q to trim things back in line.

And if you're questioning, at this point, the earlier statement that all this is simple, relax. You've just completed the *theory* part. Now we're going to put it in practice, and you'll be surprised how little of the theory is really essential to make it work.

The first step, in putting this to work, is to select an approximate Q for the circuit. As a guide, a Q of 50 for all coils will give you a possible 3 mc bandwidth on 50 mc, by overcoupling a bit. If you don't have any means of measuring Q, don't worry—just put in the coils and rig adjustable links between them.

The procedures described from this point onward will probably cause several cases of apoplexy among our more highly trained engineers with fully equipped labs available. There are rough-and-ready ways of doing the job, not precision measurement techniques. Admittedly, they are not highly accurate— but they will work.

With the links in place, you're ready to find out just what the Q and *k*Q values you actually have really are. Start out at the final stage. Hook in a grid-current meter (if your rig doesn't have one) and leave the final plate and screen voltage off. Couple a grid-dip oscillator or high-output signal generator to the grid of the driver and drive it at *output* frequency. Monitor the frequency with your station receiver, using the highest harmonic you can to make the readings more accurate.

First, tune both of the tuned circuits you're adjusting to center frequency. To do this, hook a 2200 ohm resistor across one tank while tuning the other, to swamp out the tank not being tuned. Center frequency, incidentally, is that spot halfway between your desired band edges; it would be 51.5 mc if you want to cover 50 to 53 mc.

Now adjust the coupling from the GDO to the driver to get as much grid current as you can; note the grid current reading. Then adjust the GDO frequency downward until the grid current drops to 70 percent of its original value (don't worry if it goes up first—it will, if your circuit is approximately correct to start with) and note the frequency at which this happens. Subtract it from your center frequency, multiply by 2, and you have your 3 db bandwidth.

Keep tuning downward until the grid-current reading falls to 3.2 percent of its original value; this may be a mite difficult to read if the original grid current was less than 10 ma, since with a 10 ma original grid current this figure would be only 0.32 ma. However, try to get it as accurate as you can.

Then subtract the frequency at which this happens from the original center frequency and multiply by 2 to get the 30 db bandwidth. Divide the 30 db bandwidth by the 3 db bandwidth to find out the shape factor.

Also divide the center frequency by the 3 db bandwidth, to find out the original circuit Q.

Now a look at Table 1 in this article will tell you the approximate value of *k*Q for your circuit, by comparing your measured shape factor with those listed. The final calculation gave you the effective circuit Q.

For the best harmonic reduction consistent with wideband operation, a *k*Q value of 2 is recommended. If your *k*Q value is too small, increase the coupling somewhat by moving the link on one or both coils.

If the *k*Q factor is right but the actual bandwidth is too small, lower the Q by shunting a composition resistor (100K is a good value to start with) across each coil. Increase the coupling to keep the *k*Q value approximately the same.

After each variation of the circuit, repeat the measurement process.

It shouldn't take over two or three trials, once you get the hang of it, to make the bandwidth come out to just what you want while keeping the *k*Q factor (and the resulting shape of the curve) where you want it. Once the final-to-driver coupling is properly adjusted, move to the coupling between oscillator and driver and repeat the process.

The end result will be a rig with essentially constant drive over the entire operating range you want to use, with only one tuning control—the final output.

Some hints to help—if you're working with a very low power rig, you can use the rf voltage at the grid instead of the grid current as an indication. The same ratios apply.

And this works as well with converters or receiver front ends as it does with transmitters, reducing *if* feedthrough, birdies, etc. Here, feed in signal to the grids and measure voltage past the coupling circuit with an rf VTVM.

The only essential difference between the ideas presented here and the conventional link-coupled circuits in wide use is that here, the coupling and Q are adjusted to provide desired bandpass action so that intermediate tuning in the drivers can be eliminated. Existing link-coupled rigs can be modified for easier operation by applying the measurement and adjustment techniques described in this article.

Finally, in case you want to read up on the complete technical and theoretical side of the subject, try the fourth edition of *Reference Data for Radio Engineers* published by IT&T and available from Radio Bookshop. Pages 236 to 246 contain the full details, and the theory portion of this article was derived mainly from information contained in these pages.

Good luck—and happy bandpassing.

. . . K5JKX

(Continued from page 28, October issue)

letter perfect every time, and second, the circuit may have worked for the author by a fortunate layout of parts. Try to understand the operation, see if it is logical, and grid dip the rf coils. Merely because the author's were resonant doesn't make yours resonant. Keep trying and changing, and you'll make it.

30. After the transmitter is built, the adjustment (parasitic suppression, neutralization, "bug" removal) separates the men from the boys.

31. Electrical ground and earth ground are not always the same.

32. Cathodes of a grid driven final work best when taken DIRECT to ground; measure that tube current somewhere else.

33. Usually you get higher efficiency with single band coils in the transmitter or receiver.

34. Lay your *if* strip, audio circuits, rf strip, in physical straight lines on the chassis whenever possible.

35. Shield for TVI, but make it all removable, and don't leave the heat in.

36. Ground all metal cabinets and fuse for the rating of the gadget.

37. An antenna that is adjusted to resonance in one location will probably not be resonant to the same frequency in another location if it depends on the earth as part of the operation.

38. A powdered iron core is frequency conscious, some go much higher than others in frequency.

39. To wind rf, *if*, or antenna transformers for maximum gain, they must be capacity aiding, arranged so that plate connects to start of primary and grid of next stage connects to end of the secondary, both coils wound in the same direction.

40. Just lay the leads in the solder terminations, don't twist them, and then do a good job of soldering after all the leads are in. Twisting merely makes them difficult to remove. The lead will break before the joint breaks if you soldered it properly.

41. If in doubt about a published magazine

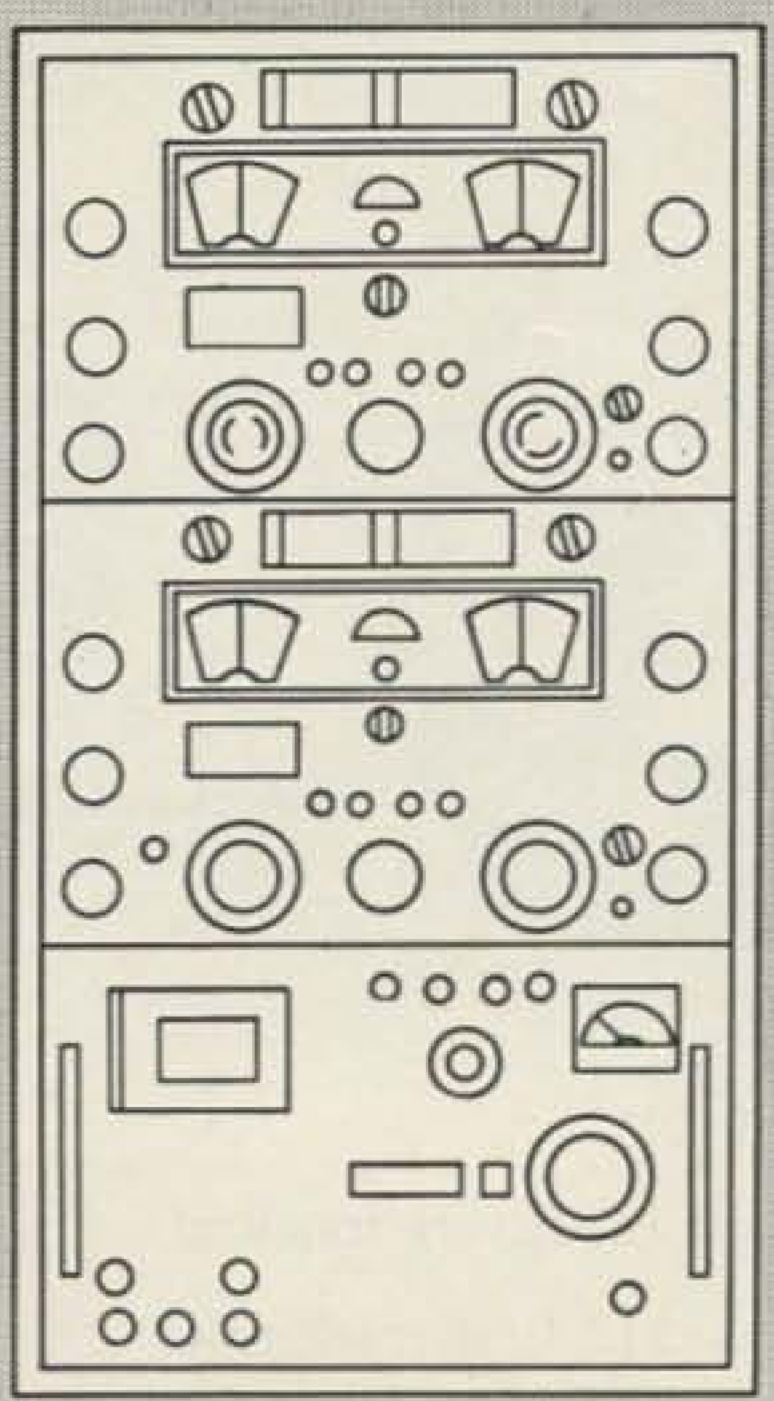
15 KC BANDPASS

OVER THE
.54 TO 31.5 MC
FREQUENCY RANGE

IN THE *New*

GPR-91 RXD

COMMUNICATIONS RECEIVER



This new GPR-91RXD Communications Receiver has all of the features — selectivity, sensitivity and reliability — of our GPR-90RXD receiver.

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42. 99 per cent of all the technical problems have already been hashed out by someone else. Check the books and journals and know, then argue if you can.

43. Know what is in your little black boxes, don't be just a knob-twister. There are too many commercial operators on the bands now.

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. . . W5IUR

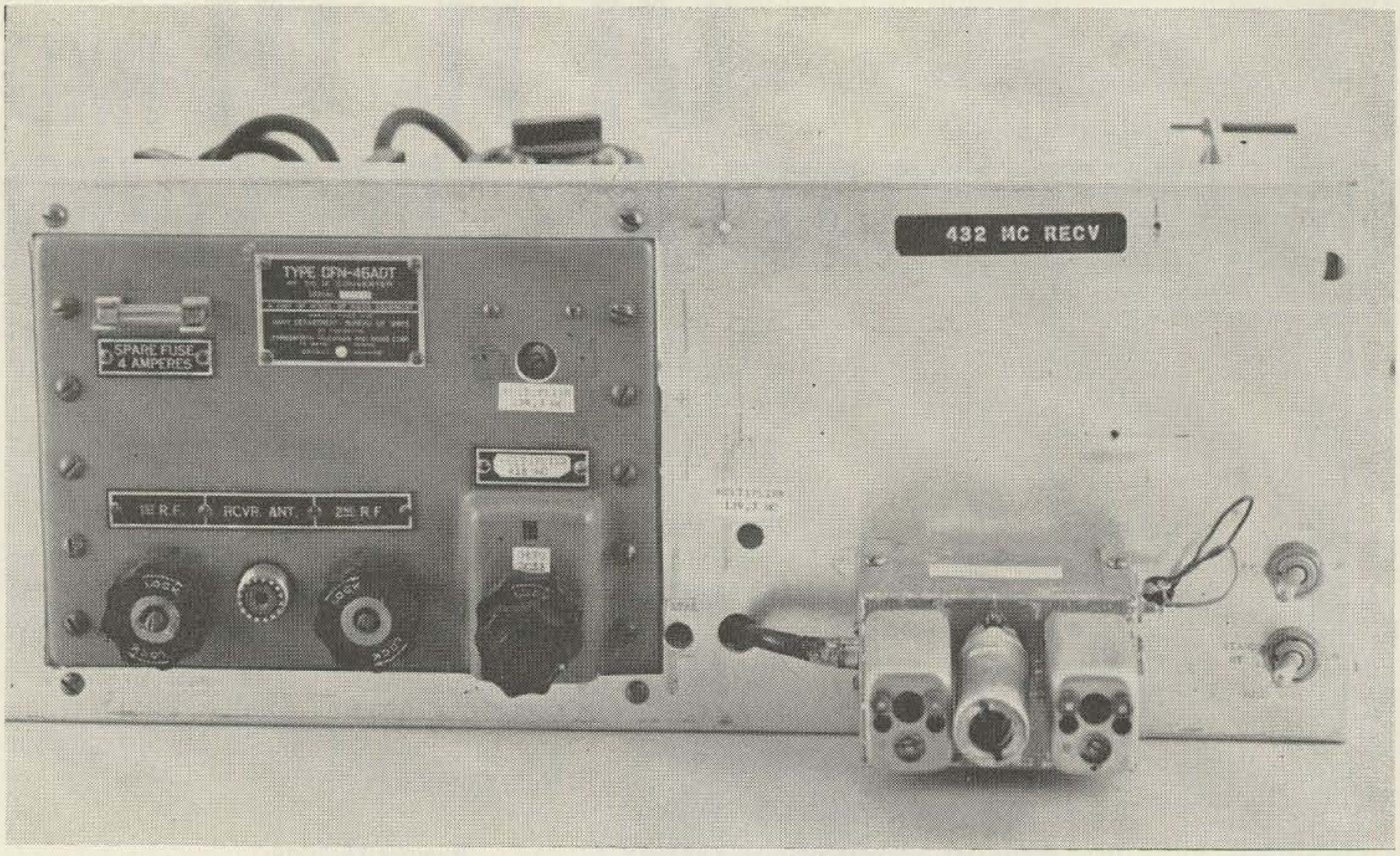
A 432mc Converter

using the Navy surplus CFN-46ADT

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas
Photo credit: Jim Dungan KRLD-Dallas

The rf to *if* converter chassis CFN-46ADT is a component of the Navy BP Radio Equipment, which is an interrogator-responder for military identification and is used as a complement to the companion radar equipment to identify the craft being interrogated. Although the complete BP equipment consists of a transmitter, modulator and *if* to video converter, the receiving rf to *if* converter is the only section in which we are interested at this time.

This unit consists of two radio-frequency amplifier stages using type 2C40/446A tubes, a converter stage using a type 2C40/446A



Front panel view of CFN-46ADT unit built into a 432 mc converter.

Plate tuning for 1st and 2nd rf stages and the antenna input is shown marked.

The old oscillator dial now becomes the tripler tuning dial. Xtal and first multiplier adjustments may be adjusted thru holes in the panel.

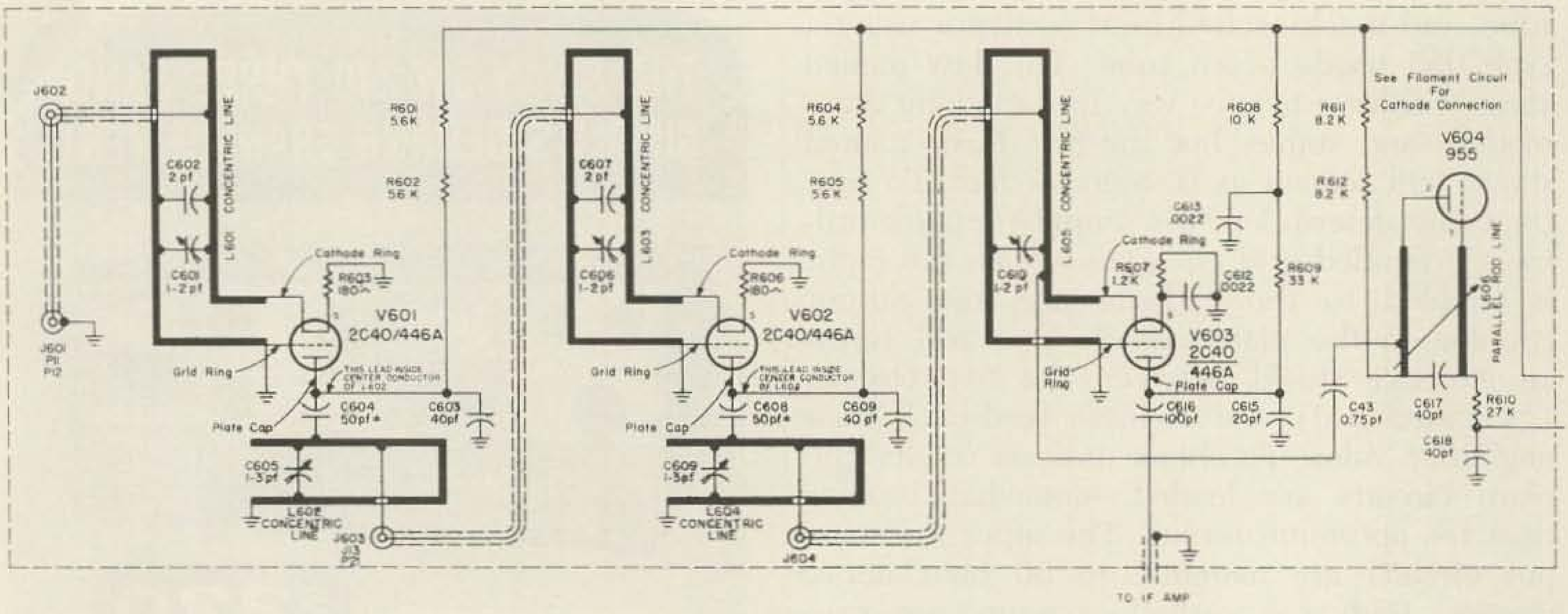
The 14 mc if Amplifier stage is at lower right. In on left, out at right.

tube, and a self-excited local oscillator using a type 955 triode acorn tube. This last named stage will have to give way to something more modern and stable, but the first three named stages will remain as is, more or less. To continue the description, the amplifier stages utilize a grounded grid circuit in which the input is coupled to the cathode and the output coupled to the plate circuit. The grid forms an effective shield between the two circuits (grounded-grid) and reduces feed-back to a negligible value. To obtain uniform results, the plate circuits are loaded somewhat heavier than for optimum output. The input and output circuits are matched to 50 ohm impedances. Both the cathode circuits are pre-tuned, and the plate circuits are tuned by means of the slotted shafts marked "1st rf" and "2nd rf" on the front panel. Because of the physical arrangement of the input and output jacks, it is possible to jump any one of the stages by merely changing the plugs. Illustratively, the 1st rf amplifier can be jumped by connecting (P602) (input to 2nd rf amplifier) to (J602). The second rf amplifier can be jumped by connecting (P603) (input to converter stage) to (J603) (output of 1st rf amplifier). It is quite interesting to jump stages in this manner and see what happens to the gain and S/N ratio of a signal. Also, other experimental pre-amplifiers may be jumped in to the rf line or directly to the mixer for comparison results.

These rf cavities are beautifully built, silver plated, and are marvels of stability. No tendency towards regeneration or oscillation is present and they will not drift in tuning over long periods of time or with temperature changes.

The converter stage (mixer) is also a 2C40/446A grounded-grid type where both the incoming signal and the signal from the local oscillator are fed into the cathode circuit. The cathode of the mixer is pre-tuned similar to the two rf stages.

The original oscillator stage is a self-excited type Colpitts design in which the tuned circuit is composed of invar open lines and makes use of a type 955 acorn tube. Tuning is accomplished by means of a pie-plate disc coupled to the open end of the line. As before mentioned, this stage will undergo some revisions and will be made into the final push-pull tripler of a crystal-oscillator-multiplier string by changing tube type and revamping the open lines. More later on this subject. A counter on the front panel marked "RECV-OSC" indicates the relative position of the pie-plate capacitor



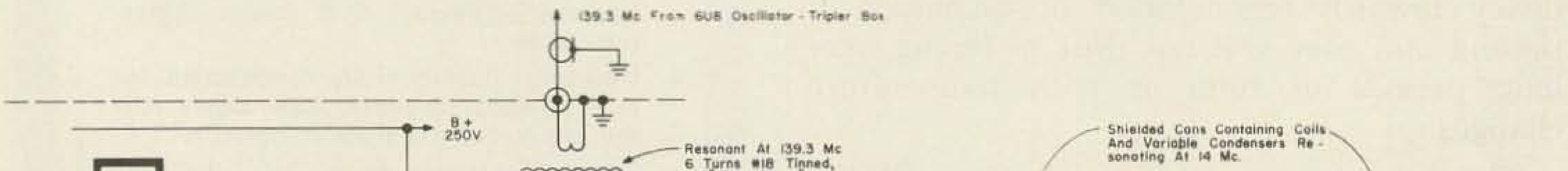
ORIGINAL SCHEMATIC - CFN-46 ADT
FIGURE 1

plate tuning the lines. This will be left as is, and merely relabeled "MULTIPLIER."

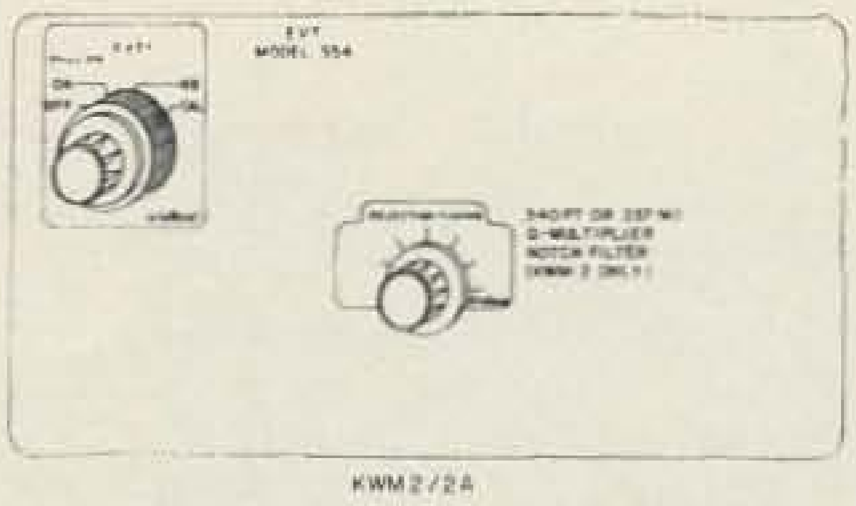
This CFN-46ADT converter was designed to receive a fixed frequency of 493.5 mc, but will tune down to 432 mc with no pain or strain. Absolutely no alterations to the two rf tanks and the mixer tank will be necessary in our first set-up. Only the existing oscillator stage will be modified and additional circuitry in the way of a multiplier chain will be added.

How good will the converter be when completed? This can not be stated to any exact degree, since precise measuring equipment is not available at this station. As far as noise-figure values are concerned, the type 2C40 tube was one of the early answers to the medium low UHF receiving problem and was widely used in radar gear during WWII. No doubt, later type UHF tubes such as the 6299, 7077, 7768 and, more recently, 8058's are better suited (and much more expensive), but the two rf stages of 2C40's with their coax cavity construction will do a reasonably good job even today. At the end of this article, additional suggestions will be presented to upgrade further, if desired, this CFN-46ADT converter, but first we should complete our modifications and get the unit receiving properly for preliminary on-the-air tests.

As far as sensitivity goes, this Navy unit as used in the original BP equipment was rated with a sensitivity of about 6 microvolts. This is



MODIFIED SCHEMATIC - CFN-46 ADT
FIGURE 2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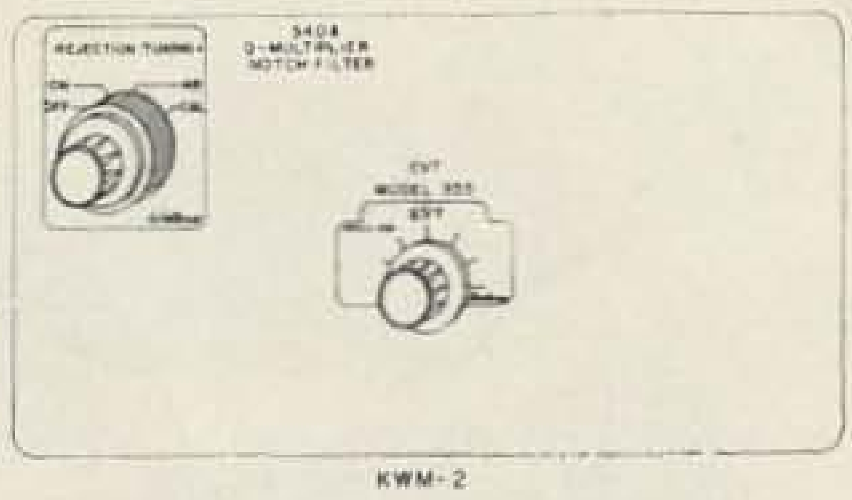
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The Model 354 mounts, **without** drilling front panel, coaxially with "ON-OFF-NB-CAL Switch."
PRICE: **$23.95**

NOTES: 1) The Model 355 will NOT fit KWM-2A.
2) On KWM-2A **only**, it is not feasible to mount BOTH EVT and Q-Multiplier/Notch Filter on front panel.

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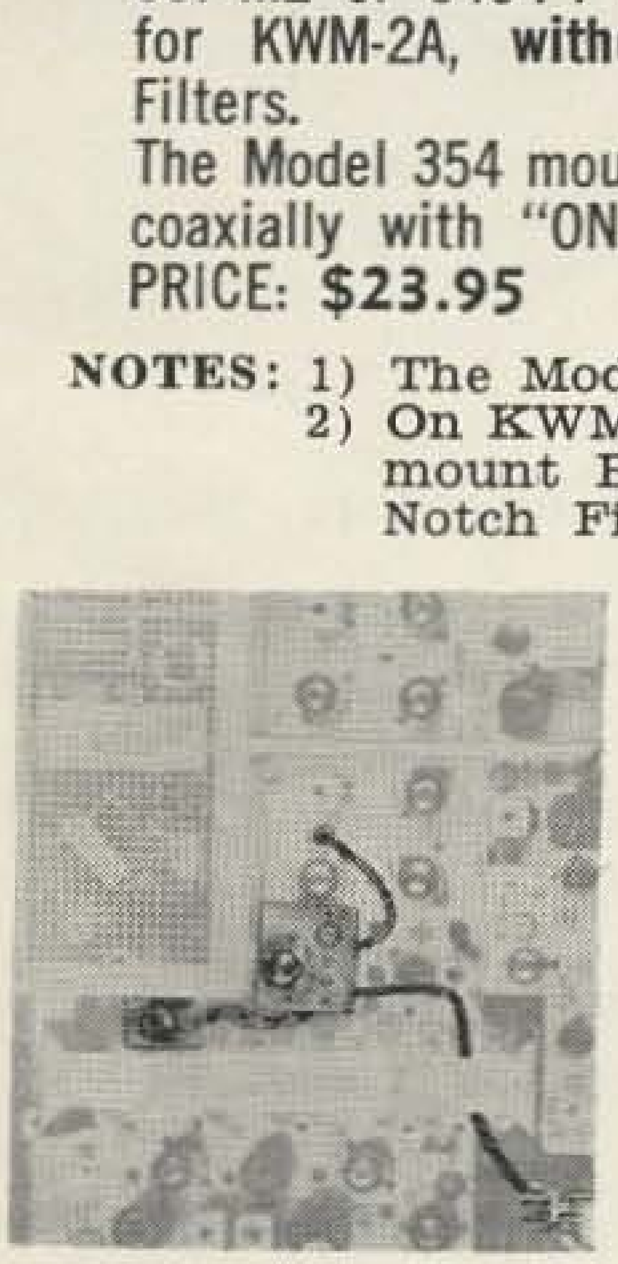

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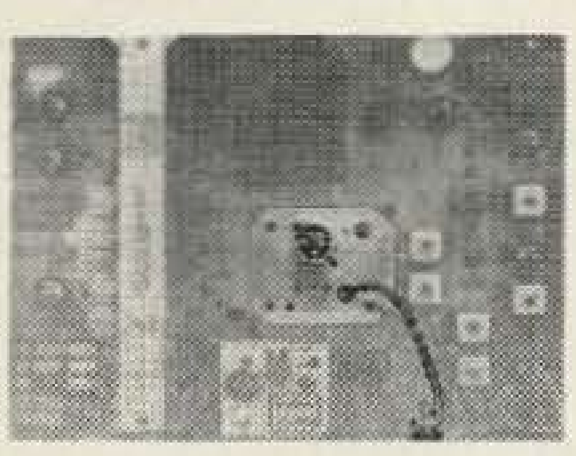

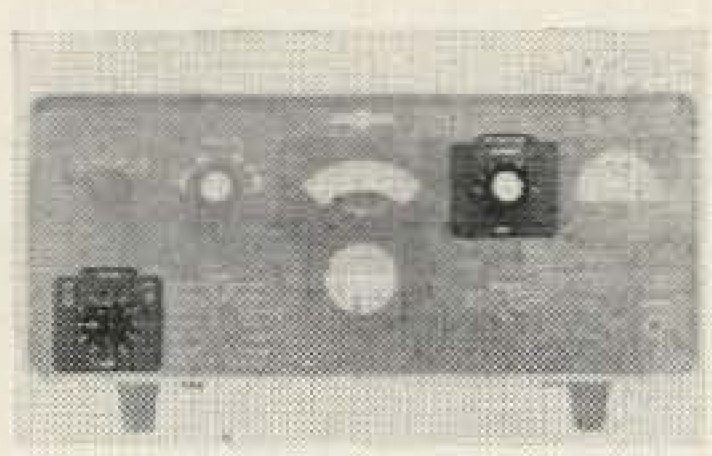

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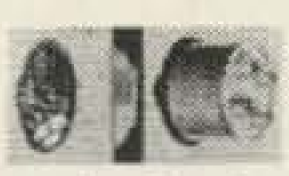

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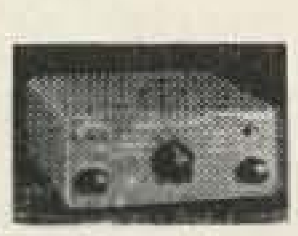

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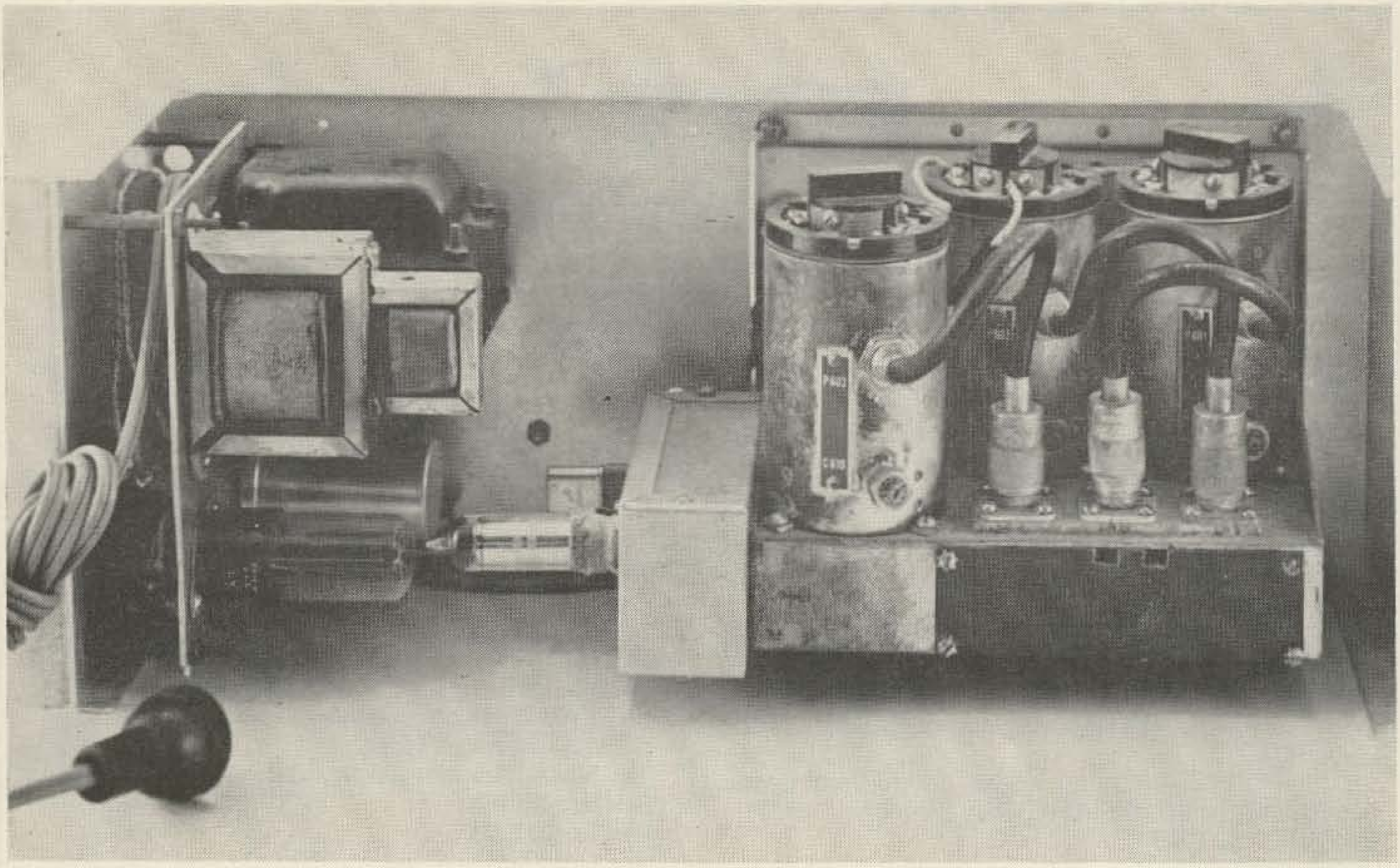

Rear panel view of CFN-46ADT unit.

Power supply equpt. at left. The crystal-multiplier minibox is shown bolted to 46ADT chassis. OB2 regulator tube can be seen as well as crystal.

The tripler to 418 mc using the 2C51 tube is behind the mixer pot and can not be seen.

The 1st and 2nd rf amplifier coax pots are from right to left. The input and outputs of the pots are on standard coax UHF plugs and can be jumped as desired.

for a signal-plus-noise to noise ratio of 3 to 1, and with an *if* bandwidth of 4 mc at 6 db down from the output at the tuned frequency. Since in our case, the converter will be working into a sharp communications type receiver, rather than a broad radar type *if* system, we should be able to beat this by quite a little bit. Certainly it is sensitive to at least a half-microvolt or less by ham standards, but again precision measuring equipment is not available. Generator leak-thru was present below the half-microvolt range, which upset definite measurements.

Availability of the unit? Actually, this is not definitely known either. Most of the 432 mc workers around this area seem to possess one of these units, or have had one at one time or another. Quite a few were distributed in the various MARS programs. They have been seen in various junk-yards, some in excellent condition—even new condition. However, very few people seem to have put them to work. It is hoped this description will be of some help in this direction.

Modifications

As previously mentioned, the first and second rf cavity stages are unchanged from the original. It may be necessary to adjust the series dropping resistors R601, R602, R604 and R605 in the B plus plate line, according to the supply being used to power the converter. This will be discussed under "Operation."

The rf cavity mixer stage V603 will require a few changes. Actually, the coax cavity itself remains unchanged but a few minor changes underneath this stage will be necessary. Consult the original schematic and then compare with the modified schematic. Included would be the resistors R608 and R609 to adjust the mixer plate voltage to the new recommended operating value. A 2.5 mh rf choke is added in the plate circuit and the 14 mc *if* output is fed to the added *if* amplifier stage through a short coax cable.

Now for the oscillator stage. This 955 acorn self-excited oscillator stage is changed into a push-pull tripler with energy at 139.3 mc being fed into the grids of a substituted 2C51 double triode push pull tube and tripling to 418 mc in its plate circuit. The 139.3 mc energy will be generated by a separate tube (6U8) enclosed in a small mini-box and fed to the 2C51 by a short link. Details on this crystal-multiplier box shortly.

Back to the 2C51 tripler. The original invar tuning lines as used with the 955 tube were altered in this manner: Capacitor C617 is eliminated and the end of the lines at this point are joined by a loop of tinned wire, thereby shorting the lines at this point. At the tube end of the lines, the 2C51 tube is substituted without removing the original 955 socket. This is done by wiring a ceramic nine-pin socket with stiff bus-wire as short as possible and soldering these short leads directly on to the existing acorn socket—pins 4 and 5 of the new socket going to pins 2 and 3 of the existing socket. The heaters of the new tube are tied to the heater pins of the 955 tube. Likewise the cathode. The new added grid coil of the 2C51 is resonated at 139.3 mc with a small butterfly type capacitor and six turns of tinned wire. A two turn link couples the preceding crystal-multiplier chain to this 2C51 grid coil. The injection take-off point on the tuned line is left as is and the original coupling capacitor C43 is left in the circuit.

Crystal-oscillator-multiplier stage. Fig. 3 shows details of the 6U8 oscillator-tripler. Since 14 mc is used as the *if* frequency, the starting crystal is 46.444 mc. All the components are contained in a mini-box 4.5 x 2 x 1.5 inches. The photograph will show this box bolted on the side of the CFN-46ADT chassis. The 6U8 tube is bottled up inside this box and the crystal is left on the outside. An OB2 regulator may be seen. All components are described under the schematic. Be sure and use all the power lead filtering as shown and you will experience smooth operation with no spurious beats or birdies.

The 14 mc *if* Amplifier. Although not strictly necessary, due to the ample rf pre-amplification ahead of the triode mixer stage, it is desirable nevertheless, to include a 14 mc *if* amplifier to bring up the output of the mixer so as to work into just about any type receiver. A gain control is included in this stage to adjust the level to suit the receiver used. A type 6CB6 pentode is used. The rather low *if* of 14 mc allows one to use a tube of this type without excess noise being added to the circuit. The over-all noise figure of the converter is determined way ahead of this stage and unless regeneration is present in the 6CB6, its added noise is considerably below the operating level of the mixer and rf stages.

It can not be argued that 14 mc is the optimum *if* for 432 mc operation. It probably is not. 28 mc, 50 mc or perhaps even 144 mc

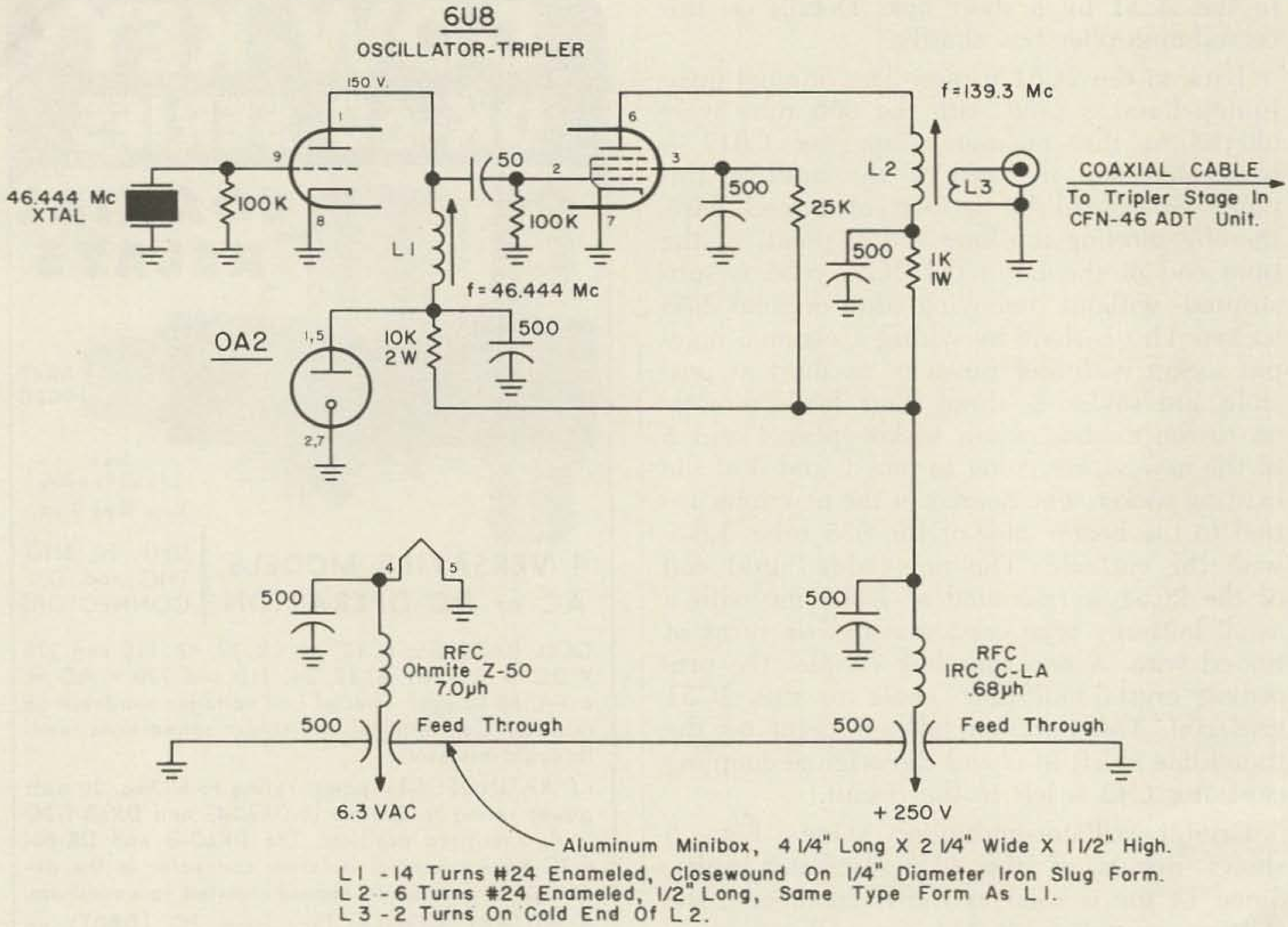

FIGURE 3

could be shown to be better on paper. However, other problems can be present, such as undesirable feed-thru from strong local 50 or 144 mc stations. This can be difficult to eliminate, especially if the 432 mc converter is fed into another high sensitivity 50 mc or 144 mc station converter, thence into the station receiver. The terrific gain an dthe various beats from the conversion oscillators may well nullify the higher *if* advantages. It also ties up the 50 or 144 mc station converter at the same time. With the 432 mc band rather uncrowded (to say the least) at this stage of the game, the lower 14 mc frequency was found to be cleaner and less troublesome by far. Actually there are no spurious beats or birdies in this receiving set up and no *if* feed-thru if the station receiver is reasonably tight in the antenna input section. If it is not tight, it would be wise to take time out and see if the feed-thru can be further eliminated either by shielding and/or filtering of power leads, etc.

Operation

A power supply capable of delivering 250 volts dc at 60 ma and 6.3vac at 3.5a will be necessary to power the converter. The instruction book on the 46ADT specifies a voltage of 180v at the plates of the two rf stages (V601-V602) and 160 volts at the plate of the mixer tube V603. After operating at these voltages for some time, we found that we could reduce this value to about 75 volts on each tube of the 2C40's without actually damaging the S/N ratio to any detectable extent. As a matter of fact, it appeared to actually help reduce the inherent noise of the unit, while the signal remained intact—and this is recommended to you to try. This is easy to do by bridging R601, R602, R604, R605, R608 and R609 with appropriate values of resistors for a trial. With the new voltages on the plates, the current drain will drop to about 4 or 5 ma per tube. Also for long life on the 2C40's it is perssible to reduce the heaters to 5.8v from 6.3v. Just add enough resistance wire from an old rheostat to the line feeding the 2C40 heaters. Tubes have been in use for two years without replacement under these conditions.

Tune up. Lacking expensive lab type equipment, the preferred method of tune-up for the average ham will be an out of town weak 432 mc signal. The run of the mill signal generator route will get you in the ballpark but the final tuning should be done with the dis-


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tant *weak* signal. Do not use a strong in-town signal unless your antenna can null the response to a very low value. The best S/N ratio is found with a very weak signal. Tune each cathode and plate control (two on front panel and three on the rear side of the cavities) until the very best S/N ratio is obtained. You will find that these adjustments will stay put month after month and the unit will be very stable in every way. The selectivity of the coax cavity rf circuits will require retuning after excursions of a few hundred kc's but this is an advantage rather than a disadvantage under present conditions.

Further Suggestions

A word was said at the start of this article regarding the evaluation of the 2C40 tube in terms of later type tubes such as the 7077, 6299, 7768, 8058 and others. It is true the newer tubes will undoubtedly produce a lower noise figure, but the availability of all but the 8058's is rather limited to the general UHF man. The 8058 shows great promise at $13.25 and it is hoped the price of this tube will be further reduced by RCA.

To upgrade further this CPN-46ADT, the use of the W.E. 416B tube is recommended. This tube is still available in scrounge circles and remains a first rate tube at 432 mc. Under full ratings with air blowing on the seals, it is entirely possible to obtain noise figures in the order of 4 to 5 db. However, the life expectancy may not be quite as good as the amateur would like. Operated with lowered plate and heater voltages and less air, the life can be made long, and the operation is still quite good under such conditions—the N/F probably being of the order of 6-7 db. Might even be a bit better with some tubes.

The 416B is also peculiarly adapted to readily fit into the coax cathode cavity tank circuits of such a converter as this, and with reasonable modifications will definitely help your over-all 432 mc receiving capability.

Such modifications have been made on the 2 rf stages of the 46ADT at this station and were well worth the effort. This will be the subject of another article, and after you get the converter working with the original 2C40's, the undertaking of such a project is again recommended for your consideration.

As this article is being written in May 1963, the tube type 8058 is being given tests in this converter. W5QOA, who helped with the original modification using the 2C40's, has come up with a very nice adapter which will allow the 8058's to be plugged into the 46ADT in place of the now existing 416B's. Preliminary work with these new tubes seem to point to excellent results—although not enough experience with on the air comparisons between the 416B and the 8058 is available at this writing. It appears definite, however, that it is going to be a rather close race, from a practical point of view.

After this, the parametric technique will of course be the ultimate answer at 432 mc, but it may be pointed out that the above converter still will make an excellent unit for the parametric pre-amplifier to work into—since it is wise to provide the best you possibly can in the way of a converter before you tie on the parametric device. . . . W5AJC

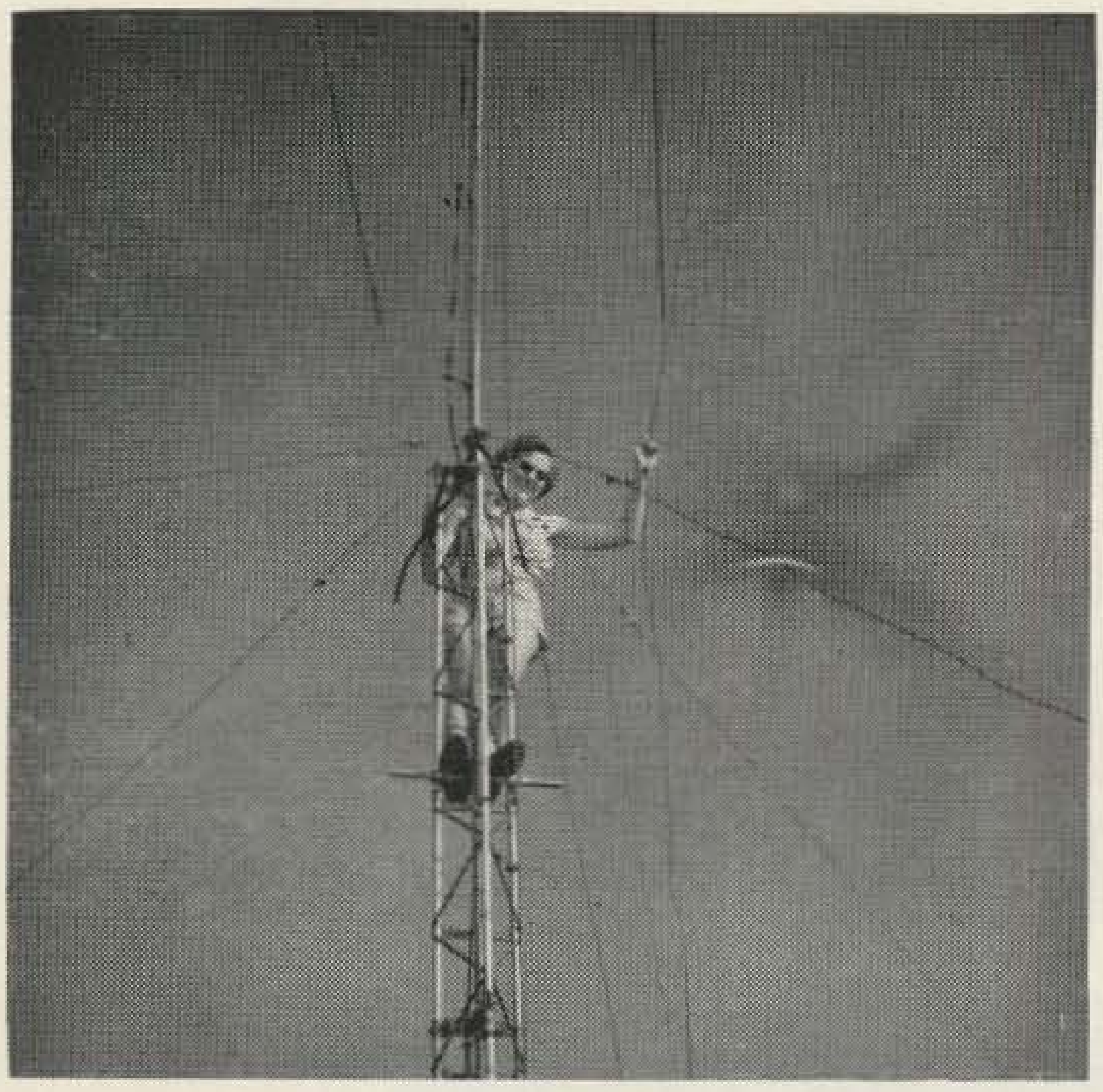
A Perfect Match

Doris Viney VE3DGV
Box 424
Kenora, Ont., Canada

So, you are going to marry an Amateur, and live happily ever after. All your friends and relations figure it's a perfect match (matrimonial wise, that is). Even Dad was won over when he heard that Bob was electronically minded enough to pass a code and theory exam, and obtain an amateur licence. "That's the type of fellow who would go far in this age of Telstar," Dad prophesied. Yes, I will agree, Bob would go far—but not quite the way Father predicted. Every ham goes far into the night, chasing those elusive dx stations; and far from home on field day, totally oblivious to any suggestions to the contrary his xyl might be making.

