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73 Magazine #105, June 1969

Features

STAFF

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Contents

...de W2NSD/1

Wayne Green

Getting away from the seemingly uncontrolled confusion that gives birth each month to a new issue of 73 gave me a chance to give a little more thought to the role that amateur radio is playing in the world today. Lin and I had a few days to dash off for a short "vacation" before Kayla left us to get married, so we decided to go on one of those packaged European ski tours where they include a car in the deal. It was our first skiing in Europe.

One day of skiing in St. Anton, Austria and one in Zermatt, Switzerland forever cured me of wanting to ski in Europe. I waited for over five hours in Zermatt on the lift lines, some of which rivalled the mob scene I witnessed a few years ago when several thousand women became a screeching, unthinking mass trying to touch the Pope. It was worse than any subway crush in New York. Here we have lift lines, there they have lift mobs.

So, while Lin was busy memorizing the galleries, palaces and castles of Florence and Venice, I ate pasta and tried to put things into perspective.

Frankly, the more I think about the problems we have in amateur radio today, the more concerned I get. Amateur radio is far more important than I suspect anyone realizes. To most of us involved in it, amateur radio is a hobby for having fun. It most certainly is that. If it wasn't it wouldn't exist. Even the reasons given for the existence of amateur radio in the FCC regulations don't give the single, most important reason for amateur radio to exist.

Those FCC purposes for amateur radio have clouded the issue. They have focused attention on PICON, on emergency traffic handling, on technical developments, on incentive licensing, etc. While we can't dismiss these factors, they are very far from being the most important.

As I see it, and I'll be blunt, unless we get amateur radio moving ahead, get it expanding as it should, serious and permanent damage will be done to the United States. There is no question in my mind that amateur radio is the most important hobby in the world, by a wide margin.

When Russia sent up Sputnik and we found ourselves obviously second in the space race, our politicians made much hay over the missile gap and for a while there was a lot of worry about how to get our teenagers interested in getting into the sciences. We are, today, keeping up pretty well with our missiles and technology. But all of us recognize fully that electronics is a fast growing field and that as it expands we will have to have perhaps ten times as many engineers and technicians as we have today in just a few years.

You don't start being an engineer in middle age, you start in your teens. And, you don't start being an engineer in your teens if you are spending your time protesting, roving with a street gang, or dropping out. The reason we are able to have the number of engineers and technicians that we do today is very largely due to the influence of amateur radio on two or .three hundred thousand teenagers in the last 50 years. Well over 80% of the high school hams go on to work in electronics and communications. What do you think would happen to our electronics industry if every man who got started via ham radio were to drop out?

Now, at a time when we should be doing everything in our power to see that amateur radio is exploding with new hams, we have ground to a halt. We should be working overtime to attract newcomers into our hobby. We should be setting up talks and demonstrations in high schools. We should be organizing code and theory classes in the schools. We should see that ham magazines and books are in the school libraries. We should put on public demonstrations of ham radio. Even notes on public bulletin boards suggesting that interested teenagers come over and see your station will help.

And, once we have them started we have to do everything we can to keep them from dropping out. Don't let them settle for just going part way. Don't let them drop out and

(continued on page 118)

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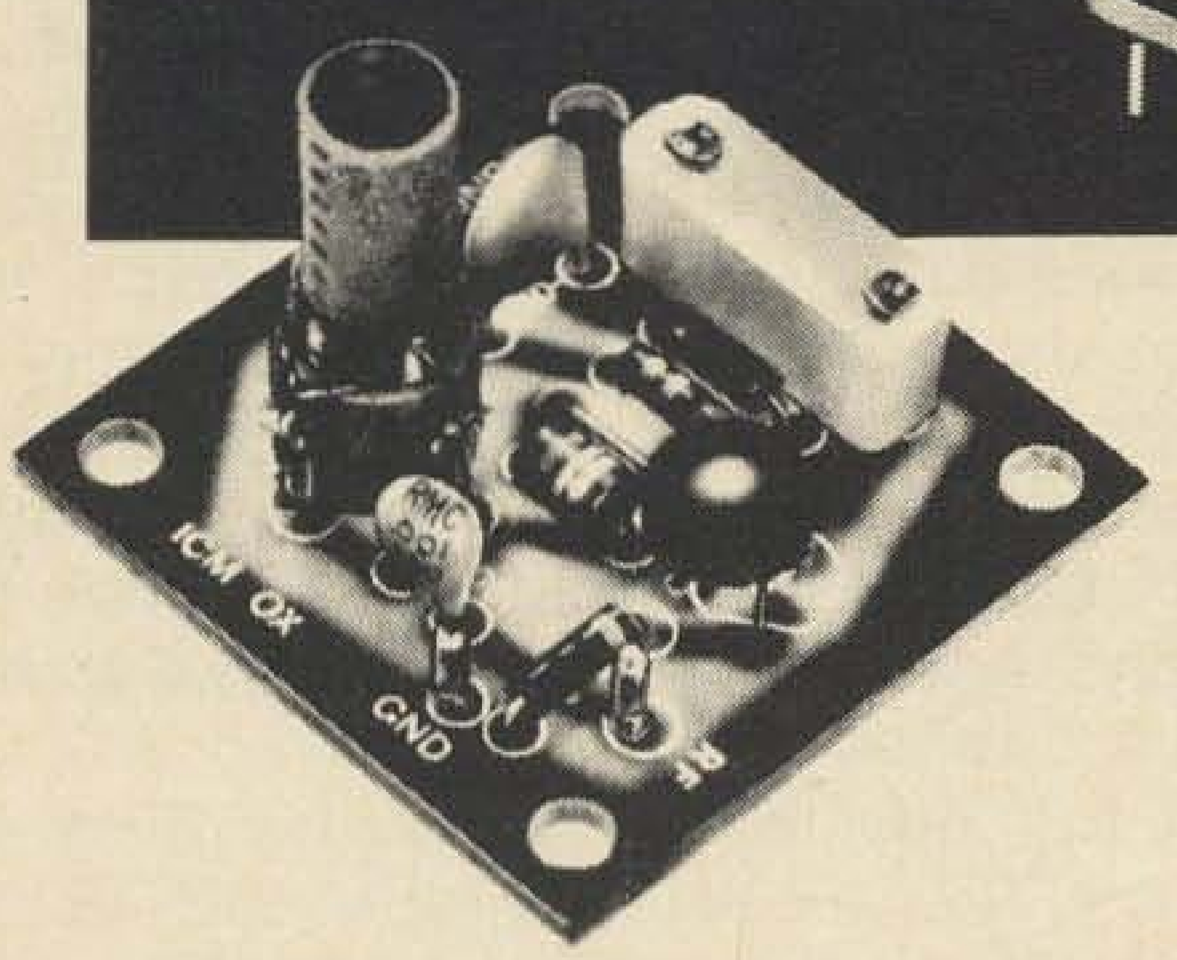

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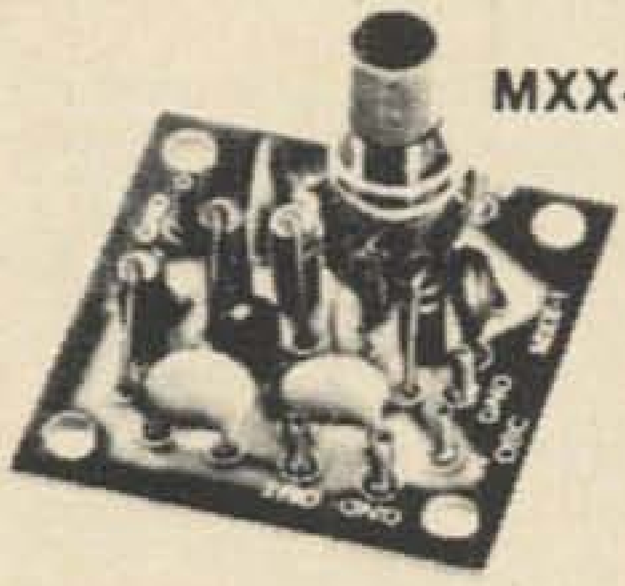

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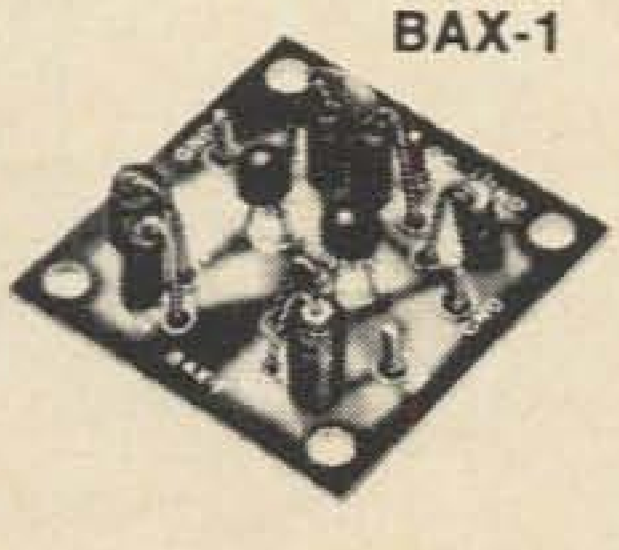

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New Ways of Generating Microwave Power

Charles S. Jones, K3PBY
181 Pennsylvania Avenue
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It is now more than a quarter of a century since a small group of physicists at the Bell Telephone Laboratory invented the transistor. The enormous technical progress that has been made in the art of semiconductor electronics during these years has been extraordinary. The field of solid state technology is moving so fast that one has difficulty in keeping up with current developments. This is especially true in the area of microwave technology. Here, semiconductors are making monumental strides that are causing a revolution in the design of microwave circuitry.

In this article I will discuss some of the most recent aspects of solid state application growth in the field of microwave power generation. Since the theory of operation of these devices is rather complex and involved, I have not devoted much attention to this area of thought. My main purpose is to shed light on what to expect from solid state microwave devices in the near future.

Today, one of the most versatile semiconductor materials is gallium arsenide. Its use has contributed greatly to the development of numerous solid state microwave devices. Transistors, varactors, microwave diodes and many other ultra-high devices are possible with gallium arsenide.

Just recently, another remarkable application for this multi-faceted semiconductor material was unearthed. It was discovered that a tiny chip of gallium arsenide can be made to emit microwaves simply by applying a steady dc voltage across it. This phenomenon, known as the Gunn Effect, is expected to revolutionize microwave technology. Ever since J. B. Gunn of the International Business Machine Corporation discovered this new solid state source of microwave radiation, engineers have been waiting for the potentially low-cost semiconductor to be made practical. All that would be required for a microwave source of power then would be a battery, a resonant cavity and the small chip of gallium arsenide. No longer would a microwave system require a klystron and its associated bulky power supply, or a radio-frequency oscillator with several stages of harmonic varactor multipliers, or a power limited microwave transistor.

Between the valence and conduction levels there is an energy level called the "forbidden" or depletion level, because no electron ever contains that exact energy level. The reason is not know, but the fact is that nature has prohibited certain energy levels.

Like silicon and germanium, gallium arsenide owes its semiconducting characteristics to the structure of its energy bands. These energy bands are shown in Fig. 1. Of course the depletion region in this illustration is amplified to a great extent. There is no sharp division between the crystal regions and the depletion region. As you move out from the junction between the P- and N-areas the charge density becomes less and less, and the number of charge carriers more and more.

At ordinary room temperature there will be very few electrons which will possess enough energy to cross the depletion region and therefore create a current flow. However, if the semiconductor material is doped with certain impurity atoms, electrons can be added at energy levels which are just below the conduction band. Very little energy is then required to boost these electrons across the depletion region and produce a flow of current.

These materials which are added to the semiconductor material are called donar impurities because each atom donates an

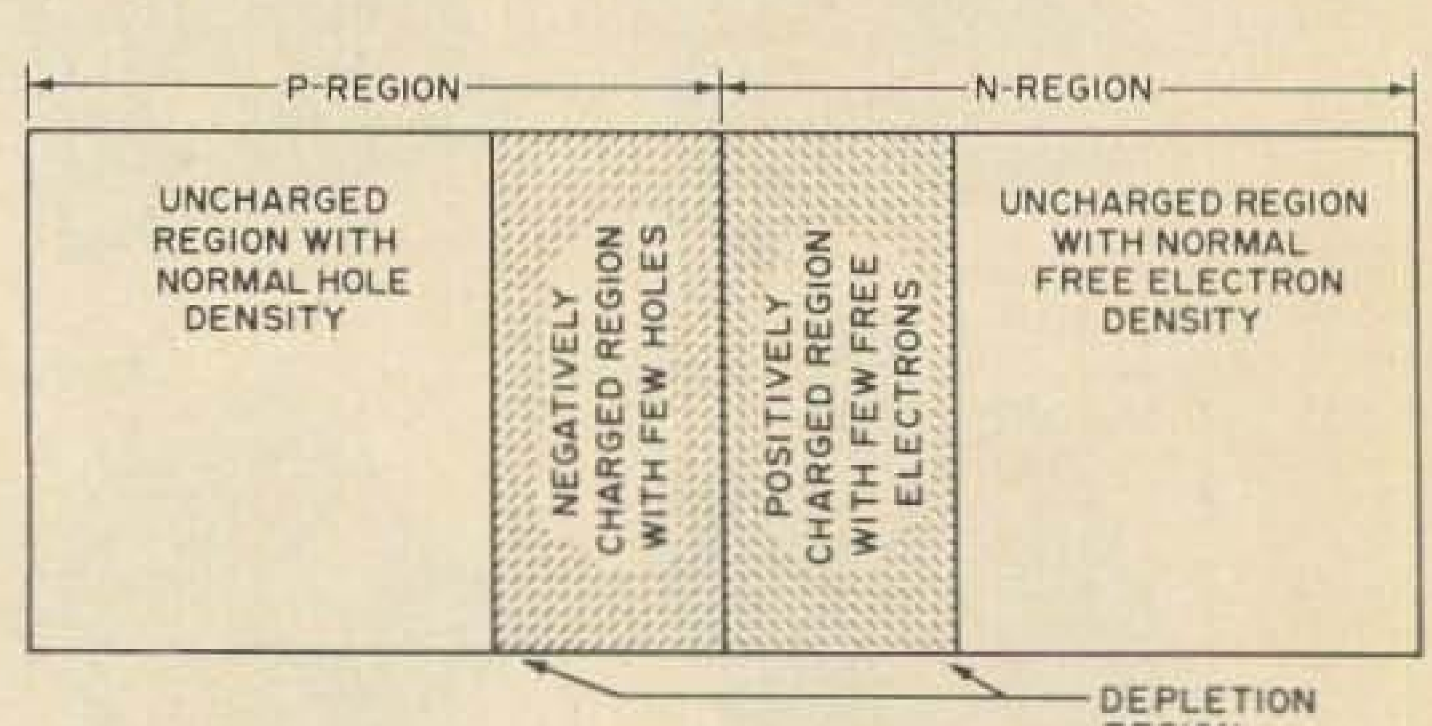

Fig. 1. The energy bands of a diode.

electron. This creates an N-type semiconductor material. Similarly, the semiconductor material can be made P-type by adding acceptor impurities. These will produce empty energy levels just above the top of the valence band. Here, the electrons can be driven out of the valence band into them, leaving holes behind.

To change the allegory a bit, let's see what's currently being accomplished with Gunn oscillators as microwave power generators. The field is moving so rapidly that it is difficult to pin down specific power and frequency figures at the present state of the art. A sample of some of the more recent lab results with Gunn oscillators are as follows: 1.5 watts peak power in the X band at Motorola Inc., Arizona; 140 milliwatts of CW at 6 gigahertz by Texas Instruments; and a full gallon of peak power at 1 gigahertz by the NASA Electronic Research Center, Cambridge, Mass.

With a good many experimental systems already successfully tested, the promise of achieving a low-cost microwave power generator is gradually nearing fulfillment. At the present time a British firm, Mullard Ltd., is marketing such a device for experimental purposes. Priced at 175 dollars, it is available in sample quantities. Granted, this is a pretty steep price tag. Keep in mind though that the first *rf* power transistors for the 80 meter band cost a pretty penny at first; now they can be purchased for less than a dollar.

Up to the present the high cost of vacuum-tube microwave sources (a small klystron and its power supply cost about a hundred dollars) and the complexity of system has seriously limited amateur radio experimentation in the microwave frequency range. The development of an extremely simple and economical microwave power generator, such as the Gunn oscillator, should do much to open the way to much more use of these frequencies by radio amateurs.

The Gunn oscillator is not the only new solid state device that looks promising as a generator of microwave power. Other semiconductor devices, such as avalanche-transit time diodes, are creating power-frequency combinations never before accomplished in solid state circuitry in the microwaves. Avalanche-transit time diodes are junction devices that depend for their operation on "avalanche breakdown", that is, the creation of extra charge carriers by collisions with atoms. As with the Gunn oscillator, they are able to amplify and oscillate due to their negative resistance characteristics.

As a class, avalanche-transit time diodes offer promise of reasonable power outputs at reasonable efficiencies in the range from a few gigahertz to many tens of gigahertz. Over much of this range they will be in direct competition with bulk gallium arsenide Gunn oscillators. Thus far, the tunnel diode has been out-distanced as a microwave power generator by both the avalanche-transit time diode and the Gunn oscillator. The avalanche-transit time diodes are expected to undergo a tenfold improvement within the next couple of years. Within five years, CW power output of one watt at 20 gigahertz may be commonplace.

At this time you are probably very curious as to how this phenomenon occurs. In this respect you aren't alone because a lot of engineers are wondering the same thing! The main features of the Gunn Effect now seem to be understood, but there is still a considerable amount of research work continuing in order to completely understand its behavior.

In a very basic sense, the operation of the Gunn oscillator can be explained as follows. When the dc voltage across a tiny crystal of gallium arsenide is slowly increased, there is a certain critical voltage where the semiconductor suddenly begins to produce a high-frequency oscillation. Capacitive probe measurements conducted by Gunn indicated that a dipole layer was moving through the semiconductor at a terrific velocity; about ten million centimeters per second. Gunn also observed that the time required for one complete pass through the semiconductor material corresponded to the period of the oscillations. For example, a chip of gallium arsenide that is 0.01 centimeters long oscillated at a frequency of one gigahertz.

An explanation of how gallium arsenide behaves is not as simple as for other more conventional semiconductor materials such as silicon and germanium. It requires our understanding quantum mechanics. These are the laws that govern atoms and electrons and the basic make-up of our physical world.

Within an atom of semiconductor material, all electrons exist in one of two energy states. Some are locked in an orbit and swing around the central structure of the atom at the speed of light. These electrons are said to be in the valence energy band. Others are free to move at random between the atoms of the crystal structure.

These electrons are able to carry current when an electric field is applied. These electrons are said to be in the conduction energy band. The word "energy" is repeated to emplasize that the electrons are constantly in motion, no matter what state they are in at the time.

Once the electrons are free in their bands, they can move under the influence of an electric field. The amount of current flow that will take place depends on the mobility of each type of charge carrier. The electrons are generally more mobile than holes.

The gallium arsenide conduction band has two valleys separated by a small energy gap. The electrons in the lower-energy valley have a greater degree of mobility than those in the upper-energy valley. When the voltage across a crystal of gallium arsenide is increased, there is a greater number of electrons excited into the upper (lower mobility) valley. As a result, the resistivity of the semiconducting material will increase as the voltage is increased.

When there are more electrons in the upper valley area than those in the lower valley area, the semiconductor assumes a negative resistance characteristic. Not all semiconductor materials have this distinctive feature.

To illustrate what is meant by negative resistance, consider the graphs given in **Fig. 2**. A normal conductor of electricity has a positive resistance in the sense that the current passing through it increases with increasing applied voltage (**Fig. 2A**). In gallium arsenide it is possible to have situation in which Ohm's law does not hold true;

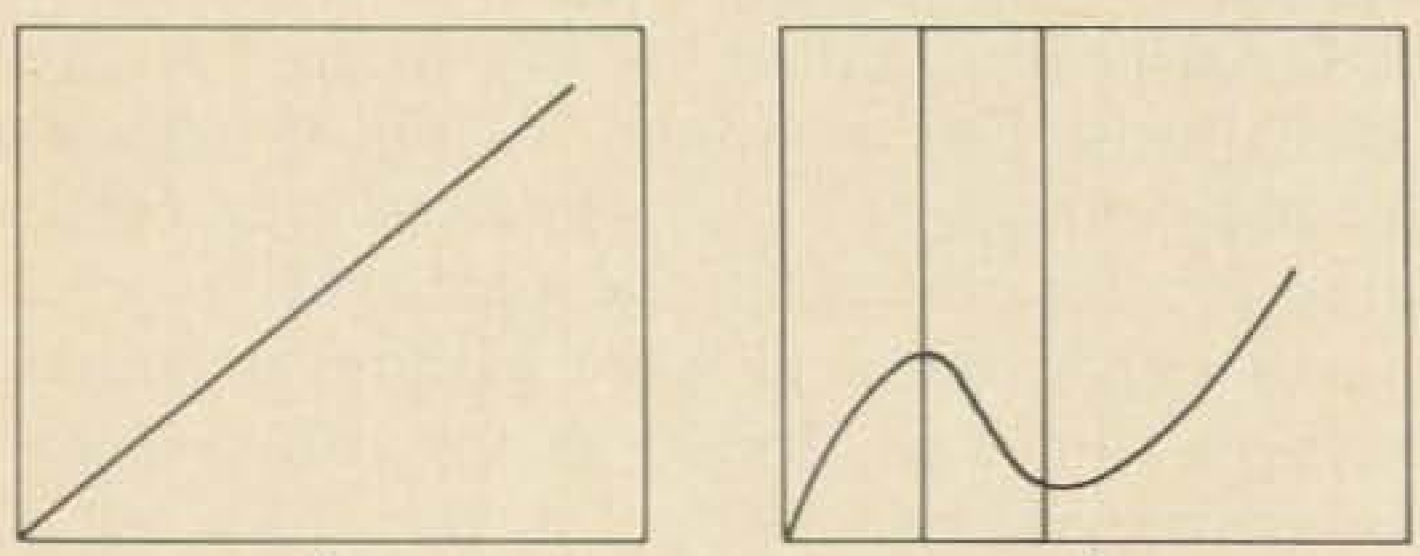

Fig. 2. The theory of positive and negative resistance are illustrated in these two graphs. A normal conductor of electricity has a positive resistance since the current passing through it increases with increasing applied voltage (Fig. 2A). In some semiconductor materials it is possible to have a situation in which the current first increases with increasing voltage but then decreases with increasing voltage (Fig. 2B). The area where the current is decreasing as the voltage is increasing is called the negative resistance region (shaded).

(courtesy Scientific American)

the current first increases with increasing applied voltage but then decreases with increasing voltage (**Fig. 2B**). The area where the current is decreasing as the voltage is increasing is called the negative resistance region of the semiconductor material.

A chip of gallium arsenide is capable of oscillation and amplification at extremely high frequencies because of its negative resistance characteristics. Any circuit having feedback can be made to oscillate if its losses, which are positive reactances, are completely overcome. Negative resistance accomplishes this by exceeding the losses. This makes it possible for energy, once it starts moving in the circuit, to keep moving indefinitely. A circuit with enough negative resistance can overcome its losses. The opposite of loss is gain – or amplification!

Conclusion

There have been a great many promising proposals and suggested applications for these new semiconductor devices passed about in engineering circles. Some of them have advanced beyond the lab, others are still in the embryonic stages. With all the applications now being explored, it is clear that economical solid state devices for generating microwave power have passed the stage of being a lab stunt and entered the stage of becoming a beneficial addition to microwave technology. We can never know when some new insight or experimental breakthrough will bring additional advances in this field. I hope that it is not too optimistic to conclude that these new semiconductor devices will bring about a substantial increase in the use of the microwave frequency spectrum by radio amateurs in the not-too-distant future. In this article I have tried to tickle your imagination with some of the seeds of ideas that are destined to do just that.

. . . K3PBY

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Loaded Coat Hangers For Two Meters

Having recently acquired a Benton Harbor "lunch pail" of the two-meter variety, I decided to try my hand on that band. However, being a poor college student living in a tiny apartment, I was hard pressed for an antenna.

The antenna I needed had to be indoors and, therefore, small. Lack of money meant it had to be cheap. And, I had to reach the local two-meter gang.

A dipole and a whip proved unsuccessful. A ground plane seemed to be the answer.

Five coat hangers and two coax connectors later, I had my antenna.

The coat hangers were cut into 20 inch straight lengths, with a loop bent in one end of each length. Four of the lengths were bolted through the loops to the top side of an SO-239 and bent down. The remaining wire was soldered into the center of a PL-259. (Rubber sealant may be used to guard against shorting.) A loop at the top aided in hanging the antenna from the ceiling of the apartment. The best dx so far has been about 50 miles.

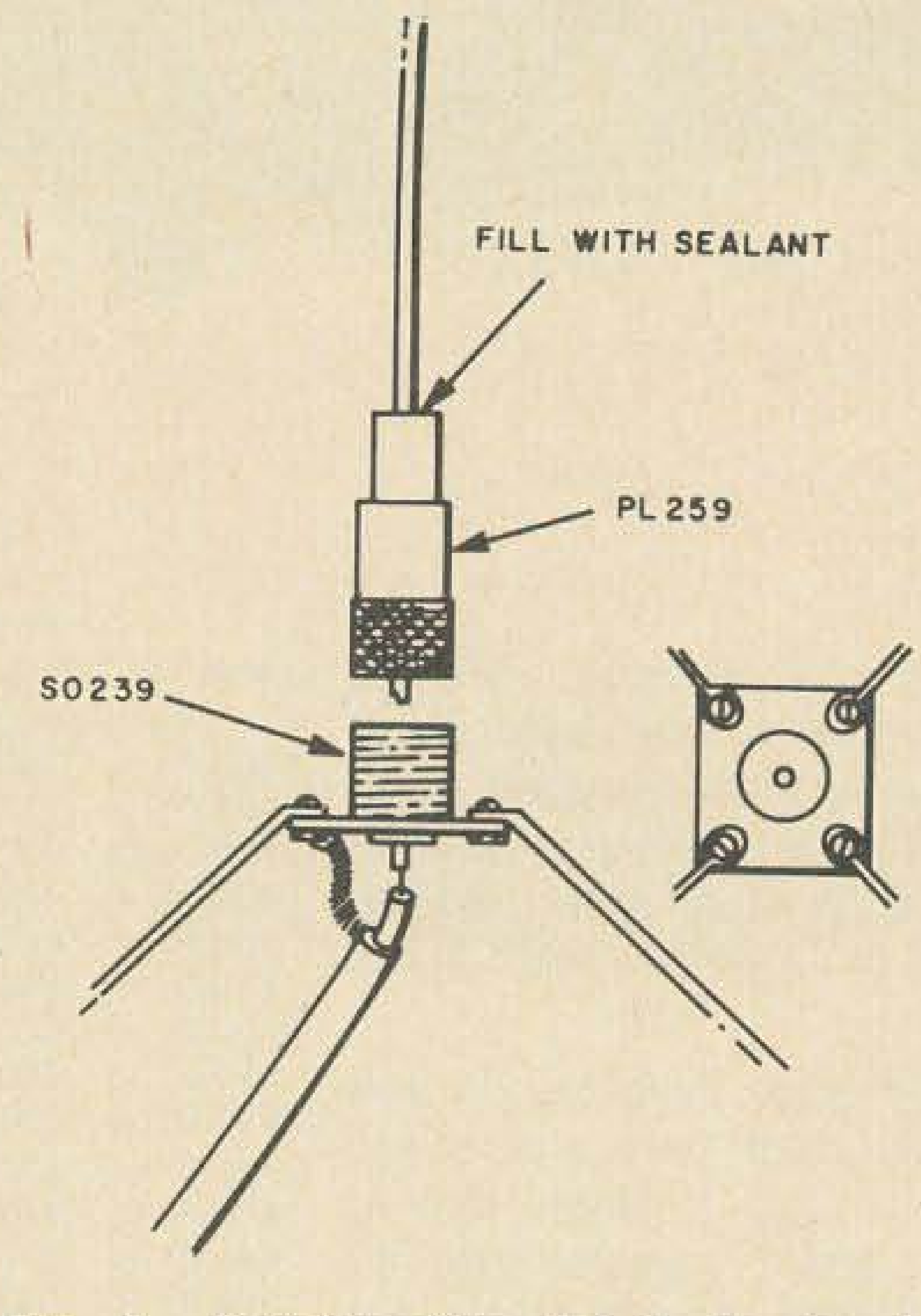


Fig. 1. Construction details for the loaded coat hanger for 2 meters.

I don't think this idea is new—but it works. *A word of caution:* Hang the antenna high enough so it won't be bumped into. You could lose an eye by running into it.

Dallas W. Williams, WAØMRG/Ø

Modification of VHF Transmitters for CW Operation

Martin J. Feeney, Jr., K1OYB
515 Central Avenue
Mt. View, Calif. 94040

Many DX contacts on the VHF bands are missed because of the lack of CW activity. This dearth of CW is usually due either to unwillingness on the part of the operator to give it a try, or because many rigs, commercial and homebrew, just don't have provision for CW operation, even in this age of enlightenment. To convince the former, I can only cite my 1250 mile QSO with W4MNT, Orlando, Florida. During this QSO I was running 70 watts, CW. I daresay this would have been difficult, if not impossible, using any other mode.

The transmitter I modified was the Tecraft TR-20, 220 MHz rig. However, the same approach can be used on many other rigs. The parts required are a DPDT toggle switch, closed circuit key jack, 7 pin miniature tube socket, .001 mF disc ceramic capacitor, OA2 VR tube, and a 15K, 10 watt adjustable resistor. Inspection of the chassis and the photographs will show the location of the components. The only critical point is to position the key jack as near as possible to the cathode pin (pin 2) of the final 6360.

The Phone-CW switch is wired so that in the Phone position the rig operates normally; in the CW position the modulation transformer secondary is shorted and the cathode circuit of the 6AQ5 modulators is opened. One part of the DPDT switch, closed in the CW position, is wired across the modulation transformer secondary. The other section is used to open the modulator circuit. This section should be open in the CW position. Unsolder the 180 ohm cathode resistor from pin 2 of the 6AQ5's. Run a wire from pin 2 of the 6AQ5's to the switch, and run another lead to the disconnected end of the cathode resistor. Tape all exposed joints.

Mount the VR tube socket and connect one end of the 15k resistor to pin 5; connect the other end of the resistor to the B+ pin on the power plug. Ground pin 2 of the VR tube socket. Replace the 6AU6 oscillator screen resistor, connected to pin 6, with a 1000 ohm, ½ watt unit. Connect one end of the resistor to pin 6 of the 6AU6 socket, and the other end to pin 5 of the VR tube socket. This will stabilize the oscillator stage, and prevent FM on Phone, and chirp on CW.

Next, mount the key jack. Wire it so that it is closed with the key out. Then unsolder pin 2 of the 6360 final stage. This is easier said than done, and may require temporary removal of other components in the area. If you are unfortunate enough to break off the pin in the process, as I was, remove the remains and replace it with a pin from

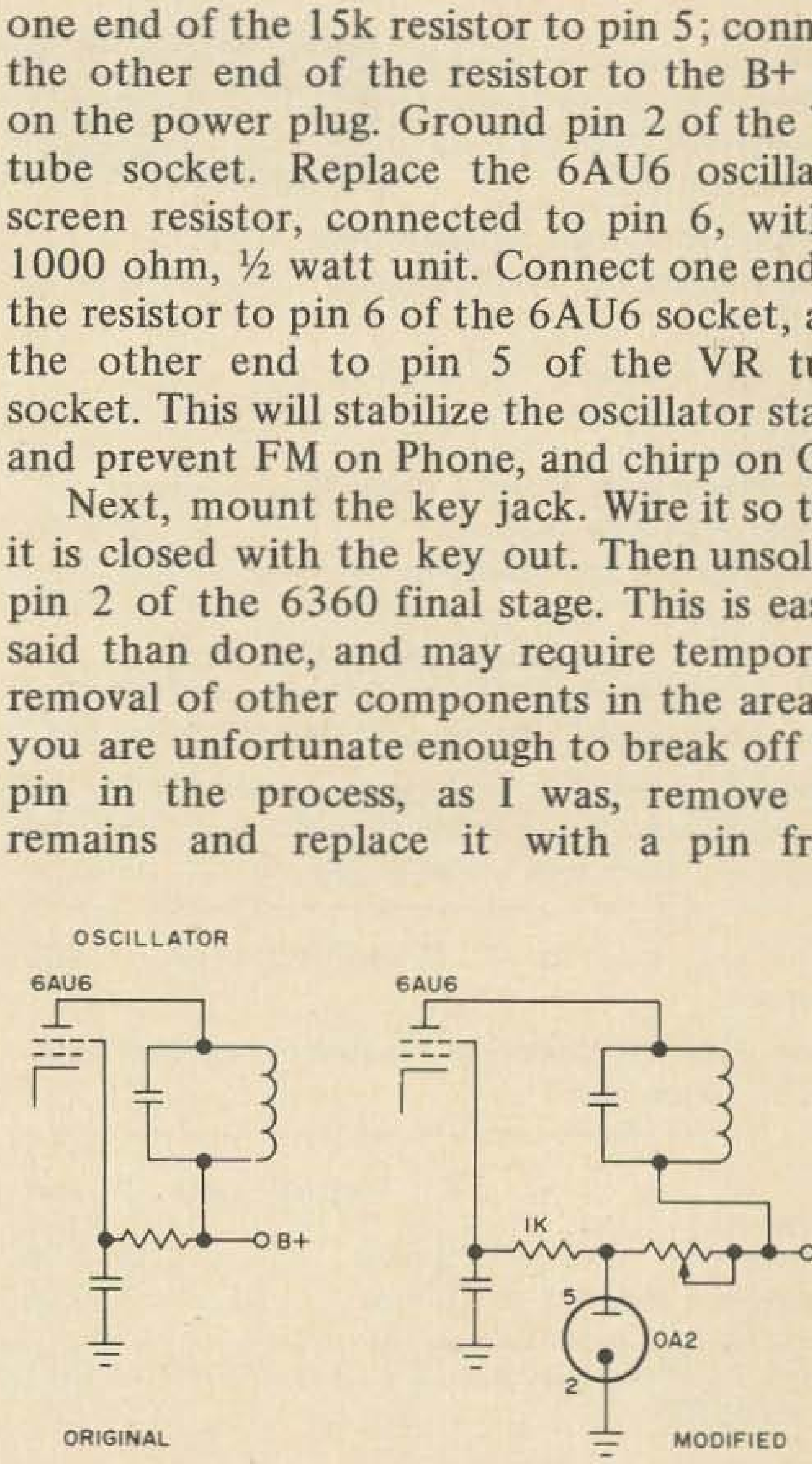


Fig. 1. Oscillator stage showing addition of VR tube.

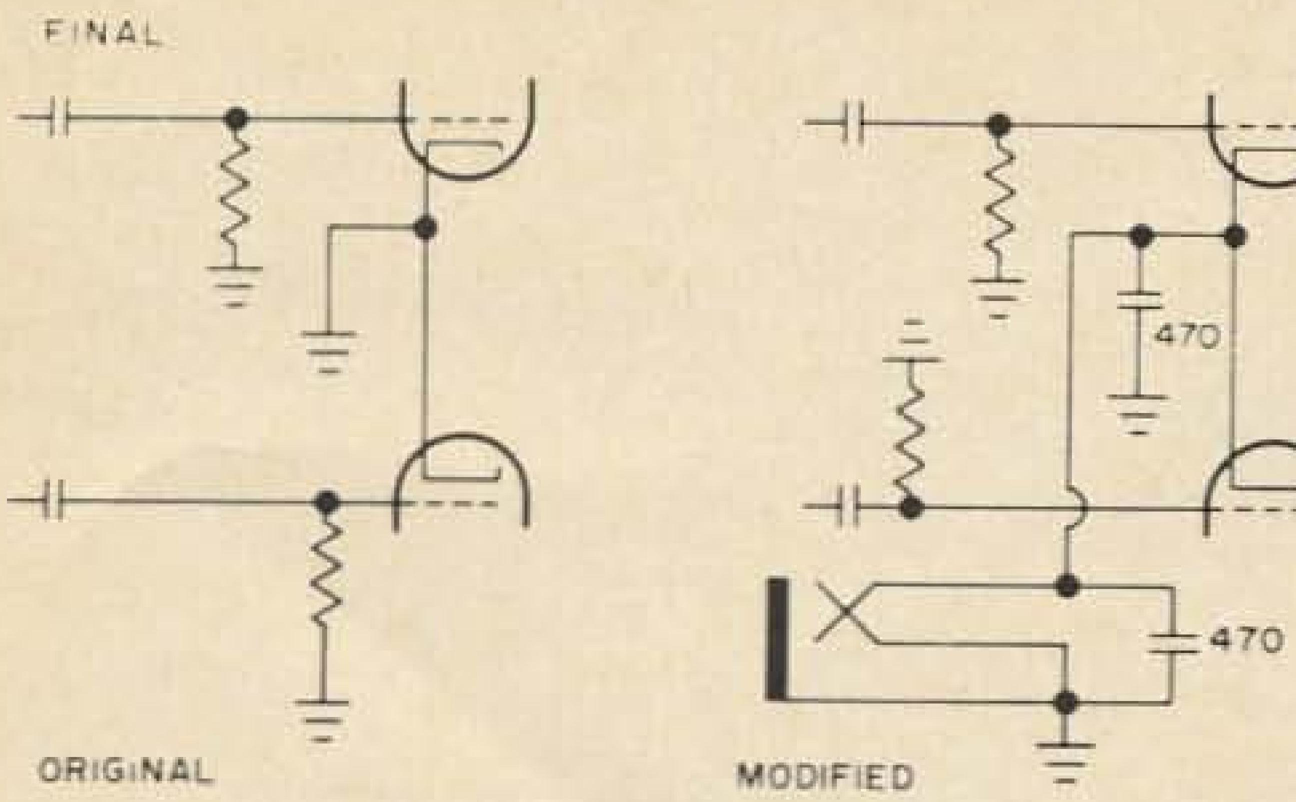


Fig. 2. Final stage indicating addition of key jack and by-pass capacitors.

another socket. Solder a 0.001 mfd disc capacitor from pin 2 to ground, and run a lead from pin 2 to the hot terminal of the key jack. Also, bypass the hot lead on the key jack to ground with a 0.001 mfd disc ceramic capacitor.

This completes the wiring. Replace all tubes; plug in an OA2, and set the adjustable resistor for about 10 ma through the OA2. With the switch in the phone position, the rig should tune up normally. In the CW position, the meter readings and the output should be somewhat higher. This is because the modulator load is removed from the power supply, causing the voltage to increase, and there is no longer a B+ drop across the modulation transformer secondary.

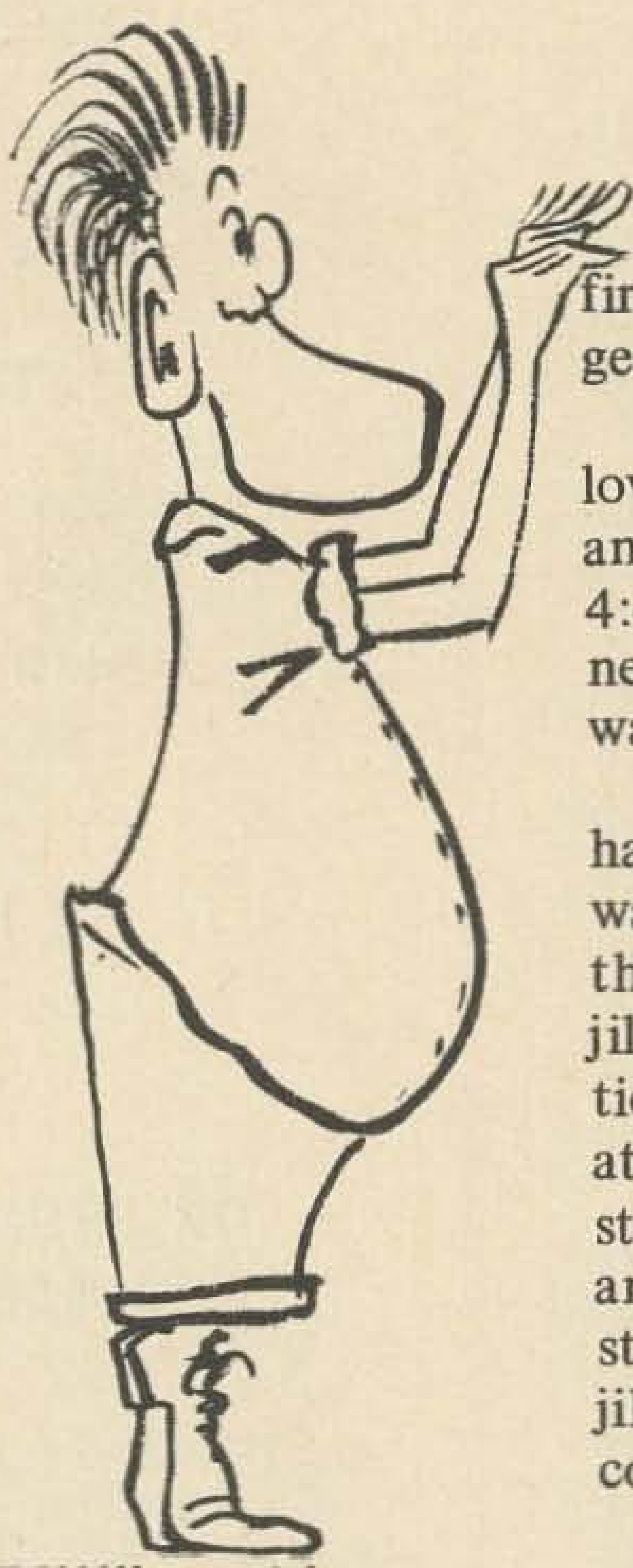
This scheme is applicable to nearly any small rig, and I have successfully employed cathode keying of a 5894 on 2 meters and an 829 on 6 meters. To put any other rig on CW, it is necessary only to open the final cathode circuit and install a key jack, and short the modulation transformer secondary. If the modulation transformer isn't shorted you probably will end up with a second-rate CW signal, and may be forced to purchase a new modulation transformer, modulator tubes, final, etc. Remember Lenz's Law! It isn't necessary to disable the modulator, but it does cut power consumption and is a bit more professional. This may be accomplished in many ways; opening the cathode, breaking the plate and screen circuits, opening the screen lead, etc. If your power supply has very good regulation, you may dispense with the VR tube, but it's cheap insurance against a poor signal.

This technique has been successfully applied to the Tecraft 220 transmitter and a 6360, 220 rig similar to the rig in the ARRL Handbook of a few years ago. Give it a try, get on VHF CW, and join the Great Society!

...K1OYB

Mondo Hamme

Bob Manning, K1YSD
915 Washington Road
P. O. Box 66
West Rye, New Hampshire 03891



"OH NO! NOT AGAIN!!!" – with a nauseating SSSHHHHGGLLOPP!!! one sixth – or roughly one hefty handful – of a Sara Lee chocolate meringue cream pie whizzzed past my head and came to rest on my sound absorbent wall-covering, in the process, my T/R switch a new RCC certificate and an autographed 8 X 10 glossy of my hero, J. Croyden Seymour. [Poor ole J. Croyden! He was instrumental in interesting me in amateur radio and assisted in the planning of my ham shack. Regretably, he was prevented from seeing the completion process – having been struck down in one of the most bizarre accidents in homo sapien history.

It seems that a jilted young lover, who lived nearby, had decided to do away with himself by swallowing something toxic, then speeding to the home of his unrequited love, dramatically expiring on her door step. Unfortunately, he arbitrarily grabbed the first bottle in the medicine chest and ingested 2.9 litres of castor oil.

On the way to his destiny, the young lover was overcome by that 'irresistable urge" and, breaking all records for the Fat Man's 4:40, he sped into the men's room of the nearest gas station (appropriately enough, it was a "Flying 'A' " station).

At that precise moment in time, the hapless J. Croyden, an extremely frugal man, was attempting to climb under the door of the only vacant pay stall in the place. The jilted lover plunged headlong for that particular door, deposited his dime and attempted to gain entry. Since he was standing on J. Croyden's spine and the door and floor were making rapid and repeated staccato contacts with J. Croyden's head, the jilted lover couldn't get in and J. Croyden couldn't get up.

The jilted lover, loudly bemoaning his fate, was doing what appeared to be a combination "War" "Rain" and "Put out that damned fire" dance all over J. Croyden's prostrate form. J. Croyden, being alternately pounded on the jawbone by the floor and the cerebellum by the metalic door was gurgling, "I'll pay – I'll pay – dammit I'll pay!"

Within a very short span of time, some other highly predictable events took place – none of which are relevant to the story save that they left J. Croyden with some odd residual inhibitions.

Since that day, his spare time is spent wandering around town with a harried look on his face, putting coins into pay phones, parking meters and gum ball machines, keeping up a continual mumble of "Ya can't beat 'em! ya gotta pay! – ya just gotta pay!!"

At one time, unable to find a coin slot, J. Croyden just up and swallowed a fistful of coins – he lay in a hospital bed for three

days before there was any change.

J. Croyden's family tries to keep him home as much as possible – not only to save money – but because every time J. Croyden hears unexpected running footsteps behind him, the Fire Department must invariably be called to rescue him from the top of the nearest telephone pole, street sign or some precarious window ledge.]

All this flashed through my mind as I watched the artificially colored meringue oozing, like some science fiction glob, onto my SWR bridge, Vibroflex and G. E. Clock/Timer. I knew, with that instinctive inborn canniness of the long-married ham, that I – through my interest in amateur radio – had somehow irked my wife. Had I forgotten to take out the garbage? Overlooked an anniversary? Forgotten our 12-year-old kid's – whozzis's – name?

I didn't turn my head – uh uh – oh no! The last time I did that, I kept right on talking and brought my D-104 along with me. The second salvo consisted of a 2-week-old bagle which made forceful and direct contact with the D-104 – driving it and my partial plate half way to my esophagus. It took an hour and a half to get pieces of the D-104 out of my teeth and another hour to get pieces of my teeth out of the D-104.

"Sweetheart," I said, "I wish you'd correct for windage – that's the third clock you've hit since Newton Minnow's birthday. The clerk at the Radio Shop almost called the 'foam rubber taxi' the last time I asked for a 'meringue-proof' clock!"

"RAAWWKKKK!!!!!" screamed my wife – or some close approximation thereof – and another fragment of Sara Lee's epicurean delight found a spot dangerously close to the intake vent of the Air Conditioner.

"You never take me anywhere!" shrieked the distaff side.

"I do too!" I expertly reparte'd. "Why only last year I took you to the 'Anti lockjaw and Tongue Wagger's combination picnic, convention and orgy.' "

"Oh Shhure, you take me to those alphabet soup affairs. 'You're the ho hum' – 'how are the harmonicas?' and 'so you're YSD's XYZ?' "

"You got it all wrong, dear; I'm the O. M. – the kids are the harmonics and you're the XYL – L, not Z," I calmy replied.

"RAAAAWWWWWKKKK!!!! Ho hum – O. M. – harmonicas – harmon-

ics – XYL, XYZ, ABC, CBS, PDQ, who knows who cares! I feel like I'm at the Podunk Valley grammar school refereeing the semi-finals of a Sanskrit spelling bee – I I WANNA GO MEET PEOPLE WHO SPEAK WHOLE WORDS!!!!"

"Okay," sez I, "How about the night I took you to Howard Johnson's for dinner and cocktails?"

ZIPPLINGGG! – the empty pie plate caromed off my hand key, ricochetted into my message blank file and came to rest, face down, atop the head of our jittery, goggle-eyed poodle, who took off like a hairy hippie midget – a little more jittery and definitely more goggle eyed.

"Howard Johnson's! Howard Johnson's! *Howard Johnson's* – what a night that was. All the way there and all the way back you kept hollering into that junk you got stuck under the dashboard – 'I'm mobile – I'm mobile' – you got so much stuff under the dashboard that I have to ride in the back seat. . . . "

"But lover, you keep kicking holes in my speaker. . . . "

"I'll kick holes in your head, you cuckoo!!! and another thing – If you say, "I'm running mobile in the car tonight with a *hustler* one more time boy and. . . . "

"But dear," I said, "that's the name of the antenna."

"Antenna smantenna! Just one more time and you'll be talking to a divorce lawyer with a carved 'Z' on your forehead and that stupid antenna hangin' out of your navel!"

Drawing another breath, she said, "Do you remember what happened when we got to Howard Johnson's? I'll tell ya – you inhaled two martinis, tap tapp tapped your way through half the meal with your swizzle sticks then commandeered the paging system microphone and called CQ into a crowded restaurant and made two contacts – one, a nearsighted insurance salesman who spent a goodly part of the evening trying to sell policies alternatively to a hat rack, the juke box and the post card rotisserie; and the other was an itinerant 'dirty book' salesman – (you sure he had mobile gear in his trunk?) Anyway, you spent the rest of the evening talking alphabet soup at the table.

"Why, we can't even have people over for an evening!"

"That's not so darlin'. We had the Carsons over just two weeks ago." I retorted, slyly trying to slip my son's whatziz name's football helmet over my head and earphones.

"That was another terrific evening," my wife blurted. "First, as they came through the door you started off with 'hi there, you've met my Wife, *W*hiskey, *I*ndia, *F*oxtrot, *E*cho, Wife and my oldest daughter, Linda, *L*ima, *I*ndia, *N*ovember, *D*elta, *A*lpha, Linda haven't you?' Then we later tried to watch TV, but you got off on UHF, VHF and TVI – more alphabet soup – then Harry started telling jokes and you brought out an old electronics magazine, opened to a dog-eared page and sat there roaring for a full fifteen minutes at the title alone – I still don't see what's so funny about an article entitled, "HOW TO MOUNT AN OSCILLOSCOPE!"

"And you kept calling Harry a stupid 'top' all night!"

"That's *lid,* dear," I said.

"Top, cover, cap, lid whatever . . . did you have to throw him out of the house just 'cause he asked if you could pick up police calls on your ham rig?"

"It wasn't just that, honey – but when he asked, 'how far will this thing pick up?' I told him 'exactly half way around the world in any direction' and he didn't even chuckle!" sed I.

"I could even take this stuff on a part-time basis, Bob, but last night you phoned and said you wouldn't be home until a hundred and sixteen Swahili – I never know what the hell you're talking about. . . . "

"That's 'sixteen hundred *Zulu,* sweetheart' "

"Swahili, Zulu or Watusi – what the hey – they're all members of the Bantu Nation. How come you can't just say 'four o'clock'??"

I was saved at this point by the ringing of the door bell.

"Come in!," I yelled overly loud and a little hysterically. The door opened and J. Croyden ambled into the shack and, with a 'clunk', deposited a nickel into the piggy bank we had installed just inside the door for just that purpose. "Ya gotta pay old son," said J. Croyden, and began to survey the shack as my wife headed for the kitchen.

Noticing the Sara Lee ingredients dripping on, over and around various pieces of equipment, he said, "Well, either someone sent you a chocolate parfait time bomb or you been having troubles with the XYL again."

"No initials puuuleeease!! I'm in enough trouble already, J. Croyden!"

"Sorry, son." 'clunk', another nickel . . . "what started if off?"

"Well," I said, wiping chocolate goo out of a phone jack – "I guess I forgot an anniversary – or I haven't been paying enough attention to the wife – or some foolish thing like that – last year it was because she wanted a 'second' dress!"

"Tough" said J. Croyden – searching for another coin – finding none, he wrote out an I. O. U. and stuck *it* into the piggy bank.

"I suppose it all started when my Mother-in-law was here. She looked up at my tower and tri-bander and asked what it was – so I told her it was a clothesline for the Jolly Green Giant – Ya know what I wish, J. Croyden? What I really really wish??

"Whazzat??"

"I wish to hell I had a way of ending this article – thats what I wish!"

"There is no end, old son," said J. Croyden "It's a vignette!"

"MONDO HAMME – IT'S A HAMS LIFE. . . . "

...K1YSD

Convention Hotel Burns

On May 9th, exactly two weeks before the New England ARRL Convention in Swampscott, just as all of the final details had finally been ironed out by the convention committee, the New Ocean House Hotel managed, with the help of a weak water supply from the town, to burn to the ground. Some very fast footwork on the part of the committee resulted in their obtaining the Statler-Hilton as an alternate. The convention will come off on the same days as planned, but in downtown Boston instead of out at Swampscott.

Straightforward SSB for 6 Meters

Murray Ronald, VE4RE
Box 947
Brandon, Manitoba
Canada

There have been many different circuits put forward over the years for getting an SSB signal on 6 meters. They range from the simple transverter to the full-fledged single band affair. This little unit was intended mainly for field day or portable use; however, it now forms the backbone for my station, being used directly on 6 meters and with transverters on 144 and 432 MHz. It was designed to be simple yet effective; thus the PTT and single conversion with option of spot frequency injection or VXO. The 2E26 final provides about 30 watts PEP input; however, substitution of a 6146 with suitable changes in power supply voltages would almost triple the power input.

L1–30T 28 e. on 3/8" form. Link 2T of hookup wire at center.
L2–12T 18 tinned airwound, 3/4" O.D., 1 1/8" long. Link 2T hookup wire at center.
L3–15T 28 e. on 5/16" form. Link 1T hookup wire at "cold" end.
L4–6T 18 tinned airwound, 3/4" O.D., 7/8" long. Link 1T hookup wire at "cold" end.
L5–9T 18 tinned airwound, 3/4" O.D., 1¼" long. Link 1T of hookup wire at "cold" end.
L6–4T 18 tinned airwound, 1" O.D., 1" long.
PC–3T 18 tinned on 47 ohm lw resistor.
T1, T2–modified 10.7 mhz *if* transformers. See text of article.
C1, C2–part of neutralizing circuit. See text.

Table 1–Data on coils and special components.

The Circuit

The block diagram of **Fig. 1** illustrates the overall layout of the exciter. The 7360 oscillator balanced modulator is a conventional circuit in which the cathode, grid and screen form the oscillator circuit while the plates and deflection electrodes are utilized in the balanced modulator circuitry. The DSB signal produced in the 7360 tank circuit is passed through the 9 MHz filter at which point one of the sidebands is removed. After amplification in the 6AU6 *if* amplifier, the 9 MHz SSB energy is applied to the 7360 balanced mixer. 41 MHz energy fed to the grid of the 7360 mixer is cancelled out in its tank circuit. The 5 pF butterfly capacitor is brought to the front panel as the "mixer tune" control. CW operation is provided through cathode keying of the mixer stage and has proved to be quite satisfactory.

The 12BY7 functions as a straight-through class A amplifier whose plate circuit trimmer appears on the front panel as the "driver tune" control. Link coupling to the grid of the 2E26 is used to further attenuate any undesired feedthrough. Neutralization of the 12BY7 was not found necessary because of careful shielding across the tube socket below the chassis. With suitable pin connection changes, a 6CL6 would serve as a good substitute for the 12BY7. The 2E26 final operates in class AB_1 in a conventional circuit employing capacitive neutralization.

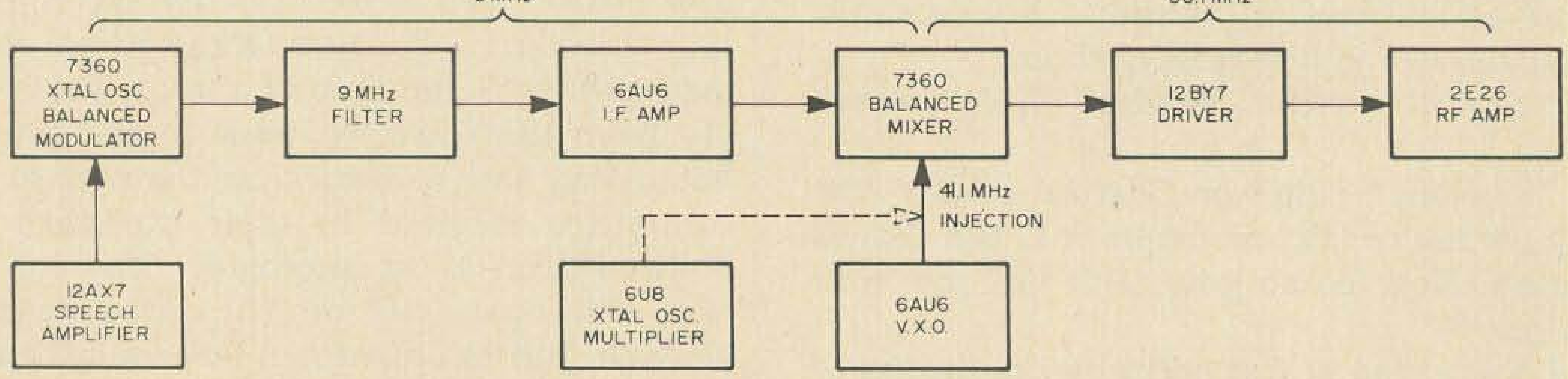


Fig. 1. Block diagram of the *rf* section. Single conversion path is illustrated.

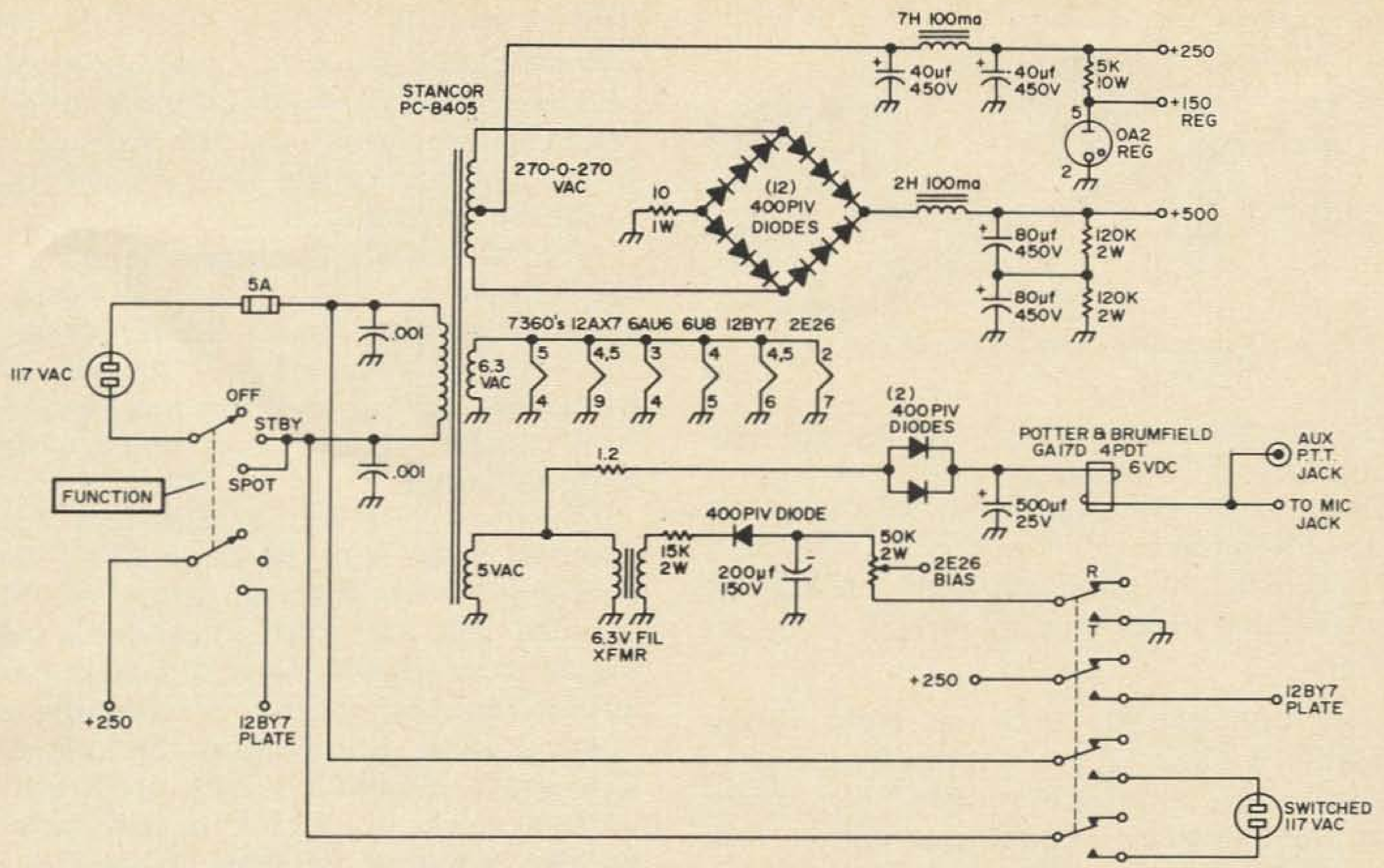


Fig. 2. Power supply and control circuitry. The controls, which are brought to the front panel, are shown in boxes.

Power Supply And Control Circuits

The power supply (Fig. 2) may consist of any common "TV" type transformer functioning in a dual voltage arrangement; the final's plate voltage being provided by bridge rectification, and the lower plate voltage by full-wave rectification through two legs of the bridge. Bias voltage for the final amplifier is derived from a reverse-connected 6 volt filament transformer connected to the used 5 volt filament winding of the power transformer. Transmit operation is provided by grounding of the floating side of the 6 volt dc relay. This may be accomplished with a push-to-talk microphone or by an auxiliary "transmit" switch. When not transmitting, plate voltage is removed from the 12BY7 to allow it to run cooler. The 2E26 bias is increased during standby by ungrounding one end of the bias adjust potentiometer.

Construction

Considerable thought went into the layout of this transmitter. Since the components are standard, builders may duplicate the layout if they wish. As detailed in Fig. 3, the 7360 sideband generator and the 12AX7 speech amplifier are located next to the front panel. Consequently the three controls and the jack associated with these stages can be mounted directly on the front panel without excessive lead length. The main chassis was assembled from aluminum, while the shielding was cut from thin brass sheet. As illustrated in the photographs, brass or copper partitions are placed across the *if* amplifier, mixer and driver tube sockets. All ground connections can be made directly to these partitions eliminating the need for ground lugs. Two of the partitions also serve as mounting for the mixer and driver tune controls. The 2E26 final is completely enclosed in a compartment at the rear of the chassis. A suitable enclosure can

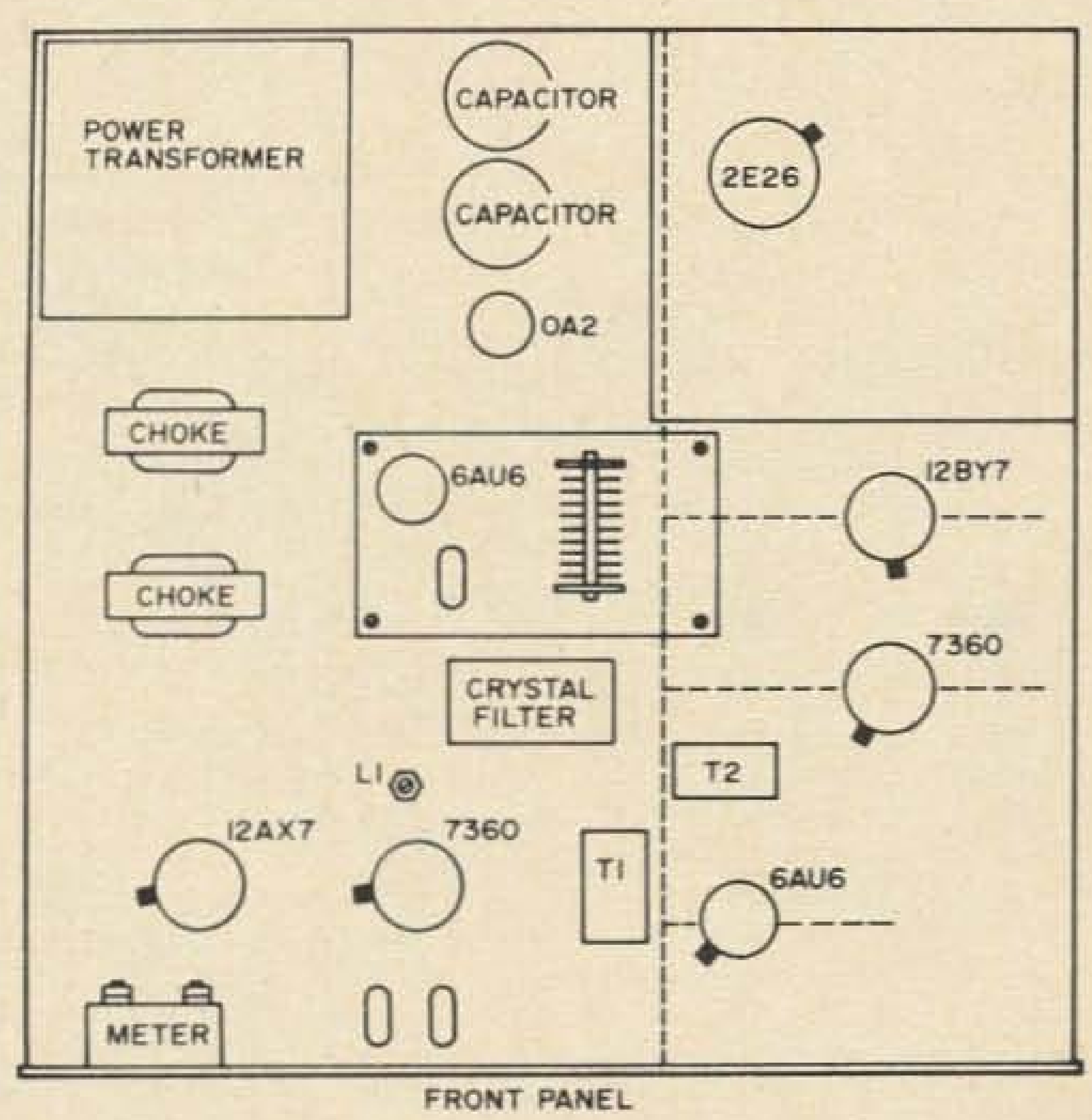


Fig. 3. Component layout viewed from above. Dashed lines indicate partition placement below chassis. The tab at each socket indicates position of pin 1.

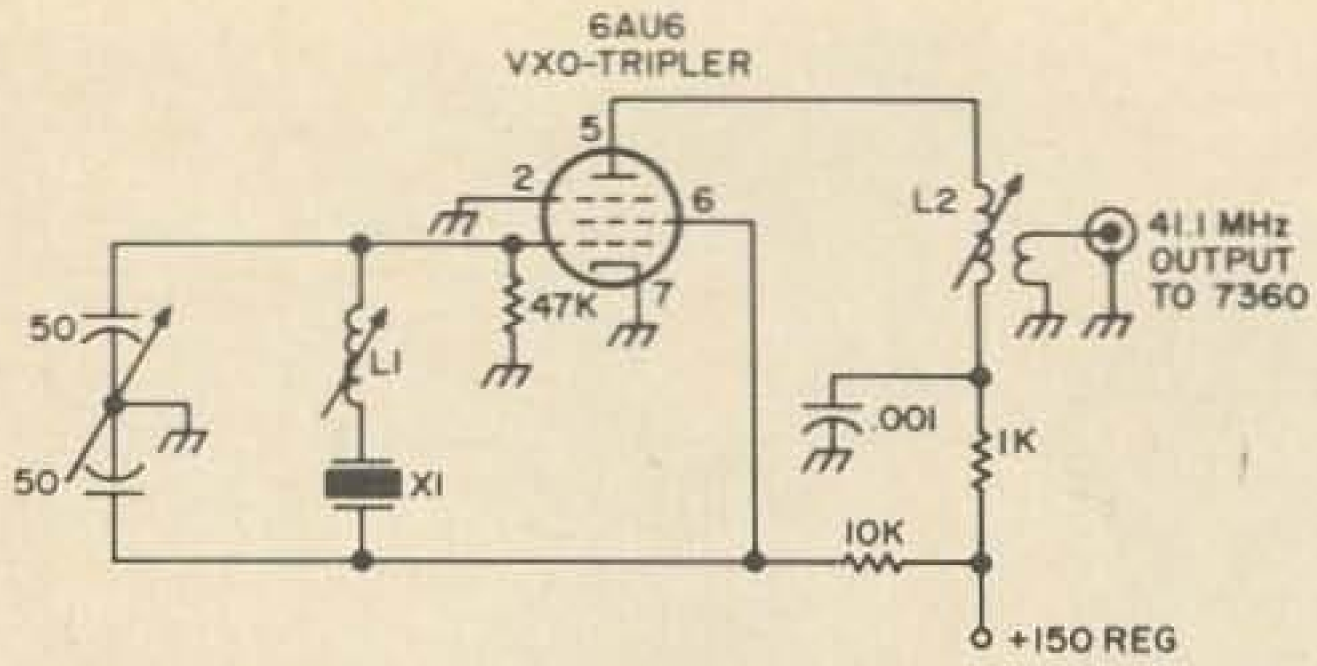


Fig. 4. Schematic diagram of the vxo tripler.

L1–30T #34 closewound on ¼" ceramic form.
L2–15T #28 closewound on ¼" form. 2T link of hookup wire.
X1–HC6/U xtal (fundamental). A 13.715 mhz crystal covers approx. 50.100 to 50.145 mhz.

often be salvaged from the high voltage "cage" of older style TV receivers. Extensions to the front panel for the mixer, driver and final amplifier controls were made from ¼ inch brass tubing. Short lengths of tight-fitting rubber tubing were used to couple the extensions to the capacitor shafts.

There are two small subassemblies used in the construction. The bridge rectifier diodes are assembled on a phenolic board which is bolted vertically underneath the chassis. Small holes are drilled in the board; the leads of adjacent diodes are placed through a hole, bent over, clipped, and then soldered together. If desired, 270 K resistors and .002 disk ceramics may be paralleled with the diodes to give voltage equalization and transient protection. The components associated with the rf output meter are mounted on a terminal strip which is bolted inside the 2E26 compartment near the antenna jack. A shielded lead carries the rectified voltage to the meter on the panel.

The 41.1 MHz injection is supplied by a VXO assembly built on a small plate and mounted above the main chassis. Certain of the VXO components such as the crystal socket and tuning capacitor are mounted ¼ to ½ inch from the plate to minimize capacitance to ground.

The usual VHF wiring techniques must be observed in order to produce stable TVI-free operation. All filament leads should be shielded and .001 disk ceramics should be placed from the hot filament lead to ground at each tube socket. In the higher frequency rf stages, lead length should be kept short. Grounding should be done as directly as possible and it is desirable to have only one or two common ground points for each stage. All plate voltage leads to the mixer, driver, and final, are routed through the main partition with feed-through capacitors.

Special Components

The 10.7 MHz *if* transformers used in the 6AU6 amplifier, are an older style of transformer using slug-tuned windings. They are more easily adapted than the smaller "K-Tran" type. In T_1 the primary winding was removed and replaced with a 3 turn link. The secondary of T_1 is moved down to 9 MHz by the addition of a mica capacitor. In

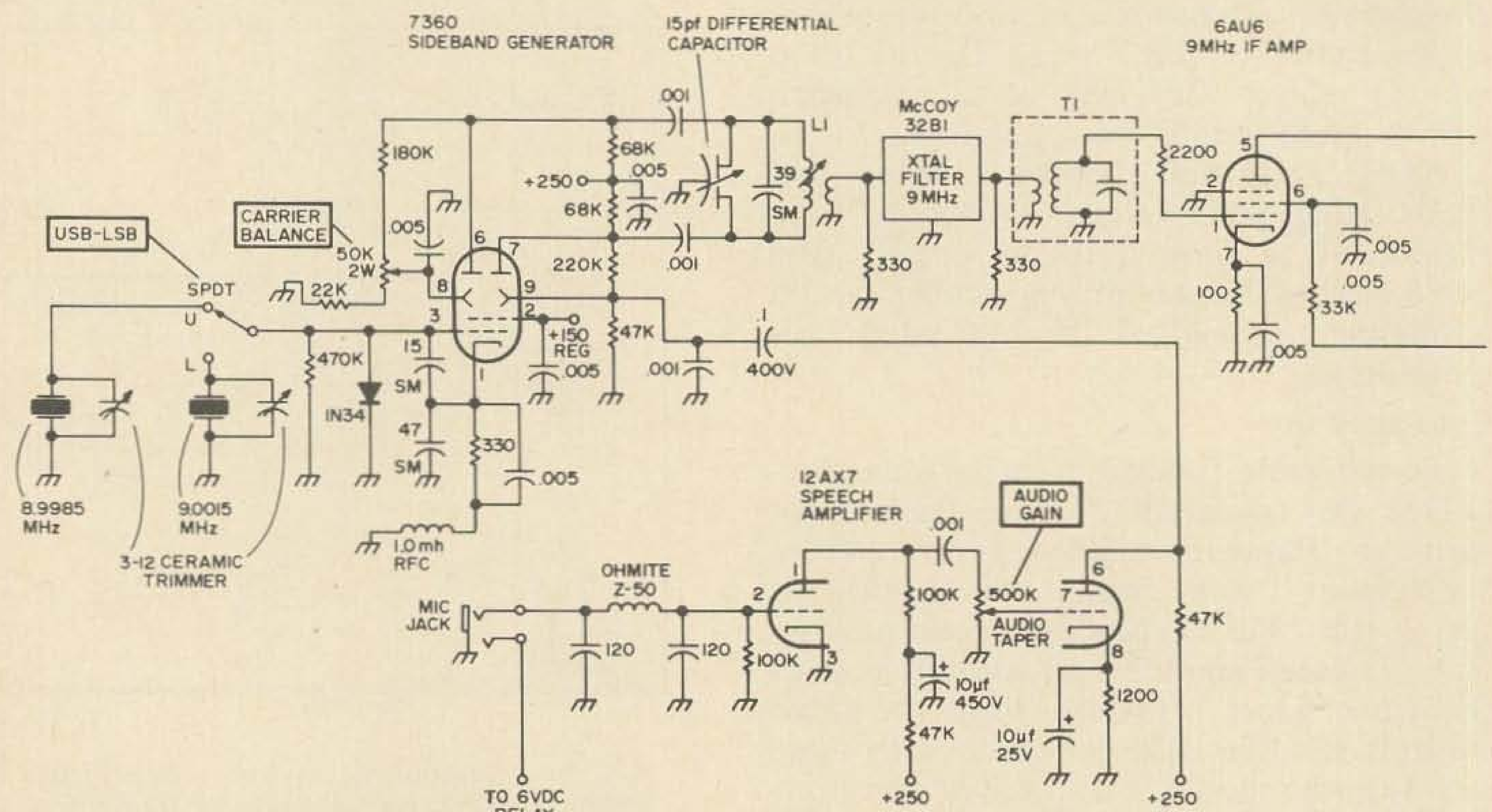


Fig. 6. Circuitry of 50 mhz exciter. Controls brought to the front panel are shown in boxes.

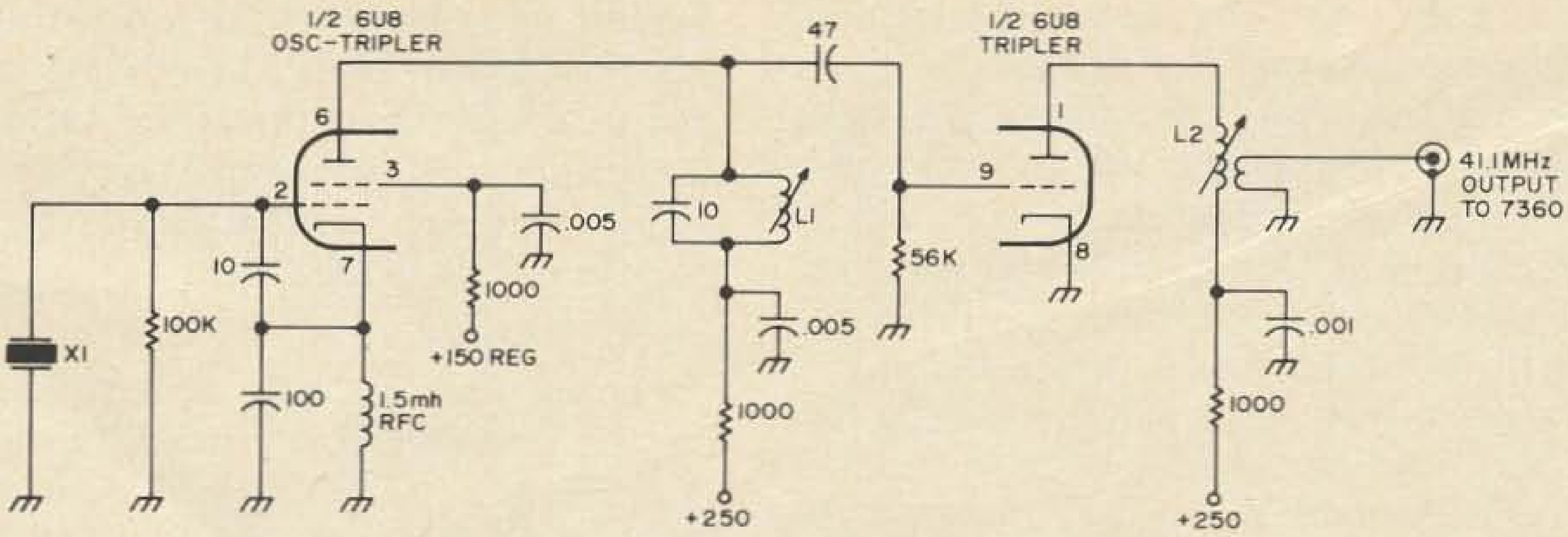


Fig. 5. Diagram for the oscillator tripler.

L1–26T #28 Closewound on ¼" form.
L2–15T #28 Closewound on ¼" form. Link 2T of hookup wire.
X1–FT243 surplus xtal. A 6.850 mhz crystal will give a spot frequency of 50.100 mhz.

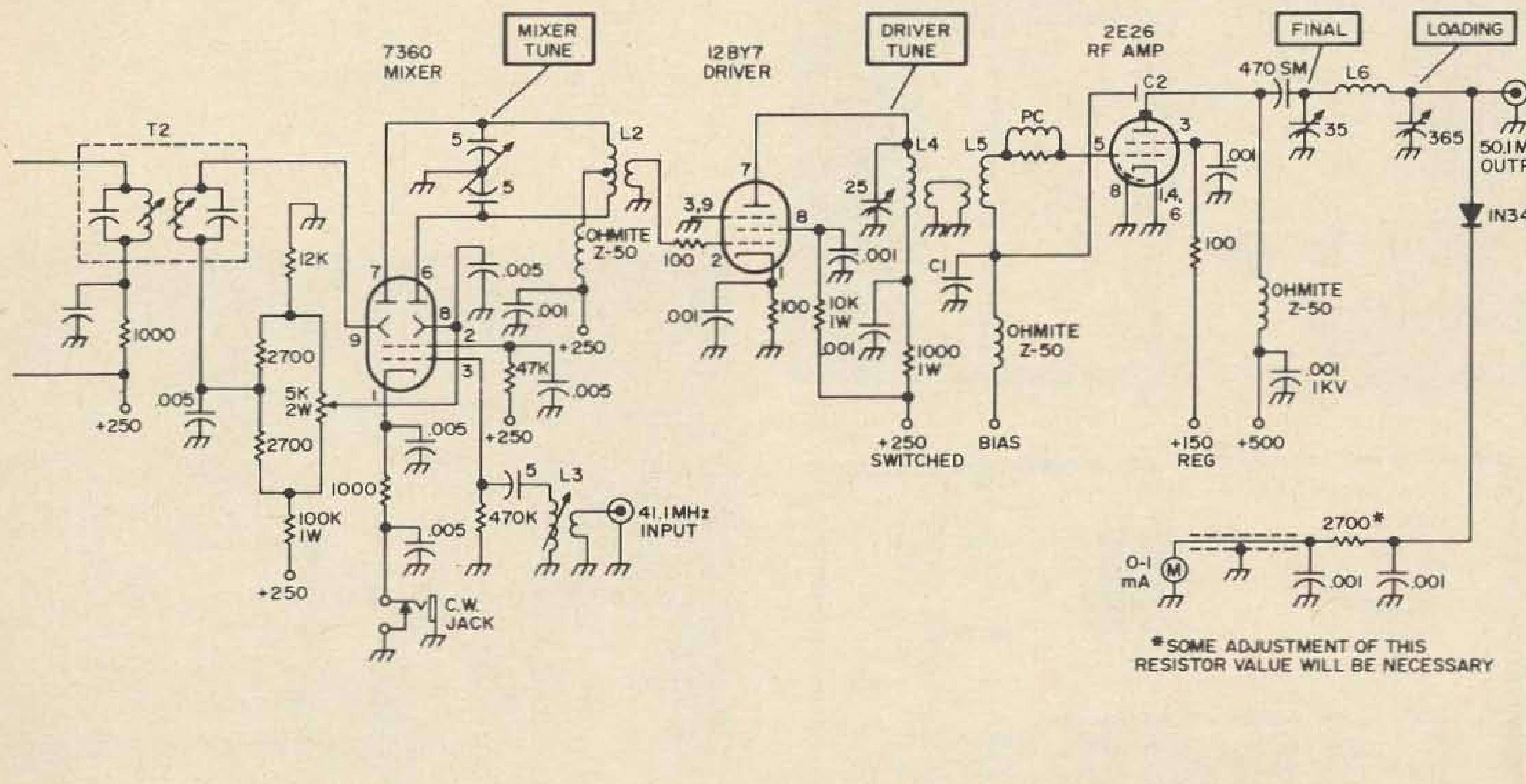
a similar fashion the primary and secondary of T_2 are lowered in frequency.

Some will argue that L_1 should be bifilar wound. Both a conventional and bifilar winding were tried and no significant difference in carrier suppression was noted. The differential capacitor associated with L_1 was constructed by taking a regular air trimmer, setting its rotor at half mesh and after inserting cardboard wedges between the stator plates, cutting through the stator with a fine toothed hacksaw blade. Of course this capacitor is available as a regular item if you can get your hands on one.

The 2E26 final is stabilized with capacitive neutralization. Capacitor C_1 should be mica and will be in the 330 to 560 pF range while C_2 is simply a stiff wire passed up through the chassis into the final amplifier compartment and placed near the tube plate.

Tuneup and Adjustment

It is assumed that the constructor will have checked all coils for approximate resonance (with the tubes in their sockets incidentally). Applying line voltage and setting the function switch in the standby position will place plate voltage on all stages up to the 12BY7 driver. A VTVM with an rf probe is almost mandatory for tuneup. Place the rf probe at the 6AU6 grid pin and adjust the carrier balance control to secure a reading. With the differential capacitor set at center adjust L_1 and T_1 for a peak reading. The differential capacitor is then adjust-



ed for a null. Set the ceramic trimmers across the carrier oscillator crystals at minimum setting and while switching from USB and LSB positions check to see that the VTVM reading remains about the same. This indicates that the crystals are centered reasonably well on the filter curve. Proceeding next to the 7360 mixer, place the probe on pin 9 and adjust both windings of T_2 for a maximum reading. Then with 41.1 MHz energy applied check pin 3 for a reading. It should be about 1 volt with L_3 adjusted to resonance. The next step is to remove the 6AU6 *if* tube to prevent 9 MHz energy from reaching the 7360. With the probe at the center-tap of L_2 adjust the 5K 2w potentiometer for minimum 41.1 MHz feedthrough.

Apply voltage to the 12BY7 with a temporary jumper and with the probe at pin 5 of the 2E26, peak L_2 and L_4 and adjust L_5 by the "squeeze" method. Moving the probe to the plate of the 2E26 adjust C_1 and/or C_2 for minimum feedthrough of 50 MHz signal.

A fairly satisfactory alignment of the carrier oscillator crystals can be accomplished as follows: with the rf probe at pin 9 of the 7360 mixer and with some carrier inserted increase capacity across the 9.0015 MHz crystal in order to move it down into the filter passband. Note the VTVM reading and then adjust the trimmer to yield a reading approximately three-quarters of the "passband" reading. Set the 8.9985 MHz trimmer to give a similar reading.

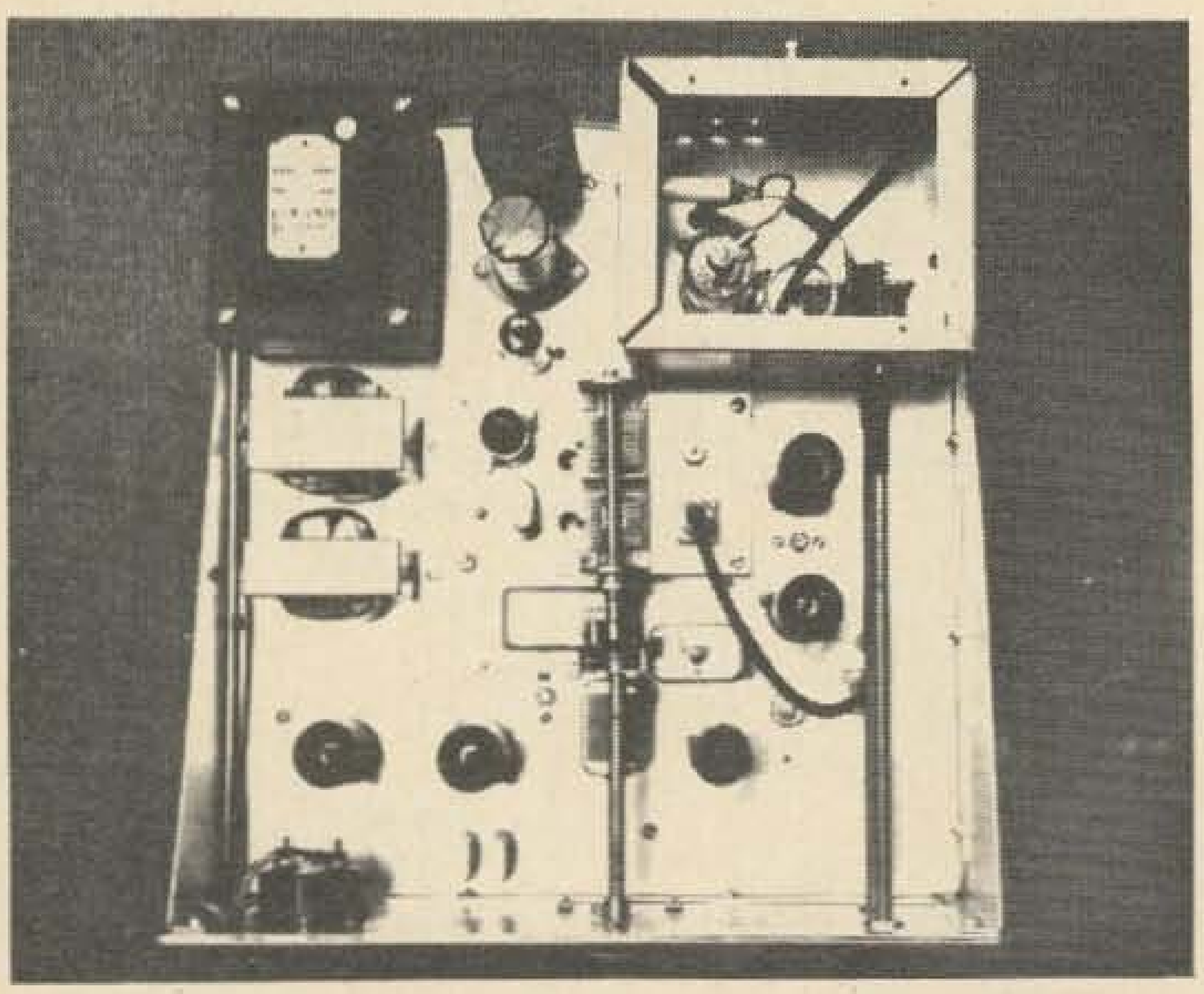
Afterthoughts

Some builders will wish to modify some of the circuitry to fit their likings and their junk boxes. One improvement would be a four position function switch to allow for a "manual" operate position. In the control section, by use of the negative bias voltage to disable the low-level rf stages one could use a relay with fewer contacts. Furthermore, only one side of the ac line need be opened for the switched 117 VAC.

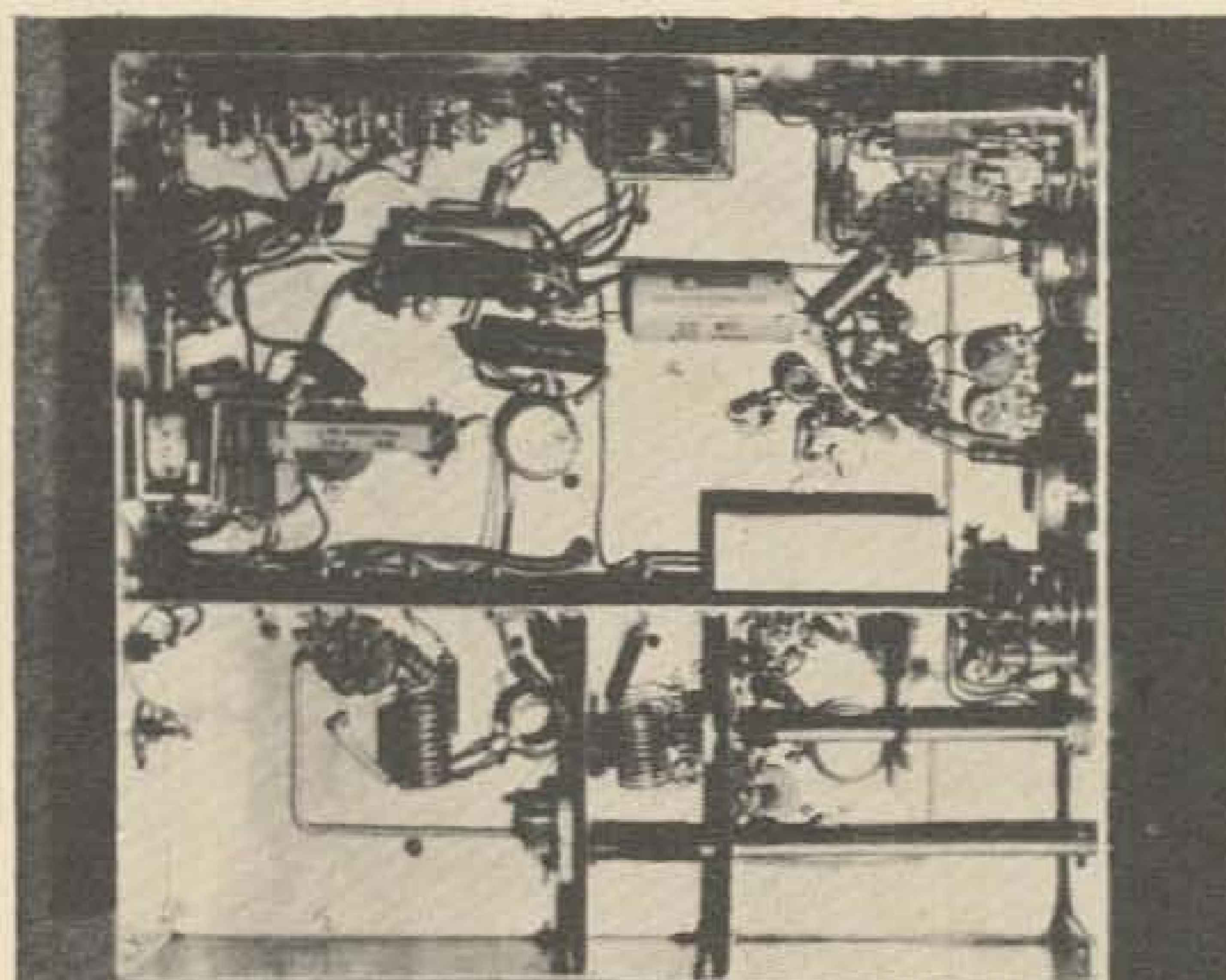
The idea of tripling in the VXO tube was suggested by W2ALL and has proved very satisfactory. VXO shift was held to approximately 40 kHz to give maximum stability, but with more series inductance coverage of 100 kHz should be possible with good stability.

Building the exciter consumed quite a few hours of my spare time, but I enjoyed it, and am looking forward to building a transistorized version in the future.

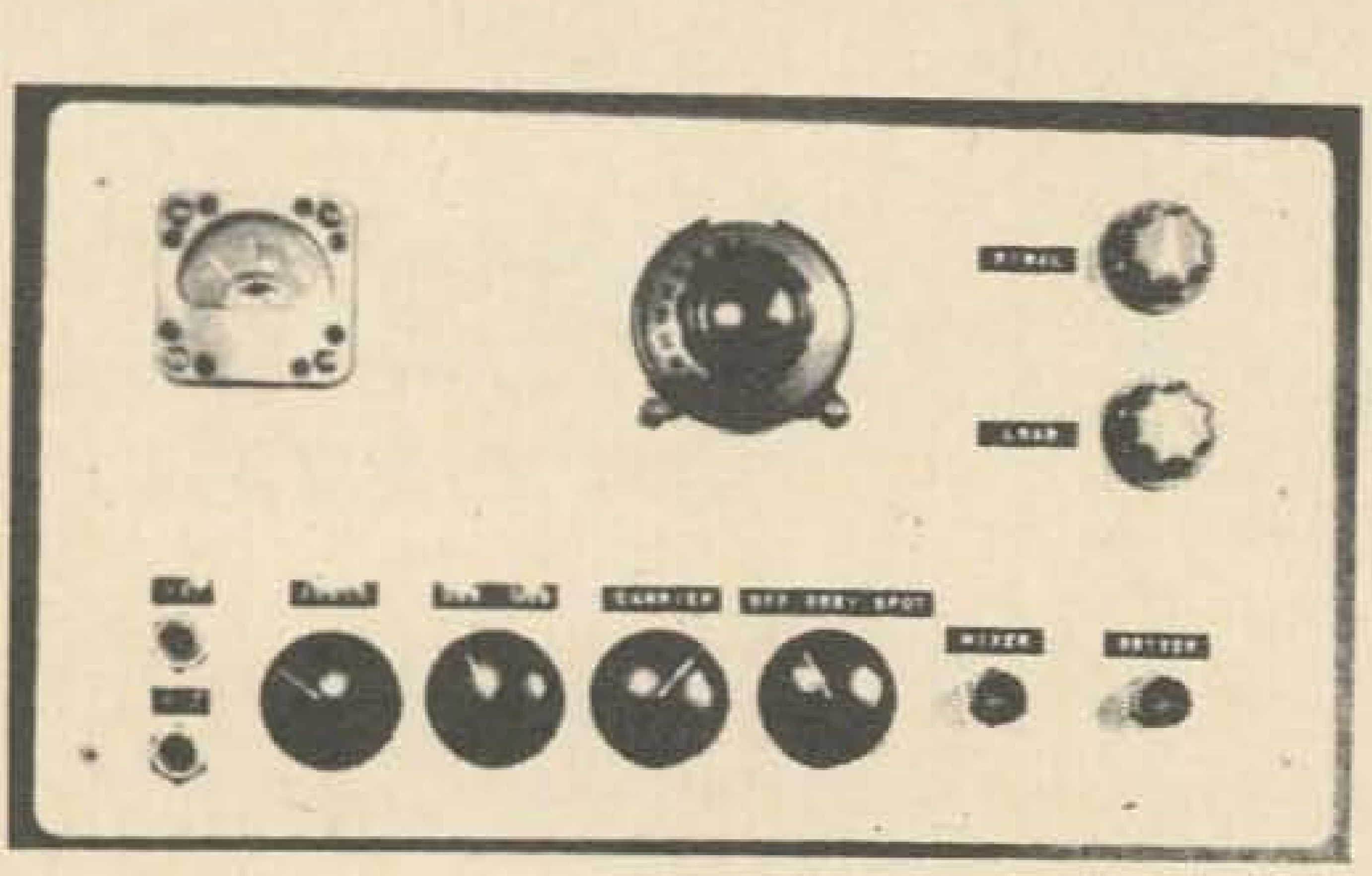
...VE4RE



Top view of the 6 meter SSB exciter.



Bottom view of the construction of the 6-meter rig.



Front panel showing all controls.

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The 432'er, Solid State

William F. Hoisington, K1CLL
Far Over Farm
Peterborough, New Hampshire 03458

This is a low-cost, all-solid state, A.M. rig complete with superhet receiver, to explore the possibilities of the entire 420 to 450 mhz band, to use in a car, boat, camping, on mountain tops, even the *walk-up* ones, and to have fun with.

You cannot use it to talk to the lads with narrow-band *if* sets clustered around 432 mhz, until you add the crystal controlled oscillator-exciter later. The *rf* amplifier is right there ready to have the crystal job plugged into it, but for the moment it is a lot easier and quicker to plug in a simple oscillator. This is the famous MOPA (Master-oscillator-power-amplifier). It takes a receiver with a bandwidth of several tens of khz, like the Gonset Communicator Three, to receive an MOPA signal on the 420 to 450 megacycle band, but just wait and see what you do with rigs like these!

As soon as you do add the crystal part you can talk to those sharp boys on 432. Then if you plug in a narrow-band *if* (like 455 khz) and a crystal-controlled local oscillator as well, you will have the best. But, and it's a mighty big "BUT," you will then have to use some kind of a tunable *if* front end.

The 432'er solid state receiver

RF Stage. Like sticking your hand into a basket of snakes! Now, I've built plenty of six and two meter *rf* stages, with various transistors, and they worked fine. But, up around 432, things are different! I've made up tube *rf* stages, as in 73 Magazine, 1963-1964, oscillators galore, and assumed that the small signal *rf* stage would be duck soup. Nothing doing! As soon as I started to bring up the gain, using a tuned base input circuit, and tuned collector output, *oscillation*! The more I matched things, the more it oscillated. The trouble with transistors today is they're just too darn hot! Also, holding to the policy here of never writing up anything not actually on the air at the shack, one and a half full days went by on this item alone. The GE "Microtabs" worked. So did the 918s, the 2n3600 RCA units were good, the KMC 2n2502s gave fine gain but oscillated more, and the Fairchild MT1116 gave the greatest gain. For $40, they ought to.

Neutralization was tried. No good so far. Oh, I haven't given up on that by any means. It's just another challenge (the story of my life) to be taken up later.

I suspect the internal resistive feedback as well as the capacitive feedback to be causing the trouble. More later, I hope.

So, to get on with the actual circuit that does work well without oscillation, **Fig. 1** shows the schematic. The input cable is matched, not perfectly but good enough, by C1, which gets to be pretty large because those base-emitter diodes have an amazingly low impedance as you go up in the hundreds of megahertz. I tried various kinds of strap and capacitors for pi networks into the base. Too susceptible to oscillation. Matched to the cable, but untuned, does the job. That little one K resistor from the base helps a lot also; partly dc-wise, into the bias network.

Table 1 shows some comparison gains with different transistors. An *rf* stage of this kind has two main purposes. A) To set the noise figure. B) To provide some gain and a

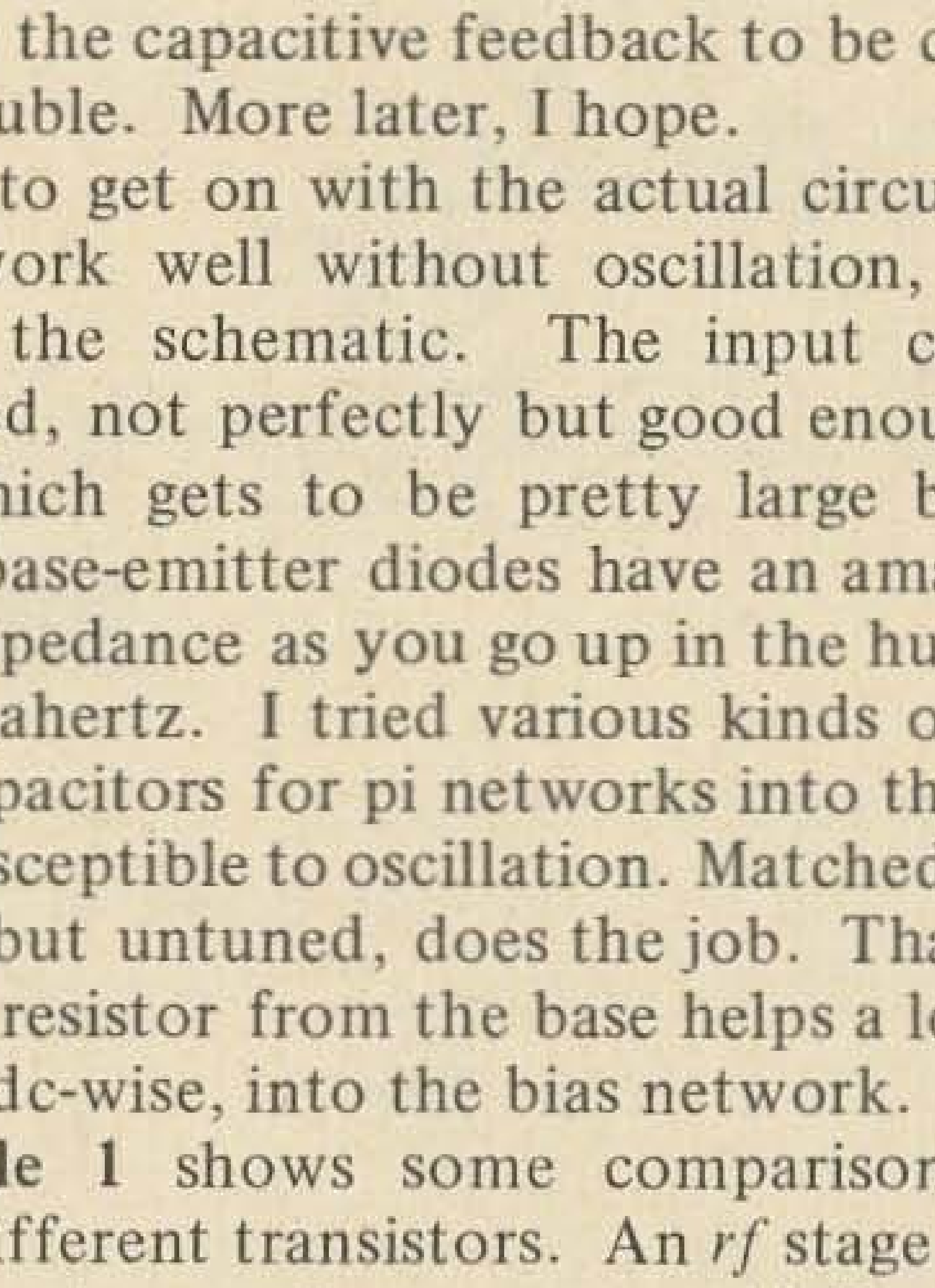

Fig. 1. *RF* stage 432 m.c.

Parts List

C1 = Ceramic Trimmer, 5-30 pf.
C2 = Brass plate by-pass.
C3 = Johnson 9 plate, Type "M."

TRANSISTOR	GAIN (TIMES)
MT 1116	350
KMC 2502	340
KMC 2502	420
918	240
918	25
MICROTAB	21
2N3600	240

Table 1. RF stage gains with different transistors.

lot of freedom from image, spurious, and harmonic mixing. Not too many unwanted signals get past that half-inch copper strap!

Bear in mind that we are setting up here a "Gonset Communicator" type of rig, with a complete receiver and transmitter, and that you can expect to put in a real low-noise stage in front later to "set" the noise figure at some better and impossible-sounding figure like 1.7 db, or thereabouts. This will help you pull in that elusive guy you hear way down in the noise some evenings.

Also, more power can be added to the transmitter later. That takes a real stuffed pocketbook though. I hope to be able to help with this item later.

When you get past the base circuit, watch the variable emitter resistor. If you're really looking for good adjustment make it variable. I wound up with 100 ohms fixed which gives a little under 10 ma of current. In any case, you should provide a variable resistor for tune-up first, because almost every solid state device (trade name for transistor) varies from one to another, even with units of the same number and manufacturer.

For emitter by-pass, I used the old reliable brass plate, nylon bolt, and thin fiberglass insulation, about three mils thick. Keep the emitter lead as short as possible. The final length in this model was between one eighth and three sixteenths of an inch.

The collector circuit is of the strap-line type and not too critical, tapping the collector down on the strap is very beneficial as to gain freedom from oscillation, raising the Q, etc.

The circuit as shown in **Fig. 1** shows mainly a large strap, and this is as it should be because the collector circuit is where the amplified power is to be found, and in this receiver with just one *rf* stage, at least to start with, we used a strap to get all the Q and filtering possible.

Fig. 2 shows the *rf* input side view with the input jack on the rear panel of the minibox. Once again, I use "phono-jacks" because they work. Use the ones with the ceramic insulation. Or "BNC" types if you like. A copper clad base board is bolted to the bottom of the

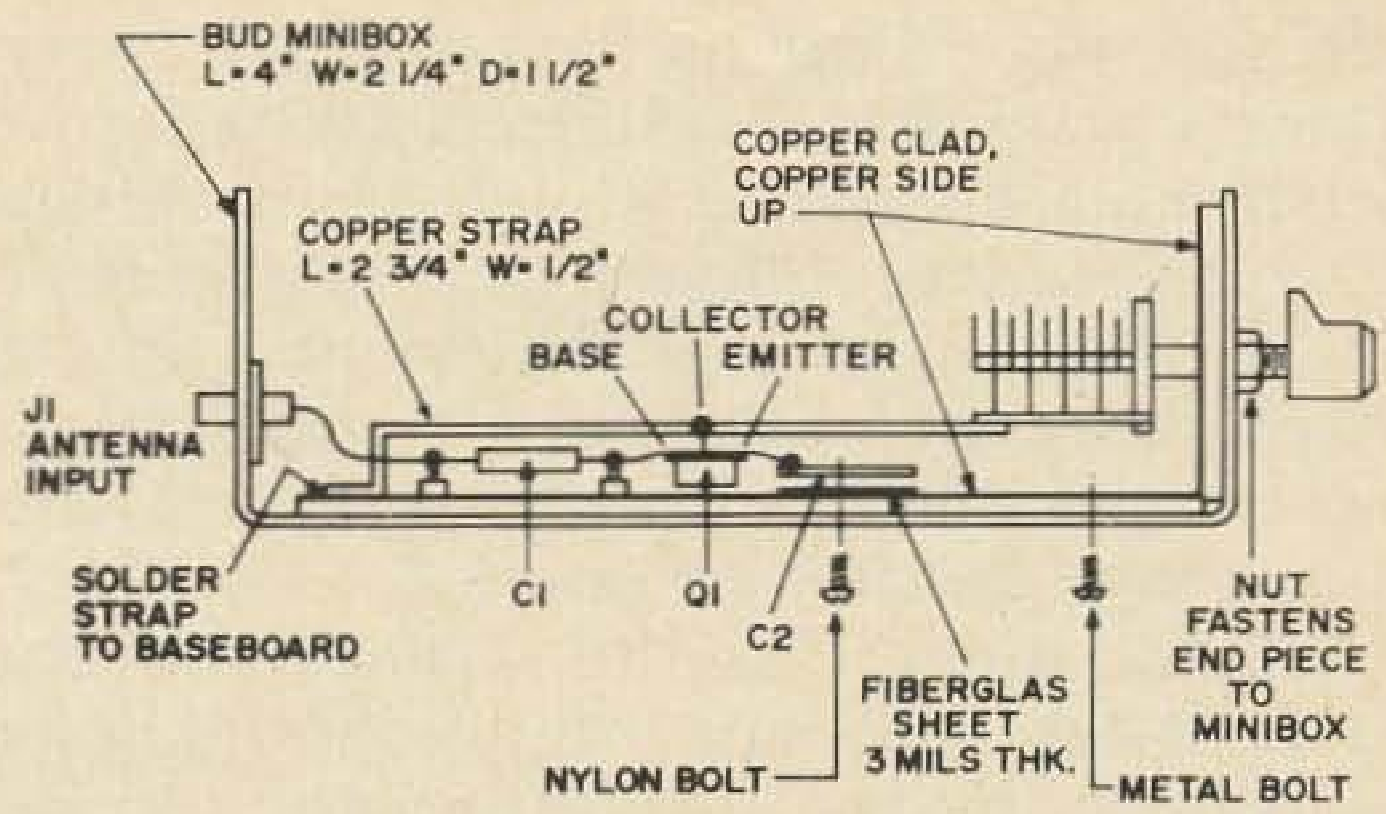

Fig. 2. Side view, *rf* stage.

minibox simply for convenience in soldering grounds, etc.

Fig. 3 is a top view which I hope is nearly self-explanatory. **Fig. 4** likewise. C3 can be used to fasten the copper clad end piece to one end of the minibox.

Dimensions are shown in **Fig. 3**, adjusted to fit into a minibox, making a complete self-contained unit with input and output jacks. As mentioned in the main preamble on the 432'er, a "Rack and Panel" type of carrier is used, but small in size, made of wood, with aluminum paint sprayed on. It is very flex-

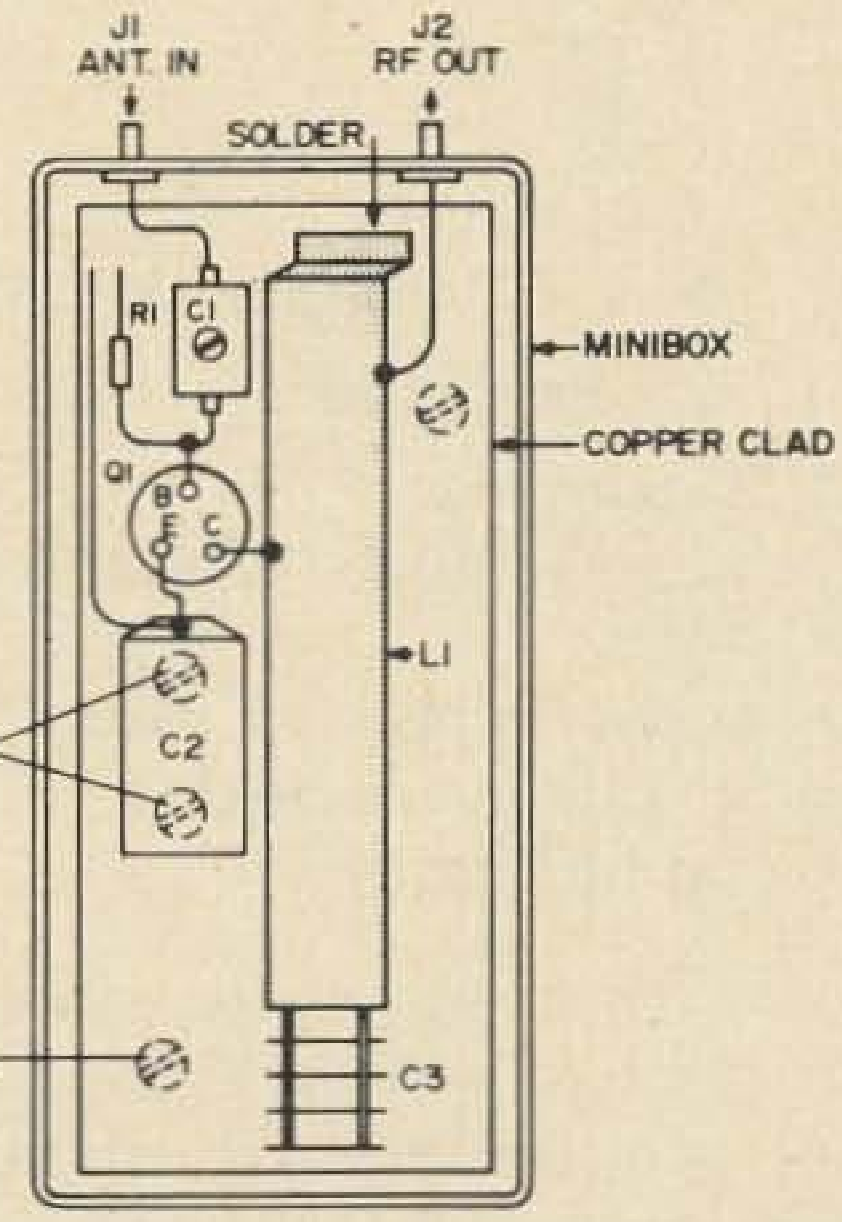

Fig. 3. Top view *rf* stage, 432 m.c.

ible to use, as you can fix the units on shelves, or use the sides like a rack.

It has a handle of dowel wood on top, antenna on the side, lantern batteries with six watts dc capability on the lowest shelf along with the *af* and loudspeaker, *af* amplifier-modulator next, then the transmitter, *if* near

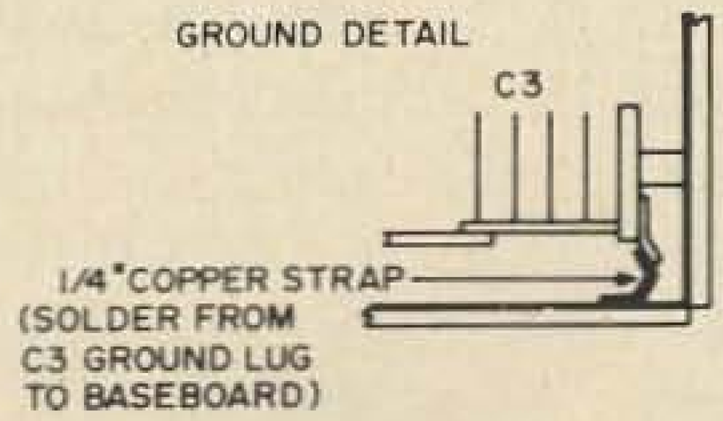

Fig. 4. Ground detail.

the top, and *rf* head on the top shelf. Everything comes out at a moment's notice for adjustment, change or repair, and the whole deal has considerable "growth possibilities built-in" as they say on Madison Avenue. So you can add an extreme low-noise *rf* stage, change to or add a narrow-band *if* strip, etc, etc. Don't say I didn't warn you!