So, right from the start, if you want this match to get off on the right footing—and be equipoised, shall we say— first things must come first. And that means hamming has top priority, about 99.9%, to be explicit. Such ordinary things as meals, bedtimes, dentist appointments, meetings, company, holidays, etc. come under the .1% heading.

Never expect your ham husband to come at the first call for meals—or the second—or the third. Experience has taught, in the worst ham cases, to give the first call to dinner at the precise moment the roast is taken from the freezer. Then, once every hour, on the hour, as the dinner progresses—another call is given.



VE3DGV

By the time the roast is done to perfection, the Yorkshire puddings have popped, and the coffee is perking merrily, he will have a slight twinge of conscience at holding dinner up so long, and dash to the table on the double. This arrangement has kept peace in many ham homes every Sunday—no more frustrated wives, or dried-out Sunday dinners. Just one precaution here, though. Better keep some TV dinners on hand just in case *all* bands are dead when the sun spots are in their worst cycle.

And, while you are blithely shopping for your beautiful trousseau—a word of advice here. Buy plenty of outdoor clothing for every kind of inclement weather. That may seem odd, but that is just what you will be needing. Statistics show more antennas are broken, rebuilt, strung up, experimented with, shortened, lengthened, soldered, swr eliminated against, etc., in weather best suited to a good book, an old armchair, and crackling logs in an open fireplace.

If there is a night school handy, quickly enroll in one of their classes that will give you a smattering of basic electronics, basic electricity, and basic engineering. You will need to know the names of the parts in the basic amateur receiver and transmitter—what each does and does not do.

A few practical lessons on working with a screwdriver, soldering iron, drill, chassis punch, etc., are excellent insurance against blisters, burns, and general frustration. Time will come when you are automatically expected to cope with such foreign aids as these. And remember, 4-40's and 6-32's just do not mix.

(Turn to page 104)

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RECEIVE: Frequency Range—Same as Transmit. Frequency Stability—same as Transmit. Sensitivity—Less than .25 UV for 10 db s/n. Selectivity—2.8 KC at 6 db, less than 6 KC at 50 db. Overload Characteristics—Less than 2% cross modulation results from any two signals separated by more than 20 KC if stronger signal is less than 5 MV across 50 ohm input. Spurious Responses—images and IF leak through down more than 75 db between 49.8 and 51 MC. AVC Characteristics—less than 6 db change in AF output for input change from 2.5 UV to 1 MV (52 db). Fast attacks, panel selectable release time. AF Power Output—more than 2 watts, 3.2 ohms. Power Requirements—met by the Clegg Model 416A, 115 Volts AC, 60 cps input power supply as well as by many commercially available power supply packages.

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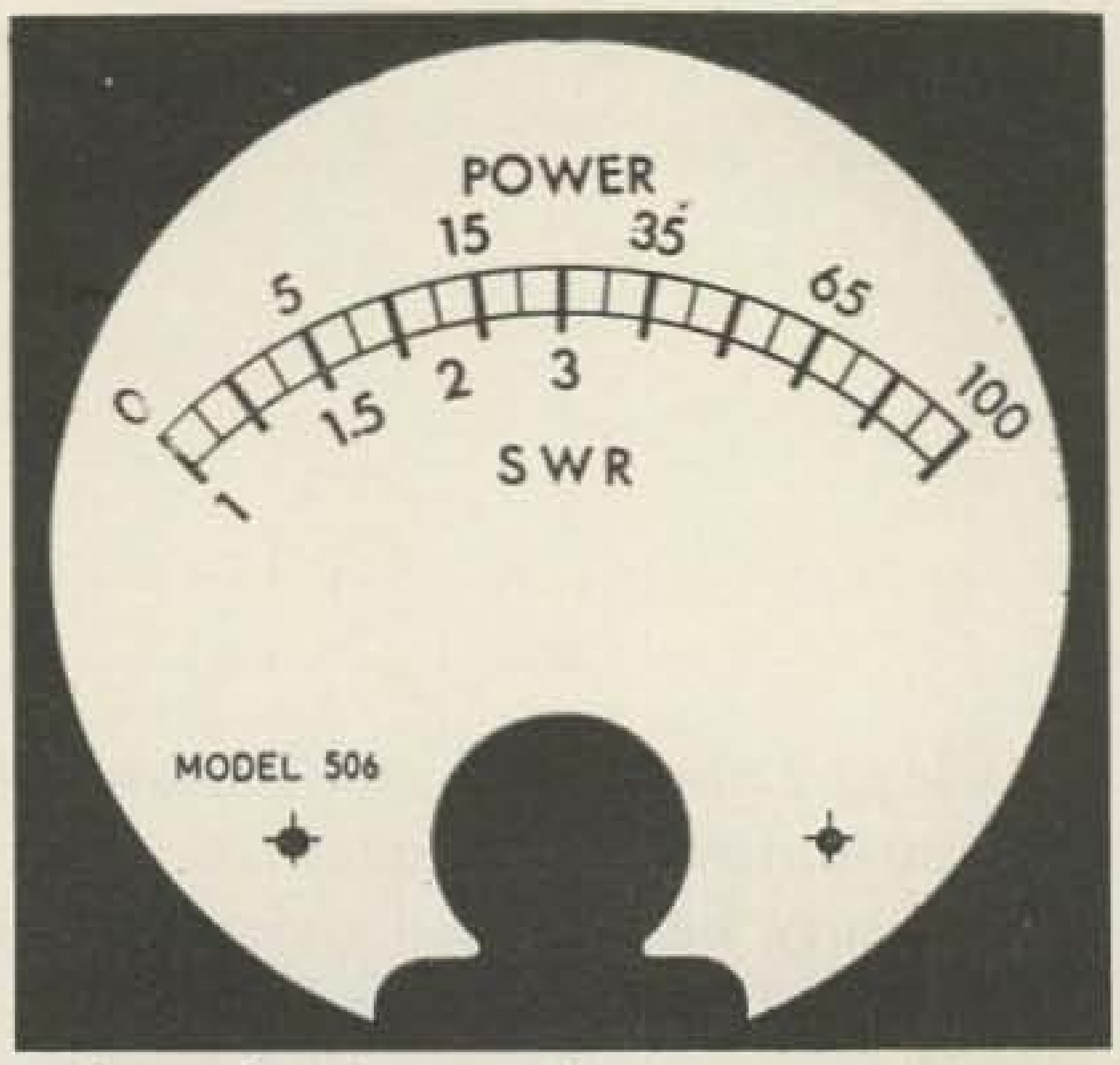

Every so often in the various radio publications there appears an article about an SWR meter or an rf power meter. Such an article did appear in a recent issue of 73 Magazine. In practically all of these projects the use of a meter having a 0-1 scale is prescribed. The meter itself may have a 0-1 milliampere or perhaps a 0-100 microampere movement.

For the purpose of checking SWR a calibrated graph may be included with the article. More often, however, even this time saver is omitted and it becomes necessary to resort to mathematical computation in order to arrive at the answer. The usual formula that is included is: VSWR= F+R divided by F–R, where F is the forward meter reading (usually full scale) and R is the reflected power reading on the meter scale. More about this later. As an assist to those using SWR meters, an SWR/PWR meter scale is being featured with this article in order to eliminate the annoying math. If this scale is cut out and handled with care it may be pasted to the back of the original meter scale to facilitate making measurements. Although this scale has been made up for a Weston model 506 meter, it should work with meters of other manufacturers as well. Using this scale it would no longer be necessary to use a 0-1 milliampere or 0-100 microampere meter. Almost any meter having sufficient sensitivity to give a full scale Forward reading with your transmitter could be used.

Now about the scales. First the meter arc itself is broken down into 10 heavy markers. This would represent a basic scale of 0-100 with each of the heavy lines indicating 10. Between each of these lines there is another line representing 5. Above the arc we find the POWER calibration indicating from 0-100. If your directional coupler is of the wattmeter type such as used by Collins, you can calibrate full scale of the meter to indicate either 100 or 1000 watts. This being the case, you would be able to read any change in transmitted power directly from the meter. Any of the usual methods could be used to calibrate your unit, such as an rf ammeter in series with a dummy load, or perhaps a calibrated VTVM with an rf probe across the dummy. If your directional coupler is of the type used to measure VSWR such as the Heath, Johnson etc., then you would merely adjust the sensitivity control for full scale meter deflection in the forward mode, and this would be your forward reference level only. The calibration of the power scale follows the "square law" principle. If for a given power the meter is adjusted to read full scale or 100, it would be necessary to reduce the power to twenty-five percent of this value for the meter to drop to half scale. This is what is meant by the "square law." There are some meters on the market that feature a linear % Reflected Power scale. Actually these meters merely indicate the percent of the full meter deflection and not the true percentage of the reflected power.

Below the arc is the SWR scale. A reflected power of 4% would also be an SWR of 1.5:1. If the reflected power is 11% of the forward power then the SWR is 2:1 and a reflected power of 25% would represent an SWR of 3:1. As standing wave ratios above 3:1 represent excessive losses, they were not included on the meter scale.

In drawing up the scale some liberties were taken in the interest of simplification. At the low end of the power calibration there will be a small error, but the accuracy increases rapidly as we approach full scale.[1]

If you are trying to measure standing wave ratios greater than 3:1, or want a reading between those on the meter scale, then it would be necessary for you to resort to math to get your answer. Earlier in the article the formula was given as: VSWR= F+R divided by F–R. Now let us try an example using this formula. First tune up the transmitter into its dummy load or into the antenna itself. With the directional coupler switched to indicate forward power we adjust the sensitivity control for full scale on the meter. Call this 100. Now throw the switch to indicate Reflected power. Suppose in this mode the meter reads to the second heavy line, which would represent 20. Using the VSWR formula we get 100+20 divided by 100−20 or 120/80. This gives us our answer of 1.5 or 1.5:1 SWR. This particular value, however, would not require calculation as it is indicated directly on the meter scale! SWR can also be calculated directly on a power basis if you are using a calibrated wattmeter type of coupler. For this method our formula becomes: SWR using power in watts $= \sqrt{F/R} + 1$ divided by $\sqrt{F/R} - 1$. As an example of this method suppose our forward power is 100 watts and our reflected power is 25 watts. Using the power formula just presented we get $1+\sqrt{100/25}$ divided by $1-\sqrt{100/25}$. This answer comes out to 3 for an SWR of 3:1. Either method can be used equally as well, although the previous method using meter scale calibration markings might be easier to handle.

It is hoped that the published meter scale along with this article will help make life easier for those that cared to read.

. . . W2KPE

Institute Museum

If you have any ham gear circa the mid or early thirties please make arrangements so it won't be junked when you leave us. We'd sure like to have it for display in the museum here with your QSL on it.

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Floyd O'Kelly W5VOH
418 E. Hickory Ave.
Midland, Tex.
and
T. O. Wallis WA5DEL
2602 Sentinel
Midland, Tex.

All Band Conical Antenna

Would you like to get away from your "antenna farm" with a separate antenna for each band, and operate on all frequencies from 80 meters through 10 meters with one antenna that will load flat with a 1:1 SWR all the way across each band?

The accompanying diagrams depict such an antenna. Dubbed the "All-Band Conical," and derived from the driven elements of a broad-banded television conical antenna, this antenna will allow operation on all amateur bands from 80 through 10 meters with maximum transmitter efficiency and vastly improved receiver reception.

The antenna system consists of two horizontal vees, back to back, center-fed with 450-ohm open-wire feed line, tied to an antenna coupler of the Johnson Matchbox type. Vertical arrangement may be either of the flat-top type, inverted-vee design, or just about any other configuration to fit your individual requirements, so long as it remains balanced on each side. The horizontal vees, with a 20° to 30° angle between each leg, cause the antenna to have very broad tuning characteristics, thus permitting large frequency excursions up or down the band from the resonant tuning point with resultant low increases in SWR.

All-band operation is accomplished by use of a Johnson Matchbox or similar parallel-feed antenna coupler. This provides a method of tuning the feed line to whichever band is desired and converting your unbalanced transmitter output to the balanced input of the conical feed system.

Maximum transmitter efficiency results with such a system because the matching coupler will present a near perfect resistive load to the transmitter on all bands. Problems of transmitter heating due to absorption of reflected power are eliminated; if you are troubled with your transmitter making like a "hotbox" with high SWR, this is the way to cool it off!

This antenna has been loaded from the low end of 80 meters through the high end of 10 meters with exceptionally good results throughout. The authors, operating a Viking II on AM and a Tri-Band Swan (home-brew conversion; both sidebands, too!) can load up on any band with a 1:1 SWR and can then move as much as 50 kc in frequency without affecting the SWR and transmitter loading enough to necessitate a change in any adjustments.

When transmitting on a coax-fed dipole or inverted vee cut for the center frequency of any single band, it is noted that movement up or down frequency from the antenna's resonant point introduces either inductive or capacitative reactance, with corresponding increase or decrease in plate current loading, and a rise in SWR. If a large frequency move is made, the final must be re-dipped, and sometimes more or less capacitance must be introduced or removed in the final tank loading circuit in order to maintain the required power level.

Not so, however, with the conical antenna; after loading the transmitter on any band and adjustment of the antenna coupler for a 1:1 SWR, movement to any other frequency within the band necessitates only minor antenna tuner adjustments to return to a 1:1 SWR at the new frequency. When this adjustment has been made, the transmitter again sees the same resistive load as previously, and transmitter loading will remain at the same point as before moving in frequency; only slight final tuning or re-dipping is required. This is indeed a bonus factor for those amateurs operating one of the fixed impedance output transmitters.

The development of the conical antenna resulted from the search for a broad-band radiator which would present a minimum physical mismatch to the feed line. The conical antenna arrangement approaches the ideal configuration to reduce this physical mismatch. The transmission line and antenna surfaces are smoothly tapered so the transmitted wave energy actually sees a metallic funnel. As the energy travels up the feed line, it will be smoothly squeezed out into the antenna while encountering a minimum change in direction of flow. Large-diameter antennas are very desirable in amateur operations, because they present very broad-banded characteristics, but a large-diameter transmission line (to avoid the undesirable physical mismatch) is not very practical. Thus a really thick antenna may prove to be less desirable than moderately thick ones unless some method of special shaping is employed to smoothly increase the cross-section of the practical transmission line to match that of the large-diameter antenna. The conical antenna herein described provides a method of making such a transition, and greatly reduces stray capacitance from such a mismatch at the antenna feed-point.

In addition, the progressive increase in cross-section from the center feed-point to the outer ends of the antenna tends to keep the surge impedance constant at each successive section of the antenna. A constant cross-section antenna such as the center-fed dipole or the inverted Vee exhibits successively higher surge impedance from the center feed-point to a point near the ends, where the surge impedance suddenly falls to a very low value.

Variations in the all band conical antenna's design are limited only by the number of individual ideas. The angles associated with the conical and the number of elements employed, from two to a solid conductor, or cone, have an infinite number of combinations, each with a small change in operating characteristics. The antennas of this design constructed thus far locally have consisted of only two legs or elements on each side of center. This is only the outline of a true conical, but the addition of two *more* elements or legs on each side would only reduce the Z/R ratio by less than 1/3 of the ratio of the two-element conical. The two-element conical reduces the Z/R ratio by more than ½ of the ratio of a single-wire doublet. The optimum ratio of Z/R is, of course, one to one. If the Z/R ratio of various antennas is examined, its importance will be realized.

Most single-wire inverted Vees have an angle of inclination from the horizontal ranging from 20° to about 45°. The Z/R ratio will be from 14:1 to 19:1, depending on the size of the wire conductor. The two-element double-vee conical can be constructed with any cone angle from 1° to 90°; the normal angle will be from 10° to 60°, with the optimum cone angle being around 30°. The Z/R ratio at this angle will be about 8½:1. With four elements

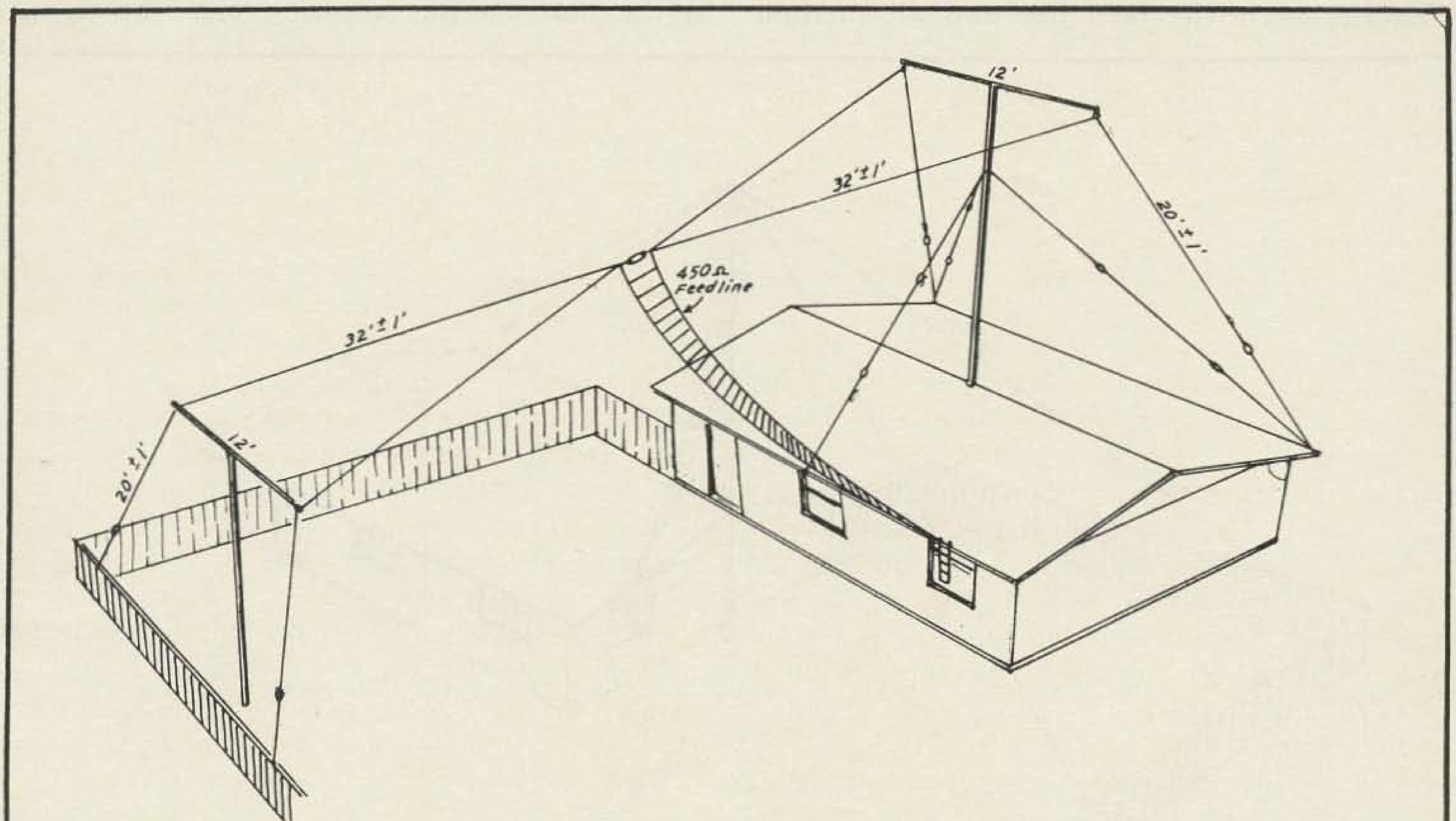

FIG. A

Fig. A—The installation at W5VOH. The spreaders are made of one inch conduit with a one inch dowel driven inside the conduit and protruding a foot on each end. A pulley on the mast makes it possible to raise and lower the spreaders. Both masts are of the TV telescoping variety.

forming each cone on each side of the center feed-point and the same optimum cone angle of 30°, the Z/R ratio is only reduced to about 6½:1. It is important to note that when Z/R is at a minimum, the ratio of R_{max} to R_{min} is also at a minimum.

Another factor to note is the load resistance, which varies with the cone angle. As the cone angle is increased, the impedance of the antenna decreases. Again the optimum cone angle is about 30°; at this point the center feed-point impedance is about 350 to 450 ohms. This impedance is also related to height above electrical ground; you should strive to elevate the center feed-point a quarter-wave or more above electrical ground at the lowest operating frequency.

Still another aspect of the conical which will be appreciated by those who are limited in space in which to erect an amateur antenna is the fact that as the cone angle is increased, the electrical antenna length is increased. At the recommended cone angle of 30°, the electrical length will be approximately 75% of the calculated length required for a single wire. Ninety feet will resonate at 3900 kcs. However, it is recommended that an overall length of 105 feet be utilized if at all practicable from an erection standpoint.

Additional efficiency is obtained by use of 450-ohm open-wire feed line and the method of feeding the antenna. RG-58/V coax, in popular usage for center-feeding inverted vees and half-wave dipoles, has an attenuation factor of approximately 2 db per 100 feet at 30 mcs, and the attenuation factor for RG-8/V is around 1 db per 100 feet. However, the attenuation factor of 450-ohm open-wire line is only 0.15 db per 100 feet at the amateur frequency mentioned. When it is considered that a doubling of transmitter power will result in only a 3 db signal increase, it can readily be seen that use of open-wire feed line as compared to use of coax results in quite a gain.

Added efficiency will also be noted at the receiver when this antenna is used as a receiving antenna. Consider a center-fed half-wave dipole, fed with coax transmission line, and cut for the center of the 40 meter phone band. The center conductor of the coax is connected to only one-half of the antenna, with the other half acting as a grounded counterpoise, so any signal to the receiver is obtained by the E.M.F. generated in 32' 3" of antenna. (The coax won't pick up any signal, either; it's shielded.) The conical antenna will provide around 300 to 400 feet of receiver antenna wire for generation of an E.M.F. at the receiver's terminals, depending on the length of the open-wire feed line (it is a part of the antenna and picks up signals also). Thus there is more wire available in the antenna for receiving and the signal

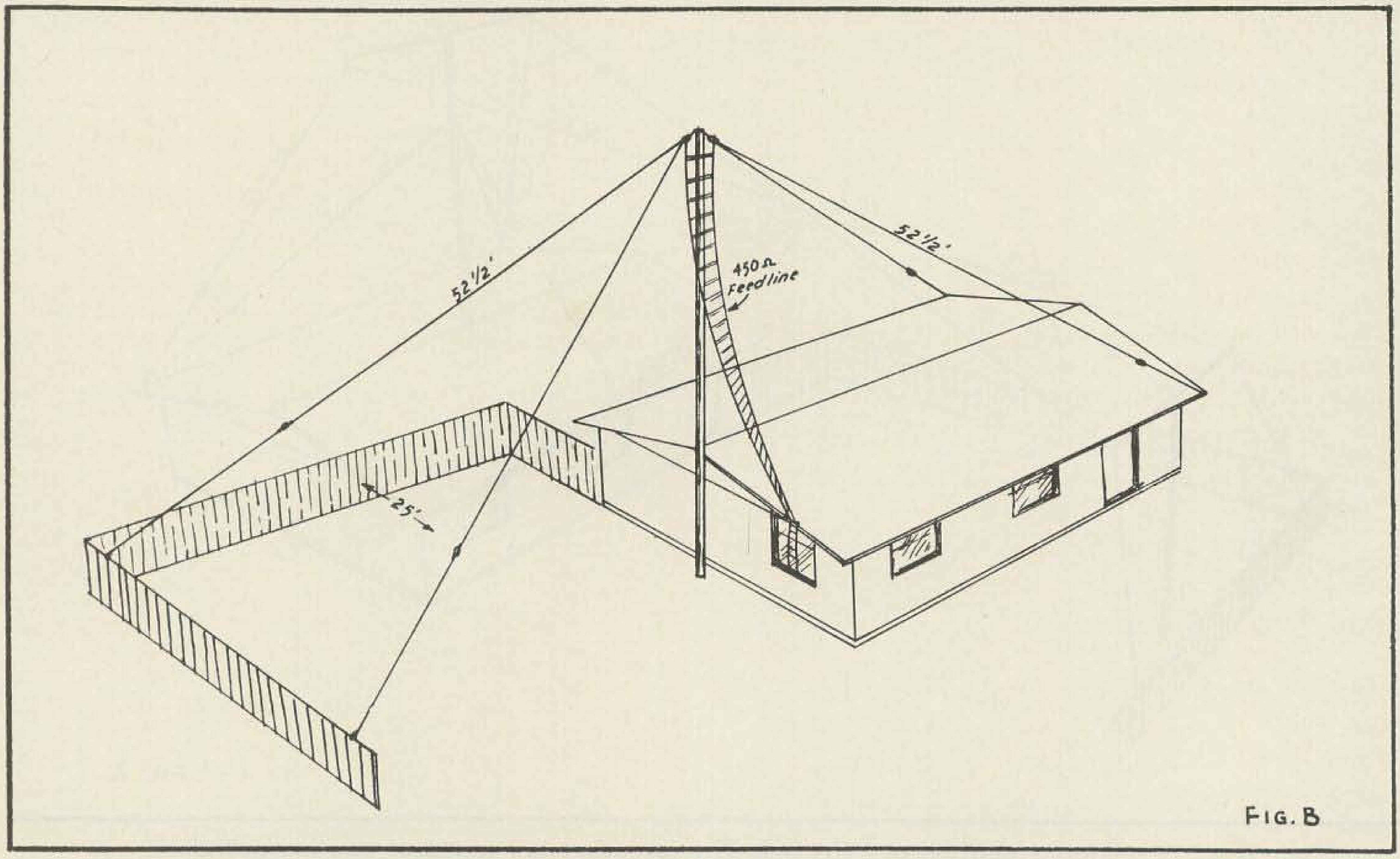

Fig. B—The installation at WA5DEL. Refer to article for descritption of insulator delta constructed at the center. The inside angle of the two sides should be larger than ninety degrees.

heard will be stronger.

Still a further advantage to this antenna will be realized by use of the antenna coupler. Since the antenna coupler's use results in the addition of another tuned circuit, further and better elimination and suppression of harmonics is obtained. And, if this is not enough, the system lends itself well to insertion of a low-pass filter in the transmission line between the transmitter and the antenna coupler for further reduction of harmonics above 30 mc if desired (TVI you know).

The directivity pattern, if any, of this antenna has not been determined by the authors. No doubt, it does possess major and minor lobes which probably shift with band changes, but it is thought that very little difference in signal strength exists between the major and minor lobes. The authors have worked with full-circle coverage on all bands with very little attenuation in signal strength reports from any direction. It should not be any more directive than the ordinary garden variety of center-fed dipole or inverted Vee, and, when the band is in, you can talk with it wherever the signals may be coming from.

An antenna length of 105 feet is recommended, with each leg of each horizontal vee being 52½ feet in length. No. 12 or no. 14 wire would probably work very satisfactorily, but the authors recommend use of no. 10 soft-drawn copper wire for the antenna, because of both the larger cross-sectional area and the added structural strength obtained. Don't worry about soft-drawn copper's stretch in hot weather; the antenna coupler will take care of changes in length due to temperature changes. Thus still another advantage is realized from the conical antenna system because you get away from the changes in antenna resonance which occur on a single-band coax-fed dipole when it is lengthened due to temperature changes or physical sag.

The 450-ohm open-wire feed line used by the authors is formed from no. 18 wire, with 1" polystyrene spacers every six inches or so, and is the commercial TV variety which is readily available for approximately 2c per foot from most radio supply houses (Lafayette, Burstein-Applebee, etc.). This size feed line should safely handle powers up to 400 watts or so on AM and a KW on side band. Remember that $P = I^2R$. Assuming a power of 1000 watts on the 450 ohm transmission time we have $I^2 = 1000/450 = 2.222$ or $I = 1.5$ amps. In an open air installation, such as a feed line, the no. 18 conductor will handle more than

(More radiate on 38)

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Braintree: Radio Shack Corp.
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Reading: Graham Radio, Inc.
Saugus: Radio Shack Corp.

MICHIGAN
Detroit: Reno Radio
Grand Rapids: Radio Parts, Inc.

MISSOURI
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Amarillo: Capitol Electronics
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Houston:
Busacker Electronics
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Norfolk: Priest Electronics

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Amateur Electronic Supply

WASHINGTON, D.C.
Electronic Wholesalers, Inc.

(Antenna from page 35)
twice this current with ease. If you are going to run a full gallon on AM you may wish to construct your own feed line from no. 12 or no. 14 wire. In this case, spacing between each side of the feed line is dependent upon the diameter of the wire used, and can be calculated for an impedance of 450 ohms by the formula for the impedance of air-insulated parallel-conductor transmission line, which is:

$$Z_0 = 276 \log \frac{b}{a}$$

when "b" is the center-to-center distance between conductors and "a" is the radius of the conductor. If you do construct your own, we suggest that you purchase ¼" diameter polystyrene rods, cut them up into lengths required for the spacers, and drill the wire holes just large enough to pass the wire through. A hot soldering iron judiciously applied will then seal each spacer hole around the wire and you've got your feed line made with a minimum of effort.

The feed line length is apparently not critical; one of the authors uses a length of 40 feet, the other uses 95 feet, while still a third local amateur installation uses 60 feet, and results at all three stations have been very good. If, after erection, trouble is experienced in loading on any band, try experimentally adding ⅛ to ¼ wave length or so at a time to the feed line until you arrive at a length where good loading characteristics are obtained. If you have trouble at all in loading, it will probably be on the higher frequencies, and if you can arrive at a feed line length which works satisfactorily on 10 and 15 meters, it will work well on the lower bands.

A word of caution: the open-wire feed line is hot with rf when transmitting, and must be insulated from contact with any conducting surface. Provision must be made for use of feed-through and stand-off insulators for passing the feed line through windows, etc., and at roof eaves. The authors utilize old-fashioned porcelain knob-and-tube insulators, such as were in prevalent use years ago by electricians for open-wire house wiring before the advent of romex house wiring. In case you have trouble locating this item at the radio supply house, try Sears Roebuck; they were obtained for 5c each here in Texas.

A method of getting through a window of the shack to the outside without drilling holes in the window itself requires a piece of masonite board cut to your window width and about 6" high; raise the bottom window sash and use the masonite as a spacer, and the top of the masonite will fit into the weather-stripping groove on the under side of the window sash, affording a weather-tight closure. The feed line is passed through feed-through insulators in the masonite and in the outer window screen wood frame.

The authors found that the porcelain knob insulators mentioned above had a high-resistance leakage to ground when wet from rain. Resistance to ground, reading infinity when dry, was found to be 700 K ohms when wet, but this defect was easily remedied by wrapping the open-wire feeders at the contact points with the insulators with plastic electrical tape and no further trouble was experienced due to leakage to ground.

A support for the antenna center feed point, and a convenient method of hanging the antenna to your mast, can be devised by forming a delta from three strain insulators about three inches in length, readily obtainable from your radio parts house. Attach each vee to one of the two bottom points and hang the whole antenna to your mast or pulley by the top point.

If difficulty is experienced in obtaining a 1:1 SWR after installation, examine the antenna to determine if a metal wire guy line or any other metal conductor might be within the field of one of the horizontal vees, thus unbalancing it with respect to the other vee. The conical is a *balanced* antenna, and metal within the field of one of the sides will cause unbalance and consequently you cannot get the SWR down to 1:1. This trouble in the installation of one of the authors' antennas, was caused by a top tower metal guy line within the field of one vee; it was remedied by replacement of the metal wire guy line with a nylon rope guy line. Another possibility that may result in an unbalance can be caused by bringing off the feed line too close to one side of the antenna. The feed line should be brought off from the plane of the antenna as close to 90° as is practicable. The angle does not have to be at exactly right angles, but an angle smaller than 60° may cause an unbalance due to coupling.

The conical antenna is a simple antenna to construct and erect. The accompanying diagrams depict the arrangements used by the authors, and you may improvise any arrangement required to suit your space requirements, so long as you keep it balanced. If you will utilize a little care in making good electrical connections and in insulating the feed line, it will put a signal on the airways that you can be proud of. One word of caution is in order: Since the conical presents such a good load and pulls all the rf available from the transmitter, the authors have found it necessary to bolt their transmitters to the operating table to prevent them from being pulled up the feed line and lost in outer space.

. . . W5VOH . . . WA5DEL

Single Diode Frequency Double

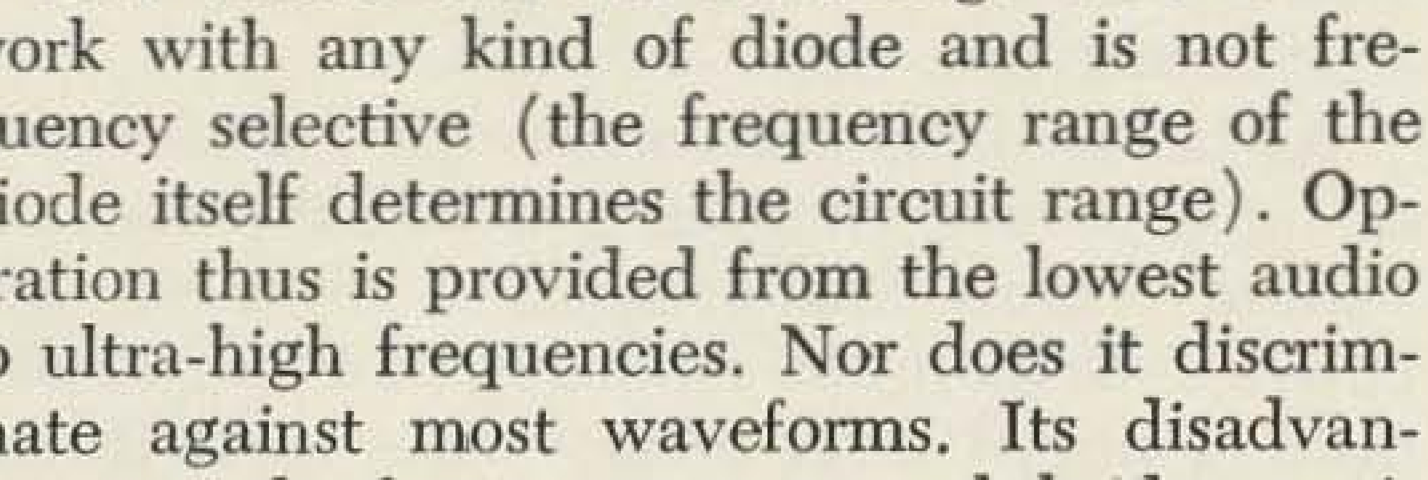
Rufus Turner K6A1

The output ripple of a full-wave rectifier is an easily obtained double-frequency voltage for synchronization, timing, tone generation, frequency doubling without amplifiers, etc. Four diodes (or two diodes plus two resistors) generally are used in a bridge circuit, since this is more economical and less frequency dependent than the transformer-coupled full-wave rectifier. Further economy is provided by the circuit shown in Fig. 1; this is the less well known single-diode rectifier bridge.

To balance the circuit initially, apply the input ac voltage, connect an oscilloscope to the output terminals, and adjust R_1 for equal height of the output-signal humps. No readjustment is needed unless the diode is replaced.

This circuit has the advantage that it will work with any kind of diode and is not frequency selective (the frequency range of the diode itself determines the circuit range). Operation thus is provided from the lowest audio to ultra-high frequencies. Nor does it discriminate against most waveforms. Its disadvantages are the few common to such bridge rectifiers: lack of a common (ground) connection between input and output, and signal attenuation due to voltage divider action of the bridge.

. . .K6A1



Tool and Workshop Practices for the Ham

SPECIAL SECTION

Fred Haines W2RWJ
Box 123
Liverpool, New York

If your tool box is at all like mine, it is most difficult to explain, and further, it doesn't even faintly resemble the surgically precise list of required tools in the ARRL Handbook, chapter on Construction Practices. What a dreamer the fellow who complied that list must have been!

Among the "indispensable" tools is listed an item (I believe they are used in tool rooms) called a center punch. A friend of mine told me yesterday they are used to mark the place where a hole is to be drilled. Ever since the advent of the aluminum chassis, the center punch has not been common in ham workshops. Why? What homebrewer worthy of the name would give up the skill required to start a ¼-inch hole in a chassis without a center punch? My method is to place the drill point about ⅛-inch from where the hole should be and then start the motor. With years of experience, the drill will "walk" right up to the pencil mark and stop. At this point a little pressure from the op, and the chips are flying. For mounting high-precision components, always use a large drill about twice the size of the required hole. This insures that the part can then be positioned to come out parallel to the edge of the chassis or panel. The author uses large flat washers under the screw heads if they have a tendency to fall through the drilled holes.

Some day I'm going to buy a real wire stripper. In the meantime, my old jack-knife does a pretty good job. You know the knife I have in mind. I inherited mine from my Grandfather, who used it for cutting dandelion greens each spring for many years. My Grandmother told me he also sometimes used it for scaling fish, but not too often. I wouldn't be able to start a construction project without that fool knife. Once I lost it for a time and almost gave up ham radio! Why, I remember the first piece of wire I stripped with that heirloom. It was to run a wire from the gridleak resistor to the grid of a type 24-A tube. Anybody remember those? The blade (I'm back to the knife now) is so nicked up and rusty that it wouldn't slice limburger cheese, but boy, you can really bear down and strip wire with it. It takes years and years to condition a knife for this use, but it's worth it. The only drawback to having one around is if you lose it it's an emotional shock. By the way, I've never found a better tool for scraping the oxide off a soldering iron tip.

As far as drills are concerned, I broke most of mine a long time ago. God bless the aluminum chassis again! Because of these new chissis I never have replaced all those broken drills. I priced a set of new ones in 1953 and boy, are they expensive! My Grandfather's tool chest had a rat-tailed file in it too. Now I have one small drill (about ¼-inch) and one large drill (about ⅜-inch), and use the rat-tailed file for gnawing out anything in between! For really small holes, finishing nails are tapped through the chassis with the old mallet.

Screwdrivers are rather critical too. With my limited budget, two screwdrivers must do for all occasions. Since the Phillips head is coming into its own, this is quite a trick. The way it's done is to grind down the blades on two flat-bladed drivers (one large—one small) so the blades will mate with one axis of the Phillips head. This has a tendency to chew up the heads a bit, but ham radio is after all only a hobby, and as I grow older I find that nothing is perfect anyway, so why struggle?

My hacksaw is circa 1925 with an old grease-soaked wooden handle. I think my father used it for years out in the garage where it had several run-ins with motor oil. It was probably a good thing because how else could a blade last all these years without getting too rusty? In case you didn't know, there's an advantage to a blade this old! Have you ever noticed it's difficult to start a hacksaw cut without the blade jumping and scarring up the work? That's because the blade is too sharp! With an old blade the teeth in the middle are about worn off and this allows a start to be made easily. After the cut is started, it's a simple matter to move the saw forward and cut with one end of the blade which still has teeth. I hope the beginners among us are taking heed so they won't be taken in by zealous salesman at the hardware store. New tools aren't always the best tools!

The best scriber for marking lines on chassis is an old ice pick I saved from the 1930's. Remember the cards we used to put up in the window to tell the ice man how much ice to bring in that week?

Long-nose pliers would be nice, but it is felt they are definitely a luxury. The author has for 20 years been successful in using a pair of diagonal cutters as a dual-purpose tool. Anything you can do with the long-noses, I can do with the cutters! In fact, I can save time this way. Admittedly, it takes practice to bend a wire around a terminal with the cutters without nicking the wire. But once the skill is gained, think how handy it is to bend the wire around the termnal and then cut off the surplus without having to set down the cutters and pick up the long-noses. Lost time and motion!

I have described the tools used most often in my tool box. They are all that stand between me and commercial equipment. I hope this has been an inspiration to those who hesitate to become homebrewers because they have been misinformed about the cost of equipping a home workshop.

. . . W2RWJ

Jack Myers W5KKB
443 Centenary Drive
Baton Rouge 8, Louisiana

A Simple AC Adaptor

This article describes an ac current adapter that will convert any VOM or VTVM to an ac ammeter. With all parts purchased new it should cost less than $10, but if you have an old soldering gun that you wanted to replace anyway, the cost will be only a couple of dollars. Basically the circuit consists of a soldering gun transformer used as a current transformer with a load resistance chosen for accurate calibration. For utmost ease of reading, this resistor is chosen so that 1 volt output represents 1 ampere input, eliminating the need for any conversion factors or tables.

Safety is assured by the complete isolation of the input and output circuits and by the relatively low voltage output. With the design shown, provision is made for in-the-line or test-lead current measurements. The effective input resistance is only 0.01 ohm, which gives a voltage drop of only 0.15 volt at 15 amperes.

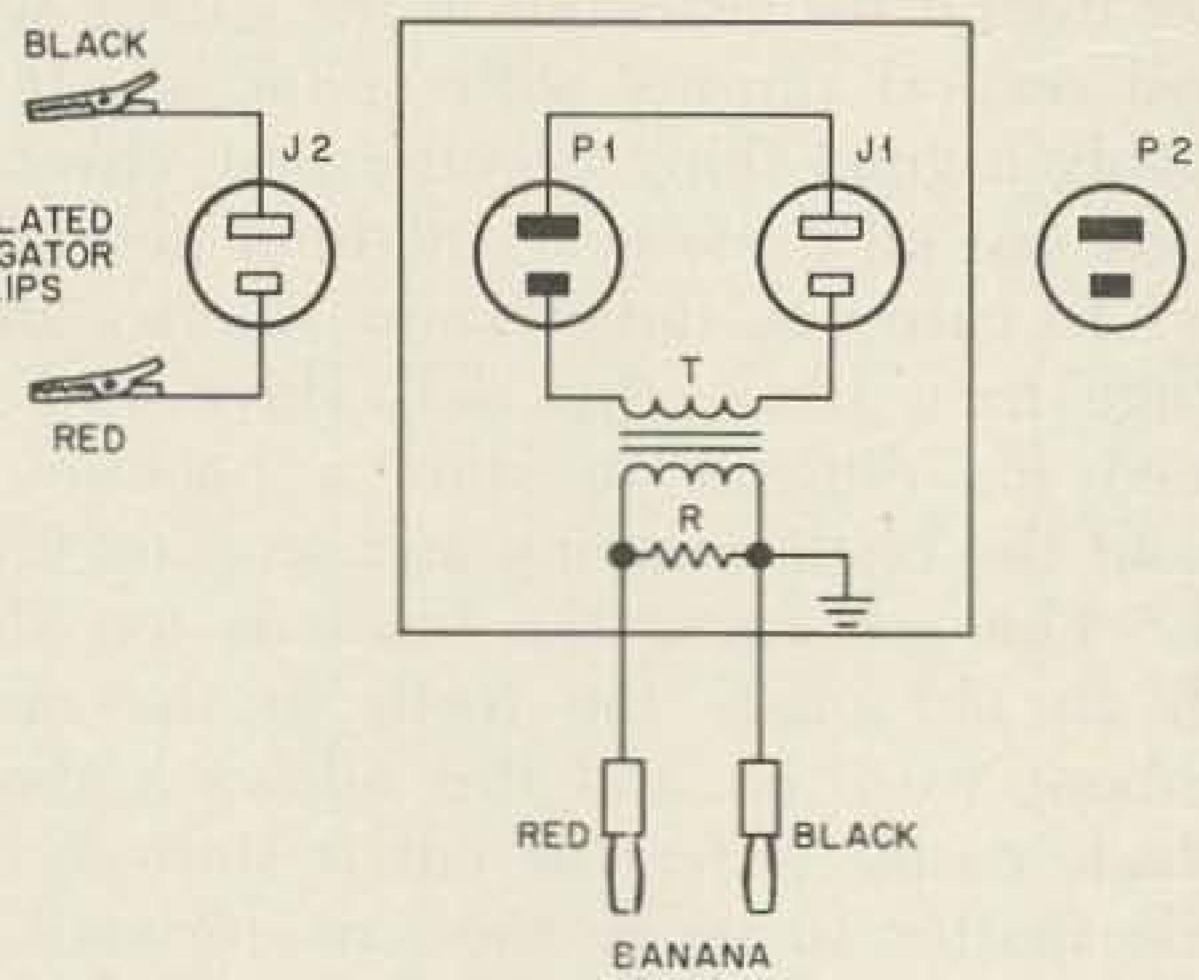
The Transformer

The transformer used by the author was taken from an old Weller S-400 soldering gun that had finally given up the ghost. It is necessary that the primary winding (the 115-volt winding) be in good shape since this winding is used as the secondary of the new transformer. The secondary of the solderin gun was copper tubing which must be removed. This was accomplished by cutting off the tubing close to both ends of the transformer core and then using a screwdriver and hammer to drive out the remaining tubing, being careful not to damage the core or 115 volt winding.

The old tubing was replaced by 3½ turns of no. 18 test lead wire, which fit very nicely. The completed transformer was then wrapped with a few turns of cardboard for insulation and clamped to the bottom of a 3" x 4" x 5" aluminum box with a U-clamp fashioned from some thin aluminum stock. The transformer leads previously used for the lights were not needed and were clipped off very short to keep them out of the way.

Calibration

Calibration is accomplished by connecting the adapter to a meter and a load which is drawing a known current and adjusting the load resistor, R, for the correct meter reading. This may be accomplished by either using a pot for R or by selecting a fixed resistor that gives a sufficiently accurate reading. *When making this adjustment it is imperative that there be a load resistor connected at all times*



R, T - See Text
P1, J1 - Chassis mounting AC connectors
P2, J2 - Cable mounting AC connectors

SCHEMATIC FOR THE AC CURRENT ADAPTER
FIGURE 1

1st Choice Among Nation's Amateurs!

Matched Pair

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"SSB ADAPTER"—The new filter-type SSB generator—with bandswitching 80 through 10 meters . . . more than 50 db sideband suppression . . . more than 45 db carrier suppression! When used with the Viking "Valiant" or "Valiant II" it places 275 watts P.E.P. at your command. Two compact units and interconnecting cables . . . RF unit is only 8" wide—may be placed on your operating desk. Power supply unit may be placed in any convenient location. Features built-in multiplier requiring VFO input only—band-pass interstage couplers require no tuning—design and front panel make operating practically fool-proof. Superb audio fidelity and balanced audio response; excellent sideband, spurious and carrier suppression. Other features: positive VOX and anti-trip circuits with built-in anti-trip matching transformer and adjustable VOX time delay. With remote power supply, tubes and crystal filter, less microphone.