Power supply for the *rf* stage is twelve volts at ten milliamps or less, depending on where you set the emitter resistor. It also works well on one of those nine volt transistor batteries. I intend to standardize on the lantern-type batteries from now on. Union Carbide rates theirs at half an ampere maxi-

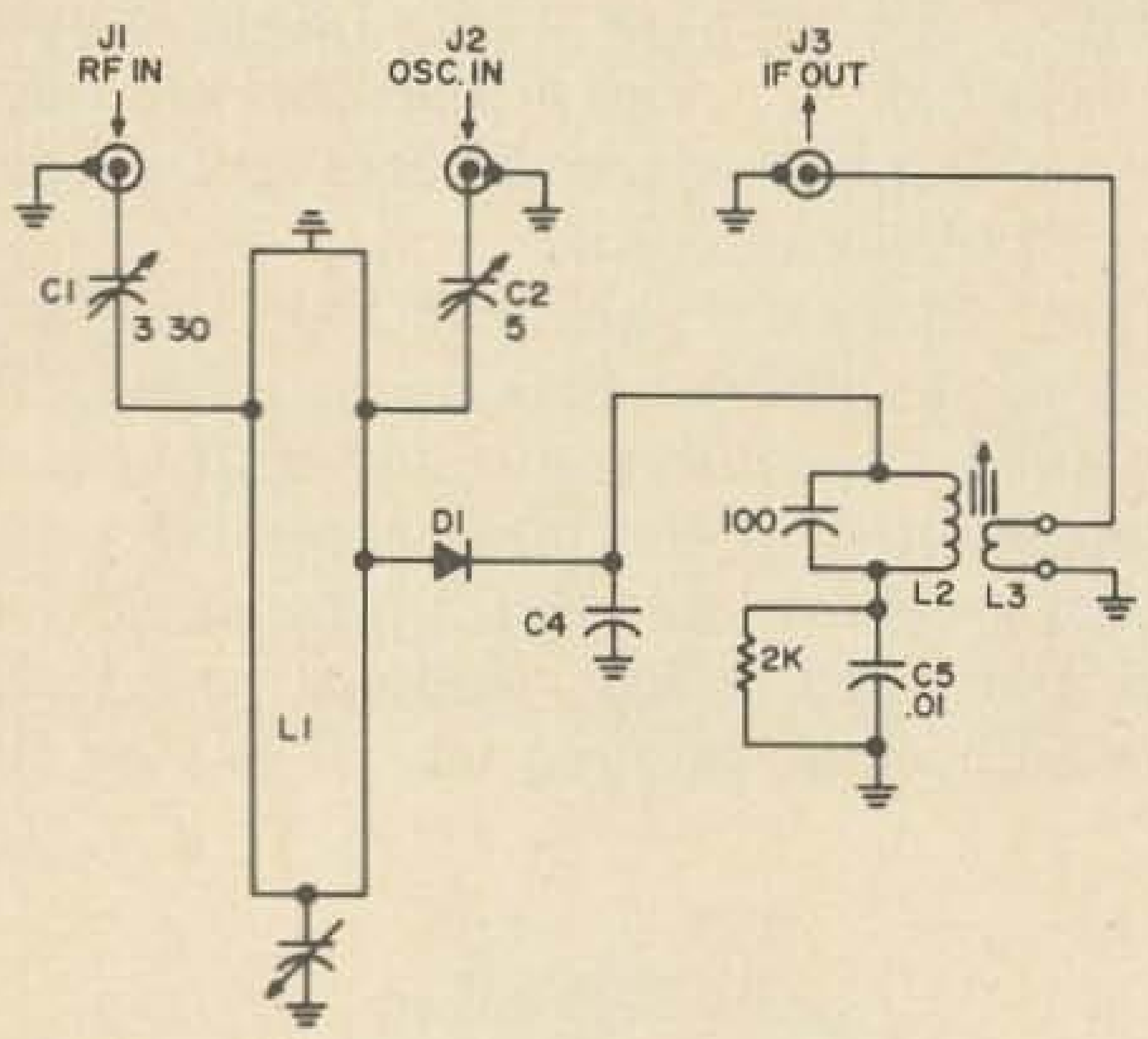

Fig. 5. Schematic, mixer, 432 m.c.

Parts List

C1 = 3-30 trimmer.
C2 = Ceramic Trimmer (about 5 pf maximum) (ARCO 400).
C3 = Johnson Type M, 9 plate.
C4 = Brass plate capacitor.
D1 = Good uhf diode.

mum, which is six watts of dc power, with two of them at twelve volts, which is about all you can easily carry up some of those good DX mountains by hand.

There are some intriguing new small non-spillable storage batteries out also, which will go for more watts, later on. Twleve watts dc seems to have good possibilities to me though.

Using a combination regenerative single transistor in an oscillator-dipper-detector circuit, I have pulled in and identified all five Massachusetts UHF TV stations between 500 and 600 mhz from here in Peterborough, N.H., using just the tuned circuit on the bench as an antenna. For security, tune up and check the mixer circuit with just a dc meter (see Fig. 10), and even then watch out. In Melrose, Mass., the Malden TV station is about 3 to 4 miles away and would move a meter from a single diode on the bench! Don't forget, those lads put out hundreds of *kilowatts* ERP.

Connecting everything up, the meter went off scale as soon as I hit 432 mhz with C1. Things got even better as the minibox cover was put on and the output went up a little. A high Q fully enclosed signal circuit is nice, because don't forget, you're going to follow it with a high gain *if* amplifier which will pull in signals of less than a microvolt. And these signals should be your new contact from across the state, not from the TV station in town. Those Bud Miniboxes are not perfect of course. Some more self-tapping screws around the edges will help to seal unwanted *rf* out and cut down on noise that can be caused by slight motion of an improperly sealed cover.

With the dimensions given, 432 comes close to the middle of the dial. Don't forget, we want to tune our whole band of 420 to 450. After all it's still ours! Yet!

The six megacycle *if* output coil is next, and a painless method of getting this inductance right, which also serves to make up the *if* coils, is detailed next. (Skip this if you're sure you know how already). There are several ways to do this but in any case the final result is "on the air" so we'll start that way and arrive quicker.

The 432 mixer

There should be no problems here. We already have a good strap line circuit that tunes below 420 and over 450 mhz and fits in a small minibox, so all we need after that is an oscillator input, a good diode and diode by-pass for 432, a tuned circuit for the *if* output on six mhz, a diode bias resistor and capacitor, and an output coupling and jack. See how simple it is?

Fig. 5 shows the schematic and **Fig. 6** the

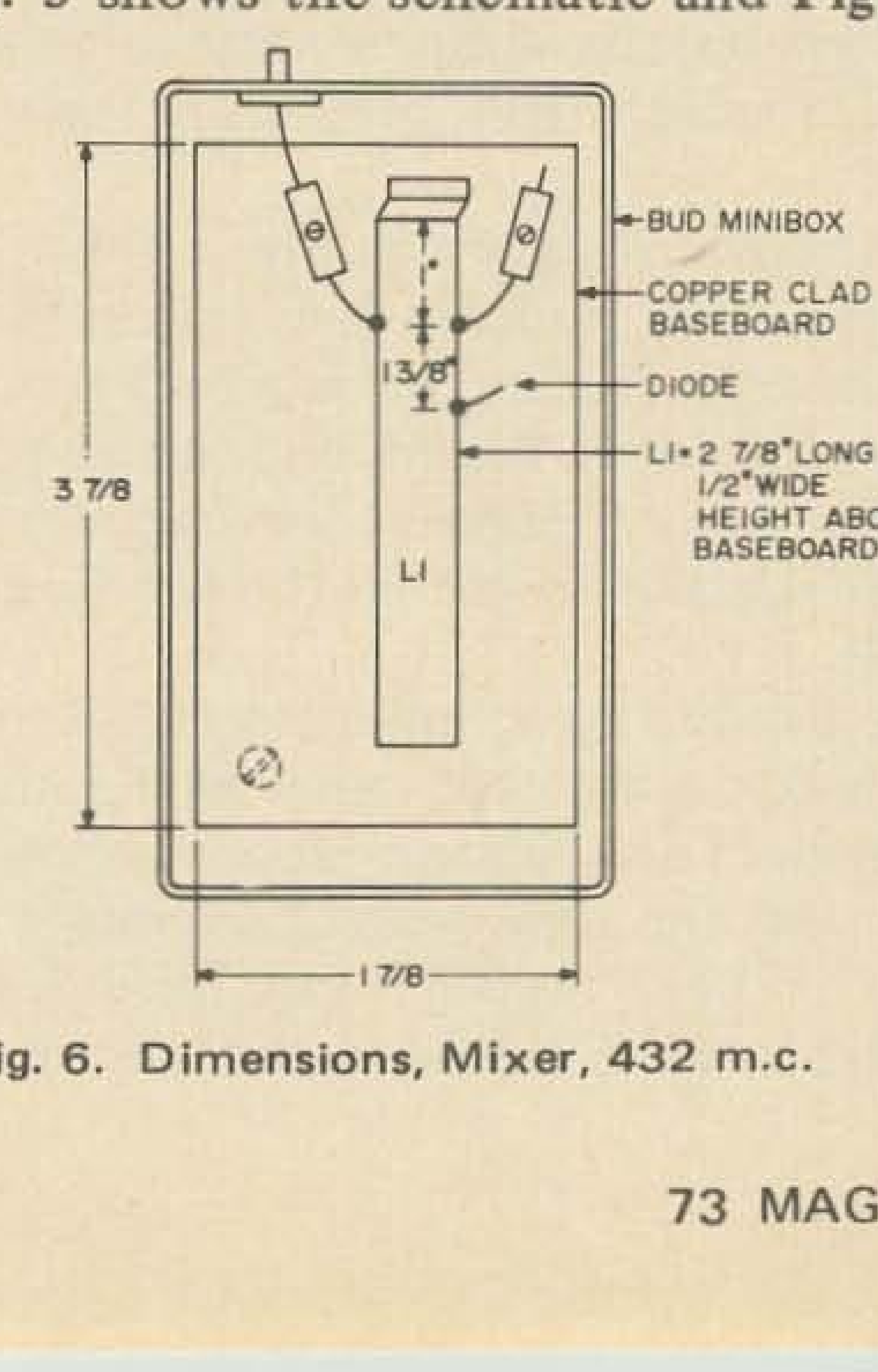

Fig. 6. Dimensions, Mixer, 432 m.c.

dimensions, which match the *rf* amplifier. With luck the oscillator will go into the same size box (it did) and we will have three small matching boxes for the *rf* head.

I have shown a dc lead (temporary) from the diode by-pass capacitor plate, C4 to J3, because this allows a fine check on the *rf* mixer section. A modulated 432 test oscillator is fed through a coax cable to the input jack and *rf* tuning and dc voltage out of the diode, with Minibox cover on and off. This is important because of oscillator harmonic mixing. This little devil has ruined many an otherwise fine home-brew project, so you'd better be aware of it. It shows up most, on six and two meters, when you start tuning up converters on the bench. That's partly what all the thousand screen rooms throughout the USA are for! Your mixer is there on the bench, no shielding (yet) and FM, VHF TV, and UHF TV all come boiling in. You're probably using a high gain *if*, most likely 455 khz. sharp, (doesn't like FM!) and of course, what with many oscillator harmonics and many TV and FM stations, you've had it! Harmonic mixing has been used, and described in the good old RCA 1500 page "Bible" on how to build receivers. The many harmonics simply act like local oscillators on higher frequencies to produce, at times, a tremendous set of nuisance signals.

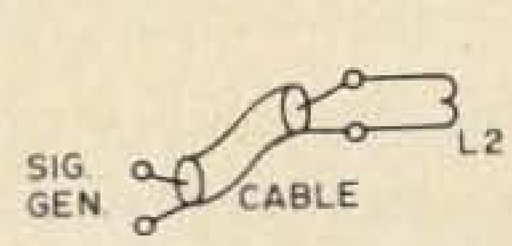

Fig. 7. Coil test set-up.

Fig. 7 (coil test set-up) shows how to do it in a real painless fashion. Connect your signal generator (the $30 Lafayette job is fine) through an *rf* cable to L2, solder coil leads to test terminals T1 and T2, connect a "diode plank" (Fig. 8–you *must* have one of *those*!) a microammeter, and go. I found 35 turns of No. 34 enamel, on about 3/8" diameter coil form to do the trick, with an 8/32 threaded powdered iron slug inserted for tuning. With 100 pf across the coil it tunes from 7.5 to 4.5 mhz reaching the desired 6 mhz with the slug about half way in. You can have lots of fun checking coils, Q, and slugs this way but, get on with the 432'er!

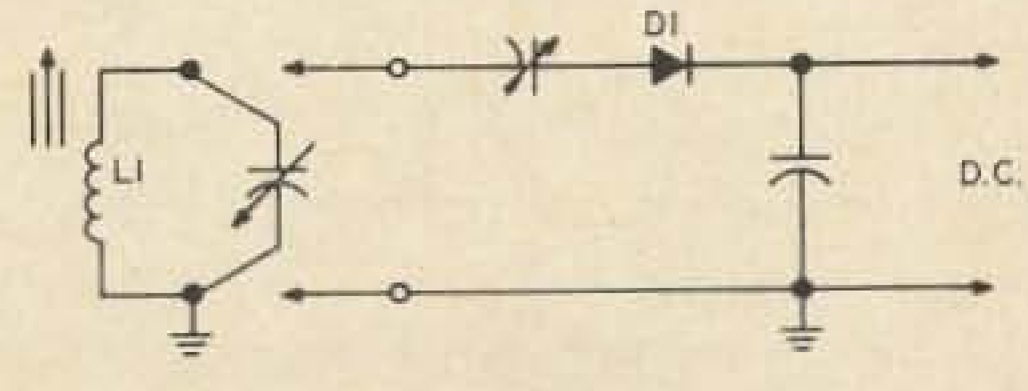

Fig. 8. "Diode plank."

Fig. 9 shows the mixer output circuit details, with two small standoff terminals holding the coil wires and C2. L3 is three turns of insulated No. 24 or 26 wound around the cold end of L2, and waxed in place with coil wax. Don't forget, all these special components you may not have on hand may be obtained in kit form (see end of article).

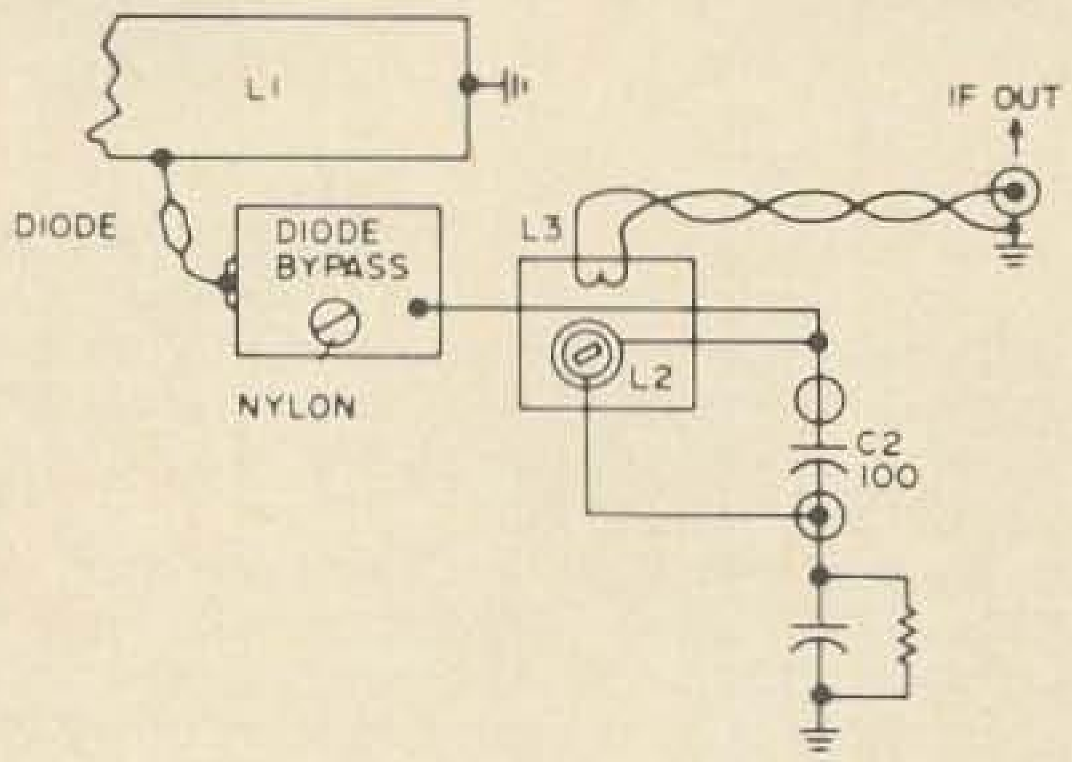

Fig. 9. Mixer output circuit details.

Have just finished assembling the mixer output circuit in the minibox and it may be tough for older eyes and fingers. But if I can do it, you should be able to also; being 64 myself right now. Of course, I've done this sort of work for many years (about 45!) and have two sets of eyeglasses, one about one and a half times magnification, the other about two times, for those really tight little spots.

Testing the mixer into a tuned *if* circuit without amplification is not an absolute necessity but sure helps as a check on the mixer conversion efficiency and getting good tuning out of the output coil. When you have a high-powered *if* running with avc it is sometimes hard to notice small differences in gain or selectivity, which can all add up, or down, together on those weak signals to come. With only a 6 mhz circuit and diode after the mixer, you *have* to get everything right such as the *rf* input, the 432 megacycle tuned circuit, the diode, its bypass, the 6 mhz diode output coil, and its output coupling. Fig. 10 shows a test circuit good for this sort of work, with both dc and *af* outputs. Simple as ABC, useful as a pocket in a shirt and yet you still have to build it or buy a grid-dipper. If you're really going in for home-brewing, you'll need a whole slew of these covering all frequencies!

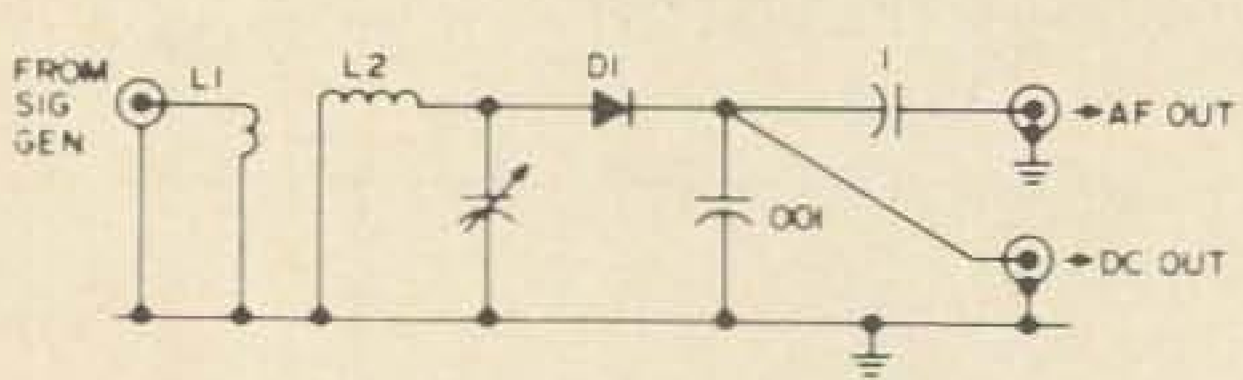

Fig. 10. Tuned diode detector with d.c. and af.

When the mixer was set up, a local oscillator and a signal generator plugged in, the *if* plugged "out," conversion to 6 mhz was soon obtained through the diode, and all circuits were peaked up. I also tried my big receiver on it and picked up the crystal controlled signal generator from way out in the field, but the non-crystal controlled L.O. was of course too jumpy for this type of operation. Check back in the first section for this item just in case you don't remember about narrow-band receivers as *if's* for tunable local oscillators on UHF.

RF local oscillator

I could breeze through this at top speed, but always there are new listeners, (there'd better be!) so skip parts you already know. After completing the assembly and tune-up I've changed my opinion. Don't skip it! With thoughts in mind of later ganging the three units (*rf* amplifier, mixer, and oscillator) this unit was made with the same baseboard, strap, and type M capacitor. Instead of the emitter being grounded as in the *rf* stage, the base is grounded putting it out of phase with the collector. This automatically makes it an oscillator except in certain extreme cases.

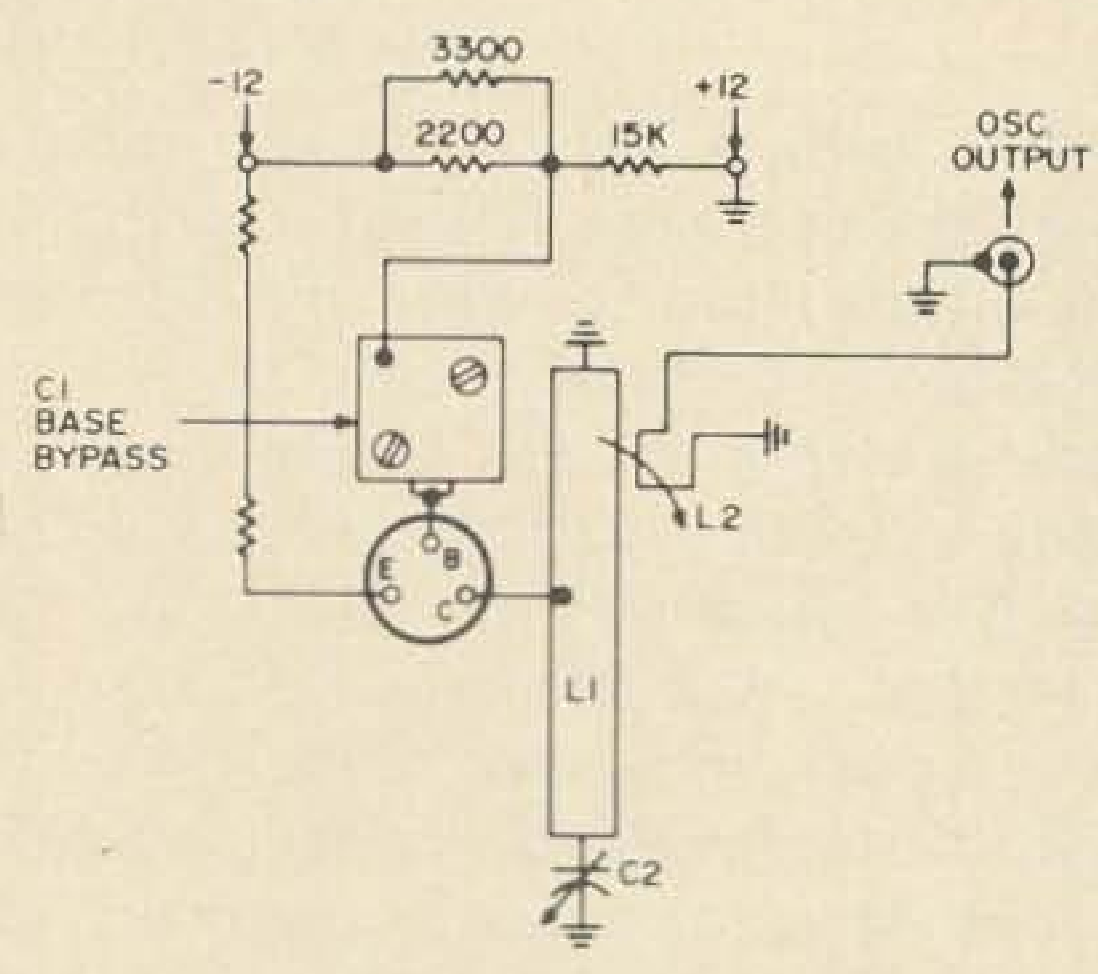

Fig. 11A. Oscillator schematic.

See Fig. 11 (schematic) and Fig. 11B (dimensions). Among the things you want in a tunable *rf* local oscillator are stability and freedom from pulling, that is, as much as you can get...So, run a fair amount of power and decouple as much as possible into the mixer. Above all, have a *good* oscillator. This one worked immediately and why not? Anyone can build an oscillator, can't he? (Sometimes I can't myself. See later). I took two plates off the nine plate Johnson type "M" capacitor to put 432 in the middle of the dial, checked out the total emitter resistor needed, with an outboard pot., and that's it. Except, there were some nasty little spurious signals tuning faster than "regular" signals. These

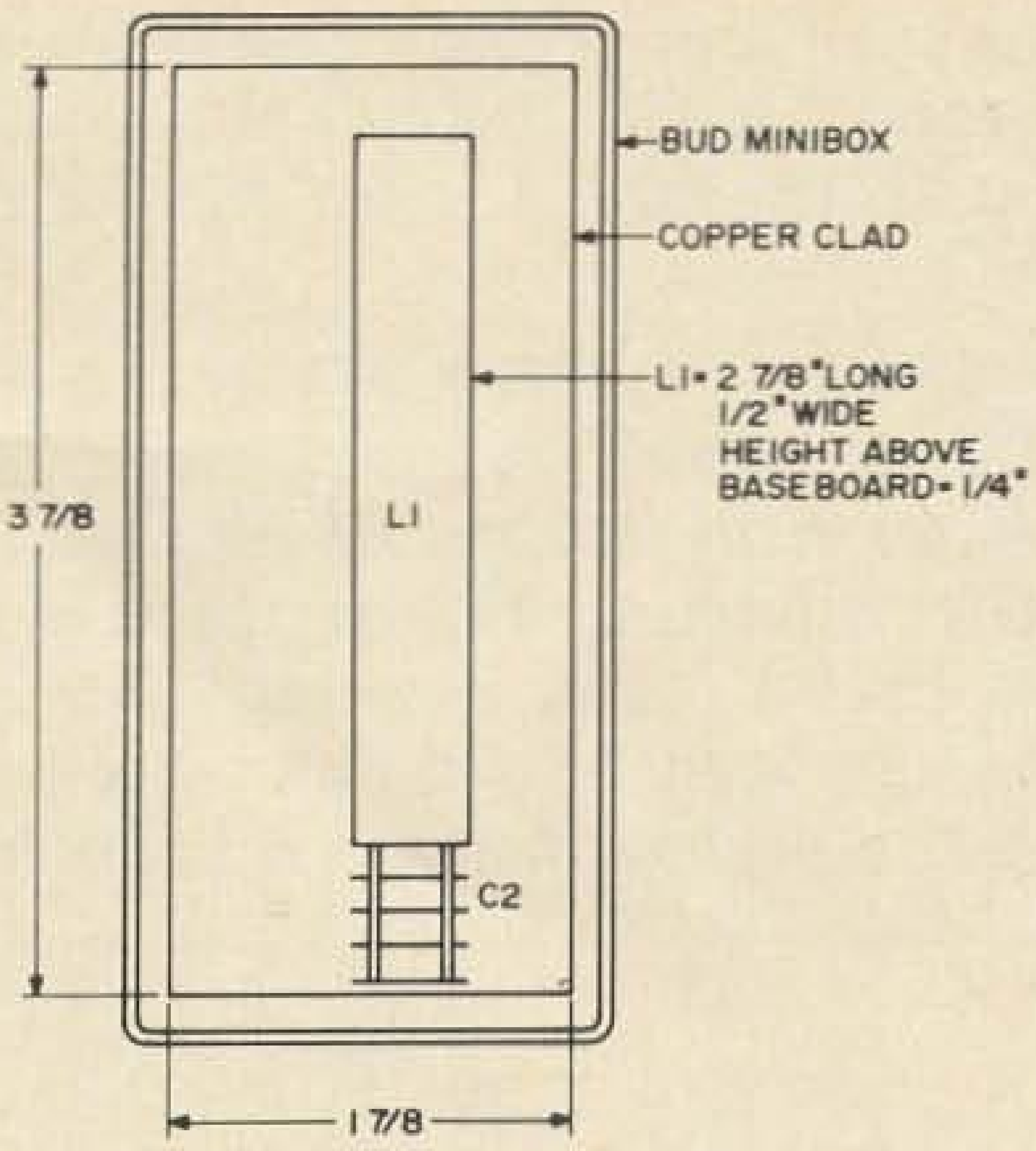

Fig. 11B. Oscillator dimensions.

little hitchhikers come in without an antenna too, which is *real* bad. Remembering the old days of a high grid leak (never mind what that was, just read on!) the base resistor was cut down a little, from 2,000 ohms to about 1,800 ohms, and the spurious vanished. I later changed the cable and coupling to the mixer and put back the 2,000 ohm resistor. In case you get this type of spurious (there are others) that base resistor is the first place to check.

The 6 mhz *if* amplifier

There is nothing too special about this unit, other than considerations of bandwidth, image, gain, freedom from oscillation, reproducability (to allow any amateur to build one), why you can't use a well-known *if* strip using 455 khz for under $5, proper avc, good *af* out, 6 mhz output tap for a low-frequency converter and narrow-band *if*, and, last but by no means least, low cost.

Going through the listed considerations in order we have: A) Bandwidth. I picked 6 mhz for the *if* frequency, giving a bandwidth of some 200 khz. I did this mainly because of my fondness for the way my good old Gonset Three acted, but it works out about right. If the bandwidth was any less, you'd have to use crystal control, if it was much more you'd begin to lose signals in the increased noise of the *if*. Of course, there are other ways to get bandwidth, like swamping resistors on the tuned circuits, etc., but this requires more stages for equal over-all gain. And, if you're going to run a narrow-band *if* after this one, you will not need *more* stages but less, at 6 mhz. You can see right now that even a "simple" *if* can get involved. We'll try and keep it short.

B) Image. At 6 mhz the image is 12 mhz away, and with two tuned circuits of half inch copper it may be enough. (It was.)

C) Gain. Three stages should carry us well into the noise region which is all the gain you need for this set. It did. D) Freedom from oscillation. Neutralization was not needed, but shielding was used. Small copper clad "walls" were installed close to the base lead of each stage, with a 3/8" hole for the base lead to go through, and this did the trick.

E) Reproducibility. This is achieved by making up coils that are easy to copy, giving detailed descriptions of how to build and test them, and laying out all components for easy checking and changing if needed.

F) You can't use a narrow-band 455 khz *if* strip with this receiver because it uses a tuned oscillator from 426 to 456 mhz, which cannot be stable enough (and low cost as well) to convert UHF signals into a low frequency, 10 khz bandwidth *if.* Later on, if you use a crystal-controlled oscillator you *can.* Again, this rig is planned to be easy to build, flexible for change and improvement, to be used along with a simple MOPA transmitter, to have fun with, mobile, hand-carried, for work across town, and who knows how far when you get two of them running. It's up to you if you add the crystal control, both in the receiver and in the transmitter. They will be described later. Don't forget that with crystal control in the receiver you will have to tune something else! And, if that something is an ac operated communication receiver, how are you going to carry it all around those mountain tops? Just a reminder.

G) AVC. This isn't too hard but there is a combination which has to be just right, so that the base bias does not put the diode detector into the wrong dc condition. All sorts of additional circuits can be used but this is planned to be an *easy* rig. So just wire it up as shown, it works well and so does the S meter which can be a simple one milliamp meter shunted down a little to read the second stage emitter current at nearly full scale. It works backwards but who cares. You can peak up beam directions and *rf* stages with it fine. H) Good audio output. This is the easiest. Just use a good diode with the right value of resistor and capacitor, plus almost any of the little Lafayette *af* amplifiers. J) The 6 mhz output is even easier. Just a link around the last stage inductor out to a jack, to be used later (perhaps) with a second mixer and narrow *if.* K) Low cost. If you already have a flock of VHF transistors that work at least at 6 mhz, some small coil forms and slugs, input and output connectors, a plank or two of copper-clad, a few capacitors and resistors, that's it. It won't cost you anything then, except maybe some of your days, and some cerebration.

Building and testing as you go

Fig. 12 shows the first *if* stage. It has lots of gain. With an antenna plugged into it, it pulls in London, etc., on the 6 mhz "short wave band." You can use almost any coil form you want because six megs is not critical but you must be sure it is tuned right. I

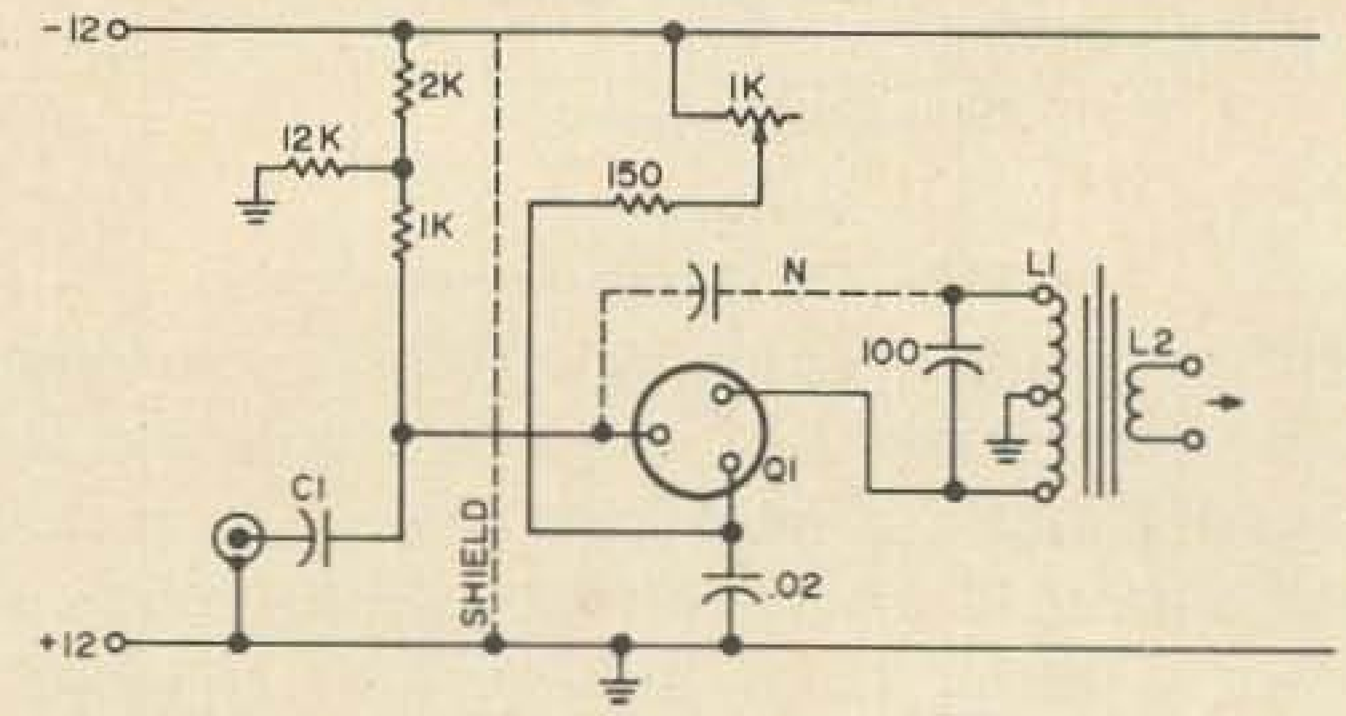

Fig. 12. First *if* stage, 6 m.c.

Parts List

L1 = 2 pi, 20 turns each, no. 30, with 6/32 threaded core.
L2 = 3 turns wound on center of L1.
N = neutralization not used. (Might be needed with other transistors.)

found the gain of the first stage to be up near 40 db with almost any of the good VHF transistors like 2n1726 and so on. It showed no sign of needing neutralization as yet so that part of the circuit is put in as a dotted line. Coil forms can be fixed iron core with leads and a ceramic trimmer, which will take a little more space; commercially available ceramic forms with movable iron core; very low cost phenolic tubing which is supposed to thread itself when you insert the core (it doesn't always do this too well so I tap them out first); or real microminiature ones.

Fig. 13 shows the second stage which worked just as well and also showed no need for neutralizing. I'm beginning to get just a little suspicious of this! Too much of a good

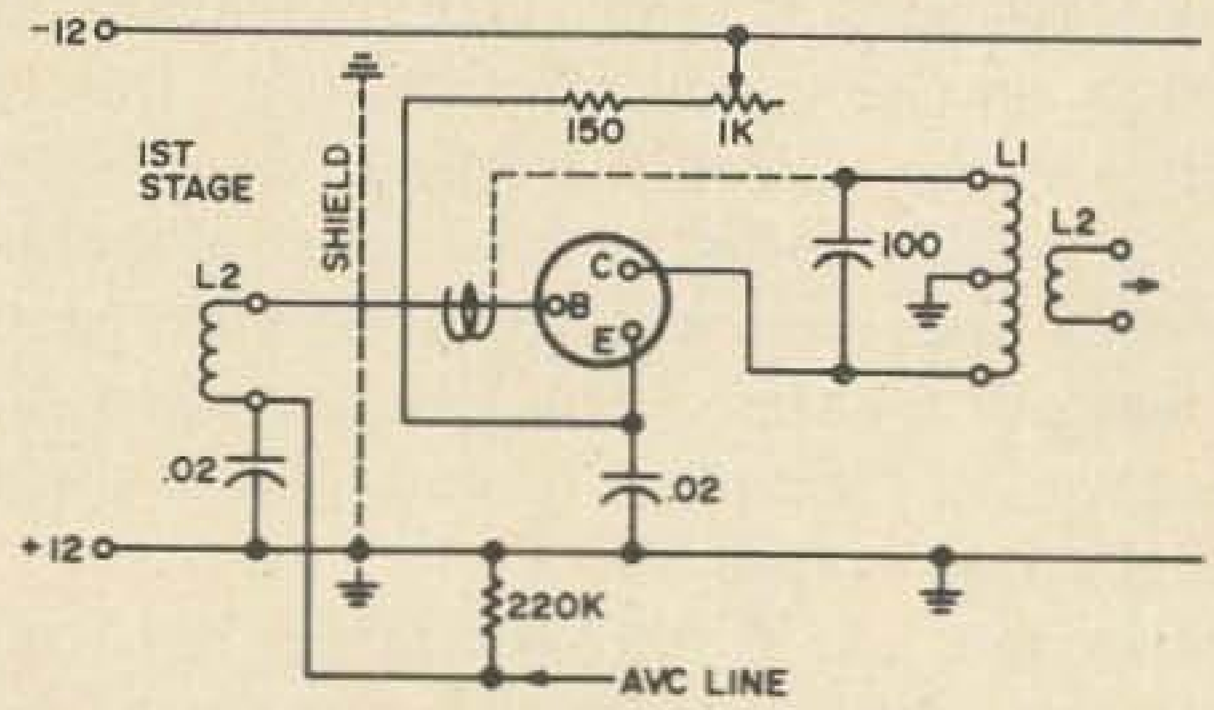

Fig. 13. Second *if* stage.

thing. The base input circuit is from L2 instead of through a capacitor. Same collector coil and circuit as the first stage.

For the third stage and diode see **Fig. 14.** Everything still going fine, with the collector coil having a larger secondary winding to the diode with ten turns instead of only three for a base input. The number of turns on this winding which feeds the diode detector and avc even though not critical, should be adjusted for best avc action and audio output. As mentioned before, you can play around with all kinds of separate avc diodes, avc amplifiers, S meter stages, etc., but let's try and keep this rig as straightforward as possible. With a two pi winding, tuned with a 6/32 threaded iron core and about 100 pf capacitor, as shown in **Fig. 14**, it works fine.

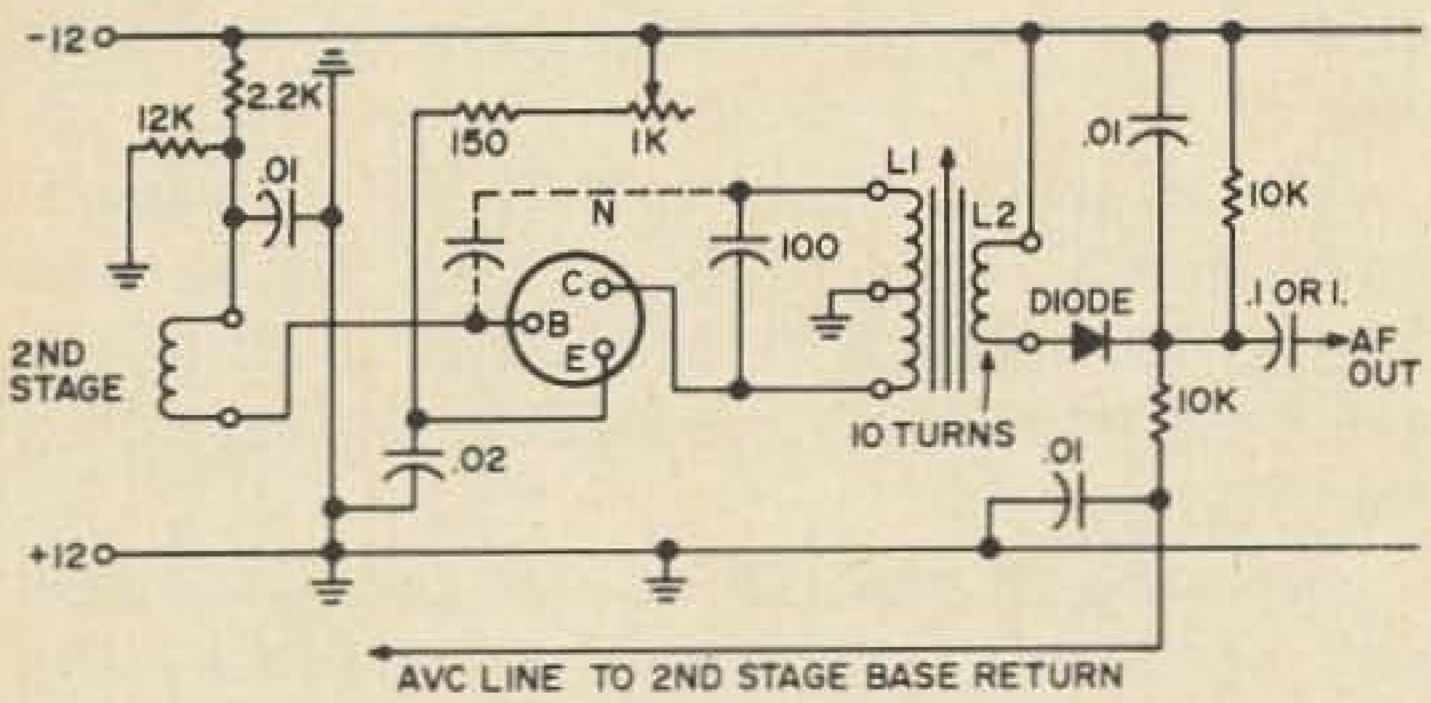

Fig. 14. Third stage, *if*, 6 m.c.

AVC

Pay attention to this item. Several little rules to watch. Do not put avc on the last *if* stage. Let it run full gain into the diode to give plenty of avc voltage. Choose a proper balance between the diode resistor R6, the avc line series resistor R6, and the bias voltage resistor R7. If you put too much dc voltage on the diode through the avc line the *af* will be distorted on low signals. If you put too much R (R6) in series with the avc line you won't get enough avc action. You could put a lot more avc action into the circuit like they do in car radios, with avc on the *rf*, the mixer, and almost everywhere, in order to help matters when you drive past those crowds of AM towers on the New Jersey flats, but you don't need that here.

With all the above details you should have a good *if* strip by now.

AF

This will be real short. Lafayette has a selection of transistor *af* amplifiers which work fine. You can get up to three watts, which is better for mobile work if you have that in mind. Get several because you'll need another one for the modulator, unless you want to do a lot of switching between microphone and speaker, etc. You can even get three, one for the modulation checker when tuning up the transmitter. Once you use this trick, with a diode and padded earphones, plenty of *af* gain to keep your voice from getting to your ears through the air you'll never be without it. You can hear every bit of hum, distortion, etc. that can creep in, and, if everything is correct, your own voice coming to you through the mic, transmitter, and antenna just as it sounds to the lad on the other end of the QSO. With the exception of unwanted FM, if any. That is another story.

Assembly

When you finish these receiver units you will have the receiver half of a nice portable rig. I have found a simple carrying rack of plywood, with as many shelves as you need, and a dowel handle on top, sprayed with aluminum paint, to be very useful. The receiver is really very simple, just a standard superhet. It helps though to know you can plug in a crystal controlled oscillator chain and narrow band *if*, check the mixer without the *rf* stage, build more *rf* stages and add or substitute them as desired.

Leave shelf room for a modulator, transmitter, and possibly "high power" addition. Two watts? Five watts? Who knows what the future, along with a little more hard work (and $) on your part, will bring you? Mount the speaker in a little box, removable, so you can place it off the rack. Audio feedback gets to the tuner through the rack itself. Or you could use foam rubber mounting to handle that matter.

Final tune up

This can be troublesome. It was here. Quite a few cables to make up, but worth it in flexibility. 1) Antenna to *rf*. 2) *rf* to mixer. 3) Oscillator to mixer. 4) Mixer to *if*. 5) Mixer to *af*. I put two lantern batteries on the bottom shelf for a total of twelve volts, with the *af* amplifier in front; the *if* on the next shelf, and the *rf* head on the top shelf. A new and taller rack will be made up for the transmitter units later.

Checking back through the circuits you will notice cable matching input capacitors going to almost every base. Some judicious testing of cable lengths can help, because, unless you have a slotted line and do a real professional job on the SWR like when *someone else* is paying you for those extra days, be happy with a few standing waves.

A simple test signal unit with two tripler stages from a 48 mhz crystal, to 144 and then to 432, was used as a test oscillator with a nine volt transistor battery, a dipole, and a modulator, and placed about 100 feet away. Works fine but sure swamps the S meter. Then came a little glop of trouble. After all my warnings about frequency checking on multiplier frequencies, it happened to me right on my own bench. I tuned up the complete receiver, found the test signal generator on the dial, and proceeded to test the *rf*, mixer, and oscillator stages, using the full gain of the *if*. Nothing worked right, and no wonder, I had inadvertently tuned in one of the higher harmonics of the test oscillator over 500 mhz, right alongside of one of the Massachusetts UHF TV stations, and then, to make matters really sticky I had, also by mistake, peaked up the test oscillator near 525 mhz too!

On checking with an old but calibrated coax mixer, everything seemed to be over 500 megs. Which it was! Just part of the game of course, so, as I keep saying, check that frequency.

As soon as everything was put back near 432 the new job showed up as having real pulling in power. The *rf* and mixer peak up nicely, and the oscillator is quite stable.

With the front end as described in the text and figures, it is quite easy to get too much oscillator voltage into the mixer. Oscillator harmonics will then show up as CW signals, but tuning much faster on the dial, because when you move a megacycle at 432 the harmonic may move two or three. Reducing coupling into the mixer by either the capacitor or the oscillator link, or both, cures this. You don't need that much signal for a local oscillator.

Listening in a little

If you hear a strange humming noise, going up and down in volume, tuning very broadly, near 420, and again maybe near 500 mhz, shut off the rig, go outside the house, and listen for a big plane. It's one of those altimeters!

This was just an indoor antenna test before putting up the big beam outside. Also heard were the Mass. TV station on 425 mhz and a very loud pulse signal on about 430. It will be very interesting to see just how far two rigs like this will be able to maintain QSO's.

All I need now is that matching transmitter.

...K1CLL

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Now, in answer to many requests, Heath has a fast, low cost way to put you on two meters . . . without having to buy a whole new rig. If you own an SB-101, SB-110A, HW-100 or the SB-301/401 combo, you're almost there. Here are the details on how to get on "2" — the SB-500 way.

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Solid, Stable Construction. The sensitive receiver and oscillator go together on well planned circuit boards. To insure stability and make adjustment more exact, the transmitter and power supply components are ruggedly chassis mounted. The SB-500 comes complete with all interconnecting cables too. Start enjoying the QRM-free world of 2-meters today . . . with the new Heathkit SB-500 . . . another hot one from the hams at Heath.

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SB-500 SPECIFICATIONS — RECEIVER: Sensitivity: 0.2 microvolt for 10 dB signal-plus-noise to noise ratio for SSB operation. **Spurious Response:** All are below 0.1 microvolt equivalent signal input, except at 145.310 MHz (50 MHz IF only). **Antenna Input Impedance:** 50 ohm unbalanced. **TRANSMITTER: DC Power Input:** 130 watts PEP. **Power Output:** 50 watts (50% duty cycle). **Output Impedance:** 50 ohm with less than 2:1 SWR. **GENERAL: Frequency Range:** Any 2 MHz segment between 144 & 148 MHz into 50 MHz or 28 MHz tuned IF. **Mode of Operation:** SSB or CW only. **Power Requirements:** (1) 120/240 VAC, 50/60 Hz at 82 watts (internal). (2) 700 to 800 VDC at 200 mA (from driving unit). **Fuse:** ¾ ampere slow-blow for 120 VAC (formerly 3AG); ½ ampere slow-blow for 240 VAC. **Front Panel Controls:** Meter-calibrate switch, final tuning, off-on (function) switch, preselector, final loading, driver tuning. **Chassis Controls:** Relative power adjust & bias adjust. **Rear Apron Connectors:** RF output, ALC, linear relay, relay, drive, power plug, low f receiver, low f antenna, fuseholder. **Tube Complement:** 6CB6 transmitter mixer, 6CB6 crystal calibrator, 6DS4 receiver RF amplifier, 6DS4 receiver mixer, 12GN7 transmitter RF amplifier, (2) 6146 final amplifiers, (types 6146A or 6146B may be directly substituted), 7059 heterodyne oscillator-amplifier, 8156 RF driver, 0A2 voltage regulator. **Diode Complement:** 5 silicon diodes, 750 mA, 500 PIV; 3 in power supply, 2 in ALC. 1 Germanium diode, IN191: REL PWR. **Cabinet Dimensions:** 12¼" W x 6⅝" H x 13" D. **Overall Dimensions:** 12¼" W x 7-15/16" H x 14" D including knobs and feet. **Net Weight:** 14½ lbs.

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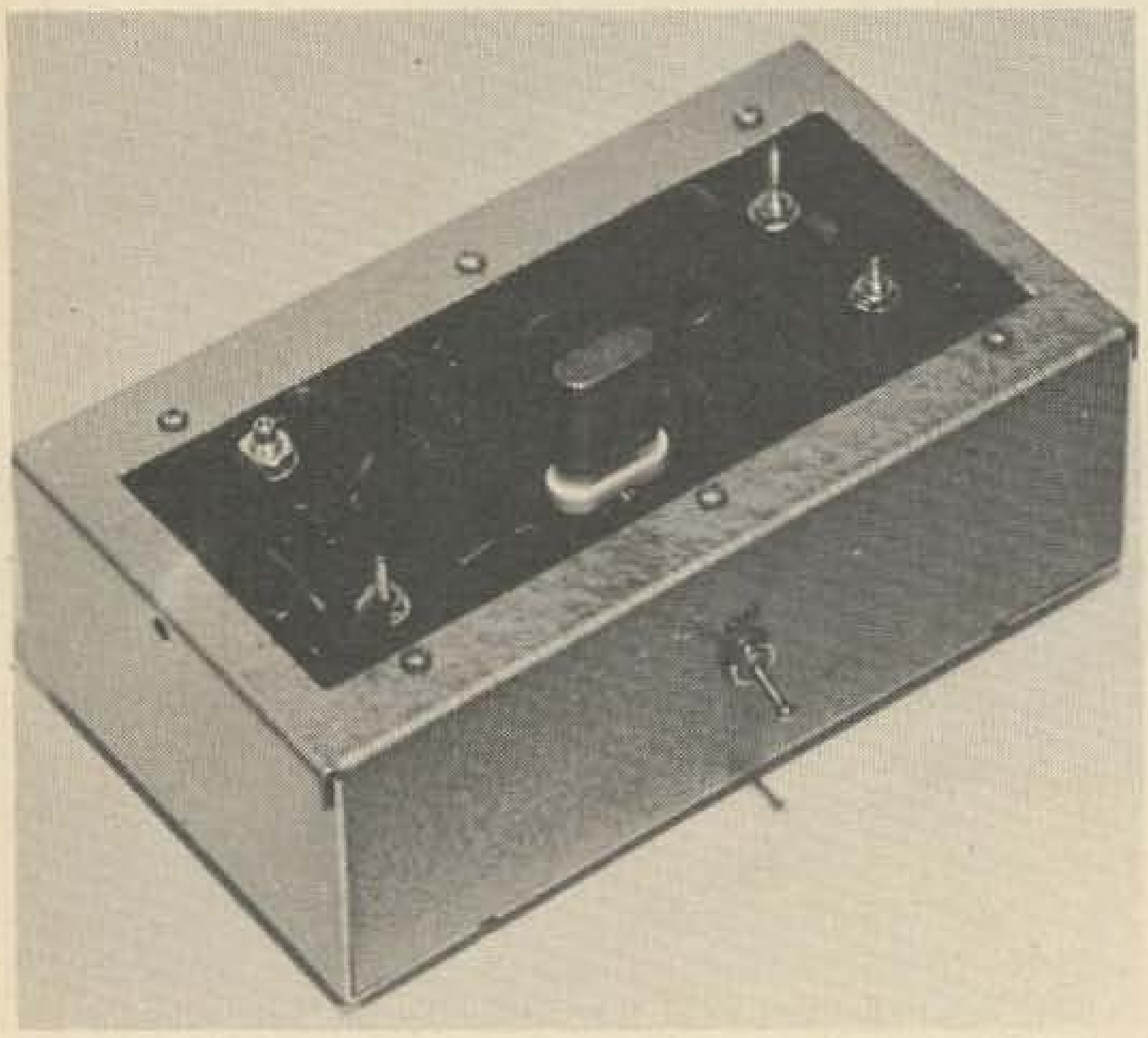
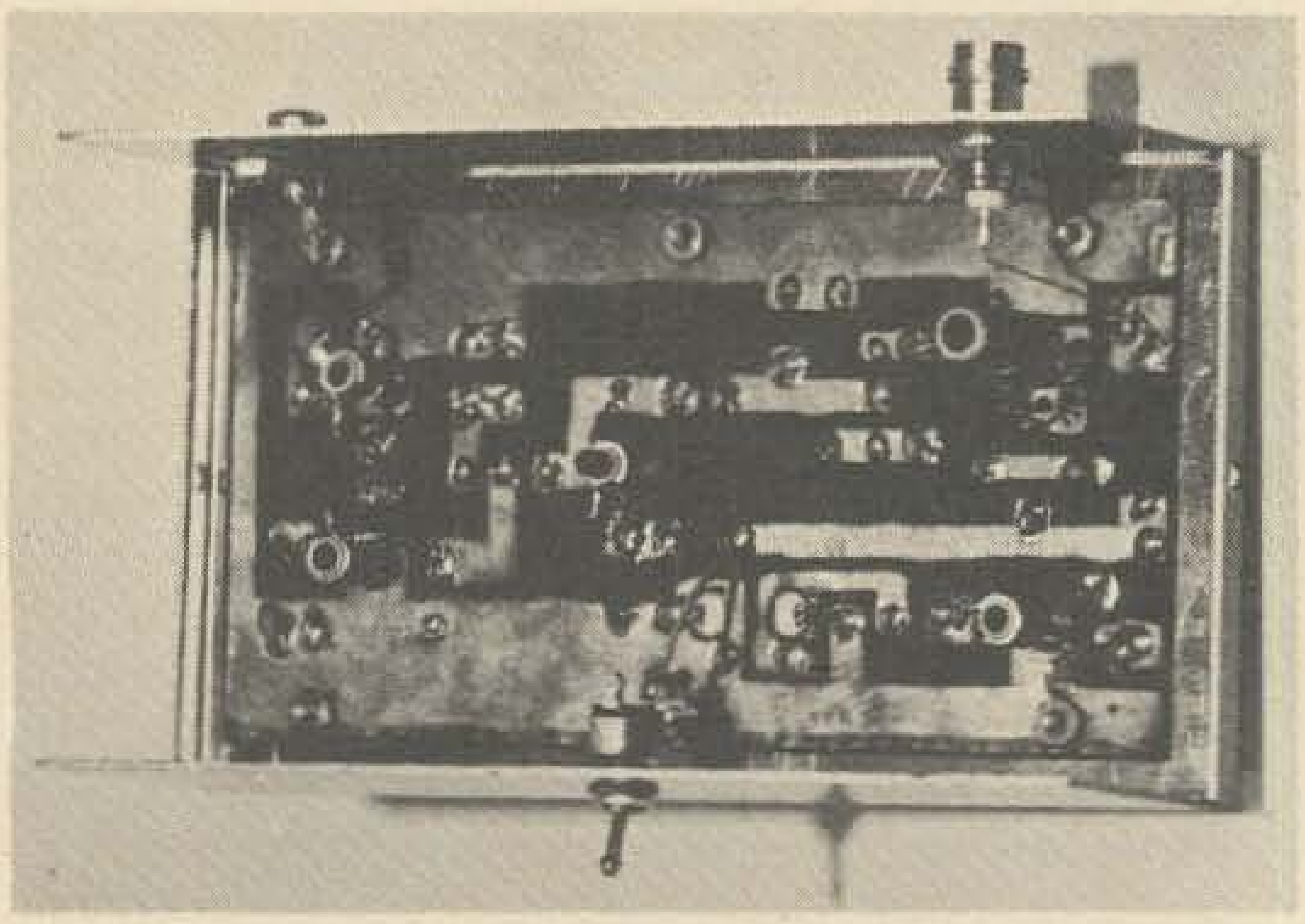
6-Meter FET Converter



William Deane, W6RET
8831 Sovereign Road
San Diego, California 92123

Recently there have been a number of interesting articles in the various amateur radio magazines describing the Field Effect Transistor (FET). The purpose of this article is to describe a simple and practical FET 6 meter converter. As you may know, the FET combines some of the best features of the vacuum tube and transistor and is rapidly being used in many new electronic circuits. FET's are divided into two main groups: the junction FET and the insulated gate FET. New terminology has been introduced to designate the FET terminal connections. They are the Source (cathode), Drain (plate) and the Gate (grid). The junction FET was selected for this converter to simplify the construction. This is possible as the Source and Drain are interchangeable in the JFET. The determination of which element is the Source or Drain depends upon the applied voltage.