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that current is applied to the adapter. If current is flowing in the primary and the load resistance is opened, extremely high output voltage will result which will probably damage the meter and cause a serious shock hazard.

To calculate the value for R, the turns ratio of the transformer must be known. In the case of the transformer used by the author, the secondary has about 350 turns. Since the primary was wound with 3.5 turns, the ratio is 350/3.5 = 100. The maximum current which can be measured is set by the ac connectors, which are rated for 15 amperes. At this current the secondary current will be 15/100 = 0.15 amperes and, for correct calibration, the secondary voltage will be 15 volts. Thus the secondary resistance must be 15/0.15 = 100 ohms at a power of 15x0.15 = 2.25 watts. This calculation does not account for any losses in the transformer, so the actual resistance needed may vary slightly from that indicated. The resistance of the meter will be negligible compared to 100 ohms for most VOM's and for all VTVM's.

Just to show what would happen in the event the resistance opened up or was removed, suppose the primary current were 15 amperes and a 5,000 ohms/volt VOM was being used. The meter would normally read 15 volts. If the resistor opened up the secondary resistance would be that of the VOM, namely 5,000x15 = 25,000 ohms. The secondary current would be 15/100 = 0.15 amperes, giving a secondary voltage of 0.15x25,000 = 3,750 volts. Of course transformer losses and saturation would prevent this much voltage output, but it does show why the resistance should not be opened. It might be good insurance to use two resistors in parallel for R.

Operation

The connector and cable system shown makes it easy to measure the current of any 115-volt device by plugging it into J1 and plugging P1 into an extension cord. In some cases it may be desirable to have regular test leads with clips; for example, when measuring filament current. In this case the clip leads are plugged into P1 and a shorted plug into J1.

There are numerous uses for the adapter. It can be used to measure actual current to a device so that the proper fuse can be selected. If the proper current for a device is known, the actual current may indicate whether improper operation is caused by a short or an open.

To facilitate power measurements, a dp dt switch may be added to switch the meter across the ac line for easy measurement of the voltage. If direct power reading is desired, a load resistance corresponding to the line voltage being used can be substituted for R. For a 115-volt line the resistance should be 1.15xR, for 120-volts, 1.20xR. Under these conditions the meter will read directly in hundreds of watts. A 50-ohm, 1-watt, resistor in series with a 100-ohm, 2-watt, pot would provide power readings for normal line voltages. A scale can be calibrated to common voltages with a special mark for the ac current position (the 100-volt position).

In conclusion, the author would like to express his thanks to Brooks Page K5LRQ for his assistance in testing and calibration of the adapter.

. . . W5KKB

Having trouble pulling cables through the attic or cellar? Do you dread going up in that boiling hot attic, crawling on your belly in dirt and soot? Eliminate all that with a come-a-long. A must in some shacks . . .

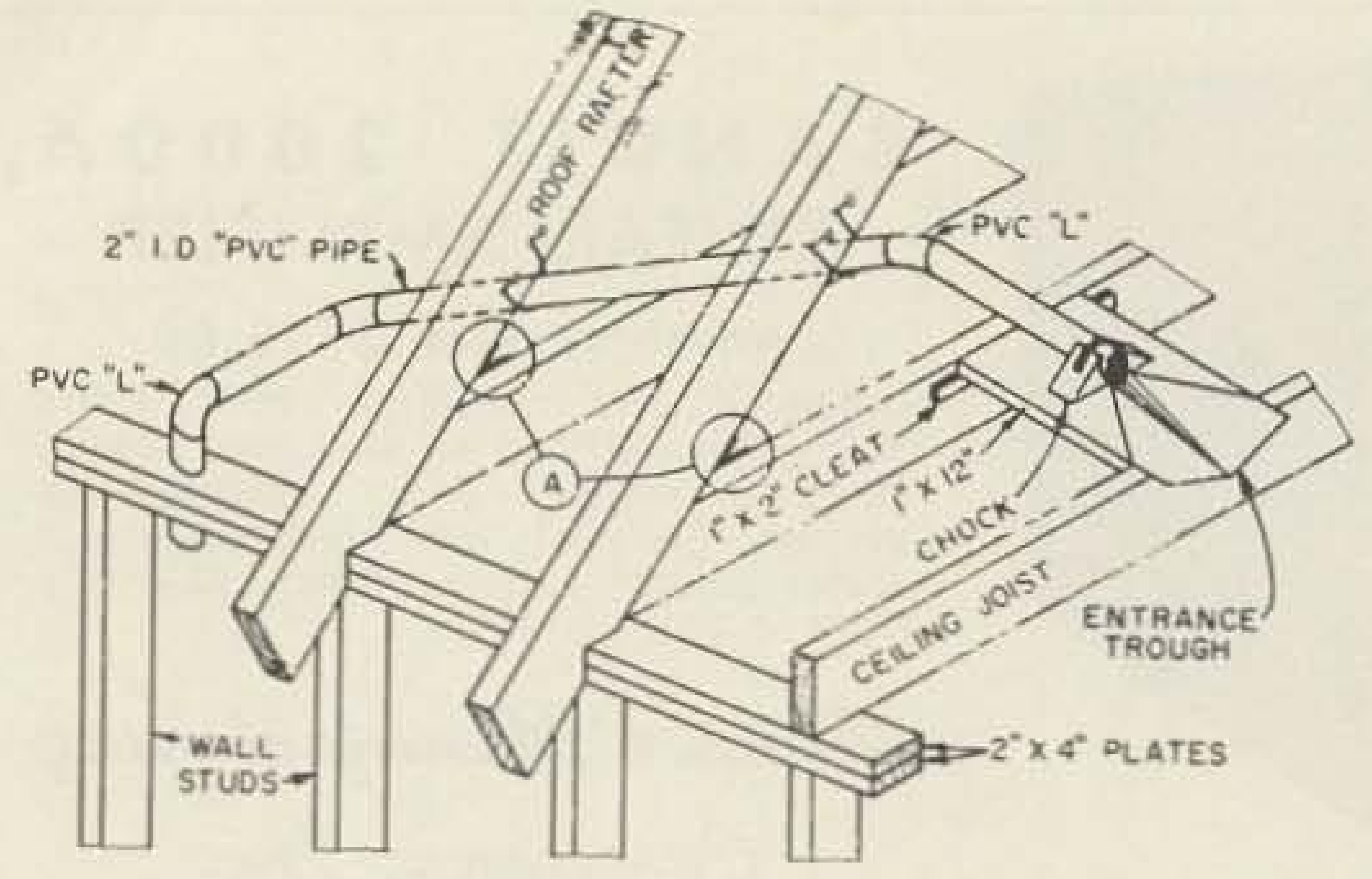
Earl Spencer K4FQU
1413 Davis Dr.
Ft. Myers, Fla.

Come – a – Longs

The recent erection of a 75' tower created an uproar from the XYL that was probably heard up thar in yankee land. The reason is that the tower is in the shape of a monstrous class A transmission pole rising some 63' out of the ground just four feet from the corner of our rambling Florida ranch house. To her the tower represents an ugly wooden pole, slightly crooked, which was planted right where a royal palm should have gone, not to mention the fact that the complete setup towers some 60 odd feet above the roof of the house in a neighborhood where the highest structure was built by mother nature and grows a mere thirty feet. I haven't heard from the neighbors yet although I have felt the temperature drop when I drive by. I wonder why the XYL's have such a warped sense of beauty. The gang thinks it's the living end, however this is another story so we shall go on from here.

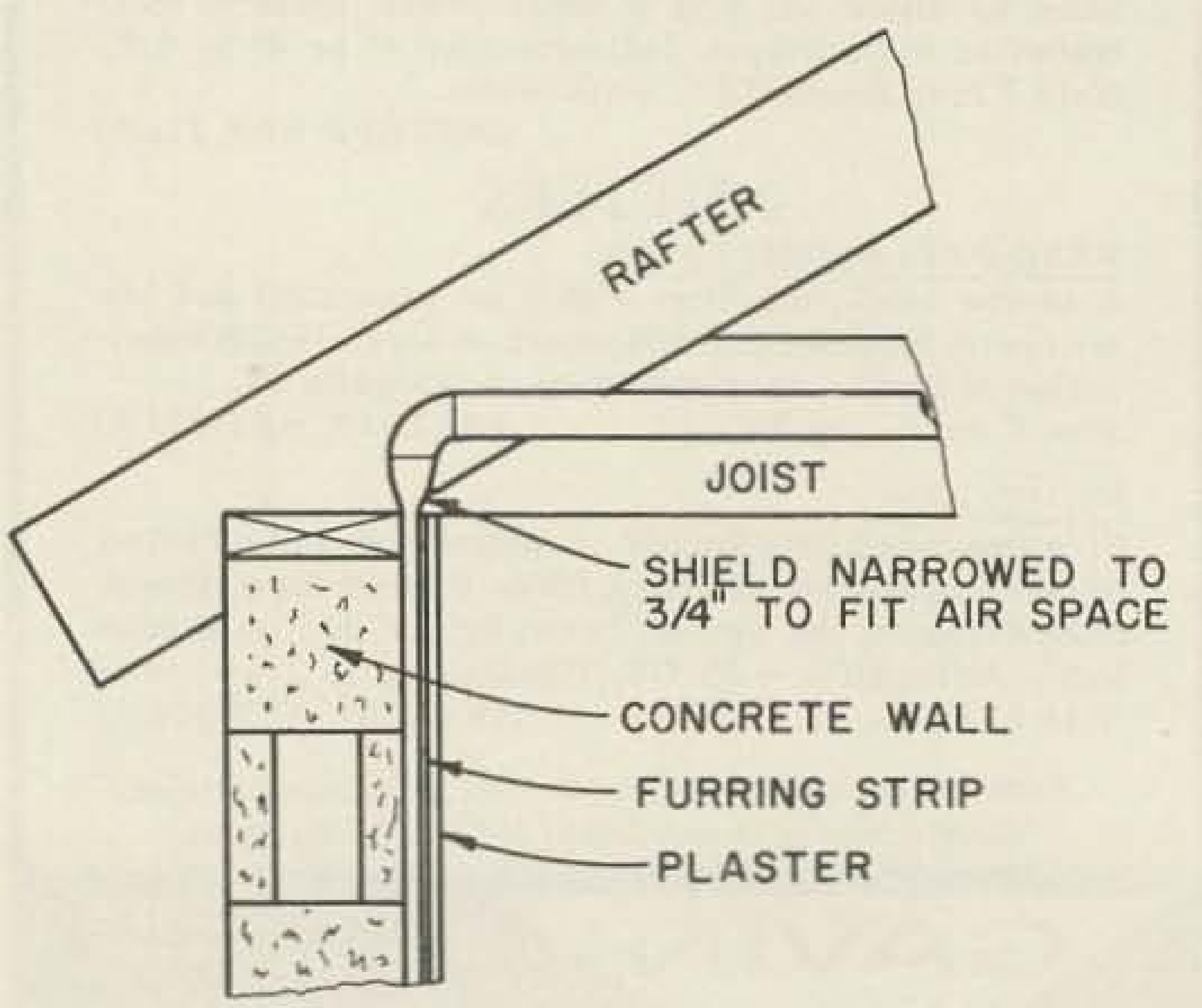
Needless to say, all antennas need feed lines and the best way is the shortest and straightest way which would have been right across our white tile roof some 50 ft to the shack and then draped somehow down the front wall of the house to the entrance point of the shack. I can hear everyone saying what's wrong with going that way but I could also hear the XYL exploding again, so rather than risk running the gamut with the wife again I did a bit of thinking (which was the hardest part) to find another way.

I thought of running around the eave of the house but this would have added some 40 ft of coax cable to the feed line that was already over 100 ft long so this way was out. I had to find a shorter route and that left only one way to go; through the attic, and I say the word attic without trying to laugh. That's what they call the space inside the roof here in sun land. It is actually just a hot dark and very dirty crawl space which is scarcely 24" high at the highest point right under the ridge, through which no man should have to crawl or wiggle some 50 ft. and back over ceiling joist more than once. To make matters worse the entrance to this fabulous place is always in the center of the house in the hallway or worse yet in a closet, which means emptying the closet to gain access to the hole in the ceiling. Either way again crosses the XYL's little temper who just can't stand her clothes (it's always *her* closet) dumped on the bed or floor not to mention all that dirty wire in the livingroom along with stepladders, dirt, etc. I have come to the conclusion that the more we stay out of our wives houses the better off we will be. So if you are in this fix and have decided to build a come-a-long the first step is to install a



new entrance to the upstairs dungeon, preferably out of doors. I cut one in the carport ceiling right under the ridge and big enough to get through without going on a diet, so some of my problems were solved. I still had to get the lines down the walls to the shack and this is a problem, as the only wall I would enter was an outside wall which has virtually no space over it in the attic due to the rafters resting on the wall. I had to go into this wall and so I continued on my merry way by attempting to cut a hole through the plates at the top of the wall. I finally managed it by using an electric drill fastened to a four ft board with a right angle chuck in the drill and a 2⅛" circle cutter. It took some time but the hole was drilled eventually.

To give explanation to such an elaborate setup just to run a few feedlines, I can only say that the drawings will speak for themselves and give reasons for the need. Note in the drawing the points marked "A." At this point the roof rafter passes the ceiling joist forming a sharp V which invariably hangs on to anything that is pulled by it on its way out. I fought this particular point through three feed lines and finally vowed that I would go



ALTERNATE FOR MASONRY WALL

up in the hole just once more, which is what finally led to the Come-a-long.

After much thought and a couple of 807's I found an answer which has been a blessing ever since. Who else can run 75 feet of RG-8 through a gable end, over 50 feet of open ceiling joists, down through a wall and into the shack in five minutes all by himself? I can, now, and so can you after building yourself a Come-a-long!

In the installation of one there are a few points to avoid or you can be in as much trouble as when you started. This piping is a commonly used material called PVC. It is plastic, usually black in color and rather hard in texture although quite soft to cut. A pocket knife or hacksaw will do a good job. It is recommended that the pipe be joined with a special glue made for PVC, however pipe clamps can be used instead if tightened securely. PVC is mated by the slip joint method which results in smooth joints inside the pipe. It can be purchased from any plumbers supply house and/or most hardware stores and is nominal in price, ranging around 15c a lineal foot. Two or three elbows will be needed in an average job and they cost about 75c each. My job cost ran about $6.00.

A few rules, if followed closely, will result in a good job. Do not bend the pipe more than a few degrees or it will kink. Be sure to clean inside of the pipe after making a cut. Lastly make certain the pipe is fastened securely or it may be pulled apart while in use.

If you can run the piping from the shack wall to the outside entrance point of your antenna system this will be the best type of installation, however I ran mine only far enough to bypass the bad obstruction points and get the cable out in the clear. If you run the entire length you will not need the sheet metal entrance trough such as I used. As you read on you will see the need of this entrance. If you follow my system it is a must as it positively channels the line into the pipe without hanging it up on the mouth of it. I learned this the hard way and had to go back up in the attic again to install the trough. The trough can be made from any scrap sheet metal or a large tin can which is cut open at both ends and flattened out. Shape to suit the individual job.

When the piping is completed there remains one more ticklish job before you are finished, which is running the first line through the pipe. This is the lead line and remains in the pipe system at all times. The best way to introduce this line is with the help of an electrician's snake if it is possible to borrow one. If you can't borrow one then try a very stiff piece of heavy wire. When the snake is run into the shack tie the come-a-long onto it and pull it back out bringing the other line out with it. Now go back to the other end and tie a large knot in the line and again go to the other end and continue to pull the line until the knot appears. You now have twice the amount of line that is needed to make the journey through the pipe. Pull about ten more ft. or so far added precaution and cut the line. You now have a Come-a-Long.

Once the line is fed through the pipe it remains so for all time and at no time should it be pulled through the pipe in either direction beyond the knot which marks the center of the line. To use the line pull it through till you have the knot accessible. Now fasten cable or whatever is to be pulled through to the line by the knot with electrical tape, using plenty to make certain that it is not pulled free of the line while in the pipe. Do not make a bulge in the line nor any projection that may catch in the pipe. Lay your cable neatly in a coil that will pay out freely and then pull the line back through from the other end bringing the cable with it. Remember not to pull the line too far beyond the knot or the other end may be lost in the pipe. Feeding a new line through the pipe is very difficult when there are other lines present. When pulling a cable use a slow steady pull and do not jerk if it seems to hang up. Pulling it back a few ft. will generally free it so that it will pull the rest of the way through.

It is a good idea to put some sort of a stop on each end of the pulling line to prevent its being pulled completely through the pipe. When not in use the line can be coiled up in a neat bundle and tied out of the way. You will come up with ideas of your own which will suit your needs and you will be glad you spent the time and money on it the first time you use it. I have just pulled my fifth cable through without a hitch and the XYL didn't even know I was doing it.

For those of you that do not have a frame house or wall to go down through but must feed through the air space between a block wall and the plaster the alternate for a masonry wall insert will probably be the solution. Everything remains the same except the manner of installing the pipe at the top of the wall. Here you will have to reduce the pipe opening to match the available space where the cable will enter the wall. This can best be done with a home brew metal shield fastened between the pipe and the opening in the wall. Make the portion of the shield which goes into the wall space about 5" wide at the bottom end to allow the cable to spread out a bit as the cables will have to run next to one another as this air space is generally only ¾". As a last resort you could enter the shack through the ceiling plaster but make it neat if you do.

There it is. Never again will I dread putting up a new antenna because I have to pull lines through the attic. . . . K4FQU

Ham Weathervane

W2NSD

Perhaps you've never priced a weathervane. After seeing the first ad by Out-O-Door Products I immediately went to my trusty mail-order catalog and found that the cheapest they had was almost double the $4.75 Out asks (postpaid, by George). Since I frequently find myself bogged down in QSO's just like everyone else I thought that the least I could do while trying to think of something intelligent to comment about was to give an accurate report on the weather, including the wind direction.

Out has quite a weathervane . . . beautifully balanced and extremely sensitive due to a ball bearing movement. It is made out of aluminum so you don't have to climb up and paint the dratted thing every year or so. It is 30" long (much bigger than most weathervanes) so you can see it from the other end of town if you want.

You would do alright with this gadget at $9.95 . . . and at $4.75 you would do well to send immediately before they find out what their product is really worth.

Of RTTY

and the TUZ terminal unit

Frank Van Brunt W3TUZ
1003 No. Belgrade Road
Silver Spring, Md.

This terminal unit is the third type of a series of transistor terminal units that have been built over the past few years. The initial effort was the usual first effort, wherein the design procedure was merely to take the circuit of a vacuum tube terminal unit and replace each circuit by the equivalent transistor circuit—a grand total of seven transistors. It worked after a fashion, but alas, the fashion was not very good. The second generation of the series used only three transistors, did an appreciably better job, and was duplicated by a considerable number of the local gang. These units have been giving good service for the last two years. While the design was simple and the performance was as good as the average ham terminal unit, it was not as good as the best of them. This model, Mark III if you will, is the result of continuing efforts to increase its effectiveness and has performance that is as good as the best and superior to most. In the process transistors have been added and the circuit complexity increased somewhat, however the results have fully justified these changes.

This terminal unit was designed solely for performance—the only limitation that we put on complexity was that it be readily built by the average ham. In terminal units there are three areas in which you can seek better performance—first is in the basic electronics of the unit, limiters, adders, triggers, and selector magnet circuitry; second is the area of filters independent of the electronic circuitry; and third are the retiming and signal processing techniques used in regenerative repeaters. This terminal unit does an excellent job in the first area, while in the second area—filters, it uses good basic design and includes optional plug in facilities for those who want to build and use the better types of modern filters. It incorporates no facilities for retiming, but the design is such that this may easily be incorporated later if it is desired. At this stage in the game regenerative repeaters are relatively rare in ham TU's but there is no reason that it could not be added later on, for a transistor unit should not be too difficult to build.

When we finished the prototype, we took it over to the shack of W3PYW to compare it with the multitube, relay rack mounted monster which has earned him first place in a number of RTTY sweepstakes contests. We set up two terminal units, two printers, and connected the resulting maze to a common receiver. Then off we went, searching for lousy signals so we could compare performance. The lousy signals were relatively easy to find! The result was a draw—there was substantially equal performance by both units, but the size differential was rather horrendous to contemplate. The total power consumption of the

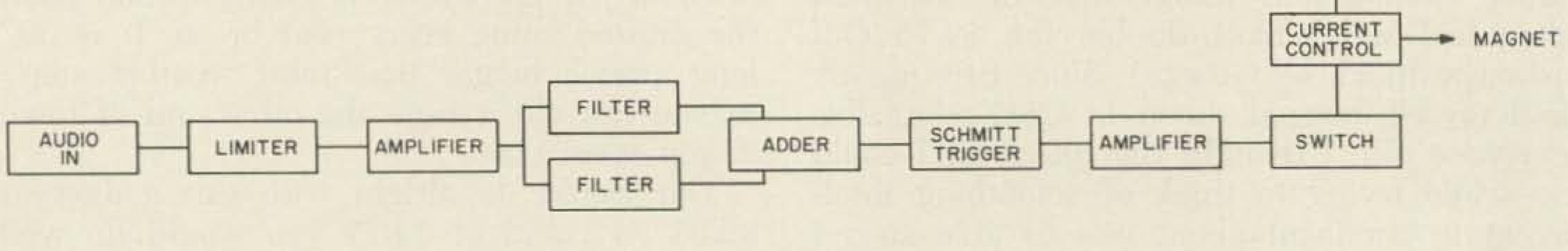
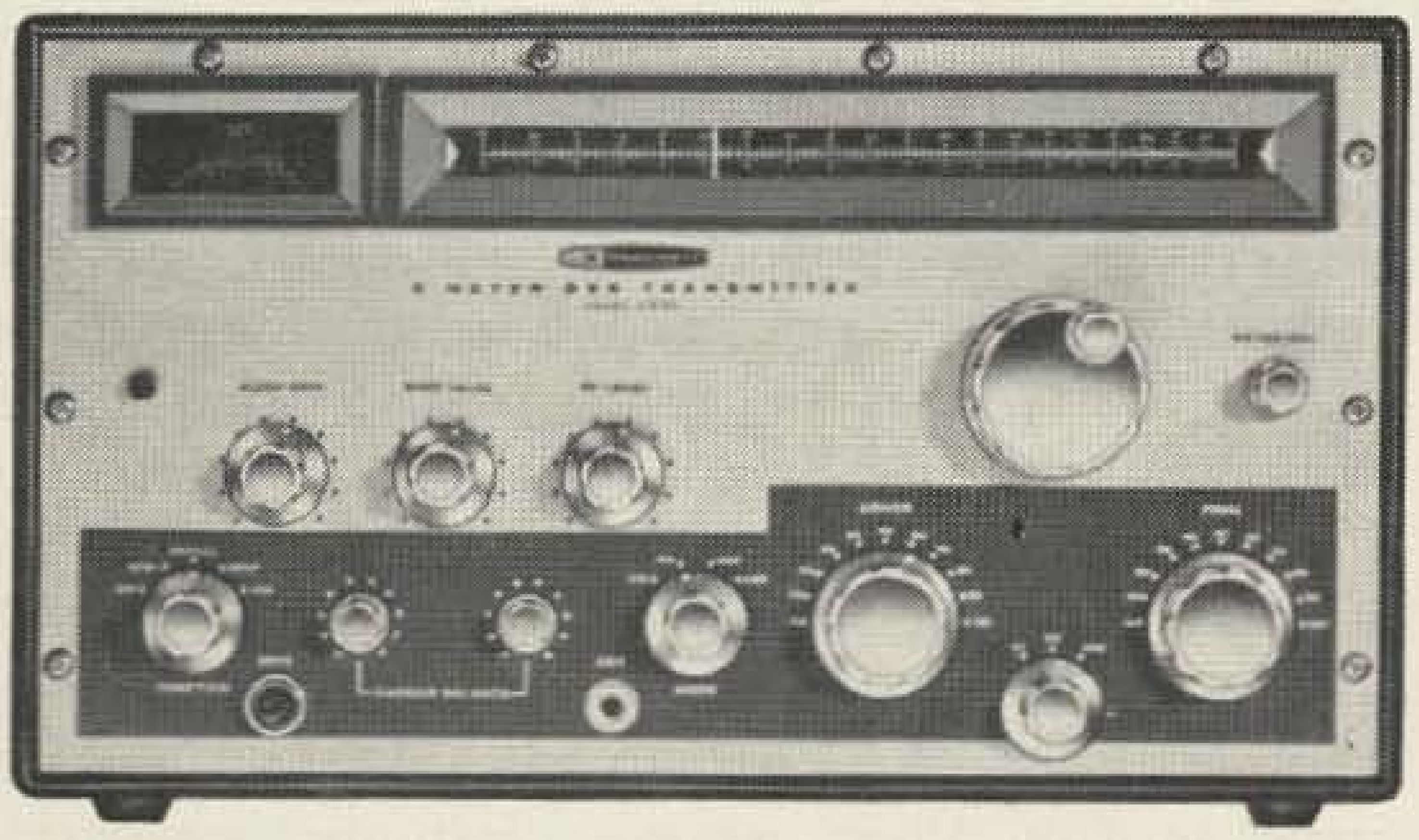
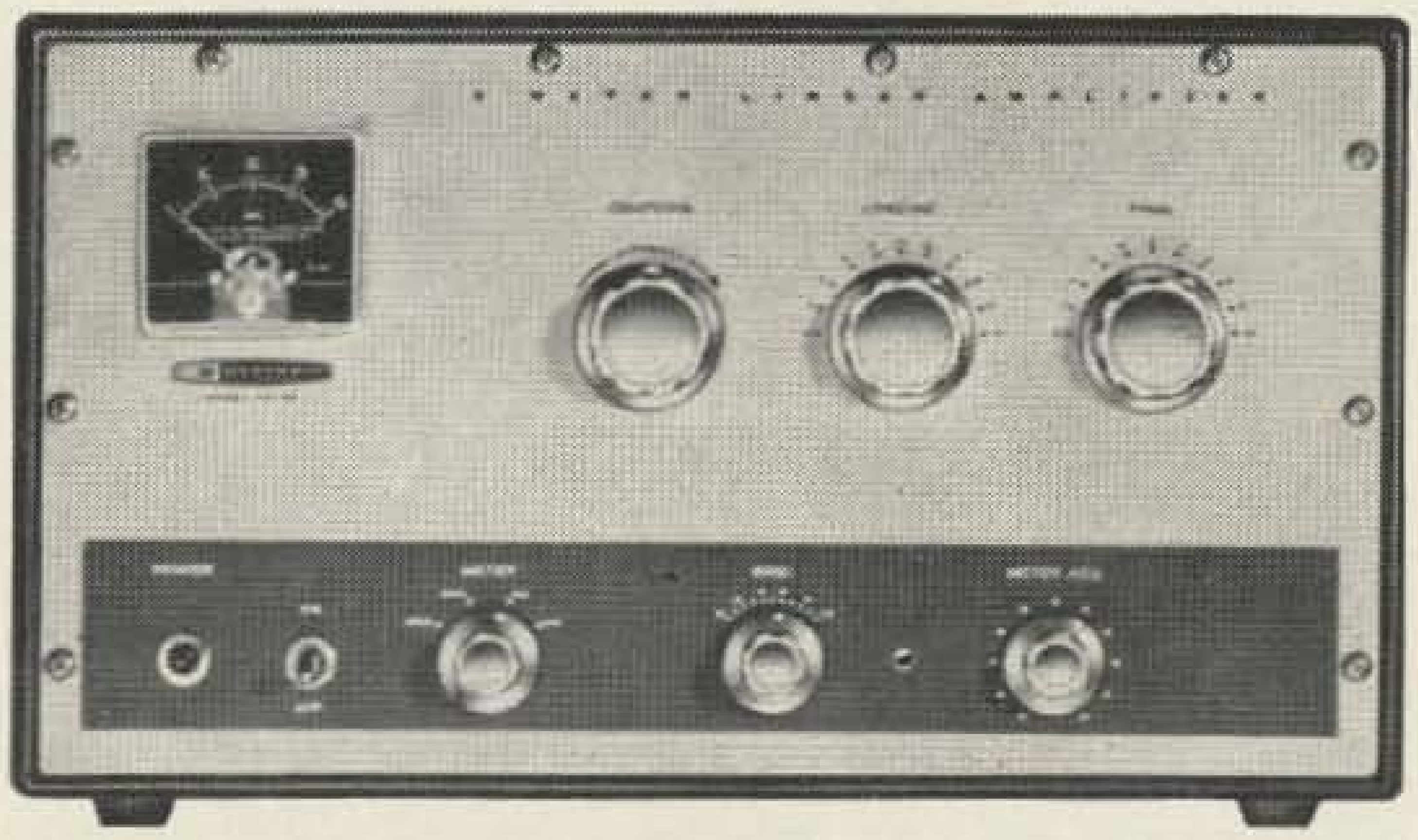


FIGURE I
BLOCK DIAGRAM

the most SSB on SIX comes from HEATHHKIT!





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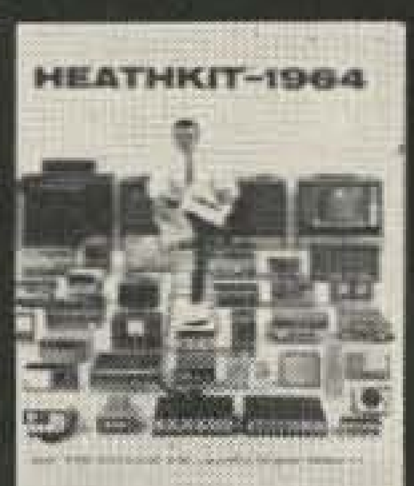

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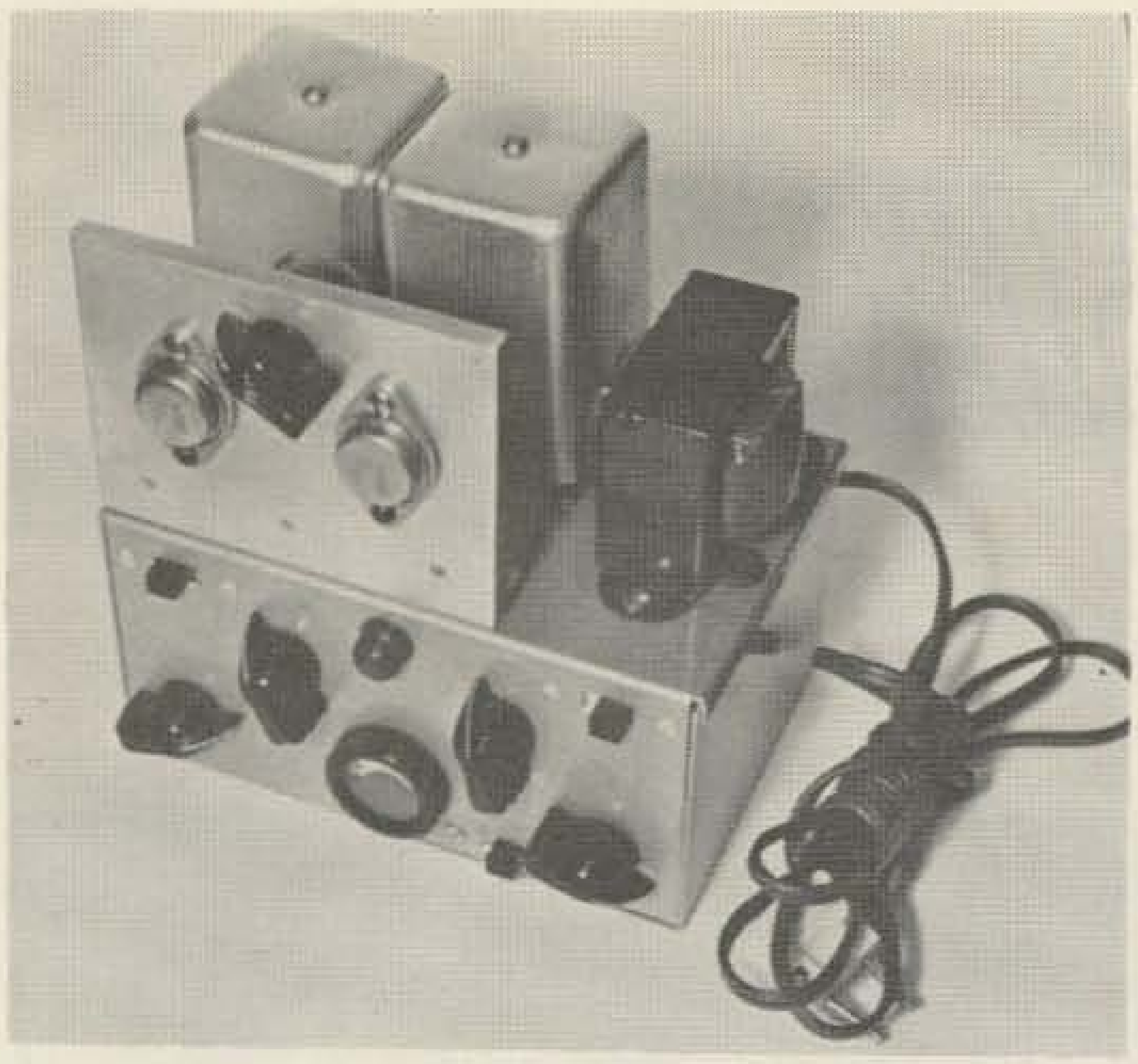


Fig. 3a

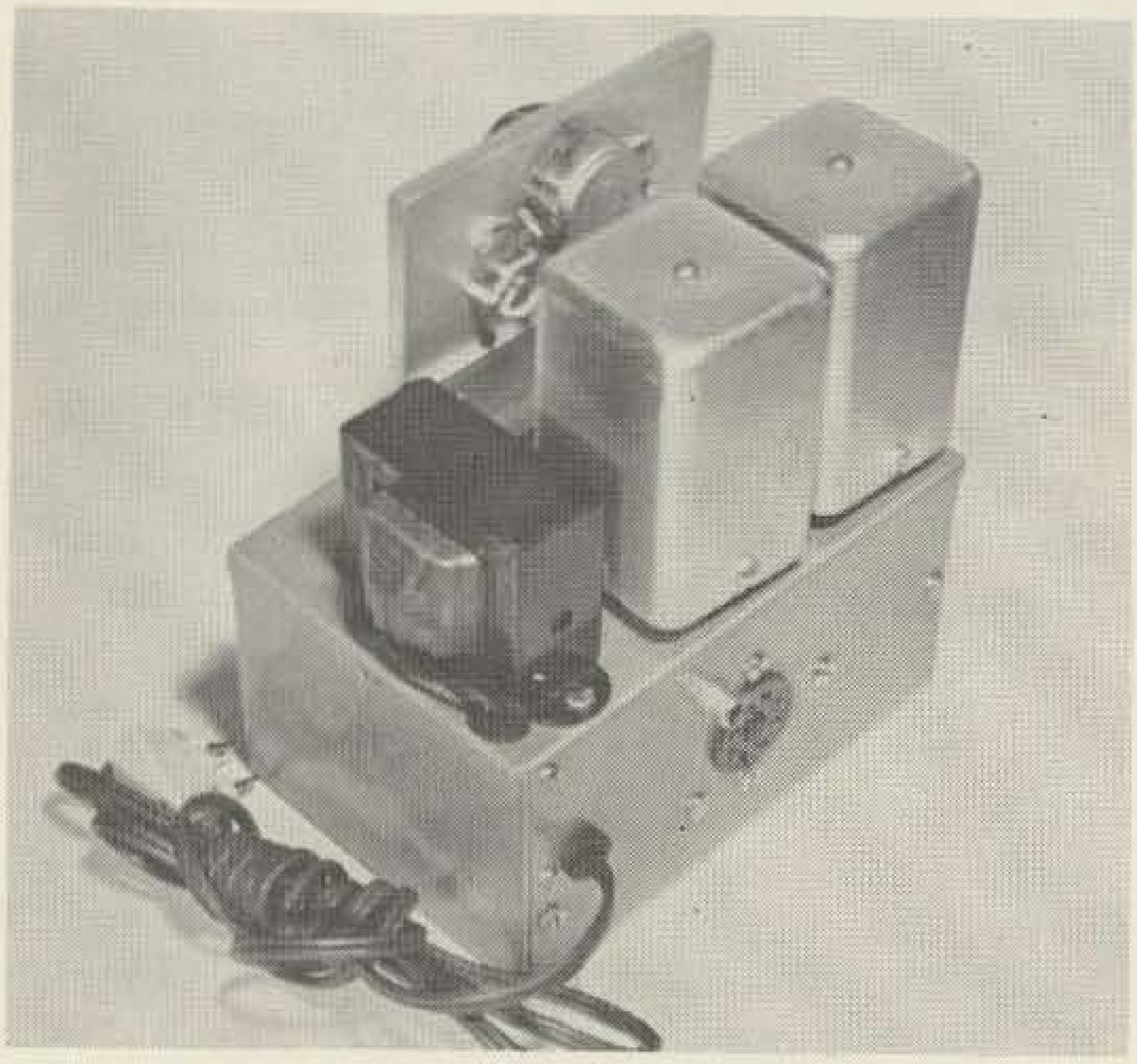


Fig. 3b

entire transistor unit was less than that of the final tube of the vacuum tube unit. A second test was made when I visited a friend who had a printer but no terminal unit. Aside from his disappointment at not being able to use his polar relay or the cubic foot of boat anchor he had for the local loop supply, all went well. We even called in on a local ARMS RTTY net for an hour drill period. By the end of the drill period it was quite evident that we were copying as much as the NCS—and as my friend remarked, he was using aa seven-foot relay rack full of equipment!

As for the specifics, it is basically a transistor terminal unit, completely electronic and self contained: no relays, polar or otherwise, are used to cause hash and get out of adjustment, and no separate power supplies are needed. You feed the audio tones from the receiver, plug in the selector magnet of the printer, and you are in business. It also provides local copy and concurrently an adjustable FSK bias voltage for use when transmitting. The only external circuitry necessary is the conventional transistor or diode frequency shifting network on your oscillator.

The design of the unit is straight forward. The basic functions are given in the block diagram in Fig. 1. The audio input from the receiver is first fed through a simple yet effective limiter consisting of two silicon junction diodes, D1 and D2. Since the peak voltage across either diode is limited by the forward conduction voltage of the other diode, the PIV requirements are negligible and practically any silicon junction diode is usable. The output of the limiter is then amplified by transistor Q1 and the output is fed to the two filters. The output transformer T1 is an ordinary tube type, 2000 ohms to voice coil. Special transistor transformers are available, but they are usually more expensive and often less efficient, while the saving in space is not too significant.

The low impedance output of the transformer is ideal for coupling to the usual toroids used in the filters, since relatively few turns are needed and the number can be easily adjusted to equalize the outputs of the two channels. The dpdt switch following the filters provides for mark-space reversal. This is necessary in cases where the transmitting station has the mark and space frequencies reversed, and is quite handy when you have your bfo on the wrong side of the signal since it is far easier to throw the switch than to retune the receiver. The outputs of the two filters are then rectified by diodes D3 and D4. These are placed so that you have opposite polarity and the outputs are filtered and summed in RC networks. If you have equal signals in both channels and equal outputs, the summed voltage will be zero—thus you have the usual cancellation characteristics of an FM discriminator. Capacitor C7 and switch SW2 are provided so that you may choose either ac or dc coupling. Briefly stated, in the ac position (SW2 open) the magnet current will be switched on a change in the level of voltage from the discriminator but the resting position may be adjusted so that the machine does not run open when no mark tone is being received. This is quite convenient in eliminating the various misprints one gets when the mark tone is tem-

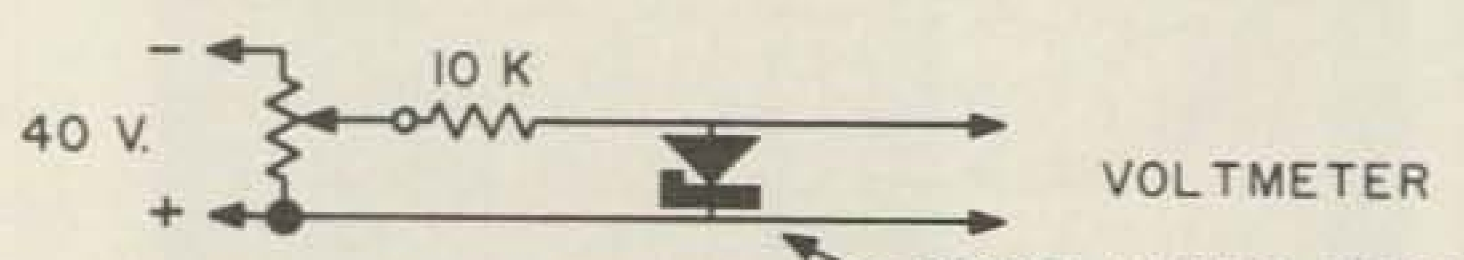


FIGURE 2

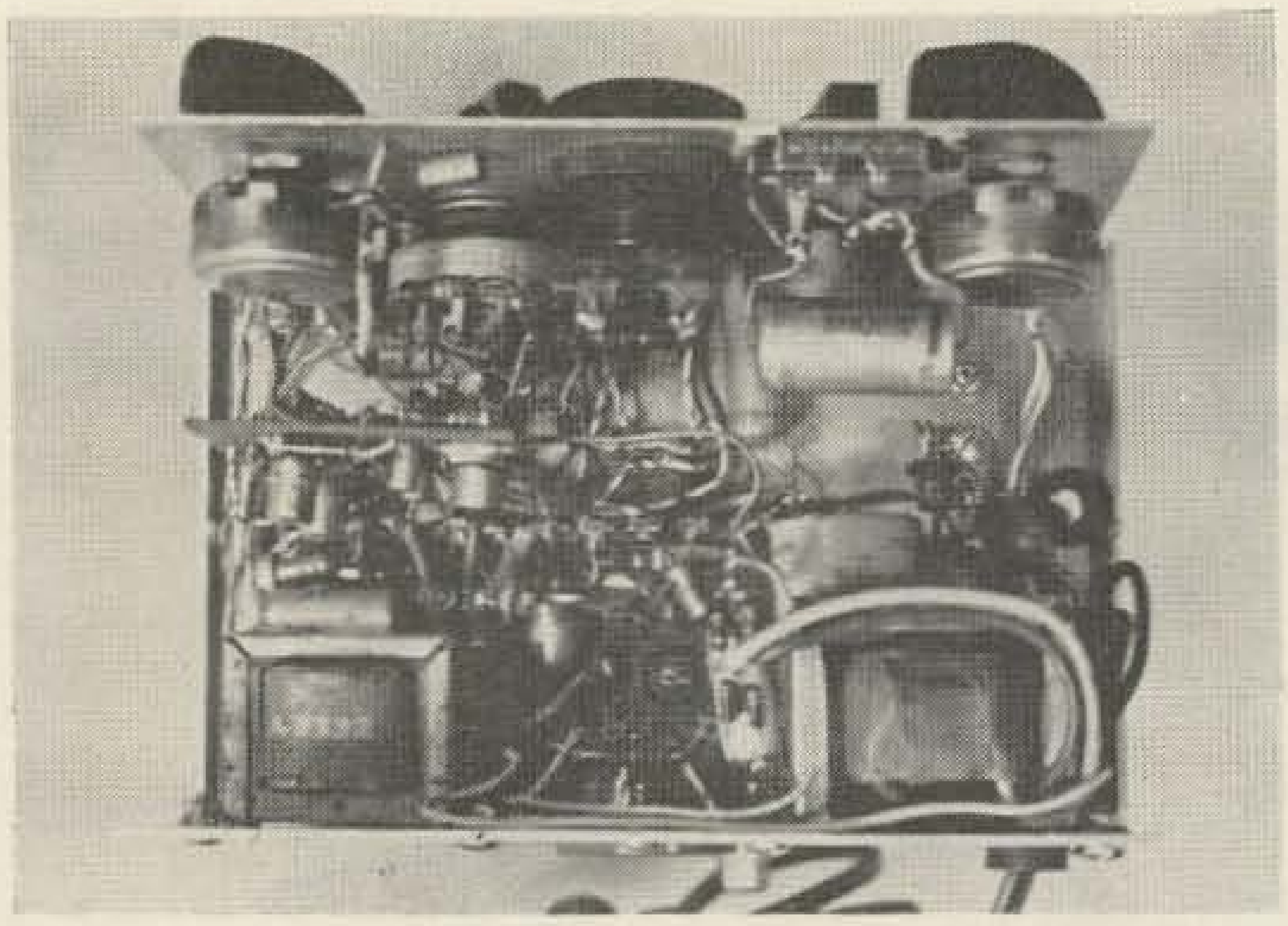


Fig. 4

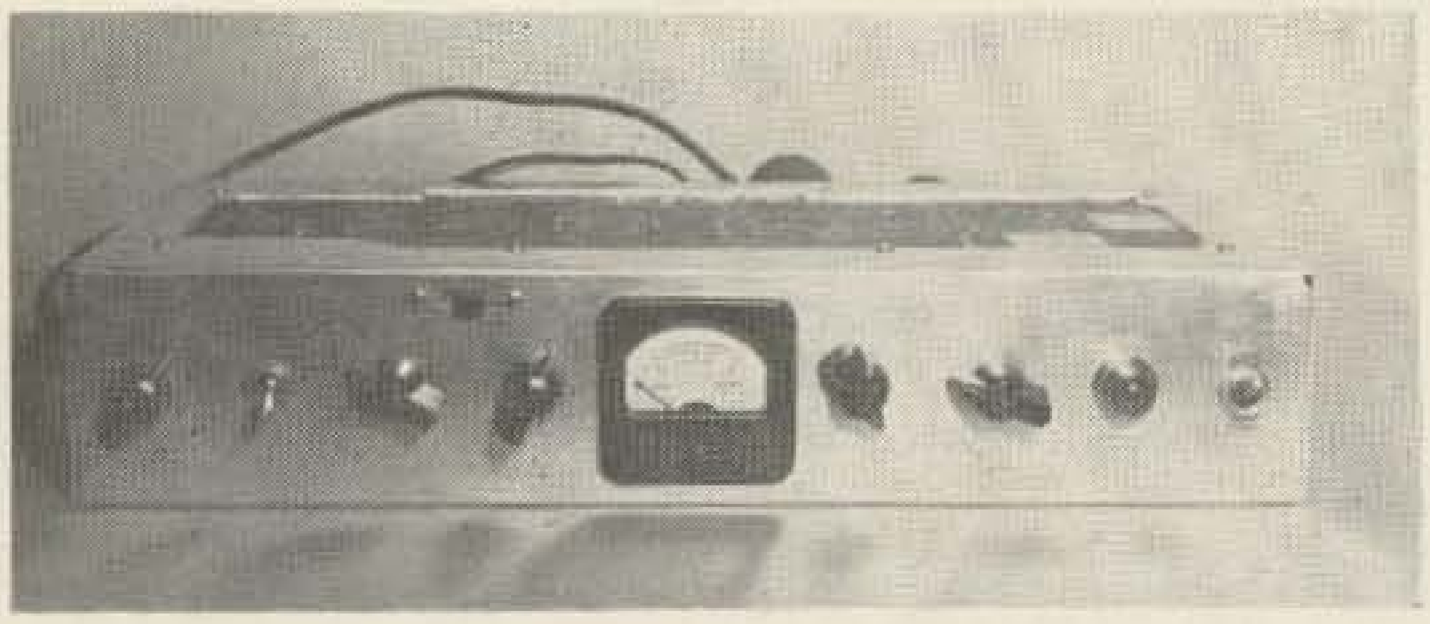


Fig. 5c

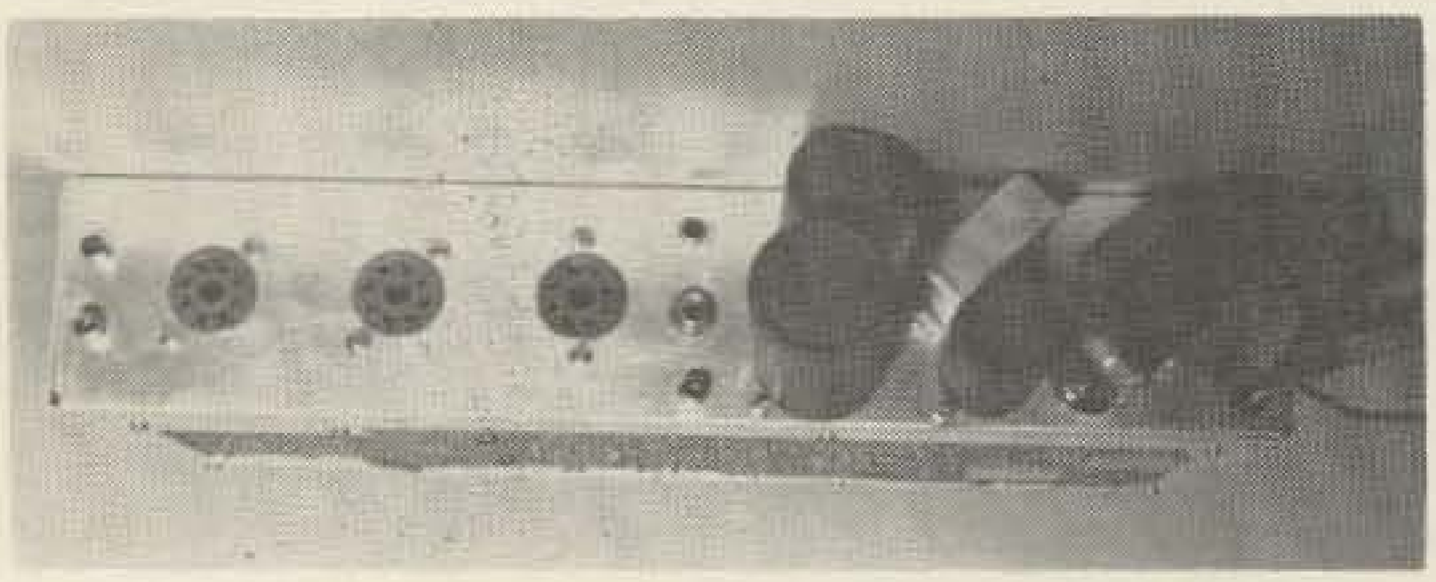


Fig. 5b

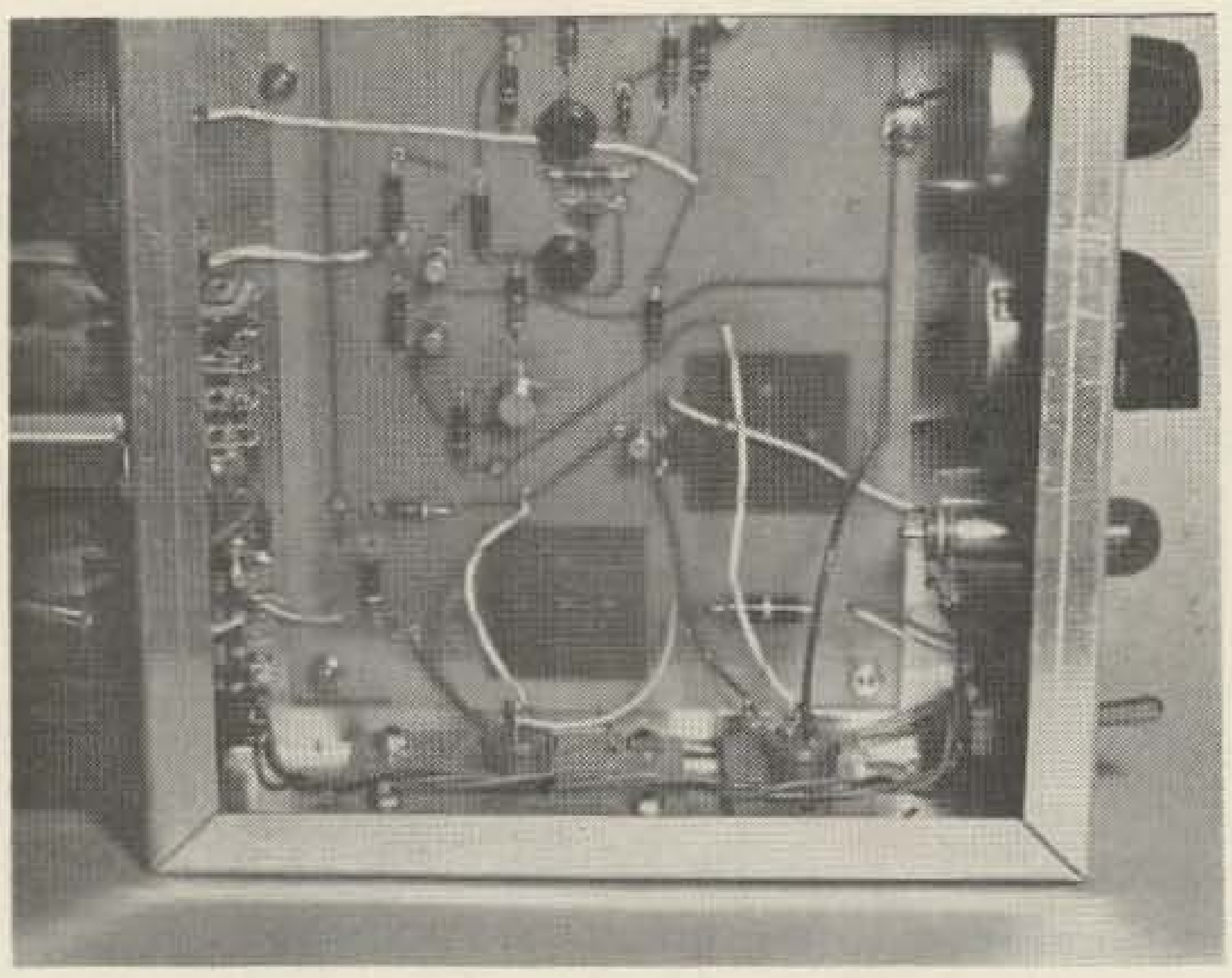


Fig. 5a

porarily lost, and also provides protection against the effects of a continuous unwanted signal in either of the two channels. In the dc position (SW2 closed) you have a greater range of adjustment for various types of distortion, although there is still a considerable range of adjustment available with ac coupling. Potentiometer R8 is a sensitivity level control and furnishes protection on occasion against misprints caused by relatively weak unwanted signals. It should be adjusted for optimum copy. When interference is not a problem it should normally be set so that the typical voltage swing at its output is equal to the range of voltage adjustment obtainable from R14. This permits the widest range of adjustments for distorted signals with maximum sensitivity.