The schematic of the converter is shown in **Fig. 1**. Three Texas Instrument TIS-34 FET transistors are used. These transistors are available for a $1.10. T1 is the *rf* amplifier, T2 is the mixer and T3 is the crystal oscillator. Note the similarity to a vacuum tube circuit with the Gate (grid) and Source (cathode) resistors and the Drain (plate) connected to the tuned circuit. No fancy biasing circuits are required. Although a standard transistor can be used in the oscillator circuit the simplicity of the FET oscillator is unique. The 50 MHz incoming signal is mixed with the 36 MHz signal from the crystal oscillator resulting in a 14 MHz output signal. In the crystal controlled type converter the receiver acts as a variable *if.* If used with the Collins "S" line, for example, you will be able to cover 50 to 50.4 MHz of the 6 meter band by tuning the receiver from 14 to 14.4 MHz. If you have a general coverage receiver you can tune the entire 6 meter band.



Bottom view of the converter shows the antenna coils L1 and L2 at the top of the photograph, with L3 in the center and L4 and L5 output coil at the bottom.

The photographs show the general layout and construction technique used. The converter is constructed on a 3 X 5¾ inch printed circuit board. If you have not had experience with printed circuit boards this will offer you an opportunity to try your hand. Small inexpensive kits for etching copper circuit boards are available at most radio stores and mail order electronic firms. The actual process is not too difficult for the average ham. **Fig. 2** is the layout of the board. Slight deviations or other arrange-

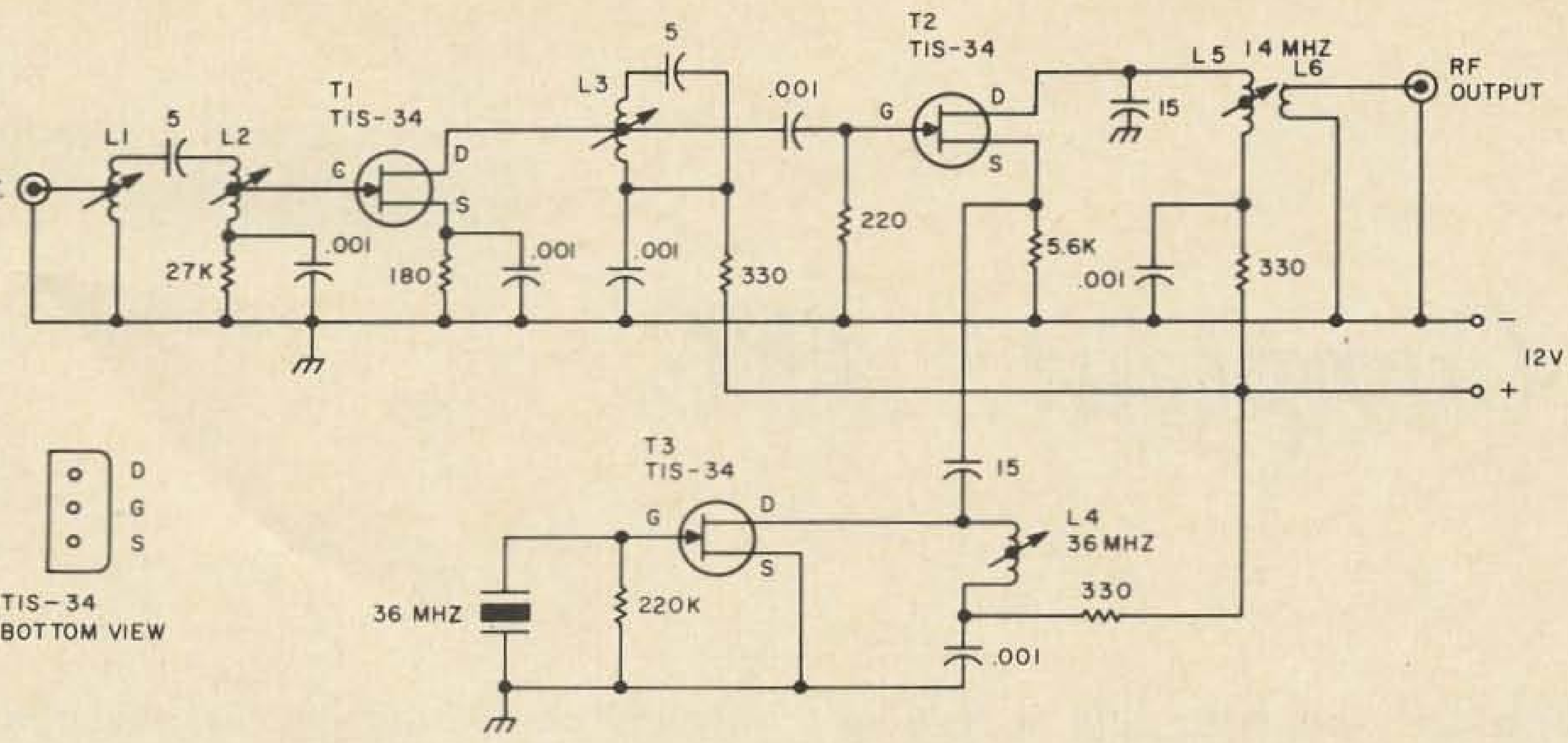
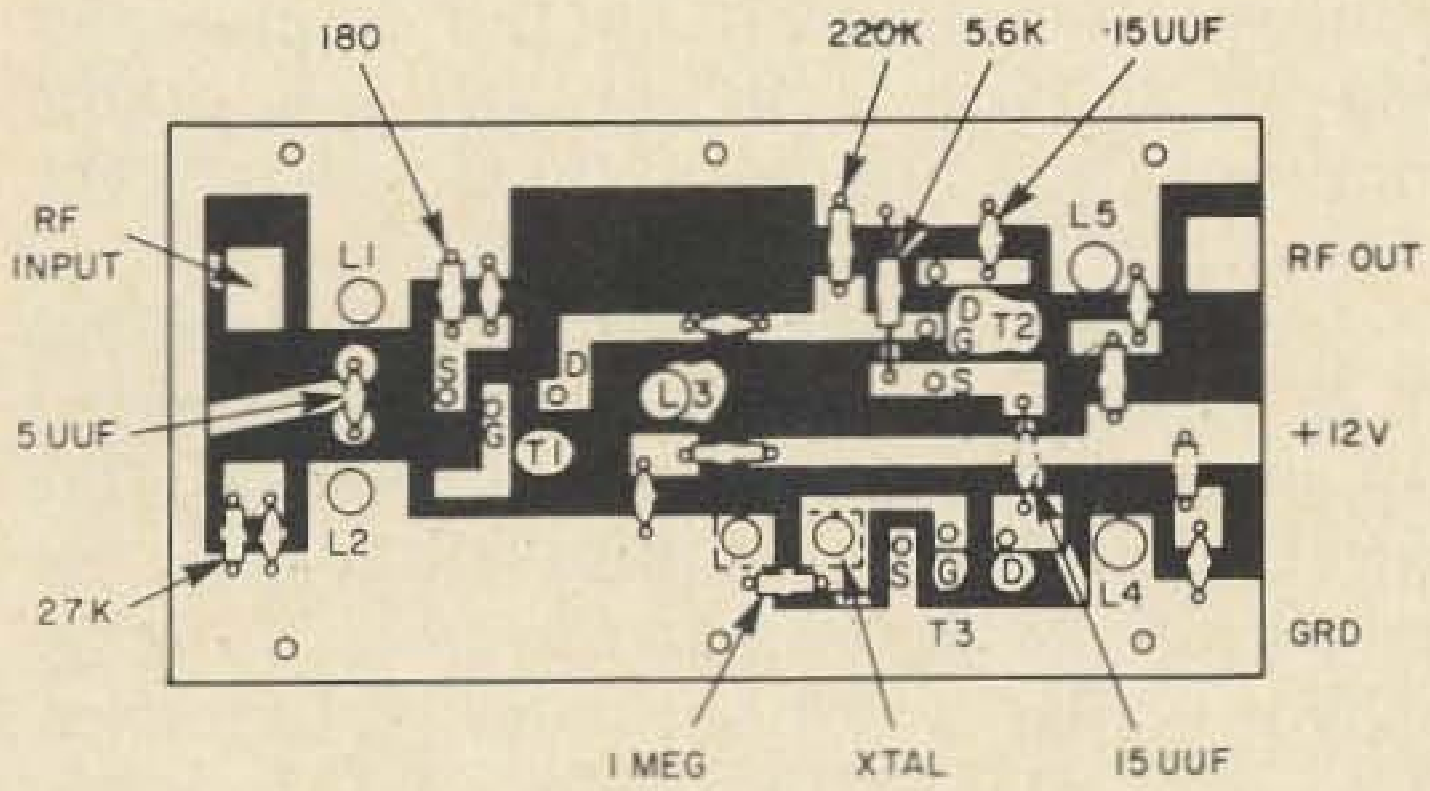


Fig. 1. Schematic of the 6 meter FET converter.

Coil Data

L1 - 10T #2BEC CW ¼" tuned form tap at 2T.
L2 - Same as L1 tap at 4T.
L3 - 8T #28 CW-tap at 4T ¼" form.
L4 - 16T #28 CW ¼" form.
L5 - 40T #28 CW 5/16" form.
L6 - 2T small hookup wire.



ALL RESISTORS NOT MARKED ARE 330 OHMS
ALL CAPACITORS NOT MARKED ARE 0.001 UF

Fig. 2. Layout of PC Board.

ments can be made. I find it best to draw the layout on the copper side of the board in pencil and then fill in those portions of the circuit board to be retained with the resist paint supplied in the kit. Actually any type of model airplane paint works quite satisfactorily. The pc board is next placed in a small plastic or glass container and covered with the etching solution. (Not used in all kits.) The etching process takes 20 to 30 minutes, during which time the solution should be agitated by rocking the plastic container back and forth. When the etching process is completed the board is washed with water.

Following the etching process the resist paint may be removed with lacquer thinner or carefully scraped from the board. After the paint is removed, the board should be cleaned with steel wool or fine sandpaper. After the board is cleaned the resistors and condensers can be mounted as indicated in Fig. 2. The transistors, crystal socket and coils are then mounted. As mentioned previously, the Drain and Source are interchangeable so you don't have to worry how the transistors are installed as long as the Gate is connected to the proper terminal. The transistors require a supply of 12 volts dc. This can be obtained from a small battery pack or a standard 12 volt power supply. The unit requires 18 mA. If intermittent use is contemplated the battery pack will be satisfactory, but if you plan to have the unit on for long periods of time, a standard power supply is suggested. The unit is mounted in a small chassis box 6 1/4 x 3 1/2 x 2 1/8.

With the unit connected to the receiver, antenna and power supply, the coils can be adjusted for maximum noise in the receiver. This should allow the reception of signals and the coils can be peaked on the receiver "S" meter. In some areas channel 2 may cause some interference. If this is a problem in your area, a tuned circuit consisting of a 45pF trimmer and 5 turn coil ¼ inch in diameter can be installed between the rf input and the antenna jack to trap out the channel 2 signal. My thanks to Don Bidwell, for his photographs of the converter.

...W6RET

Robert L. Grenell, ex W8RHR
3926 Beech Street
Cincinnati, Ohio 45227

Compleat AVC

If it's worth and hour and a half of enjoyable labor and $5.00 worth of new parts to make a dramatic improvement in your receiver, heat up the soldering iron, pull off the cabinet and get to work!

One of my failings as a homebrewer is my tendency to modify and reuild my projects in occasionally successful efforts to improve their performance. The pursuit of excellence, and all that, you know. As a consequence, very few of my projects are ever totally completed. Take the avc circuit I described in conjunction with a product detector in a previous article. It was simple and worked beautifully . . . permitted overload only on the strongest local signals. But after a few weeks, I had to admit that the output of my 75A2 fluctuated just a little bit too much for really comfortable reception. The only answer was dc amplification of the avc voltage, a feature which was originally included in the receiver, but which I removed in developing the audio-derived

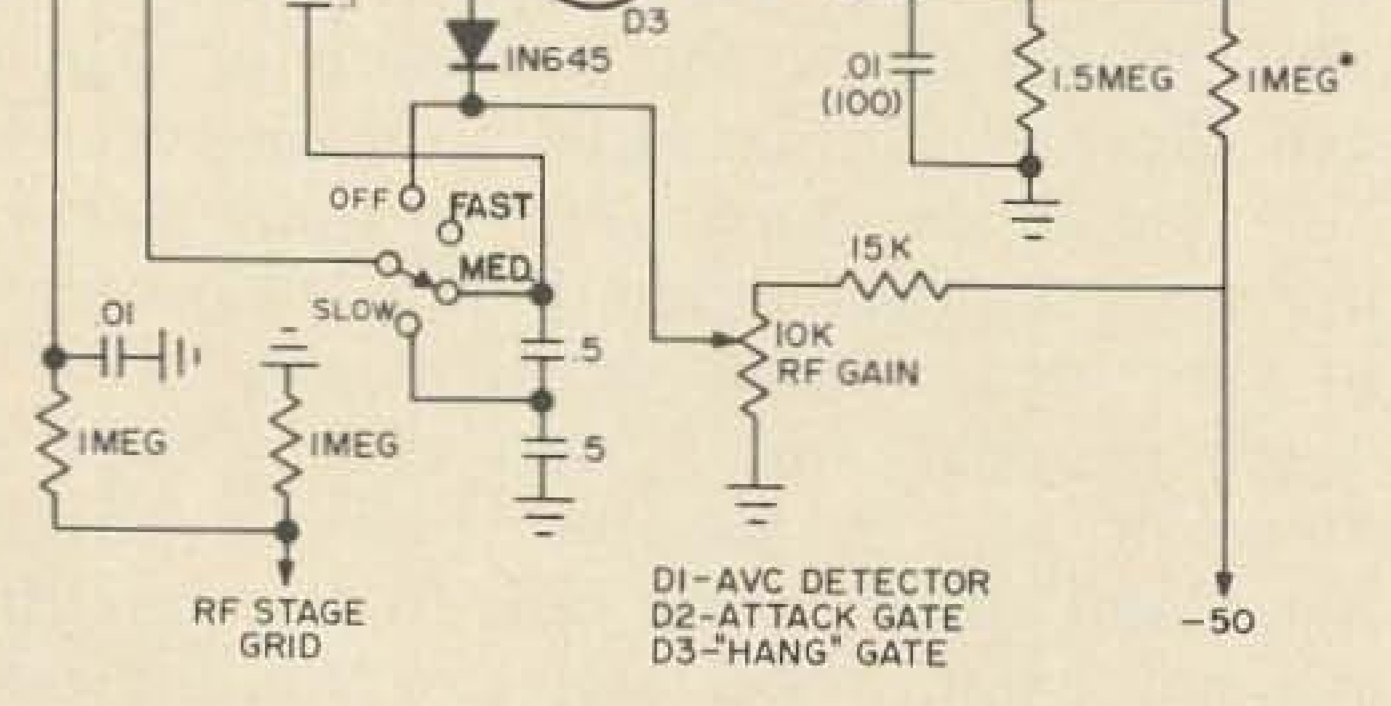


Fig. 1. Values shown in parentheses are to be used when deriving control voltage from the last *if* stage. *See text.

avc circuitry. I did not feel that the original circuit was very effective, or I'd never have removed it, so rather than replace it and try to improve it, I decided to start from scratch.

The result is the circuit shown in **Fig. 1.** It features dc amplification, voltage delay, fast attack and slow decay, and handles a wider dynamic range of signals than you'll find on the air. Detector overload is eliminated altogether. I have shown the whole avc system for a good reason: It is, in the strictest sense of the word, a *system.* Its performance and specifications depend on the proper relationships among all the components. If you build up the dc amplifier and try to stick it on your avc line, results may not be satisfactory. So if you're going to do it, go the route, or not at all.

I tried this circuit deriving control voltage from both audio and *if* signals with about equal success. Should you decide on the latter, it will be desirable to reduce the values of the input and filter capacitors as shown in **Fig. 1** for optimum performance. Also, it is more effective to take the signal from the primary of the last *if* transformer than from the secondary.

I chose a 6T8 for the convenience of having all the necessary elements in one package, thus eliminating several tie points and terminal strips. Depending on the physical set up of your receiver, you may wish to use a 6AV6 or 6AT6 with a silicon diode for the "hang" gate. Perhaps you can use half of a 12AX7 or other high-mu triode with germanium diodes for the avc detector and attack gate. Another important factor is the availability of proper B+ and negative bias voltages. The value of the cathode load resistor can be changed to accomodate different voltages, but B+ should not be less than 180 volts, and the bias should be -50 volts or better if you want to take full advantage of this system's capabilities. If your voltages are radically different, the value of the cathode resistor should be varied to achieve the best compromise between satisfactory voltage delay and effective avc action. The purpose of the voltage delay is, of course, to prevent avc action on weak signals, permitting maximum sensitivity until a certain signal level is reached.

The operation of the circuit is quite simple. On weak signals, the rectified signal voltage is not great enough to overcome the positive voltage in the grid circuit, so no avc voltage is developed. When the rectified signal voltage exceeds the positive voltage, the triode is biased in the direction of cut-off, the cathode goes negative in proportion to the signal strength, the attack gate is forward biased, and a proportional degree of the negative bias is applied to the avc line through the "hang" gate. Should the rectified signal voltage be great enough (as when operating full break-in), the triode will cut off, and full bias voltage will be applied to the avc line, muting the receiver.

An additional form of delay is introduced by the voltage divider through which the avc voltage is applied to the *rf* stage. This keeps the sensitivity of the *rf* stage high enough to preserve a satisfactory signal-to-noise ratio on moderately weak signals which activate the avc but need some "help". This is not a technique to correct a design flaw, but rather allows the avc to act early enough to maintain satisfactory control over the output level without masking the signals in noise. Of course, as has been pointed out, on weak signals, no avc voltage is applied at all.

The divider sets the decay time constants of the system. As it is shown in **Fig. 1**, decay times of 140 milliseconds, 500 milliseconds, and 1 second are provided in the Fast, Medium and Slow positions respectively. Attack time is less than 75 milliseconds in any position.

RF gain control is achieved by biasing the avc line through a silicon diode, which prevents further loading of the line. The diode is reverse biased until the negative voltage applied through the *rf* gain control exceeds the avc voltage, so the control has no effect until that point. Beyond that point, the avc is inoperative unless an extremely strong signal would cause the avc voltage to exceed the *rf* gain bias. This would, or course, reverse bias the diode again, permitting the avc to take control. This method of control offers some interesting possibilities. Turning the avc switch to the off position bypasses the diode, loading the avc line heavily enough that the avc voltage is "killed". After you've used this system for a while, you'll probably find that you never have occasion to use the *rf* gain control at all. I guarantee, this is one avc that will be left on.

The superiority of this system is evident. As installed in my 75A2, it holds the output within 6 db on *all* signals, and I have yet to encounter any signal strong enough to overload either the AM detector or the product detector. Because of the delay, weak signal work on 6 meters is greatly facilitated. Signal levels which previously would not yield copy now give Q-5 copy, in many cases.

One final word . . . a high noise level can render the delay function of the system completely ineffective. However, the great benefits of amplified avc action are no disturbed. A good *if* noise blanker will make it possible to derive the full benefit of this avc system, and you should definitely consider adding this feature to your receiver. I'm presently developing a simple blanker, and when it's finished, *73* will be the first to know.

. . . W8RHR

Leaky Lines

There's been a great deal of favorable comment about a newly formed net on 7255, called ECARS (East Coast Amateur Radio Service.) Evidently patterned after MWARS and WCARS, its prime purpose is to assist mobiles with traffic and weather information, run phone patches and so forth. I've sat in about a dozen times, and can report that for a new net it's doing a first class job. Membership is being formed up, with current rolls up to about 350 members, and they print a monitor which will be sent to all members. For information about joining, I suggest you listen, or better still, check in. This net looks like a winner, and I believe it will be around a long time. It starts around 6:30 A.M., EST, daily and goes till unconscious, as the saying goes. How about joining in on the action?

*

They had a really great turnout at the Harrison Sideband shindig, at the Statler-Hilton in New York. I saw lots of old buddies, and had a swell time, just roaming around. I gave them a start; they didn't expect me to walk in with a growth of chin whiskers. I sure got the horse laugh from a few of them, but that's okay. My beautiful Penny said she likes it, and that's good enough for me.

*

I missed the North Jersey DX Association's annual round-up. I had a prior engagement, unfortunately. I was sorry to miss it, as it's always a ball being there. Next year I'll make sure to keep the date clear.

*

No doubt, by this time, you are all aware that our peerless and redoubtable editor, Kayla, W2EMV, is getting hitched to Doc Hale, K4MWS, and is leaving the magazine for a life of connubial bliss down in sunny Florida, the Land of the Laughing Dollar. After 22 months of Dublin, New Hampshire's ubiquitous snowstorms, she is indubitably looking forward to the warmth of the tropics, and a life of soft ease, under the palm trees. I predict, however, that she won't forsake her Smith-Corona for long, and will be re-appearing in print from time to time. Congratulations, Doc, and much joy and happiness to you both, Kayla.

*

I'm soon going to be trying to work the repeaters on 2 meters, with a little NBFM rig, through the kindness of Chuck Bell, K3HHP. I don't know how much of this activity goes on up this way, but in some areas they're having a whale of a time with it. I should think that our hf bands will profit greatly with the burgeoning opportunities afforded by these vhf repeaters. A lot of qrm will disappear, and that's all to the good. I think that somebody with experience in the repeater field should write a piece about it. What say, somebody?

*

I've been carrying on a campaign, with the tacit approval and blessings of many others, to stop the idiotic use of meaningless drivel on the air.

When someone asks for my handle, I usually answer, "The handle is broken off; my name is Dave." I never, but never, say qth, Queen Roger Nancy, H..I.., or even 73. Why use all this CW parlance when we have a perfectly usable language with which to express ourselves? Boring and trite at best, it gets to be moronic when poor band conditions do not necessitate its use.

By far, though, my pet peeve is the nauseating use of the royal or editorial first person plural. When a guy says, "we" or "us" in place of "I" or "me," I always ask him if he is a Siamese Twin, or if he has two heads. This practice sickens me. By the way, we all know what a linear amplifier is, but would someone please tell me: what's a linear?

Here's a commonly heard stupidity. A net is in session, passing traffic. Or perhaps it's a round table, just chewing the rag. All of a sudden, out of the clear blue sky, without so much as a "By your leave," someone interrupts the proceedings with an urgent sounding, "Break, break, break, break." At this point, of course, realizing that something imperative in the voice of the breaker commands immediate recognition; perhaps a catastrophe of unthinkable proportions has occurred, the NCS, or one of the rag chewers calls in the station.

I must add an editorial aside at this point. Fellows who wouldn't dream of sitting down at your table in a restaurant, or getting into your automobile uninvited, have no hesitancy about rudely interposing their unwelcome presence into a private conversation on the air. Just plain rude, that's all.

Well, anyway, the station is called in, since the occupants of the frequency are eager to render assistance to the emergency breaker. The following transmission, incredible though it may be, is what they hear.

"Fine business, Old Man. The handle here is Ignatz....Ignatz....Idiot, garbage, nosebleed, alimony, termite, zilch....Ignatz. Our qth here is Split Lip, Calichussetts. We just put a doo-hickey on our frammis here, by golly, and we wonder if you could give us a signal and audio report. By the way, Old Man, by golly, the rig here is a Duck, and the old hearing aid is a Goose. The sky wire is a double-whammy super Mark seven quadrical cube pointing in your general direction, Northeast by Southwest. Our linear is a Swinette, in grounded grid, with a dixie-cup readout. It's been doing a fine-business job for us, by golly. So whatsay, Old Man, how copy, H...I...break, break. Ooooooohhhhhh-ver!"

Well, what are you going to say to a jerk like that? I mean to guys like those? I mean...oh, the hell with it. He had more we's than a men's room. All that was missing was, "That's a big ten-four!"

Wait till I get to the guys who give you this; "See ya down the old electric light bill." And the big mouths who say, "From the beautiful snow-capped, sun drenched hills overlooking the peaceful valley of the Fugahwi Mountains, this is the voice of Penwiper, Pennsyltucky, saying, the very best of seventy-threes, seventy-sixes and eighty-eights, Old Man. May the bluebird of happiness light on your windowsill every morning, and may the old master brass pounder in the sky take a liking to you; and till we meet again, aloha, au revoir, auf wiedersehen, hasta la vista, and a rividerci, Old Man. Dit...Dit..." Oh, brother!

I wish that stations would refrain from calling DX stations on their own transmitting frequency. Lately, despite repeated entreaties to listen five or ten up, some guys insist on clobbering the DX in this fashion. It makes things rough for everybody, and certainly doesn't do the offender any good either. The best procedure is to listen to the DX operator, and follow his instructions, whatever they may be.

By the way, it is not legal to go down into the foreign portion to explain to another foreign ham that he is interfering and should change frequency, for when we do this, we are merely compounding the problem by adding to the interference. Plus that, it's an open invitation to the FCC for a nice little pink slip.

There's been some discussion of late about broadbanding 75/80 meter dipoles. Quite a few lads and lasses like to work both the phone and CW segments, but have neither the space nor the inclination to put up two wires, nor do they desire the addition of a matchbox or L network, or other type impedance-adjusting device.

The Collins people once had an interesting configuration in one of their manuals. I believe it has been called a fan dipole. An extra length of conductor is soldered in at each side right at the feed points, then fanned out in a horizontal plane. The spacing at the ends is anywhere between five and twelve feet, depending upon available space. The resonant point is somewhat lower, so that the entire antenna must be shortened for a given frequency. This is, for all practical purposes, a section of a discone. I'm told that it effectively broadbands the dipole so that the entire 500 khz of the band may used, with pretty flat vwsr. Worth a try? I think so too.

I can't recall anything which has given me greater pleasure than the letters in April's QST, in response to the February editorial. For a long time it has been evident that hams are a heckuva lot smarter than some folks think. They are very much more aware of things than they are credited for, and their knowledge is not restricted to radio and electronics. They resent, rightfully, any efforts to limit their freedoms, just as any other citizen would. Especially resented is any idea that somebody else, because he holds some title or office, is fitted to decide such limits. Americans, by tradition, have respect for high office, but this does not mean that they automatically respect men who hold such office. They do not regard officials with any particular reverence. This very Republic was founded in the crucible of irreverence for autocratic authoritarianism, as exemplified by the British Crown, and it goes against our grain to accept with bland docility any type of dictatorial censorship against the free expression of opinion. In fact, in America, one of our most important traditions is the right to express unpopular opinions. And the degree of freedom which we enjoy, unique in all the world, is gauged precisely by the right of the individual to stand alone in an unpopular opinion, though he were opposed by all the rest of us. We regard that right as something sacred.

The letters which were printed, (and I can only gather by the huge proportion against the editorial, that there were very few letters for it,) clearly showed a high degree of understanding, were articulate and to the point. There is no question that hams are well-informed, involved persons, determined to safeguard their rights and Constitutional privileges against any incursion, whether from outside or within our own group. They understand the bankruptcy of the vigilantism proposed by the editorial. They recognize the folly of committing suicide to keep from being killed.

It is very clear that very few hams are about to accept a "Big Brother" with a proposal for self-appointed thought police, no matter how sacrosanct his position or office. Those letters in QST express more honest-to-goodness Americanism than a dozen civics text books. Makes me feel proud, when I realize the intellectual capacity of my colleagues in Amateur Radio.

Dave Mann, K2AGZ

Field Day Fever

Alan Shawsmith, VK4SS
35 Whynot Street
West End, Brisbane
Queens, Australia

Man, was I in double trouble. It was a long week-end. The kids were away with their grandparents at the beach. In an early morning, clear and mild, the YF and I were at breakfast on the sun porch. All should have been serene and happy. But, not so.

I had disgraced myself the night before, but that was not the end of it. I had made away from home plans without telling my OG. We all know what that means, particularly as she was planning a party and had been slaving these past two days to bring the house to its best.

Jadedly, I knocked the top off a boiled egg. My spirit seemed about the same as its contents; weak and soft.

I gazed across the table at the Nephritete-like head of my beloved and wondered at my devotion all these years. The shiny black hair tumbled as she bent over the morning paper, reading me the headlines.

"Drug running now big business off the East Australian coast. Racketeers continue to elude patrols."

"Do you think they use radio?" she asked.

"Who?"

"The dope smugglers."

"Yes, almost surely."

But my mind was on the week-end plans. How could I manage to tell her, especially after last night? I finished the egg, toast and coffee and felt a little more virile.

Every married male might be the man around the house, but the *subtle* master is the mistress of it. In my case, should I threaten to step out of line, I was given the "ego boosting" treatment. A sort of confidence trick it is really. With a meaningful look from the XYL's gypsy-like eyes, I am reminded every so often that I am a gentleman. How could I ever be unethical. Thus my will is imprisoned and conduct assured.

But this morning the male was about to roar. I *was* going away for the week-end, because arrangements had been made, even if they were concluded through a slightly inebriated haze, the night before.

"Honey," I said in a voice that was meant to be quietly final, but in effect came out weak and pathetic.

"Forget about the party tonight. I want to take you away for the next few days."

There was no immediate reply. Then she raised her head and looked past me into the kitchen.

"What are you going to do about *those*?"

"Ah yes, *those*." Oh my shame, I must explain.

Last night, leaving the pub after my quota of a quick two, I ran into Harry Watermaine. Field Day fever possessed him. (Actually I had forgotten about the event.)

"Say," he enthused. "I know of a DX Utopia. The perfect QTH. Optimum angle of radiation and everything is S9 plus. I'm taking the car and caravan. You must come."

Each succeeding beer made the idea seem rosier. It was late at night before the final details were settled and I could hardly wait.

Unsteadily creeping up the front porch steps, I knocked over a milk bottle. End over end, it went shattering the quiet.

"Shh, shh," I hissed, "You'll wake the YF."

"Where the heck is the door key." Why does a man need so many pockets. Top and bottom, back and front, inside and out. Eventually, it was located but a lot of 10 and 20 cent pieces were spilled in the fumbling process. "Never mind, I'll retrieve all in the morning."

I awoke with the expected. Headache and heartburn and my excesses demanded I rise immediately. Foggily the loose change on the porch came to mind. Unsteadily I opened the door and stepped back in amazement. The silver money was gone but in lieu, stacked phlanx-like, were 27 bottles of milk. Surprise quickly gave way to irritable temper. "A smart-alec milkman," I mused. What a cheap piece of petty capitalistic exploitation. Then through my misty hangover the ridiculous began to dawn. Tottering back to bed I burst into a loud guffaw of laughter.

Sleepily, the YF opened her eyes and regarded my mirth suspiciously.

"Sweetheart, is there any rum in the fridge?"

"No. Why, haven't you finished yet?"

"Ha, ha, ha. Where's the cat?" This brought her bolt upright.

"How should I know. Are you all right? What's so funny?"

"Like a bath in cow's juice?"

Disbelief crowded into the half-awake face.

"You're nuts–or in the DT's," she said.

"Aw, fair go kid. I'm okay. That smart Charley of a milkman just sold me 27 bottles of milk."

This was too much for my Helen. She fell back and pulled the bedclothes up over her ears.

"Go and have a cold shower–and shut up," came the muffled voice.

*****

So, now I suggested we put all those bottles in the freezer until our return. "From where–and with whom?" The YF challenged coldly.

Remembering her planned party, I prepared myself for the ego build-up bit.

"Up to the Lost World country. It's AR Field Day tomorrow. Monty Watermaine is taking his gear–and us."

"NO."

"Aw gee, Honey," I pleaded. "Field Day only comes once a year. We can hold a barbecue anytime."

"The party's off. When you didn't come home last night, I rang no one. A trip to the mountains is okay–but not with 'Gusher'." (This is Monty's nickname. Aptly tagged because his effacious manner irrates most of his friends.)

"No," she insisted. "Not with that arty eccentric. Besides you only want me along as a char. While you two drool over the rig, I'm the one to attend your creature comforts–or act as a rigger on the sky hook."

She banged the newspaper on the table in one of those small transitory piques, I had come to know so well.

"Look my Sweet," I implored again. "This is a chance too good to miss. Monty has found a DX Eldorado. You know, a place where reception is super dooper. All sigs S9 plus."

"Why Gush–and how did he locate it?"

"Oh well, he paints you know and seeks out virgin country for his landscapes. Sometimes he takes a radio along."

"Rings phoney."

At that moment, there was a mounting roar from outside.

"Oh that'll be the pantechnicon for the Hunter's. They're moving you know. One more TV griper off your back, eh? I must wish them good-bye."

I let the barb pass and stared miserably at the vibrating dishes. The milk bottles tinkled in sympathy. My heart rose in my throat and what courage I have trickled into my slippers.

She was back in a second; wide-eyed.

"Hey, it's Gusher and he's towing a railway carriage."

"It's his caravan," I said feebly.

"Where did he buy it–from a circus or the Government?"

"No, it's homebrew."

"It's like a tired daschund. Sags in the middle. Who painted it?"

"He did."

"Why so monstrous?"

"He uses it for his art besides AR. Has a piano in it too. He plays you know."

"A black square Buick and a tangerine and mauve caravan. Ye Gods."

"...and the interior is psychedellic," I snapped irritably.

"How could I drive away from here in that?"

"Shame. Where's your integrity?" It was my turn now.

"Monty," I called from the door, "won't be long."

In the bedroom the YF was camouflaging herself behind dark sunglasses and a large bandana.

"I can see," she said, "that if I care for your safety, I have no choice other than to come along and protect a couple of fools from themselves."

I sighed deeply.

*****

It is best to draw a veil over the trip to the mountains. We eventually made it, but the fates must have been in a benevolent mood. Enroute, a service station pad was cleared to allow us to draw in and fill up. The proprietor was paid for his pains by Monty driving off with most of the stations advertising bunting. Off the main road the Buick's brakes weren't up to a sudden stop and we nearly removed a farmer's cattle gate by flattening it; and a mile further on, the caravan's radio aerial sliced off someone's telephone wires. After several stops to allow the old bomb's gasping, wheezing motor to cool down and recover its strength, we suddenly emerged from a tropical rain forest, out on to an elevated plateau. A magnificent panorama surrounded us. Behind were the towering mountain peaks, and away below, now hazy in the fading light ran the ribbon of coastline. A white string between purple Pacific ocean and lush green vegetation. But even up here human habitation was apparent. Well-tended banana plantations nestled against the slopes.

"Monty," I said softly. "This splendor humbles me."

But Gusher was impatient to test his theory and in no mood for philosophy. Besides, he'd been here before.

"See that Flying Fox just there. It's about half a mile long. What a great long wire antenna, if I swing a bare wire over it for a lead in. No one will be using it over this week-end." (A Flying Fox in this part of the world* is a long cable or wire, strung from one elevation to a lower one, down which bananas and crates, etc., are slung to a central point. A great manpower saver.)

"Okay," I said, "it's your gear—go ahead."

Monty deftly weighted his lead-in with a stone and skillfully threw it so that it wound around the Flying Fox.

"Boy Scout days," he smiled at my admiration. "Let's have a listen first up and see—Wow."

He threw the wire from his hand. "That's HOT—it burnt me."

He sniffed a forefinger. "Yep, that wire's got *rf* on it."

"Impossible," I said, gingerly testing it. "See—nothing. The altitude's got you," I ribbed.

"Well, let's go in and tie it to the receiver."

The set was barely warming up, when a harsh, distorted voice crackled through the speaker.

"—use alternative rendezvous at 03. Two drops."

The S meter was slammed hard against the pin. Monty frantically wound back the controls.

"What was that? What frequency?" I asked surprised.

"Well the receiver was on 28 mcs but it was all over the dial. It could only be a local sig. Probably outside the ham band because the image rejection in this ole set is crook at 30 mcs."

Suddenly it came again. This time the full text.

**Queensland, Australia*

"Z1, Z1. Traps trolling the reef. Use alternative rendezvous. 03. Two drops. Use caution. Confirm."

Monty reached over and touched the aerial.

"Yep, that Fox is being used as an *rf* line, for sure."

We left the receiver running and sat in hopeful silence for something further, but nothing eventuated. We began to speculate on it's significance.

"The Fox disappears into those trees down there," I observed.

Helen, my YF, said, "If I know my geography, the only reef east of here is Shark Reef, and the newspapers have been saying it is a likely spot for dropping contraband."

"Let's examine the message some more," I said. "Traps in criminal vernacular means the police or the law. 'Trolling' is patroling. '03' is most likely 3 a.m. East Australian Time, and 'two drops,' two packages or containers."

"Put like that, it sounds ominous, but couldn't there be quite a simple explanation. Maybe it's just a message for fishermen somewhere?"

"What, so far from the coast and not showing a proper aerial?"

"Who'd look for a drug gang up here," Helen said.

"Aw heck, let's ignore it. We came up here to test this QTH and work DX, so why worry about it. I can sling up a Ground Plane in ten minutes. I've got a tri-bander pre-cut stowed here in the caravan." Field Day fever still gripped Monty and he was itching to get into the thick of things.

"There's a law that says every citizen is duty-bound to report any criminal act or what appears to be an irregularity," Helen said.

My YF was at it again, setting me up. Her eyes were directly on me and the meaning clear.

"If we report this and it turns out to be authentic, we'll look like a trio of nosy irresponsibles with red faces," I cautioned.

All sat silent, ruminating. Finally, I said, "If anything is to be done, it must be now as 03 EAST is only hours away. Will that ex-disposals TX work Monty—and on the small ships base frequency?"

"I'll try it and see."

The set-up in the caravan was a wonder to behold. Being unmarried, Monty could afford to indulge himself. His gear was a mixture of new and old. The TX in mention had general coverage.

"We'll load it into the short vertical on the caravan roof," explained Gusher.

"Honey," I beckoned, passing her a pencil. "I'm going to try and contact a base station north of here. I want you to take down the text of what passes both ways–for the record."

In response to my first call, back came the reply. "You're loud and clear. Have you a message?"

The text of what we had picked was passed and the request was made, that if the message lacked authenticity, please pass to the proper authorities. After identification, we signed off–quickly.

"Probably think we're the phoney's," Monty voiced the guilt within us all. "We've just operated outside the limits of our license."

"Yes, but with good intentions."

"–which may be hard to prove. What if the sender of that message picked up our transmission?"

The YF interposed. "He's either laughing his head off at a couple of silly hams–or if we've hit the jackpot, slipping a slug or two into his shoulder gun and coming to find us."

"Please, Helen," I demurred, "don't be so sinister. You make it sound like a TV movie."

A sort of frustrated, embarrassed silence descended upon us as if *we* were the wrongdoers. We had done ourselves as far as Field Day activity was concerned. All that was left was to pack up Arab-style and fade into the night.

Defeated, I went to the caravan door and looked down into the night to where the Flying Fox disappeared into a clump of trees. It all seemed so unlikely that I began to feel we were the victims of altitude hallucinations. But worst of all, I had spoiled Monty's week-end. So, with the question of the site as a DX Utopia still unresolved, we set the old Buick moving at it's lowest possible revs and crept off the plateau on top of the Lost World and began our descent into the mists and vapors of the heavily scented rain forests. Unbridled imagination is truly a bolting horse. On every bend I expected to see a road block and a couple of characters standing in our path. The sight of the highway back to town brought a big sigh of relief.

Back home, the noise of our tired arrival probably woke the neighbors but even the YF was too travel-weary to worry.

"Stay and have a kip," I invited Monty. "You look dead beat Om."

"Me too," yawned Helen.

*****

The sound of the piano being played brought me out from the last layers of sleep.

Must be Gusher keeping his hand in. Whew, it was hot. Must be late in the day.

The OW breezed into the room. Refreshed, prim and pert. I could see immediately by her eyes that something was up.

"Log," she accused. "We tried to tell you the news earlier, but stirring a dugong from its sleep is impossible. So we just let you be."

"Wa-ssat? Er–thanks. Oh, what news?"

"Gusher, will we tell him or leave it to the reporters?"

"–reporters?" I was now on my feet. She pushed me down again.

"We scored a bullseye. They've picked up some of the smuggling gang and expect to arrest others. The newspapers want to interview you and Monty."

The weight of sleepiness vanished. "What? Great, great! When are they coming?"

"You'd better get dressed because we're having a party tonight. May as well cap our little achievement with a little get together. Monty's staying to play piano."

"That message?" I said curiously. "It was rather vague. Fair dinkum did–?"

"Yep, caught 'em red-handed, and it seems like the credit's yours and Monty's. Appears the drug runners were able to obtain prior info on the patrol's movements but we settled that."

Life suddenly seemed warm and rich, like a perfect spring day–or nearly so. There was still the matter of the bottles of milk.

*****

The time was 3:30 a.m., and the last guest had bid his farewell. What a wonderful evening! Monty's skillful fingers had charmed away the irritation his mannerisms had caused the YF. We had enjoyed the wit and humor of friends, my beloved's wonderful cuisine, and the radio news flash of our little drama up on the Lost World.

Helen appeared with the last edition paper in hand and bounding with impish mischief. Opening the fridge she peeked in at the milk bottles–all 27 of them, then came close and slipped her arms around my neck.

"Darling," she said, "there are times when you are magnificent–LOOK."

She waved the paper under my nose. It's headlines read: *"Milk Strike. No Deliveries for 4 or 5 Days."*

She chuckled, I laughed. We both laughed and laughed.

...VK4SS

William R. Stocking, W8 BVU
16213 Blackstone
Detroit, Michigan 48219

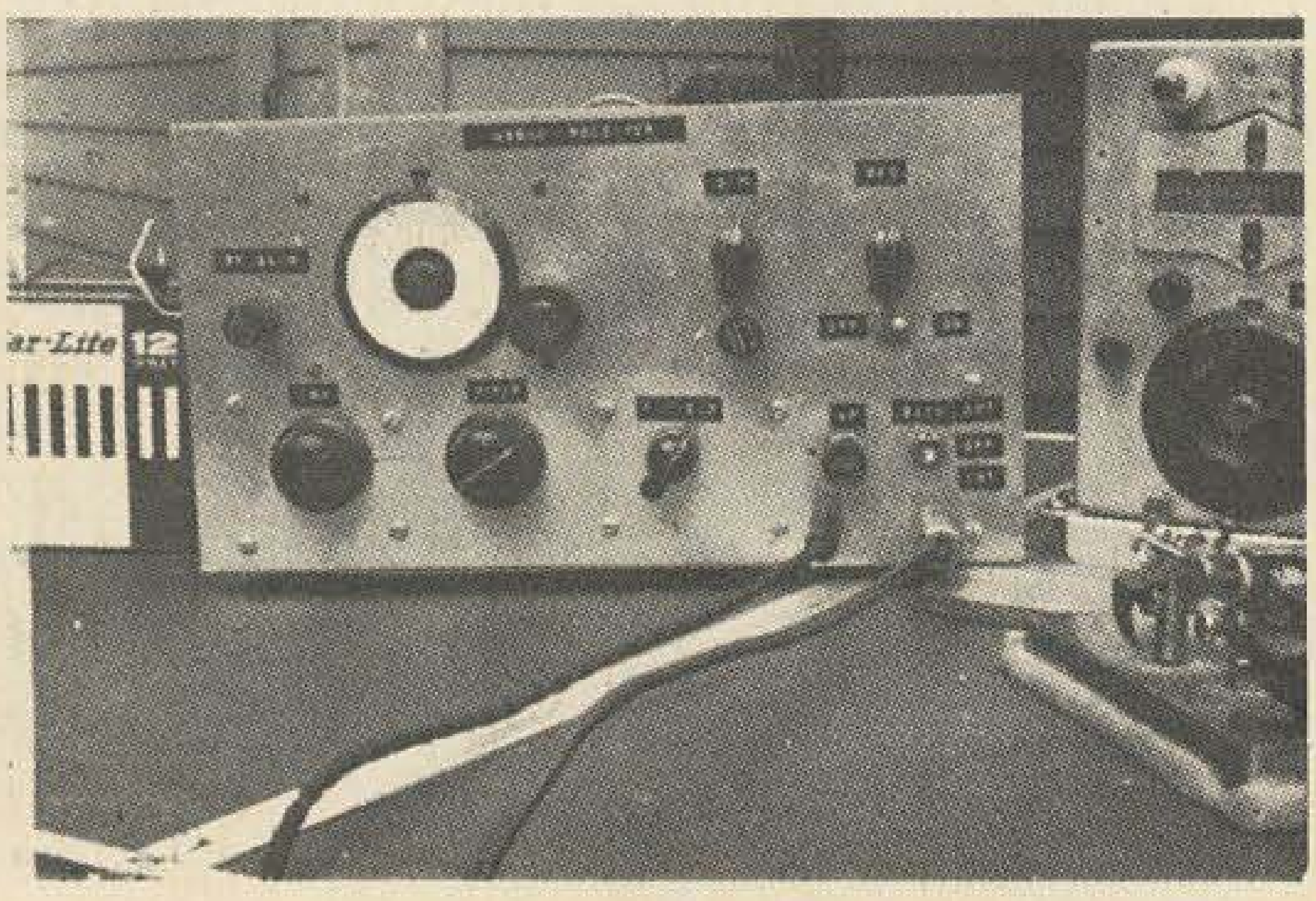
A Field Day to Remember

Fascinating, frustrating, or fun, Field Days are good tests of amateurs' engineering and operating ability. Although I had helped with two Field Days, I had done little operating because the other operators were 40-wpm men with contest experience. My contributions had been to design the antennas and to "supervise". This spring two 15-year-old Novices, Dave, WN8WMV, and Ron, WN8WMR, decided that we ought to have a Field Day. The new rules looked interesting, but there seemed to be too little time. Lack of success in building transistor transmitters had discouraged me, and I was very busy. However, Ron and Dave were persistent in their "encouragement", and I said we would have a Field Day, if we could get ready in time. My "Field Day receiver", built in 1966 as part of a "mental conversion" from tube to transistor thinking was designed for operation on 80 and 40 meters. It works well, is stable, and selective. We were determined to have battery operation for that 1.5 battery multiplier. We also wanted to have a ten-watt CW transmitter so that our power multiplier would be four. At this point, a "little bit of luck" intervened. I was given a 6-volt vibrapack that would put out 300 volts dc.

Flash! Idea! A tube transmitter! Perhaps one or two Command transmitters converted to 6-volt tubes might work. More luck! George, K8APT, donated a car transmitter from which two coils and a variable condenser had been removed. (The transmitter had a 5763 crystal oscillator and a 2E26 amplifier in a circuit taken from the 1959 ARRL Handbook.) The variable condenser was replaced, and two slug tuned coils were wound that could be tuned to resonance in both the 80 and 40-meter bands. The heaters were re-wired for six volts, and we had a transmitter. Would the vibrapack run it? Yes! Could the power be held down to ten watts? Yes! The vibrapack had a switch to change its output voltage. How about a vfo? A modified BC-457A Command transmitter with a 6J5 tube in place of the 1626 oscillator tube and with a shielded wire from the grid pin of one of the 1625 tube sockets to the car transmitter's crystal socket, provided a stable vfo. Break in? Yes! By mounting a VR-90 voltage regulator tube on the vibrapack to control the oscillator voltage, and by keying the whole transmitter in the B- lead, break-in was possible. The transmitter combination had a very good note and was remarkably free from chirps. The vfo and car transmitter were mounted on a board along with a telegraph key, a voltmeter, and a milliammeter so that the power input to the final could be calculated at all times.

With a receiver, a transmitter, and 6-volt storage batteries, all that was now needed were some operators, an antenna, a means of charging the batteries, permission to use River Rouge Park, a tent, and a few other items such as suitable lamps, tables, chairs, etc.

Ron had a tent, a lawnmower engine, and a 6-volt car generator. He worked long and



The CW receiver.

The CW transmitter.

Ron and the battery chargers in front of the sound baffle.

hard to get the right combination of pulleys, belts, and generator field resistances so that my 6-volt telephone line batteries could be charged.

Field Days are always cooperative projects, and we needed more manpower. Arnold, WA8OVY, a technician, promised to help us "set up", and offered the use of his 12-volt trailer battery. To charge this battery, I purchased a 12-volt car generator for $3.00 and mounted it on some boards with another lawnmower engine, some switches, and resistors.

In the search for manpower, I stopped at a house that had antennas and a car with an antenna. There I met Chuck, WA8WAH, and was glad that he was not a "CBer". I liked Chuck and invited him to join the group. Chuck offered to take his Heathkit HW-12A, 75-meter SSB transceiver out of his car for us to use on Field Day. (Being strictly a CW ham, I thought this might be good to make a few contacts when the CW operators got tired. Later, Field Day really educated me to the value of SSB!!!!) Thus, our working group consisted of Chuck, Arnold, David, Ron and me. I was the only one who previously had participated in a Field Day. Although we lacked experience, we had much enthusiasm.

Preparing for Field Day required much thought and work. We carefully studied the rules, and decided that such a small group should not attempt to have more than one transmitter on the air at any one time. By operating Class 1-A, only one transmitting antenna would be needed. We wanted to make each contact count as much as possible. By keeping the CW power 10 watts or less, each contact would count 18 points (independence of power mains 3, times battery power 1.5, times power multiplier 4). For the 75-meter SSB contacts, the power multiplier would be only 2 (50-200 watts), so each SSB contact would count only 6 points. According to the rules, we could get 200 points for using emergency power and 200 points for publicity. *The Detroit Suburban Newspapers* kindly published an article which told of our plans and explained the purpose of Field Day. The article also explained that *our group* would use equipment designed and constructed *especially for portable and emergency operation*, and would not merely run home-station equipment with a portable alternating current generator. Since we had no experienced contest operators, we felt that we would do well to get 100 CW contacts. We thought we could earn 2200 to 2500 points, (1800 for 100 CW contacts, plus 400 "bonus points") plus a few more points from SSB contacts. There was also a possibility of earning 200 more "bonus points" if we could get a message through to the Sections Communications Manager.

To get permission to use a high flat place in River Rouge Park, a letter was written to the Superintendent of the Department of Recreation, phone calls were made, and the park Supervisor was visited. The police were also notified in advance and given a copy of our letter from the Department of Recreation granting us permission to use the park.

Planning and construction work continued whenever time became available. Gooseneck lamps were fitted out with tail-light bulbs and battery clips. Pieces of pipe were collected to be driven into the ground to hold the guy wires. Spare tubes, spare spark plugs, an absorption type wavemeter, and other small items were collected. Lists of things to take were made.

The most important part of any radio sta-

Chuck, Arnold, and the batteries. Chuck's right hand is on the power supply of the HW-12 transceiver.

tion is its transmitting antenna. To be effective, a transmitting antenna must have three important characteristics: (1) resonance to the transmitter's frequency; (2) efficient transfer of the radiofrequency electricity from the transmitter to the antenna; and (3) height above ground. The Field Day antenna planned was an "olde tyme centre fed zepp". The two top sections were each to be 66 feet long connected to 64-foot-long open wire tuned feeders in the center of the 132-foot antenna (66 feet either side of the center where the feed line is connected). Thus, on both 40 and 80 meters the feeders could be voltage fed from a parallel tuned (center grounded) antenna tuner, link coupled to the final tank coil of the transmitter. Fifty feet of center height was provided by 2 by 4's, a 12-foot dowel, and fishpoles clamped together. The guy wires were fastened to the top of the 12-foot dowel. The ends of the antenna were about 25 to 30 feet up, one end in a tree, the other end held up by a 16-foot 2 by 4 to which was clamped a small sailboat mast. An open wire feed line was made of No. 14 enameled wire separated by 2½-inch wooden spacers that had been boiled in paraffin. The antenna wire was somewhat thin (No. 20 or so taken from an old loudspeaker field coil), and we twisted nylon string around the wire to support its weight and prevent the antenna from stretching. The antenna and feeders were rolled up on a detergent barrel and stored until Field Day. The four guy wires (broken electrically by "egg" type insulators) were coiled up and stored inside the barrel.

A week before Field Day, a practice session was held in my yard to try out the CW equipment and the six-volt lawnmower-driven generator. (The Heathkit HW-12A and twelve-volt generator lawnmower engine combination were not tried out until Field Day itself.) Ron had a 100-foot-long cable made up of three No. 8 wires which was used to take the dc charging current from the generators to the batteries. This 100-foot distance and a sound-absorbing baffle kept the lawnmower engine noise from being too loud.

During the "dry run", the home antenna was used, and several contacts were made before something "blew" during a QSO with VE3FPM. A .1 mfd 200 condenser in the vibrapack had shorted and was shorting out the telegraph key! The condenser was replaced with a .1 mfd 400-volt condenser, and there was no more trouble. This one correction made the practice session worthwhile. At the practice session a 64-foot piece of wire was cut for the receiving antenna, and a checklist of things to take was made. (In spite of the checklist, when Field Day came, the sledge hammer was left behind!)

There was also mental preparation for the Field Day. In 1966, I purchased a second-hand "bug" (semiautomatic telegraph key) and learned to use it to increase my sending speed. For three weeks before Field Day, I tried to get on the air often operating at as high a speed as possible. (I was probably up to 20 WPM by Field Day.) David, WN8WMV, took code practice every night from W1AW and got his code speed up to 15 WPM. He planned to help with the logging.

The big day came suddenly. In the morning, the equipment, lumber, food, tent, ladder, cot, chairs, table, batteries, antenna, wire, and generators were put near the garage driveway. At about 2:00 pm three loaded cars started for River Rouge Park. At the site, the cars were unloaded, and the long wait (15 minutes) until 1900 GMT began. At 1900 the antenna lumber was put in place, and with a good posthole digger we started digging the four-foot-deep hole into which the eight-foot-long double 2 by 4 center post was put. The long double two by fours were bolted to the bottom of the center post. The center of the antenna was fastened to the top of the fishpole section. The middle sections of the center support were clamped in place. The north end of the antenna was fastened to a rope in the tree. The south end of the antenna was fastened by a rope through the pulley in the top of the sailboat mast, and the antenna was walked up into place. Next, the four guy wire pipes were driven into the ground. (The

Chuck and Ron making contacts on 75 meter ssb. The equipment visible includes the CW station and the antenna tuner.

sledge hammer was badly missed!) The guy wires were fastened to the pipes, and the antenna was "rarin' to go". Next the tent floor was put down near the end of the feed line, so that the antenna feed line could be taken into the tent. As the tent was being put up, the folding picnic table was put up on the tent floor. The station equipment was set up on the table. The batteries were put outside the tent door. (To keep the acid of the batteries from injuring the tent.) The vibrapack was connected up, and we were on the air at 21:23 GMT, before the tent was completely assembled. Later, the generators were connected to the batteries through the 100-foot power cable. Seven 40-meter CW contacts were made before 2200 GMT. Field Day CQs were answered and, to our surprise and delight, most of the stations came back giving us good reports, 569, 579, 589, etc. The ten-watt transmitter with the big antenna was really putting out!

David's code was better than had been expected. His log keeping made it possible for me to concentrate on making contacts. David also made some contacts himself running crystal-controlled in the 40-meter Novice band.