Switch SW3 has three positions: local, receive, and transmit. The local and the transmit positions are the same except for the extra set of contacts which are used for station control on transmit. With RTTY your hands have more than enough to do—one switch is plenty! The resistor network R9 and R11 and zener diode D5 give a variable output voltage for controlling the frequency shift of the oscillator of the transmitter and at the same time provide a voltage to the subsequent stages (via resistors R10 and R13) which furnishes local copy. The FSK voltage can also be used for keying an AFSK oscillator if you want to join the 2 meter RTTY gang.

Transistors Q2 and Q3 form a complementary emitter follower, providing both isolation and impedance transformation, the circuit being analogous to the conventional vacuum tube cathode follower. The complementary circuitry provides for equally effective operation on both rising and falling waveforms. Transistors Q4 and Q5 form a Schmitt trigger and the output from the collector of Q5 is a square wave—regardless of the shape of the input signal. Potentiometer R14 provides an adjustable trigger level for this circuit and permits a wide range of adjustment for distortion of the incoming signal. Transistor Q6 performs three functions: it serves as a buffer-amplifier (mostly buffer) between the Schmitt trigger and the switching transistor (Q7), it provides the phase reversal which is necessary for using the FSK voltage for local copy, and it permits the application of a positive bias to the switching transistor to assure effective cutoff of the transistor.

Transistor Q7 is simply a switch to turn the selector magnet current off and on. Since the input is a square wave (i.e. either off or on) the actual power dissipation is very low. The steady state dissipation is 100 milliwatts or less in either the off or on state, and during switching it reaches an instantaneous peak value of about 1 watt. The average power dissipation on continuous reversals (RYRYRYRYRY . . . . .) should not exceed 150 milliwatts.

Actual transistors tested have ranged from 300 mw units up to the largest of power transistors —in practice we would suggest medium power units merely because of the added safety factor. The current regulator transistor Q8 and the associated circuitry provide a very low resistance path when the magnet current is less than the required value—when the current reaches the required value, the voltage drop across the transistor increases until it is sufficiently large to assure this desired current. This transistor has to dissipate about 4 watts with current on, thus it must be a medium power transistor with a moderate heat sink. The zener diode D10 provides the reference voltage for this current regulator circuit and a 3 or 4 volt unit is recommended—theoretically the lower the voltage the better, but the actual value is not critical. Higher voltage units may be used with a very slight decrease in performance, but if they are, the value of R28 should then be increased somewhat to protect against excessive current.

The power supplies are conventional in every

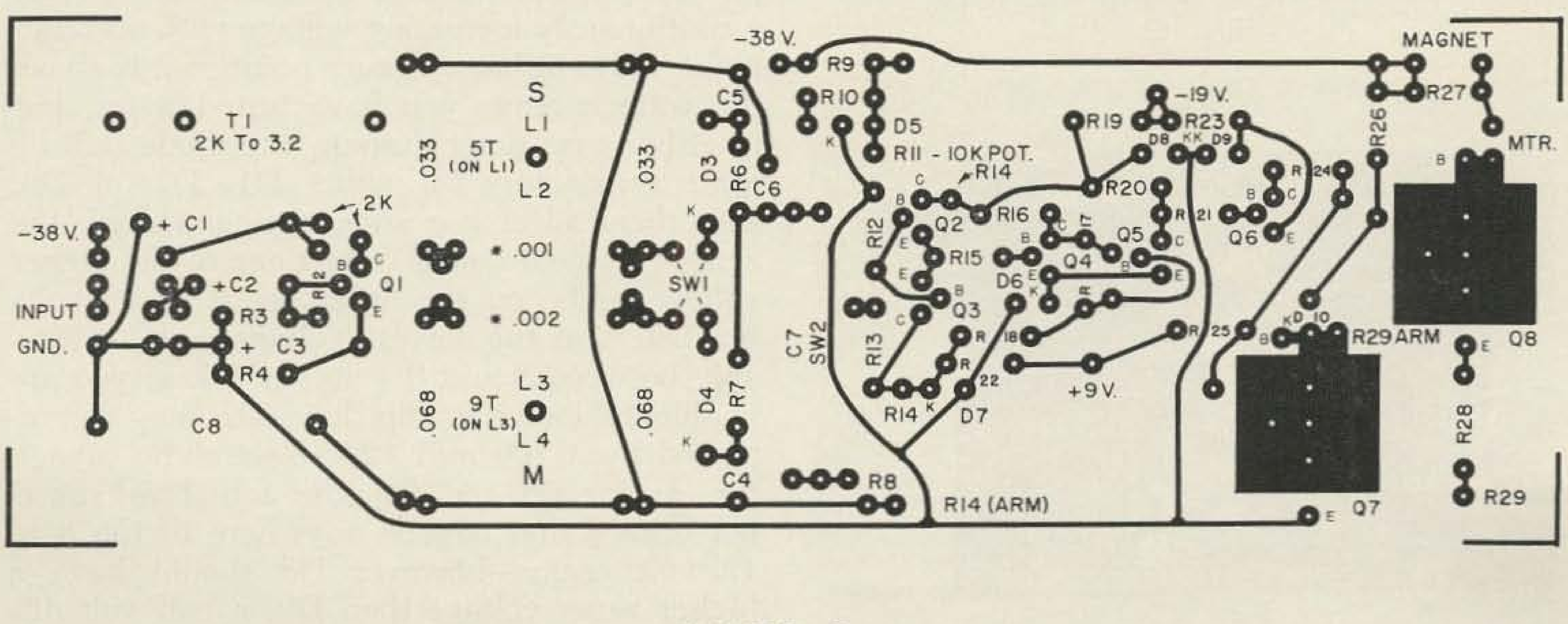


FIGURE 5d

respect. The diodes used in the high voltage supply are 100 volt PIV units with a current rating of .25 a or more. The bias supply used surplus 1N482 diodes which were available from the junk box, but any diodes rated for 15 v PIV, 10 ma or better can be used—and those are very easy specs to meet or beat. You could probably save some space, components, and initial expense by using a standard 9 volt transistor battery and eliminating the bias supply and zener diode D7. Another possibility which might be tried is to use a simple half wave rectifier in the bias power supply. Actually our supply of the aforementioned 1N482 diodes was such that we just went ahead with the bridge rectifier since its output does not need as much filtering as the half wave type. The current drain here is very low and the filter used should be ample.

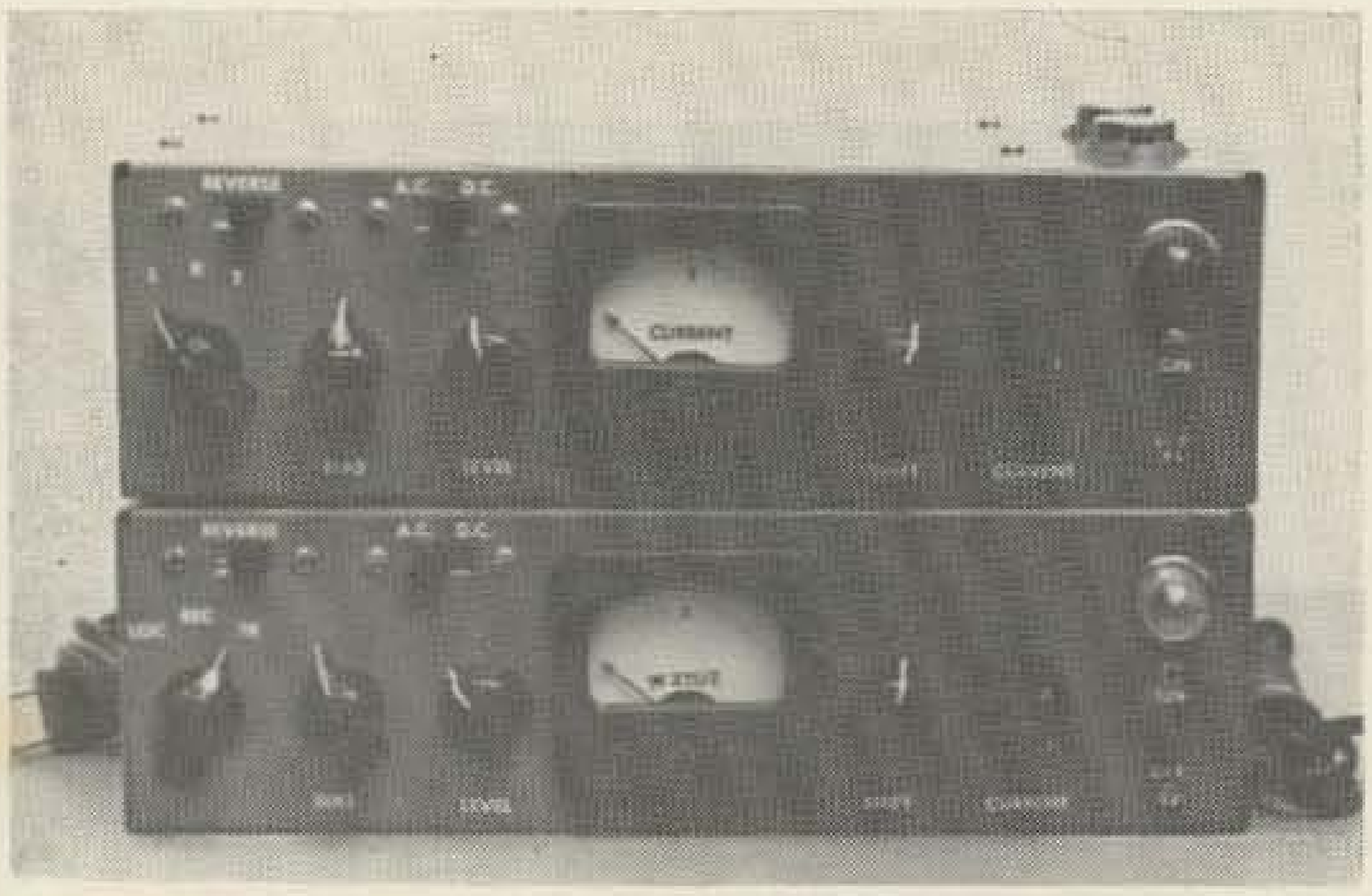


Fig. 6a

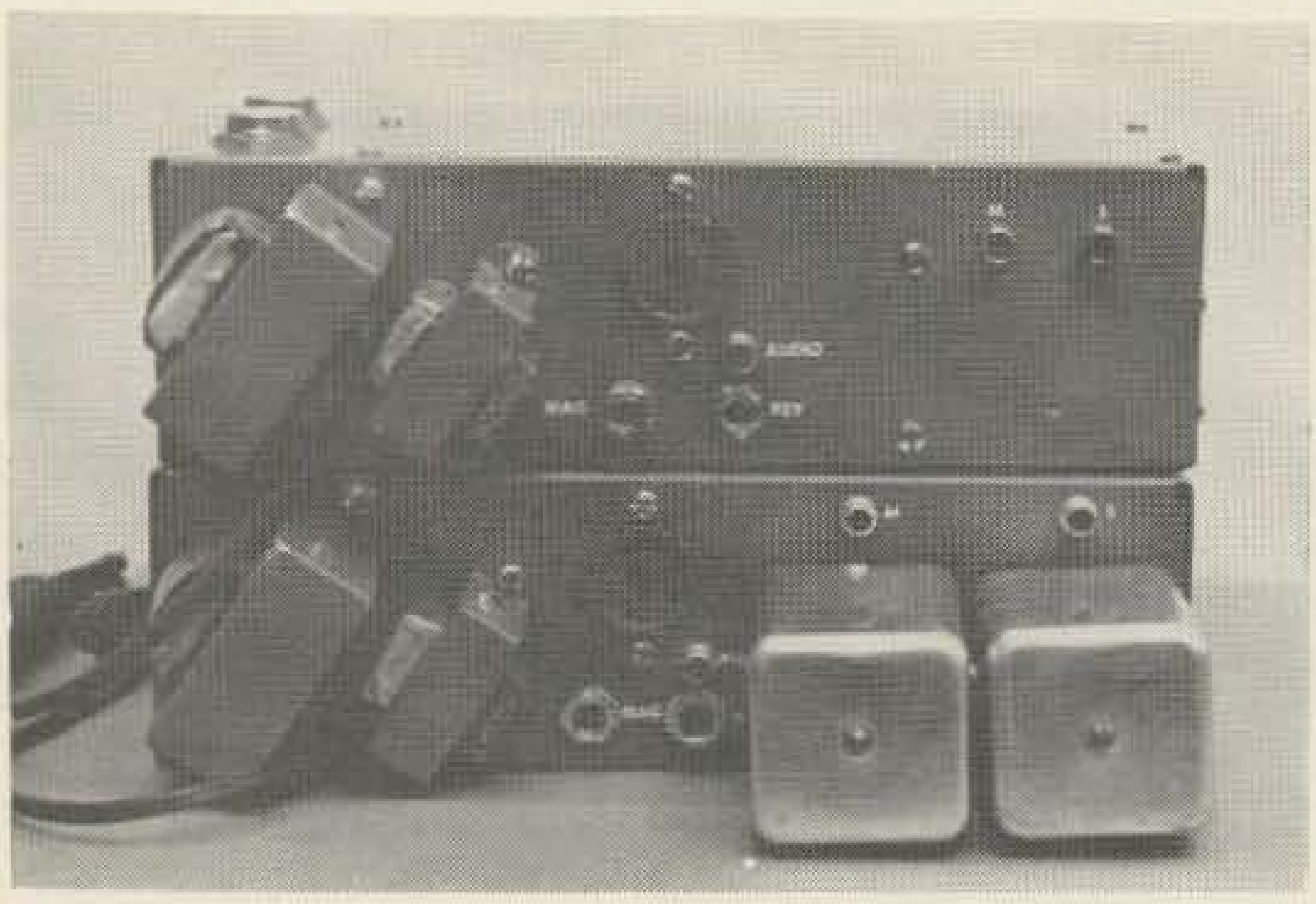


Fig. 6b

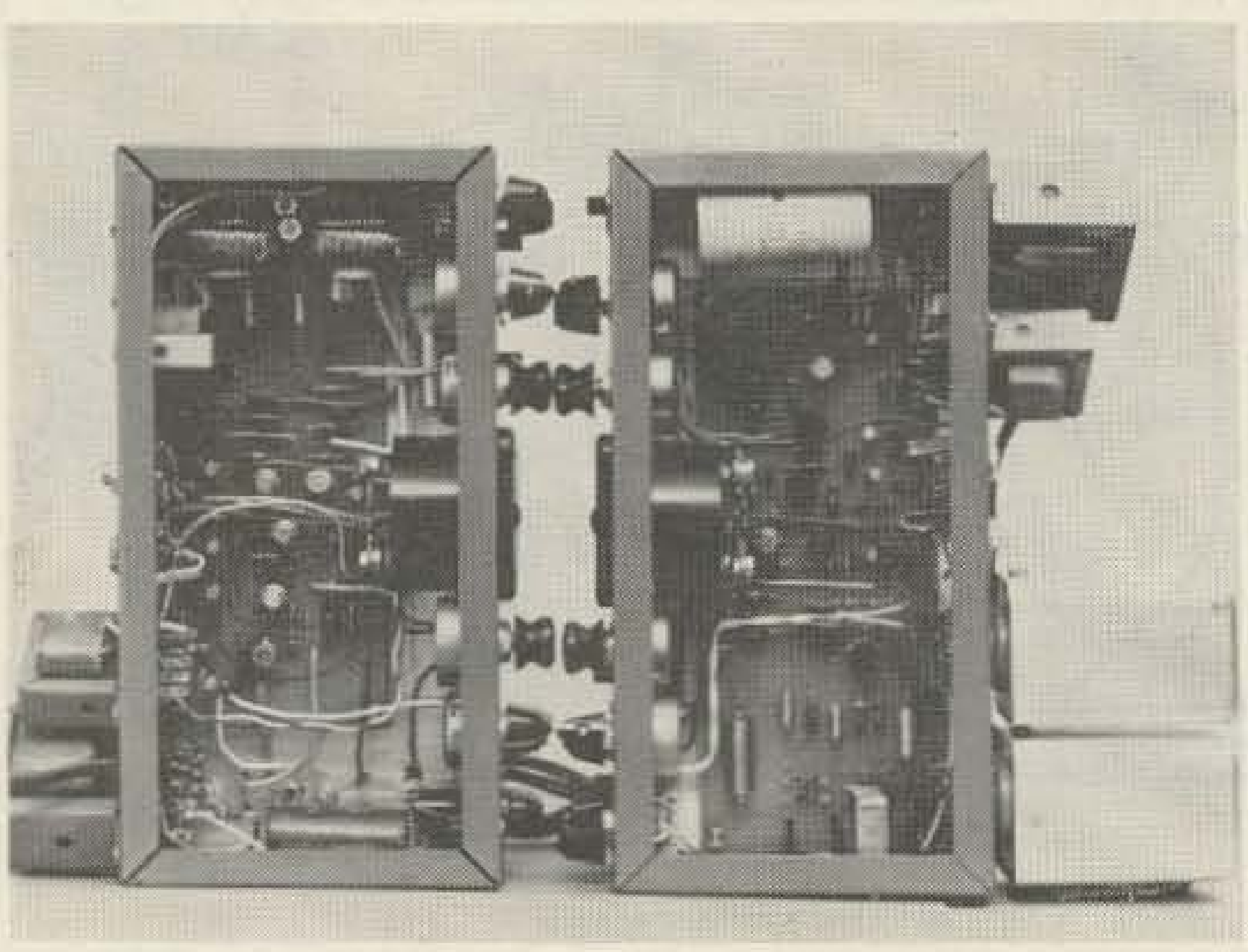
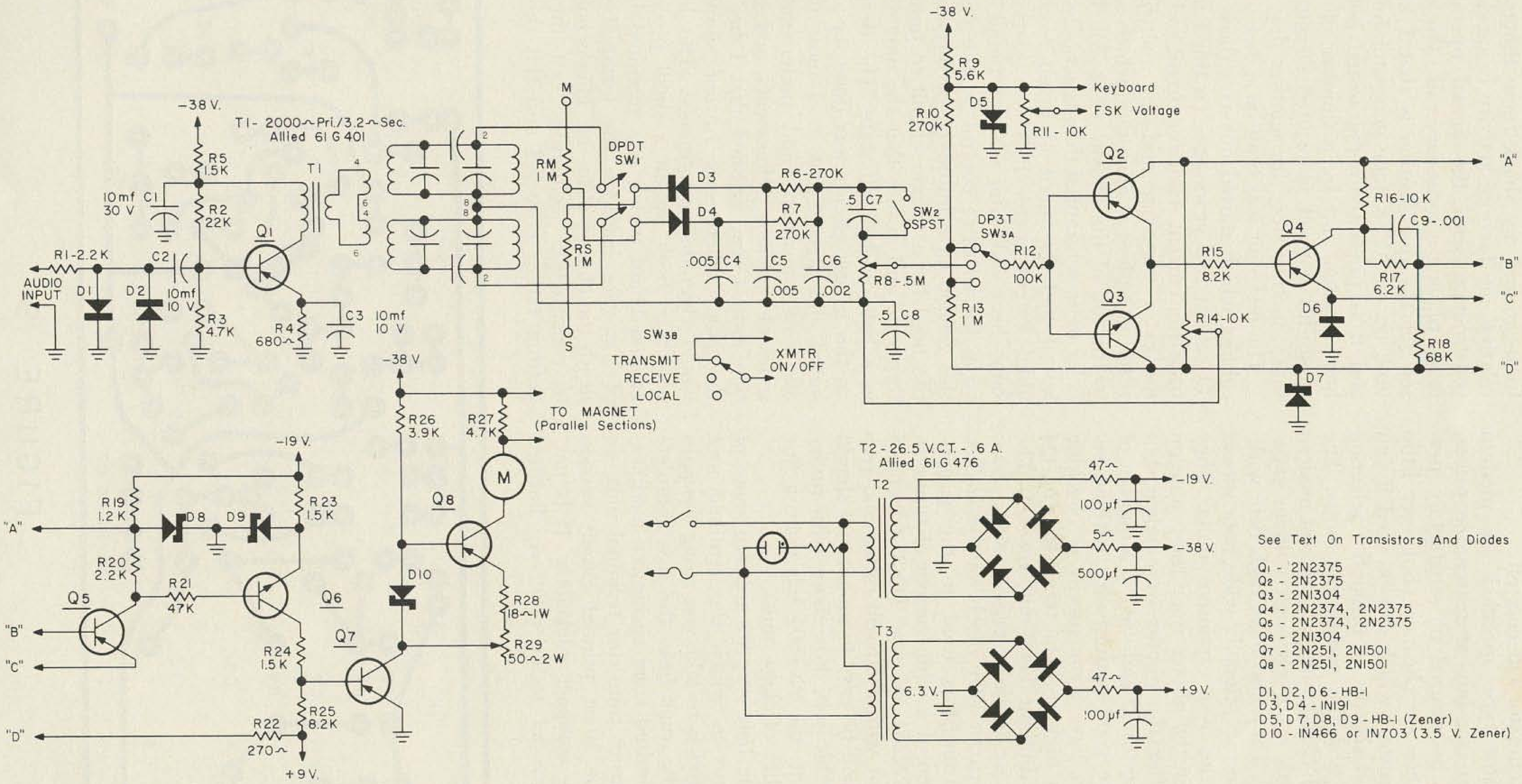


Fig. 6c

With the exception of the diode D10 in the current regulator circuit, all the zener diodes specified are Hoffman HB-1. These are listed in their catalog as general purpose diodes guaranteed to have a PIV greater than 7.5 volts. We have bought and used these over a period of years and have checked hundreds of them. They practically all have zener points within the range from 7.8 to 15 volts with the vast majority falling within the 8 to 12 volt range. These are undoubtedly fallout from their regular zener diode production which do not meet their commercial standards—but they are quite adequate for a variety of amateur applications. At 44¢ they are a real bargain and we've used them in a large number of things we've built. They are more effective than electrolytic capacitors, since their impedance is not frequency dependent, and in a terminal unit we are dealing with some very low frequencies. In addition they take up a lot less space than electrolytics and as long as you stick to the HB-1 variety they're cheaper. Checking them is a simple matter, just use the test lash up given in Fig. 2. The power supply can be that of the unit. The value of the potentiometer is not critical but the fixed resistor in series with the diode should be sufficiently large to limit the current to less than 10 ma. Just connect the diode and run the potentiometer slowly up. The voltage should rise smoothly until the zener voltage is reached. Increasing the pot further should not cause any significant increase in voltage. If you have less than a volt or so across the diode, you have the polarity of the diode reversed; just turn it around and try again! If you get a continuously increasing voltage with no zener point, either it has no zener point or it is above the voltage range you have tested it for, but in either case don't despair, the diode will be quite satisfactory for either D1, D2, or D6. Test them all at the same time and mark the zener voltage on each. Select one of the higher voltage units, on the order of 10 or 12 volts for D5. Use the lowest voltage unit, preferably between 8 and 9 volts for D7. If you are unable to find one this low, D7 may be replaced by a 100 mfd 12 v electrolytic capacitor. As for D8 and D9, the actual voltage is not critical and can be anywhere in the 8 to 12 volt region—however D8 should have a higher zener voltage than D9; a half volt differential is quite adequate. This differential



-38 V.
T1- 2000~Pri./3.2~Sec.
Allied 61 G 401
R5 1.5K
10mf C1 30 V
R2 22K
Q1
T1
R1-2.2K
C2
AUDIO INPUT
D1
D2
10mf 10 V
R3 4.7K
R4 680~
C3 10mf 10 V
M
RM 1M
DPDT SW1
RS 1M
S
D3
D4
R6-270K
R7 270K
.5 C7
SW2 SPST
.005 C4
C5 .005
C6 .002
R8-.5M
.5 C8
-38 V.
R9 5.6K
R10 270K
D5
Keyboard
FSK Voltage
R11 - 10K
Q2
DP3T SW3A
R12 100K
R13 1M
Q3
R14-10K
R15 8.2K
Q4
R16-10 K
C9-.001
R17 6.2K
D6
R18 68K
D7
"A"
"B"
"C"
"D"
SW3B
TRANSMIT
RECEIVE
LOCAL
XMTR ON/OFF
-38 V
R26 3.9K
R27 4.7K
TO MAGNET (Parallel Sections)
M
Q8
D10
R28 18~1W
R29 50~2 W
-19 V.
R19 1.2 K
D8
D9
R23 1.5 K
R20 2.2K
R21 47K
Q5
Q6
Q7
R24 1.5 K
R25 8.2K
R22 270~
+9 V.
T2 - 26.5 V.C.T. - .6 A.
Allied 61 G 476
T2
47~
-19 V.
100 pf
5~
-38 V.
500 pf
T3
6.3 V.
47~
+9 V.
100 pf
See Text On Transistors And Diodes
Q1 - 2N2375
Q2 - 2N2375
Q3 - 2N1304
Q4 - 2N2374, 2N2375
Q5 - 2N2374, 2N2375
Q6 - 2N1304
Q7 - 2N251, 2N1501
Q8 - 2N251, 2N1501
D1, D2, D6 - HB-1
D3, D4 - IN191
D5, D7, D8, D9 - HB-1 (Zener)
D10 - IN466 or IN703 (3.5 V. Zener)

FIGURE 7

assures that transistor Q6 cuts off.

The transistor type specified are modern units that you can buy at reasonable prices, plug in, and be assured of satisfactory performance. There are cheaper (but very little cheaper) transistors which can be used if you are willing and able to go through a selection procedure to find the satisfactory units. The 2N2374 and 2N2375 units are low cost modern PNP units with relatively high voltage capability (−35v). They also have high beta without having the exceptionally wide beta spread of some of the less expensive units. They aren't shown in the photos since they came on the market after the photos were taken, but they have been tested and used in a number of units and gave good performance without selection. If you have some means of checking beta, use the highest beta transistor for Q4 and the next highest beta unit for Q5. The 2N1304 are moderately priced NPN transistors and perform very nicely in the circuit. The output transistors used in the various units have been of a wide variety of types, in general the 2N251 or any TO-3 (diamond base) transistor with a 50 volt rating and reasonable beta will be easy to mount and should do an acceptable job. For those who prefer the stud mount, the 2N1501 has done a fine job in a number of these units.

Probably the best way to indicate some of the many ways in which the terminal unit can be packaged is to take you along the path I travelled. This runs from the first complete unit, which resulted from successive modifications of an earlier transistor terminal unit, on through to the latest printed circuit version with relatively compact packaging. It is now in what I consider to be relatively finished form—around my shack these things are only relative, my favorite activity being design and construction with the actual operation normally playing a secondary role. The other reason for the qualification is that I have since built up an AFSK tone generator for the unit and it is presently being tested both at the home station and by a number of the local gang. It's not yet in printed circuit form, so that's another story for another day.

The first unit was built on a 3x4x6 inch box cabinet which started out as a three transistor TU about two years ago. To this I added the transistor current regulator circuit and mounted the extra transistor and the switching transistor on a piece of aluminum which was bolted to the top of the chassis (Fig. 3). The piece is far more substantial than is actually required, but it had the merit of being readily available! Potentiometer R29 was placed on the same heat sink later when I found I needed room for an extra control on the unit. While this version gave improved performance, I felt the need for a trigger circuit to improve performance and ensure that the unit did not sit in a half on—half off state. The design work on the trigger circuit was done on a separate board and started out as a most impressive array of transistors, and underwent a long series of revisions, refinements, and simplification until I was satisfied that I had reached the point where any further simplifications would degrade performance. The final form was then built up on a small piece of perforated board which was mounted by means of the wire leads to the terminal strip beneath the chassis (Fig. 4). This is not the best of construction techniques, but things were getting rather crowded and this did a good

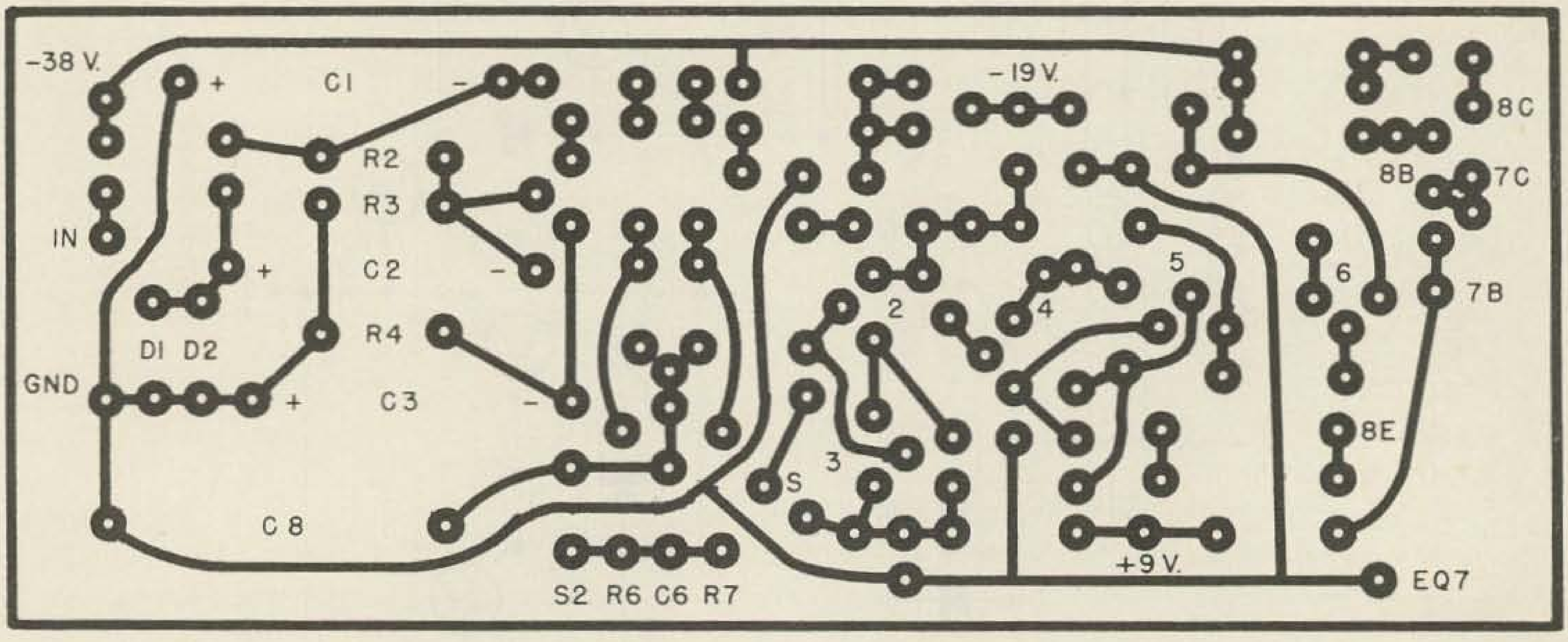


FIGURE 9

job of using what little space was available. The power supply for the 9 volts of bias was also crowded in beneath the chassis. The unit contained a fixed resistor rather than a potentiometer for R8, but is otherwise identical electrically to the circuit diagram and the other units. The performance of the unit was excellent—but the possibilities for mass duplication were small indeed!

The next step was a lengthy conference with W3ITO, who during the normal daylight hours spends his time packaging electronic equipment for some rather fancy end uses—and in considerably smaller packages. After some discussion we settled on some general ground rules for the subsequent units: first they should be relatively easy to duplicate, second they should all be designed for standard parts and components, and last but not least they should be relatively flexible, permitting the board to be used in a number of different mounting configurations. The next work was Fred's, and about a week later (let's be honest—it was more than a week) he reappeared with some beautiful printed circuit boards, made of epiglass, neatly eyeletted and everything. The resulting unit is shown in Fig. 5. These have plenty of room not only for the circuitry, but even have provisions for mounting the toroid filters and transformer T1 directly on the printed circuit board. They also provide space for mounting 2N173 type transistors (guess which transistors Fred had in his junk box?), which are considerably larger than necessary, but which provide good performance without requiring a heat sink. My first reaction was that the boards were huge indeed—but in retrospect, after building some of the smaller units I must confess I am far more pleasantly disposed toward this version. It is relatively large but it is a real pleasure to work on a unit of reasonable size and not have to contend with small clearances and tight quarters. You will note that in this unit we cut a section out of the top of the 7x15x3 chassis that we mounted the unit in, so as to provide access to the bottom of the printed circuit board. It's lucky we did—one of the transistors worked fine for ten seconds and then slowly died! In later units we have been brave (and I suspect foolhardy) and we would recommend this technique for those of you who would prefer a 1 minute task to a 2 hour task in case things do not go perfectly the first time around. If you are brave you can do the job carefully and then mount the circuit board on stand offs on the bottom of the chassis; we also put a thin sheet of mylar between the board and the chassis just in case. The large chassis size provides plenty of room on the front for mounting the controls, and as one of the gang remarked the unit is made to order for those who like to have knobs to play with. We also mounted two extra octal sockets on the rear of the chassis so that if we ever want to convert from the fixed filters to plug in filters, the conversion will be a relatively simple matter. The third octal socket, which is in the center of the chassis in the rear provides for *all* the inputs and outputs of the unit. Thus when changing from one TU to another we have only one octal plug to transfer rather than the usual morass of wires (magnet, keyboard, audio input, FSK voltage, etc.) that one is normally faced with. It makes life considerably easier, and for added convenience in testing units or operating away from home we have provided redundant jacks for the magnet, keyboard, and audio input.

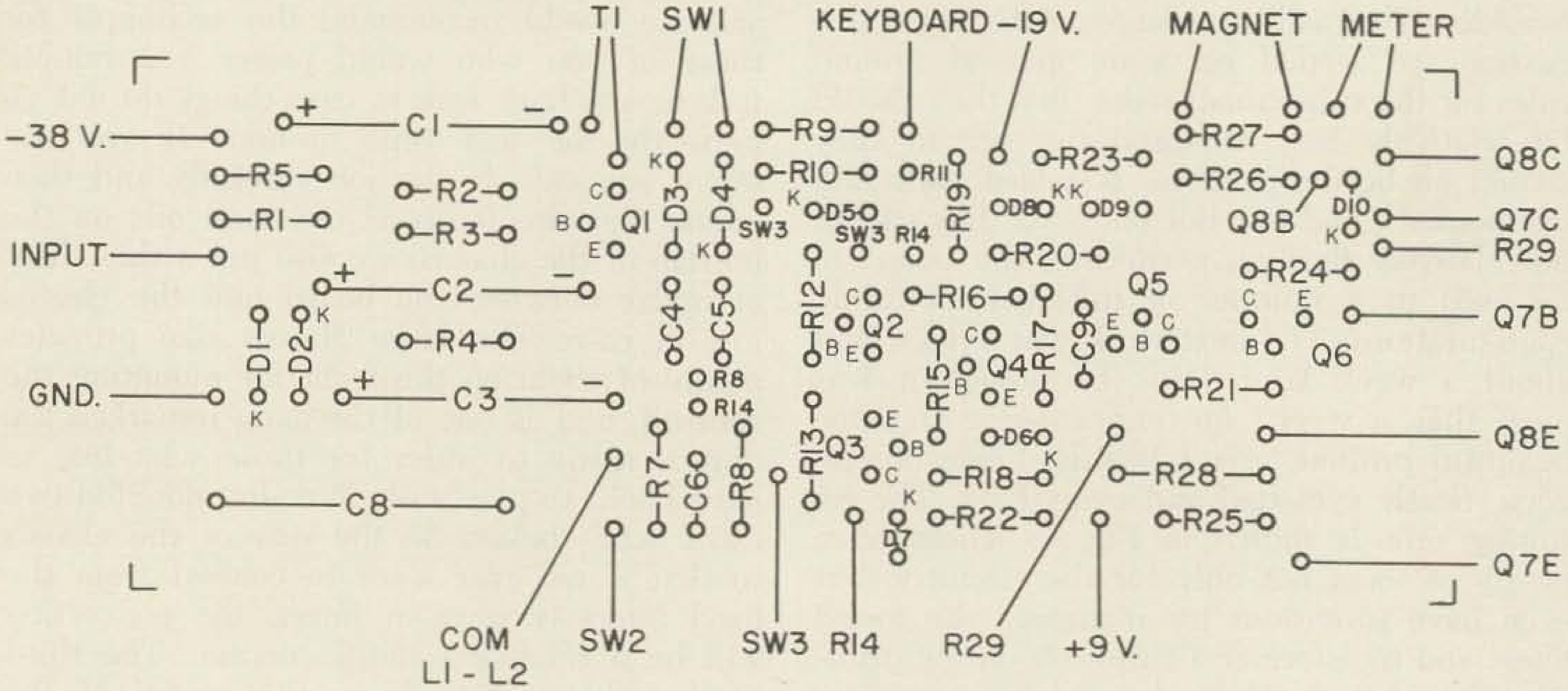
In the version shown in the photograph we did not mount transistors Q7 and Q8 on the printed circuit board, but used 2N1501 transistors which we had on hand and mounted these on small aluminum heat sinks on the side of the chassis (See Fig. 5c). The leads were then wired to the appropriate points on the printed circuit board.

The final version, which is the neatest looking of the units is shown in Fig. 6. The circuit diagram is given in Fig. 7 and the parts list in Fig. 8. The photographer was economizing, so we have two units which are quite similar shown—there are differences which illustrate some of the options open to the builder. These units use a much smaller printed circuit board —roughly 3 inches by 8 inches in size. The layout of the board is shown in Fig. 9 and the parts layout on the top of the board is shown in Fig. 10. This board provides a large percentage of the circuitry of the unit, but since it provides for separate filters, controls, output transistors and power supply, it does provide a considerable degree of flexibility in packaging. It can, of course, be readily adapted to relay rack mounting by the use of a standard 3¾ inch relay rack panel. One of the units pictured uses 2N251 transistors and has the toroid filters mounted integrally in the unit. The other unit shown uses plug-in filters and has 2N1501 transistors mounted internally. This actually has an extra transistor mounted internally to be used as an additional output for a reperforator. This permits a reperf to be used along with the page printer and gives separate control of magnet current. The circuitry for this modification is shown in Fig. 11. The jack which is paralleled with the magnet output of the octal plug on the other unit is here wired up to handle the extra output. The plug-in filters may be mounted in the Vector C-12 cans shown in the photo, or may be more complex units mounted in a 3x5x10 chassis—which is the chassis size used for these two units.

With this size circuit board you can choose your own size cabinet and your own panel layout—the space occupied by the board is small indeed. Please don't get the idea that this represents the ultimate in packaging techniques and shrinkage. Had we not adhered to the original requirements of ease of construction and standard parts, it could have been made considerably smaller. If you want to try, just use smaller size potentiometers, wind a single transformer for the two voltages required, use a miniature meter and miniature electrolytics and you can end up with a considerably smaller unit.

The filters used in the terminal unit are bandpass units of the conventional type.* The

* For more complete discussion see article in Nov 62 issue.

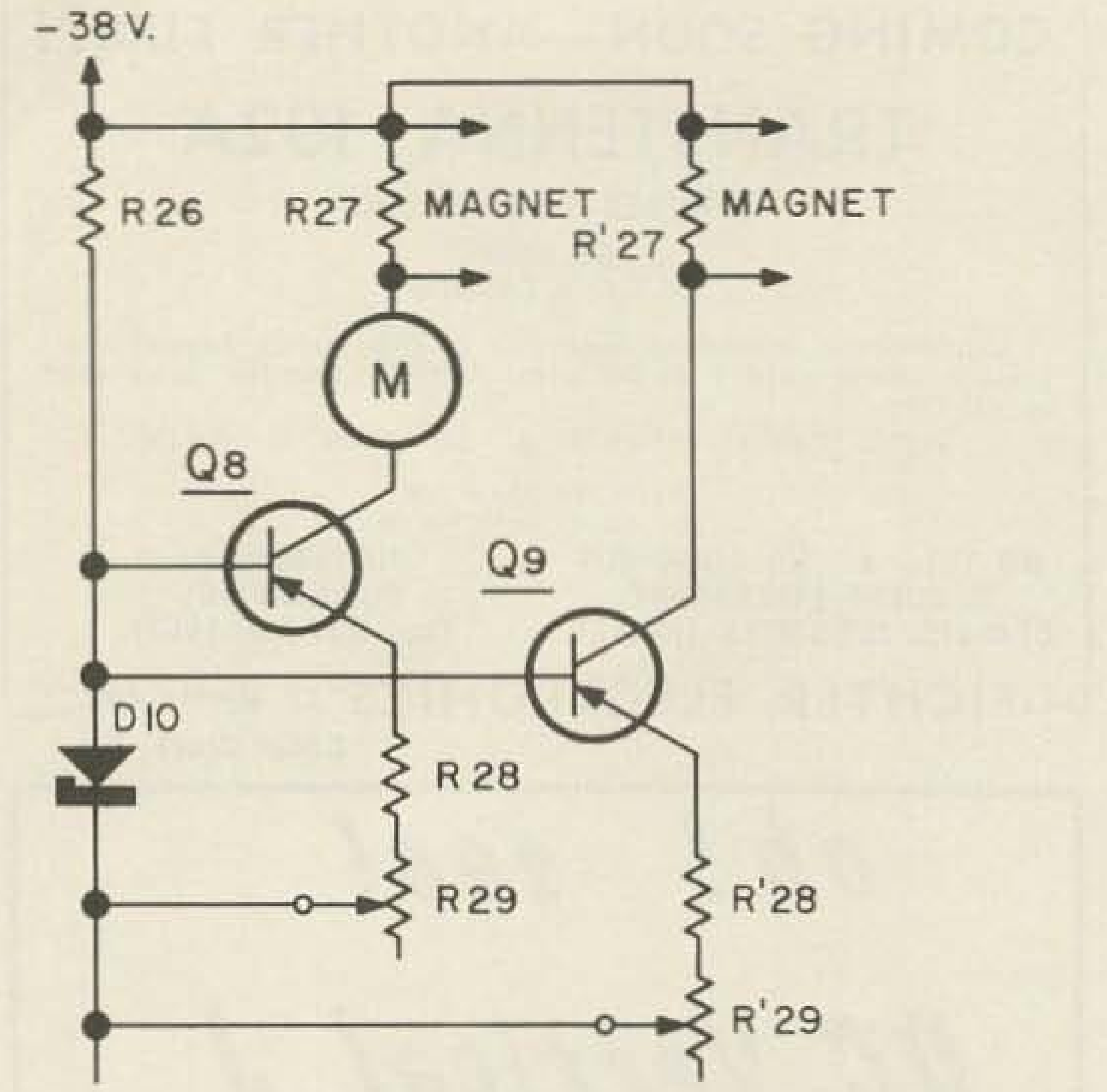


NOTE: C7 Is Mounted On Switch SW2 On Front Control Panel.
K Is Marked For Cathodes Of All Diodes.

FIGURE 10

PARTS LAYOUT - COMPONENT SIDE OF PRINTED CIRCUIT BOARD circuits and the component values are given in Fig. 12. There is also an illustration of the set up for tuning the filters. Tuning is simple using the test set up. Connect it to the LC pair to be tuned, short out the other LC pair of the filter you are tuning, and either by trying different capacitors, or by adding or subtracting turns from the toroid, bring that section to resonance on the desired frequency (either 2125 or 2975 cycles). Then switch the short to the section you have tuned up and proceed to une the other section. Note that this procedure effectively adds the coupling capacitor to each LC pair. The coupling capacitor is chosen from normal 10% capacitors, which should be close enough for proper performance. You should preferrably tune the output section with the load connected so that tuning does not shift after the unit is wired up. The values given are for a bandpass of about 200 cycles, which is our recommendation for general use. If toroids or space are problems, you may prefer to use only one toroid in each section; this will not give quite as good performance as the bandpass unit with two toroids per section, but the performance will still be considerably better than the average terminal unit. Just omit the coupling capacitor and the second LC pair.

When building the unit you can either mount the filters on a terminal board and put it inside the unit, or you can make each of the filters a plug-in unit. The numbers at the terminals are the base connections for the octal sockets used with the plug-in units. We found it handy to have these standardized, thus we could check out terminal units before the filters had been finished. The plug-in units also permit you to have other filters with narrower bandpass or special filters for short shift. By making up just one filter for 2550 cycles, you are equipped for copying the commercials using 425 cycle shift. The dual plug-in units are each mounted in a Vector C-12 can which is 2x2x3 in size. The Millen 74400 can has also been used, but things are a little more cramped inside. When the units are finished and connected in the circuit, check to see that the bandpass is smooth across the top and not double humped. If you do have a double hump with the units operating with the normal load, add a resistance across the output toroid of each filter. By careful selection of the resistor you should have no difficulty in smoothing the response. Without a load you will surely have a double humped curve, and the value of resistance needed will depend to some extent on the betas of transistors Q2 and Q3. You may not need any—if not, fine.



Values Are Identical To Those Of Normal Circuit.

FIGURE 11

CIRCUIT FOR OPERATING TWO PRINTERS

Checking out the unit is a relatively simple procedure. For the initial check, disconnect the lead supplying voltage to Q_7 and Q_8. Plug in the unit, apply power, and check the power supply voltages. First check the voltage at the collector of transistor Q_5. By varying the setting of R14, the voltage should at some point shift from a little less than one volt to approximately the zener voltage of D_8. You should *not*, repeat *not*, be able to obtain an intermediate voltage reading regardless of the setsing of R14. If you can, the transistors you are using for Q_4 and Q_5 probably have too low a beta. The switching should occur when R14 is set approximately to center scale, i.e. when the voltage on the center arm of the pot is about −1 volt. One unit on which detailed voltage measurements were made switched on a .03 volt change on the bases of Q_2 and Q_3. The next step is to check Q_6. The collector voltage should switch from about the zener voltage of D_9 to about zero volts. A further check should be made on the voltage from the collector to the emitter of Q_6. When this transistor is conducting, the voltage drop should be less than one volt. If it is higher than this, either use a higher beta transistor for Q_6 or decrease the resistance of R21.

Next check the mounting of transistors Q_7 and Q_8 to see that you have not grounded the collectors in the process of mounting and heat sinking them. (This bit of advice is the result of some experience!) After reassuring yourself on this point, connect the power to the units, plug in the selector magnet, and turn on the unit. By now varying the setting of R14 you should be able to switch the magnet current off and on. Then with the current on adjust R29 for the proper magnet current. For Model 14 or Model 15 machines with pulling magnets, be sure the two sections of the magnets are in parallel and run 120 ma to the paralleled magnet sections. With holding type magnets, less current should be satisfactory. If you are unable to draw the full 120 ma with R29 set at minimum resistance, you probably have a very low zener voltage diode for D_{10} and the cure is simple—merely decrease the resistance of R28. Normally you set R29 and leave it alone, so if space is a problem you can locate this pot at any position on the chassis you have the room for it. Alternatively, you could merely select R28 for the proper current and delete R29 completely. Check the voltage from the collector of Q_7 to ground. When the magnet current is on this voltage should be less than one volt. Readings of .1 volt to .4 volt are typical. If it is more than a volt, the beta of the transistor is probably low—but with identical transistors being used you can easily switch transistors and see if this improves the situation. Actually when you use power transistors here you are normally well off since the betas are usually considerably higher at the 120 ma operating point than they are at the full rated current the devices are designed for. You can compensate for an extremely low beta unit by decreasing the resistance of R24 from 1500 to 1200 or even 1000 ohms. A number of the units built have used 2200 and 2700 ohms for this resistor, but the 1500 has been specified to provide latitude for the lower beta transistors.

Assuming all works well now, the only remaining step is to feed audio tones into the unit and see if it plays. The audio tone is limited by D_1 and D_2 (an oscilloscope will demonstrate this visually), it is then amplified by Q_1, and the two filter sections separate the tones. With a mark tone input you should get a positive output at the junction of R6 and R7, while for a space tone you should have a

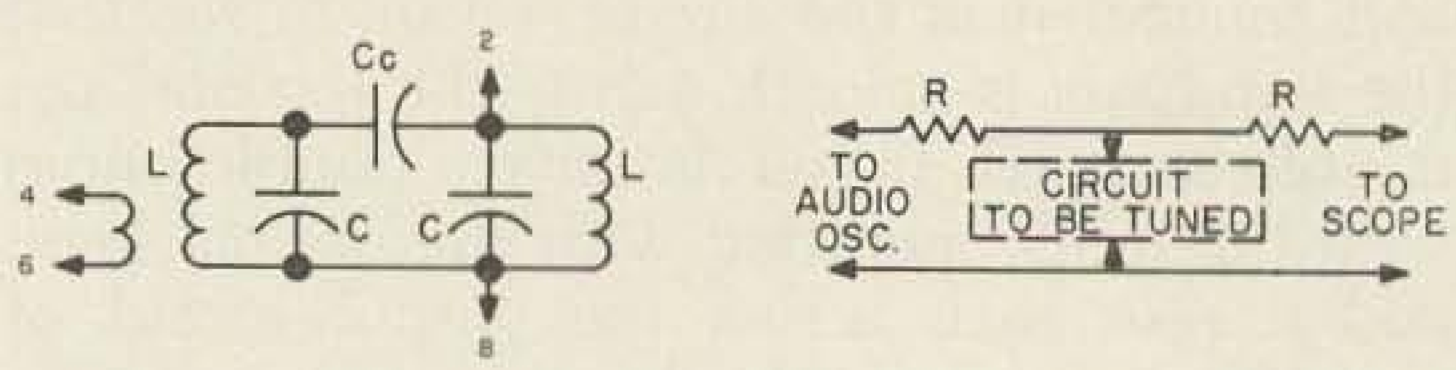


FIGURE 12

L all 88 mhy.	R = 1 meg. or larger	
	2125 cycles	2975 cycles
C	.06 mfd.	.03 mfd.
C_0	.0059 mfd.	.0022 mfd.
Link	9 turns	5 turns

negative output. If they are reversed, just throw SW1 and the situation should be as specified. With SW3 in the receive position (center) these tones should switch the magnet current on and off.

Last, but certainly not least, I want to thank the gang who helped me in the process of getting these beasts into their final form, especially Fred, W3ITO who is responsible for the printed circuit board work and who has built, checked out, and struggled with modifications on a number of these units. He's also been willing to test a number of my brainstorms—both good and bad! To Frank W3PYW who has been of great help in discussing RTTY and related problems in general and checking out a numbers of units in particular. To Bob, W3OII for the very fine photos and continuing encouragement in my efforts to get this thing down on paper. He must indeed be persuasive, for these last paragraphs are being written in Paris—and I can assure you there are better things to do in Paris than to write articles on terminal units! And last to the many locals who built them and criticized them.

As for making printed circuit boards, I have no sage words of advice to impart. Just get hold of one of the numerous articles that have been published in the past and get to work, they're not difficult. If you're lazy, you might check to see if any of the guys who make printed circuit boards for hams would be willing to make one up for you. But don't write me or any of the hams mentioned above. About three dozen of them have been turned out for the local gang and none of us have any desire to go into the printed circuit business. We've retired. However, if printed circuit boards are new to you I suggest you use a small iron and much caution. The transistors may be soldered directly onto the printed circuit board or you may prefer to use sockets. (ELCO 3304 sockets work nicely.) One of the last two units pictured uses sockets while the other has the transistors soldered directly to the board. If you use the direct approach, get some surgical forceps, they make fine heat sinks while soldering.

Good luck. . . . W3TUZ

Fig. 8. Component Values

Transistors:

Q-1	2N2375
Q-2	2N2375
Q-3	2N1304
Q-4	2N2374 or 2N2375
Q-5	2N2374 or 2N2375
Q-6	2N1304
Q-7	2N251, 2N1501
Q-8	2N251, 2N1501

D-1, D-2, D-6 HB-1 (see text)
D-3, D-4 1N191
D-5, D-7, D-8, D-9 HB-1 zener (see text)
D-10 1N466 or 1N703

Resistors:

R-1	2.2 k	R-11	10 k	R-21	47 k
R-2	22 k	R-12	100 k	R-22	270
R-3	4.7 k	R-13	1 meg.	R-23	1.5 k
R-4	680	R-14	10 k	R-24	1.5 k
R-5	1.5 k	R-15	8.2 k	R-25	8.2 k
R-6	270 k	R-16	10 k	R-26	3.9 k
R-7	270 k	R-17	6.2 k	R-27	4.7 k
R-8	.5 meg.	R-18	68 k	R-28	18—1 w.
R-9	5.6 k	R-19	1.2 k	R-29	50—2 w.
R-10	270 k	R-20	2.2 k	R_M, R_S	1 meg.

Capacitors:

C-1	10 mfd. 30 v.	C-6	.002 mfd.
C-2	10 mfd. 10 v.	C-7	mfd. .5 mfd.
C-3	10 mfd. 10 v.	C-8	mfd. .5 mfd.
C-4	.005 mfd.	C-9	.001 mfd.
C-5	.005 mfd.		

Switches:
SW- DPDT SW-2 SPST SW-3 DP3T
61G401, Stancor A3332

Transformers:
T-1 2000 ohm voice coil Allied Radio 61G401, Stancor A3332
T-2 115 v./26 v.c.t. Allied Radio 61G476, Triad F-40 X
T-3 115 v./6.3 v.

73 Test

Donald A. Smith W3UZN
Associate Editor
Kent A. Mitchell W3WTO

The Hallicrafters SX-140K

Are you in the market for a receiver in the $100 to $125 price range, but undecided whether to purchase a commercially built set or one in kit form? Why not combine the advantages of both and consider the Hallicrafters SX-140K? This is the companion receiver for the HT-40K transmitter kit as described in the May 1962 issue of 73 Magazine.

A ham band only receiver, the SX-140K covers 80 through 6 meters. Priced at $104.95 in kit form (also available factory wired and tested for $124.95), this receiver offers many features not usually found within this price range.

Lest you have misgivings concerning constructing a receiver because of the usual associated task of rf and oscillator stage alignments, let us hasten to mention that the SX-140K receiver kit is supplied with a completely aligned and prewired bandswitch assembly.

The receiver incorporates a pentode rf amplifier, one half of a 6AZ8, with a manual rf gain control in series with its cathode. A 6U8A is used as the local oscillator-mixer stage, its output fed to a 6BA6 *if* amplifier. The oscillator frequency is varied by a main tuning capacitor. No fine tuning control is necessary due to the 25-to-1 tuning ratio of the main tuning, which is very adequate for the 6 inch per band of slide-rule dial provided. The selectively-bfo control in the suppressor grid of the *if* stage is actually a regeneration control and effectively varies the selectivity of the stage from approximately 8 kc to approximately 2 kc. Advancing the control until the stage breaks into oscillation provides a beat note for CW and SSB reception. Operation and adjustment of this control is both simple and effective.

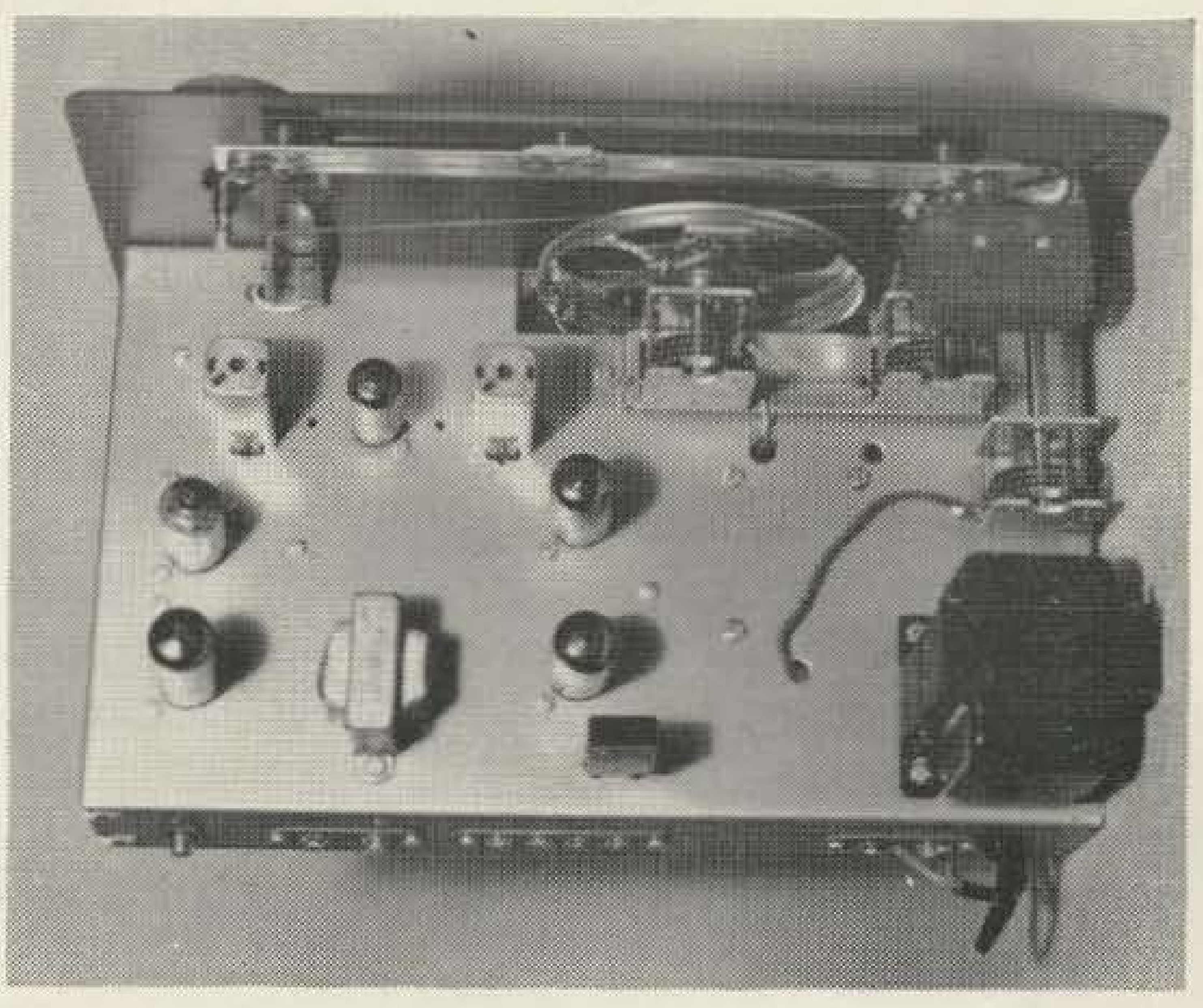
The *if* output signal is coupled to a 6T8A, which not only functions as the detector and first audio amplification stages, but performs as noise limiter and avc control stages as well. Noise limiting is by diode action and avc by the conventional feedback method.

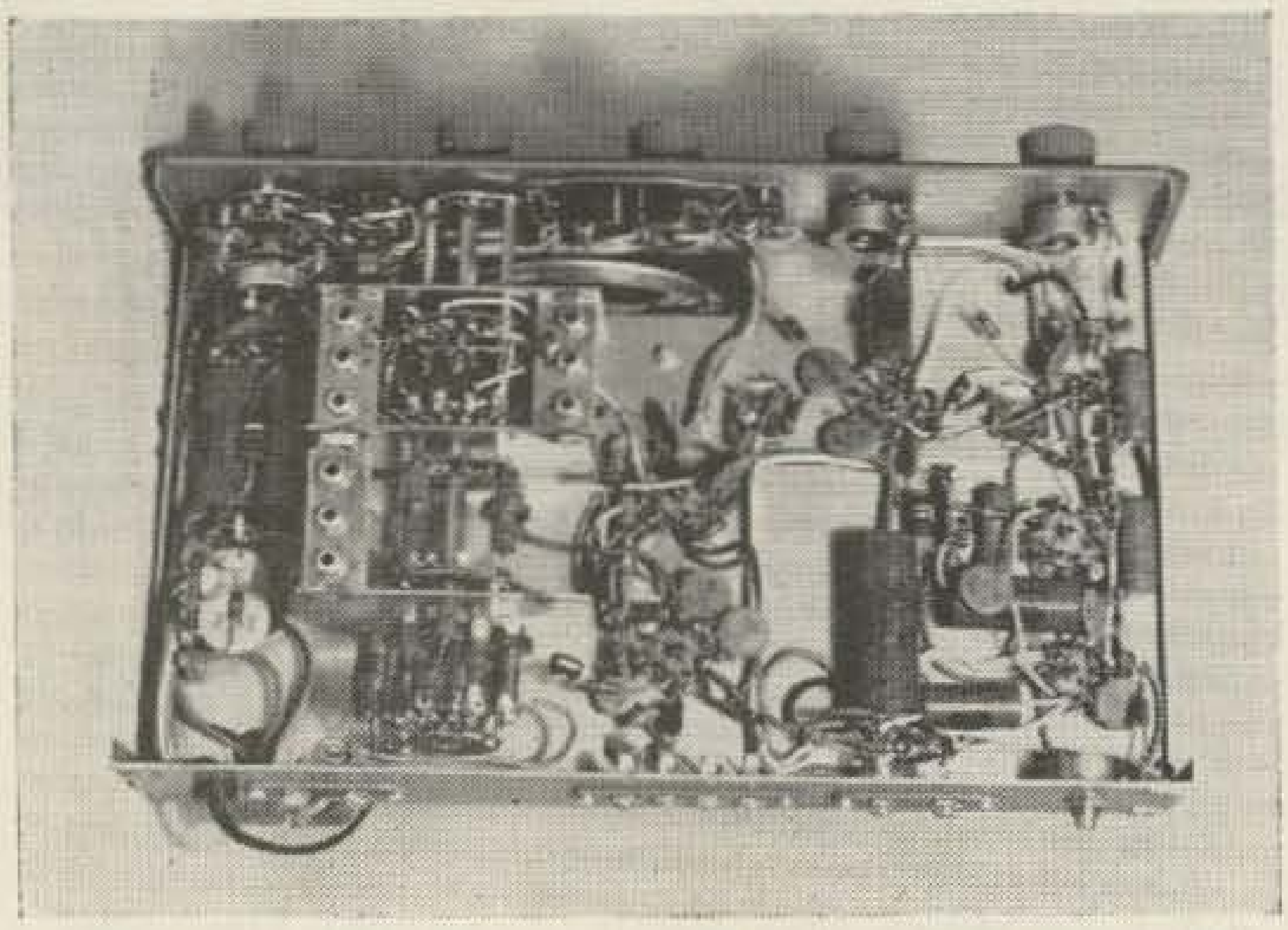
The tetrode section of a 6AW8A is the audio output stage and is connected through an output transformer to a pair of terminals on the rear chassis apron and to a headphone jack on the front panel. Though there is no built-in speaker, there is enough cabinet space for a 3″ x 5″ speaker to be mounted on the top of the receiver cabinet by the more enterprising builder.

The remaining triode section of the 6AW8A is incorporated as the S-meter amplifier. It must really amplify too, as the S-meter calibration goes up to 90 db above S9! The meter is disabled in the CW-SSB mode to prevent the needle from pegging and otherwise flopping around unnecessarily.

An unusual, useful, and welcome feature, especially for a receiver in this price category, is the inclusion of a crystal controlled calibration oscillator. With the oscillator (the triode section of the 6AZ8) operating at the crystal frequency of 3.5 mc, fundamental and even harmonic signals are injected into the local oscillator to produce band edge calibration points at 3.5, 7.0, 14.0, 21.0, and 28.0 mc. For 6 meters, an odd harmonic must be used, and is heard at 52.5 mc. The Calibration Reset control on the front panel is a variable capacitor paralleled with the Main Tuning variable.

The power supply is transformer operated, thereby safely isolating the chassis from the ac line, and has silicon diode rectifiers.





Provisions are made for transmitter control and antenna changeover hook-ups via auxiliary contacts on the function switch. When placed in the standby position, two pair of terminals on the rear chassis apron are shorted, providing switch action.

Two manuals are furnished with the SX-140K; one is the assembly manual and may be discarded upon completion of the kit, and the other is an operation and service manual. Keeping these two items under separate cover is a good idea . . . would like to see some other kit manufacturers do the same.

All said and done, the authors are very impressed with this little receiver, both in design and performance. Sensitivity and especially selectivity appear to be well above average for receivers of this type. In short, it would be hard to find a comparable receiver at this price, particularly with 6 meter band coverage to boot. It is also interesting to note that, checking the current used equipment price lists, we find that both kit and factory wired models have the same resale value . . . something to keep in mind.

. . . W3UZN . . . W3WTO

SX-140K Specifications

Frequency Coverage	80, 40, 20, 15, 10, 6 meters. (ham bands only)
Tube Complement	6AZ8 rf amplifier/calibration osc. 6U8A local oscillator/mixer 6BA6 *if* amplifier 6T8A detector, ANL, 1st audio 6AW8A audio output/S-meter amplifier
Controls	Main Tuning, Function (Off, Standby, am, cw-SSB), Audio Gain, Band Selector (6 position), rf gain, Selectivity/bfo, ANL(on-off), Calibrator(on-off), Calibration reset, Antenna Trim.
Antenna Impedance	50-75 ohms
Audio Output Impedance	3.2 ohms
Power supply	Transformer operated, silicon diode rectifiers in a doubler circuit.
Power requirements	117 VAC, 50-60 cycles @ 47 watts.
Dimensions	13⅜" wide, 8¼" deep, 7 3/16" high
Weight	13½ pounds
Price (kit)	$104.95
(factory wired and tested)	$124.95

The Amateur's Cape Canaveral

Matthew Russel K2YIH
131 Skycrest Drive
Rochester, N. Y.

There is probably not an amateur on the subscription list who has not felt pangs of envy at seeing pictures of the electronic installations at Cape Canaveral and other missile places. A few of you readers probably already have installations of parallel quality. Some other few of you will have looked up the prices in a catalog and promptly forgot the whole mess. The rest of you haven't even bothered to look up the prices because you *know* it is too expensive.

Well, fellow hams, take another look and compare with the photographs of what I did for less than twenty dollars!

Since every installation is different there isn't much point in giving exact constructional detals. The photographs explain the methods I used and should give you some hints for your console.

The corner console shown in Fig. 1 was made to fit into a space beneath the basement stairs only 4½ feet wide. It has two sloping front sections with nineteen inch rack width each and a center section with seventeen inch rack width. This is not standard but it enabled the console to be fitted into the available space.

Each of the three sections was made from

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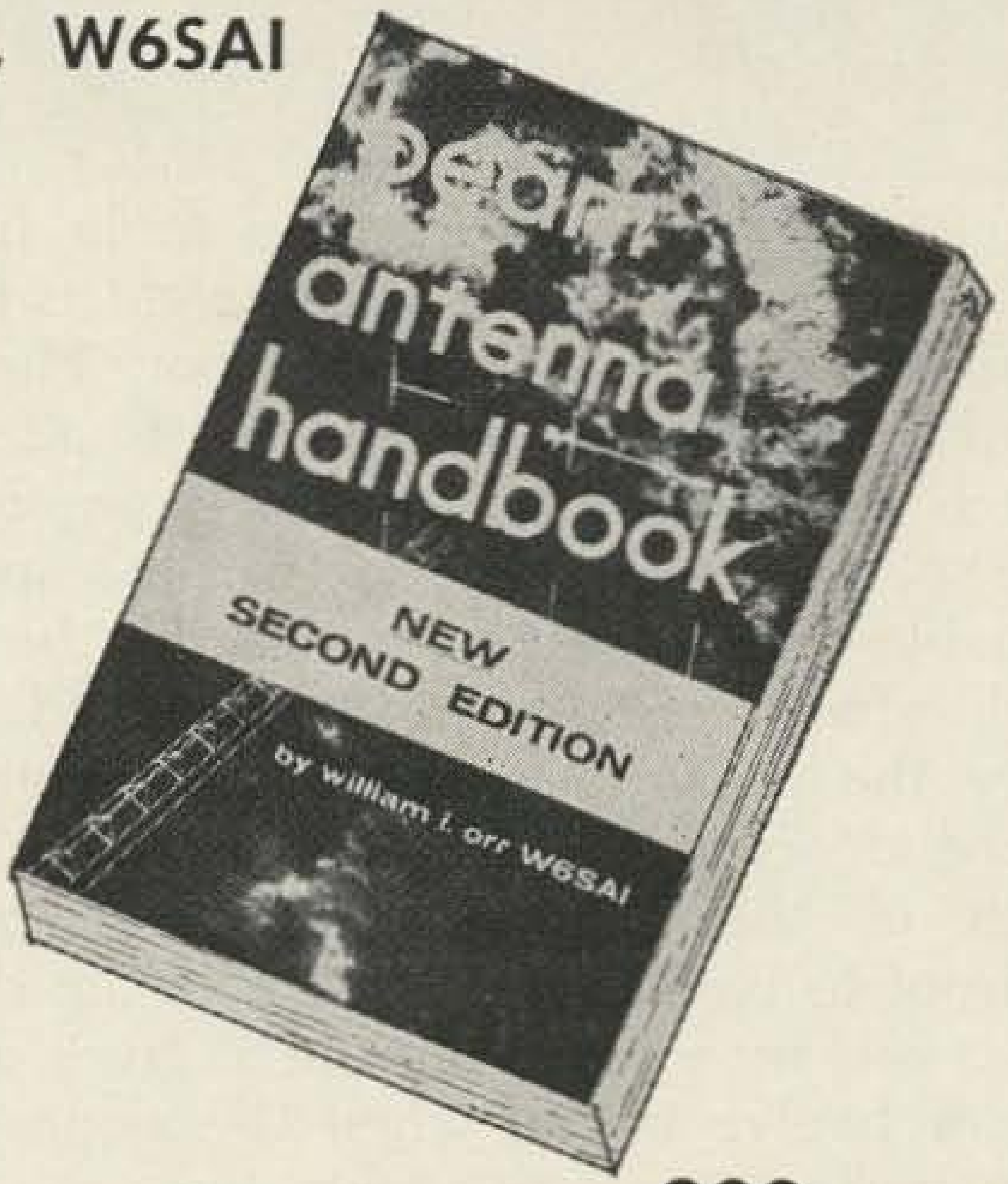

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half-inch interior plywood. The table height is thirty inches and the console height is forty-nine inches measured from the floor. The two triangular wedge panels were cut to fit from ⅛th inch masonite. Two five-sided top pieces fill the space between the rack sections and are detachable so the entire console can be "unhinged" after the table top is removed. This enables the console to be pulled through a standard doorway. (See Fig. 2.)

Each of the sections is eighteen inches from front to back and the pitch of the sloped front is six in seventeen which gives a top depth of twelve inches when the slope starts at two inches above the table top.

Fig. 3 shows my SX 28A receiver mounted on the left, being of standard rack width. The transmitter, a Viking Challenger, is not of standard rack width and merely sits in place on its own rubber feet. A wood block behind it keeps it from sliding out of position.

The other panels were made from sheet aluminum. The mounting hole spacing in all panels is a multiple of one inch, and threaded holes in angle iron supports behind the panels are also spaced every inch so that any panel will fit in any position. This takes care of any rearranging of components at some later date.

The base of the receiver section serves as a speaker enclosure. The bases of the other two sections would make good locations for power supplies and for gear that doesn't have to be touched while operating—converters, modulators, etc. Or, it can be used for a foot rest, like my center section.

Also in the left hand section is a Q Multiplier and 100kc standard. The right section holds an all-band antenna coupler, VSWR meter, 6 Meter vfo, and plug panel for key jack, auxiliary mike, and vfo output plug.

The center panel houses an antenna patch panel, a power distribution panel for controlling vfo, push-to-talk switch, and antenna rotator controls and indicators. Also in the center panel is a Panadapter in its first stage of construction.

The console has been in operation for about four years and has proved to be very versatile in spite of its outward finished appearance that seems to say "this is the final design. Do not add as much as one more knob." Adding new components, however, has been very easy and general wiring changes have been done with complete freedom since the entire console can be pushed out of the small operating room and into the workshop where access is free, tools handy, and the lighting better.

Once you get your console started you will face many decisions concerning the best way to achieve an effective arrangement of components, cabling, and controls. Let me pass on a number of suggestions and solutions that I have learned by experience. Maybe these hints will be just what you need or maybe they will spark an idea even better.

Construction

The console pictured was made from ½ inch plywood, AD interior grade. I used plenty of glue and a few screws at important joints. Other joints received only glue and finish nails. Finish your cabinets with several coats of shellac with plenty of sanding between coats. The first three coats of shellac are the most important to tame the wild grain of fir plywood. For goodness sake do not spoil your console by staining it brown. You should be trying to simulate a $1000 metal cabinet, not an antique hutch cupboard.

Mount each section on caster wheels and pay attention to load ratings when you buy them. Electronic gear is heavy!

The actual shape of your console must be a product of its environment. Remember, though, that a curved console such as mine is easier to operate from than a console with everything in a straight row. No switch or knob on my panels is farther away than a comfortable arm's reach.

Plan now for expansion later. This alone suggests that your panels should be modular widths so that they can be arranged in different ways to suit your amateur fancy. Even in my limited size radio room I can still double the available panel space by placing another tier of panels above the present ones, but tipped forward instead of back. When the time comes, some of the little-used controls can be shifted up and the operating controls shifted down.

Mounting of your commercial gear can be done in several ways:

a. Standard Rack Panels.

Some manufacturers still build their gear to fit a standard rack but be careful of TVI and receiver radiation if you take things out of their boxes. My SX28A seems to perform just as well out of the cabinet as it did in. It has an enclosed rf compartment and a full bottom plate, however. Most present day receivers lack both of these features and may suffer from signal entry directly into the chassis if they are taken out of their shielding cabinets.

b. As is mounting.

Some commercial gear can be mounted into your console and still look as if it belongs there. My transmitter is mounted this way merely by placing it in position and holding it there with a wood block behind it. Other panels around the transmitter make it appear to blend in. Be careful when you build your console that you allow enough room to slide your gear in without scraping. Some of the Heath gear, for instance, measures 19¼ inches over-all width. If the sides are perforated for heat transfer, allow some extra width for air flow.

c. Remounting on new panels.

I mounted my Heath vfo and Q Multiplier behind console panels by drilling matching holes for the shafts and holding the whole thing together with the shaft nuts and original screws. Then I had to do my own lettering. Generally, it will look better if all your panels are alike in style and color. Some panels may be mounted on the front surface with the console panel sandwiched between the manufacturers panel and equipment cabinet.

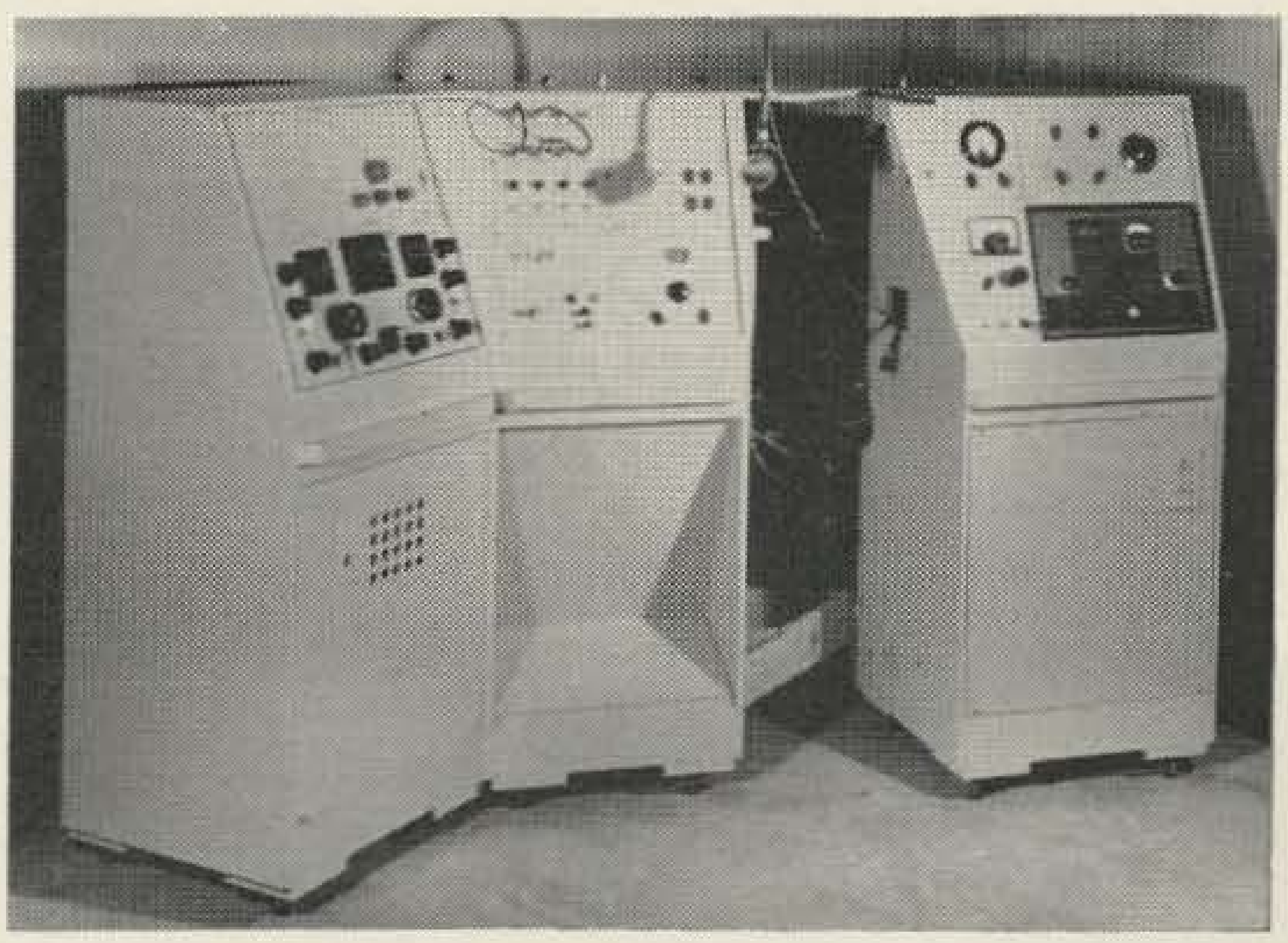
I have placed receiving functions on the left, transmitting functions on the right, and control functions in the center. This arrangement will suit most right-handed people. Left-handers will prefer the reverse.

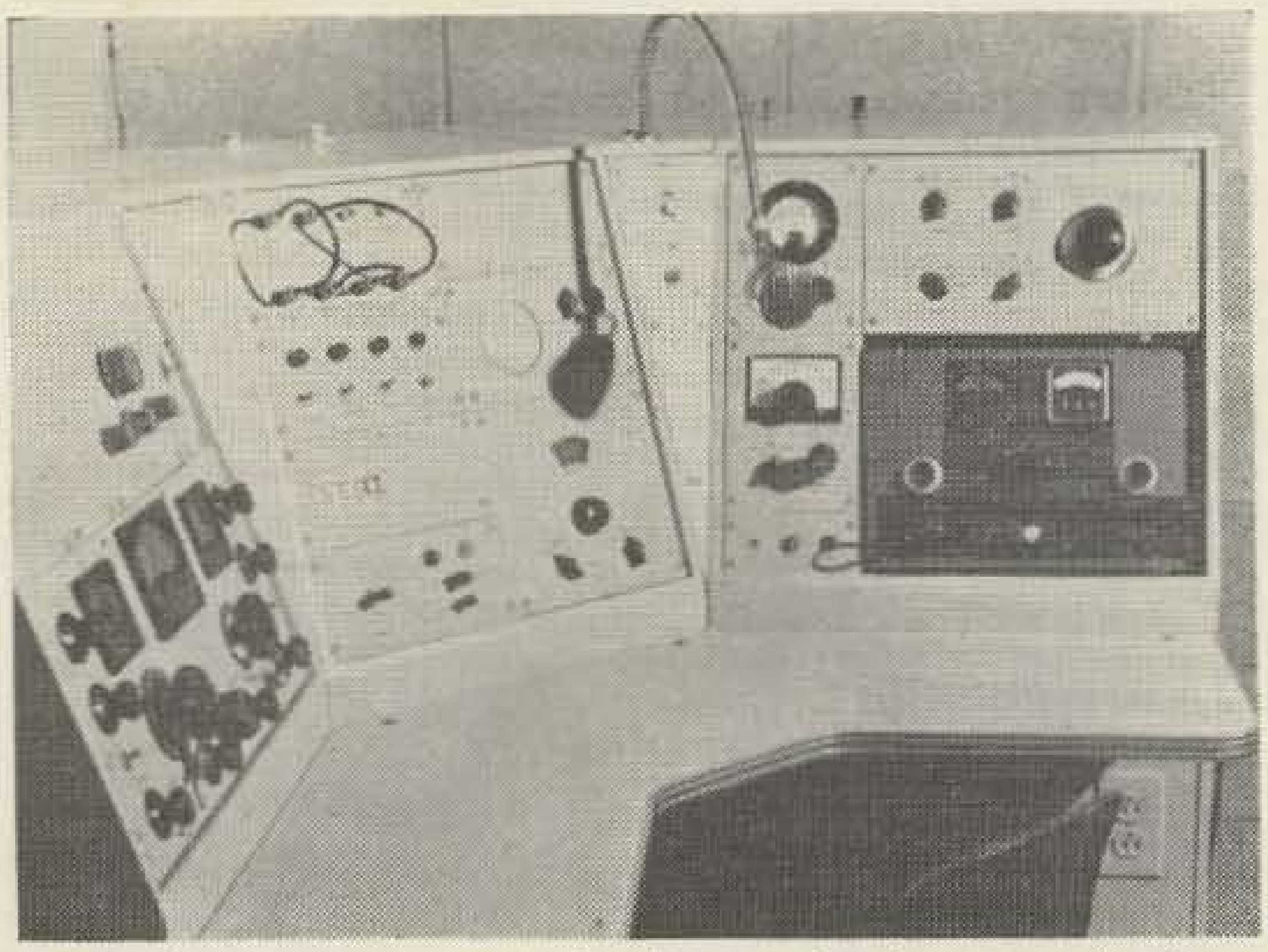
Finishing

My console, like a lot of them at Cape Canaveral, is a soft green color with light grey panels. You may want to match the color scheme of your existing equipment but be careful of dark colors. They can be very tiring to look at after a while.

Buy plenty of paint for the panels. I used a grey spray-can paint but found that the color had been discontinued when I wanted to add a new piece of gear. I consequently bought three cans from the same color lot and painted the entire set of panels over again. Now I have all the present panels painted to match and also have a reserve supply for touch-up and future additions.

Labeling of the panels is a formidable task. There are a number of solutions, however, depending upon how professional you want your





console to appear. A few of these solutions are listed here:

a. Decals. This is the most common solution. However, I have found the quality of the decals available to be rather unreliable. Also, if you spoil one of the decals and find it is the only one of its kind on the sheet, you must try to splice pieces together or buy a new sheet in order to get the one word you want.

b. Wax Transfers. These come by the sheet also. To use these, the sheet is placed over the panel and the word transferred by rubbing on the plastic sheet backing with a blunt stick. The letters transfer to the panel and adhere. An overcoat of clear lacquer is necessary.

c. Rubber Stamp. Several companies make a rubber stamp built like an adjustable date stamp but with a complete alphabet and numeral set on each moveable band. I have used one with six bands and found it adequate. Careful attention to registry and orientation is necessary to get the words on straight. Stamp pad ink is too transparent for most uses on metal panels and doesn't leave sharp edges. A better method is to use black printers ink. Practice on a scrap panel first to learn the "touch." Also keep a rag handy with lighter fluid or solvent to wipe off your mistakes before they dry. This method is also very useful for marking your chassis with tube type designations by each socket. A protective lacquer coat is advisable. These stamps are available through stationery stores for about $10.00.

d. Silkscreen. This process is simple but lengthy and requires a good deal of equipment that most of us do not have. For one-of-a-kind panels it is rarely justifiable.

e. Hand Lettering. Even the steadiest of artist's hands can not letter carefully enough to be acceptable for close observation reading.

f. Machine Lettering. Several types of mechanical lettering guides are available from engineering supply stores, My console panels are lettered this way with India ink.

Electrical: (See Fig. 4)

Main power should be controlled by one easy-to-reach switch. A pilot light is also a wise safety precaution. Each piece of gear should be fused internally and ac power distribution wiring should be fused where the main line comes into the console.

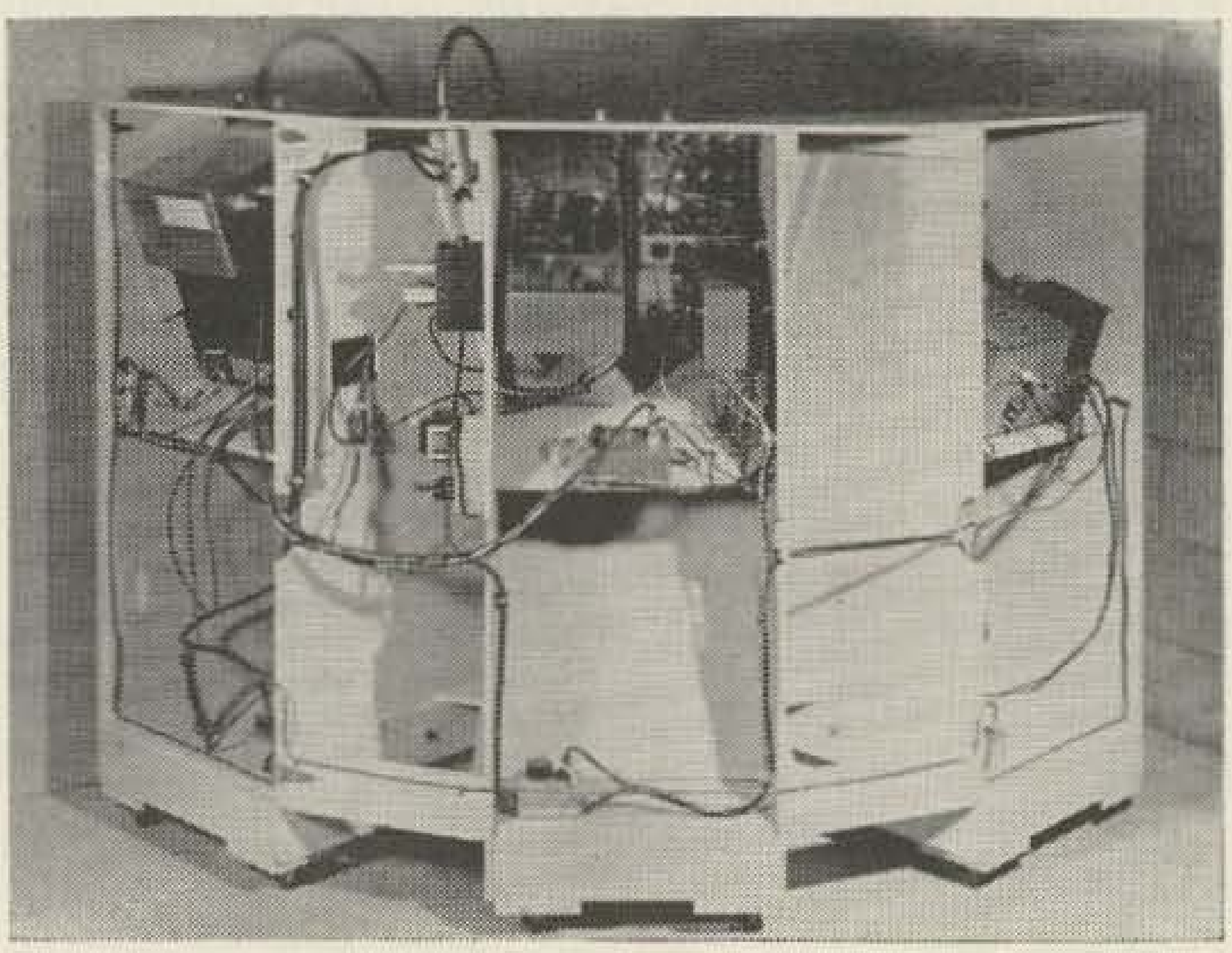
AC power distribution is not difficult. With normal safety precautions and observance of U. L. and local codes, route your ac lines as you wish. A useful item is a strip of appliance outlets in each console section near the top of the console. My console contains a power distribution panel from which I can turn on ac power to converters, relay control circuits, vfo power supplies, etc. Neon indicator lights are very handy. Make at least one ac outlet available from the front of the console for soldering irons, etc.

A good low impedance ground bus is a good idea. I used No. 6 bare copper wire with a series of copper straps soldered at useful points.

Be careful of long coax runs that may turn out to be undesirable fractions of a wavelength. Normal tehniques still apply for determining how long your feed lines should be but be careful to include the lengths of feed line you may install in the console. It is a good idea to measure each critical piece as it is installed because you may not be able to measure it accurately after it is installed!

Install your digital clock in a panel by removing it from its case and taking out the plastic window. The number wheels can then be set from the front of the console, Remember to put the clock on the supply side of the main power switch unless you want to reset the clock every time you operate.

Switching of rf can be accomplished with rotary coax switches which occupy valuable panel space, or by a patch panel arrangement. My installation uses bnc connectors and several



short patch cords so I can rapidly patch from one antenna to another, to dummy load, to converter, or directly to the tr switch. Patch panels are versatile in combining several modes of operation without the expense and confinement of switches.

I cabled all my wiring with Nylon lacing and you will find it well worth the time and expense to get rid of the snarl of wires otherwise a part of every installation. There are a number of substitutes that would do the same job and not be so permanent. The plastic coil-cord wrapping seems particularly adaptable to a changing amateur's needs.

A handful of cable clamps screwed in convenient places will train your cables from one compartment to another. I even cut some holes in the console walls in the interest of shortening up my vfo leads.

Make wiring diagrams of every piece of gear you install. These diagrams should be labeled with wire numbers for all interconnecting cables. These same wire numbers then should be branded on each wire using self-sticking number strips. A twenty-five cent number strip is the best investment you can make in terms of being able to pick out a particular wire in a cable some time later.