At 2303, Dave and I were tired enough to let Chuck try his 75-meter SSB transceiver. The antenna tuner was connected to the output of the HW-12A, and the transmitter was carefully tuned up. At 2320, the first SSB contact was made, and in 16 minutes nine other contacts were made. What a terrific surprise to this "dyed in the wool" CW operator! Although Chuck had never been on a Field Day before, he operated as if he were an experienced Field Day operator. He instinctively had the knack of getting contacts quickly and with as few words as possible. Ron did the logging for Chuck. At one time, three contacts were made in less than two minutes. With 180 watts P.E.P., the HW-12A and the big antenna were putting out a loud signal. Some stations said the signal was the loudest on the band. (The 12 volt generator and lawnmower engine, that had not been previously tested together, worked beautifully.) SSB worked so well that we wished that we had a way of accurately measuring the input plate power of the final so that we could cut it down to 50 watts, so as to have a larger power multiplier. We think that nearly as many contacts could be obtained with a signal less strong. (We shall take care of this item next year!) The "few extra points" from SSB turned out to be many, many points, 1146 to be exact!

Dave and I stayed up all night working 80-meter CW. Early in the morning, we heard the Sections Communications Manager, W8FX. We were tired, but by "hook or crook", and with much repetition, we managed to get the 200-point message to him.

The rest of the day was spent either with 40-meter CW or 75-meter SSB. We operated until 2155 Sunday afternoon to try to get as many contacts as possible. In all, there were 109 CW contacts counting 18 points each, and 191 SSB contacts counting 6 points each.

(On September 10, 1968, we received a QSL card confirming a Field Day contact from W5US in Texas that would have given us another 18 points. The report said that our signals were 579.)

At the end of the Field Day period, we were sleepy, tired, but very happy. We were thinking about how to improve our score next year! However, even if we were to earn 10,000 points next year, we do not think it really could be a better Field Day than the one we had this year *as beginners*.

This was the Field Day that we shall never forget!

...W8BVU

Sunspots? *Who Needs 'Em for 6 Meter DX*

Morgan Monroe, K7ALE
224 Home Street
Moscow, Idaho 83843

Stop! Don't stow that six meter beam in the garage just because someone said the sunspot cycle is declining. The cycle is on the way down but that doesn't mean the end of vhf DX for those who know how.

Many six meter enthusiasts, particularly some who have discovered the pleasures of 50 mhz operation in the past five years, fear that 1968 marked the end of everything but local-area ragchews and net check-ins on ground plane antennas until the sunspots peak again a decade or more in the future. Not so.

Keep that six meter beam high. Peak up your 50 mhz gear. For many of you, the best is yet to come.

If the declining years of sunspot Cycle 20 (the next five or six) are remotely like the waning years of Cycle 19 in the period from late 1958 through 1963, 50 mhz DX possibilities should be plentiful for those prepared to exploit them with knowledge and operating skill. But, you'll need more than a corroded ground plane and poorly-aligned receiver to make the best of them.

Big power? No, that's neither necessary nor desirable.

Working six meter DX consistently is an amateur activity in which, literally, knowledge is power. Six or seven clean watts to a good antenna system does the job nicely. Twenty or 30 watts assure that you can work virtually anything in the world you can hear.

Successful six meter DX operators invest most of their effort and funds in efficient, directional antenna systems and sensitive, reliable receiving equipment. Above all, they learn everything possible about propagation effects that account for 50 mhz DX frequently missed by less informed operators. That's why knowledge *is* power on six. With an understanding of propagation effects, an efficient antenna, and good receiving equipment, you need very little transmitter power to rack up an impressive DX score—with or without sunspots.

Those who have studied the vhf segments of the amateur spectrum carefully in the revealing years since World War II, know that some of the higher frequencies offer excellent DX possibilities in periods when lower frequencies are deep in between-sunspot-peaks doldrums. This is particularly true of the six meter band, a true DX part of the spectrum for those who know how, why, when and where.

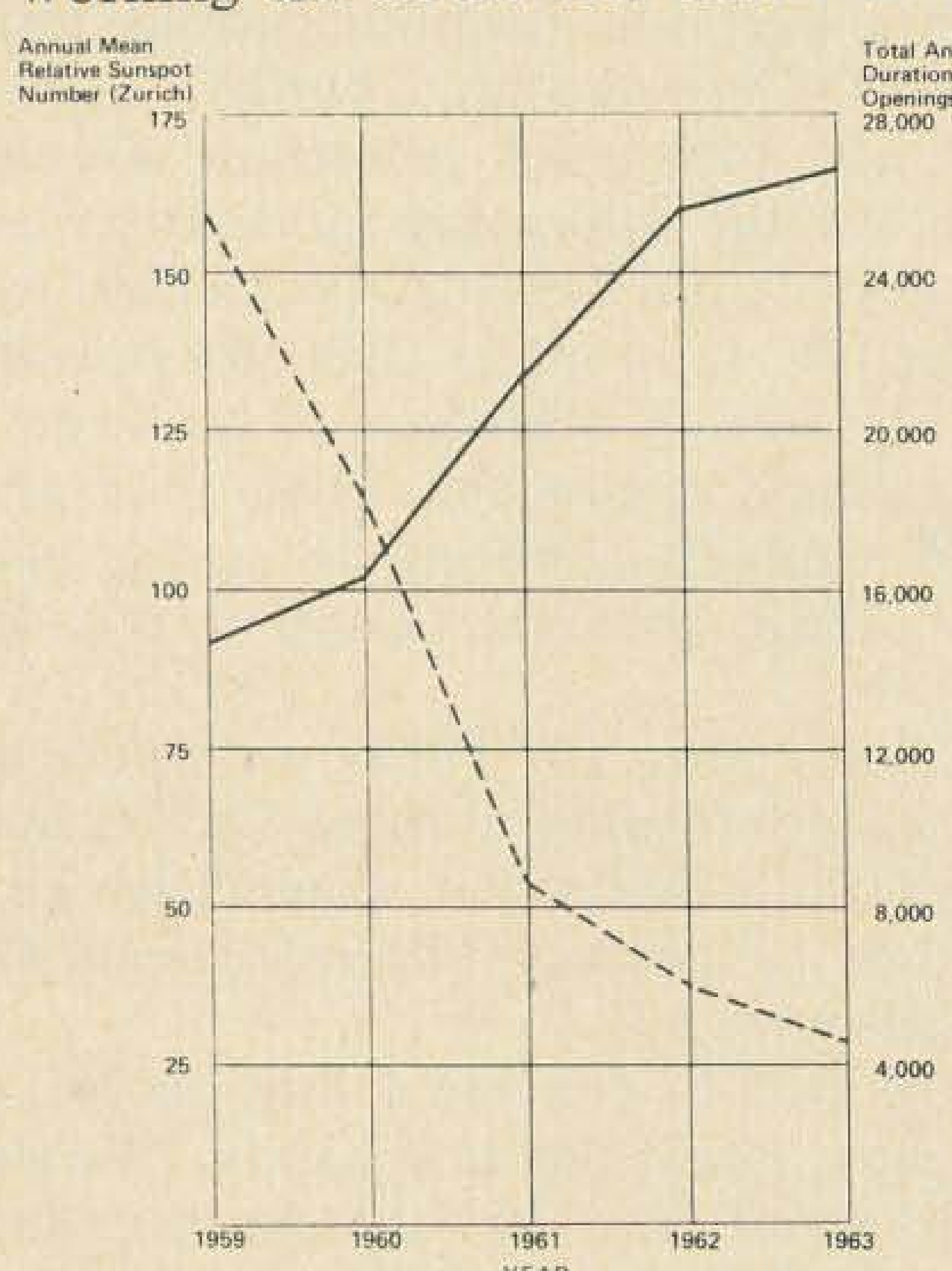


Fig. 1 - Relationship between annual duration of 50 mhz band openings, in minutes, and annual mean relative sunspot numbers as determined by the Swiss Federal Observatory at Zurich. Solid line indicates annual duration of openings (read on scale at right); dashed line indicates annual sunspot numbers (read on scale at left).

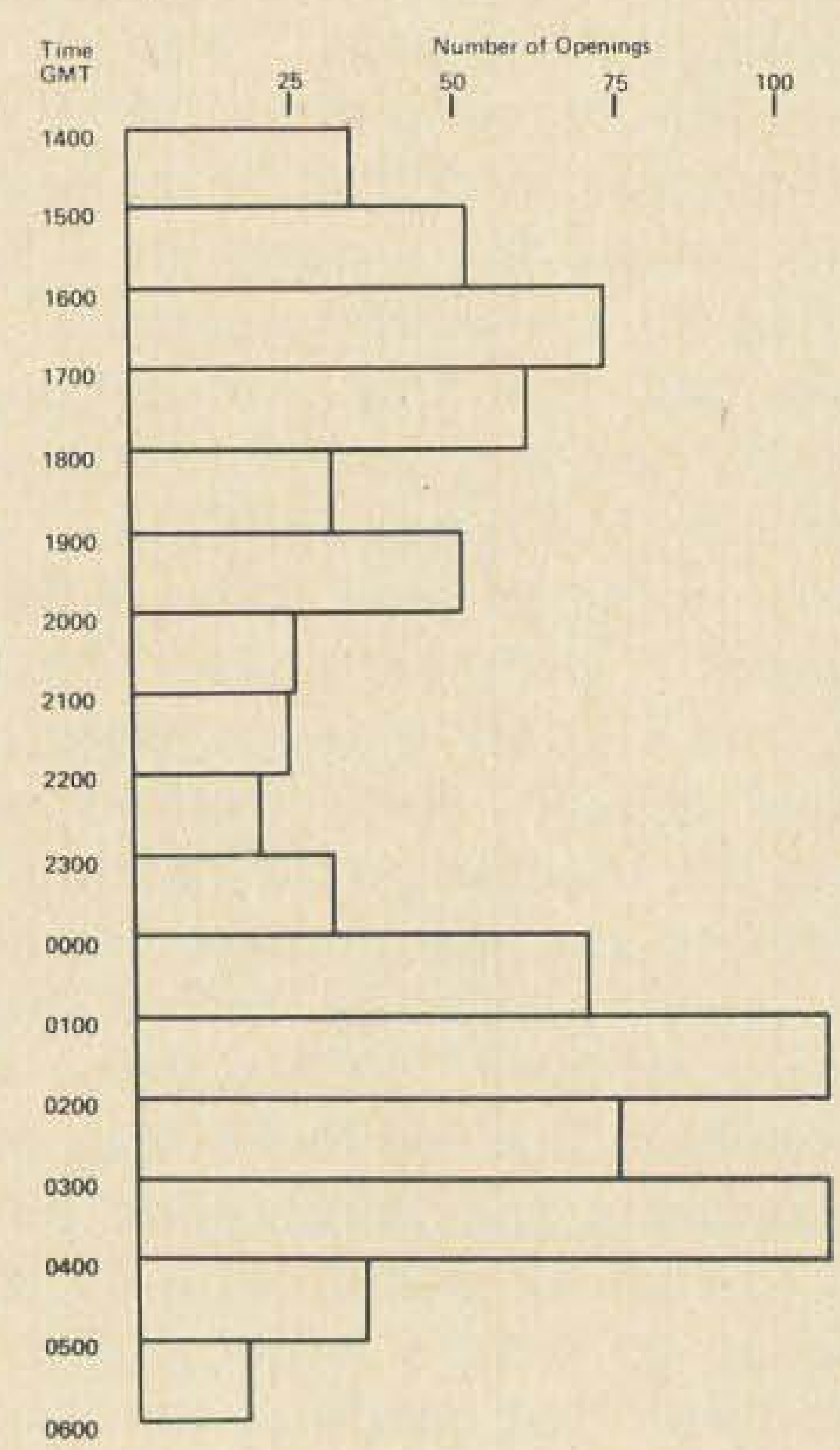


Fig. 2 - Beginning time, to nearest hour, of the 808 six meter openings recorded during the 1958-1964 investigation.

Older vhf operators perhaps recall the five-year investigation of 50 mhz propagation effects that my wife, K7ALF, and I conducted during the declining years of sunspot Cycle 19. That carefully-controlled study was initiated late in 1958, a full year after Cycle 19 had peaked and started down, and continued until January 1, 1964.

The most significant single finding of that 27,855 hour research effort demonstrated that sporadic-E propagation supported six meter DX opportunities *increased steadily as the sunspot cycle declined.* **(Figs. 1, 2; Tables A through H).**

Table A
COMPARATIVE SUMMARY
Six Meter DX
November 1, 1958–January 1, 1964

	1958 2 mos	1959 11 mos	1960 12 mos	1961 12 mos	1962 12 mos	1963 12 mos	Totals or avg.
Avg. mean sunspot number (Zurich)	184.8	159.0	112.3	53.9	37.5	27.9	—
No. monitored days	61	335	366	365	365	365	1,857
No. days band opened	45	99	126	101	113	109	593
No. band openings	70	121	169	140	152	156	808
Total mins. band open	6,197	14,797	16,326	21,316	25,594	26,494	110,694
No. states heard/worked	19	42	30	46	44	40	50
No. foreign prefixes heard/worked	18	11	15	7	10	6	40

Our investigation further showed that the six meter band opened between the Arizona study site (we have since moved to Idaho) and regions *outside* the continental United States in 62.3% of the 61 study months during the constantly declining years of Cycle 19.

But that's just part of the story. DX of one kind or another, foreign and domestic, was recorded in *91.8% of those 61 months,* **(Table D).**

If the waning years of Cycle 20—those from now until 1974 or 1975—are only two-thirds as productive, they will offer six meter DX in more than 60% of all the months during the next five or six years. That's a lot of DX, so keep those beams up and get ready. Sporadic-E (E_s) DX openings should begin mounting this summer.

Some of the things we discovered during the downfall of Cycle 19 can be helpful to you throughout the present sunspot decline. All pertinent data from our 1958-1964 records are contained in the charts and tables herein. This information can help you work more DX with less effort. And remember that at no time during the investigation did we feed more than 27 watts to the antenna. All DX recorded in the first five months of the study was worked with an output of only *seven* watts.

If you aren't familiar with our research, all of which was done on AM, you should know several things not indicated in the statistics. Some of our principal findings were

Table B
STATES HEARD/WORKED
(Figures indicate number of times H/W)

	1958	1959	1960	1961	1962	1963	Total Times H/W
Alabama	0	1	0	4	10	9	24
Alaska	*	4	0	0	0	0	4
Arkansas	3	7	4	7	13	14	48
California	2	24	36	35	32	46	175
Colorado	0	7	12	20	14	18	71
Connecticut	11	0	0	1	3	0	15
Delaware	0	0	0	8	1	0	9
Florida	0	11	3	9	13	17	53
Georgia	0	1	1	3	7	9	21
Hawaii	*	6	1	0	0	0	7
Idaho	0	4	6	7	6	6	29
Illinois	2	2	0	0	3	3	10
Indiana	0	2	0	4	4	1	11
Iowa	0	9	3	10	23	20	65
Kansas	3	9	4	17	28	27	88
Kentucky	0	1	0	4	3	4	12
Louisiana	3	12	13	20	26	20	94
Maine	26	1	0	1	1	0	29
Maryland	0	0	0	4	0	0	4
Massachusetts	25	4	0	7	2	0	38
Michigan	0	1	1	3	2	3	10
Minnesota	0	8	4	12	6	11	41
Mississippi	0	4	0	2	5	5	16
Missouri	3	10	3	20	29	25	90
Montana	0	10	12	9	11	9	51
Nebraska	0	15	21	31	34	35	136
Nevada	0	7	7	8	3	6	31
New Hampshire	15	1	0	2	0	0	18
New Jersey	6	1	0	11	3	2	23
New Mexico	0	0	0	1	5	7	13
New York	7	0	0	6	4	3	20
North Carolina	2	2	1	3	2	6	16
North Dakota	0	7	5	7	3	1	23
Ohio	0	4	1	9	7	10	31
Oklahoma	3	18	15	26	33	31	126
Oregon	0	21	34	25	35	30	145
Pennsylvania	4	2	2	7	8	3	26
Rhode Island	15	0	0	1	3	0	19
South Carolina	0	2	0	2	1	4	9
South Dakota	0	7	8	17	16	16	64
Tennessee	0	4	4	4	9	7	28
Texas	12	42	74	72	85	85	370
Utah	0	3	1	2	3	6	15
Vermont	8	0	0	1	0	1	10
Virginia	1	3	2	8	2	4	20
Washington	0	21	30	22	31	29	133
West Virginia	0	3	1	5	2	2	13
Wisconsin	0	5	2	3	5	8	23
Wyoming	0	8	12	16	10	7	53

*See Table C, foreign prefixes, prior to statehood

in sharp disagreement with widely-accepted theory. That is due, in part, to the fact that much of the DX heard and worked during a sunspot decline is via E_s propagation, a phenomenon about which little was known at that time. Even now, much remains to be learned; that's one of the fascinating things about working 50 mhz DX.

Sporadic-E propagation is the so-called "short skip" form resulting from unexplained, exceedingly high ionization densities occuring sporadically in the E layer of the ionosphere; hence, the term "sporadic-E." Such enhanced densities are capable of reflecting radio waves of much higher frequency than are reflected by the E layer under normal ionospheric conditions. They are therefore extremely helpful to six meter operators who know how to use them.

Unlike the F_2 form of propagation, which on six meters is associated only with high levels of sunspot activity, E_s propagation possibilities on six are in *inverse* ratio to sunspot numbers. As the numbers drop, E_s band openings increase and are of longer duration (Fig. 1). Our 1958-1964 research established this previously suspected, but unverified, phenomenon beyond doubt, at least so far as six meter operating conditions and Cycle 19 are concerned.

Table C
FOREIGN PREFIXES HEARD/WORKED
(Figures indicate number of times H/W)

	1958	1959	1960	1961	1962	1963	Total Times H/W
CE3*	0	0	1	0	0	0	1
CO2	0	0	0	1	5	0	6
CT1*	3	0	0	0	0	0	3
CX8	0	0	1	0	0	0	1
EI2*	4	0	0	0	0	0	4
FG7	0	0	0	0	0	1	1
HC1	0	3	2	0	1	0	6
JA1	1	0	0	0	0	0	1
JA3	1	0	0	0	0	0	1
JA4	1	1	0	0	0	0	2
JA5	3	0	0	0	0	0	3
JA6	1	0	0	0	0	0	1
JA7	1	0	0	0	0	0	1
JA8	2	0	0	0	0	0	2
KH6	8	4	(See Table B after statehood)				12
KL7	10		(See Table B after statehood)				10
KM6*	1	0	0	0	0	0	1
KP4	1	4	0	5	2	2	14
LU1	0	0	3	0	0	0	3
LU2	0	0	2	0	0	0	2
LU3	0	3	6	1	0	0	10
LU4	0	2	7	0	0	0	9
LU5	0	0	3	0	0	0	3
LU7	0	0	1	0	0	0	1
LU8	0	1	0	0	0	0	1
LU9	0	0	2	0	0	0	2
PY6*	0	0	0	0	1	0	1
VE1	33	5	0	0	0	0	38
VE2	4	0	0	0	0	0	4
VE3	1	0	0	1	1	0	3
VE4	0	1	0	1	0	0	2
VE5	0	0	0	0	2	0	2
VE6	0	0	2	5	4	5	16
VE7	0	2	1	0	4	2	9
VK3*	0	0	1	0	0	0	1
VK5*	0	0	1	0	0	0	1
VO2	7	0	0	0	0	0	7
VP7	0	0	0	0	1	4	5
XE1	0	6	8	11	16	4	45
XE2*	1	0	0	0	0	0	1

*Indicates prefix heard but not worked

Don't let that term "short skip" fool you. Six meter E_s openings normally permit working stations from a few hundred to 1,700 miles distant. But at times there is multiple reflection, termed "double hop," which makes many solid contacts possible well in excess of 3,000 miles. Our longest double-hop qso during the last sunspot decline was 3,300 miles. We. did it in June 1963 when the mean monthly sunspot number was just 36.6, far below the Cycle 19 peak of late 1957.

E_s openings have two substantial advantages over F_2 openings on six. They are not frequency critical, which means you can work DX just as well at 50.5 or 50.8 mhz as near the bottom of the band where qrm is likely to be heavy, and they last longer; an aid in building up your DX score.

Another form of propagation which is wholly independent of the sunspot cycle is termed "tropospheric" because the phenomenon is associated with the earth's troposphere rather than the ionosphere. There is also much yet to be learned about this form.

As is true of E_s, no single theory adequately explains just how "tropo" works although knowledge of it has mounted in recent years. At present, it is generally believed to be connected with turbulence in the atmosphere.

This connection in turn is thought to be associated with weather fronts. It is suspected that fronts may cause the refractive index of the troposphere to fluctuate at random, thereby aiding six meter operators by bending their signals back to earth at varying distances.

Table D
NO. DAYS PER MONTH
SIX METER BAND OPENED

	1958	1959	1960	1961	1962	1963	Totals
JANUARY	—	13	6	8	3	2	32
FEBRUARY	—	12	4	0	0	8	24
MARCH	—	3	3	3	0	2	11
APRIL	—	—	10	3	5	0	18
MAY	—	4	16	9	23	21	73
JUNE	—	19	21	26	26	27	119
JULY	—	18	21	26	23	23	111
AUGUST	—	14	14	7	2	8	45
SEPTEMBER	—	1	1	2	4	0	8
OCTOBER	—	3	6	6	8	2	25
NOVEMBER	29	7	9	5	4	9	63
DECEMBER	16	5	15	6	15	7	64
Totals:	45	99	126	101	113	109	593

Working tropo on six can be an instructive and rewarding experience. Such openings are marked by two fading components, one rapid, one very slow. These are certain indications of tropo propagation, making it easy to identify.

In addition, there are seasonal variations in median signal levels, with strongest signals in summer months. Also, there are meteorological variations, with best signal levels at times when the troposphere contains very warm or very dry air. All these variations add challenge and DX for those who learn how to exploit tropo.

Still another propagation form unrelated to the sunspot cycle is "atmospheric ducting." This phenomenon is certain to puzzle you the first time you encounter it. Signals from distant stations come booming in. But all of the stations are located within a very compact geographical area, sometimes within one small town or single suburb of a metropolitan area. Operators there can hear you as well as you hear them but neither you nor they can work into other areas.

A duct in the atmosphere often lasts many hours and serves the same general purpose as a waveguide. Signals propagated through ducts are strong and steady but always confined to a small geographical area at each end of the circuit. In effect, a duct serves as an atmospheric radio pipeline between two comparatively small areas on the earth's surface.

Ducts form when the refractive index of the lower atmosphere is altered. This is usually caused by the overlay or shifting of warm and cold air masses in such a manner that a non-homogeneous atmospheric "channel" is formed between or beneath them. VHF radio waves are trapped and superrefracted within the duct which guides them along its length and returns them to earth at the opposite end. The strength and range of signals are enhanced. Often they may be heard 1,500 or more miles away—but only in the area at the other end of the duct.

Add these frequently encountered propagation forms to the less common DX possibilities of scatter propagation and, in northern areas, auroral openings, and you have a helpful collection of six meter propagation tools largely independent of sunspot cycles. Proof that these forms of propagation pay off in good DX is apparent in the results of our investigation during the last sunspot cycle decline.

All of the 50 states and 40 foreign prefixes (**Tables B, C**) were heard/worked during a five-year period in which the mean annual sunspot number shrank from 184.8 to 27.9.

Table E
NO. BAND OPENINGS PER MONTH

	1958	1959	1960	1961	1962	1963	Totals
JANUARY	—	14	7	11	3	2	37
FEBRUARY	—	15	4	0	0	8	27
MARCH	—	5	3	3	0	2	13
APRIL	—	—	18	5	5	0	28
MAY	—	4	26	9	35	35	109
JUNE	—	23	30	38	41	51	183
JULY	—	20	28	42	33	29	152
AUGUST	—	20	18	7	2	8	55
SEPTEMBER	—	1	1	3	4	0	9
OCTOBER	—	4	8	9	9	2	32
NOVEMBER	52	10	11	5	4	11	93
DECEMBER	18	5	15	8	16	8	70
Totals:	70	121	169	140	152	156	808

Table F
PERCENTAGE OF OPEN TO MONITORED DAYS

	1958	1959	1960	1961	1962	1963
JANUARY	—	41.94	19.36	25.80	9.70	6.45
FEBRUARY	—	42.86	13.79	0	0	28.57
MARCH	—	9.68	9.68	9.68	0	6.45
APRIL	—	—	33.33	10.00	16.66	0
MAY	—	12.90	51.61	29.03	74.19	67.70
JUNE	—	63.33	70.00	86.88	86.67	90.00
JULY	—	58.06	67.74	83.90	74.19	74.19
AUGUST	—	45.16	45.16	22.22	6.45	25.81
SEPTEMBER	—	3.33	3.33	6.66	13.33	0
OCTOBER	—	9.68	19.35	19.35	25.81	6.45
NOVEMBER	96.66	23.33	30.00	16.66	13.33	30.00
DECEMBER	53.33	16.13	48.39	19.35	48.39	22.58

Table G
AVERAGE DURATION OF BAND OPENINGS
(Minutes)

	1958	1959	1960	1961	1962	1963
JANUARY	—	76.0	134.0	68.6	53.3	98.5
FEBRUARY	—	56.3	30.0	0	0	131.0
MARCH	—	51.4	29.0	115.0	0	40.0
APRIL	—	—	59.1	40.0	158.0	0
MAY	—	77.7	101.1	447.2	206.7	159.2
JUNE	—	190.7	95.2	224.5	185.4	212.7
JULY	—	199.9	131.6	130.8	193.2	189.1
AUGUST	—	103.9	53.0	132.1	27.5	170.0
SEPTEMBER	—	132.0	195.0	70.2	38.0	0
OCTOBER	—	38.7	56.8	51.1	49.9	17.5
NOVEMBER	101.2	52.0	55.9	14.0	175.0	78.6
DECEMBER	50.2	212.0	182.0	45.0	129.7	125.0

Table H
COMPARATIVE SUMMER E_s SEASONS
(May 16–August 15)

	1959	1960	1961	1962	1963
No. monitored days	91	91	91	91	91
No. days band opened	51	62	66	63	63
No. band openings	63	89	94	93	99
Total minutes band open	10,157	9,556	18,785	16,870	20,345
Avg. duration of openings (mins.)	161.2	107.4	199.8	181.4	205.5
Avg. no. openings per open day	1.24	1.44	1.42	1.48	1.57
No. states heard/worked	36	28	46	43	39
No. foreign prefixes heard/worked	3	2	6	7	6

The mean monthly number dropped as low as 14.9, yet E_s-supported DX time alone increased steadily for more than five years after the Cycle 19 peak (**Tables A, D, G, H**).

How to cash in on what lies ahead?

First, you should forget some things. Then you must learn some others you may not know at present. And, if you're a newcomer to six meters, don't feel alone. A surprising number of hams with years of experience on the lower frequencies don't know how to work 50 mhz DX consistently either!

Most of the "rules" you've probably heard about working six meter DX mean little during a sunspot decline. Some of these are based on working F_2 openings and you will not find many of those in the next five or six years.

Also, there are some erroneous ideas around that have nothing to do with F_2. For example, you've probably heard or read that E_s propagation may occur at any time but that essentially it is a daylight phenomenon *peaking at or near midday.*

Our investigation showed clearly that there is considerably *more* 50 mhz E_s DX available *in late afternoon and evening hours* and *much less at or near midday* than theory suggests. Of the 808 band openings recorded during our research, more than 50% of the total occurred after 0000 GMT and 41.83% after 0100 GMT (Fig. 2). These are late afternoon and evening hours throughout the United States.

More openings were recorded between 0100 and 0400 GMT than in any other three-hour period of the monitored day. Daily monitoring periods during the study extended from 1400 to 0500 GMT (7 am to 10 pm MST). At times when the band was open or opening at 0500 monitoring was continued until it closed. The gap in our data for the month of April 1959 is due to moving the study site from Phoenix to Tucson, Arizona. The antenna tower and beam were being erected at the new site in April and no records were kept until the entire antenna installation exactly matched that at the former site.

A move like that—only 100 miles— makes little difference in DX results. But bear in mind that your general geographical location determines to some extent how much E_s DX you may expect. There is a relationship between latitude and E_s propagation. This is apparent in the southern states where six meter operators experience an abundance of year-round E_s openings. But those in northern states have the advantage of auroral openings, so things balance out fairly well regardless of where you live.

Here are 15 suggestions for catching more six meter DX than you may believe possible during a sunspot decline. They have worked for me; I'm sure they will for you:

1. A good, directional antenna is a must. Net forward gain of 8 to 10 db *after* transmission line loss deduction is essential. Use the best low-loss coax you can afford and keep your swr down. You need all the gain you can get.

2. Sensitive, well adjusted receiving equipment is much more important than transmitter power. Whether you use a straight 50 mhz receiver or converter makes no difference so long as the result is efficiency and good sensitivity. Transmitter power is secondary and there's little difference between AM and ssb although ssb buffs like to argue the point. CW is not widely used on six.

3. If, like most of us, your operating time is limited, try to concentrate as much of it as possible between the hours of 0100 and 0400 GMT. Next best bet is 1500 to 1700 GMT (Fig. 2).

4. If you haven't already done so, learn to tune, not talk. If you can't hear 'em, you can't work 'em. Local ragchews are fine but don't attempt to mix them with DX chasing. Much fine DX is missed this way.

5. Get a good *modern* book on vhf propagation and read it. Then reread it slowly and apply what you've learned. But keep an open mind; there's much yet to learn that isn't in the books.

6. If you are not doing it now, form the habit of monitoring WWV daily and make notes of the short-term propagation forecasts it broadcasts hourly at five-minute intervals. They don't apply directly to six meters but you will soon learn that disturbed conditions on the lower frequencies can mean DX on six at times. If you don't know how to read the WWV coded forecasts, write to the National Bureau of Standards, Boulder, Colorado, for information; it's free.

7. Be patient. Don't flip on your receiver, tune quickly across the band and, because you hear no DX coming in, assume the band is dead. A lot of DX is missed this way.

8. Look for E_s openings any time but particularly in summer months. They usually peak in June (**Table H**) and, on a smaller scale, again in December. South American stations are most frequently worked in spring and fall months. Bear in mind that six meter activity has increased substantially in the West Indies in recent years. Look for them when you hear southeastern states.

9. Check weather patterns and beam in directions where rapid weather changes are reported. And learn how to determine when atmospheric inversions are likely to occur in your area. Such knowledge often aids in working a tropo opening before the less-informed competition discovers it and clutters up the band.

10. In busy band openings, choose an operating frequency that takes you out of the heavy qrm. If you stick with the pack you may experience togetherness but it's unlikely that you will get your fair share of DX with low power.

11. When working an atmospheric duct don't waste time attempting to get into areas you can't hear. It's impossible unless some other form of propagation occurs simultaneously.

12. Replace your transmission line every two years. This is particularly important in industrial, desert and coastal areas. Regardless of quality, coax deterioriates in time. A line that does a fine job when new, may rob you of several precious db a few years later. And, check your antenna at least monthly. Wind, snow, ice, smog, birds and salt air do strange things to antennas.

13. Check all tubes in tube-equipped receivers, converters and transmitters every 60 days and retube throughout annually. Sell your replaced tubes to someone who prefers local ragchewing.

14. Never—*never*—get on frequency with a foreign station. Not only is this bad manners, but some foreign operators are so sensitive about it that they will leave the air if some thoughtless U.S. ham commits this cardinal sin. Try 10 or 15 khz away, if you must, but never zero beat foreign DX.

15. Maintain an accurate log and use GMT, which makes life easier for everybody, particularly so when comparing notes with foreign operators. Keep a record of propagation conditions and effects and report your long-term findings to one of the amateur radio journals. There's so much yet to learn about vhf propagation effects that any serious six meter operator who keeps accurate records may well make a significant contribution to scientific knowledge at any time.

Sunspots? Who needs 'em on six meters? There's plenty of solid DX ahead. Good hunting!

...K7ALE

The DX Desk

With this issue, 73 inaugurates this DX page. We do not go to press with any preconceived format; that will depend largely upon you. We will rely upon the comments and suggestions of those who are concerned enough to make the page a reflection of their own needs and wants.

There is no point in including DX items, expedition news, and the like. Our deadline is so far in advance of publication, that by the time you saw such items in print, they would be as cold as a landlord's heart. Moreover, it is not our intention to pre-empt the function of the many news sheets and bulletins in this field. These are readily available and do a splendid job. We urge you to subscribe to one or more of them. They deserve your support.

What, then, will be our function? Just a short while ago, in New York, Wayne and I discussed this. We came to some definite conclusions. We are convinced that there are several areas in which we DX'ers can play an important role. Of prime importance, however, is the job of bringing DX back to its position of former eminence. Many of us, concerned with the state of DX, due to highly regrettable events in the recent past, have lost our taste for the game, and are sour, more or less, on the whole idea. This feeling of indifference and cynicism must be replaced by confidence and a sense of enjoyment. DX is badly in need of a shot in the arm.

I think that what happened to DX was the inevitable result of our own attitudes. We permitted DX to become a dog-eat-dog rat race, and inevitably this resulted in a debacle. The end began to justify the means. Right and wrong ceased to have any meaning. Expediency, rather than ethics, motivated the quest for contacts. We began to overlook the sharp practices, cutting of corners, and outright dishonesties taking place all around us.

This is not to say that the competitive factors ought to be removed. Rivalry is a healthy part of all endeavors. Competition is very much a part of the world in which we live. But when a hobby assumes the characteristics of intrigue, conspiracy, and even blackmail and intimidation, then it is no longer a hobby; it is more like war! When hams resort to favoritism, granting preferential advantage to individuals and groups, the entire hobby suffers irreparable injury.

A spirit of scrupulous integrity and fair play must characterize every phase of Amateur Radio. We can only be considered as worthy and reliable as our most untrustworthy DX colleague. Unfortunately, we are judged collectively, not as individuals.

73's award, WTW, is being administered very carefully. Every entry is scrutinized as through a high-power lens. We do not intend to allow dishonesty to be rewarded, and will tolerate no hanky-panky. We and our validation affiliates are determined to maintain the highest level of integrity in this award. The penalty for cheating is absolute and irrevocable; disqualification without re-instatement.

We've always felt it was too bad that DX contacts are always so brief. A merely cursury exchange of signal reports, names and locations, followed by the usual QRU, vy 73-tks OM hpe CU agn CL dit dit; this seemed always to fall somewhat short. At this point in time, when nations are seeking ways to establish closer ties of friendship and understanding, DX could be a positive force toward building "bridges of peace" among the peoples of the world. It would be good to develop broader contact, deeper relationship on a personal level, whenever possible. Naturally, we do not mean to imply that an individual should tie up a rare DX station in an interminable rag chew when others are waiting to work him. But certainly we could expand our contacts to a certain degree, seeking ways in which to make friends through radio, rather than mere contacts. We actively solicit suggestions from readers, on this point. There must be many of you who have shared more than the tenuous type of momentary contact which, all too often takes place.

Many foreigners talk about "Ugly Americanism." If we can change the opinions of foreign hams with respect to this over-stressed image, we will be doing our country a great service. Never forget that overseas hams also have families and associates, with whom they discuss ham radio, just as we do. Many minds may be changed, many hearts may be reached. People respond to a spirit of respect and courtesy. And these qualities can be displayed effectively during a qso. Perhaps we hams can do a better job in this field than the diplomats and politicians; a sort of person-to-person program.

The very nature of the science of communications attracts many persons to Amateur

Radio. Non-hams are invariably intrigued with the idea of contacting others via wireless. But I have noticed that the more distant the contact, the more irresistable this attracting becomes. Many times, more often than I can recollect, guests in the shack, only mildly interested in stateside contacts, would become absolutely ecstatic at the sound of a VK, ZL or VR coming through the speaker. There seems to be tremendous incredulity attached to the miracle of overseas communication from one's own home. If we wish to improve the flagging growth rate of Amateur Radio, (and it needs improving,) we can contribute much by exposing more people to the intriguing world of DX. I have used one particular ploy quite successfully. First determining the land of origin of the forebears of my visitor, I would then endeavor, usually not unrewarded, to make contact with the country sought. At the first sound of the familiar tongue from the ancestral motherland one can sense the feeling of tension and excitement. I recall vividly one Hungarian fellow upon hearing an HA answer me with the phrase, "Budapest calling you," practically going berserk. He forced me to promise him right on the spot to help him become an amateur as quickly as possible! At this very writing, I am engaged in teaching code and theory to the young husband of one of my wife's friends. He is so set on getting his ticket that he calls me on the phone every day with questions that stump him; too eager to wait for our regularly scheduled get-togethers. And this came about as a direct result of a 4X4 contact.

How about arranging community DX demonstrations with organized groups: Boy Scouts, Lions, Kiwanis, Rotary Clubs, fraternal organizations, etc. These groups are always on the lookout for program ideas for their luncheons and social evenings. If we can set up portable stations for field days and other events, why not for DX demonstrations. A bit of extra effort on the antenna set-up, and it's a cinch! The potential is incalculable. We might win a bonus in the form of a new unwillingness to condemn us for every malfunctioning TV set, while gaining recruits at the same time. We can contribute a good deal toward the enhancement of ham standing in the community, merely by organizing such activity. Of course, someone might say, "What's this got to do with DX?" Well, whoever said that the only hams who can set up these affairs are traffic net people, or Civil Defense people? Why should not DX'ers do the same?

You have probably gathered that I feel strongly that the emphasis, which has always been on individual achievement, should be tempered with the spirit of group effort as well. You are correct in your assumption. DX has never quite reached that plateau of collective co-operation enjoyed by other phases of the hobby. I see no reason for DX enthusiasts to remain isolated from one another in the exercise of their chief interest. The reason that the other types of activity are so well thought of, is because they contribute toward the welfare of society. We must also find ways of doing this. Well, how may this be done? In point of fact, it is being done, and a lot more often than is generally known.

I can cite example after example. When earthquakes strike, and floods and epidemics, American DX'ers are always on top of the emergency, giving of themselves. I know a doctor ham who spent over 48 hours at his rig, running patches during a recent disaster in South America. The same ham has never failed to arrange for overseas shipments of medicines and serums when they were required. Yet, the newspaper coverage in these situations has been minimal, or non-existent altogether. If a kid jumps into a lake and saves a dog from drowning; if a hook and ladder company rescues a kitten from a tree, there's always a big hue and cry...picture feature stories, and all. But if a ham, through tremendous expense and eagerness to help, saves the lives of entire communities, or gets word through to the survivors of a disaster, you're lucky if you find it opposite the Lost and Found or the used car ads on page 29.

Why shouldn't DX clubs and individual DX'ers get the kind of publicity they deserve. Or is the Little League more important? Or the Garden Club? Or the local standings of the baton twirlers and tiddly wink team? We desperately need publicity so as to improve our public image. And through DX exploits, we can get it. We merely have to get on the ball and establish liaison with the media. How about it? Again, we want suggestions.

*

Now I come to the piece de resistance. I've left it for last, not because it's a delectable tidbit, but because it's a tough nut to crack, and demands serious thought.

The presently designated sub-band segments, and those slated to be added to the restrictions next November, while they may be well intentioned, are working special hardships on DX'ers, most particularly the CW operators. Because these sub-bands were positioned at the very lowest edge of the bands, it is very difficult to prevent the intrusion of commercials and other interlopers. The anticipated use of these segments has not approached the projected estimates. There is very little activity on these low ends, leading to some wide-open spaces which are very attractive to unauthorized operators. There does not appear to be any active move on the part of our League to request a change from FCC. It appears unlikely that any change can take place without the backing of the League. Since the portions in question are, in large part, the concern of DX'ers rather than others, I feel that we should carry the ball in seeking the changes. We can do this only by concerted action, through letters on both an individual and collective basis. We should request that the sub-bands be re-located well up within the central portions of the previously designated bands. I am not asking you to make "waves." I simply feel that an error in judgement has been made, and that an injustice has occurred as a result, and that we ought to try to do something about it by communicating with the League. I hope you will give this your attention.

*

Well, that's about it for this inaugural page. I hope some of it has been provocative. Please get in touch if you think of an idea which has merit. Remember, I told you that the page will reflect your needs and wants. I have no way of knowing what those needs are if you don't express them.

Next time we'll publish the current WTW standings, new certificates issued, and some pertinent data on the award. By the way, some of the fellows are getting so close to the 300 mark, I asked Wayne to have some certificates made up. We surely would like to see more activity on WTW 40 and 80 meters. The other three bands are getting all the action. How about it, people?

...K2AGZ

DX Quiz

The Numbers Game

OK, all you DX'ers, let's see how much you remember in the way of country names when faced with prefixes. Score five points for every correct answer. 300-country men should get 100% on this. 250-country ops should get 95%. 200-country beginners should get 90%. Here are the prefixes, you write in the country name. Spelling doesn't count.

1M4	7G1
1S9	7P8
3W8	8F4
4M	9A1
4Z	9F
5B4	9H1
5L2	9K3
5R8	9M2
5T	9X5
5U7	9Y4

The answers to the quiz are on page 117. Don't sneak a look until you've done your very best.

NEW BOOKS

Fairchild Catalog

The 1969 *Fairchild Semiconductor Discrete Device Condensed Catalog* is now available. This book contains a complete listing of Fairchild discrete devices, from diodes to FETs to power transistors.

Devices are listed numerically within specific categories enumerated in the table of contents. All are available from your Fairchild Distributors. The catalog contains a list of all the distributors who have these items on the shelf for immediate sale. It contains a numerical index as well as a break-down of the various devices.

Free from Fairchild Semiconductor, 313 Fairchild Drive, Mountain View, Calif. 94041.

New Semiconductor Handbook

Motorola has announced publication of the Semiconductor Power Circuits Handbook, containing the latest information in power circuit design. Prepared especially for users of power transistors, thyristors, rectifiers and zener diodes, this 264-page manual includes many designs being published for the first time. Some 150 new circuits have been specially designed, constructed and evaluated in Motorola's applications test laboratories to ensure design-improving performance.

The information-packed "how-to-do-it" handbook is divided into six chapters that cover the major application areas of interest to semiconductor power device users -- (1) motor speed controls, (2) inverters and converters, (3) regulators, (4) static switches, (5) audio and servo amplifiers, and (6) miscellaneous thyristor and transistor switch applications -- covering virtually every type of power application.

Approximately 270 illustrations complement the text, providing detail circuit illustrations and waveform diagrams. Complete bibliographies are also included for each chapter.

Copies may be obtained by sending check or money order for $2.00 per copy payable to Motorola Inc., at Box 20924, Phoenix, Arizona 85036.

What Am I Eating?

Can you guess the food from the list of the ingredients? "Contains water, coconut oil, non-fat dry milk, tapioca flour, lactic acid, mono and diglycerides, citric acid, locust bean gum, artificial flavor, quar gum, carrageenan, potasium sorbate and artificial color." What am I eating? See page 136.

Whipping "Two" Mobile

Alton E. Glazier, K6ZFV
3154 Jordan Road
Oakland, California 94602

The need for a better two-meter antenna for mobile use was the reason for trying both five-eighth and three-quarter whip base-loaded antennas. From the schematic, it will be noted that two antennas were tried out, one with a series coil, and the other with a grounded coil with a tap for impedance matching.

The parts required are:

1. Connector, of a type to be determined by individual need. However, in the grounded coil configuration, be sure to use a connector which makes a positive ground connection.
2. Plastic pill vial, size 1-1/8" O.D. and 2-3/4" long, which can be purchased at your local drug store.
3. #14 enamel wire
4. 3/8" dia. brass rod stock, 2" in length
5. 2 ounces of casting resin, catalyst (4 drops per ounce) and coloring if desired. Dye will give a transparent effect, pigment opaque. These items can be obtained from most hobby shops.
6. 1/8" diameter metal rod, 53" long, for series coil antenna.
7. 1/8" diameter metal rod, 48" long, for ground coil antenna (these rods are much longer than necessary).

Construction

Take the 3/8" diameter brass rod. From one end, drill a 1/8" diameter hole 1¼" deep. Measure 3/8" from this end, and at right angles to the previous hole, drill and tap for a 6/32" bolt. Measuring from the same end 1", drill and tap for a second 6/32" bolt. On the opposite end of the brass rod, drill a hole ¼" deep, just large enough for #14 diameter wire.

The series coil is wound on a ¼" diameter form, using #14 wire, 11 turns. The coil length is 1½". At one end of the coil, bend the #14 wire at a right angle, then clip off at 3/8". At the opposite end, bend #14 wire to a right angle, and clip at a distance of 1½". Scrape enamel off both ends. Solder the short end to the brass rod. Take the pill vial, and starting with a small drill, drill a hole in the center of the bottom. Slowly increase this diameter to 3/8", being careful not to crack the plastic.

Insert the brass rod with the coil attached into the open end of the pill vial and slip it through the 3/8" hole so the rod will protrude from the bottom of the vial for a distance of 1-3/8". Slip the coaxial fitting over the long end of the wire, and insert enough of the fittings so that it will be into the vial,

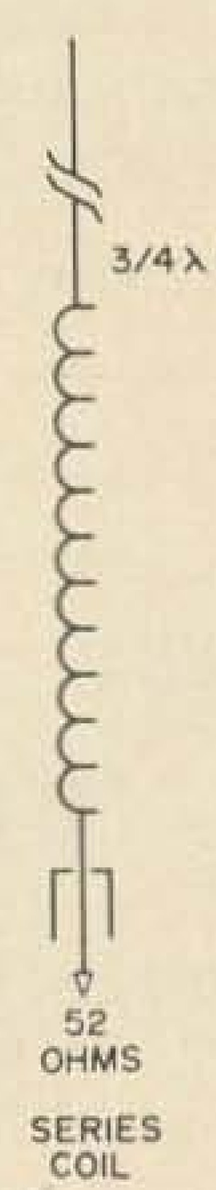


Fig. 1. Coil encapsulated in plastic pill vial.

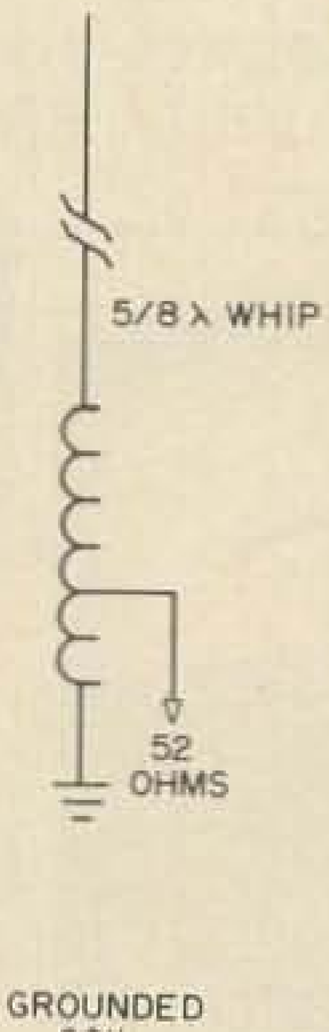


Fig. 2. Three quarter wave whip with series coil.

but be sure the connector will be clear to operate.

Now center the brass rod and keep it parallel with the plastic container and the coaxial fitting. Solder the long wire to the coaxial connector. Check once again to be sure the fitting, the plastic vial and brass rod are all vertically in line.

In order to keep the plastic from escaping, and to keep the brass rod in line, it may be helpful to use either putty or a fast-drying glue. With the vial upright (coaxial connector up) you are now ready to pour the casting resin. This container will require two ounces of casting resin and eight to ten drops of catalyst. If coloring is desired, mix either pigmented color or dye with the resin before adding the catalyst. See the manufacturers instructions for details on mixing. Carefully pour the resin into the vial, and let it stand for twenty-four hours.

The second antenna is made in very much the same manner, except the coil is wound on a 5/8" form. The total number of turns is six, and the spacing between turns is the width of the wire. The end opposite the brass rod is soldered to the outside material of the coaxial fitting. A piece of flexible #16 wire is brought up through the connector and is tapped to the coil two turns from the grounded end.

To prune these antennas to frequency, use a piece of expendable wire the same diameter as the final whip. Insert into the opening of the brass rod and secure with 6/32" bolts. Insert a standing wave bridge in the coaxial line, tune up the transmitter, and check the swr, which should be fairly high. Shut off transmitter and clip approximately ¼" from the top end of the antenna. Turn on transmitter, retune, and check swr. Keep using this procedure until swr is at minimum. After finding the proper length, remove the whip and use this measurement for the permanent antenna, which will be made of spring metal. For best results, be sure this pruning procedure is done at the permanent position of the antenna on the vehicle.

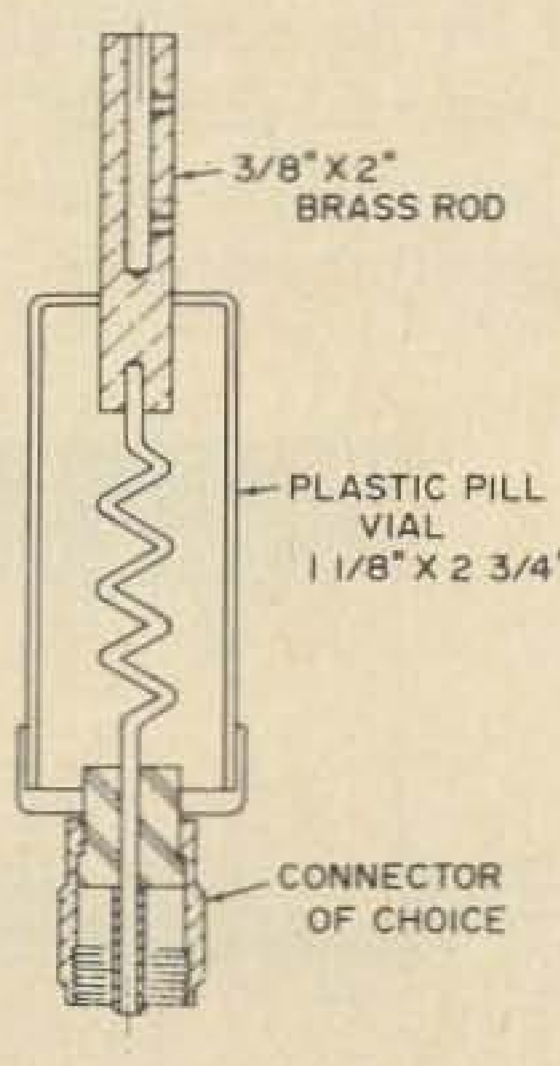


Fig. 3. Five eighths wave whip with grounded coil.

The tests were conducted over as flat a terrain as possible, trying to preclude the possibility of reflections. Three different test sites were used. The reference antenna was a quarter-wave 19" whip. All tests conducted showed the long antennas to give better signal strength and less mobile flutter both on transmit and receive.

It would appear that possibly the three-quarter wave antenna has a higher angle of radiation than the five-eighths wave antenna; however, not a sufficient number of tests were made for angle of radiation to be conclusive. It would also appear that there was no advantage in one method of coupling over another. The number of tests made was thirty. Although S-meter readings in most receivers are rather meaningless, they do give us a relative indication as to strength. The thirty tests made showed an average increase of over one S-unit. The standing wave ratio of the various antennas was as follows:

Quarter-wave, 1.3 to 1
Five-eighths wave, 1.1 to 1
Three-quarter wave length, 1.2 to 1

The antenna was located on the roof of a station wagon. The transceiver was an SR-42, and the standing wave bridges were a Mars and a Calrad.

Although it is never a good idea to encapsulate the antenna coil, in this case the inductance was so small that no apparent differences were noted between this type of construction and air-wound coils. It was apparent the mechanical advantages were well worth any slight degrading.

...K6ZFV

Design of UHF Tuners Using Silicon Transistors

Suleyman Sir
Communications Applications
Care of Fairchild Semiconductor
313 Fairchild Drive
Mountain View, California 94041

FIG. 1. PHOTOGRAPH OF THREE UHF TV TUNERS IN THE MARKET.

Since the 1964 FCC requirement that all television sets provide UHF reception, manufacturers have spent considerable time and money on the design and development of economical UHF tuners.

Size, performance, cost and reliability are the objectives in tuner design. The introduction of small screen portable sets has made the dimensions of the tuner a decisive factor in design. A miniature UHF tuner is attractive in that it may be used in all sets, but miniature units are not efficient in performance and are expensive to manufacture. A larger tuner, for example, 2.7" x 1.3" x 2.8" is more efficient, easy to manufacture, but often will not fit in small sets. The size problem is solved by manufacturing different size tuners, but this requires additional manufacturing lines and increases inventory cost.

Transistorized UHF TV tuners are superior to tube types because they can be manufactured in small sizes, are more efficient and stable, and do not require periodic maintenance while providing a longer life span. **Figs. 1a, b and c** show three sizes of UHF tuners presently in use. The first two can be used in small screen portable sets while the larger is suitable for console sets.

Description

The UHF TV tuner described here was built to demonstrate the capability of the new UHF oscillator device, SE3005, and to provide guide lines for its use in tuner design. After the basic size of the tuner is established the design problem would be to assure optimum performance, simple construction, reliability, low cost and ease of manufacturing. Fig. 2 shows the finished tuner. The two compartments on the left are double tuned passive *rf* pre-selector cavities, while the third, on the right, is the local oscillator cavity. The center section also houses the mixer diode and associated components.

RF Sections

The pre-selector *rf* cavities have capacitively tuned lines. The lines and the cavities are self resonant at 1,000 MHz. The lines are selected by an empirical method, mathematical analysis is difficult because the frequency of operation spans from the point where simple transmission line theory can

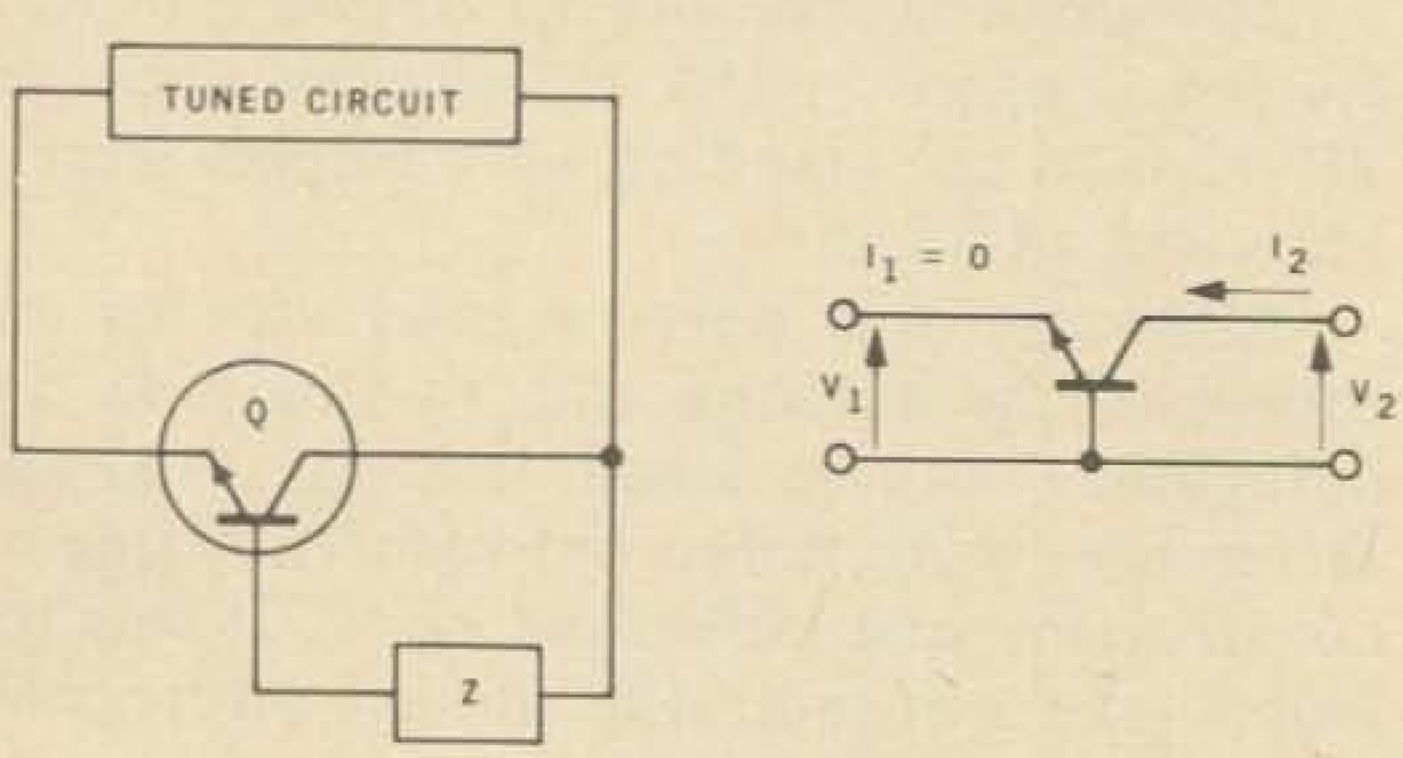


FIG. 1A. BASIC TRANSISTOR OSCILLATOR CIRCUIT.