I have not attempted to color code all my cable wiring since the wire number system is easier and more versatile.

Generally it is a nuisance to have loose wires on the operating side of the console. My microphone was therefore mounted on a flexible gooseneck from overhead. My key has a cable just long enough to reach the key jack on the panel.

Antenna terminals were provided on the top surface of the console with UHF connectors for coax inputs and two screw terminals for open wire feeders. The main console ground bus is attached to an external ground by a strong spring clip. Connections to the antenna rotator are made through a surplus multi-pin connector. Thus the entire console can be disconnected from its input and output lines with a minimum of disconnections.

Conclusions

Investigation of the catalogs will show that a three section console similar to mine will cost more than $800.00. It will be all metal and precisely made, but it will not go through a doorway and will not provide any more enjoyment than my twenty dollar investment. Hamming doesn't have to be all on-the-air time. And just because my console looks good doesn't mean that it is inefficient either.

So get out the ruler and saw and start *your* console. You will be surprised how much enjoyment it will give you.

. . . K2YIH

Listen . . . Fellow Radio Amateur

Bill Orr W6SAI

Author's Note:

Some time ago Wayne editorialized that he had received practically no correspondence in favor of the Incentive License proposal of the A.R.R.L. Upon writing Wayne that I wished to write on this subject, he graciously permitted the inclusion of this article in 73 magazine. I strongly believe the incentive License proposal is a crucial decision facing radio amateurs. This article gives my reasons for supporting this proposal.

Some time in the future, amateur radio will again face a Moment of Truth at an international gathering whose function will be to examine the radio spectrum with an eye to the future frequency allocations for the various services. At that time the question raised will be: What does the radio amateur contribute to the public welfare, convenience, or necessity that justifies his continued use of important world-wide frequency allocations that are desired by other countries and by other services?

As the question revolves about public interest, convenience, and necessity (commonly called *PICON*), the radio amateur must reply in this context, and with an unprejudiced eye. I propose to do that now. I will speak to you as the Devil's Advocate; that is, I will examine the pessimistic side of the situation, in order to say the thoughts that each one of us keeps buried at the back of his mind. I am going to step on your toes, jab you in the ribs, and give you a poke in the eye with a sharp stick.

No organism grows unless it is irritated, and amateur radio has not been irritated for many, many years. It is going to be irritated to a high degree during the coming years, I assure you.

Let me begin this critical self-examination with reference to Paragraph 78, Article 1 of the International Radio Regulations, Geneva, 1959 which defines amateur radio as:

"A *service* of self-training, intercommunication, and technical investigations carried on by amateurs; that is, by duly authorized persons interested in radio techniques, solely with a personal aim, and without pecuniary interest."

Note that the word "hobby" is not used in the definition of amateur radio.

Further, Section 12 of the Federal Communications Commission Rules and Regulations defines amateur radio as:

"A *service* whose purpose is expressed in the following principles . . . a voluntary, noncommercial communications service, particularly with respect to emergency communications . . . a continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art."

This description of the radio amateur service is further clarified by the following . . . "to be brought about by encouragement and improvement of the radio amateur service *through rules which provide for advancing skills* in both the communication and technical phases of the art . . . expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronic experts, and . . . continuation and extension of the amateur's unique ability to enhance international good will . . ."

You will note that in neither the Geneva Regulations nor in the F.C.C. Rules and Regulations is the amateur radio service defined as a hobby. Amateur radio is legally defined as a *service*: just as much a service as the maritime radio service, the Land Mobile Service, or the Fixed, point-to-point service. The idea that amateur radio exists as a hobby is a dangerous one, and a purely amateur concept: to defend amateur radio on the basis of a hobby is, in my mind, a dangerous risk, placing us in an indefensible position that we otherwise would not have to face in the coming years.

The view of amateur radio as a hobby is a widespread and dangerous one, and the fundamental definition of amateur radio as a service has been gradually eclipsed in the past few years in a mass exodus to the hobby concept. Where, may I ask do certificates, round tables, DX-chasing, or other operating pleasures fit within the concept of PICON? Could we be mistaking the pleasant trappings of hobby-ism for the real pursuit of amateur radio?

To examine this fundamental difference of viewpoint, let us look backwards a few years in order to ascertain from what position amateur radio has grown, and from that position observe the state the amateur service has now reached. The pre-World War II year of 1940 is a good starting point, as it signifies a distinct break with a way of life.

The 1940 radio amateur constructed a good deal of his equipment. His ability to talk—to have a QSO—was the successful and only reliable test of his station and equipment. In those days before propagation predictions were generally available, a vast fund of intuitive knowledge was gathered by virtue of DX contests and long distance QSO's to further the new art of propagation prediction. "Long path" openings were first exploited on 14 megacycles by radio amateurs in pre-war days. Further, radio amateurs led the way in expansion of the VHF field. Commercial VHF gear was patterned after amateur equipment.

The 1940 amateur radio license (particularly the old class A license) implied a high degree of manual skill and technical knowledge in the holder thereof. *Thinking* and *doing* were essential, and the radio amateur absorbed knowledge in the process of getting on the air and making contacts. True, the level of knowledge was low compared to today, but the level of mastery was high. The 1940 amateur achieved, in the broad sense, the mastery of his subject matter to the state-of-the-art level. The state-of-the-art was the pride of the radio ham.

Since 1940, however, mighty forces have been set adrift and we are living in a vastly complicated world of change. We have microwaves, lasers, back-scatter, space communications, single sideband and other sophisticated concepts thrust upon us. The advent of television obsoleted the breadboard transmitter, and today's ham rig is wrapped in an r.f. enclosure that is hardly capable of being made on the kitchen table with a Boy Scout knife. In truth, we now find the radio amateur state-of-the-art approaching the graduate engineering level. If the definition of amateur radio as a hobby is true, should the radio amateur attempt to master this high state-of-the-art?

Perhaps to answer this pointed question, we should look about us today. The 1963 radio amateur now buys almost all his equipment. What amateur builds his receiver today? For that matter, who builds his own transmitter? Or, to be more specific, who modifies his factory-built transmitter? Watch out—a modification may spoil the trade-in value! Alas, what has happened to the thinking and doing aspect of amateur radio?

A good friend of mine owns a radio distributing store specializing in sale and repair of amateur radio communications equipment. You would be amazed at the stories he can tell of hams who bring in their gear to be repaired. "My receiver won't work properly," says the disgruntled owner. Opening the lid, the serviceman finds a burned-out tube, a blown fuse, or other obvious trouble. "Today's amateur doesn't even bother to read the instruction book," says my friend. "He's too eager to get on the air and chatter in a round-table Que-so!"

Suppose we look for a moment at today's "reservoir of trained operators, technicians, and electronics experts." A pool of trained operators (communicators, that is, adept in all modes of communication) is certainly a comforting thought and right in line with *PICON* concepts. Yet, today's communicators have been diluted in a sea of confusion. We have several phonetic alphabets, and common procedures and techniques are forfeited to outright rudeness and ignorance.

"Break . . . break"

"Gimme a clear channel for phone patch traffic"

CW operating skill is being subordinated to contest-style operation, and a skilled traffic-operator is vanishing like the Dodo Bird. Phone operation, with the exception of a small public service function of questionable value, does not contribute one whit to the requirements of *PICON*.

As to the "pool of trained technicians and skilled electronic experts"—it is obvious that such a group of radio amateurs—if they really exist—is indeed valuable and a contribution to *PICON*. These amateurs are the living potential for tomorrow's growth in amateur radio, and in engineering, technology and allied arts. This group can contribute to unique areas of research and development that are in the interest of amateur radio and the public.

How fares this "reservoir of trained technicians and skilled electronic experts?" Judging from the words of the radio store owner—not so hot! Others agree!

A well-known West Coast educator, who is also a radio amateur, has this to say:

> "Young radio amateurs, in general, are among the poorer students in engineering and technology. They have the assumption they do not need the basic theory of engineering. They question the worth of the mathematical approach, relying instead on hit-or-miss work. In general, they have no desire to learn basic circuitry. They exhibit a lack of original thinking, and slavishly follow the ideas of others. They cannot analyze a problem, nor do they know the order of magnitude of results to expect."

A sad commentary on today's "reservoir of trained technicians."

A well-known engineer, who is a radio amateur and a project director in a large electronics firm, has this to say about the "reservoir of skilled electronic experts":

> "Twenty years ago when a radio amateur came to our organization for employment, his amateur license was prima facie evidence that he was a technician and knew which end of a soldering iron to pick up. He could read a schematic, he was eager to learn, and he had the capability of technical growth. Today, although the electronic industry is crying for trained technicians and engineers, by and large, they are not coming from the ranks of the radio amateur. Possession of today's radio amateur license does not mean that the holder is technically qualified in any sense of the word. The level of skill of the majority of today's radio amateurs, generally speaking, is not high enough for even proper maintenance and operation of commercial or military electronic equipment. Openings are continually available for competent people. It would be nice if they were radio hams."

A sad commentary on today's "reservoir of skilled electronic experts."

These remarks are not unique, and they are symptomatic of amateur radio today. It may be overly pessimistic, but it looks to me as if the fundamental basis of a radio service has been eclipsed in amateur radio in a mass exodus to the level of the hobbyist.

Now, the radio amateur stands today in a naked and exposed position. He has abdicated his natural curiosity in electronics and basic communications and has substituted a superficial desire to chatter. The hobby aspect of amateur radio has stripped today's ham of even a rudiment of technical know-how.

Regardless of the complexity of today's communications, there exists a minimum body of knowledge that must be known by the up-to-date radio amateur. This body of knowledge continually increases, as the state-of-the-art increases. Unless the radio amateur keeps abreast of this body of knowledge, he really cannot justify his existence in the eyes of *PICON*.

Those radio amateurs who do not keep abreast of conventional knowledge and who thereby do not justify their existence are called "appliance operators" by many.

The appliance operator has the same technical grasp of electronics as the housewife who dumps a load of dirty clothes in the automatic washer and presses the "on" button. And like the housewife, when the washing machine breaks down, the appliance operator calls the serviceman!

I believe, to our shameful detriment, the true radio amateur is rapidly being drowned in a sea of appliance operators. This new species of non-radio amateur is a talker par-excellence. He collects certificates, joins the local radio club, joins round-tables, earns awards and is certainly in evidence on all the bands. If nothing else, he is certainly vocal. Unfortunately, his real technical knowledge is nil, his interest in the service aspect of amateur radio is nil, and he exists only to enjoy his own chatter.

The appliance operator looks upon amateur radio as a hobby—an emotional release from the cares of the day, involving little or no technical skill or understanding, and little intellectual involvement. He does not view amateur radio as a vehicle for advancing the state-of-the-art or satisfying *PICON*, but as his own personal hobby. He has a party-line telephone to the world!

Now: this appliance operator has a grim, vested interest in his hobby and he exhibits a determined desire to cling to his great, electronic toy. Why?

First, he achieves a degree of status in his community of friends by the mere fact of owning and operating complex gear in his home. Possession of complex equipment is thus equated into knowledgeable use of the equipment.

Then, too, by the expenditure of money (ten percent down), any Mister Milquetoast can become a loud voice on the ham bands. Unfortunately, opinionative and often uninformed appliance operators find amateur radio an excellent outlet for their frustrations. Tune in any day and listen to the self-styled experts solve all problems!

Also, the appliance operator enjoys the homey, person-to-person social aspect of the hobby. Clubby meetings, a little intrigue, round-tables, contests, certificates of false achievements, DXpeditions: all provide a romantic thrill and sense of well-being and an emotional release from daily monotony. Why worry about *PICON?*

In addition, the appliance operator enjoys an equality of all on a first-name basis. He can "exchange handles" with the scientist and the senator. He is as good a ham as the next fellow.

This may be fun, but in my opinion, it is not the basis of amateur radio, nor can the hobby aspect justify, on an international basis, the use and occupancy of valuable frequency bands coveted by other nations and by other services. These aspects of ham radio do not tie in with either the Geneva or the F.C.C. definition of amateur radio. The unnatural stress and inflated importance placed on the hobby aspect: contests, certificates, and chattter—by the appliance operator literally submerges the service aspect of amateur radio and reduces us to impotence and frustration. A continuation of this blather will soon result in QST and other amateur radio publications being reduced to historical journals, dealing with past victories of the hobby of amateur radio.

As things are going now, the place of the appliance operator really belongs in the Citizens Band. To be brutally frank, the hobbyist: the appliance operator, emulate to the highest degree the hopes and aspirations of the Citizens Bander. Yes, you, the appliance operator represent the final goal of the Citizens Bander. He yearns to be you!

Yes, the division line between the CB jockey and the appliance operator is a thin one, indeed. And there are close to a half million CB'ers. Two minds but with a single toy to play with!

It would seem, therefore, that a purely hobby-style philosophy of amateur radio is a dangerous view and cannot justify the retention of valuable radio frequencies in the amateur service in view of the pressures that will be placed upon us by other countries and services. What is to be gained for amateur radio by Citizens-Band style of operation beyond the self-satisfaction brought about by the ego-inflating sound of one's own voice? Here, indeed, is our dilemma.

There is no doubt that the hobby aspect (the communication aspect) of amateur radio delivers a great deal of comfort and enjoyment to amateurs who couldn't care less about the more important service connotations of amateur radio. The idea that ham radio is a hobby and every ham is free to pursue his hobby is a widespread and simple belief. The appliance operator, adamant in his vested interest in the status-quo refuses to acknowledge that amateur radio is more than a hobby. The fact is that amateur radio cannot justify the luxury of self-styled hobbyists subordinating the PICON service definitions for his selfish interest in hobby-time chatter.

Observe the hue and cry raised throughout the land over the simple proposal of Incentive Licensing! The appliance operator shouts, "You can't take my rights away from me." Listen, radio amateur: we do not posses "rights"! Amateur radio is a *service* and we enjoy a privilege granted to us on an international basis that may be taken away by a majority vote of nations, many of whom could care less about the amateur service!

The serious radio amateur listens in amazement as he hears arguments against a philosophy of self-education and self-improvement. He is chagrined as he hears the radio amateur service debased and degraded by a flood of chatterers who have no concept of the true meanings and deep traditions of amateur radio. This is a sorry spectacle, indeed. The Incentive License Proposal, actually, is only one important point in establishing amateur radio as a true service. All other services have strict disciplinary structures; why not amateur radio? What excuse do we have for mail-order-style licenses? Do we not all join other services, and all use the same electronic gear and the same ionosphere? A good case may be made that the radio amateur examination be raised to a technical level equal to the radio telegraph or radio telephone first class licenses. Why not?

On the other hand, those who insist amateur radio is only a hobby could very well hold the opposite view: reduce the code exam to the minimum allowed under the Geneva convention and open the gates to everybody. After all, you don't have to have a license to be a stamp collector!

So the all-important question that I submit to you is this: Is amateur radio a service, or is it a hobby? Once this question is answered, the answer to the future of amateur radio is self-evident and requires no argument.

I look at the Geneva definition and the F.C.C. definition and I say amateur radio is a service. I also say that, in general, amateur radio is to-

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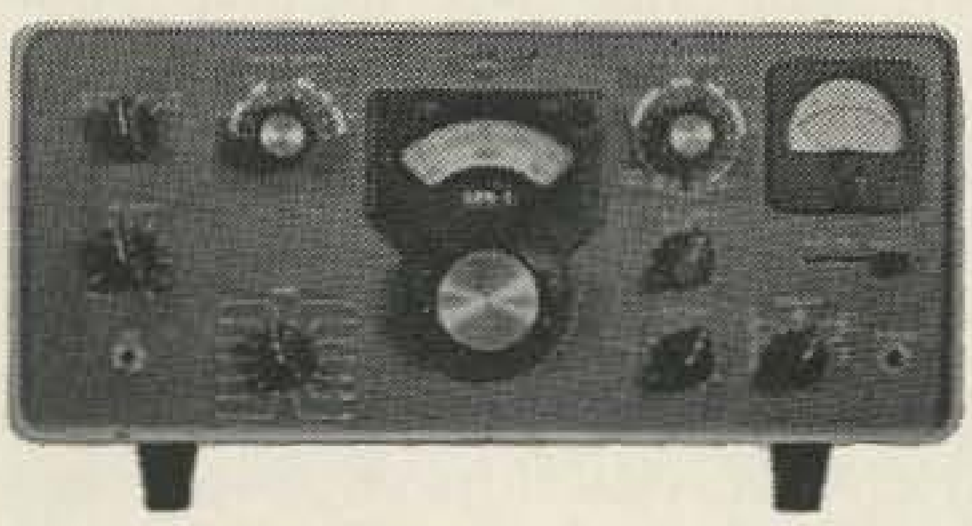

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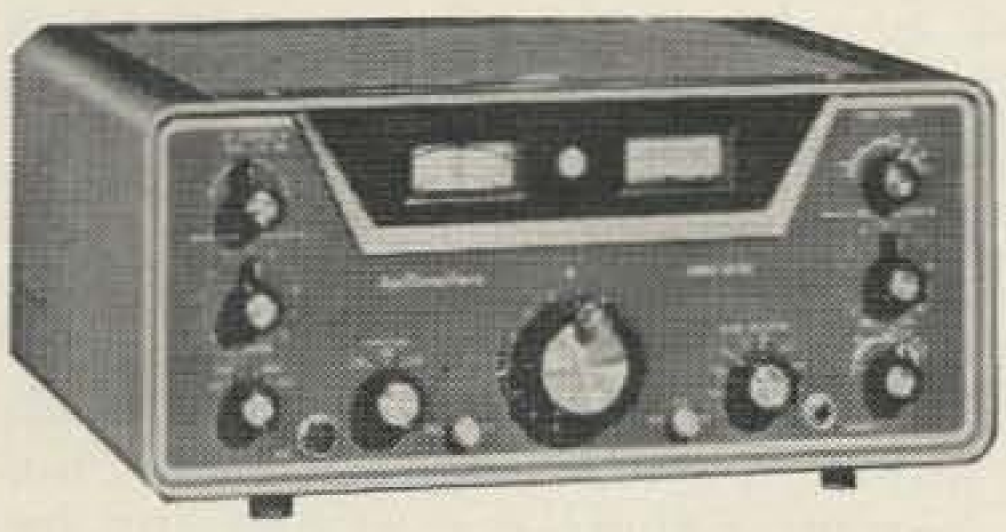

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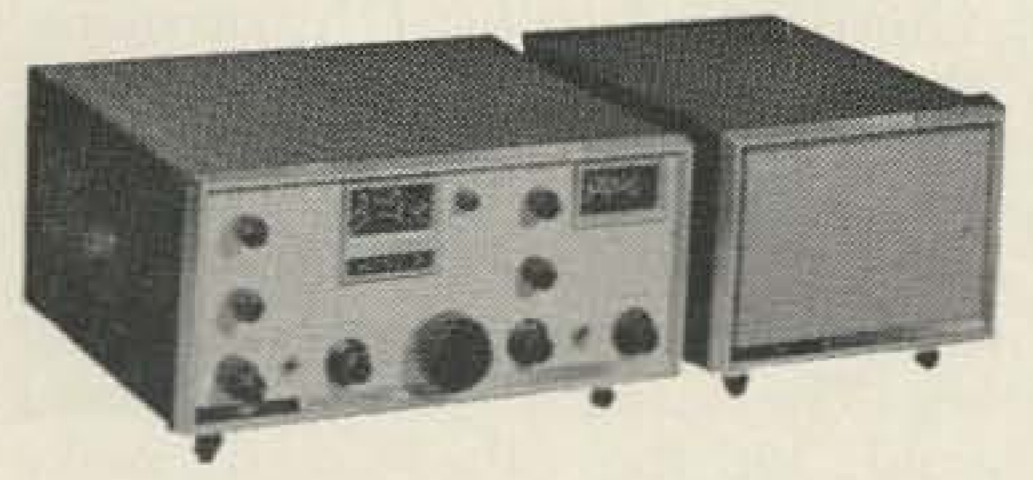

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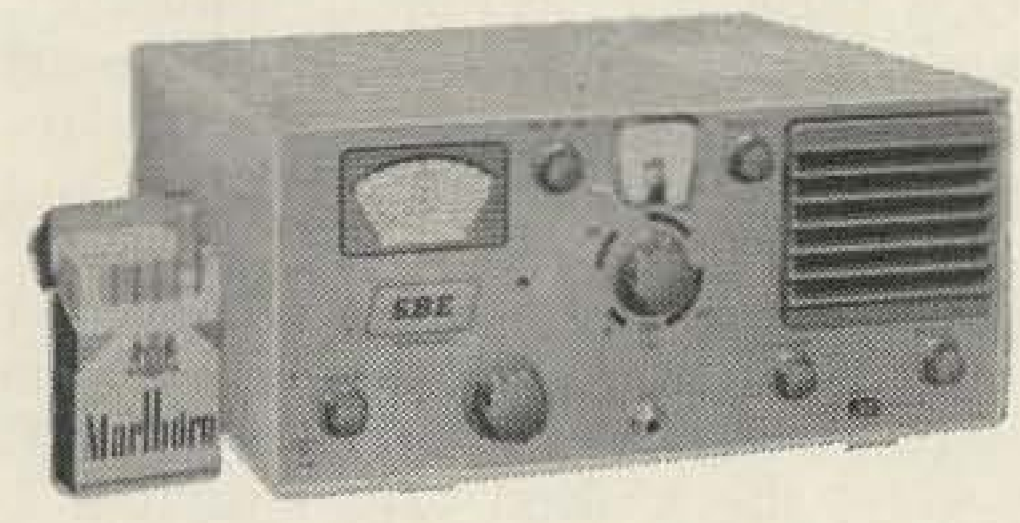

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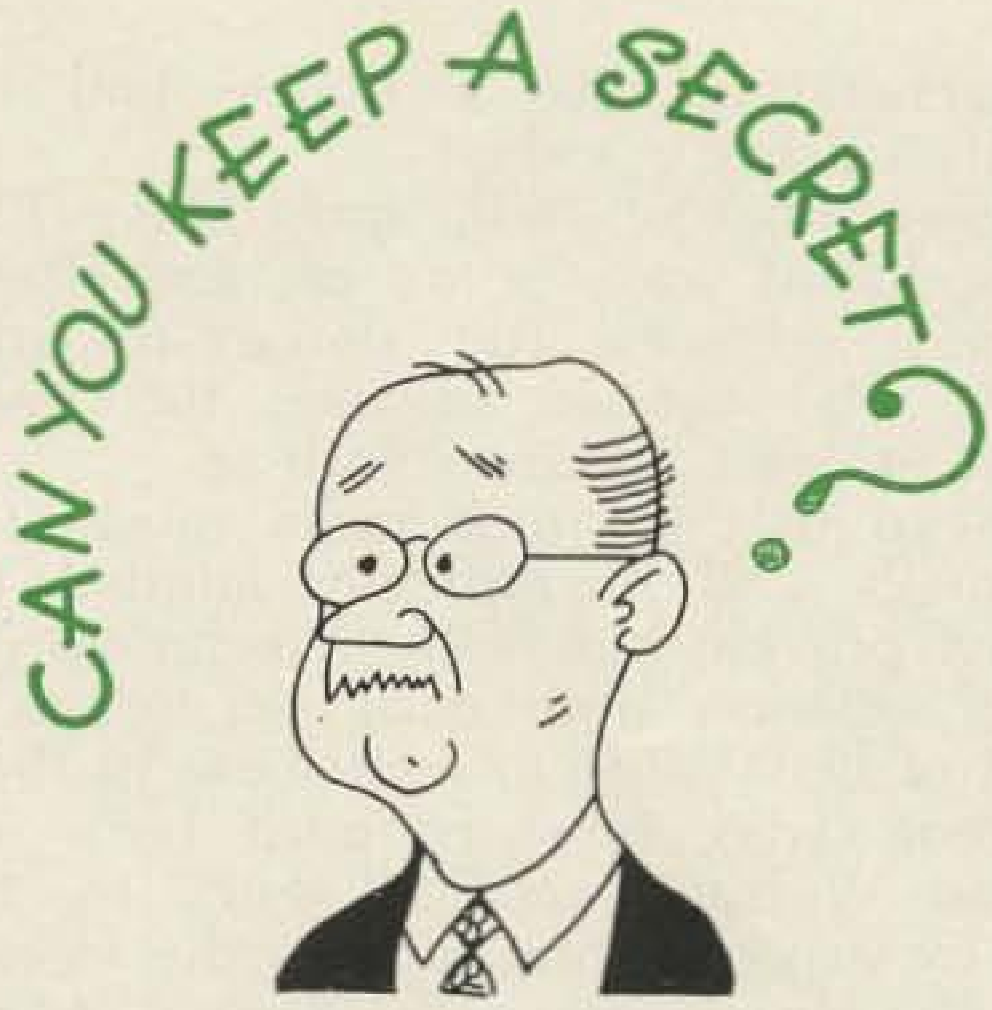

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day degenerating into a hobby and does not justify its existence today.

I believe amateur radio must serve PICON in the most literal way, or we are lost. Radio amateurs must advance the state-of-the-art. Those amateurs who cannot advance the state-of-the-art must at least advance with it.

I believe that amateur radio must attract the intellectually and scientifically minded youngster and must provide him with a technical entré into fields of science, and must encourage him, to the best of his ability, to contribute to these fields.

Amateur radio, in short, must be a vehicle of education. We must not "sell short" the beginning Novice by exposing him only to the vices of amateur radio. He must see the virtues as well.

I believe amateur radio must contribute to international good will and understanding between countries. The RST 599 DX-style QSO with a buck for the QSL card holds us up to the contempt of most foreign radio amateurs. We should use our wonderful radio ham spirit and DX-ability for better purposes than this!

I believe the provincial outlook of our amateur radio periodicals must change forthwith. When you read today's ham journals, it would seem that ham radio does not exist outside the U.S.A., except for ersatz DX-peditions. We must achieve an interchange of views with overseas amateurs and must introduce the new I.T.U. nations to amateur radio, if possible. Perhaps this may be accomplished by amateur radio through the Peace Corps. Life must once again be breathed into the International Amateur Radio Union. We must speak to overseas amateurs in their own tongue. How many of us could hold a QSO in Spanish, French, or Russian? How can we gain the respect and good will of people if we can't speak their language? The immense good will power of amateur radio lies quiet in our hand and we must avail ourselves of this power immediately.

Moreover, I believe these additional questions must be answered: Can amateur radio be of help in advancement of underdeveloped areas of the world? Can amateur radio work with schools and colleges to assist in the education of young people? Why does not amateur radio sponsor a scholarship program to aid worthy, young amateurs who cannot afford a formal scientific education? Why not?

I believe amateur radio has the unique opportunity to enter new and exciting fields of astronomy, mathematics, telemetry, space communications, and propagation. Areas *do* exist wherein the true radio amateur can expand the state-of-the-art. Lasers, upper atmosphere study, Faraday rotation, moonbounce, space location of objects, space satellites, voice to digital conversion, one-way propagation effects, and many other aspects await our interest. I sincerely hope we have this interest.

It is discouraging in the extreme to hear that whenever QST prints a technical article in some advanced field, the League receives a barrage of letters from appliance operators complaining that the article is too technical, and that it takes up space that otherwise could be devoted to contests, DX, operating news, or gossip.

I believe that we stand at the crossroads today, and every indication points to the wrong choice of direction. The appliance operator's emphasis on communication pleasure as his right and hobby will not prove to be a justifiable reason for the continued existence of amateur radio in the years before us. Amateur radio cannot afford the luxury of existing for the appliance operator, without having compensating efforts exerted in *PICON*, or the service aspect. We cannot escape the Day of Judgment, which is fast approaching.

Happily, there is still time left to place our house in order. If we act quickly and properly, we will not have to face the Moment of Truth when we will be found wanting. All is not lost if we recognize what has to be done and if we live up to our responsibilities. The present image of amateur radio as the private hobby of 250,000 individuals, the great majority of whom are oblivious to the *PICON* service aspect, could not possibly stand up under the cold scrutiny of countries who have but a handful of radio amateurs, and who are in need of vital telecommunication frequencies.

Does this all mean that I am proposing that only graduate engineers with a Ph.D. degree should qualify for amateur licenses? Or that all commercially built ham gear should be classified as contraband? Most certainly not! What I am saying to you is that if we use commercially built equipment we should certainly have a good working knowledge of what goes on behind the panel knobs and be able to make a good start at repairing and adjusting the innards ourselves if the gear doesn't work right! Simply stated, we must keep abreast of the state-of-the-art.

There will always be those who lean towards the technical side of amateur radio, just as there are others who find more enjoyment in operating. The latter group, particularly, are the ones who should be searching their consciences to see if they are really contributing to *PICON*, or merely entertaining themselves with a "hobby" at the expense of a truly great service.

I have no wish or desire to eject any radio amateur out of our ranks. Far from it. We need every amateur we can get: real amateurs, not appliance operators. The latter are Citizens Band material. We should, on the other hand, make an honest effort to raise our technical standards, technique and knowledge to meet state-of-the-art specifications. In addition, we must always remember that *PICON* comes before chatter, not after it!

I say we must wake up! We must realize that there are over 120 countries represented in the International Telecommunications Union and each country has one vote, the United States included. Over thirty new nations have recently been added to the I.T.U., since the last radio conference in 1959, and many of these countries do not even have the necessary high frequency channels necessary to conduct their own internal affairs, let alone conduct international communications. They gaze with envy and a cold eye upon our amateur bands, chock full of chatter and nonsense. Ask yourself: what possible interest could these countries possibly have in the reservation of over *ten percent* of the high frequency spectrum for the exclusive enjoyment of a group of hobbyists, playing with communications as if it were a toy, or a party telephone, dabbling with contests and certificates at a buck a throw?

We must provide the U.S. Delegation to the I.T.U. with sufficient ammunition to protect us!

Amateur radio must live up to *PICON* and the Geneva definition. It must provide, at a bare minimum, some means of self-advancement and incentive for the radio amateur to prove his worth and to justify his existence. The proposed Incentive License Proposal is a specific case in point. It amazes me to see such a worthwhile proposal, designed for the betterment of amateur radio, meet with so much emotional opposition—and from individuals that should know better!

In my opinion, amateur radio has the choice of either progressing forward, in step with the advancing art of communications—in the true definition of *PICON*—or of gradually disintegrating into a lowly form of Citizens Radio, in the worst sense of the word, restricted to narrow frequency bands. I fervently hope it will do the former, and I am encouraged that so many amateurs take this long-range attitude. We must raise our sights and embark on a program of self-improvement. One logical step—and I believe others must follow—is the creation of an Incentive Grade License. We stand in a morally defenseless position without this. The shoe may pinch a bit at first, but the disadvantages and risks we run by doing nothing are more than those run by taking decisive action to improve ourselves.

Let us hope, then, that if we take the correct turn at the crossroads, following the path through this forest of diverse interests, we will soon arrive on the broad, sunny uplands wherein the communications operator can occupy his correct place in this wonderful amateur radio service we all enjoy so much, and which is capable of so much good.

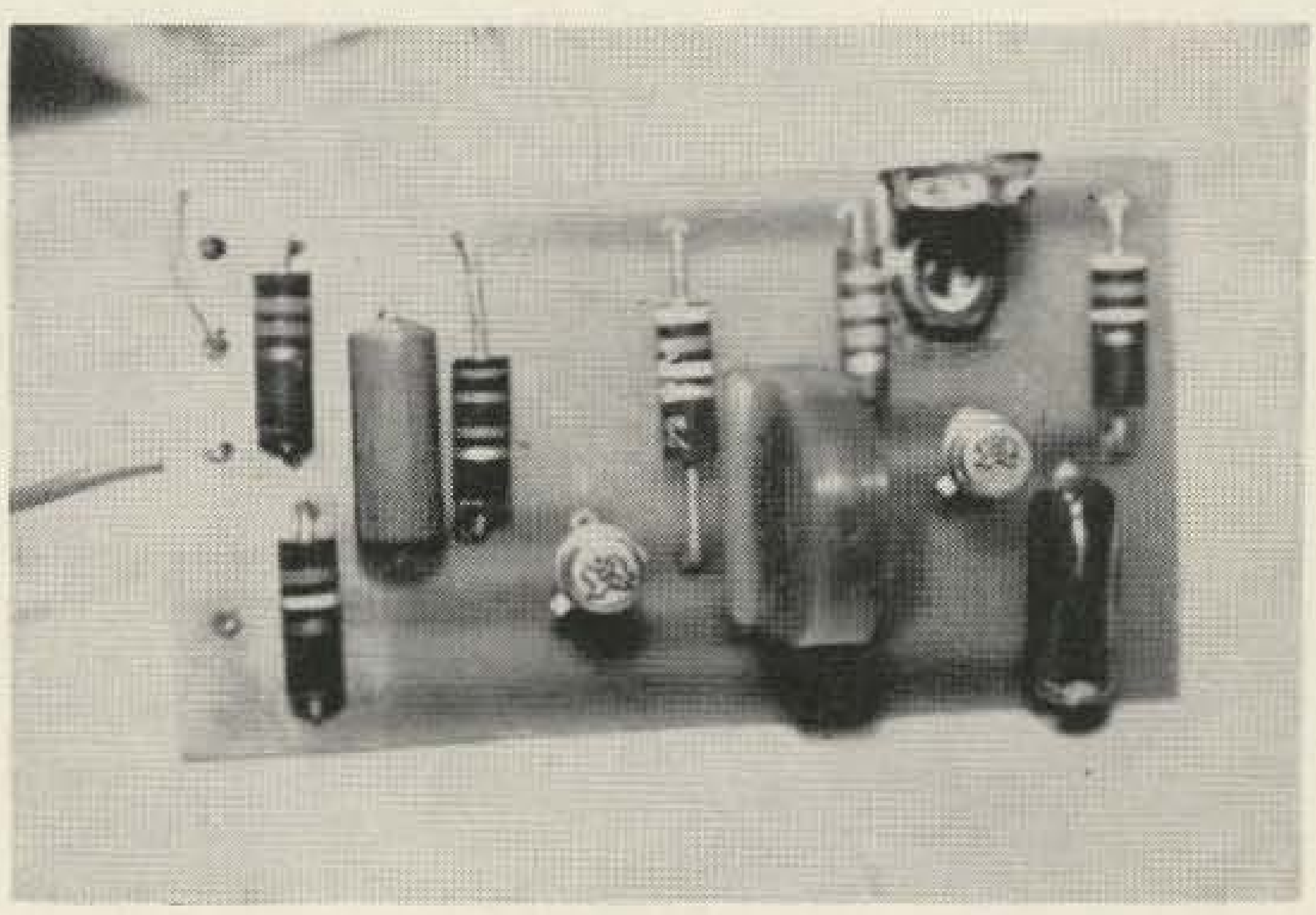
These pursuits which reflect the hobby aspect of amateur radio, when viewed in the proper perspective, are well and good. In the proper degree, these enthusiasts—the so-called appliance operators—will in actuality disappear and true amateur radio operators and enthusiasts will be found in their place, joining the estate of amateur radio, growing with it in stature as the art progresses.

Let us face this pressing problem. The answer must come, and it will determine our fate. The time is short. The American Radio Relay League asks your hand and heart in a vote of confidence. I say, cast a vote for amateur radio!

. . . W6SAI

Communicator IV BFO

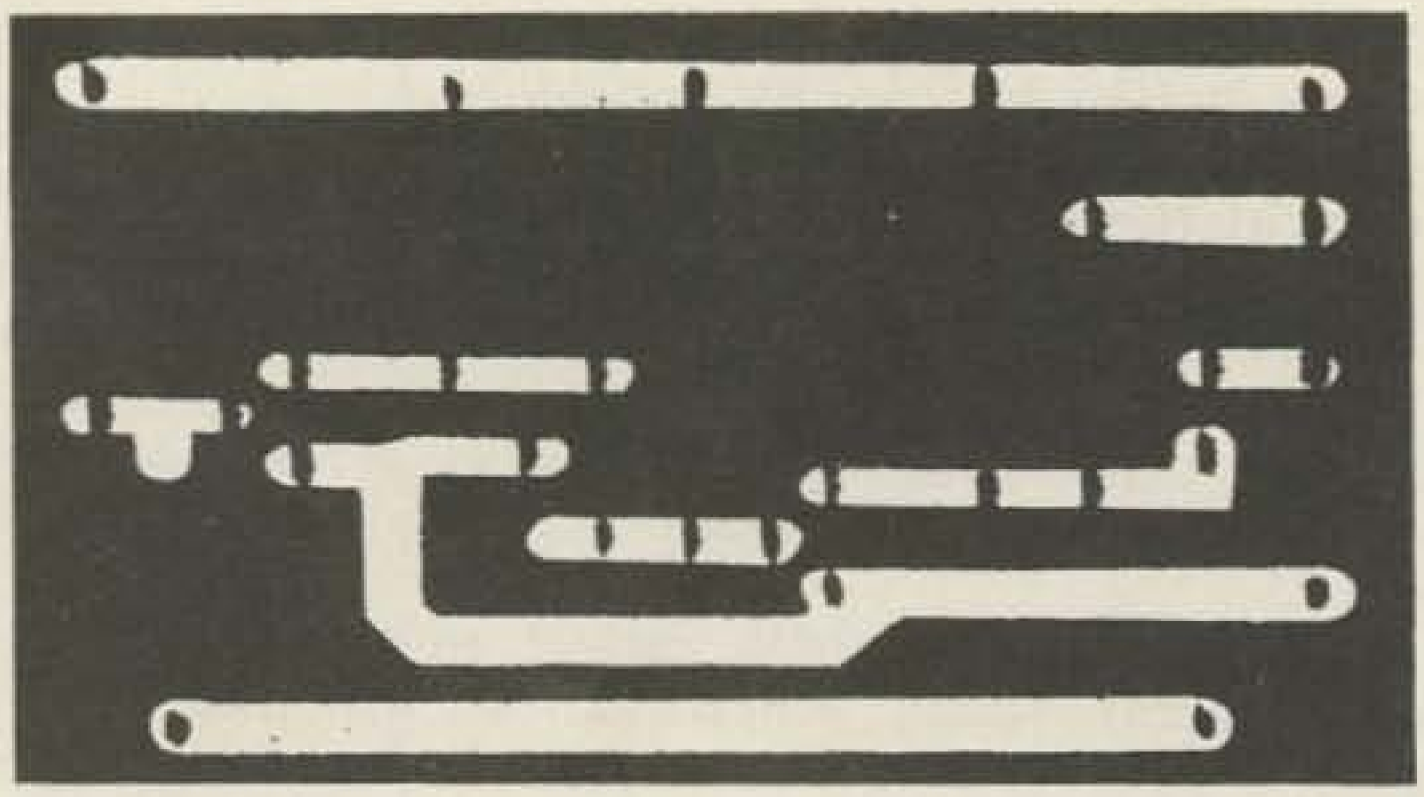
Ronald Vaceluke W9SEK
Buckhorn Ranch Trailer Park
Lot B-39
Des Plaines, Illinois

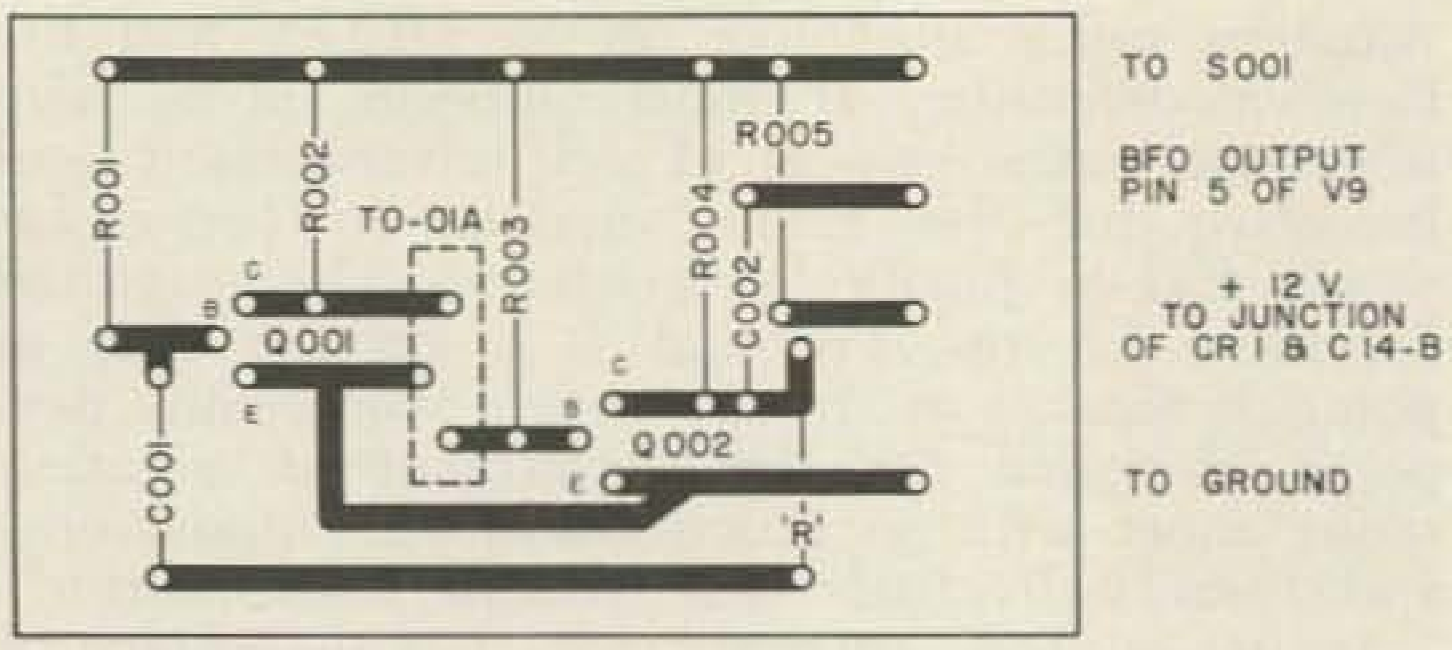


Transfilter TO-01A shown between the two transisters

The "stock" model Communicator IV as manufactured by Gonset leaves few things to be desired in a package VHF unit. However, the need for CW provisions became apparent at the Syracuse VHF roundup when W2WZR replied to my CQ on CW (Jim refuses to use AM!). Oh, sure, I could copy him by setting the threshold point on the squelch and letting him break through the noise, but this is a crude way of doing things. It can be done with a strong signal, but when the signal level is down this method is useless. What is needed then is a BFO and of course, since we want to be able to reciprocate and squirt CW back to the other end, we need a key jack to plug the old J-38 into and a few more odds and ends. The odds and ends for receiving are a BFO, and rf gain control. As for transmitting, a key jack and AM/CW switch. Since the audio circuit is common to both transmitting and receiving it has to be switched automatically, this means the addition of a relay.

Now comes the hard part; where to put all the modifications without damaging the resale value of the unit. Close examination of the rig will show that the mode switch, key jack and rf gain control can be added without changing either the front panel or rear apron. Just below the VFO control jack on the rear of the unit is a spare D shaped hole for an optional variable capacitor. By filing a flat on





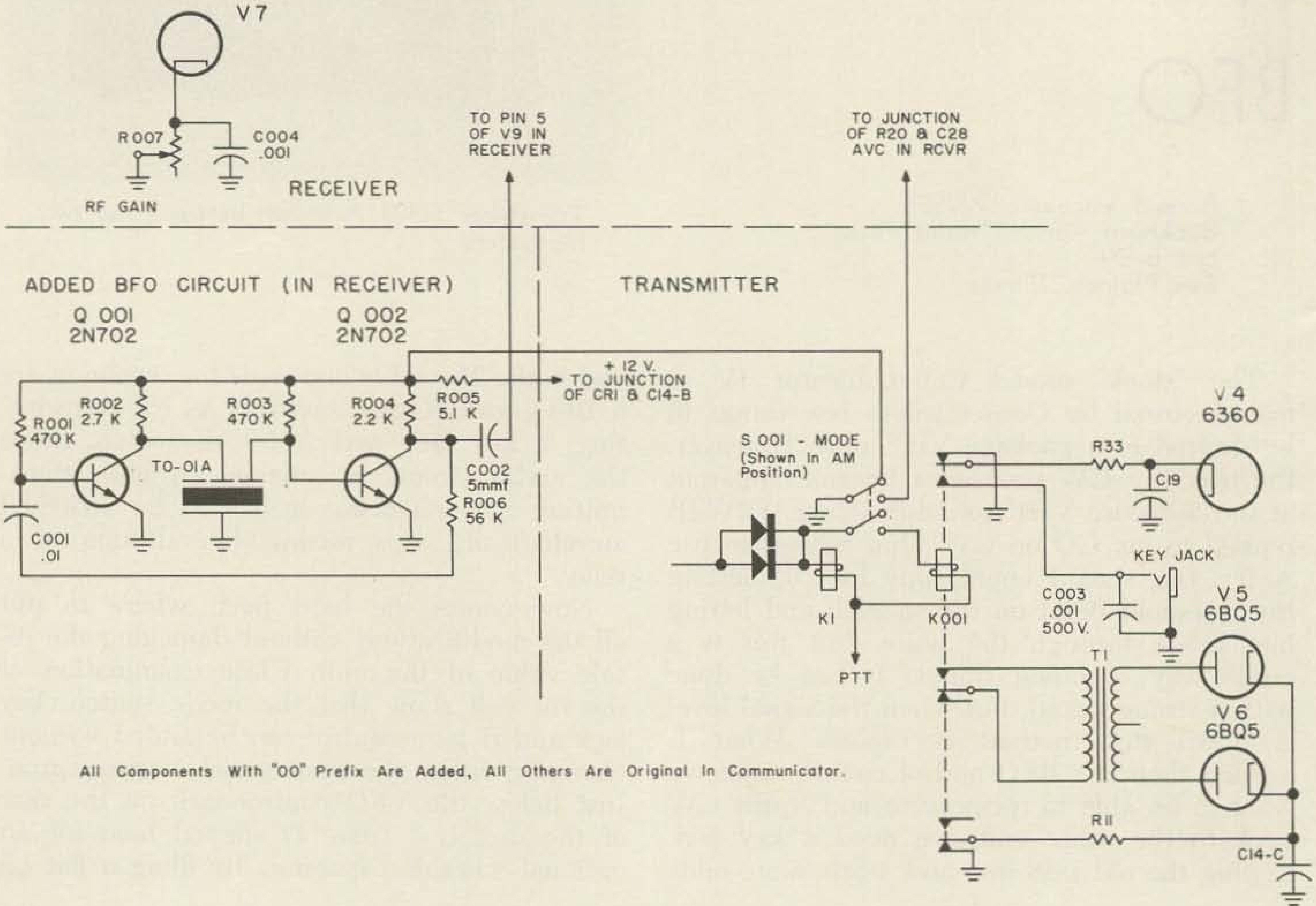
the threads of a phone jack, we have a very usable key jack. Now to attack the front panel with a gain control and mode switch. The rf gain is easy if we use a concentric shaft control in place of the audio gain. By using this method we have an audio gain and rf gain control with two knobs where there was only one. How about the mode switch? Hmmm . . . say, how often do you turn the dial lamps on and off? That's good because this now will serve a different purpose. Remove the two leads on the lamp switch, solder them together and insulate. The switch is a spst unit and must be changed to a dpdt. There are two ways of doing this. The first is by removing the front panel and drilling out the rivets that hold the switch, inserting a new one, and fastening it into place with small screws. The second and easiest method (my way) is to merely change the working parts. This is done by carefully raising the four tabs that hold down the bakelite insulation; removing the innards, replacing them with new parts from a dpdt unit, and then bending the tabs back down. It takes longer to describe it than to do it.

The mode switch performs the following functions:

CW—Put RY 001 in the circuit; Ground the AVC line; Turn the BFO on.

AM—Remove RY 001 from the circuit; Restore the AVC line; Turn the BFO off.

The relay is mounted next. The one I used came from a friend's junk-box and was originally a surplus unit but any small 3 or 4 pdt contact arrangement can be used. I mounted my relay under the main chassis next to the receiver with a small bracket by drilling several small holes in the chassis to accommodate this bracket. The relay mounting and placement will depend upon the size of the unit you use but it is not critical. The relay oper-



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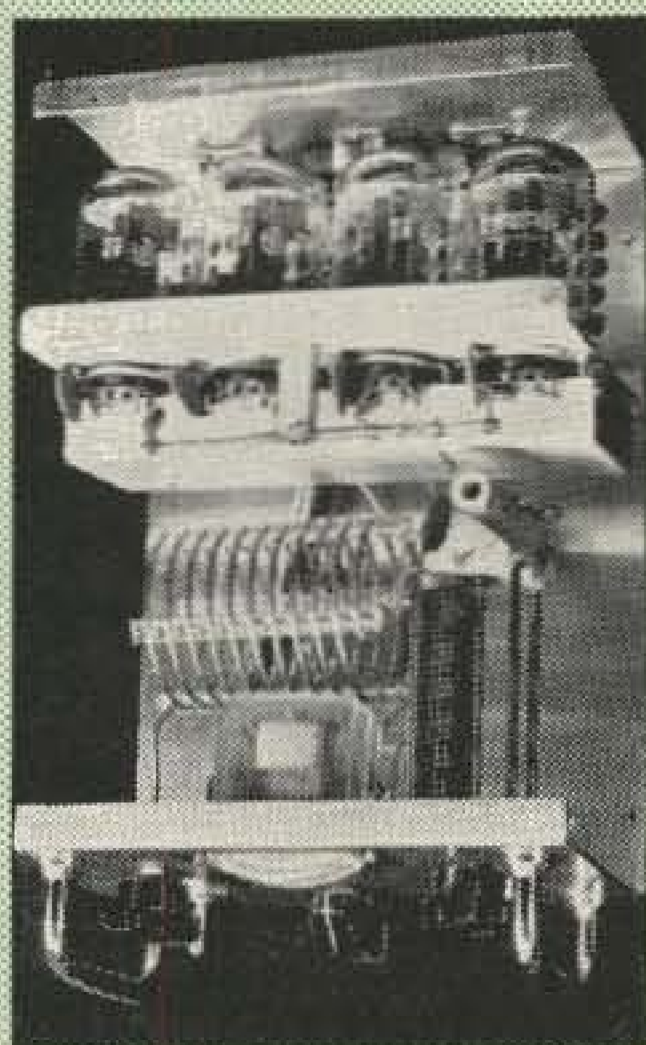

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- CONTROLS — On-off switch — Band selector — Tune and load — Plate current meter
- RELAYS — All transfer relays are included for TR or independent operation of the exciter
- POWER SUPPLY — A separate solid state power supply for either mobile or fixed station is a companion feature:
  AC — LSA-3/115 — for 115V. AC Input
  DC — LSA-3/12 — for 12 V. DC Input
  Output — 800 V at 650 MA Plate
  270 V at 100 MA Screen
  0-90 V Negative Bias
  12.6 V — Filament

With AC or DC Power Supply . . . $249.50
LSA-3 Linear Amplifier without Supply $150.00

Order now from your favorite dealer

LINEAR SYSTEMS INC. ADCOM
605 UNIVERSITY AVENUE
LOS GATOS, CALIFORNIA

ates only on transmit and only when the mode switch is in the CW position. The function of this relay is as follows:

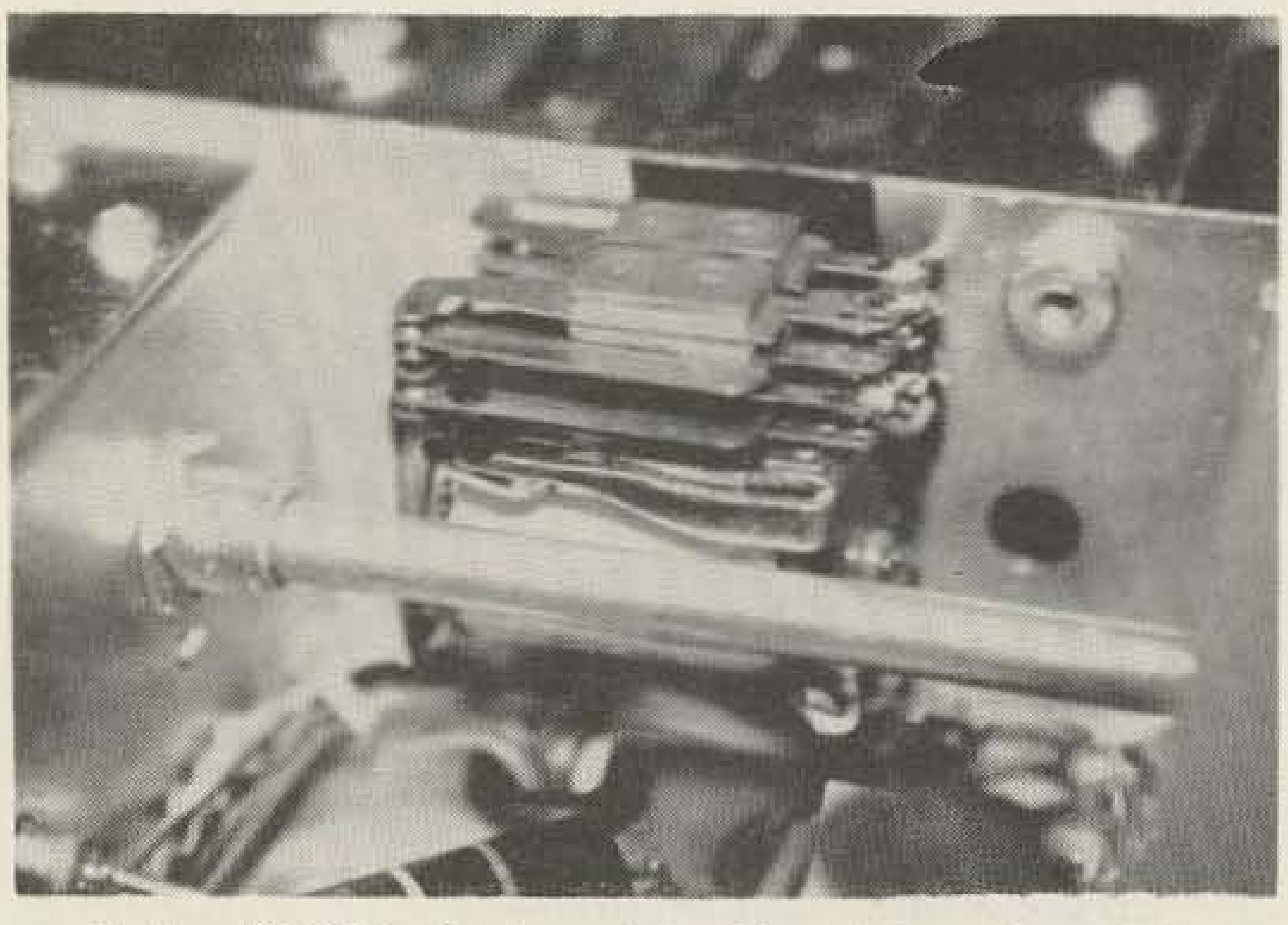
Transmit: Short the secondary of the modulation transformer; Lift the cathode lead of the modulator/audio output tubes from ground; Put the key jack in cathode lead of the 6360.

Receive: Remove the short from the modulation transformer. Restore the cathode lead to audio tubes. Restore the cathode lead of the 6360 to the normal switching line.

Since the Communicator parts list does not give the current rating of the relay rectifier, I was not sure if it could handle too much additional load current. Therefore, I merely added another silicon rectifier in parallel with the original—any diode that can handle 15 to 20 volts at ½ amp or more can be used.

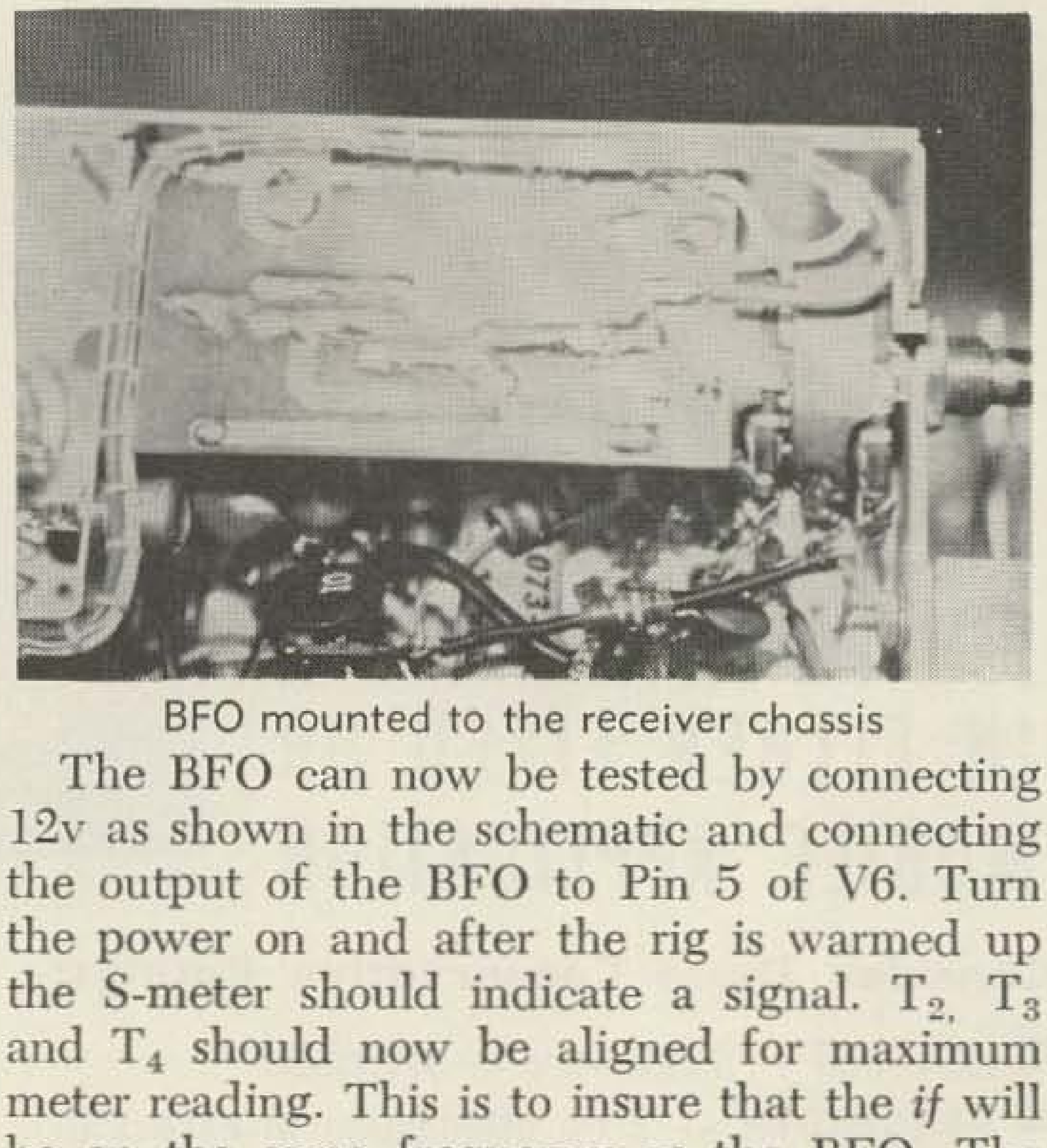
When keying the rig was first tried, the signal was a bit chirpy due to the poor power supply regulation which affected the oscillator screen voltage. This was quickly remedied by the use of a zener diode connected from the screen (pin 1) of V1 to ground. This method is quick and simple and provides a good note on CW.

Modifying the receiver takes a little longer than modifying the transmitter but it is not very difficult.



Relay KOO1 fastened to the side of xmitter chassis

There are several ways to add a BFO, however I believe that the most practical approach is a transistorized unit. Transistors were chosen because of their small size and most important, their lower power consumption. After looking at several schematics of free running oscillators, a recent magazine article [1] caught my eye. The oscillator as originally described used two PNP transistors. These were changed to two 2N702 NPN's that were handy. These can be almost any NPN unit that will oscillate at 455 kc. Construction is not difficult or critical and for those who wish to duplicate my unit, a printed circuit board is shown. If this type of construction is not desired then perforated board and terminals can be substituted.



BFO mounted to the receiver chassis

The BFO can now be tested by connecting 12v as shown in the schematic and connecting the output of the BFO to Pin 5 of V6. Turn the power on and after the rig is warmed up the S-meter should indicate a signal. T_2, T_3 and T_4 should now be aligned for maximum meter reading. This is to insure that the *if* will be on the same frequency as the BFO. The old audio gain control can now be removed and the new dual control added. Leave long leads on the BFO and mount it by means of the ventilating holes in the bottom of the receiver chassis. This placement of the unit will assure that it will be ventilated by convection cooling. After several months of operation, no degeneration of the transistors was experienced due to heat (or anything else for that matter). Now complete all connections as shown in the schematic. All leads concerned with this conversion should now be terminated in a miniature connector and the mating connector should be wired into the main chassis. Remount the receiver and apply the power, putting the new mode switch to CW and the spot switch on. Tune the receiver to the transmitter frequency and listen for the beat note.

It should sound clean. If not, check all connections and both transistors. After the receiver is working properly, plug your key into the key jack and switch to transmit. No output should be indicated on the Communicator's meter until the rig is keyed. Now have your signal checked by another ham or on another VHF receiver in the shack. The note should sound T-9, but if there is excessive chirp check the screen voltage while keying the transmitter. If the voltage swing is more than 2 or 3 volts, the value of the oscillator screen resistor R-2 may have to be lowered to assure "firing" of the zener diode. In my unit this was not necessary.

A cover plate for the new mode switch can be made to dress-up the unit. The original audio knob is drilled thru and will be used as the rf gain and a new knob can be purchased or fabricated on a lathe as mine was.

After several months of use I am quite pleased with the results. Stations have been heard on an aurora opening and with careful tuning SSB stations can be copied.

My thanks to Jerry W9QXP and Art K9TRG for letting me glean parts from their junk boxes. . . . W9SEK

[1] "End of if Transformers? . . . Transfilters!" John Potter Shields, Radio-Electronics, Oct. 1962, Page 41.

Note: Clevite Transfilter available from
Ace Radio Control, Inc.
Box 301
Higginsville, Mo.
Price is $1.25 plus 50c charge for orders less than $3.00

5-7-9

You say you're a contester and don't know when the Goose Bay QSO Party or the PACC CW Contest is? Solve this problem by subscribing to 5 7 9, the only magazine devoted strictly to the fine art of contesting. 5 7 9 publishes monthly listings and complete rules of all contests from small local QSO parties to monstrous DX contests. It also includes the earliest listings of high claimed scores and final results, reaching you only a week after the latest information is received. And cheap, too, only $2.00 per year. Send check, money order, or a roll of nickles to 5 7 9 Magazine, Peterborough, New Hampshire.

Propagation Charts

J. H. Nelson

EASTERN UNITED STATES TO:

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

CENTRAL UNITED STATES TO:

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

WESTERN UNITED STATES TO:

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

* Indicates next higher frequency has a chance of getting through on good days.

Good: 1-4, 17-19, 27-28
Fair: 5, 10-14, 16, 20-23, 25-26
Poor: 6-9, 15, 24, 29-30
Es: 1-5, 16-19, 26-27 (High MUF and/or freak conditions)

Items of Interest

The blackout that came on quite abruptly September 22nd was the most severe of 1963 so far.

The sun was carrying a very large spot at the time about one day past the Central Meridian. A sunspot this size is extremely rare at the present part of the sunspot cycle. With proper eye protection it was visible to the naked eye.

Premium Tubes . . . con't.

TSgt. William Gardiner
511C F.T.D.
Walker A.F.B., N. Mex.

W4WKM's article on premium tube replacements in the November 73 was most enlightening to those of us who frequent the surplus outlets and have a large supply of "four digit" tubes to prove it. Having long ago decided that such a substitution list was vital, I had compiled my own after much research and head scratching.

After comparing my list with W4WKM's work, I found that there existed some discrepancies between the two. I have carefully gone over my list and re-evaluated the cross reference data. The revised list has a few differences, but these could cause much trouble to anyone trying to substitute where substitution is not practical or technically possible. My own listing is herewith shown along with a few notes showing where differences exist between the premium tube and the tube it replaces. I have added some that were not shown in the original work, plus a few CRT substitutions and crystal diode replacements.

Premium Tube	Prototype
1003	OZ4
1223	6C6
1231	7V7
1258	3C45
1613	6F6
(1613 rated for high frequency operation)	
1613	6K6GT
(6K6GT filament current rating is 43% lower)	
1616	836
(836 output current is 92% higher)	
1620	6J7
1621	6F6
(1621 is rated for high frequency operation)	
1621	6K6GT
(6K6GT filament current rating is 43% lower)	
1633	6SN7GT
(Filament voltage rating of 6SNGT is 75% lower, filament current rating is 300% higher)	
1805P4	5AP4
1899	2F21
5022	4-400A
(5022 plate dissipation rating is 37.5% lower)	
5311	931A
5517	1B48
(1B48 current rating is 50% lower)	
5557	287A
5589	376B
5608	6AG5
(6AG5 filament current rating is 70% higher, plate voltage rating is 100% higher)	
5608	6BC5
(6BC5 filament current rating is 70% higher)	
5648	2C39B
(5648 ratings are 11% higher)	
5655	2P23
5681	930
5691	6SU7GT
5693	6SE7GT
(6SE7GT transconductance is 100% higher, plate current rating is 50% higher)	
5695	866JR
5725	6AS6
(Grid-plate capacitance of 6AS6 is 100% higher, plate and screen dissipation is 11% higher)	
5765	2C37
(5765 has feedback)	
5804	1AK4
(Filament current rating of 1AK4 is 66% lower)	
5823	395A
5824	25L6GT
(5824 plate voltage and current rating is 20% higher)	
5826	2P23
(2P23 has lower sensitivity)	
5852	6X5GT
(6X5GT filament current rating is 50% lower)	
5852	6AX5GT
(Output current rating of 5852 is 95% lower)	
5894A	829B
(Filament current rating of 5894A is 20% lower)	
5897	6K4
(Amplification factor of 6K4 is 26% lower, transconductance is 5% lower, grid-plate capacitance is 57% higher)	
5898	6AD4
5910	1U4
(Grid-plate capacitance of 1U4 is 100% higher)	

5933 807
(807 filament current rating is 100% higher, filament voltage rating is 50% lower, length is 1.0625 inches greater)
5993 . . . . 6X4
(5993 has nine pin base, 16% lower output current rating)
X6020 . . . . 1N24
6021 . . . . 6BG7
(Transconductance of 6BG7 is 11% lower)
X6021 . . . . 1N26
6046 . . . . 25B6
(Plate voltage and current rating of 25B6 is 20% higher)
6060 . . . . 12AZ7
(Input capacitance of 12AZ7 is 42% higher, filament current rating is 30% higher)
6085 . . . . 12AZ7
(Substitution satisfactory for audio, not recommended for other applications)
6087 . . . . 5Y3GT
(5Y3GT does not have indirectly heated cathode)
6094 . . . . 6AQ5
(6094 has a 9 pin base)
6106 . . . . 5Y3GT
(5Y3GT does not have indirectly heated cathode)
6111 . . . . 6BF7
(Amplification factor of 6BF7 is 75% higher)
6113 . . . . 6Su7GT
6130 . . . . 3C45
6136 . . . . 6BA6
6137 . . . . 6SD7GT
(6SD7GT plate current is 32% lower, screen grid current is 27% lower, transconductance is 80% higher)
6137 . . . . 6SS7
(6SS7 filament current rating is 32% lower, screen grid current is 27% lower, transconductance is 80% higher)
6155 . . . . 4-125A
6155 . . . . 4D21
(4D21 rated at 25% more driving power)
6186 . . . . 6AK5
(6AK5 filament current rating is 40% lower, plate voltage rating is 50% lower)
6186 . . . . 6BC5
(Transconductance of 6BC5 is 15% higher, plate current rating is 15% higher)
6187 . . . . 6AS6
(Grid-plate capacity of 6AS6 is 100% higher)
6188 . . . . 6SL7GT
6201 . . . . 12AX7
(Filament current rating of 12AZ7 is 50% higher, input capacitance is 30% higher)
6293 6146
6386 . . . . 2C51
(2C51 filament current is 14% lower, amplification factor is 100% higher)
6550 . . . . 6L6G
(Current and voltage ratings of 6L6G are 50% lower)
6660 . . . . 6BA6
(6660 is designed for mobile communications)
6663 . . . . 6AL5
(6663 has heater cycling rating)
6667 . . . . 6CL6
(6667 designed for mobile communications)
6669 . . . . 6AQ5
(6669 has heater cycling rating and is designed for mobile communications)
6677 . . . . 6CL6
6679 . . . . 12AT7
(6679 designed for mobile communications)
6680 . . . . 12AU7
(6680 has heater cycling rating and is designed for mobile communications)
6681 . . . . 12AX7
(6681 has heater cycling rating and is designed for mobile communications)
7700 77
7756 . . . . 6AR6
8020 . . . . 100R
8020 578

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HQ-145XC	General Coverage Receiver	289.00	10.25
HQ-170AC	Ham Band Receiver	379.00	13.50
HQ-180AC	General Coverage Receiver	449.00	16.03
HK-1B	Electronic Keyer	39.95	1.26

Model	Description	Price	Look At These Low Monthly Payments After $5.00 Down
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HXL-1	Linear (Available Soon)	395.00	14.08
S-100	Speaker	14.95	.48
S-200	Speaker	19.95	.62
CB-23	23 Channel Citizen's Band	249.50	8.82
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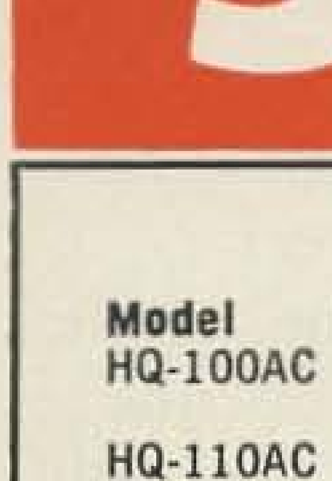

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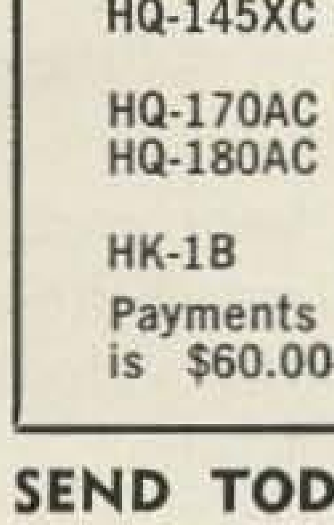

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I have to trade________(what's your deal?)

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Not only will I give you a terrific trade-in allowance, but you can keep your equipment until you receive your shipment.

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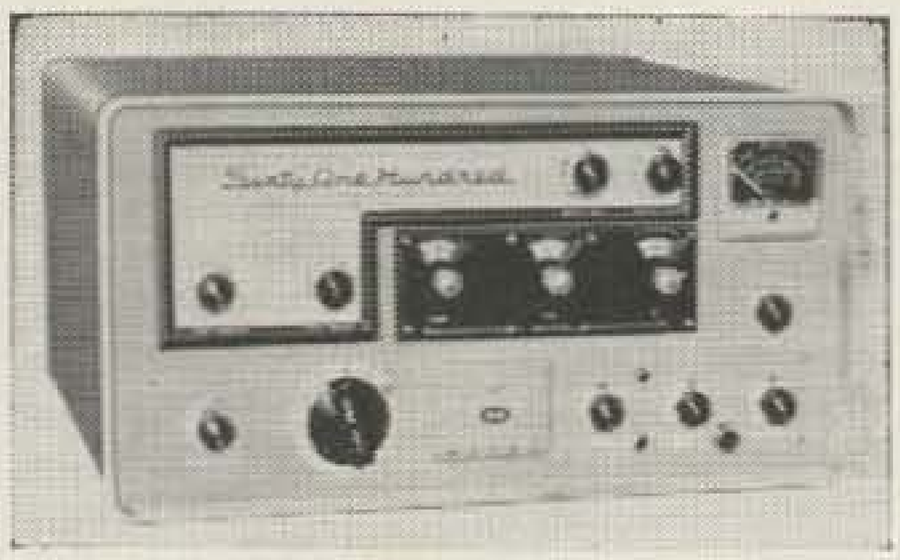
73 Tests the



B & W 6100

An incredible amount of design has obviously gone into the B & W 6100 transmitter since it is a radical departure from present day amateur transmitter equipment. The big difference is the tuning system. Instead of the usual one knob for tuning the transmitter VFO, the 6100 uses three and they are so accurate that you can read your frequency directly on them.

This is accomplished by means of a frequency synthesizer, a veritable forest of crystals inside which are switched by the 100 kc control, the 10 kc control and then "rubbered" by the last knob, which is calibrated directly in kilocycles. The megacycles are set by the bandswitch.

The crew at the 73 hamshack were quite impressed by the ease with which you can go to any desired frequency just by setting the dials . . . and you are within 200 cycles, invariably. Needless to say the unit is rock-stable. Another good feature was the extreme ease of tuning up on any band. Once you learn the system you can flip to any frequency on any band and be tuned up in a few seconds. Though fellows don't pay a lot of attention to how ham gear looks, we did notice that the XYL's visiting the station almost always had something nice to say about the 6100. It *is* a beautiful piece of gear, in case you hadn't thought of it.

The 6100 runs 180 watts PEP on sideband and CW, and 90 watts on single sideband AM phone to a pair of 6146's in the final. It has VOX, push-to-talk and manual operation.

The ALC circuit is particularly effective in the 6100. It feeds back voltage to two earlier stages, each with a different time constant (one is .03 seconds to control the gain during syllabic variation, the other 1.5 seconds to control the gain between words), with up to 10 db of voice compression resulting. This can be read on the panel meter in one switch position.

The panel meter also reads the cathode current of the final and the output power.

The power supply uses all silicon diodes, with the result that the 6100 operates noticeably cooler than most transmitters. The input of the rig can be matched to your line voltage from 105-125 volts.

The sideband signal is generated by means of the B & W crystal lattice filter. Filter bandwidth at the 3 db points is 3000 cycles, so voice comes through clear and clean.

The 6100 provides extra contacts on its VOX relay to operate antenna relays, disable the receiver, etc. It also provides -100 volts for possible blocking of your receiver or a linear.

The clickless grid-block keying was very popular with the CW ops in our crew.

The output of the 6100 is designed to match either 52 or 75 ohm coax, though it will tune anything from 30 to 100 ohms with the pi-net. Beyond that it is prudent to use an antenna matching unit. We *always* do.

B & W is to be congratulated on turning out such a good looking, well designed and fine operating transmitter. We enjoyed our tests of this rig very much and there were many groans when the time came for it to go back to B & W.

Now that B & W has broken the ice and proved that it is possible to have a frequency synthesizer in ham equipment we may find more manufacturers following their lead.

. . . W2NSD/1

Specifications

Frequency coverage: 3.5-4.1 mc, 7-8 mc, 14-15 mc, 21-22 mc, 28-29 mc, and 29-30 mc.
Power Input: 180 watts CW/SSB PEP, 90 watts AM PEP.
Final: 6146's in parallel.
Power supply included.
Price: $875.
Manufacturer: Barker and Williamson, Bristol, Pennsylvania.

Just because the editor of 73 was not invited to the innauguration of the new ARRL Building is no reason to hold back on your subscription to 73. Subscribe immediately and right this grievous wrong.

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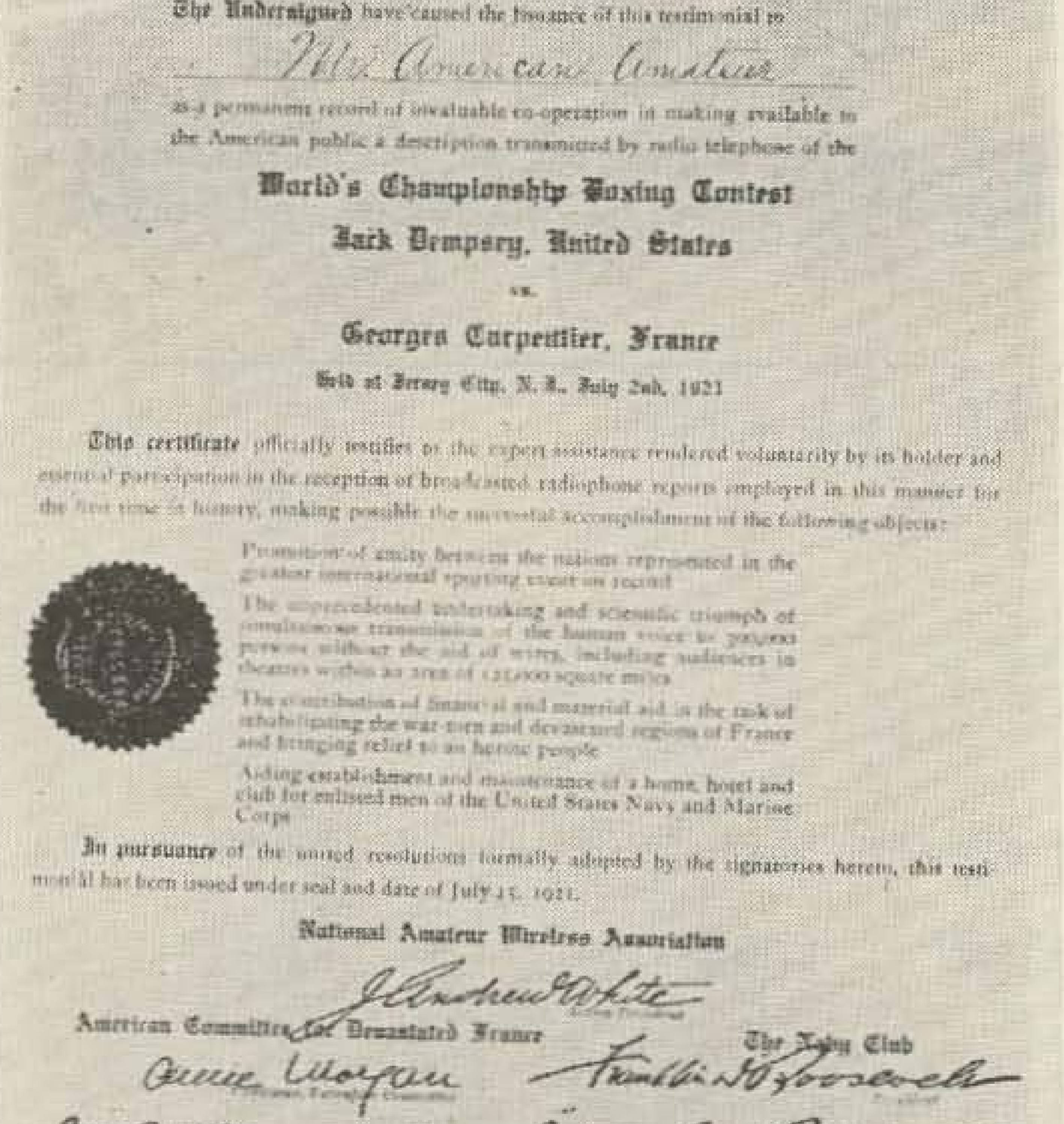
Badge. Red___, Black___. (page106) First name:______			Call ______	$1.

Frank Whitmore W2AAA
223 W. Holly Ave.
Pitman, N. J.

The Battle of the Century

If you enjoy winning awards in Amateur Radio, you'll envy the ol'sters the certificate they earned forty-two years ago. It bears the date of July 2, 1921. Old-timers in the east still talk about that one. It contains the signatures of Franklin Delano Roosevelt shortly after he retired as Assistant Secretary of the Navy; and Jack Dempsey, then heavyweight champion of the world.


In Grateful Appreciation

The Undersigned have caused the issuance of this testimonial to

Mr. American Amateur

as a permanent record of invaluable co-operation in making available to the American public a description transmitted by radio telephone of the

World's Championship Boxing Contest

Jack Dempsey, United States

vs.

Georges Carpentier, France

Held at Jersey City, N. J., July 2nd, 1921

This certificate officially testifies to the expert assistance rendered voluntarily by its holder and essential participation in the reception of broadcasted radiophone reports employed in this manner for the first time in history, making possible the successful accomplishment of the following objects:

Promotion of amity between the nations represented in the greatest international sporting event on record

The unprecedented undertaking and scientific triumph of simultaneous transmission of the human voice to [illegible] persons without the aid of wires, including audiences in theatres within an area of 125,000 square miles

The contribution of financial and material aid in the task of rehabilitating the war-torn and devastated regions of France and bringing relief to an heroic people

Aiding establishment and maintenance of a home, hotel and club for enlisted men of the United States Navy and Marine Corps

In pursuance of the united resolutions formally adopted by the signatories hereto, this testimonial has been issued under seal and date of July 15, 1921.

National Amateur Wireless Association

J. Andrew White

American Committee for Devastated France

Anne Morgan

The Navy Club

Franklin D. Roosevelt

Jack Dempsey

G. L. Rickard

G. Carpentier

Frank E. Coultry

Julius Hopp

Fig. 6 — The certificate issued to Amateurs July 15, 1921 by the National Amateur Wireless Association in grateful appreciation of their expert assistance during the Dempsey-Carpentier heavyweight fight.

With commercial broadcasting non-existent and a public without receivers, the Radio Corporation of America set out to broadcast the forthcoming Jack Dempsey-Georges Carpentier heavyweight championship fight. At the start they possessed only the idea. They needed everything: permission of the fight promoter, a powerful radiotelephone transmitter, and a means for the public to hear. Many in the radio business just laughed at the whole idea. In their opinion the transmitter didn't exist that could cover an area big enough to make the plan worth a try. Others, though the odds loomed large against success, willingly lent their assistance. Hams joined the adventure as soon as they heard.

The event spelled a big success for amateur radio and left a public deeply impressed. For some reason it doesn't appear in QST. Yet the episode taxed the ingenuity of the amateurs to the utmost and required them to do the "impossible." Through the union of the amateurs with the professionals, several hundred thousand sport-lovers from Maine to Florida thrilled to the blow-by-blow description direct from ringside as Jack Dempsey and Georges Carpentier fought the battle of the century for the heavyweight title of the world.

When the call for help went out to the amateurs, hams chatted and experimented on one wavelength—the 200-meter band. Ham calls lacked prefixes. They began with a number followed by a couple of letters. Commercial radio broadcasting didn't exist either. Broadcasting consisted of special programs by some of the amateur stations and the pioneer broadcasts from radio station KDKA in Pittsburgh. Only the amateurs and some experimenters enjoyed these broadcasts; no one else owned receivers. Radio fever didn't strike the public

Double Your Money Back Guarantee?

Well, no. But we were thinking of it. Only a slight worry about hanky-panky stopped us from giving it a try. We know that you'll like your REDLINE converter, but we just weren't sure whether anyone might be induced to part with one for twice the price.

The very least we can do is offer you an iron clad 100% guarantee that we will refund your purchase price in 100% full if you are willing to send back your REDLINE converter after giving it a try. And we welcome comparisons with any converter on the market, never mind the price. Try your REDLINE converter for 30 (thirty) days and see if you can bear to part with it. We're almost (but not quite) convinced that you won't part with it for DOUBLE YOUR MONEY BACK.

These converters are available by direct mail and only from REDLINE, JAFFREY, N. H. We sure would like to sell these through ham distributors, but we're afraid that this would price 'em right out of the market entirely.

Our DGC converters are our proudest achievement. They represent the last word in current technology. Here we have achieved the lowest noise figure of any converter. Intermodulation is kept to an absolute minimum. Stability is fine for sideband. Etc. It has everything. It is built in an extruded aluminum case for dimensional stability and shielding. No penny has been pinched, no tube left out. These converters are custom made to your order, so figure on about three weeks delivery. Please specify what output i-f you want or else which receiver you will be using with the converter so we can send you the best i-f ouput. The price is $98.50 complete with tubes, crystal, all set to use. The DGC is available in 50, 144 and 220 mc models at this price. The DGC-432 is $119.50. A matching power supply for the DGC converters, regulated and highly filtered, is $49.50.

DGC

HJC HJS

Now we realize that everyone either can't afford a hundred dollar converter or else doesn't really need quite the all out scraping the signal out of the mud ability of our DGC converters. Our HJC converters are the answer. We give you the same guarantee on our HJC converters as we do on our DGC: Money back. The HJC-50 sells for $31.95 and has a 14-18 mc i-f output. The HJS power supply, in case you don't want to borrow a little power from your receiver, is $9.95. The HJC-144 converter also provides 14-18 mc output and comes complete with built in power supply for only $49.95.

Please order the above items and watch our ads for future products.

REDLINE

JAFFREY, N. H.

Fig. 1 — Lost in a sea of fans. A general view of a portion of the 90,000 sport fans that crowded into Boyle's Thirty Acres in Jersey City to watch the Jack Dempsey-Georges Carpentier heavyweight championship fight.

until later that year after the Department of Commerce started issuing regular broadcast licenses in September 1921.

But something did hold the public's interest that spring: the forthcoming heavyweight championship fight between the American champion and the French contender. Interest ran high on both sides of the Atlantic. Sport followers from all over the world planned to attend. In the United States, everyone who could "come-by" a ticket intended to see the fight too. Unfortunately, however, not all could attend. Though Boyle's Thirty Acres in Jersey City, New Jersey, represented the biggest outdoor arena in the world, it could hold only 90,000. Thousands of fans faced disappointment.

At RCA, a corporation just formed two years before, a handful of aggressive men got an idea. If thousands of sport fans couldn't get in to see the fight, maybe they could bring the fight out to them. Hearing a broadcast coming direct from the ringside would provide the multitude of disappointed fans with the next best thing. The RCA men stood nearly alone in their belief that it could be done. How could they persuade the fight promoter, Tex Rickard, to permit the broadcast? Where could they find a radiotelephone transmitter powerful enough to spread the contest over hundreds of miles? And the public! What could a receiverless public use to hear the fight? Surely no group of adventurers faced any blacker conditions.

By the beginning of June, things looked much brighter for the adventurous promoters. By offering the broadcast as a service to charity, they won Tex Rickard's permission for the broadcast. The United States Navy eventually succumbed to a "durability" argument and promised to lend the most powerful radiotelephone transmitter ever built. Now, only the means for the public to hear remained unsolved. For this solution the RCA professionals turned to the amateurs.

The call for help went out to the amateurs on June 10th. Less than a month remained before "fight time." The urgent plea asked the amateurs to convert their receivers to long waves, add amplifiers and loudspeakers, and install them in public places so large audiences could hear. What a chore! Most hams happily got along with a crystal set splitting earphones occasionally so a guest couldalso hear. To fill an auditorium with sound from a receiver absolutely escaped the imagination of many and eluded the pocketbooks of a great many more.

The notice soliciting the amateurs' help emanated from two sources: The National Amateur Wireless Association and the radio journal, Wireless Age. Both operated from 326 Broadway, New York City. Guillermo Marconi held the position of president of the amateur association with J. Andrew White presiding as acting president. White, in addition, edited the Wireless Age and worked for the Radio Corporation of America.

Wireless Age, a national magazine subscribed to by many amateurs, carried a full page notice of the pending broadcast attempt. This magazine flourished from October 1913 until August 1925. The make-up differed considerably from amateur journals of today: it carried both short paragraphs and page articles concerning commercial radio progress and activities; and, in addition, featured many how-to-do-it articles that the amateur fraternity enjoyed. QST's advertisement showed up regularly in its pages.

The opportunity to assist with the "fight" broadcast reached the hams at an ideal time. Bounced from commercial longwaves down to 200 meters by the Wireless Act of August 13, 1912, the hams generally still held their grievance. Though they realized that only by a hard fight before Congress did amateurs get any wavelength at all, still they longed for the longwaves. Now suddenly an opportunity dropped right into their laps. The invitation

Fig. 4 — The commercial longwave receiver borrowed from Westinghouse by the Springfield Amateur Radio Club to present the Dempsey- Carpentier fight to 10,000 people in Springfield's Court Square.

from the professionals announced a transmitting wavelength of 1600 meters for the broadcast.

Hams rallied to the cause with delight. Several things pleased them about this break. First, of course, relief from the monotony of 200 meters. But two other equally important reasons also stood out both touching on their pride: the special broadcast offered a chance for amateurs to show their mettle; and their services would contribute to a good cause. Under the arrangements between the broadcast promoters and the fight promoters, two charity organizations—The American Committee for Devastated France and the United States Navy Club—would share equally in the proceeds from the broadcast.

During the two months prior to calling upon the amateurs, a tremendous amount of work took place. Preparations for the broadcast split into two parts: technical and business. The National Amateur Wireless Association busied itself finding a suitable transmitter and selecting the transmitter site. Later they organized the amateurs for reception of the broadcast. The American Committee for Devastated France took on the business arrangements. Representatives of this charity organization—headed by Anne Morgan, daughter of the banker J. P. Morgan—contacted theatres, halls and auditoriums in cities and towns within a 200-mile radius of Jersey City. They arranged the details for public presentations and established the admission price.

Finally, with the transmitter obtained, the broadcast site picked, and public places available for listening, the National Amateur Wireless Association directed its attention to the amateurs. "Fight-time" loomed three weeks away! Concentrating their attack on the receiving problem, the association rushed notices to amateurs, amateur clubs, manufacturers, and radio organizations seeking their help. At the same time, the exciting details of the great experiment appeared in the July issue of Wireless Age.

From the start, nearly every amateur wanted to help. Applications poured in. Out of the heap of applications received, the National Amateur Wireless Association selected and assigned the most qualified amateurs to install and operate their equipment in the leased theatres and halls. Those not selected took part in other ways. The association asked them to invite friends and acquaintances into their homes to hear the broadcast and to send contributions collected to the association's New York office. By this invitation, a big sector of the public lying beyond the 200-mile radius of Jersey City also got to share in the charity

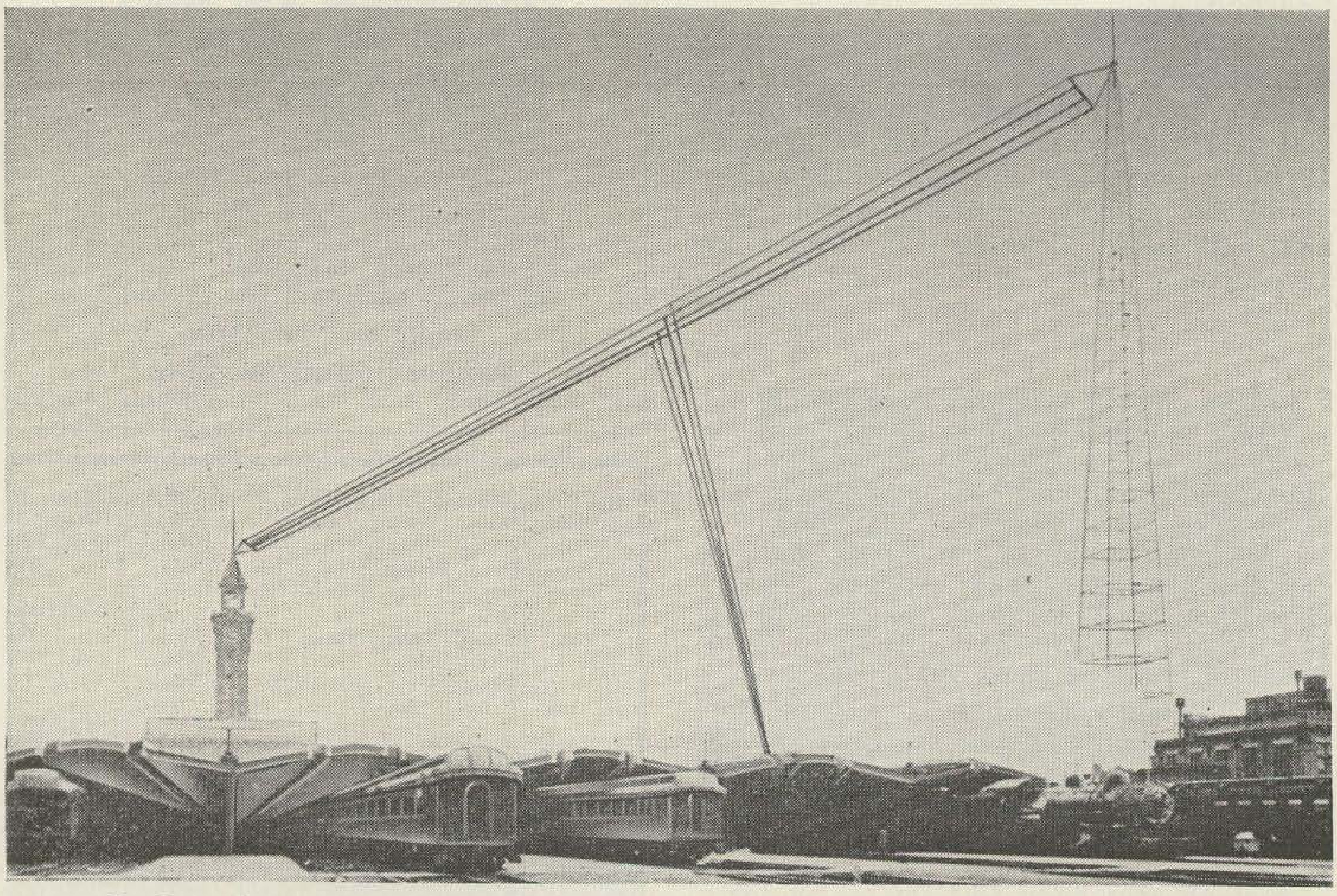


Fig 3 — A view of the multi-wire antenna system erected in the Lackawanna Railroad Terminal in Hoboken, N. J.

drive.

Hams quickly discovered that a big frequency gap separated 200 from 1600 meters. Setting up good 1600-meter installations required plenty of hard work and sweat. But with concentrated effort, skylines in the selected cities and towns changed practically over night. Above the theatres and halls acquired for the presentations, long multi-wire antennas swayed between distant supports. Inside, amateur equipment looked different too. Converted receivers lay burdened beneath large honeycomb loading coils; and two-stage amplifiers strained noticeably in a struggle to feed sufficient volume to multiple loudspeakers. Receiving installations varied from the newest manufactured gear to the latest homebrew innovations. Some boasted superb Magnavox loudspeakers; others operated with homemade adaptations joining dissected headsets to dismantled Victrola horns. Upon such a conglomeration of apparatus the amateurs braved the hazard of satisfying a paying public.

The search by the National Amateur Wireless Association for a suitable transmitter ended at the General Electric Company plant in Schenectady, New York. There, almost ready for shipment to the Navy, sat the most powerful radiotelephone transmitter ever built. Just what they needed!

Not at all backward, the broadcast promoters set out to borrow it. But, did you ever try to borrow something from the Navy? A direct attempt brought a quick, *"no!"* The Navy thought the proposition too sticky and wouldn't cooperate. Refusing to be dissuaded, the promoters approached the problem anew. This time they centered their attack on the Navy's weak spot—dependability. Contacting Franklin D. Roosevelt, the Assistant Secretary of the Navy until just a short time before, the eager promoters sought his help. They maintained that the broadcast would present the severest test the Navy could ever get for this piece of gear. Their argument apparently impressed Roosevelt, for shortly afterwards, the Navy reversed itself and agreed to lend the transmitter.

The Navy transmitter combined six 250-watt tubes with 2000 volts on the plates for about 750 watts output on voice. Amateurs, used to their flea-power tube rigs, felt awed in the presence of such power. In telephone service, three tubes operated as oscillators and three as modulators. No taboo existed in those days about modulating an oscillator. On CW, a switch connected all six tubes together to work as oscillators for about 1500 watts out. Alternating current from a separate winding on a direct-current motor fed the tube filaments.

To get away from as much interference as possible, the broadcast promoters looked to the longwaves. They finally settled on 1600 meters. Comdr. D. C. Patterson, the District Communications Officer in New York, gave his consent for use of that Navy frequency and assured the promoters the Navy would keep off that channel during the afternoon of the scheduled fight. Arthur Batcheller, Chief Radio Inspector for the New York district, rushed the special license through and secured call letters WJY. To this day, those call letters stir fond memories among the "Gang" who tuned in that epic broadcast.