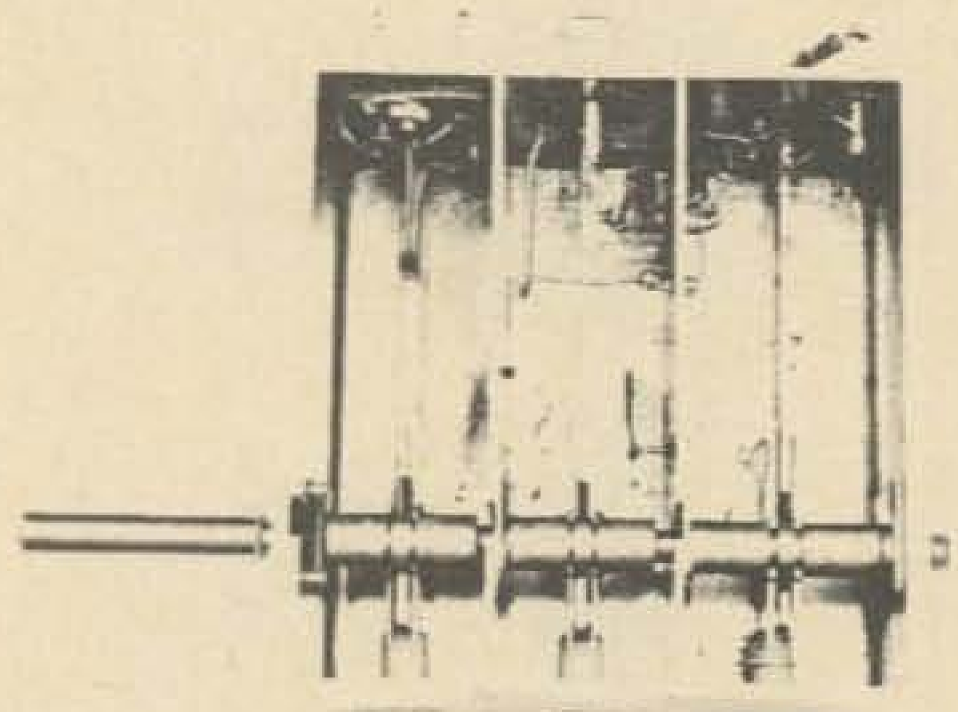


FIG. 2. PHOTOGRAPH OF TOP VIEW OF A UHF TUNER.

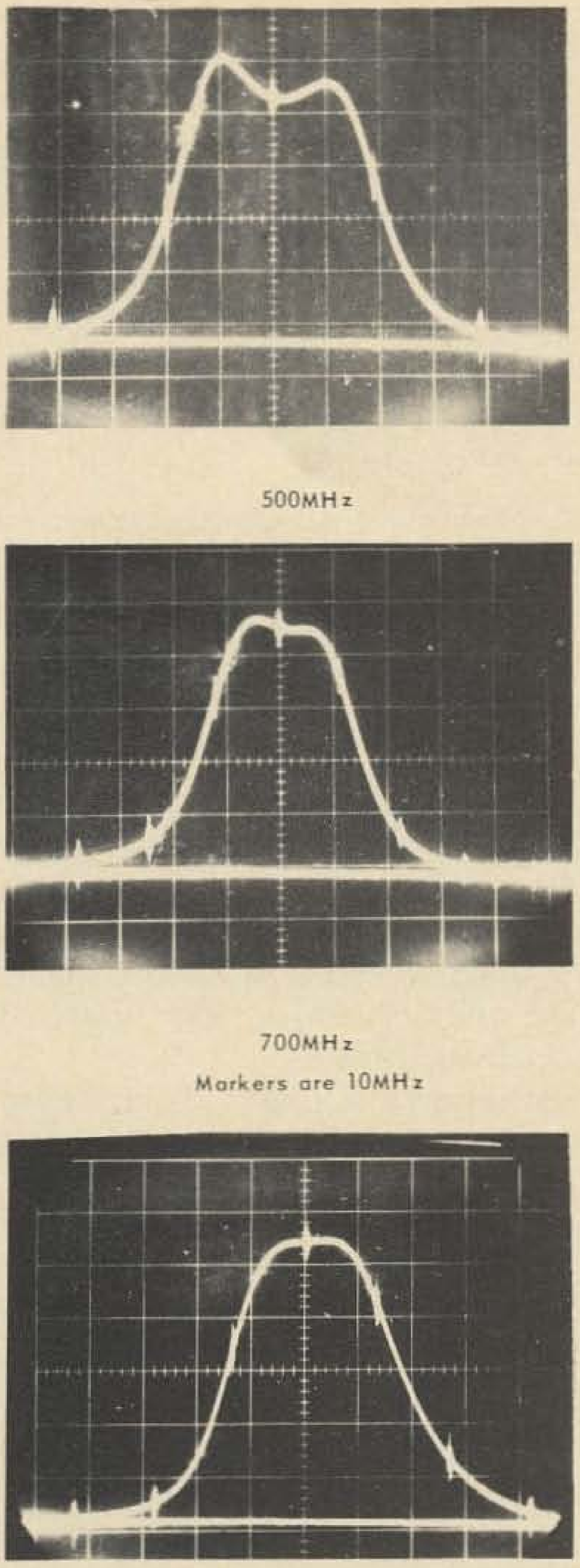


Fig. 3. Q_L of the tuner at three different frequencies.

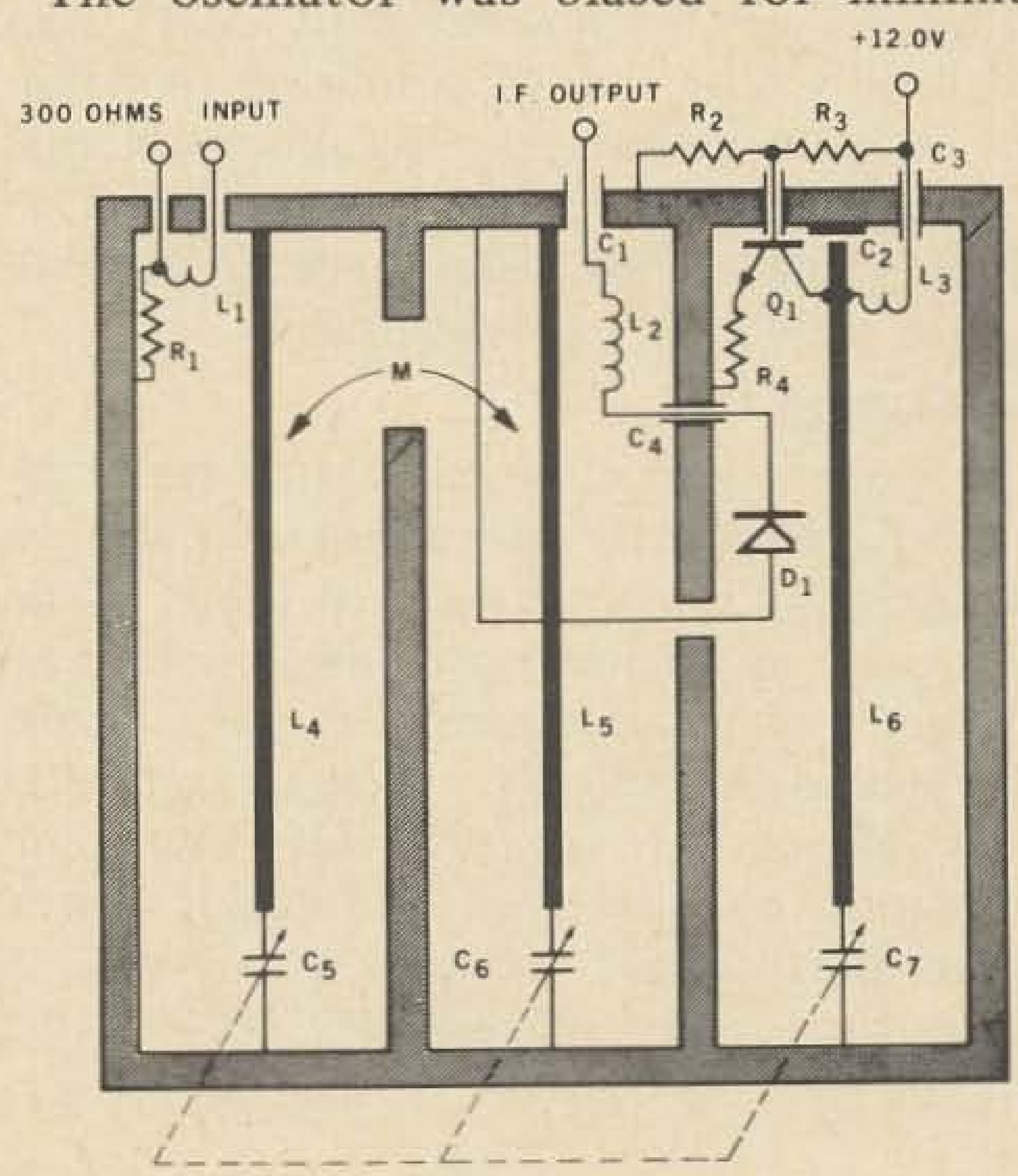
be applied (890 MHz) to frequencies where lumped inductance (470 MHz) is effective. The loaded Q_1 of the cavities are high at the high frequencies and lower at the low frequencies. The calculated unloaded Q_U of the cavities is about 1,500 at 470 MHz and 1,800 at 900 MHz. The Q is considerably lower at 470 MHz because the variable capacitor's sliding contacts acts as a signal path at this frequency. The bandpass response of the pre-selector cavities is shown in **Fig. 3** at the indicated frequencies. These cavities are coupled by a 1.3 x 1.8 cm window. The location and the dimensions of the window are determined by the bandwidth requirement and the location of the capacitor rotor shaft.

The 300-ohm input is inductively coupled to the cavities. The lines in *rf* sections are 2.4" x 0.4" x 0.05" silver plated brass. One end of each line is welded to the cavity wall, while the other is anchored with a ceramic stand-off. This method of mounting helps to prevent microphonics.

Oscillator Section

A common-base oscillator was used. The SE3005 has sufficient internal feedback capacity to sustain oscillation across the UHF TV band. Therefore, additional external feedback was not used. The schematic of the oscillator circuit is shown in **Fig. 4**. The transistor base was *rf* grounded through capacitor C_1. The collector tuning tank circuit consists of the transistor collector capacitance, line L_6, and variable air capacitance C_7. The transistor collector was shunted with capacitor C_2 for the desired frequency of oscillation and stability. Capacitor C_2 is a ceramic disc; one side of it was soldered to the cavity wall and line L_6 was soldered to the other side. Therefore, C_2 acts as support to one end of L_6 while the other end of L_6 was supported by a ceramic column. Tying down L_6 in this manner prevented the possibility of mechanical vibration.

The oscillator was biased for minimum



R_1 = 15M	C_4 = 50 pF. Tubular
R_2 = 3.3k	L_1 = Matching network for 300 Ohms
R_3 = 10k	L_2 = 5T, 0.15" ID. #24 Wire
R_4 = 330 Ohms	L_3 = 10T, 0.10" ID. #24 Wire
C_1 = 500 pF. Tubular	L_4, L_5, L_6 = See text
C_2 = 10 pF. NPO	Q_1 = SE3005 Fairchild
C_3 = 1000 pF. Tubular	D_1 = FH1100 Fairchild

FIG. 4. A TYPICAL UHF TV TUNER SCHEMATIC.

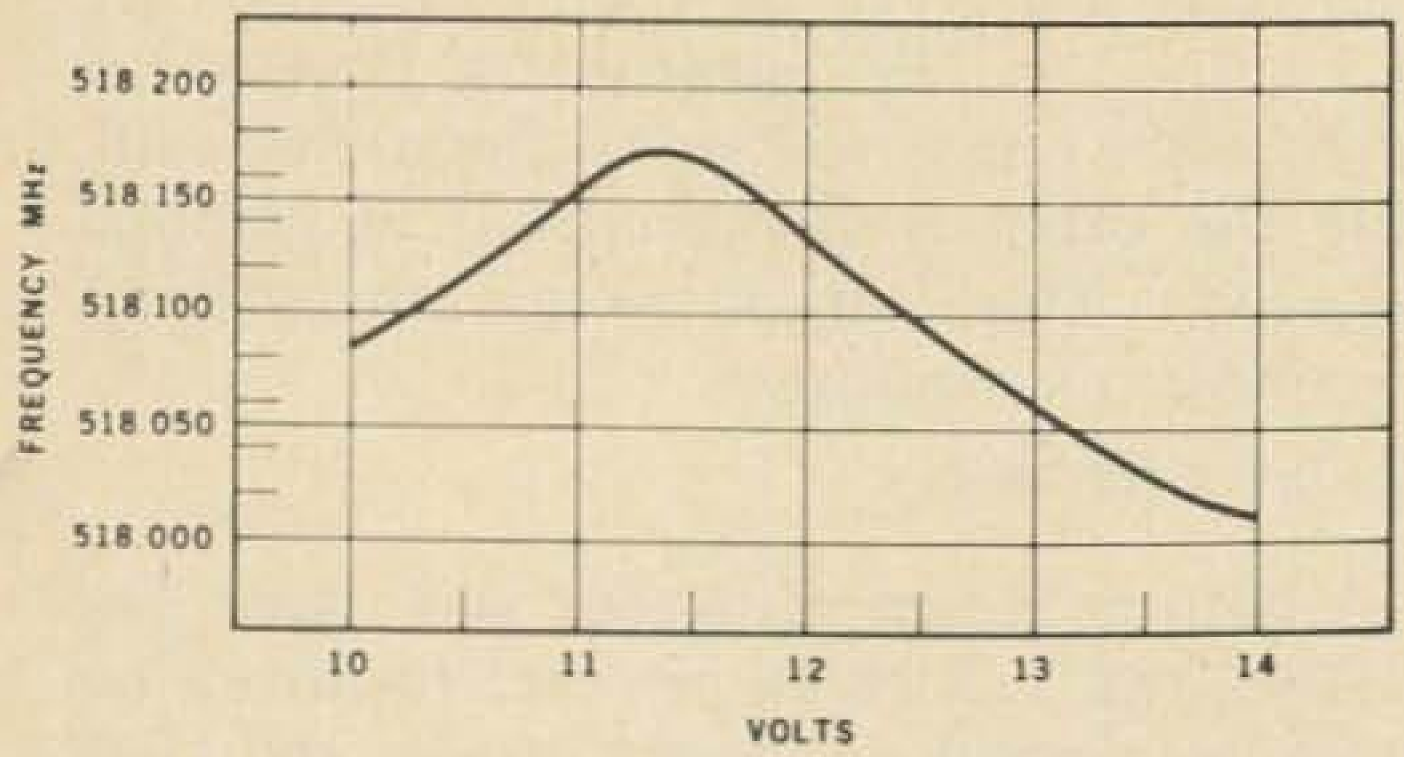


FIG. 5. FREQUENCY VARIATIONS WITH VOLTAGE.

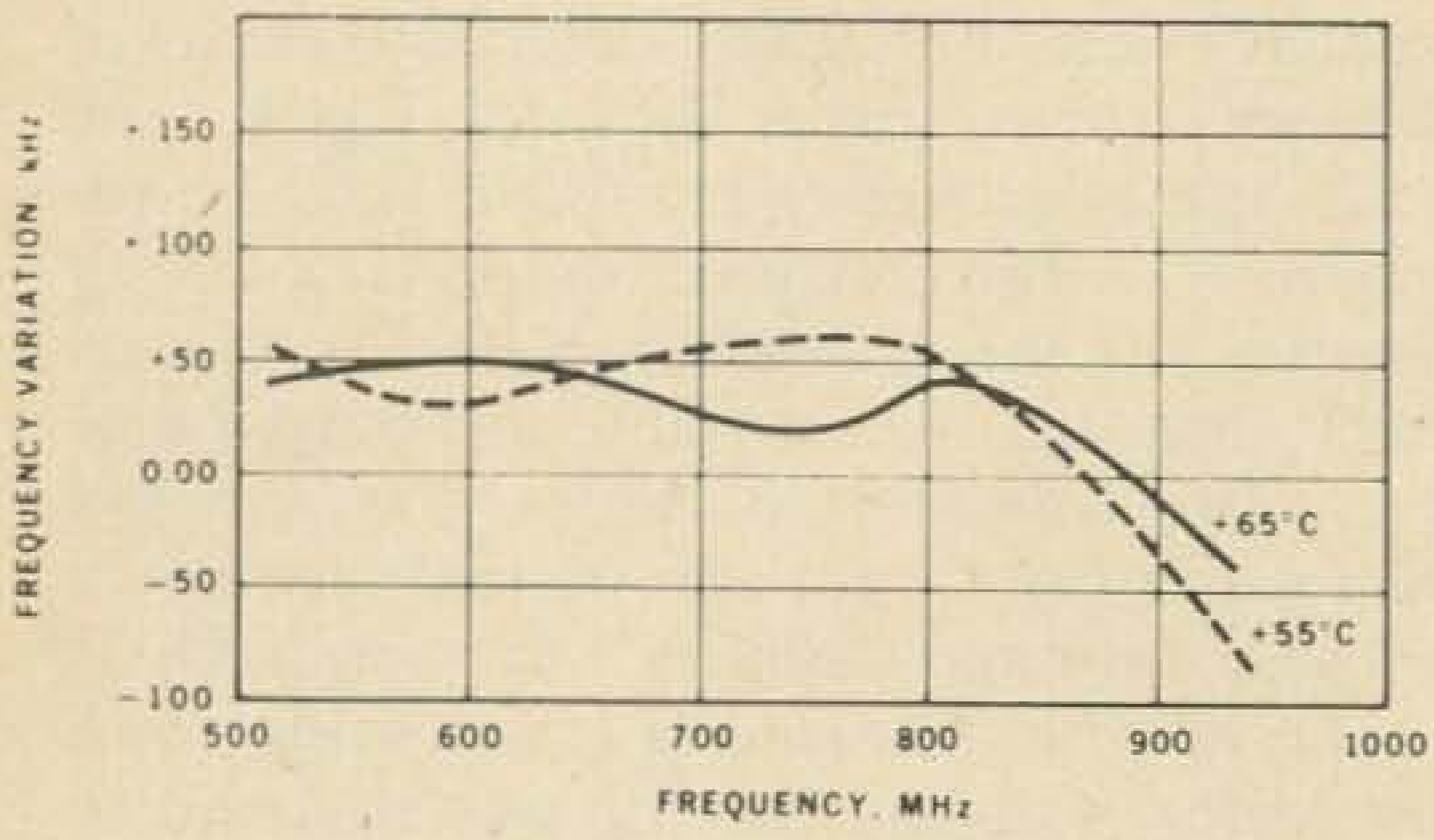


FIG. 6. FREQUENCY VARIATION WITH TEMPERATURE.

frequency drift. Fig. 5 shows frequency drift versus bias voltage while Fig. 6 shows the frequency stability with temperature change.

The oscillator cavity was built larger than the *rf* cavities for ease of soldering the transistor and its associated bias components. The transistor leads were kept as short as possible because long leads have an adverse effect on oscillator performance.

Mixer Section

The mixer section consists of a Hot Carrier Diode (FH1100), an inductance (L_2), a capacitor (C_4) and two pick-up loops. One loop is used in the local oscillator cavity and the other in the mixer cavity. The mixer cavity works as follows: The incoming *rf* and LO signals are coupled into the non-linear diode element; the LO signal forces the non-linear diode element to become a time-varying active network. Under this

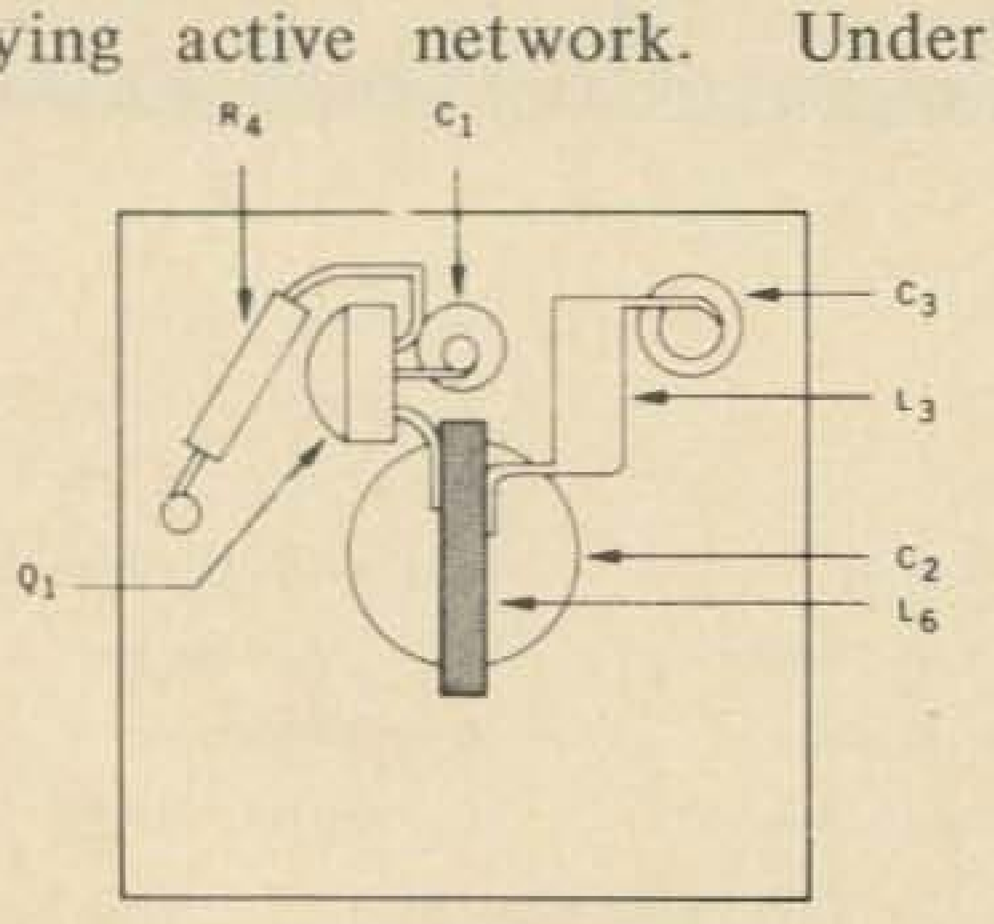


FIG. 7. COMPONENTS LAYOUT FOR OSCILLATOR.

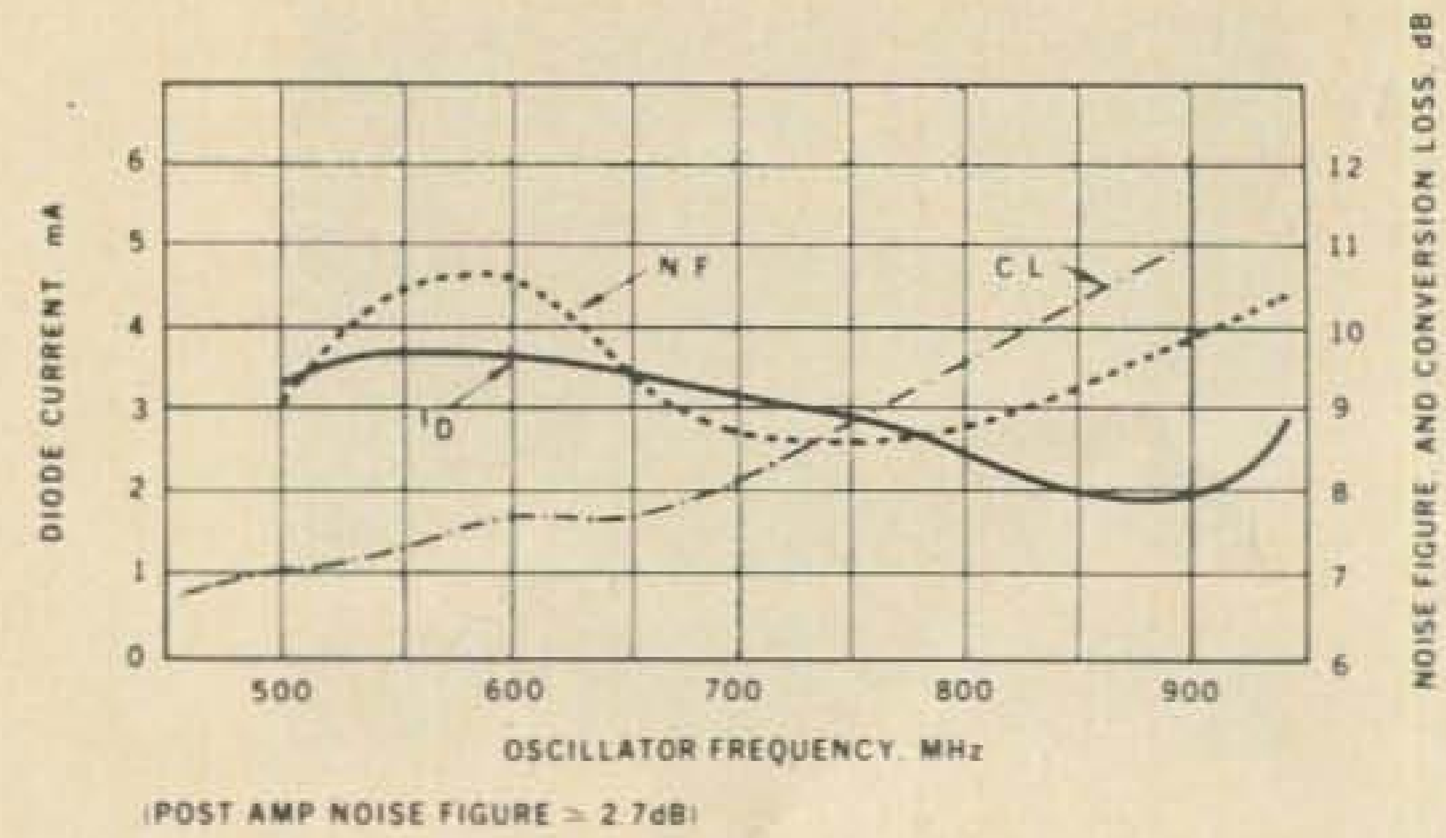


Fig. 8. Diode current, noise figure, and conversion loss of tuner.*

condition the diode generates harmonics; either the sum or the difference of LO and *rf* signals is extracted from the output of the mixer diode and is called the *if* signal. In UHF TV tuners, the LO signal frequency is above the *rf* signal. Until 1966 point contact diodes were used as mixer diodes in UHF TV tuners but Hot Carrier Diodes are seeing increased usage because of better reliability, better V-I characteristics, low noise figure amd low conversion loss.

The inductance L_2 and capacitance C_4 provide a low-pass filter for the *if* signal and provide a matching network between the diode output and the *if* amplifier. L_2 and C_4 are self resonant at 80 MHz for image suppression. The mixer diode current is adjusted by changing the size of the pick-up loop in the oscillator cavity. The magnitude of the diode current depends on loop area and its proximity to the line L_6. The location of the loop was chosen to prevent overloading the oscillator. Since the location of the loop would change the load reflected to the transistor, it could cause the oscillator to stop. Fig. 8 shows the diode current, noise figure and conversion loss variations across the UHF TV band for one diode loop setting. A smooth current output is desired since excessive variations impair overall reception. Forward biasing the mixer diode will affect the noise figure and output current; however, an optimum bias setting is difficult to establish because the oscillator output is not constant across the UHF band.

Conclusion

The tuner described here performs with an output that was not appreciably affected by variations in transistor parameters. Since mass production was not the aim, life expectancy or durability of the cavity under use was not analyzed.

Adjusting FM Deviation

The proper adjustment of the deviation control is important for good FM communications. If it is too low, the audio at the receiver is also low. If it is too high the over-deviation will bring you reports that though your signal is strong, it breaks up when you talk.

Test instruments for measuring transmitter deviation cost upwards of $250. There is, fortunately, a shortcut method for deviation measurement using just an FM receiver and an ac voltmeter (or oscilloscope).

To adjust deviation using this method you must use a receiver with the appropriate bandwidth. The economy priced monitor receivers are of no use here. If you want to use a narrow band $\pm$ 5 khz system, you must use a receiver with this bandwidth. If your system contains both wide and narrow band units, adjust all transmitters for narrow band operation. This will cause slightly reduced audio in the wide band receivers, but will provide much better overall performance.

Most commercial units such as Motorola, GE, etc., have power supplies which will allow the transmitter and receiver to be used simultaneously for short periods of time. Refer to the schematic to see how this can be accomplished. In this way you can use your receiver to check the deviation of your associated transmitter.

Connect the ac voltmeter or scope across the speaker terminals. Substitute a five watt resistor for the speaker if you can't stand the noise. Apply a 1 kHz tone to the transmitter or whistle steadily into the mike if an audio oscillator is not available. Slowly advance the deviation control from its lowest position (with the transmitter turned on) and watch the ac meter.

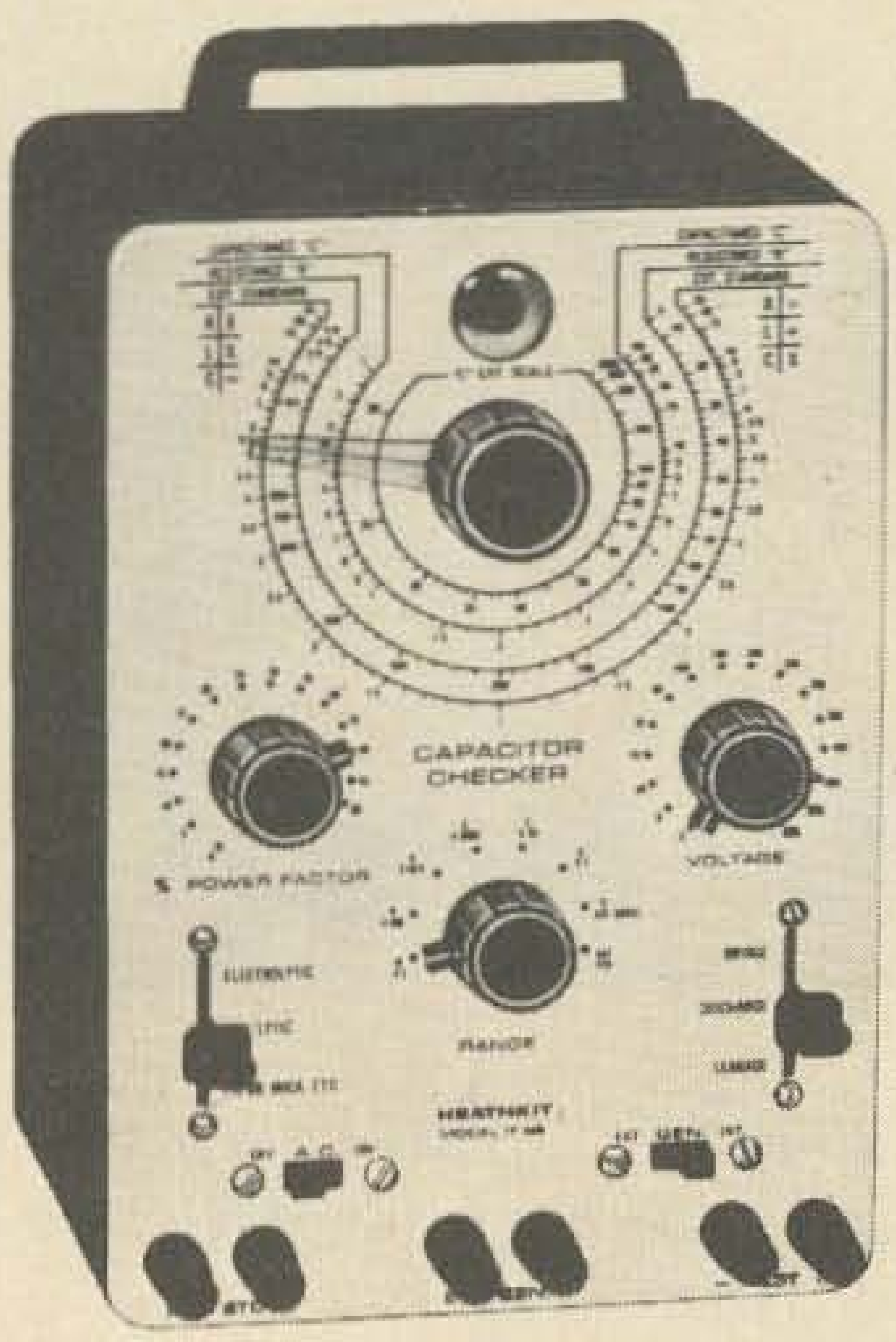
As you increase the deviation you'll see a fairly linear increase in the receiver audio level, followed by a flattening out, and then, as you go outside the passband of the receiver, the audio level will fall off and the noise level will increase. This is just what happens when an over-deviated signal is received by another FM mobile.

Repeat the adjustment several times, paying particular attention to the point at which the linear rise just starts to flatten. This is the point at which the deviation control is properly set.

I've used this system to set deviation on many occasions and have been amazed at its accuracy when compared against properly calibrated instruments.

Review of Heathkit IT-28 Capacitor Checker

Eugene Fleming, WØHMK
328 Gunnison Avenue
Grand Junction, Colorado 81501



A careful scanning of most of the electronics magazines from the early '50s to the present has brought to light some interesting capacitor checker circuits, but none of the construction articles on these instruments boasted a range from picofarads to hundreds of microfarads.[1,2] This is the range encountered by even a casual builder.

Examination of the specs. of commercially available capacitor checkers revealed that most of them do not cover the wide range of values needed by the experimenter and builder. The one that is satisfactory has a price tag that disqualifies it.

When the announcement of the revised Heathkit Capacitor Checker IT-28 recently appeared, I immediately began to devise means to get the XYL out of the house long enough for me to pick the lock on the piggy bank.

Manual

An outstanding feature of the kit is the three page circuit description included in the construction manual. Simplified schematics are used to clarify the theory of operation. Any ham with elementary knowledge of test instrument circuits will find these pages enlightening reading even if he has no intention of building the tester.

In addition to the standard Heathkit step by step instruction and pictorials, there is an easy to read two page schematic of the instrument at the back of the manual. Included on the schematic are operating voltages expected at the tube sockets, which are indispensable for trouble shooting.

Circuit

The big surprise came when the power supply schematic was examined. The half wave vacuum tube rectifier is unusual for new equipment in this time of semiconductors. A little reflection indicates that there is about 1500 PIV in the circuit, which inexpensive diodes do not handle.

The heart of the IT-28 is the bridge circuit, which uses the 6E5 "eye tube" as an amplifier and null indicator. Three resistance and three capacitance standards are included in the instrument. Driving voltage for the bridge is provided by a transformer which supplies 60 Hz ac. Provision is made for use of external driving voltage of up to 10 kHz. There is also provision for connection of standard resistance, capacitance, or inductance for comparison with a component of unknown value connected to the "Test" posts.

Construction

Construction time for a nearsighted, butterfingered technician was approximately 9 hours.

Wiring is greatly simplified by a ready-made harness that already has the insulation stripped from the ends of the wires. Components are uncrowded for the most part.

Most of the electronic components are mounted on a conventional chassis using tube sockets and terminal strips. Controls are bolted to the front panel. A sizable portion of the construction time is consumed in the interconnection of the panel and chassis.

The hardest part of the whole operation is mounting the line cord strain relief insulator.

Even the beginner should have little difficulty getting this instrument to operate, for construction is straightforward.

Operation

With 8 front panel controls, this instrument might at first glance appear a complicated knob twirler's delight. It does not turn out to be nearly as complicated as it looks. Care is required to be sure the range, bridge-leakage, type, and power factor controls are properly set before beginning to try to get the eye tube to open.

Anyone with vtvm available will find resistance measurement easier with it than use of resistance ranges on the IT-28, even though these ranges are quite usable. The 200 ohm, 1% resistor included for calibration of the instrument also comes in handy for calibrating the vtvm.

The capacitance ranges are a real delight to those who salvage parts from defunct equipment, but who do not want the "junk box" cluttered with components in doubtful condition. These ranges will serve the builder or repairman well as a tool in positively indicating a capacitor's condition.

For best results in checking capacitors of a few tens of pf, it is best to use an external generator connected to the posts supplied for the purpose. A check indicated the frequency of the external signal is not as important as the ability of the generator to supply adequate voltage to the low impedance of the input. A 1000 Hz tone taken from the 16 ohm output of an amplifier running at high gain made the null much sharper than did the internal 60 Hz. It was possible to measure capacitance of a pair of twisted wires.

The "Mini-lytic" function of the "Type" switch will be most useful to those who work with transistor circuits. Who doesn't, these days?

The "Electrolytic" function also provides a test of "power factor" of the capacitor. "Power factor" is the cosine of the angle by which the applied current leads the voltage in a capacitor. Use of a capacitor with a high power factor can seriously degrade the performance of filter, bypass, or coupling circuits.[3]

The "Leakage" position of the "Bridge-Leakage" switch will test quickly the condition of all three types of capacitors, with differences in type taken care of by proper setting of the "Type" switch.

Since the instructions specify that the upper operating frequency of the IT-28 is 10 kHz, it is inconceivable that the comparator range is useful for checking any inductance other than those used at audio frequencies. If much work using this range is anticipated, precision inductances of 1 henry and 100 milahenries should be acquired. Turns ratios of those old transformers cluttering up the "junk box" can also be determined.

Conclusion

For the ham builder who has a vom or vtvm, a grid dip meter and access (maybe at the corner drug) to a tube checker, the IT-28 is recommended highly as the next piece of test equipment.

...WØHMK

References:

1 R.L. Waters. "Direct Reading Capacitance Meter," *Radio-Electronics;* Vol. XXXIV, No. 8 (Aug., 1963), pp. 32-33.

2 Eugene Fleming, "Electrolytic Saver," 73; Nov., 1964, pp. 31-32.

3 H.P. Manly, "Power Factor...What It Means," *Radio-Electronics;* Vol. XXVIII, No. 7, p. 82 ff. (Aug., 1963).

Specifications:

Test Circuit

AC bridge powered from internal 60 hz or external source.

Ranges:

Capacitance–10 picofarad to 1000 microfarad in 4 overlapping ranges, one range for comparison with external standard.

Resistance–5 ohms to 50 megohms in 3 ranges. One range for comparison with external standard.

Inductance–One range for comparison with external standard only.

Power requirements

115 or 230 (nominal) volts ac 50/60 hz. 30 watts.

Internal power supply

Half-wave rectifier.

Tube complement

6E5, 6AX4, 6BN8.

Controls

Bridge balance, power factor, test voltage, range switch, type switch, bridge-discharge-leakage switch, on-off, int.-ext. bridge power.

Size

9-5/8"x6-5/8"x5"

Weight

5 pounds.

How to Convert Your Receiver for 6 Meter Reception Without Really Trying

...a chapter in the life of a 75A2...a story that asks the question, "Will Collins recognize this receiver after he's done with it?"

Robert L. Grenell, ex W8RHR
3926 Beech Street
Cincinnati, Ohio 45227

Those of you who are fortunate enough to have a 75A2 have undoubtedly been waiting with bated breath for someone to write an article on a six meter conversion. This is your lucky day, because you can now resume normal breathing. You can also prepare to dig into the innards of your receiver.

One feature I particularly wanted to incorporate in my revision of the 75A-2 was the convenience of internal capability for 6-meter coverage. The 75A-2, being a double conversion receiver with a crystal-controlled first oscillator, lends itself to this treatment very nicely, since the front end is really a multi-band crystal-controlled converter. I even had an extra bandswitch position to play with, since it originally covered the lamented 11 meter-band, tuning 26 to 28 MHz. In order to keep the bands in ascending order, I decided to convert the 11-meter band to 10, and 10 meters to 6. The first step entailed only plugging the 10-meter crystal into the 11-meter socket and repeaking the coils. Nothing much to that.

Now, the fun began. First, there were a number of decisions to make and considerations to be met. The *rf* stage uses a 6AK5. Let's face it-6DC6's, 6BZ6's and 6GM6's notwithstanding, you can't find a better tube than the 6AK5 for low noise, high gain, and efficient performance over a wide frequency range. Futhermore, we're talking about 6-meters, where atmospheric and thermal noise are the limiting factor. Only in cases of the grossest misdesign or bad tube choice will the front end noise ever be a serious problem. The 6AK5 is still in excellent shape at 50 MHz. So, I decided to leave the *rf* stage alone-except for the coils. The 6AK5 is just out of vogue, but it's far from outmoded. Obviously, the noisy 6BE6 mixer would have to go, but first I wanted to get things perking on 6 so I could try some substitution tests. I was not particularly impressed with the

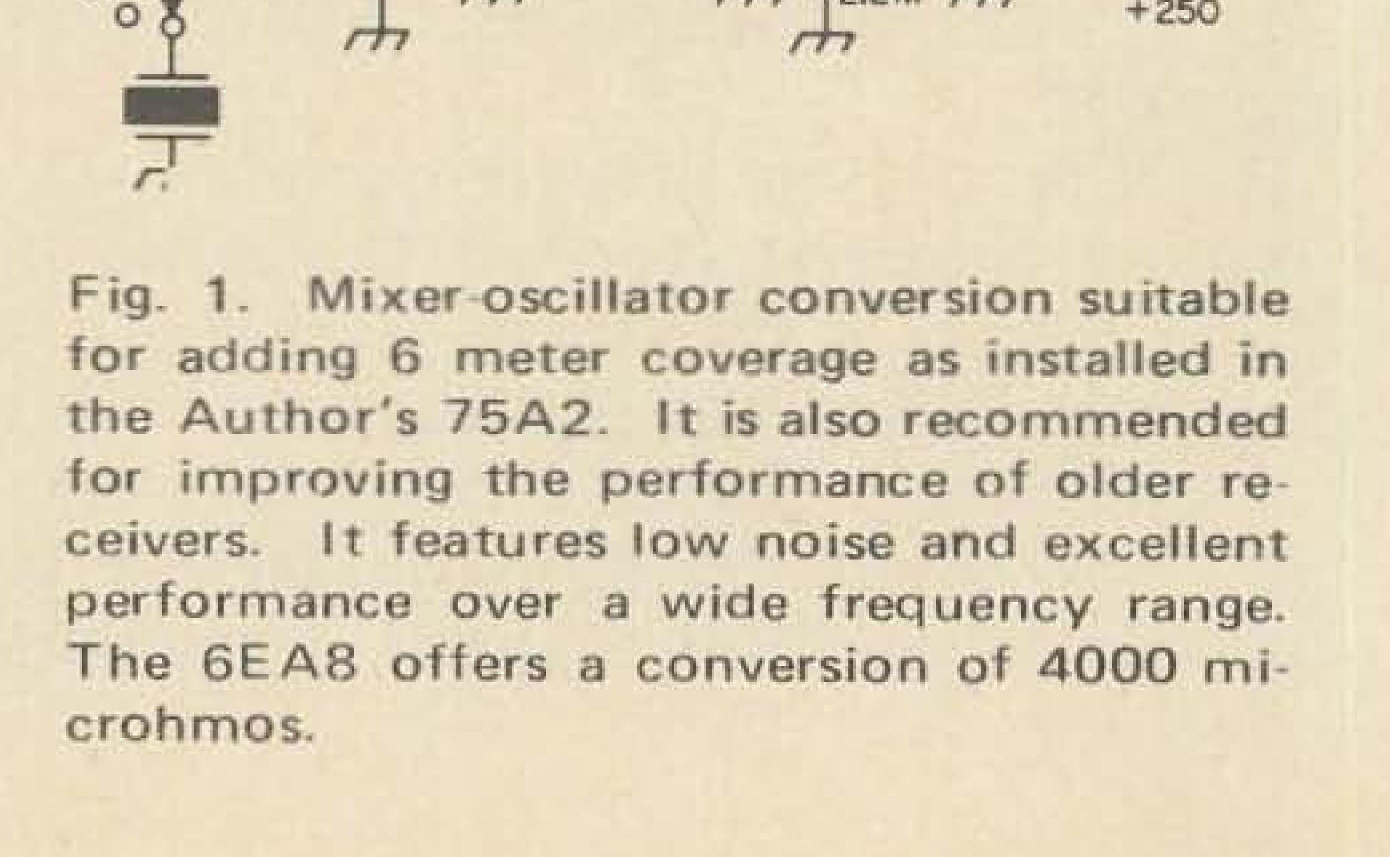


Fig. 1. Mixer-oscillator conversion suitable for adding 6 meter coverage as installed in the Author's 75A2. It is also recommended for improving the performance of older receivers. It features low noise and excellent performance over a wide frequency range. The 6EA8 offers a conversion of 4000 microhmos.

range of tubes which I could try in this application, but, as you will see, circumstances forced me to an excellent choice.

I now began to physically attack the receiver. The 10-meter coils were pulled, rewound for 6, reinstalled, and peaked with a grid-dipper. I plugged in a 55.455 MHz overtone crystal. Nothing happened. It wouldn't oscillate. It seems that the Collins 12AT7 multivibrator oscillator circuit required more crystal drive than I could get at that frequency. Major surgery was called for. Now I had to redesign the oscillator as well as the mixer. However, the problem of choosing a mixer was solved. A quick survey of the tube manuals, literature on new equipment, and back issues of 73 revealed that my best choice would be the 6EA8, a triode-pentode mixer-oscillator closely related to the 6U8. This nifty little bottle is designed for VHF television applications, and provides a conversion transconductance of 4000 micromhos compared to only 475 for the 6BE6—which is a noise generator above 20 MHz. It has excellent noise characteristics, and I felt sure that 6-meter performance would be good, and 10-meter performance much improved.

Everything was stripped from the 12AT7 and 6BE6 sockets. The mixer-oscillator circuit shown in Fig. 1 was built up using the 9-pin socket. The only other change necessary was to reduce the value of the VR tube dropping resistor from 2500 to 2000 ohms. I plugged in the 6EA8 and peaked up the oscillator coil. It took off at once. I realigned the whole front end and started listening. Results were beautiful. Without the masking noise of the 6BE6 I discovered how noisy my location is! The extra gain and low noise characteristics of the 6EA8 really shine on 10 and 15. Signals average 6 to 8 db farther out of the noise than before the conversion. On the lower bands, there's little difference, predictably, except during opening and closing on 20, when the low noise factor and extra gain help greatly. Performance on 6 is excellent. The noise figure is slightly better than that of the familiar Handbook converter using 3 6CW4's! If that seems hard to believe, remember that a converter running into a receiver is subject to matching problems, and that every stage means that more noise is generated in the receiving system. The use of converters as we are accustomed to them is convenient and economical...but it's certainly not optimum!

Six-meter ground-wave reception is solid for a 100 mile radius, and I regularly hear stations in Michigan, Tennessee, Pennsylvania, and West Virginia—as well as the expected Kentucky and Indiana. Although I don't have the equipment necessary to make a good evaluation, receiver noise is well below thermal and atmospheric noise. I hear everything anyone else in the area hears, and more than some. Birdies are not evident, another advantage of an internal arrangement over a converter set-up. The conversion was completed by making the appropriate changes in MHz dial calibration and the band switch index. A conversion of this type is easy and suitable for any receiver having a crystal controlled front end. Even if you don't have an extra band (like 11 meters) to play with, you can add a position on your bandswitch, if you're the ambitious type.

The whole thing goes together easily, is uncritical, and stable. It's nice to be able to flick up to 6 without having to wade through the usual rat's nest of wires, and there's absolutely no compromise between convenience and performance—both are improved! The only thing I don't like is that empty socket that used to hold the 6BE6 mixer. It just sits there begging to be used. Let's see now... what could we put in there...?

...W8RHR

Monitor 2

Alton E. Glazier, K6ZFV
3154 Jordan Road
Oakland, California 94602

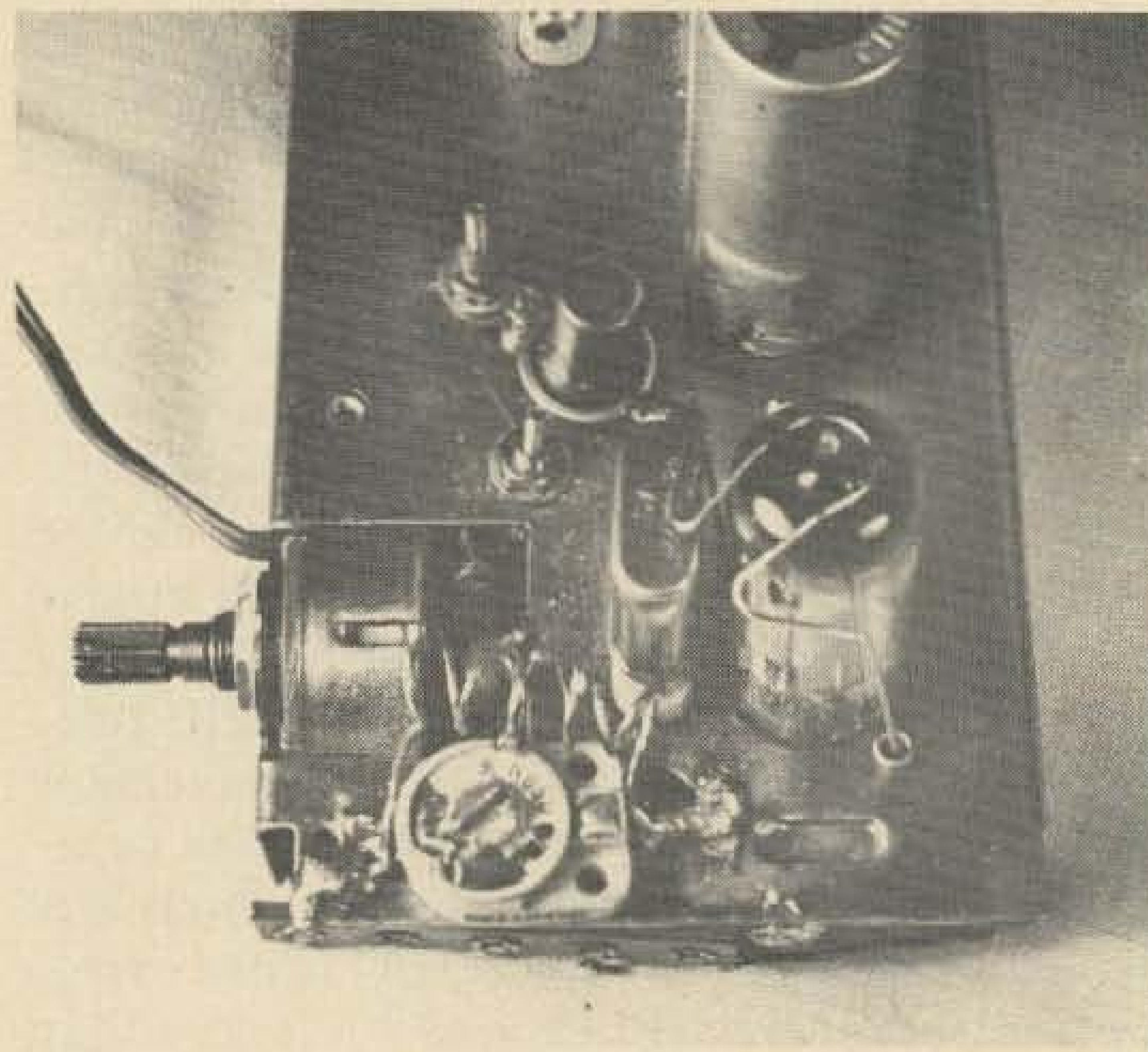
The need for Monitor 2 arose from the many hams who want to monitor two meter repeaters while still leaving their main equipment free, and possibly is an answer to 24-hour-a-day emergency listening. It was decided to make the project as easy as possible, with high reliability and low cost.

The basic receiver is the old standby, the five-tube ac/dc broadcast radio (12BE6, 12BA6, 12AV6, 50C5 and 35W4), purchased from most catalog houses or drug stores for about $10. Most of these imports are hand wired, and this is recommended for ease of conversion.

The major change is at the converter (12BE6). The *if*, second detector, and audio stages are left as is. Remove the variable capacitor, antenna coil and oscillator coil. This will give you the space needed for the crystal oscillator tube and components. The oscillator is the one described by Frank Jones, W6AJF ("The Overtone Harmonic Crystal Oscillator," *CQ Magazine*, February, 1963). This is an excellent circuit, and makes possible this simple conversion.

Remove everything from pins 1, 2, 6 and 7 from the 12BE6. Bypass filament pins 3 and 4 to ground with a .002 capacitor. Mount L-2, C-2 as close to socket as possible. One side of L-2, C-2 connects to pin 7. The other ends of L-2, C-2 connect to ground. Connect a 27 K ¼ watt resistor and a 4.7 pf capacitor from pin 1 to ground. Dress this resistor close to the chassis. This completes the mixer conversion.

The oscillator uses a 6CW4. Although the filament current is slightly different from the rest of the tubes, no harmful effects have been noted. Trace the filament series string and find that filament lead which goes to ground. This will vary according to the manufacturer. Remove from ground, and install a choke made up of ten turns of hookup wire 1/16" in diameter. From the previous filament, connect to pin #12 of Nuvistor socket. Also bypass to ground with a .002 capacitor. Ground pin #10. This completes the filaments. From pin #8, connect a 4uh choke and a 10 pf capacitor. Ground the opposite ends. From pin #4, install a



The Monitor 2.

100K ¼-watt resistor, also a lead to crystal socket. The opposite end of resistor and crystal socket go to ground. From pin #2 connect a lead to top of L3 and C3. Also connect lead of 4.7 pf capacitor. The opposite end goes to pin #1 of 6BE6. At the bottom of coil L3 and C3, bypass to ground with a .002. Also connect a 4700 ohm resistor. The opposite end of resistor goes to nearest B-plus lead. This completes the oscillator circuit.

For those who live within line of sight of the repeater, this simple mixer-oscillator should provide enough sensitivity. For an antenna, connect a piece of insulated wire from the top of L-2, C-2 to back of receiver, then to a wire rod. Because the receiver is hot to ground, be sure to use insulated sleeving over antenna. The connecting wire and rod should measure 38" overall. It is interesting to note that this directly coupled antenna outperformed any attempt to use an outside ground plane.

For those not in line of sight of the repeater, the following *rf* amplifier is very worth while. The *rf* amplifier is quite straightforward. Just be sure antenna coil is shielded from the mixer coil or at least at right angles. The transistor was taken from the *rf* section of a junked RCA FM receiver. Most PNP vhf transistors should work quite

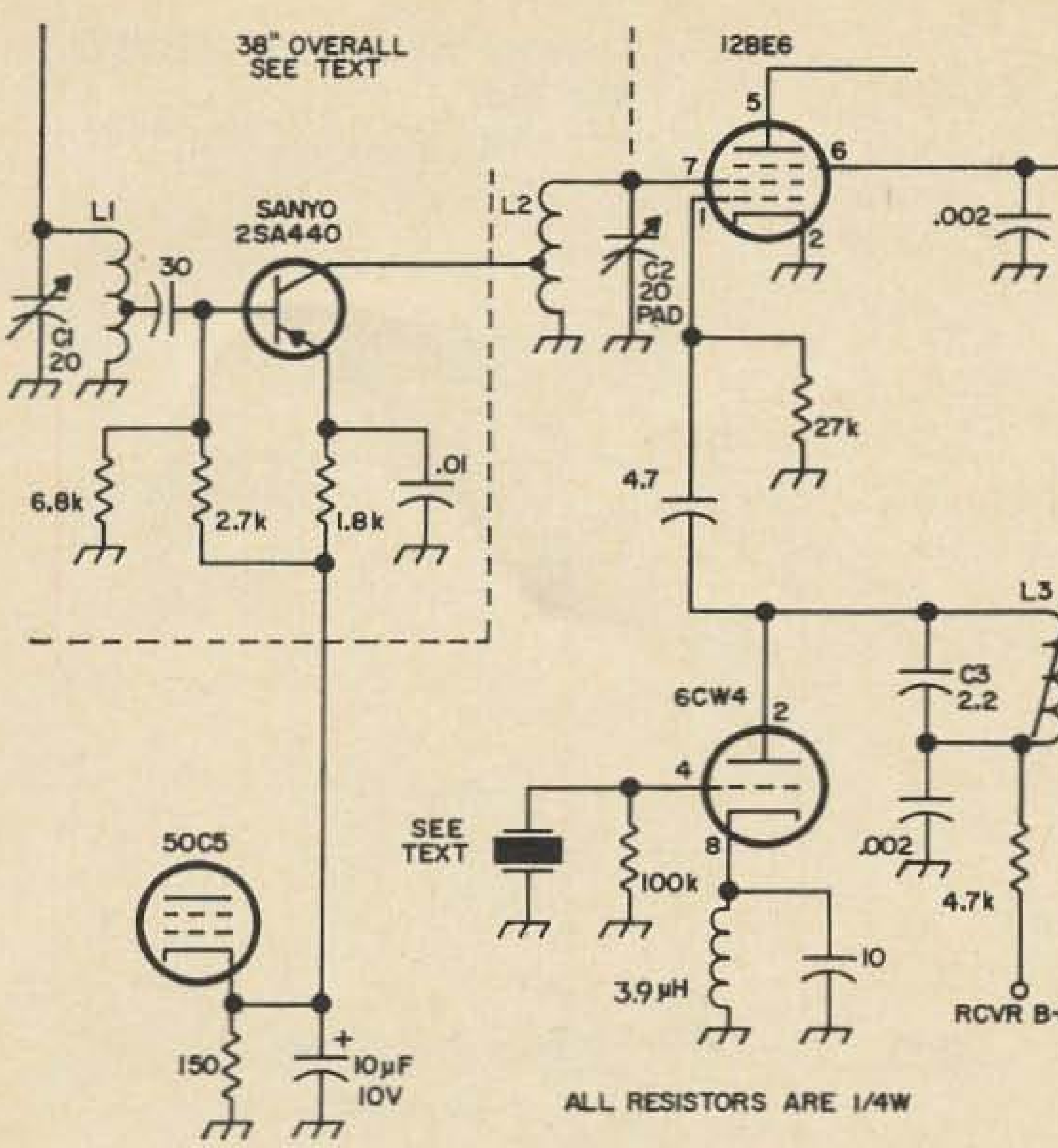


Fig. 1. Complete diagram for Monitor 2.