Originally, the promoters planned to install

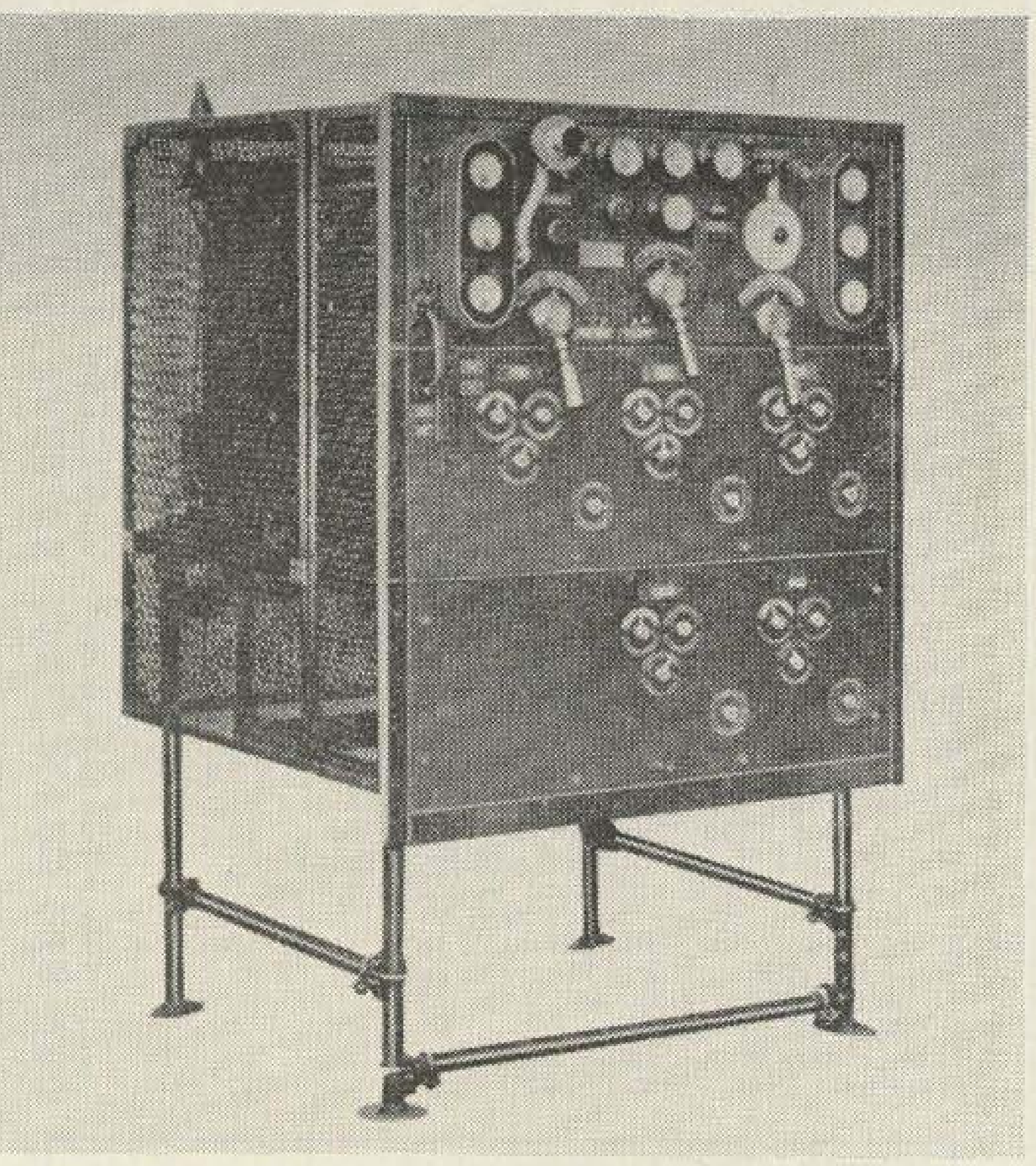


Fig. 2 — The Navy transmitter borrowed by RCA for the Dempsey-Carpentier championship fight. Note the pipe-rack construction typical of switch gear in those days. The transmitter used six 250-watt tubes. On voice, three worked as modulators and three as oscillators. On CW, all six oscillated.

the transmitter right at the ringside. However, after determining the cost for a suitable antenna system, they scrapped the idea. Erection of an adequate antenna system came too high for a project where all proceeds went to charity. However, they found just what they needed practically ready-made at the Lackawanna Railroad terminal in Hoboken, New Jersey. Following the prompt consent of the railroad officials, technicians quickly strung a four-wire T antenna between the four-hundred-foot-high tower in the railroad yard and the clock tower on the terminal building four hundred and fifty feet away. From the center of the antenna, the lead-in dropped down to the transmitter housed in a converted railroad shack used by Pullman porters for changing their clothes. The elaborate ground system consisted of copper roofs of train sheds and other low buildings, the network of railroad tracks, and a system of pipes running into the salt water of the Hudson River. The combination of antenna and ground presented a fundamental period of 750 meters. Telephone lines, stretching over a distance of two miles, connected the transmitter shack with the announcer's booth at ringside.

A week before the fight, tests began. Starting with reduced power, engineers conducted the tests from both the transmitter site and ringside. The tests lasted several hours. Each successive night, hams at their listening posts noticed the signals grow a little stronger as the engineers increased power. Following the broadcast test runs, the promoters checked the telephone reports coming in from the amateurs. On July 1st, the night before the two contestants met, the transmitter engineers turned on full power. Reports from seven states along the Atlantic seaboard poured in tying up eight trunk lines. By nine o'clock all doubts vanished. The excellent reports assured the promoters the fight broadcast the next day would be a success.

The gong clanged for the start of round one! Amateurs from Maine to Florida huddled tensely over make-shift receivers and mopped beads of sweat from their brows. Tense audiences, packed tightly into non-airconditioned theatres and halls, leaned forward to catch every word unmindful of the perspiration wetting their clothes. On the outside, temperatures in some places reached ninety in the shade. And miles away, confined in an 18-foot square, the bodies of Jack Dempsey and Georges Carpentier glistened in the humid atmosphere as they fought the Battle of the Century for the heavyweight championship of the world.

At the Gaiety Theatre in Utica, New York, George Benas, owner of amateur radio station 8CC, donned earphones and sat before the receiver controls to monitor the broadcast. Benas gained prominence in radio circles by receiving telegraphic messages from foreign countries at his ham station on Elm Street. The J and N Electric Company where he worked, lent the three-tube modern receiver and the four loudspeakers facing the audience. The whole installation sat on the stage just in front of the footlights in full view of the paying public. A lead-in running up to the roof connected to a 250-foot long multi-wire antenna atop the theatre. Robert Evans, a commercial radio operator, stood by on the stage to assist.

J. Andrew White announced the fight from a special booth at the ringside. By drawing upon his early days as a lightweight boxer, he captured realistic flavor as he reported every move of the contestants accurately and quickly. But the radio audience didn't hear White's voice; they heard, instead, the voice of amateur radio operator J. O. Smith. Smith, the well-known operator of amateur station 2ZL, covered the radiotelephone installation for the Radio Corporation of America. Because telephone company restrictions prohibited connection of the special line from ringside direct to the transmitter, Smith, standing by at the transmitter, repeated word-for-word into the microphone White's description as it came in over the telephone line from the arena.

The record breaking crowd at the Gaiety Theatre totaled 790. Many women fans attended too. As the American champion and the lightning-fast Frenchman "mixed it up" in the first round, the crowd applauded and shouted. Finally, Robert Evans stepped to the edge of the stage and cautioned them, "let those at the ringside do the applauding. The contestants can't hear you and you'll miss some of the fight if you don't remain silent."

Paid audiences in 112 other cities also listened to the realistic fight description pouring from loudspeakers. In New York City, fight fans assembled at ten scattered locations. In a great many places where the charity organization did not contract for halls or theatres, enterprising and enthusiastic amateurs undertook independent affairs of their own. Many took up collections from their listeners and forwarded the money to the charity.

At Asbury Park, N. J., W. Harold Warren using a loop antenna, detector and two step amplifier, enjoyed the fight from a roller chair on the boardwalk. A ham in Jamaica, Long Island, N. Y., received the fight with a 15-foot clothesline antenna and a crystal set. Hams at Stamford, Conn., Fordham and Brooklyn, N. Y., and Allentown and Philadelphia, Pa., coupled megaphones to their earphones and entertained up to 25 people in their homes. An amateur in the Frankford section of Philadelphia, strapped a Victrola horn to his earphones and extended the listening range to 100 feet.

G. C. Brown listened to the broadcast at Eastport, Maine, a distance of 425 miles. At Poultney, Vermont, F. C. Fassett reported the gong between rounds clear and loud and the broadcast reception excellent. Hardwick, Vermont, reported fine reception too. At Donora, Pa.,—350 miles away—listeners enjoyed the fight in temperatures 90 degrees in the shade. Captain C. H. Butchelder of the SS Acropolis enjoyed the fight while 400 miles out at sea. Charles P. Hoyd heard it fine at Salem, Ohio, also 400 miles away. Even Fort Pierce, Florida, reported good reception as did a ship 1800 miles at sea.

But at Springfield, Mass., a young radio club and its group of youngsters pulled the biggest surprise of the whole broadcast. Springfield hosted two amateur groups; The Connecticut Valley Radio Club and the Springfield Amateur Radio Club. The older, more experienced hams belonged to the Connecticut Valley Club, while a group of teenagers made up the other one. Naturally, a little rivalry existed —especially on the part of the youths.

By arrangements with representatives of the American Committee for Devastated France, the Connecticut Valley Club handled all technical activities for the public presentation of the broadcast at the Plaza Theatre in Springfield. This left the young group completely

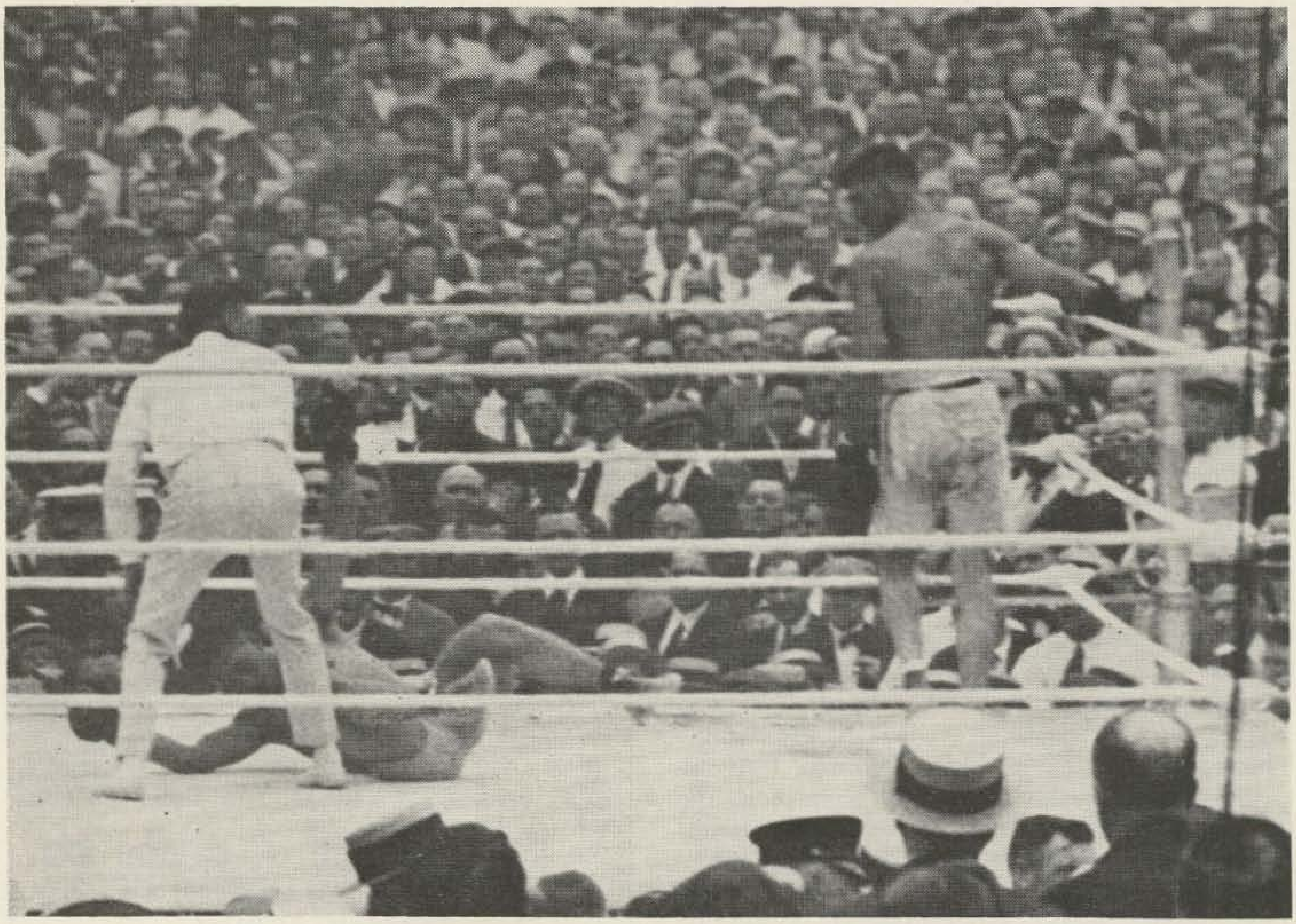


Fig. 5 — The start of the end. Dempsey goes to his corner after dropping Carpentier for the count in the fourth round.

out of the picture. So, the Springfield Amateur Radio Club held a council of war. Soon their strategy took form.

The core of the Springfield Radio Club's activity centered around Court Square in Springfield. Atop the department store next to the Square, the members stretched a long-wire antenna. Inside the store, the club president, H. R. Dyson, installed a special long-wave commercial receiver borrowed from Westinghouse where he worked. Soon loudspeakers bristled from the second and third floor windows like a broadside of cannon out the open ports of Old Ironsides. The battery of speakers consisted of one Magnavox and a number of Victrola horns strapped to the earpieces from dismantled Baldwin headsets. Separate audio amplifiers fed the speakers. In addition, two telephone lines from the receiver installation direct to two of Springfield's newspapers supplied those papers with the fight details a half hour ahead of the regular news services.

With the preliminary bouts scheduled for 1 PM and the main event at 3, the crowd, alerted by the newspapers, began forming about noontime. By 3 PM the crowd overflowed the Square and completely blocked Main Street running along side. At the arena in Boyle's Thirty Acres, 91,000 fight fans filled the bowl from rim to rim and paid $5.50 to $50.00 per seat to see the fight. At the Plaza Theatre in Springfield, 410 people paid an admission price to sit and hear it. But at Court Square, 10,000 stood elbow to elbow and heard it for nothing—the Springfield Amateur Radio Club forgot to pass the hat around for a donation.

The clang of the bell for round one silenced the crowd. As the announcer's voice poured from the loudspeakers, dignified gentlemen cupped hands to their ears, and little boys sat motionless absorbing every word. Tired business men rubbed elbows with the unemployed oblivious to everything except the battle. From the very start, the lightning-fast Frenchman revealed the potency of his right. Darting in and out, the popular contender caught Dempsey several times with the punch. Rooters in the Square divided pretty evenly between the two contestants. During the action, both sides remained quiet. But between rounds, they cheered wildly for their favorite.

In the second round, Carpentier tipping the scales at 172, exhibited the speed and punch of his light-heavyweight days. Six times he smashed through Dempsey's defense, landing his baffling, brilliant, battering right-cross to the American champion's unshaven chin. The blows hurt Dempsey. He sagged back and his left leg stiffened when the second blow landed. The furious pelting left him dazed. Carpentier followers, feeling victory, yelled their approval.

But the action of the second round portrayed the final result. Dempsey, unshaven for five days, still stood on his feet. Though Carpentier hit hard, he didn't hit hard enough. Dempsey now knew he could take everything the French contender could offer; Carpentier knew the American champion was too tough for his punches; and the crowd sensed that the smiling Carpentier gave his all in that round and that his all just wasn't enough.

Early in the third round, Dempsey got in his deadly work. The Manassas Mauler, brown from hours spent in the sun, punished the Frenchman with at least a dozen savage blows to the body and chin. Avoiding all long-range boxing, the 188-pound Dempsey kept in close and clinched and battered his smaller rival all over the ring. Dempsey rooters, frenzied by the change in action, roared delight.

Carpentier came to the center of the ring in the fourth, but only his smile and dauntless courage remained. In the middle of the round, a left to the jaw and a right to the body dropped the challenger for the count of nine. But the game Frenchman arose and faced his fate standing up. A woman in Springfield trying to shop said, "Oh that d—— fight. We can't get by." Then curiously triumphant she exclaimed, "Dempsey wins by a knockout that's what's the matter." Carpentier lay on his side on the canvas close to his own corner. A left to the body followed by a right to the jaw ended the fight after 10 minutes and 16 seconds of actual fighting.

Things like this make you proud to be an amateur. Hams seldom get an opportunity to make radio history; but when they do, the world can depend upon them to do their part. The Dempsey-Carpentier fight broadcast set a new communication record for voice. Also, it awoke the public to the possibilities of radio and readied them for the era of commercial broadcasting that opened up that fall.

Hams lucky enough to take part in the public presentation of this epic broadcast received a certificate in grateful appreciation. When you're around some of the old-timers, ask them to show it to you. Besides containing the signatures of Franklin Delano Roosevelt and Jack Dempsey, it also contains those of J. Andrew White, Anne Morgan, Tex Rickard, Georges Carpentier, Frank E. Coultry (assistant to Tex Rickard), and Julius Hopp (manager at Madison Square Garden at the time).

(W2NSD from page 4)

understand what is going on. Radio clubs can help quite a bit by encouraging tech sessions during or before meetings to iron out confusion in recent tech articles.

The articles in 73 are particularly well suited for this project because they are all written for the average ham and not for the engineer. You can hardly find an article in 73 that you can't understand if you take the time and effort to actually sit down and read it through.

If every one of our readers followed this idea we would soon find the level of technical understanding moving definitely ahead in our hobby. How about it? Will you give it a try?

In Defense of the Appliance Operator

While it is perhaps rather unlikely that many Appliance Operators will read this, their interests naturally leaning away from a magazine primarily devoted to technical and construction articles, I do feel moved to spring up with a few words in their defense. For those of you who came in in the middle of the show, an Appliance Operator is one who memorizes the theory for the amateur license test, then goes out and buys a complete ham station, which he operates from then until a fuse blows, at which time he rushes back to the dealer in a panic for repairs.

Before I plunge into the seemingly impossible job of trying to cook up a defense for this type amateur, perhaps you might indulge me a moment while I ruminate over how this sort of thing came about.

It is the path of least resistance. The AO is able to get in on most of the fun of ham radio without having to go through all of the horseradish of learning theory. This is made extremely simple by the ARRL and their License Manual, probably one of the most memorized books out today. The great emphasis on operating in QST doesn't help much either. I'm not carping to be nasty, you just pull out the last ten issues of QST and look them over objectively and see what you come up with. How many simple construction projects are there? How many simple theory articles? And more to the point, how many tech articles were there that you skipped over as being too technical? How much space was devoted to operating news? To contests? To awards? What would ham radio be like without the DXCC award, the RCC, the DX Honor Roll, the BPL, and on and on and on? Is it any wonder that we have so many Appliance Ops? It is a wonder we don't have more! Obviously the ARRL is responsible, in the large part, for ham radio being the way it is today.

But is this all bad? If I am to believe the editorials in QST of late, this is bad. Bill Orr says it is bad. But is it? Let's go back to fundamentals for a moment. Let's go all the way back to Part 12 of the FCC Rules and Regulations. The opening paragraph of Part 12, paragraph 12.0 Basis and Purpose, states that "The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles: (a) Recognition and enhancement of the value of the amateur service to the public as a voluntary non-commercial communication service, particularly with respect to providing emergency communications."

Got that mulled over yet? Mull.

OK, what did they put down as the number one reason for the existence of the amateur service? "A voluntary non-commercial communication service." The Appliance Ops certainly qualify 100% on this, don't they? They are on the air and communicating. How about that . . . " particularly with respect to providing emergency communications" bit? The Appliance Op qualifies 150% here, like it or not. I've overstepped myself now, you say.

(Turn to page 103)

Shocking . . . but true

Jerry Vogt WA2GCF
160 Grafton Street
Rochester 21, New York

A worker got tangled in a 4800 volt primary line; both hands were burned off. A two year old bit into a worn lamp cord; it took several operations to restore his appearance to normal. A ham reached after a part that fell inside his new home brew rig; he lost a finger and almost the rest of his hand. These are just a few examples of many cases of electrical shock which occur every year when we fail to treat electricity with respect.

Fellow hams, it isn't too often that a ham who writes a few articles in his spare time finds a topic which is of interest to every single person reading a magazine. Being of the human race, we all make mistakes. We can all learn from others on this subject. It is much easier than finding out first hand. (Ouch!)

I have recently joined the ranks at R. F. Communications, Inc., a local company involved in the design and manufacture of commercial and military single-sideband and associated types of equipment. Included in a present list of projects is a two-and-a-half million watt pulse transmitter which is the size of about five average ham shacks put together.

Naturally aroused by this project, one of the fellows dug up quite a bit of material on the subject of electrical shock and wrote it up in a booklet entitled "This Will Kill You!" With his permission, I have taken some of these facts and condensed the information into an article which may *Save Your Life*.

Let's start with a few fundamentals. The effect of electricity on the body is determined to a large extent by the amount of current passing through it. There are several different general effects of electricity on the body. When currents in excess of two amperes pass through the body or any part of it, severe burns are usually the result. Currents in this range might be called "frying currents." Some burns are external—caused by arcing at the point of contact. Although they resemble other heat burns, they are usually much deeper. Between the points of contact there are internal burns which cook the flesh, and, if the victim survives, they are very slow in healing. Quite often amputation might be necessary in these cases.

Vital organs and nerves in the path of the current will most likely be destroyed or severely injured. If the shock is caused by alternating current, severe tightening or contraction of the muscles will result. Currents between one and two amperes are called nerve block currents. Because of the damage to nerve centers, a permanent paralysis of various parts of the nervous system might result and chances are almost certain that a temporary paralysis will occur.

Death might be caused by current flowing through parts of the nervous system controlling vital functions such as breathing or heart cycling. Fortunately a chance exists for the victim to recover breathing before the body cells are destroyed for lack of oxygen. Artificial respiration can keep cells alive by supplying oxygen until natural breathing is restored. However, this will work only if the heart action is still strong enough to distribute oxygen in the blood system.

Under normal conditions the heart functions as a smooth-operating type of pump and can be roughly compared with an engine with perfect timing. When a current of roughly 100 milliamperes flows through the body in a path which includes the heart, it may produce a condition known as ventricular fibrillation, a flutter of heart muscles which resembles faulty timing of the valves of an automobile engine. In general, deaths resulting from contact with less than 600 volts is caused by this malfunction. Unfortunately, artificial respiration has little, if any, merit in such a case.

So far we have seen how currents can kill. Don't think, however, that smaller currents are safe. On the contrary, they can be even more dangerous due to other reactions they produce. Currents ranging from 25 to 75 mils may cause unconsciousness and are called "knock-out currents." These won't generally cause serious damage to vital organs but may burn. Because of the severe shock to the nervous system, the current does not need to pass through the vital organs or a major nerve center to cause unconsciousness. Injuries will probably not be limited to shock alone but may include burns and sore muscles.

Currents in the vicinity of 25 mils are called "freezing currents" because they cause muscular contractions which freeze the victim to the circuit. Under 25 mils the violent involuntary reaction to shock might injure a person.

So far we have talked about the reactions the body makes and the damage resulting to the body due to varying amounts of current flow. Now let's take a look at how we might come into dangerous contact with electricity and what determines the amount of current flow in the body.

Normally house circuits have both 110 volts and 220 volts available but only 110 volts is accessible. This service in each branch in the house is usually fused for 15 amps. This amount is available in any light fixture or receptacle, but remember we are dealing with only a fraction of that amount. 100 mils is quite capable of killing and 110 volts can easily cause this amount of current to flow in a body.

Your body acts as any other conductor when it is in series with a circuit. A conductor has a certain amount of resistance through which the current must pass. This resistance may be of two types. One, external, is that resistance of a path through the skin. The other, internal, in the resistance through the tissues under the skin.

Skin resistance varies with the part of the body involved, the moisture content and the extent to which the skin is calloused. The most external resistance you can expect to have is 1000 ohms, most likely less than that. A good general figure for internal resistance would be about 300 ohms, again depending on the particular path taken by the current. Considering, then, that the series circuit formed by the body includes the internal resistance and the skin resistance on both ends of that path, we might say that a good estimate of the total resistance the body could possibly offer would be about 2300 ohms.

If you have one hand on a grounded object when operating a portable power tool such as a drill whose frame is crossed with the wiring, the body would offer about 2300 ohms as we have said. At the moment contact is made on a 110 volt circuit at 60 cycles, the body will pass 50 mils. You would either freeze or be knocked out. After only three seconds contact, blisters would start forming and the body resistance drops to 500 ohms. The current through your chest would be now raised to 220 mils, more than enough to start the deadly fibrillation effect on the heart. This could be fatal.

Wet shoes present an even greater hazard due to increased contact area and moisture content if the path happens to be from hands to feet.

When the current approaches one ampere the contractions of the muscles in the body may become so severe as to tighten every muscle in the body and may throw the victim from his deadly position in contact with the wires. However, it is likely that the damage to the heart controlling nerves would have already been done and death would still result despite the fact that the circuit had been broken.

The severity of the damage always increases with the length of time the body is in contact with the circuit. This is due to the blistering and burning effects at the points of contact as well as injury to the vital organs and nerve centers in the pathway. The higher the voltage, the quicker this takes place. Blisters form in seven seconds at 50 volts and in three seconds at 110 volts.

To review: the factors involved in the danger of electricity to the body are: The amount of current, the pathway this current follows and the length of time of the contact. The important thing to remember is safety. Be sure there is no potential shock *before* you go toward a circuit to work on it. Be sure the house circuits are safe. Go check them now. Electricity can be a useful servant—it can also be a deadly enemy.

. . . WA2GCF

Slow Scan Vocoder Transmission

Dana Griffin W2AOE

Everyone with a reputation in the scientific community, however small it may be, is delighted to see his work used by others as the foundation for a further advance in the state of the art. This is the sort of thing which leads to progress in every field of scientific endeavor from better mousetraps to better H-bombs.

The writer was quite astonished to see that his work on bandwidth conservation, which was published in the February and March issues of QST, had been used by Dr. Costa and Mr. Rapp as the basis for an even greater advance in the quest for bandwidth conservation as described in the columns of the July issue of 73 Magazine.

The use of the Bell Laboratories Vocoder Transmission System, which Rapp cleverly purloined from the archives of the mostest of the mostest in Murray Hill, N. J., has undoubtedly begun to generate a great deal of interest on the part of amateur sideband operators, who pursue a further reduction in the bandwidth required for voice transmission with the ardor of a Richard Burton.

Perhaps it was the lateness of the hour or merely the magnitude of Rapp's corporate planning for the mass production of gear for military and amateur Vocoder System Transmission (VST). But to have both of these erudite gentlemen miss the opportunity to present what appears to be the ultimate system for bandwidth conservation, simply astounded me.

The key may be found in the third from the last paragraph of Dr. Costa's story. I quote, "Could it be that the information rate is the fundamental quality and not the bandwidth?" Why didn't you answer your own question, gentlemen? This is *it!*

If you had done so, I would have been denied the honor and prestige of presenting to a waiting world, "The Slow Scan Vocoder Transmission System," or SSVTS for short. It is unfortunate that this system will destroy Rapp's dreams of empire before they get further than the initial planning stage. But the SSVTS concept will only require a bandwidth of 30 cycles in place of the picayune reduction from 3000 cycles to 300 cycles as proposed by Rapp.

We must admit that the "ex" sidebanders using this new system must start with the VST system proposed by Rapp. But this system cannot be put on the air because of the excessive bandwidth of 300 cycles for voice transmission which it requires.

One must slow down the rate of information transmission to conform to the new 30 cycle limit for narrow band tone transmission, which the FCC will undoubtedly require when the SSVTS system emerges from the prototype model stage. This is the key point which Messrs. Costa and Rapp missed.

Unfortunately, the means to accomplish this are not patentable. They are well known even to the lowly hi-fi fan. Instead of modulating the transmitter directly, the voice actuated Vocoder output is recorded on tape at the rate of 17.75 inches per second. By means of another head and motor drive, the Vocoder will modulate the transmitter at the tape speed of 1.775 inches per second. At the receiver, the process is reversed. After the incoming signal has been recorded at 1.775 ips, it will be fed into the receiving Vocoder at the rate of 17.75 ips. Presto, out comes the voice at the other end of the radio link.

The 100 to 1 reduction in voice transmission bandwidth which the Griffin SSVTS system provides, makes Rapp's 10 to 1 reduction in bandwidth appear ridiculous by comparison. Inasmuch as an SSVTS QSO will take ten times as long to complete as it does today, brevity will become the watchword of every SSVTS operator.

Dr. Shannon's work on the redundancy in speech clearly indicates that SSVTS operators will undoubtedly become masters of monosyllabic conversation. Conversely, the verbose types, so prevalent on AM, will never know the joys of SSVTS communication. One of their typical short QSO's would last longer than a chess game via mail between Keokuk, Iowa and Kazahkstan, Siberia.

BUYERS GUIDE CORRECTIONS

Considering the number of possibilities for errors we didn't do too badly. Hallicrafters reported a rash of orders for their $2650 FPM-200 which we put in for $26.50. I believe the price on the 200 is back down to $1995 now, in case the high price was holding you back.

World Radio got a shock when we rated their Galaxy 300 at only 200 watts PEP. Since they went to an awful lot of trouble to have the rig develop 300 watts I can see their point. The Galaxy 300, for clarification, is a $300 sideband transceiver for 80-40-20 meters which runs 300 watts PEP or SSB. The ac power supply with clock is $119.95, less clock $99.95, and the accessory VOX $24.95.

Hunter pointed out that their Bandit 2000A linear only required 100 watts of drive, not 160 as reported.

Redline noted that we mixed up the type on their ad. Nothing personal.

When SSVTS communication is employed by thousands of displaced SSB operators, another not so obvious revolution in communication practice will be in order. Inasmuch as SSVTS voice communication only requires a 30 cycle bandwidth, for the first time in history the SSVTS fone men can gripe at the excessive bandwidth used by CW men when they send at 40 words a minute or more.

Fortunately, there are two solutions to this problem. The high speed CW men and the RTTY gang can also use SSVTS techniques. The second, less expensive solution which the high speed CW gang can employ, is to shift to single side band CW transmission. thereby cutting the required bandwidth to 50% of that which they need today.

It will take considerable time for an appreciable number of SSB, RTTY and CW operators to convert to the new SSVTS mode of communication. It is difficult to visualize all of the effects that the adoption of this revolutionary technique will create.

Is this the ultimate scheme for bandwidth reduction? We are inclined to think so unless Messrs. Costa and Rapp can come up with a method to modulate an AØ carrier, using mental telepathy.

All facetiousness aside, as a group, the amateur body will undoubtedly be forced to come to grips with many new problems when thousands of displaced sidebanders shift to the SSVTS mode.

For example, our population increase cannot possibly keep up with the amount of empty space in our bands which will become available when the use of SSVTS becomes widespread. Unless these vacant holes in our amateur bands are completely filled up with spectrum wasting AM QRM, these channels may be taken over by the commercial interests.

But wait, fellow amateurs, I don't intend to permit Messrs. Costa and Rapp to "tat" me again after producing such a magnificent "tit" as the Slow Scan Vocoder System Transmission concept. I also lay claim to the use of restricted licensed technicians using wideband pulse position modulation on 20, 40 and 75 meter fone to fill up the holes which SSVTS will create. Lastly, in a justifiable attempt to out Costa Dr. Costa, if two sidebands are better than one, why not 4, 6 or 8 sidebands? All you need to do is to put AM subcarriers on an AM suppressed carrier system at 10 kc intervals from 3800 to 4000 kc. I am now one tat and one tit ahead; gentlemen, it is your turn to tat.

. . . W2AOE

(W2NSD from page 97)

What sort of equipment do you want in emergencies? Do you want home made gear that only the builder knows how to hook up or tune? Gear that might go pffft at the wrong time and need its daddy to get it back on the air again? Or do you want commercial gear that everyone knows how to use . . . stuff that is designed to withstand the mishandling of idiots and still put out good signals Our Appliance Operator wins hands down here.

Part (b) has to do with the amateur contributing to the advancement of the art. Our AO contributes here too, but only indirectly. The size of the ham market today makes it possible for amateurs to design products for sale to amateurs and this has greatly stimulated amateur advancement of the art. Immediately comes to mind such achievements as the 600L, the 100V, and the many sideband transceivers we have today.

Part (d) "Expansion of the existing reservoir within the amateur service of trained operators, technicians and electronic experts." Here we see that the FCC has established our AO as one of the three types of amateurs that are considered important. And they are important. In time of emergency we need fellows who know how to use radio equipment and know how to communicate. You often don't have the time to teach a non-ham how to go about communicating. Even in war time our AO is way ahead of non-ham. I recall the early days of WWII when the great percentage of the licensed amateurs went into the armed services. They didn't know any more than hams today, but they were able to learn quickly enough in the armed forces schools. They had a considerable advantage over other fellows in that they liked radio, even if they didn't know much about it. . . . I remember, I was one of them.

Do you still sneer at the Appliance Operator as a nogoodnick? It's true, our AO could be worth a lot more to the amateur service if he were not only a trained operator, but also a technician or electronics expect. He would probably get even more enjoyment out of amateur radio too. Contests are fun and they develop one's operating ability to a high state of perfection, but I feel sorry for the ham who has not lived through the experience of building a piece of equipment and getting it going.

I'm not out of ammunition yet. Part (e) says, "Continuation and extension of the amateur's unique ability to enhance international

(Turn to page 104)

(W2NSD from page 103)

good will." Ha! Sure, our electronic experts can bring us good will if they will get on the air and talk to some DX stations. So can the technicians. But our Appliance Operators are on there day in and day out working every DX station they can pull through and doing a rather thorough job of international good will. Some of 'em are lousing things up, too.

In reviewing the Basis and Purpose, as set forth by the FCC, it seems to me that our rules are quite explicit in their establishment of the worth of the so-called Appliance Operator.

DXpeditions

The main complaint I have with DXpeditions is that I'm not on 'em. Back in 1957 six of us went down to Navassa Island, struggled some thousands of pounds of equipment up the lousy cliffs, operated around the clock for four days and probably enjoyed it more than anything else any of us have ever done.

Gus makes me sick. Gus is ruining all of the choice DX spots. He is going everywhere and working thousands of stations. He is even up in Nepal! It is awful. New Hampshire is very nice, but I sure wish I could be DXing from some spot like Nepal. Now there is no point in it. I figured that in another year or two 73 might be doing well enough to start putting on little DXpeditions. By the time we have a few hundred dollars saved up there won't be anything larger than a rock sticking out of the ocean in Antarctica that hasn't been worked by everyone.

The Hammarlund DXpedition of the Month program is eating away at the rare spots something fierce. The DX fraternity is fortunate to have a DX nut running Hammarlund. That's a pretty clever way of getting some new ones, eh? Stu Meyer W2GHK is to be congratulated for resisting the temptation to over-commercialize on these DXpeditions. .

Say, if any of you hook up with any of the many DXpeditions, why not put the pressure on them to write about some of their mishaps and adventures and send them in to 73 so we can all enjoy them. No matter how you feel about Danny, you'll have to admit that his stories that I published in CQ a few years back were darned exciting. Wayne

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(Match from page 25)

Gym classes are a good idea—especially exercises on the parallel bars and trapeze lines. Not many hams can afford automatic push button collapsible towers for their antennas. But a surprising number can afford Xyls—the tree climbing kind, who can go up a ladder or tower at a moment's notice, without any qualms over dizziness and the height factor.

Lucky for you if you have been through the ropes in your Brownie and Girl Scout stages. Better just brush up on all those knots you have learned and never found any use for, as yet. You will be using them quite unexpectedly every time antenna changes are made. Sparks (of temper) will fly if your clove hitch tangles into a granny, and down comes what was designed to be the best antenna yet!

"Be Prepared" was once your motto—well carry it across the border into your next state (married, that is). Always "be prepared" for your OM disrupting the ordinary household. Funny(?) how he will decide that hole has to be drilled through the plaster, or a major rebuilding job has to be done right on the living room rug, just after you have finished the weekly vacuuming. Walls, floors, and ceilings present a challenge to the ham experimenter, and eventually might resemble a woodpecker's habitat. Any building, or your favorite tree may have to come down if it stands in the way of progress in radio propogation.

Diplomacy should be practised until it becomes second nature to you. When the local tv repairman fiendishly points out your OM's antenna farm to your neighbour, as the logical cause of all your neighbour's tv troubles; and the hitherto friendly couple living next door, suddenly descend upon you, transfixed from their Dr. Jekyll to Mr. Hyde state—remember, taking your shoe off and banging it on the desk, will get you nowhere. Invite your irate visitors in, extoll the fascination of hamming, let them twirl the magic knobs, and bring in the exotic dx. If you can only convert them to the hobby, your OM might get permission to extend his antennas into the next yard, and try for that 40 meter beam he has been dreaming about.

And contests! All ham activity tends to peak up in the weeks preceding the OM's favorite contests. And there is a contest just about every weekend. By zero hour when the contest starts, he will be absolutely confident that he is going to win. Since there are probably 10,000 or more amateurs in this contest, and only 1 winner, be prepared to face his frustrations a little later. It's an unbroken rule, that 1 hour after a contest has started, Murphy's Law, and IPIO will have taken command of the ham shack. If you have not run into these two yet, let me fill you in. Murphy's Law states that if anything can go wrong, it will; and IPIO is the Innate Perversity of Inanimate Objects. So, watch out!

Possibly the zenith of all ham activity reaches its climax in that most glorious weekend in June, No, not the Niagara Falls type weekend to get away from it all—but the hams dream come true—field day— 48 hours solid of hamming, hamming, hamming! Just working one station after the other, the more the better. No distractions, no meals, no sleep, no shaves—not one thing can interrupt this strange annual phenomenon. Better plan on going home to Mother on field day weekends.

What's that you say? You are not going to leave Mother? You are going to put off the wedding date until you study up on the code and theory, and get yourself an Amateur Licence! You've read about G3NMR's friends, Em and Joe. You did not like Em, and you are not going to be like her. You want Bob and you have a perfect match. (Both ways!)

Well, good for you. Vy Fb!

Oh, but better not tell Bob I've had this little chat with you. If he asks for me, just say I rather unexpectedly left on a DXpedition for parts unknown.

. . . VE3DGV

73 parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 .... $4.00

TRANSISTOR POWER SUPPLY. Voltage regulater adjustable power supply for running transistor equipment. Takes the strain off those transistor batteries. Great for the test bench. See April '63 page 8. Uses five ransistors, one zener, cute little (expensive) meter, etc. Will deliver up to 100 ma continuously, voltage from 0.35 to 15.0.
W1ISI $25.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W9DUT-2 .... **$20.00**

TUNING EYE KIT. This kit enables you to install a dual tuning eye in any transmitter to indicate the tuning of two or more stages. It works far better than a meter or even meter switching. See page 22, July '63.
K6GKU $7.50

NOISE GENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a ener diode. Kit includes even the battery and mini-box.
K9ONT $5.00

CAST IRON BALUN. Eentsy balun using ferite core, covers 6-40 meters, will handle up to 20 watts, complete with cabinet, connectors, etc. See September 1963 page 8.
W4WKM-1 .... $3.00

BOURBON S-METER. Much better than the usual Scotch S-meter. Here is an S-meter kit for those of you with receivers without S-meters. Includes tube, adjusting pot., socket, resistors, and meter. See September 1963 page 18.
W6TKA-2 .... $6.50

NEW PARTS KITS

Bowing to reader demands for us to enkitify some of our past construction articles, we hereby present three new parts kits.

TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, crystal, etc.
W9DUT-3 .... $15.00

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc.
VE7QL $27.50

SHORT WAVE CONVERTER FOR HAMBAND RECEIVERS. One tube short wave converter so you can tune SW broadcast stations. Power supply included.
W2LLZ $13.00

WRETCHED K2PMM

BADGES $1.00 each.

One of the big problems at hamfests and club meetings is to have everyone plainly enough marked with their first name and call. All sorts of stickers and pieces of cardboard have been tried, plus little cards which can be typed up and stuck in holders . . . all have the same problem: they are hard to read from any distance.

The best answers to date are these engraved laminated plastic name badges which can be read by Cousin Weakeyes from seventeen paces. You are in luck. We've arranged to make these darbs available at a real low price, all personally engraved. The badges are 3" x ¾" and come complete with a pin and safety lock. Please give your first name, call and specify whether you want the badge to be bright red with white letters or jet black with white letters.

Order from

73 Peterborough, N. H.

OTHER 73 BULLETINS AND BOOKS

6up. Monthly VHF magazine, editor Jim Kyle K5JKX, technical articles and latest VHF news from all over the country. $2.00 per year.

ATV Bulletin. Semi-monthly bulletin for the ham TV enthusiasts. Technical and operating news. $1.00 per year.

5/7/9. Monthly bulletin for those interested in contests. Lists all contests being held, gives rules and results on contests not covered in QST or CQ. $2.00 per year.

73 News. Published monthly, editor VE3DQX. Keeps you up-to-date on current ham events.

In valuable to club officials for discussions at club meetings. Good source material for club bulletins. 1.00/year.

Ham-RTTY. This is the most complet book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

Bound Volume 1. Gorgeously bound library volume (bright red) of the first fifteen issues of 73. This is the only way to get a complete set of the early issues of 73. We'll pay $1 each for copies of the January 1961 issue in good condition so we can make a few more bound volumes. Covers October 1960 through December 1961. $15.00

Bound Volume 2. Complete matching volume covering 1962 issues of 73. $15.00

Binders. Bright red leather binding. Specify which year you want stamped on them: 60-1, 62, 63. Darbs. $3.00 each.

Back Issues. Since each issue of 73 features articles of a fairly timeless nature each back issue is just as much fun reading as the current issues. All back issues except January 1961 (we'll pay a dollar for these if you can find any) are on hand, some in mighty small quantities. 1960 issues $1.00 each. February 1961-date 50¢ each.

Care and Feeding of Ham Clubs—K9AMD. Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. Hundreds of grateful letters have been received from clubs who have applied the ideas in this book. $1.00

Simplified Math for the Hamshack—K8LFI. This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. 50¢

Index to Surplus—W4WKM. This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. $1.50

Ham-TV—WØKYQ. Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. $3.00

Surplus TV Schematics. You can save a lot of building time in TV if you take advantage of the real bargains available in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. $1.00

AN/ARC-2 Conversion. This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 29 mc (160-80-75-40 meters). This booklet gives you the complete schematic and detailed conversion instructions. $1.00

AN/VRC-2 Conversion. Completely different from the ARC-2. This book gives you complete instructions on converting the inexpensive VRC surplus gear into a six meter wide band FM transceiver. There are probably over a thousand stations now operating on 52.525 mc around the country. Join the crowd. Fun. $1.00

Coils—K8BYN. Basic book which covers the theory and practical aspects of the many different types of coils found in ham work. Well illustrated. 50¢

CW—W6SFM. Anyone can learn the code. This book, by an expert, lays in a good foundation for later high speed CW ability. 50¢

3D Map of World. Maybe you've been eating your heart out for one of these beautiful relief maps after seeing one at a friend's shack. Comes complete with one year subscription or extension to 73. $9.95

3D Map of U. S. Complete with one year sub to 73. $9.95

Mickey Miker—WØOPA. Complete instructions for building a simple precision capacity tester. Illustrated. 50¢

Frequency Measuring—WØHKF. Ever want to set yourself up to measure frequency right down to the gnat's eyebrow? An expert lets you in on all of the secrets. Join Bob high up on the list of Frequency Measuring Test winners. $1.00

Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

SSB Transceiver Schematic—W6BUV. Giant size schematic of the transceiver that appeared in the November 1961 issue of 73. Complete with extra November issue. $1.00

Radio Bookshop

SPECIAL RADIO BOOKSHOP SALE

We were doing some cleaning of the Radio Bookshop shelves and found a vast collection of single copies of various books. Many of them are still available from the publishers, but some are out of print and are rapidly becoming rare. In order to make our fall inventory easy we will offer these books at a price, which in many cases is less than our cost. First come, first served basis.

TITLE	WAS	NOW
Digital Logic Handbook	1.00	.50
TV Fault Finding		.50
Radio Amateur Operators Handbook		.50
Laymans Guide to Hi-Fi	1.75	.75
TV Antennas	.50	.25
Radio Electronics	1.95	1.25
What Makes Guided Missiles Tick	1.50	1.00
Broadcasting Without Barriers	3.00	1.50
CQ YL		1.00
Elements of Radio	7.95	5.75
TV Servicing Handbook		3.25
Electron Tube Circuits	10.50	7.50
Sound of Hi-Fi	3.95	2.95
Transistor Audio Amplifiers	6.95	3.95
Radio, TV and Electrical Repairs		2.00
Silicon Controlled Rectifier Manual		.50
Elements of Radio	6.00	4.00
The Practical Dictionary of Electronics	6.50	2.95
Transistor Electronics	7.95	3.95
The Technique of Magnetic Recording	7.95	4.95
Transistor Theory and Circuits	1.75	1.00
Germanium Diodes		.50
FM Radio	3.00	1.50
Hi-Fi From Mike to Ear		.50
TV Engineering	15.00	3.00
Basic Electricity	7.65	5.75
Two-Way Radio	9.50	7.50
Practical Television Servicing	7.95	4.95
Elements of Magnetic Tape	8.50	5.95
Solder—It's Fundamentals and Usage		1.00
Basics of Analog Computers	12.50	8.95
Self-Synchros & Elect. Servomechanisms		1.95
Math Puzzles and Diversions	3.50	1.95
ARRL Lightning Calculators A and B		1.00
AM-FM Tuner Manual	3.50	2.75
Auto Radio Manual	3.00	2.25
Radio Amateur DX Guide	1.00	.50
Maintaining Hi-Fi Equipment	2.90	2.00
Radio Control	2.25	2.00
FM Stereo Multiplexing	1.50	1.00
TV Troubleshooting and Repair	3.90	3.00
QRG Calibration Log	2.00	1.00
Video Speed Servicing Systems		1.00
Basic Radio and Receiver		1.50
Surplus Schematics Handbook	2.50	1.75
CQ Mobile Handbook 1st	2.95	2.25
CQ Anthology	2.00	1.50
TV Signal Range Calculator		.50
Care and Repair of Hi-Fi	2.50	1.75
Missiles and Satellites	1.50	1.00
Closed Circuit Industrial TV		1.50

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

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

21—VHF HANDBOOK—Johnson (W6-QKI). Types of VHF propogation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, to install it, how to tune it. **$2.70**

23—NOVICE & TECHNICIAN HANDBOOK—Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. **$2.85**

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it, building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. **$2.85**

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6AU8	2nd Low IF Amplifier
6AU6	First Limiter
6AU6	Second Limiter
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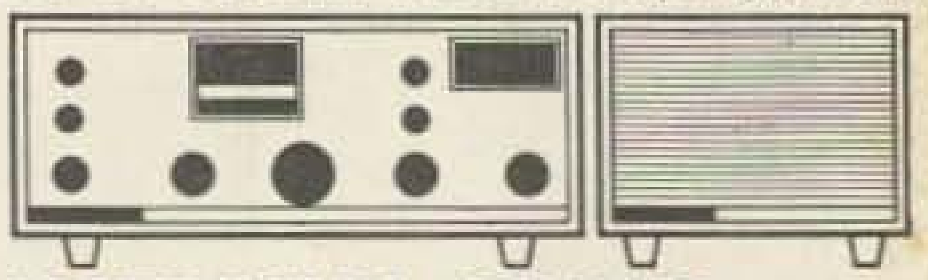

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