L1—5T, ¼" diameter, 3/4" long, airwound center tap.
L2—3T, ¼" diameter, 3/4" long, airwound center tap.
L3—4T, ¼" diameter, ¼" long, Miller #4300.
L4—3.9 uh choke.

well, and perhaps a FET would be better. The power for the *rf* amplifier is taken from pin #1 (cathode) of the 50C5. Be sure to use a cathode bypass capacitor if it is not already present. Ten to twenty-five mf, ten volt.

The crystal is a third overtone, and is lower in frequency than the receive signal. The reason for this is that the receive signal that I wanted to monitor was at 145.100 mhz. Due to the fact the *if* frequency is 455 hkz, this puts the image on the lower end of the two-meter band. In one month of monitoring, no image signal has been heard; however, if the receiver is to be used in the upper end of the band, perhaps the crystal frequency would be better on the high side. This will depend on the activity in your area.

As to the crystal frequency, after it has been multiplied three times, it must be 455 khz different than the receive signal or thereabouts. If a surplus crystal is found near enough in frequency, the *if* transformers can be shifted to allow for some difference, for 455 khz is the design center of the *if* transformer, and it can be moved up or down in frequency. For example, in the author's receiver, the crystal used (surplus) is marked "48.222 MC." After being multiplied, it gives a frequency of 144.666 mhz. The frequency of the monitored repeater is 145.100 mhz; therefore, the *if* frequency is 433 khz. The *if* transformer has been shifted 22 khz.

Tuneup

First adjust L-3 in or out until oscillator oscillates. This can be determined by your regular receiver tuned to the multiplied oscillator frequency. Then check for repeater activity. If on, tune first *if* until repeater is heard, then peak for maximum, then the same for second *if* transformer, then peak C-2 for maximum and C-1 for maximum (if used).

Conclusion

This receiver has given excellent reliability, has a narrow bandpass, no drift problems, small in size (5" x 8" x 4"), light weight and low power consumption. By their basic design, any ac/dc radio is dangerous when out of its case. Be sure to remove power cord before working on chassis. In tuning, use insulated tools, stand or sit on insulated material.

Any of the conventional noise clippers or squelch circuits may be used if desired.

...K6ZFV

40, 20, and 2

Thomas Niedermier, WA8IYL
Box 163
New Washington, Ohio 44854

The tower here that supports the two meter ground plane and twenty meter inverted dipole also serves as a forty meter vertical. It consists of thirty three and one half feet of one and one quarter inch pipe insulated at the top and bottom with a dielectric pipe union. These are available at most plumbing stores. *This type pipe connector makes it easy to put several antennas on one pipe and insulate them from one another. These dielectric unions have a built in spark gap which makes the whole thing a fairly good lightning rod.

The two meter ground plane is constructed on a one inch pipe cap as shown in the Antenna book. The inverted dipole is also right from the book. I have a twenty meter dipole, but one can be put up for any band.

A five foot section of one inch pipe was used between the ground plane and the vertical here, but any length can be used to get the height you want. Although too much height might get you into support problems.

The dialectric pipe union.

The inverted dipole can be used to help support the tower against prevailing winds.

A hook is installed just below the ground plane for hanging the dipole.

The coax from the top two antennas cannot be run down the vertical, but should be run off at as near a right angle as possible. All three antennas are fed with 52 ohm coax, but each must have its own feed line.

The antenna is held to the side of the house by two snap-in wall mounts from Allied Radio. The weight of the whole thing rests on the bottom dielectric union and the ground pipe driven into the ground.

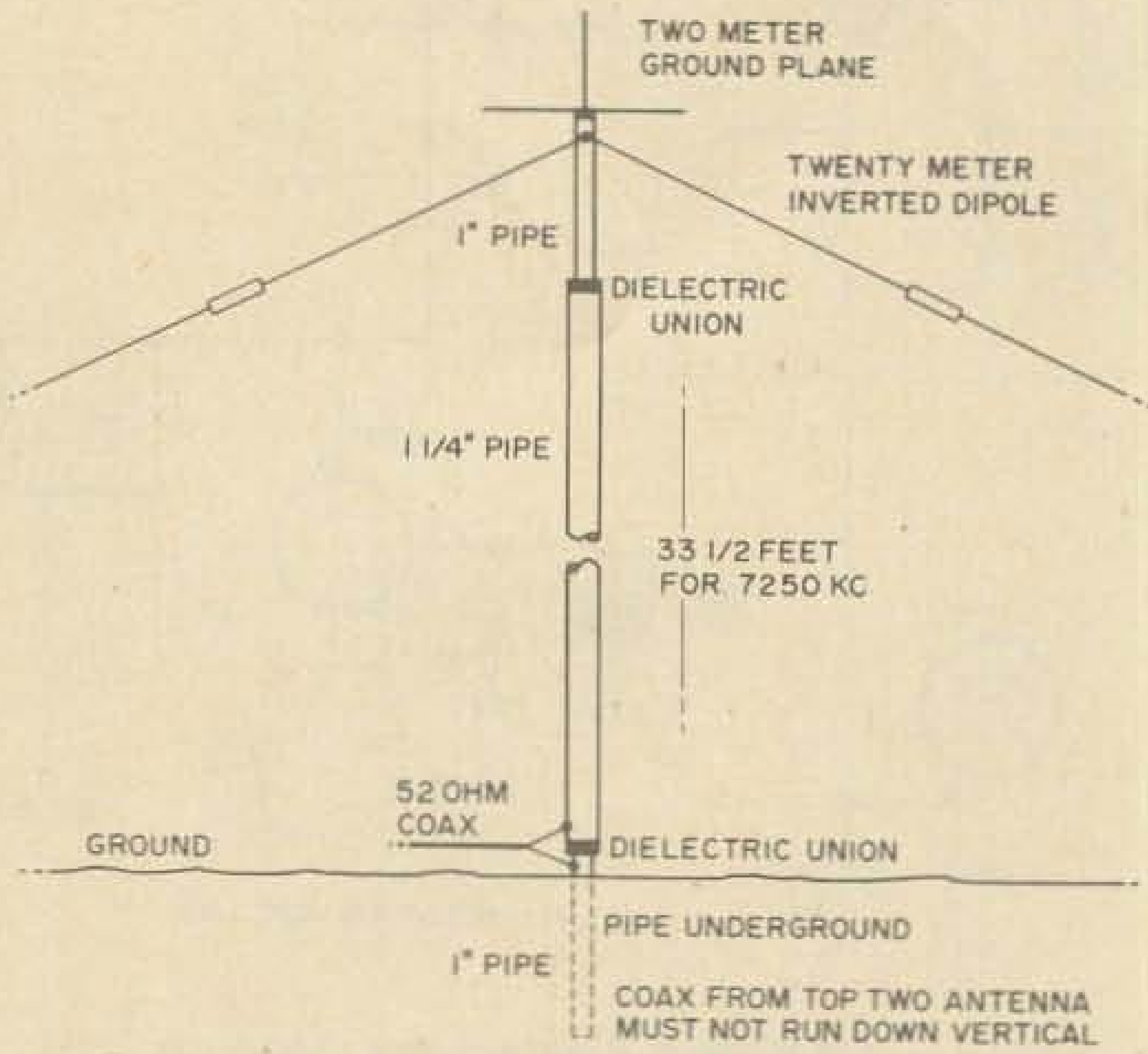
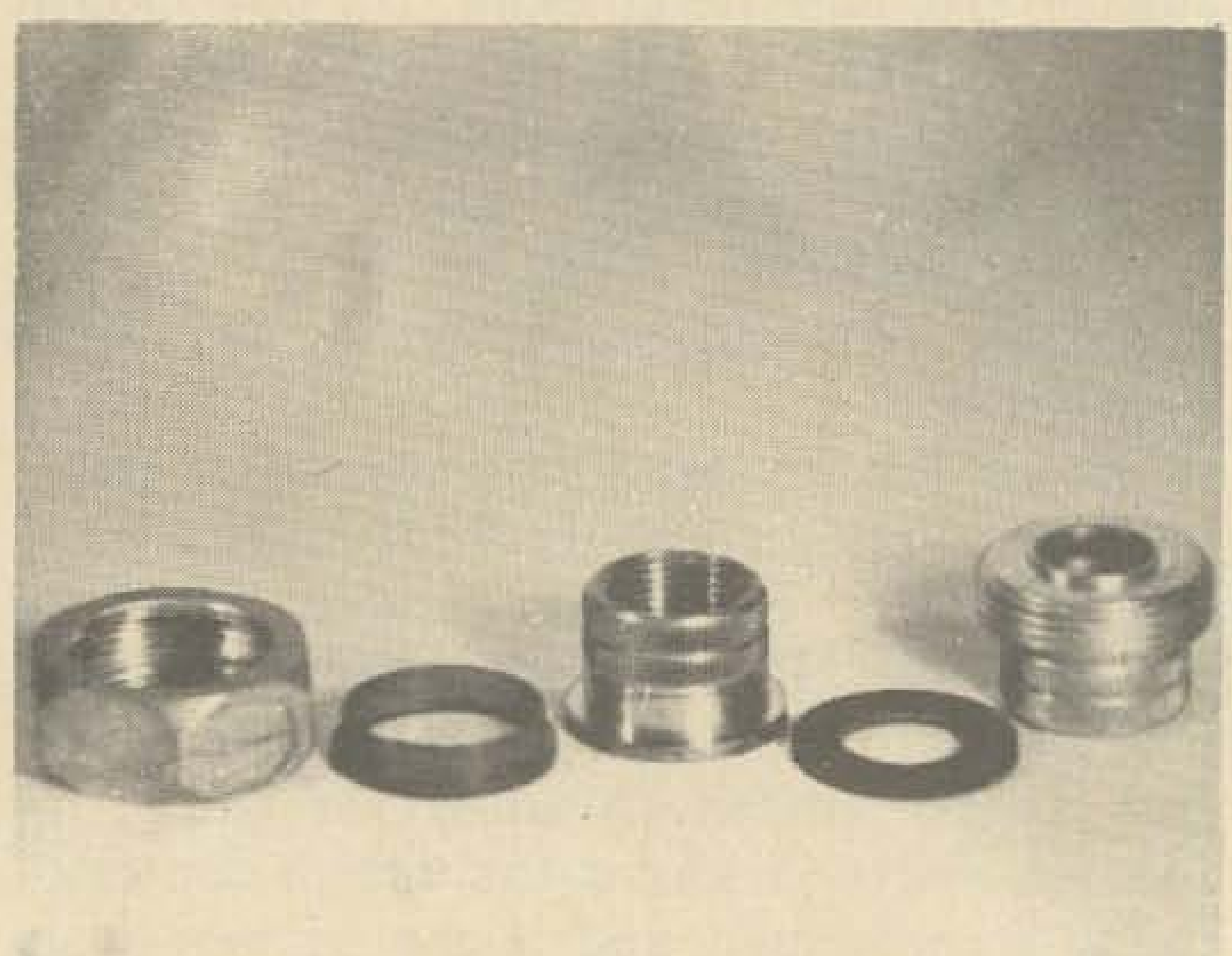


Fig. 1. Assembly of the antenna.

Each of the dielectric unions are one and one quarter on one end and one inch on the other. The one inch pipe driven into the ground can be any length to give a good ground and plenty of support. Here it is about eight feet long and is next to a good well. The ground is always moist, which helped in driving in the pipe.

The vertical must be cut longer than a normal vertical. Maybe because of the end effect caused by the pipe on top. Mine is thirty three and one half feet tall and is resonant at 7250 kHz.

...WA8IYL



Breakdown of the parts of the dialectric pipe union.

*Capital Manufacturing Co., Columbus 16, Ohio. Epco Dielectric Unions, Cleveland 9, Ohio.

Review and test of the Caringella ACP-1 Compressor-Preamp

John J. Schultz, W2EEY/1
40 Rossie Street
Mystic, Connecticut 06355

The ACP-1 is available in either kit or assembled form from Caringella Electronics, P.O. Box 327, Upland, California 91786.

The Caringella unit offers some unique features as an audio compressor. It is available at reasonable price in both kit and wired models.

One hears and has read about so many audio compressors, both commercial units and those described in various magazines, that the tendency is not to get particularly excited when another unit of this type appears on the scene. This was my initial reaction when I started to review the Caringella ACP-1 unit. However, upon some study of the compressor circuit and particularly after I had built and tested the unit, I felt that it had various unique features that made it well worth a detailed review.

Fig. 1 shows the schematic of the ACP-1 unit and the table below gives the "dry" specifications on the unit. I use the word "dry" to describe the specifications because they are technically accurate, but they give only a static presentation of the performance to be expected from the unit. A better illustration of the performance of which the unit is capable is shown in **Fig. 2.** This graph shows quite clearly the large compression range over which the unit is effective.

Circuit Description (Fig. 1)

Five transistors and one diode made up the semi-conductor compliment of the ACP-1 unit. The input stage, Q1, is a silicon N-channel FET (Texas Instruments 2N3819).

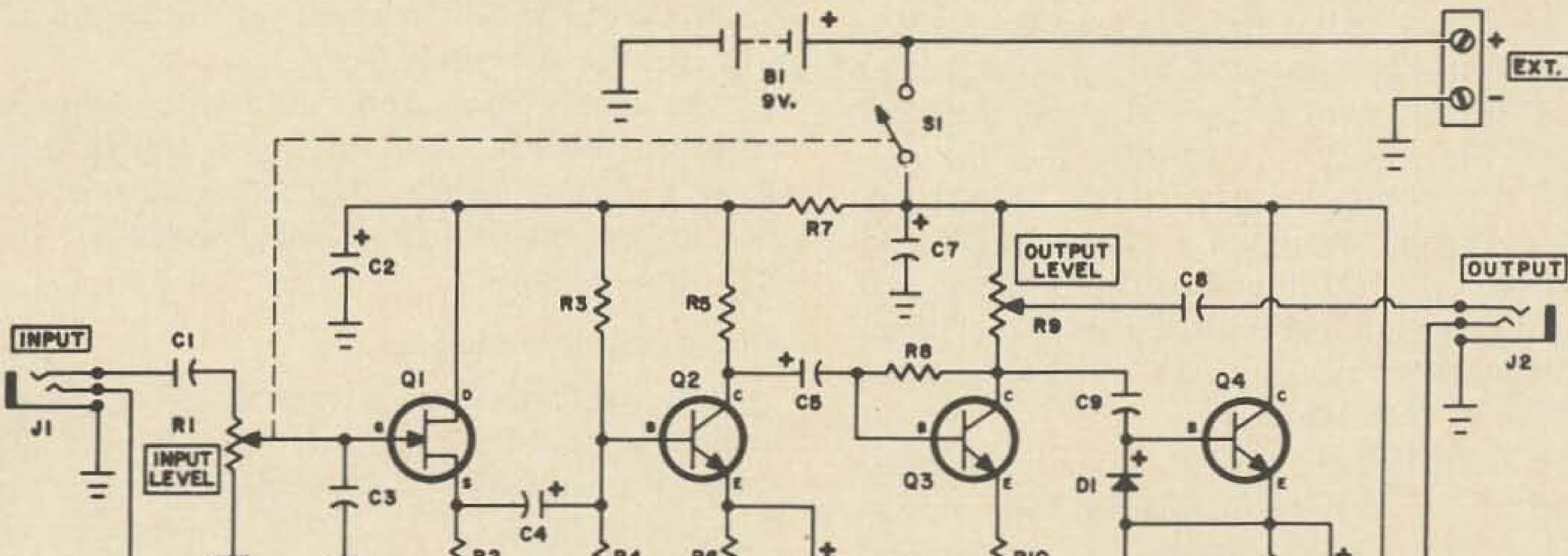


Fig. 1. Schematic and performance specifications for the ACP-1.

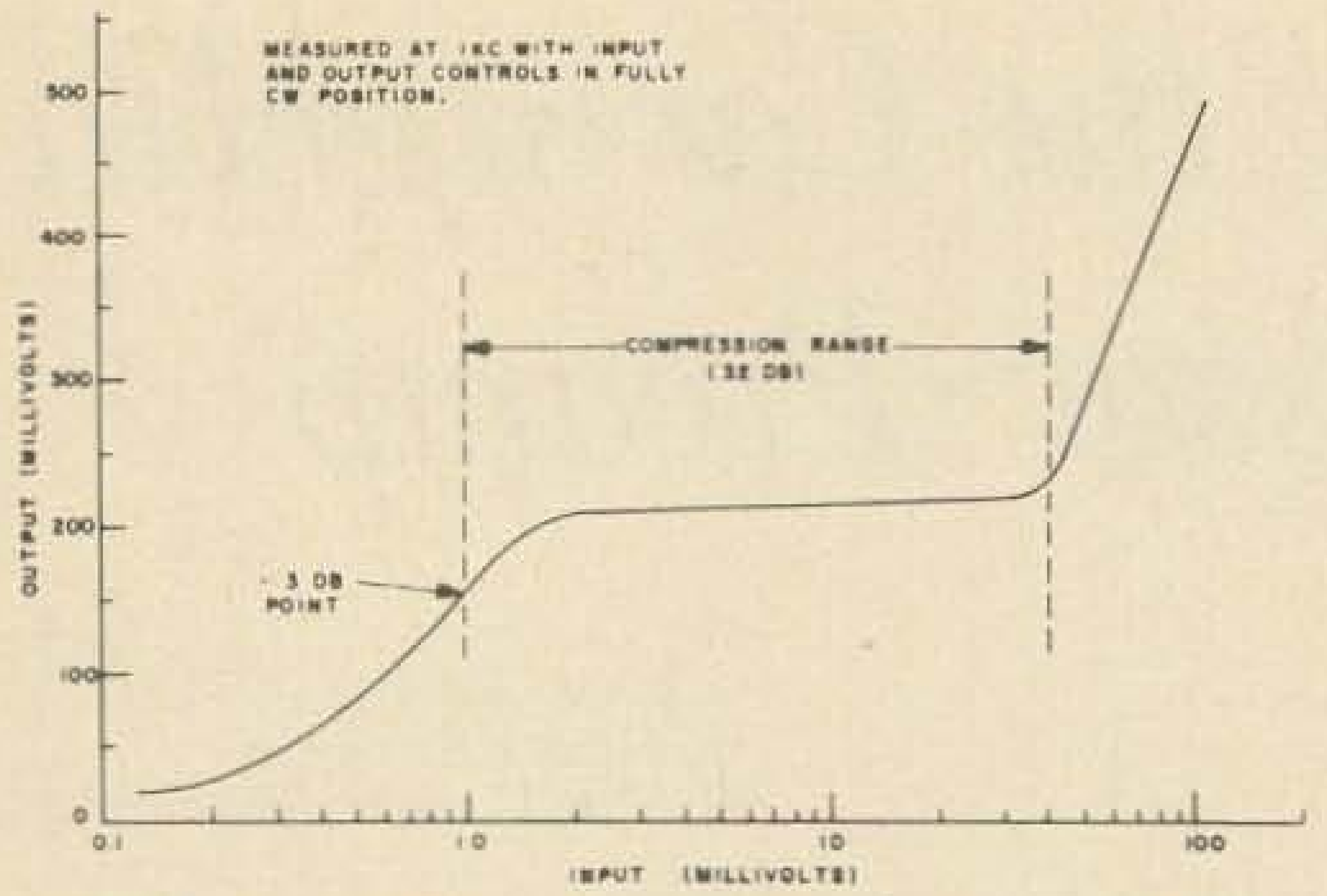


Fig. 2. Extreme compression range of the ACP-1 is illustrated by this graph.

This unit is an extremely low-noise device and, therefore, input noise from the "front-end" of the compressor is negligible. The 2N3819 also provides a very high input impedance for this first stage. R1, a 1 megohm potentiometer, serves as the input level control and is located on the front panel of the compressor.

Transistors Q2 and Q3 are NPN silicon devices used as common emitter amplifiers to boost the audio signal coupled through the source output of Q1. The emitter swamping resistor of Q2 is bypassed through C6 via Q5 in a circuit arrangement which provides the basic compressor action. The emitter swamping resistor of Q3 is not bypassed and the stage operates in a slightly degenerative mode.

The output signal is developed across R9, a 5K ohm potentiometer which also serves as an output level control mounted on the back panel of the ACP-1. Regardless of the setting of R9, however, part of the output signal is coupled through C9 to diode D1 and transistor Q4. D1 rectifies the audio signal segment coupled through C9 and the resultant dc current is amplified by Q4, another NPN silicon transistor.

The amplified dc output of Q4 is used to control Q5, a PNP germanium device. Q5 is operated in its linear resistance region and acts as a current-sensitive variable resistor. This variable resistance is in series with C6, the emitter bypass capacitor for Q2. The gain of Q2 changes as the resistance of Q5 changes since the effect of C6 is reduced and the stage operates in an increasingly degenerative mode.

Circuit Features

One of the significant differences over many other circuits that one notes in the foregoing description is the use of the 2N3819 FET input stage. The use of this FET provides two significant features. One is very high input impedance so that a correct match is provided to the usual hi-z crystal or dynamic microphone. Low impedance microphones require the use of a matching transformer for proper operation. The other significant feature is that the extreme low-noise characteristic of the FET prevents the noise buildup or noise "rush" that is common between speech pauses when using various other compressor circuits. The lack of noise "rush" is also partially due to the well chosen release time of about two seconds.

Another significant feature is the use of Q4 as a dc amplifier stage. The use of this extra stage provides a greater compression range than is possible when only a diode or dual-diode voltage multiplier is used to control the variable resistor element in a compressor. R11 and C10 determine the compression release time while the voltage divider formed by R13 and R14 set the output level at which compression action starts.

Construction

All the components supplied were of high quality and a complete set of plugs and battery connectors are included (the battery itself is not supplied). The components all mount, except for the panel controls, on a heavy duty glass epoxy printed circuit board. The enclosure has a gloss brown speckle finish with white lettering. Provisions are made for internal mounting of a 9 volt transistor-type battery.

The assembly, circuit and operating details are all described in a 3½ page folded sheet. Following the instructions given, the assembly time required was somewhat less than two hours.

Operating Experience

The unit was tried with a SB-34 transceiver and crystal microphone (as well as a SBE microphone through a matching transformer for the input). The SB-34 has no alc circuitry and particularly outstanding results were obtained. Stations worked consistently reported an apparent 6-8 db increase in signal strength when using the compressor. Audio reports were clean and no appreciable noisiness from use of the compressor was reported. It was interesting to note that the tubes used in a linear with the SB-34 started to redden slightly, a sure sign that greater average power was being generated. Transmitters having a usual 8-10 db range alc circuit should exhibit only a slightly less improvement when using the compressor.

SPECIFICATIONS

VOLTAGE GAIN: 40 db minimum

COMPRESSION RANGE: 30 db minimum

FREQUENCY RESPONSE: Flat 20 to 20,000 cps (without RFI filter)
Flat 20 to 5,000 cps (with RFI filter)

INPUT IMPEDANCE: 0.5 megohm

OUTPUT IMPEDANCE: 5K ohm

ATTACK TIME: 1 millisecond maximum (time required to reach full compresion from zero compression)

RELEASE TIME: Approximately 2 seconds (time required to reach zero compression from full compression)

SEMICONDUCTOR COMPLEMENT: 1 — n-channel silicon FET
3 — npn silicon transistors
1 — pnp germanium transistor
1 — germanium diode

FRONT PANEL: Input level control with on/off switch, 3-way phone jack for input connection

REAR PANEL Output level control, 3-way phone jack for output connection, terminal strip for external power connection

POWER REQUIREMENTS: 9 VDC to 12 VDC, 3 ma. to 5 ma.

DIMENSIONS: 4¼" wide x 2½" high x 3½" deep

MISC: Furnished with two matching phone plugs, high quality MIL-type glass-epoxy printed circuit board, and easy-to-follow instructions

SHIPPING WEIGHT: 15½ oz.

PRICE: Model ACP-1 KIT.............................$18.50*
Model ACP-1 WIRED...........................$26.50*
F.O.B. Upland, California
**less battery*

The unit was tried both using an internal battery and powered by the 12 volt line in the SB-34. In the latter mode, for best stability, it was found necessary to use a 100 pf bypass and a 100 ohm/50 μf decoupling network on the 12 volt line to the ACP-1. The need for these components may partially have been due to the use of an unshielded cable between the SB-34 and the ACP-1.

Summary

The ACP-1 confirmed its specifications as a superior compressor unit. The emphasis in the ACP-1 kit seems to be more on hardware rather than software but, in this case, the emphasis is certainly correctly placed.

The output level control is generally not necessary when the unit is used with a transmitter having a microphone gain control. This "surplus" control space on the back panel plus the space still available in the ACP-1 enclosure sorely tempts one to compact into the enclosure other small transistor or IC station accessories, such as tone generators, VOX or keyer units. I, in fact, easily put an IC keyer that was unhoused into the enclosure and there is still room for a VOX unit.

...W2EEY/1

Promoting vhf

An excellent way of promoting contacts, friendship, and interest in ham radio on the vhf bands is to collect a list of operators on a particular band and mode. In many areas the vhf bands are sparsely populated and for this reason there is much dependence upon ground wave contacts to keep the bands alive. Collecting the call, handle, and city of all known operators within a 200 to 300 mile radius and sending a copy to each new operator along with your qsl creates a feeling of comradeship which can't be gotten any other way. The new man appreciates being a part of the gang, knowing everyone's handle, and what to expect in the way of contacts.

Keep your list current by adding and deleting as soon as changes are made and making new copies at regular intervals. The list will be most useful if some blank lines are left for additions to be made between issues.

Usually there is someone in the area who has access to a copier or mimeograph, who can make copies at little or no cost. Postage costs the same as a qsl when the qsl is stapled inside the list and the two are sent together.

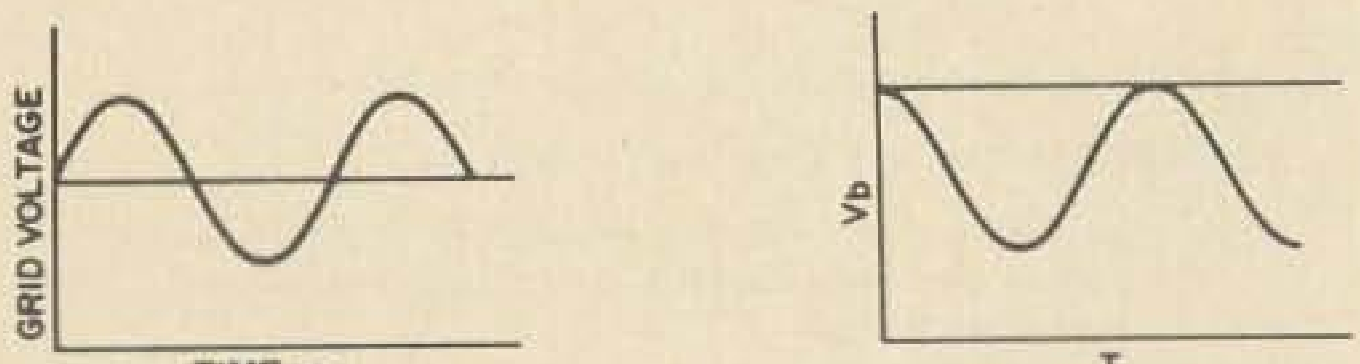
William P. Turner, WAØABI

ATV Video Modulator

Tom O'Hara, W6ORG
10253 E. Nadine
Temple City, California 91780

Here is an easy way to put a 435 MHz transmitter on the air for ATV. This one-transistor video modulator will provide 10 MHz wide high resolution pictures when used with a good camera and a 450 MHz FM transmitter strip. Any of the FM transmitters that have a 5894, 6907, 6939, etc., dual tetrode, or home-brew rigs using 4 x 250's will work without sacrificing their FM audio capability. The AM or FM mode will depend only on which modulation jack is plugged in. AM phone can even be used by plugging in 1 volt p-p audio from a microphone and preamp.

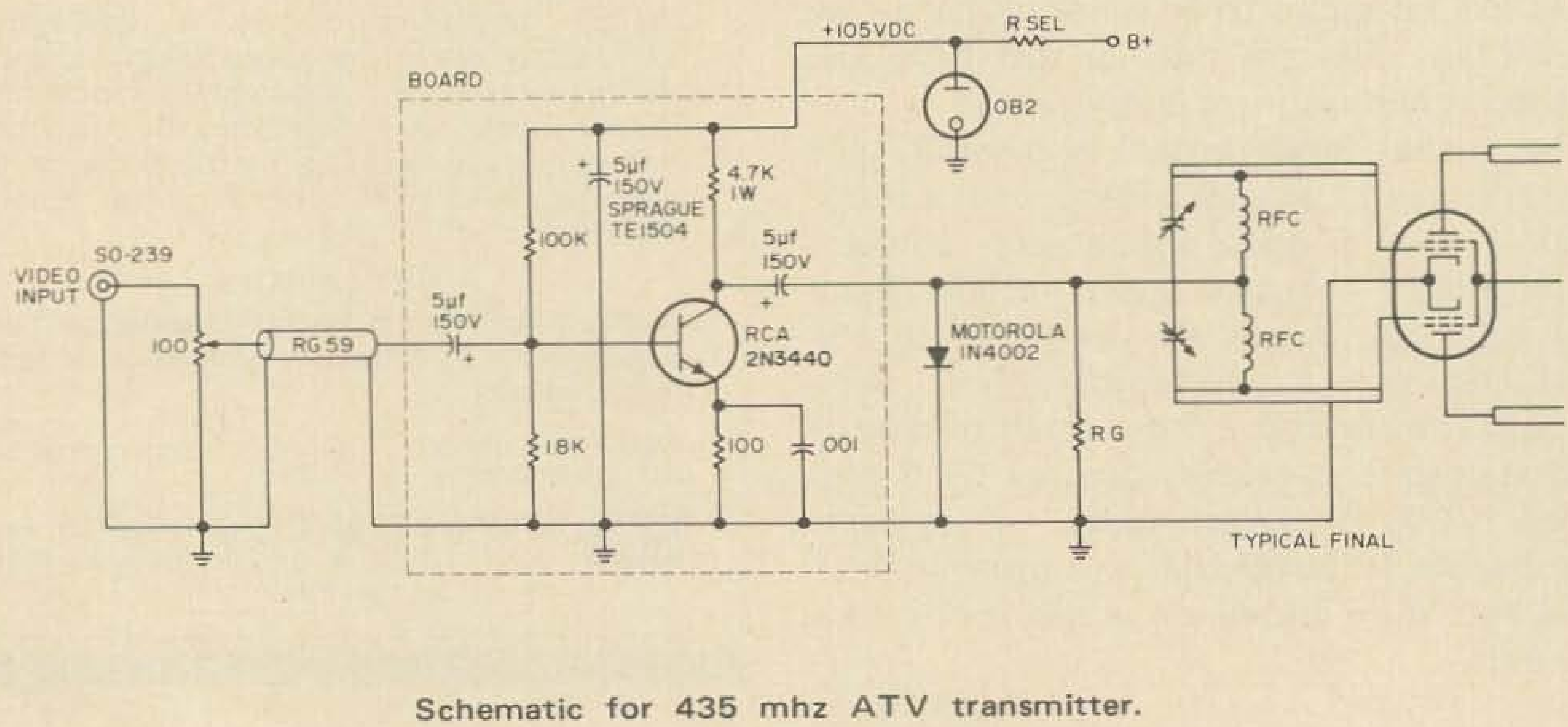
The input accepts the standard 1 volt peak-to-peak positive going sync signal from the TV camera 75 ohm coax to a SO-239 UHF connector. A 100 ohm pot in parallel with the input impedance to the transistor amplifier approximates the required 75 ohm resistive termination. This is important as any SWR or roll off encountered as the modulating frequency increases will decrease the resolution. The transistor amplifier has a voltage gain of about 50, which is the maximum necessary for the largest tube–4 x 250. The 100 ohm video gain pot varies the negative swing as seen by the final grid. A .001 capacitor by-passes the 100 ohm emitter to give a boost to the higher frequency component of the video. The transistor has a ft of 25 MHz and a collector-emitter breakdown voltage of 300V yet costs only $1.21 each from Allied Radio or your RCA distributor. It's a 6AQ5 without filaments.



NORMAL AC ON THE BIAS VOLTAGE

DC RESTORED AC ON THE BIAS VOLTAGE

The output of the amplifier is coupled to the control grid of the final tube. The silicon diode dc restores the video so that maximum



Schematic for 435 mhz ATV transmitter.

power always occurs at the sync tips and gives a better contrast picture. This also lets you run the final at the highest class C continuous FM ratings.

Construction

The modulator must be mounted directly at the final grid to minimize *rf* pickup. The amplifier components should also have short leads. The components can be mounted on a copper, fiberglass, vector, or printed circuit board (PC board available from author—$3). The lead from the 5 μf coupling capacitor to the rfc should not be longer than ½". Take off any by-pass capacitor that may have been at this junction. Rg is existing grid bias resistor typically 10 to 22K. The B-plus dropping resistor is selected for a 20 ma flow from the lowest voltage source.

Operation

Plug in the vidicon camera,[1] flying spot scanner, or color bar generator and adjust the gain pot for best received video at a distant location. Your own set may give a false picture from overloading. Get a friend to pad down his UHF TV converter with 2 pf added across each variable tuning capacitor to look at your picture. He can describe your picture as you turn the gain pot, antenna and lens. The Blonder-Tongue BTD-44 converter makes a good 435 MHz ATV converter as all it takes is to screw the two variable capacitors all the way in and go into the TV set on channels 2 or 3 rather than 5 or 6. This will move reception up about 12 channels and 435 MHz will appear just below channel 14.

To keep sync buzz out of phone receivers and to keep modulation bars out of the pictures, I suggest choosing 435 MHz as the ATV carrier frequency. AM phone usually occupies 431 to 433 MHz and FM'ers 440 to 450 MHz. If you later add 4.5 MHz subcarrier audio[2] it will be still in the ATV frequency range at 439.5 MHz. FM transmitters such as the RCA CMU-15 get about 10 watts output and enable you to send a picture to most any station you can talk to on 2 meters with 5 watts. 144.45 and 146.1 MHz are usually used as the ATV calling frequency since recognizing an ATV signal is difficult unless the antennas are orientated right. The Cushcraft 16 element colinear seems to be the best antenna for ATV because of its reliable gain and bandwidth. Hope to SEE you on the air.

...W6ORG

1. *ATV Anthology*, available from 73.

2. *FM Subcarrier Generator for Ham TV*, W6ORG, 73 April 1967, P. 46.

Martin Herlihy, K6KTP
2338 Berry Street
Lemon Grove, California 92045

VHF, FET, More of

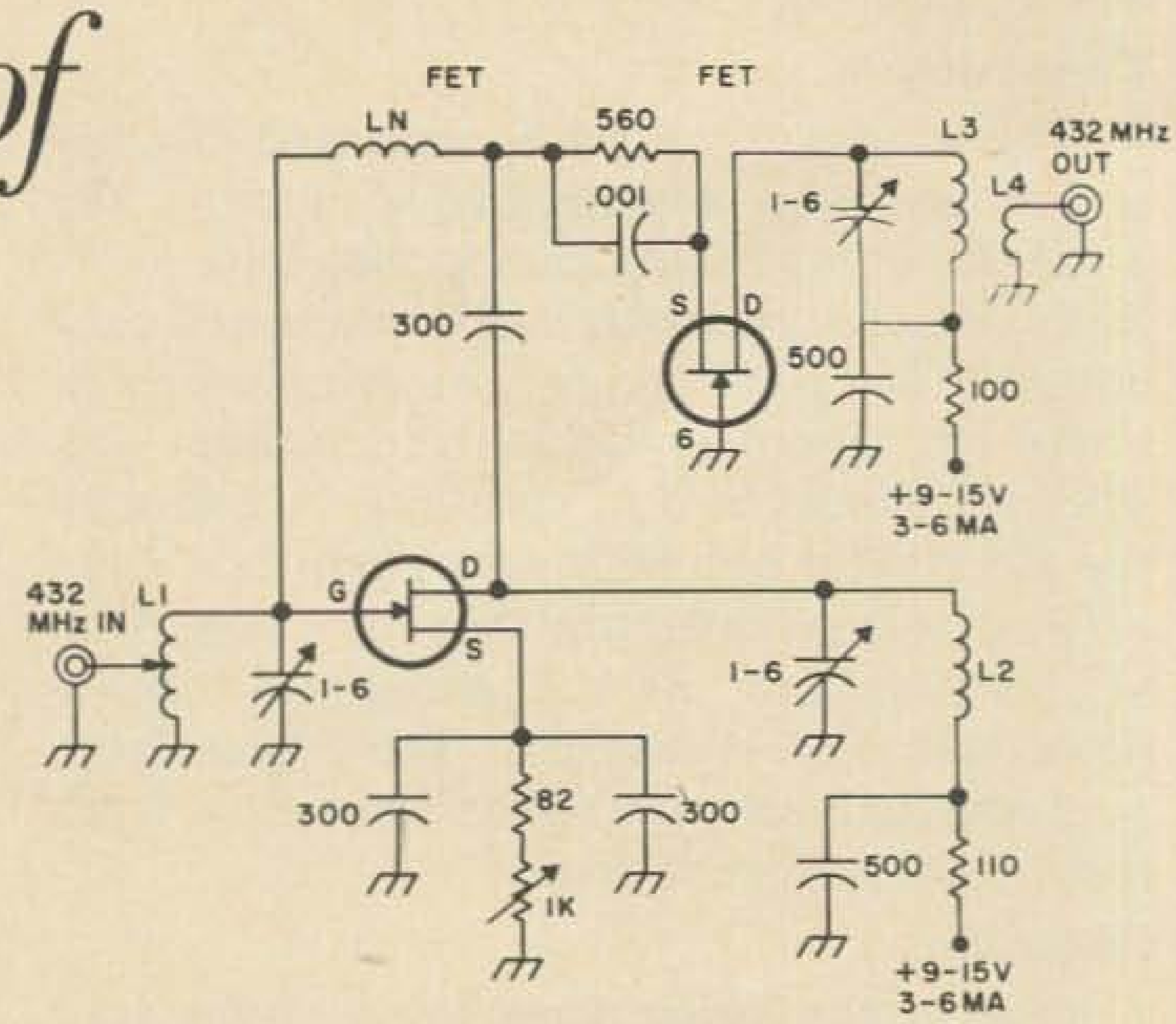


Fig. 1. 432 mhz FET preamp.

Parts List

L1 - 1" long x ¼" wide copper strip. Center tapped.
L2 L3 - 1½" long x ¼" wide copper strip.
L4 - 1" #18 wire coupled to L3.
Ln - 2-4 turns #22 ¼-3/8 long x 3/16" diameter slug tuned.
FET - UC734 Union Carbide.

Not being a writer, I found this undertaking to be something short of impossible. But, being a ham fortunate enough to have two or three home spun circuits that work very well, I felt I had to share my joy with others.

The units described here are all based on the use of inexpensive plastic FET's. The designs are by no means mine but rather ideas collected from many sources. The principle source, and that which prompted my experimentation with FET's, was an article written by W6AJF, Frank Jones, in the Sept. issue of 73 for 1968.

My first endeavor was to construct a preamp for 436 MHZ ATV. Being primarily interested in signal gain, I constructed a two stage unit employing the Union Carbide UC734E epoxy field effect transistor. This unit consisted of a neutralized grounded source coupled to a grounded gate. I used sockets in this unit mainly because I am new at transistor construction and didn't want to damage them while soldering. Also, as Mr. Jones points out, this allows the selection of the best transistor for the first stage. I also shielded the drain from the source on both transistors and this proved to be very useful in preventing feedback.

After the usual mistakes were corrected the preamp started to perform. Once the first stage was neutralized, which wasn't too difficult, I had a very hot preamp.

This was fed into an old uhf TV converter employing just a crystal mixer, but retuned to cover the 435 MHZ band. The results were excellent. Local signals, as well as one

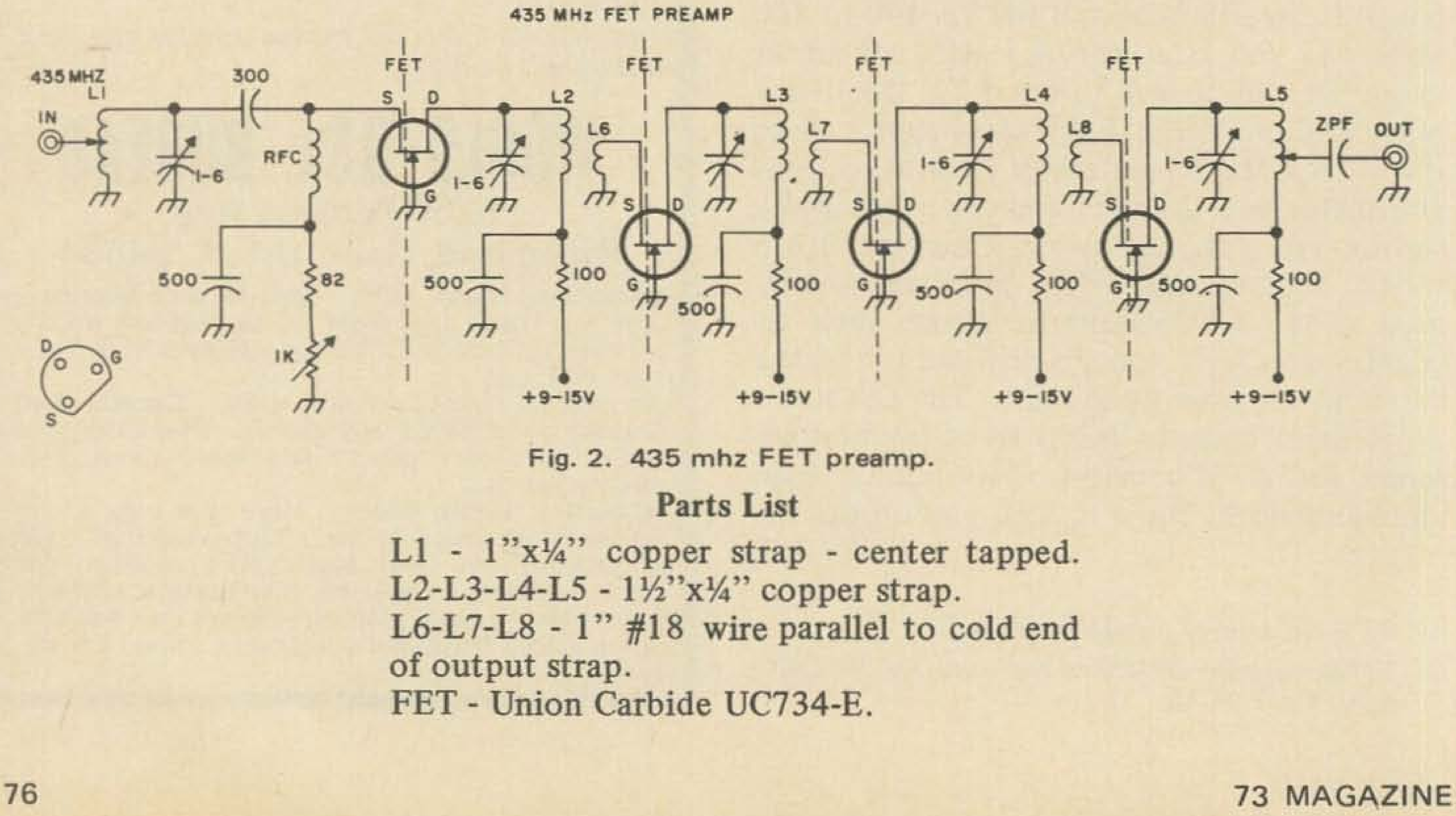


Fig. 2. 435 mhz FET preamp.

Parts List

L1 - 1"x¼" copper strap - center tapped.
L2-L3-L4-L5 - 1½"x¼" copper strap.
L6-L7-L8 - 1" #18 wire parallel to cold end of output strap.
FET - Union Carbide UC734-E.

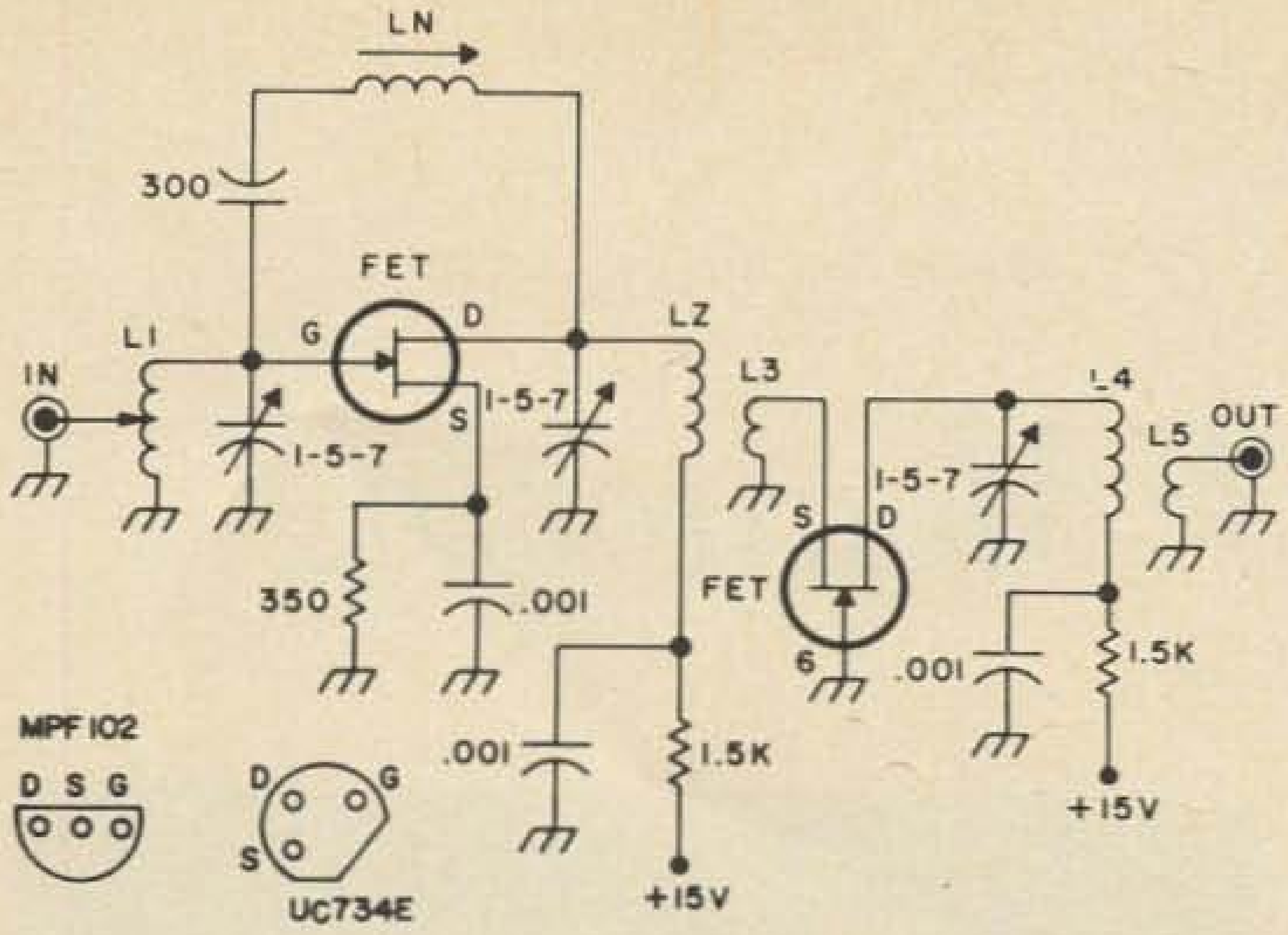


Fig. 3. 2 meter FET preamp.

Parts List

L1 - 4T #20 5/16" dia. x ½" L
L2-L4 - 5T #20 5/16" dia. x 7/8" L
L3-L5 - 2T pickup loop
Ln - 8 turns #26 ¼" slug form
FET - UC734E Union Carbide (1st choice) – mpf102 Motorola

about 100 miles distant, were received with S9 copy. Please note the only antenna at this time was a home brew 3 foot reflector with a dipole in the center.

After such astounding success with the two stage unit, I "naturally" concluded that four stages would be better.

I proceeded to build another preamp of that same configuration except for two additional stages of grounded gate. WOW, was that unit loaded with problems. I spent several weeks trying to tame it down but achieved little success. I then changed the input stage to a grounded gate and experienced the same problems. It became apparent that my shielding was inadequate so I put shielding on top of shielding until I had completely enclosed each tuned circuit. This cured the problem very well. I realize now that the circuit as I had originally built it would have worked very well if I had been much more careful in the way I had used the interstage shielding.

Both 436 MHZ circuits employed the UC734E FET mounted in sockets. Copper clad board was used for the base and also for the between stage partitions. Capacitors are all Arco # 400 miniature trimmers which are very inexpensive, but do a very good job.

It should be pointed out at this time, that all the accepted vhf techniques should be employed in this type of construction or success will be very limited. Shortest possible leads, good bypassing, and adequate shielding as shown above, are all essential at these high frequencies.

After getting both of these units working, I constructed a two meter preamp utilizing the MPF102 in a grounded source to grounded gate configuration. (This FET was used because I ran out of the UC734E.) This preamp required very little adjustment to get it working. It also seems to outperform my 417A preamp as far as noise figure vs gain. I say "seems" because I don't have the know-how or the necessary equipment at this time to perform noise figure tests.

As I have tried to indicate, I am no engineer and these units evolved out of a cut and try approach.

I heartily encourage any one needing a good preamp to try one of these because they are not at all difficult and require a minimum of parts. I suggest though, that before attempting to build one, the reader should refer to the very excellent article by Frank Jones in the Sept. 73 issue. His article covers the basics behind these preamps very thoroughly and takes care of what I have left out.

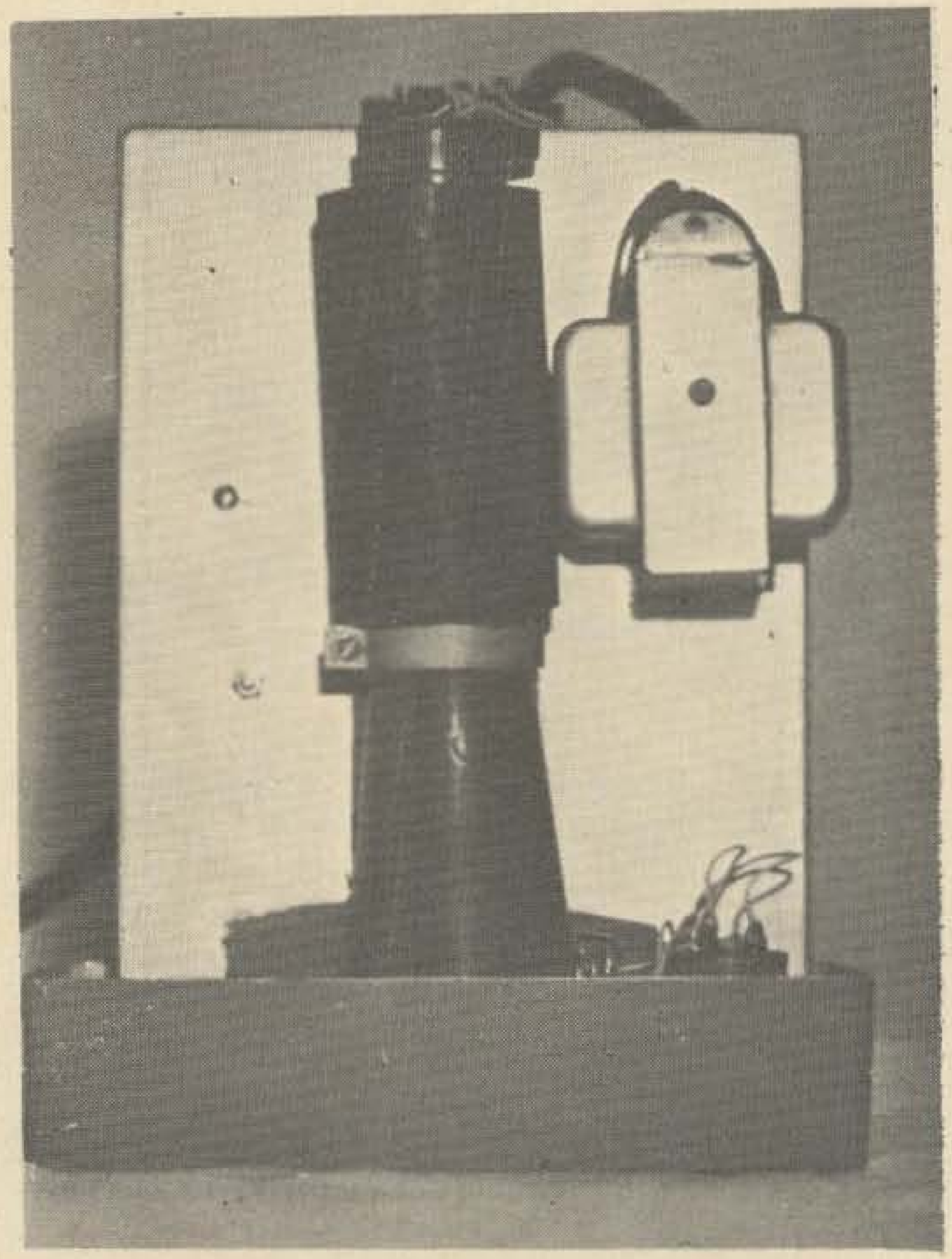
...K6KTP

A Simple Scope for RATT Monitoring

Sam Kelly, W6JTT
12811 Owen Street
Garden Grove, California 92641

Tuning in an RTTY signal is virtually impossible unless some form of tuning indicator is used. The most common indicators are the tuning eye tube, meter, and cathode ray tube. Of these, the most flexible by far is the cathode ray tube. In addition to providing tuning information it can be used to identify interference and check on proper transmitter operation.

For some reason, most amateurs shy away from building oscilloscope indicators. Actually, they are no more difficult than any other electronic project. This little indicator is about the ultimate in simplicity. This is due to the availability on the surplus market of the 902-A cathode ray tube. This tube is available for about $3.00. It has a deflection sensitivity of 90 V/inch making it

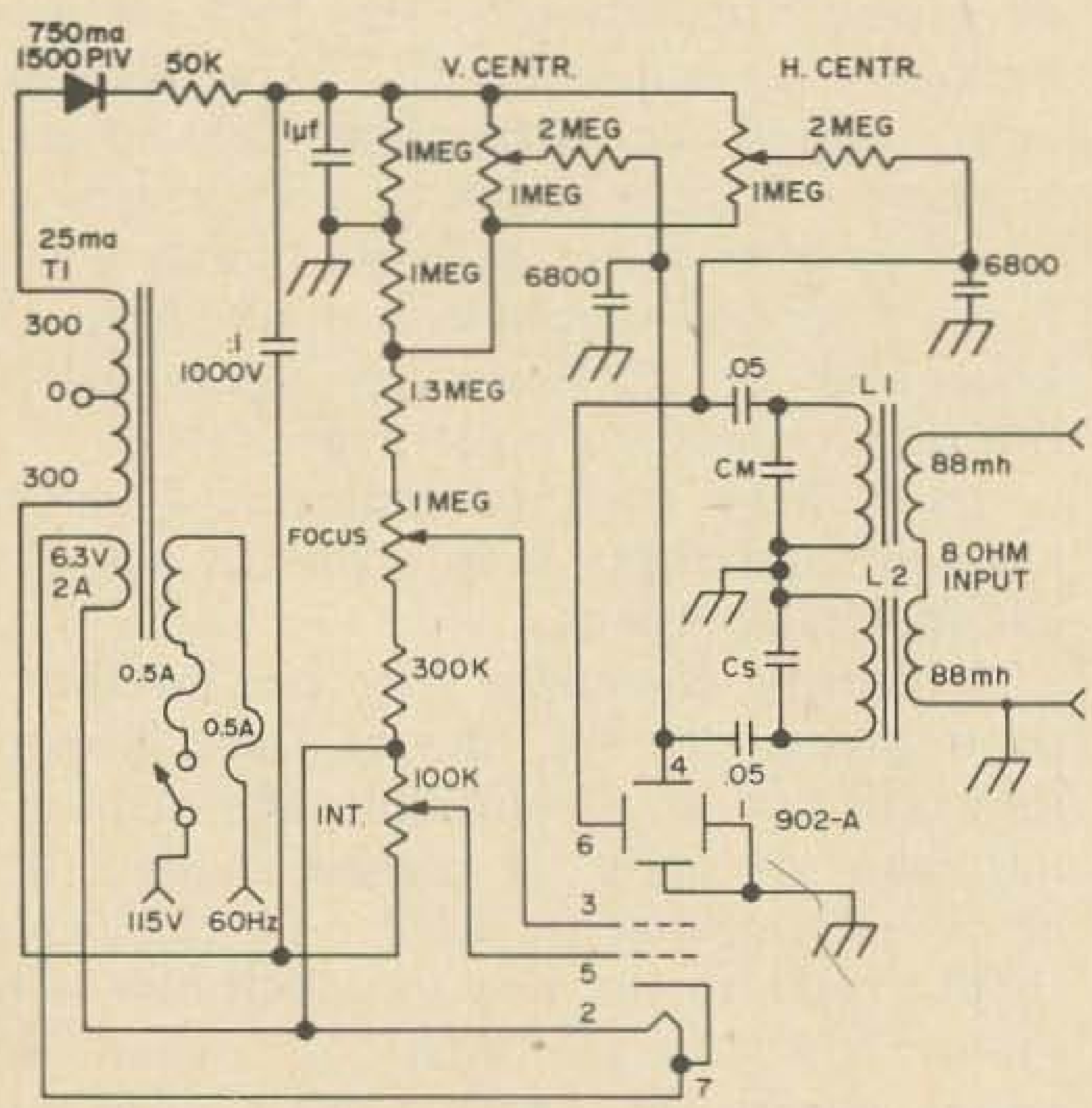


Top view showing water pipe shield installed. Note the small foam rubber cushion at the front of the tube.

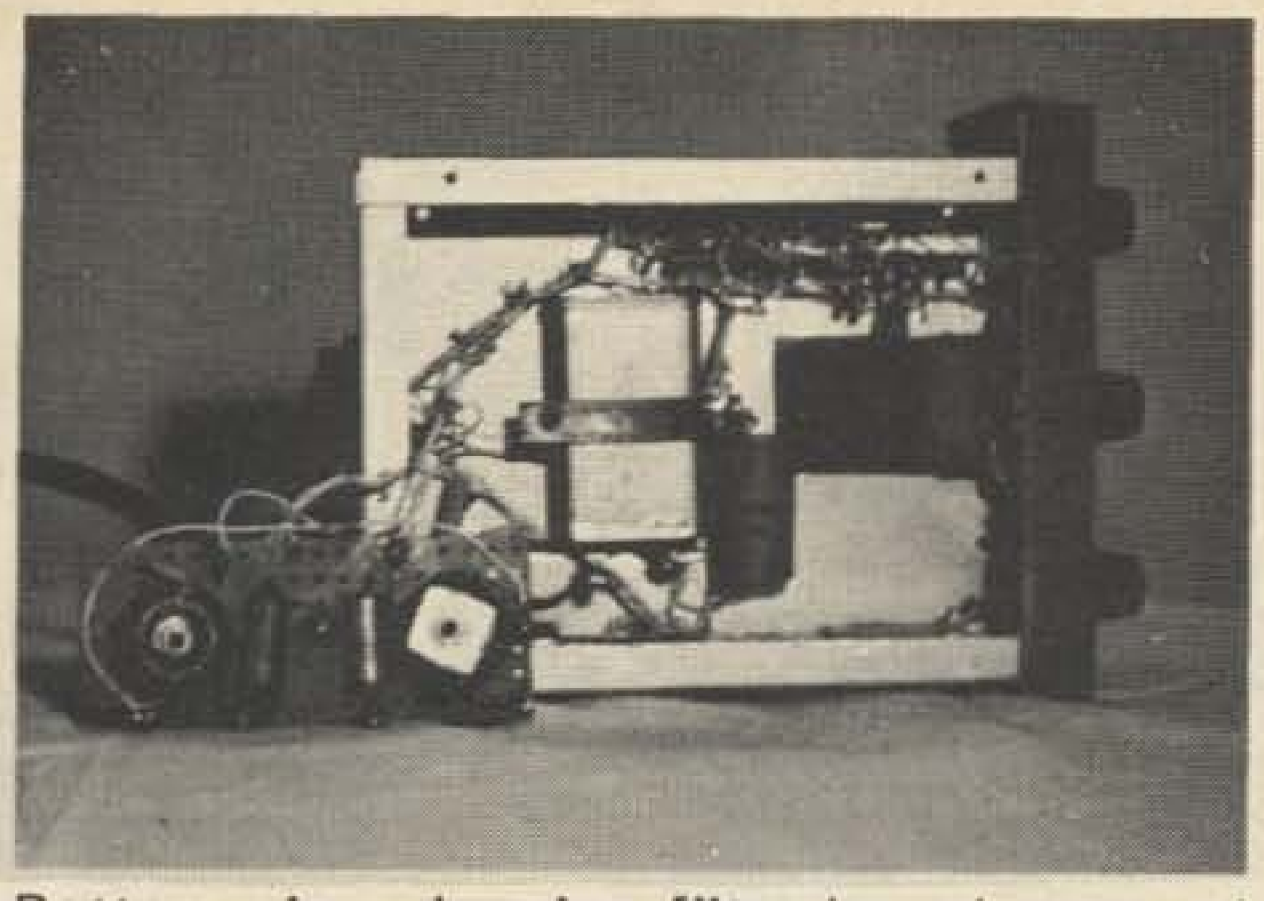
possible to obtain adequate deflection without amplifier stages. In addition, its high voltage requirements are modest, allowing the use of a small cheap power transformer (300-0-300 v) in a half wave rectifier configuration.

The scope was constructed on a 6 x 9 x 2 inch aluminum chassis. The circuit (**Fig. 1**) was divided into two sections. The power and oscilloscope control components were mounted on the panel and chassis. The input transformer – tuned filter networks were constructed on a 2 x 5 inch piece of vector board which was mounted underneath at the rear of the chassis on stand-offs. Leads to this board should be long enough to allow the board to be slid out of the chassis for tuning.

Due to the small size of the cabinet it was



Schematic for the Simple Scope.



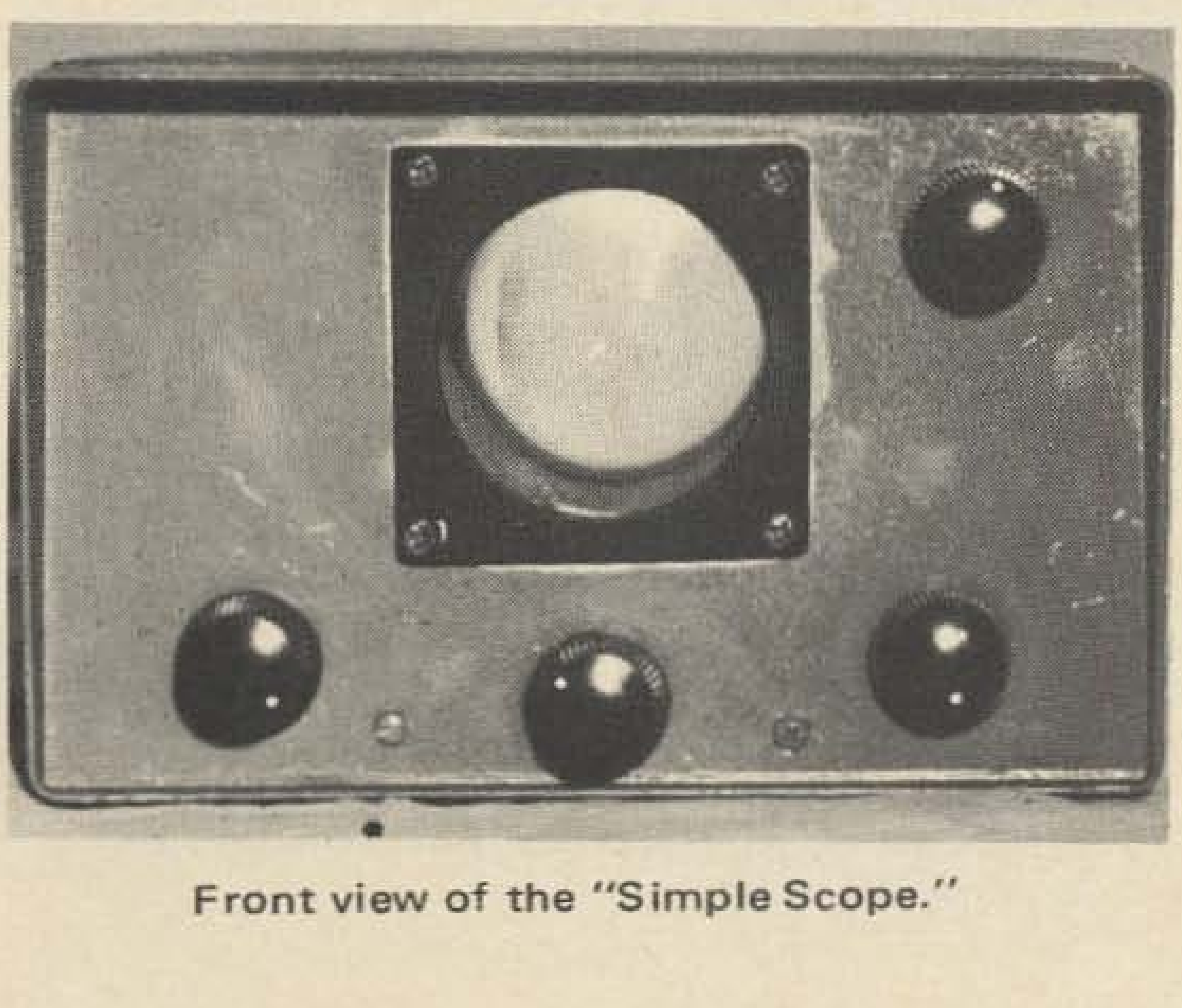
Bottom view showing filter board removed for tuning.

necessary to mount the transformer with the core parallel to the axis of the cathode ray tube. This produced an un-wanted deflection. The cure was a tube shield made from a 4 inch length of 2 inch diameter galvanized water pipe. After cutting, the shield was de-burred and painted black.

All my receiver output lines have an 8 ohm impedance whether they are from the hf communications receivers, or the vhf FM system. A standard 88 mH toroid is used for a combination tone filter and step up transformer. To match the 8 ohm line a primary winding of 35 turns of No. 22 enameled wire is wound over the existing turns of the toroid.

After checking the wiring, turn the scope on, allowing it to warm up. Advance the brilliance control until a spot appears, then sharpen the spot with the focus control. Center the spot with the centering control. Connect an audio signal generator to the input. Remember, most audio oscillators have a 600 ohm output impedance, so a matching transformer should be used.

Now you are ready to tune the filters. There are several ways to do this. The results obtained by using a counter to check the frequency of your audio oscillator are well worth the trouble of obtaining the use of this instrument. If you are active in Army MARS a counter can usually be obtained from your nearest test equipment pool.



Front view of the "Simple Scope."

The easiest way to tune the filter is to use a value of 0.033 uF for the space capacitor. With your oscillator set at 2975 Hz tune the circuit to resonance by removing turns from the toroid.

About 4 turns per Hz is a good rule of thumb. Next tune the mark filter using a 0.066 mF capacitor to start with, and the same procedure. The audio oscillator should be set to 2125 Hz.

An alternate method is to substitute capacitors until the desired frequency is reached. This is simpler than removing turns only if you have a large selection of capacitors.

Remember in both cases, a good grade of mylar or paper capacitor should be used.

If you can't get your hands on a audio oscillator, the output from a friends AFSK oscillator can be used.

In operation the input line is bridged across the 8 ohm input to the TU. The receiver BFO is turned on and the desired RTTY signal tuned in until a distinct cross is obtained on the CRT. The audio gain is adjusted to obtain the desired height.

. . . W6JTT

Curtain Rods, Coat Hangers, and Control Links

Glen E. Zook, K9STH
818 Brentwood Lane
Richardson, Texas 75080

One of the recent trends in amateur radio is the rapidly increasing number of six and two meter FM repeaters. Since FCC requirements specify the use of a control link above 220 MHz, and since the 450 MHz commercial band "splitting" has rendered many older units obsolete, many repeaters utilize the 420-450 MHz band for the control link and for satellite transmitters and receiver links. Prime consideration must be paid to the antenna system used in these links. The master control link must use directional antennas, and directional, gain antennas are desirable for satellite links.

Although many of the repeaters are backed by large amateur groups with excellent financial position, others are maintained by small clubs or individual groups on a limited budget. These small groups must rely on donations of time and material to establish and maintain the repeaters. Since there are few 450 MHz antennas gathering dust in amateur shacks which could be donated to the repeater, these groups often make do with cut-down 2 meter ground-planes and similar antennas. The purpose of this article is to describe a yagi antenna which is very inexpensive (cheap!) and easy to construct, which will fulfill the antenna needs of these repeater links.

The basic items needed are described in the title: Curtain rods, coat hangers, a piece of threaded rod, and a piece of aluminum tubing. The boom is constructed from a cafe type of curtain rod. These rods come in varying sizes. Since there are two sections to each rod (one sliding inside of the other) two antennas may be made from each rod. The rods which extend to 48" and are brass plated make excellent booms for 420 – 450 MHz. All parasitic elements are constructed from coat hanger wire and the driven element is constructed from a combination of 1/4" threaded rod stock and 3/8" aluminum tubing. The parasitic elements are soldered directly to the boom and the driven element attached by a single No. 10 bolt. The antenna may be easily mounted either vertically or horizontally and weighs less than two pounds.

The first step is determining the spacing between elements and the length of the elements themselves. This may be done with the use of the various antenna handbooks. The antenna described in **Fig. 1** will work well at the high end of the band where most links operate. If desired the spacing and number of elements may be varied to result in more gain, better front-to-back ratio, etc. if desired. The dimensions in **Fig. 1** were chosen to facilitate the boom material available while giving good gain without critical adjustment.

Lengths of coat hanger wire should be cut to the desired length (three coat hangers will provide enough material for the antenna in **Fig. 1**). Next scrape the paint from about ½" either side of the center of each element.

The driven element should be constructed from a piece of 3/8" aluminum 2" longer than the calculated length of a ½ wave driven element. The extra is to allow 1" to be flattened and turned up at each end which will be drilled to hold the remainder

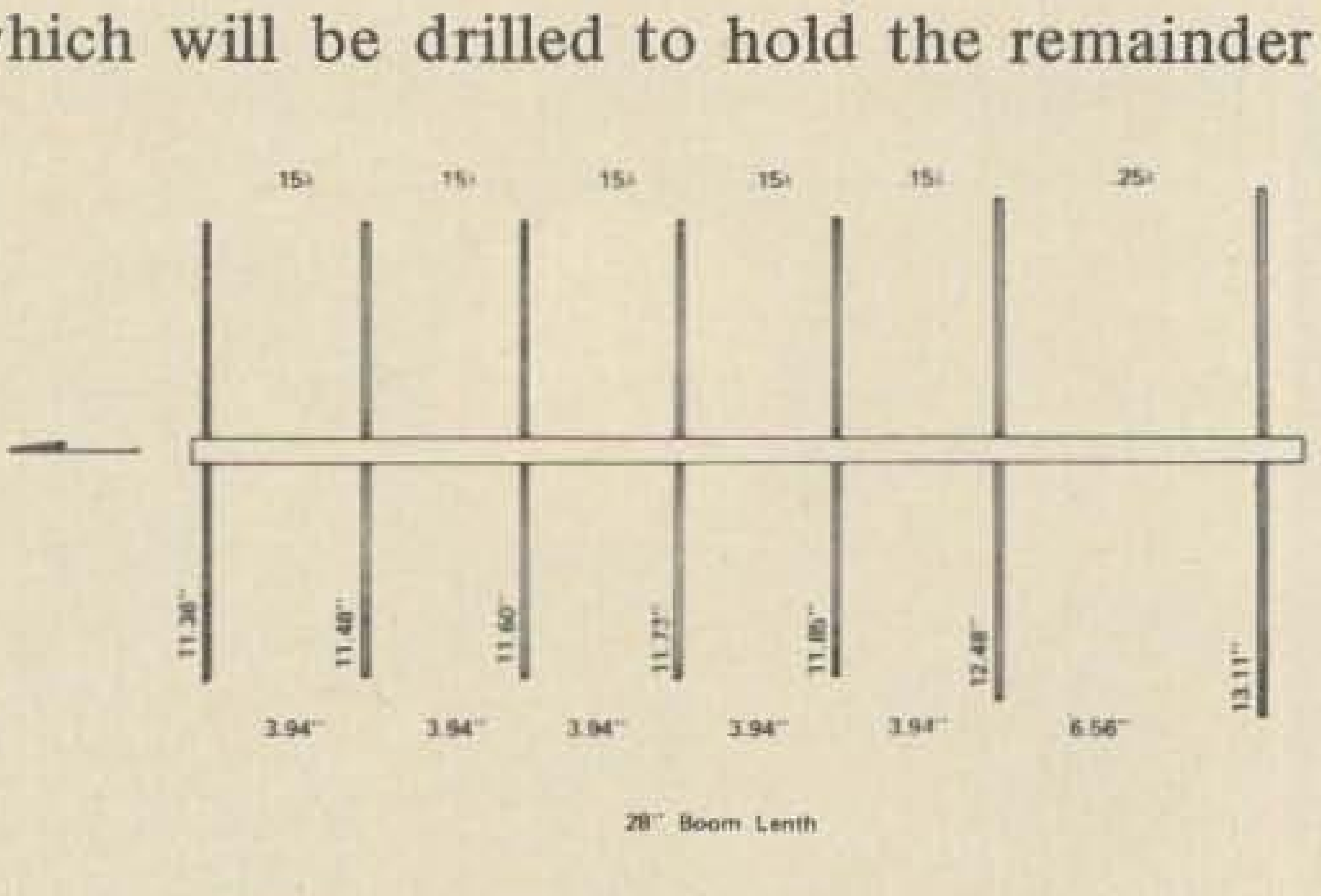


Fig. 1. Dimensions of antenna. 10.5 db measured over ground plane at Denton, Texas, Repeater Link.

of the driven element. The remainder of the driven element is made from two sections of ¼" threaded rod the length of which total the length of a ½ wave driven element. When these rods are mounted as in **Fig. 2** the amount of rod taken in attaching a nut to hold it to the remainder of the driven element will allow a gap in the center of the antenna. To this place the 300 ohm (don't worry about matching, I'll cover this later) twin-lead will be attached.

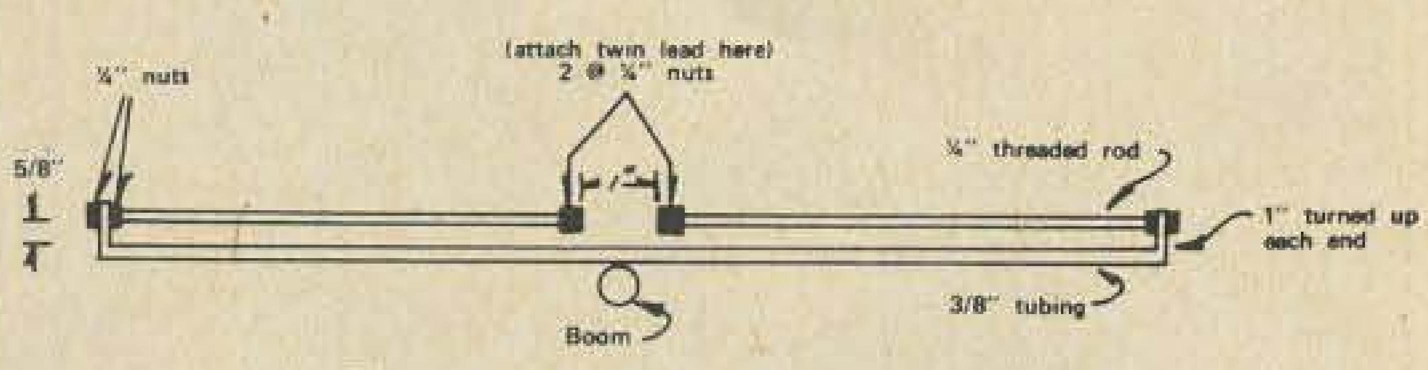


Fig. 2. Driven element.

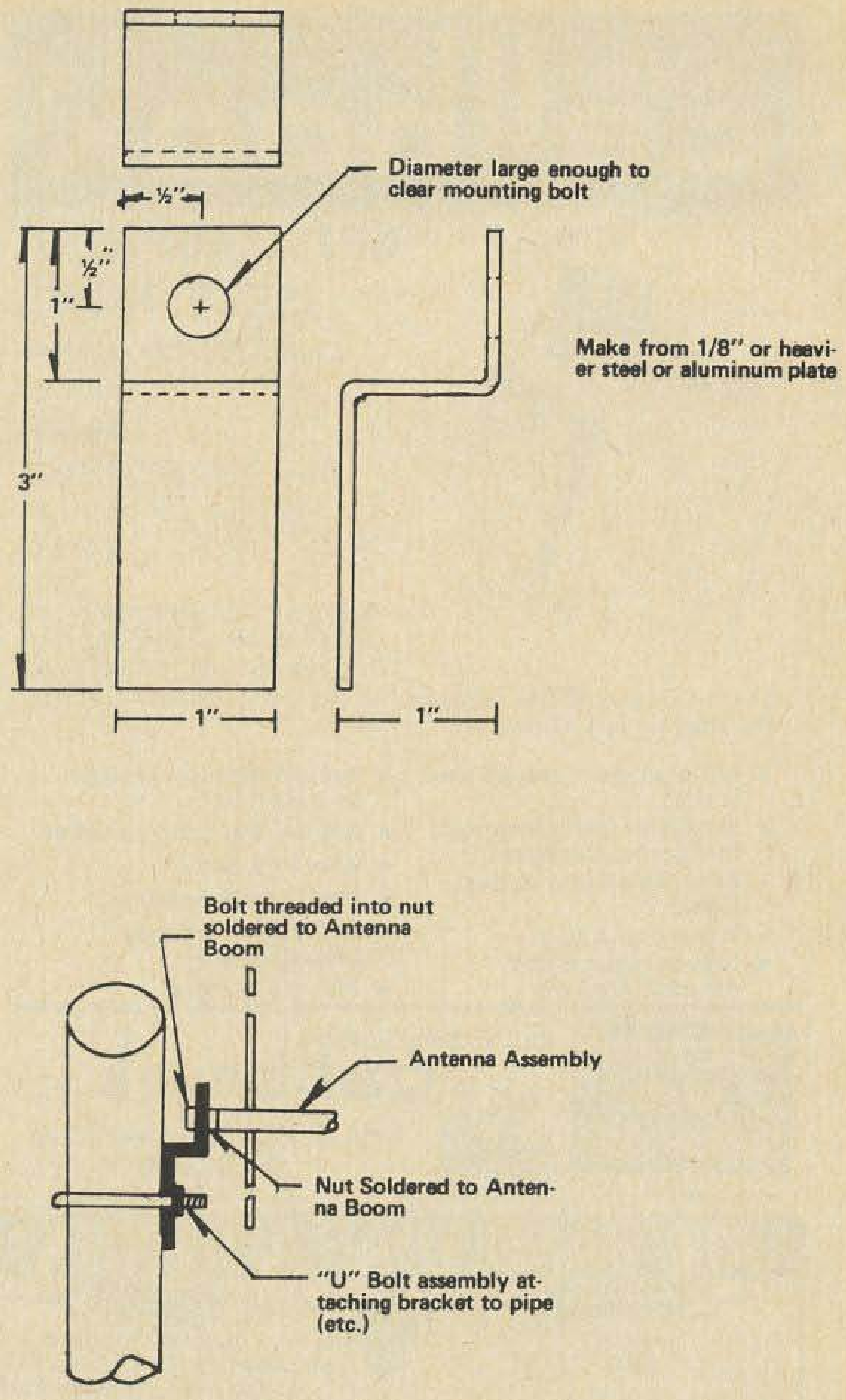
For most of the remaining steps a soldering iron or gun with a fairly high wattage rating will be needed for best results. The antennas in the accompanying photographs were built with an old 250 watt gun. No problems were encountered while soldering.

A close look at the curtain rod will show that it is basically a brass plated sheet of steel rolled into a cylinder. Since there is no weld at the seam the rod can be distorted by twisting. To overcome this the seam should be spot soldered every four or five inches. Most rods have a coating of laquer which should be scraped away at each spot. The whole operation takes about five minutes for the first boom, and less time after you get the "hang of it."

The next step is to attach a nut to the open end of the boom (as in photograph) by soldering. A 5/16" nut and bolt work quite well for most booms. The purpose of this nut is to hold the bolt which in turn mounts the antenna. If care is taken in soldering, the joint is quite strong and will support considerable weight.

Next the parasitic elements should be soldered on the boom 180° from the seam. Again make sure that the proposed joint is scraped clean. The elements may be aligned by letting one end rest on the bench as they are being soldered. Since the wire is relatively soft the remaining distortion may be easily eliminated.

The driven element is attached by a bolt inserted in a hole drilled through the boom and the driven element. The feed line is attached to the driven element as shown in the photographs. Finally the antenna may be mounted by inserting the bolt through a drilled hole into the nut soldered on the reflector end. Or, as an alternate the antenna may be attached to a small bracket (as in **Fig. 3**) and the bracket attached by "U" bolts or other means.



• Fig. 3. Bracket details, and assembly sketch.

The reasoning behind the use of a folded dipole driven element and 300 ohm feed line may be obscure to some new comers to the UHF bands. The reasoning is simple: 300 ohm twin lead is cheaper than, and has much less loss than most coax (and all coax within the budget of most amateurs). Also, it is easily available and fairly easy to work with. The main restrictions is to avoid sharp bends and to keep it spaced from other objects. This may be accomplished by standoff insulators which are easily obtained.

All obsolete commercial UHF equipment commonly available utilize a coax feed system. To match the 300 ohm feed line to the transmitter and receiver a balun must be built. This may be constructed from either a ½ wave length of coax or a 1½ wave length of coax. If the dimensions in Fig. 4 are followed, do not use foam type of coax. If it is desired to use foam coax then the length must be modified to allow for the increased velocity factor. The formula for calculating the length is also part of Fig. 4.

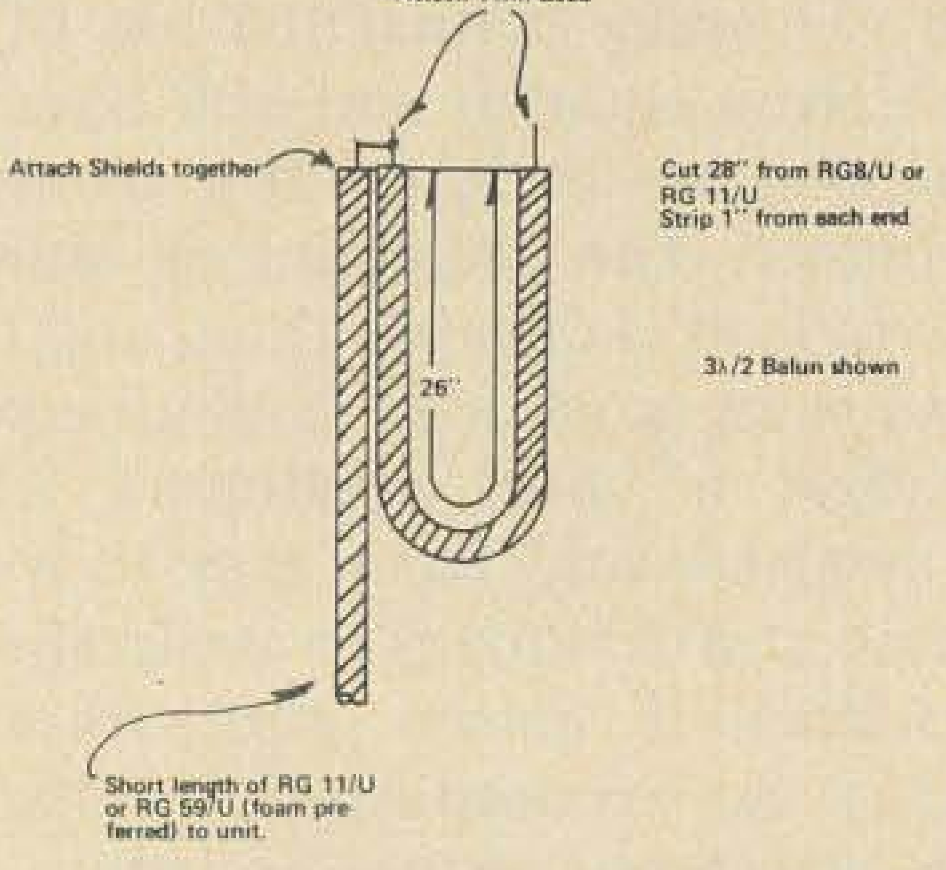
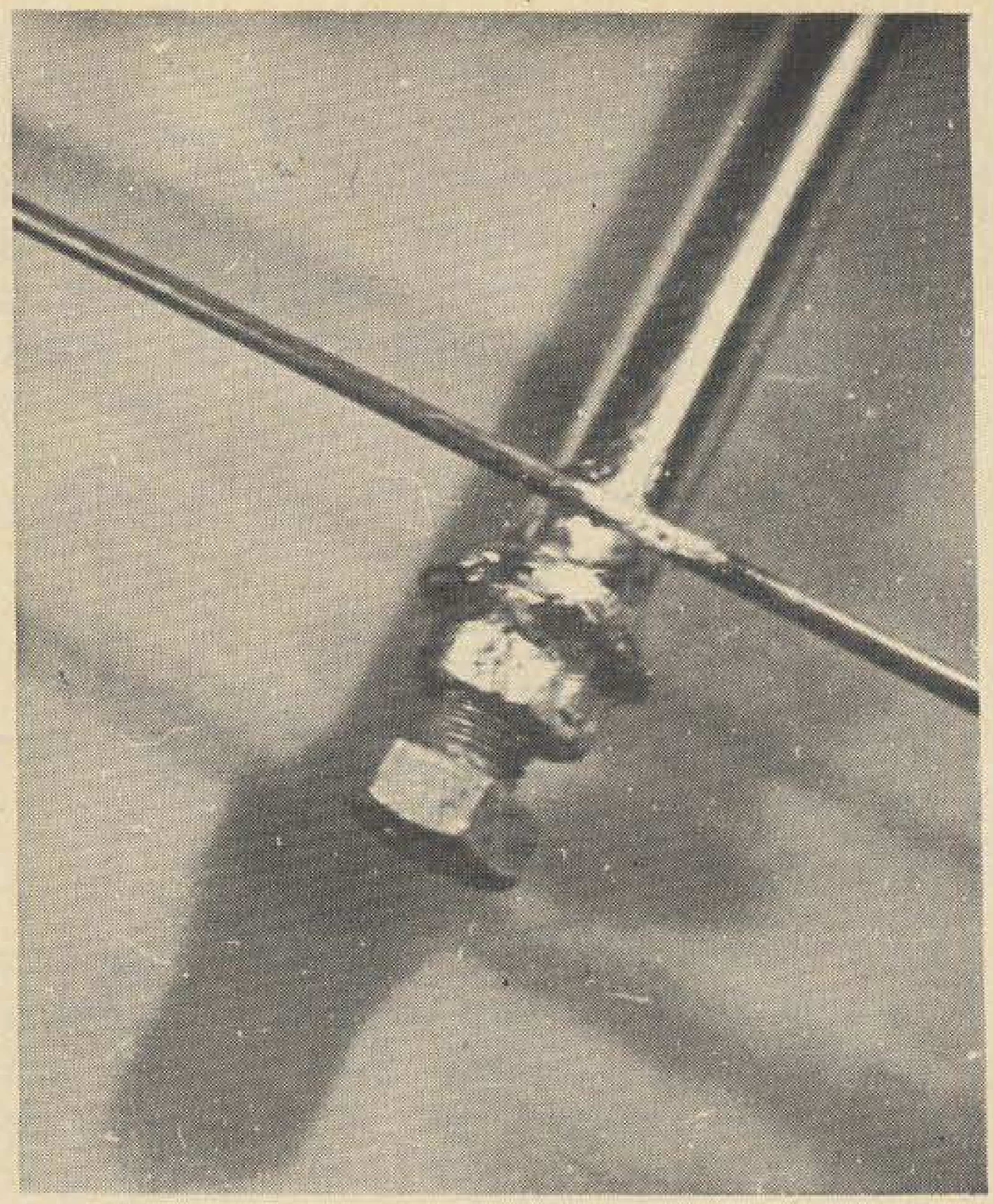


Fig. 4. Balun dimensions. Formulae (length of shield) in inches. V = velocity factor (.66 for regular coax):

$$\lambda/2 \text{ Balun} = \frac{11811}{F_{MH_z}} \times V \times .5$$

$$3\lambda/2 \text{ Balun} = \frac{11811}{F_{MH_z}} \times V \times 1.5$$



Mounting nut details.

Optimum gain in the antennas may be obtained by adjusting the spacing and element lengths as in any other type of yagi. However, formula derived lengths and spacing are usually satisfactory. Also, once the spacing has been determined for the first antenna, each additional antenna may be built with the same dimensions.

The prime advantages in using this antenna are the low cost (approximately 25 cents each) and the ease in mass producing several for use at remote receiving and transmitting sites. In the case of two or more remote locations it may be desirable to utilize a non directional antenna at the central site and directional antennas (as described herein) at the remote sites. In the latter case, the over all system gain will not be as great as when using directional antennas for both halves of each link, but the improvement over ground-planes at each end is remarkable.

One last note: After completion of the antenna it is desirable to coat the entire antenna with clear Krylon to prevent corrosion, especially at points which have been scraped clean to facilitate soldering. By the way, this antenna does not have to be used only on control links. It will do a fine job when used for other amateur work.

...K9STH

An Antenna With a New Twist

After reading the article on the Spiralray antenna[1] I decided to make one. I now work 2 meters AM and FM, so I thought this would be a good antenna to try, since AM is normally horizontal polarization and FM is vertical. While I usually use a 3 element vertical colinear for the FM because of its all directional gain, a beam is sometimes very useful.

Like most hams, I look around for the easiest and cheapest way for my first try at something. I just happened to have a Cush-Craft 11 element beam on hand which hadn't been put up yet, so I decided this should do the job. Although the **Fig. 1** and the photo are for the 11 element beam, it will work with any beam on hand.

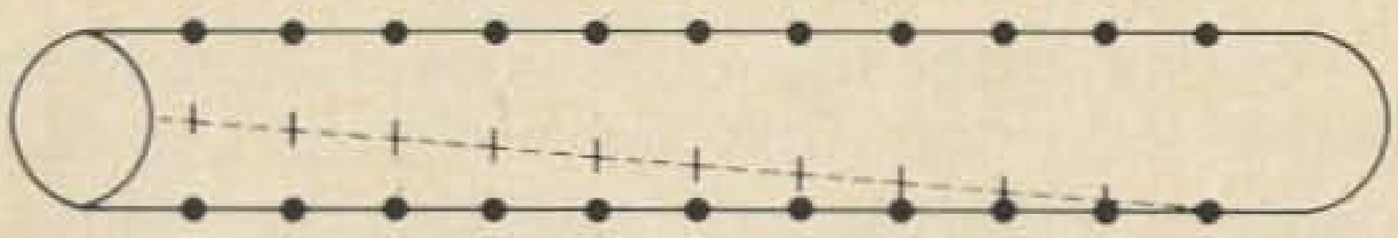
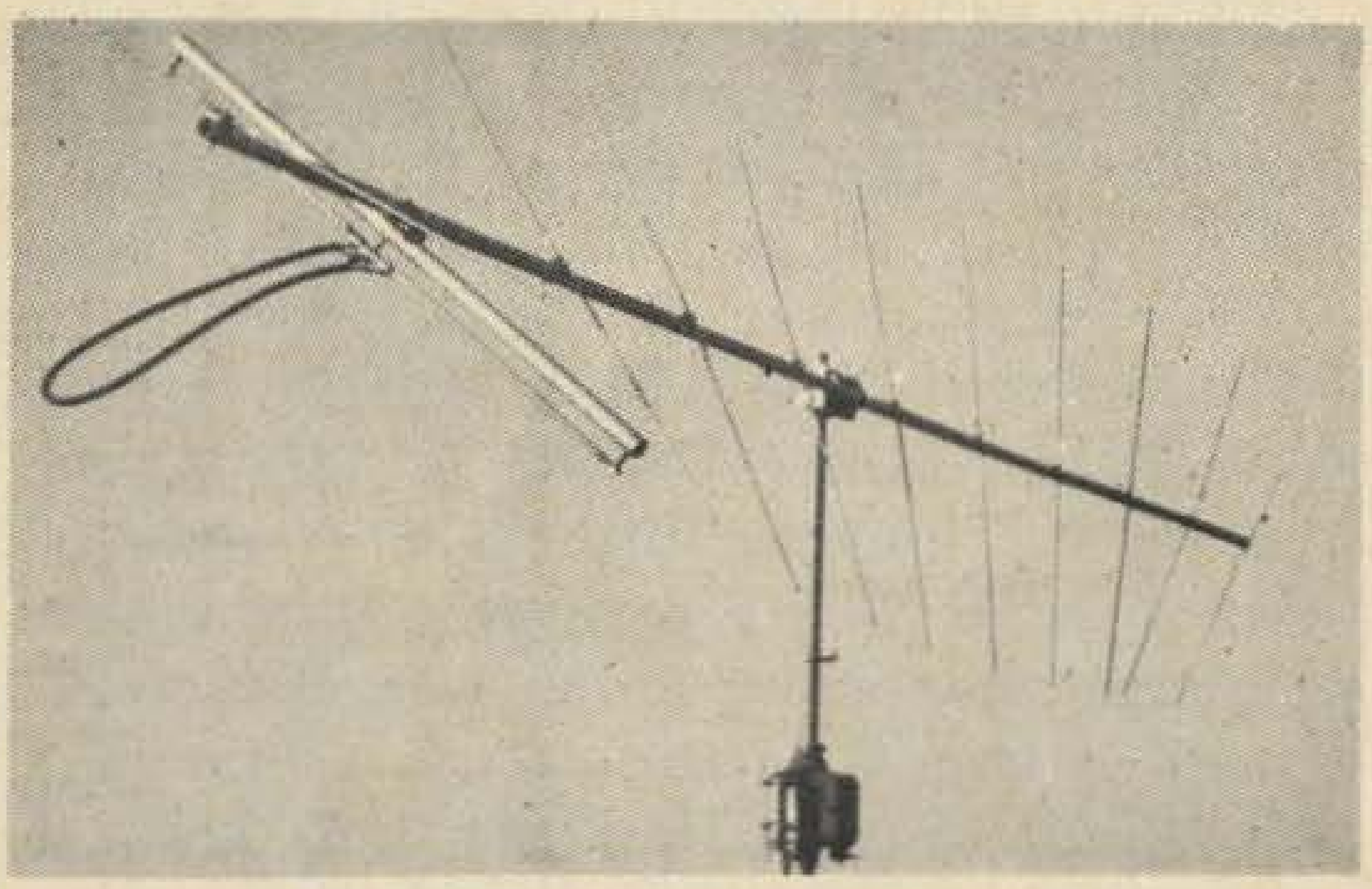


Fig. 1. Marking the boom for the new placement of elements.

The first thing to do is to number all the elements so they will go back in the right place. Then remove everything from the boom. To get the proper twist in the elements take a piece of string and put one end



An antenna with a new twist.

through the existing mounting hole for the reflector and fasten it tight. Then run the string the length of the boom and tape it so that the end is ½ way between the existing mounting holes for the forward director. With a center punch make a mark for the new mounting holes along the string line and even with the old ones. The new holes could be made with a hand drill but I would recommend using a drill press so that they will be straight.

All that remains is to re-install the elements, check the swr, and put it up. Reports show excellent results on both AM and FM, with either vertical or horizontal polarization.

Don Marquardt, K9SOA

(1) 73 *Magazine*, January 1965, page 68.

Facsimile and the Radio Amateur

Part II

Ralph Steinberg, K6GKX
110 Argonne Avenue
Long Beach, California 90803

The response to my article on facsimile equipment[1] was most surprising and encouraging, with letters arriving from all parts of the United States seeking more information about the equipment and operations.

In the first article, mention was made about Western Union Telegraph Company donating some of its older models of the Interfax equipment to radio amateurs. Judging from the letters received, some of the amateurs did acquire some of the machines and are looking for information about schematics and facsimile paper for the Interfax equipment.

Through the courtesy of the Western Union Telegraph Company, schematics will be furnished, at no cost, by writing Western Union Telegraph Company, 60 Hudson Street, New York City, attention of Catalog and Specifications Library. Be sure to mention the model numbers of the Interfax equipment for which you need schematics. Also, this company will sell the facsimile paper for the machines at $1.56 a roll. This paper can only be purchased from the offices of the technical managers of Western Union. These offices are in the large cities of the United States such as New York City, Los Angeles, Chicago, Washington, etc. If you wish the address of the technical manager in your area, contact the manager of the Western Union office in your town and he will give you the needed information.

The most common question in the letters received was "Where can I secure facsimile equipment if I don't belong to MARS?" The answer to this is to check the advertisers in 73 as several advertisements appeared in the December issue offering facsimile equipment at very reasonable prices. Watch the ads each month as more of this equipment is gradually reaching the surplus market. Another source where this equipment can sometimes be purchased is at the retail surplus stores at military bases. The most likely place to find this surplus item would be in these stores at Naval Shipyards, Naval Air Stations, Air Force and Marine Air Stations.

Another question which was asked, "What frequencies are weather maps transmitted on?" There are a number of radio weather stations in both Canada and the United States. For frequencies, check with your local weather bureau and also write the U.S. Weather Bureau, Suitland, Maryland, which is headquarters of all U.S. weather stations. You will find more of these weather stations after you have become accustomed to the tones of facsimile on the radio bands.

In one letter the question was "Are there clubs or groups that are interested in facsimile and is there a magazine or manual published on the equipment?" On the first part of this query, I have not heard of any groups or clubs experimenting with facsimile, but would like to find out if there are any so the information could be passed on to others. A list could then be published of these groups or clubs so that information on facsimile could be exchanged. In reference to the second part there are no special magazines or manuals published for the radio amateur about facsimile equipment and operations. There possibly may have been articles published in the amateur radio magazines in past years, but I believe this article and those previous[2,3] on facsimile are the only ones of recent date. If there is enough interest in facsimile, allowing for the letters I have received, a series of articles could be prepared for later publication. Write *73* and let them know if you want more information published on this subject.

With slow-scan television legal on the low bands, facsimile may be the next mode of communications to follow in the near future. All it needs at the present time is enough interest by the radio amateurs to show the Federal Communications Commission, by petition, that facsimile will contribute to the state-of-the-art. It has been proven by Paul Blum, W2KCR, in 1957 and myself in 1968 that facsimile operations by the radio amateur could be a great morale booster for our servicemen in all parts of the world. With these operations being on record there is no doubt that other radio amateurs will continue to carry on projects to expand the interest in facsimile.

I wish to thank the many radio amateurs

for their letters in reference to the article, "Facsimile and the Radio Amateur," in the December issue. If there are others who seek information on facsimile, send them with S.A.E.

...K6GKX

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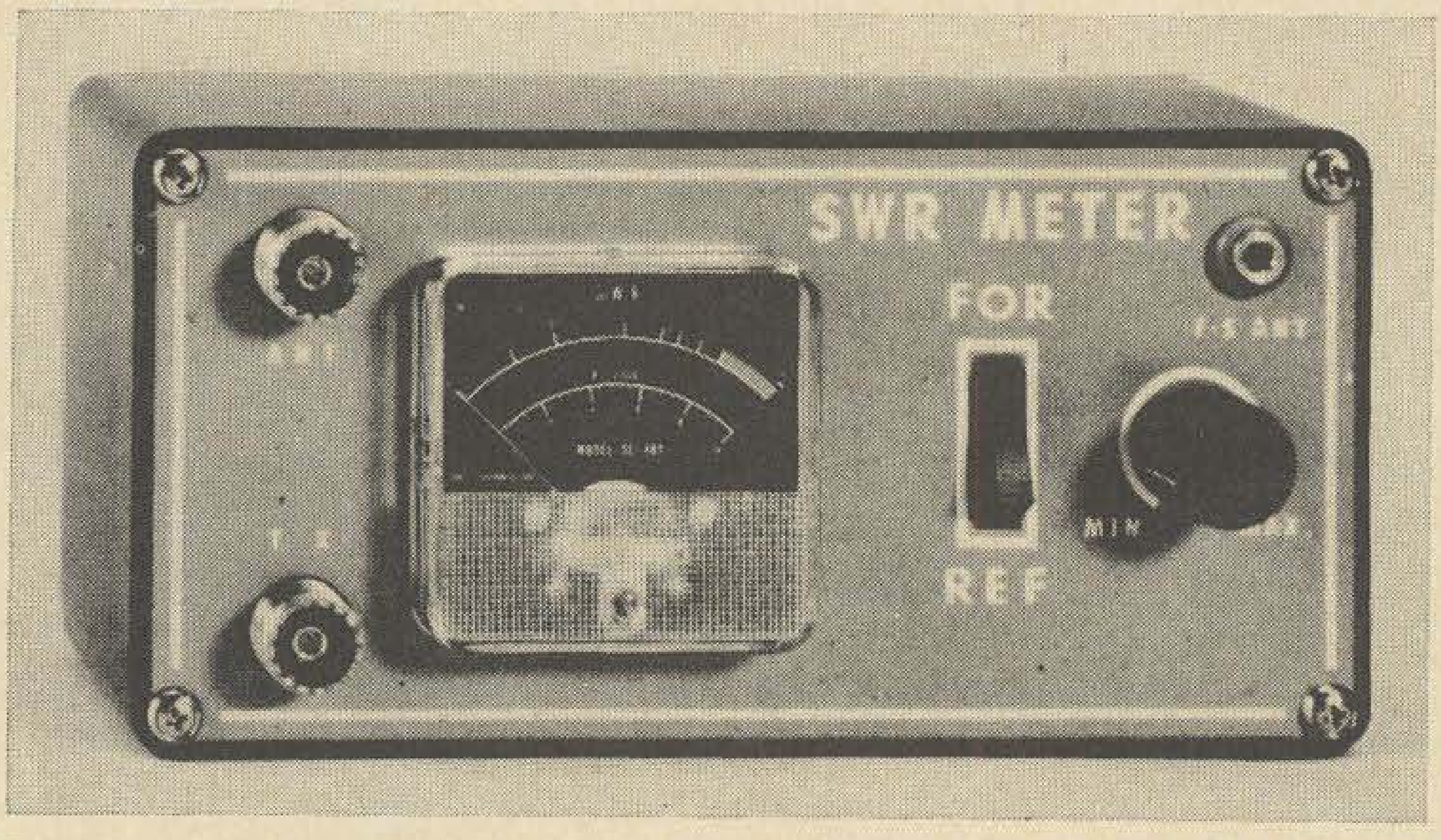
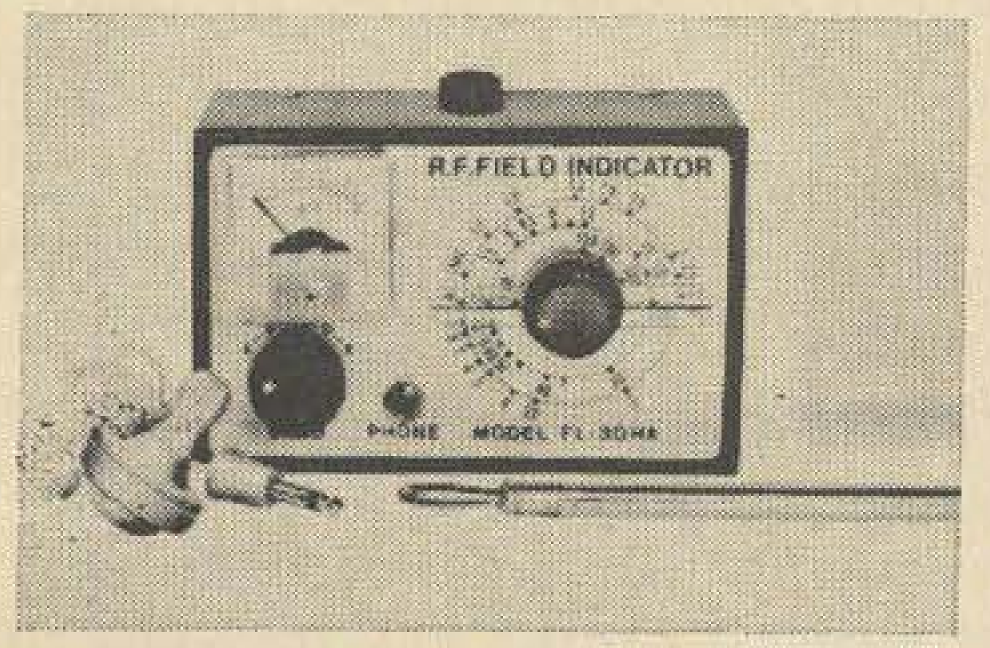




Getting Your Extra Class License

Part V - Transmission Lines

Staff

Last month we examined some of the basic principles upon which antennas and radio-wave propagation operate, and promised to continue the discussion in this issue.

This time we'll to into an area which has been the subject of possibly more discussion—and fewer hard facts— than any other in all radio, amateur or otherwise. What we'll come out with won't be new—but we may offer you some new light on it along the way.

The questions from the FCC Extra Class study list which we'll be covering are:

22. Can a lossy transmission line be used to transmit signals? Explain.

32. Explain the properties of a quarter-wave section of radio-frequency transmission line.

44. What are the current and voltage characteristics along a transmission line when it is matched, and when it is mismatched?

55. A 70-ohm transmission line is connected to a 35-ohm antenna. Calculate the standing wave ratio (SWR), the reflection coefficient, and the percent reflected power. If 10 amperes are flowing in the antenna terminals, what is the current in a transmission line node?

79. Describe briefly some well-known types of antennas and antenna systems used by amateurs which do, and do not, reduce harmonic radiation.

As usual in this series, we'll rephrase these five questions into new ones which will hopefully include all the subject matter of these five together with enough additional related material to provide complete coverage of the subject.

Four of the five questions deal with transmission lines; only one deals directly with antennas. A logical first question for us, then, is "What Is A Transmission Line?" From this foundation, we can then ask "What Are The Major Characteristics of a Transmission Line?" We will find that one of the major, although secondary, characteristics is our old friend SWR; this leads to our third question, "What Is a Standing Wave Ratio?"

By this time we should have waded through more information than most of us ever want to know about transmission lines and their properties, so we can return to antennas. The major properties of antennas were covered last month, but with the main emphasis being placed upon their directional effects. Let's turn now to their frequency-sensitive sides and ask "How Are Operating Frequency and Antenna Design Related?" With that taken care of, we'll close our examination of antennas and transmission lines by determining "What Are The Most Popular Types of Antennas in Ham Use?"

All set? Let's get going.

What is a Transmission Line? Strictly speaking, of course, a transmission line might be considered as a "line that transmits." However, when engineers use the term they mean any line which is conducting electrical energy, and when we as amateurs (or the FCC examiners) use it we usually mean an *rf* transmission line, which is a special type of cable conducting *rf* energy.

Two general types of transmission line are in wide use; they are parallel line, of which the familiar TV twinlead and the open-wire feedline are common examples, and coaxial cable. While coax is probably in wider use because of a number of practical advantages it has over the parallel type, it's much easier to see the theory of what happens in the parallel variety so we will be talking primarily about parallel lines.

Before we do, though, we might as well summarize the advantages of coax; the reasons why they are advantages will come out as we proceed. In a coaxial line, the *rf* is essentially confined to the interior of the cable and thus cannot radiate so easily. Neither can noise contaminate received signals. Coax is relatively insensitive to its surroundings as well. These three points are the major advantages; counteracting them are the facts that coax is (1) more expensive and (2) has higher losses, in general, than parallel lines.

Having disposed of coax cables for now, let's turn our attention to parallel lines to determine what a transmission line amounts to.

Any line conducting alternating current, at any frequency, loses at least some of that energy by radiation. The radiation is a direct consequence of the flow of alternating currents in the line, which create (or at least are accompanied by) reversing magnetic fields about the line.

A flow of current, though, requires two conductors, and if the two conductors are located very close to each other the radiated energy from one is effectively cancelled by that from the other. The net result is that almost no radiation occurs.

If the conductors are separated an appreciable fraction of a wavelength, however, this mutual cancellation cannot occur. Whenever the size of the circuit is physically such that no mutual cancellation is effective, energy will be radiated.

The terminated or "travelling-wave" antennas we examined last month were examples of "transmission lines," which had only one-way net current flow (ground serves as the second conductor in this example). Such a "transmission line" is an excellent radiator of *rf* energy–if it's big enough.

Mere physical size is not enough, either. The dimensions must be large in comparison to a wavelength. A cross-country power distribution highline fails to do much radiation of its 60-cycle power although it's many miles long, because its conductors are spaced only a minute fraction of a 60-cycle wavelength apart and their fields mutually cancel. A 6-meter antenna, on the other hand, radiates nicely from elements which are much shorter than the distance between highline conductors, and a microwave circuit can provide appreciable gain from a beer can!

Since a transmission line consists of two conductors, which are insulated from each other, then it must have some capacitance between them. In addition, each of the conductors also has some self-inductance, and of course at least a little resistance as well.

Let's look at a very short section of a very long line, such as that shown in **Fig. 1.** In even this very short distance along the line, the voltage between wires is not the same at all points, nor is the current in either wire.

For instance, the current flowing through the wires must by Ohm's Law result in at least some voltage drop across the resistance and inductive reactance of each tiny portion of each wire. That is, the voltage from A to D indicated by dotted line 1 is greater than that from B to C indicated by dotted line 2, because of the two voltage drops–one from A to B and the other from C to D– caused by the current flow.

Similarly, alternating current effectively "flows" through a capacitance, so that the current flowing from E to F is greater than that from F to G, because of the leakage current through the line's capacitance from F to H.

Since this is ac we're discussing, to be theoretically accurate we would have to resort to a set of differential equations–but for all ham purposes it's adequate to think in terms of Ohm's Law for ac. This tells us that the effect of the inductance and capacitance as illustrated in **Fig. 1** upon the voltage and current in the line must be an *impedance,* since only an impedance can relate voltage and current in an ac circuit.

And impedance, like a resistance, is essentially independent of voltage or current. It's determined by the physical characteristics of the device or component, not by the signal that happens to be applied or the devices to which it may be connected.

In the case of our transmission line, the impedance is determined by the inductance and capacitance of each tiny part of the line. Both the inductance and capacitance are distributed over the entire length of the line, rather than being lumped into coils or capacitors, and thus the impedance is an essential built-in part of the line.

Incidentally, this capacitance which helps form the impedance is no theoretical fiction. Should you ever be in need of small precision capacitors, you can cut them to measure from *rf* feedline such as TV twin-lead. All these lines are rated for capacitance in picofarads per inch; simply cut off as many inches as you need. It's a handy trick to keep in mind when electrically small capacitors are necessary.

What Are The Major Characteristics of a Transmission Line? We've already met some of the characteristics of a transmission line. Its impedance is one of the most important, for *rf* use. But impedance is not the only characteristic—and a length of line lying on the floor has far different characteristics than does the same line when trimmed to dimension and installed in an *rf* circuit. Let's look both at the intrinsic characteristics of a feedline, such as impedance, capacitance, inductance, etc., and also at the effective characteristics or properties of specific lines of special length or with special terminations.

We have seen that the impedance of a line is determined by the inductance and capacitance distributed throughout the line's length. For *rf* transmission lines, the impedance is approximately equal to the square root of the ratio of inductance to capacitance. If the resistance of the wires in the line were absolutely zero, and the leakage resistance of the insulator separating the wires were infinite, then the line's impedance would be exactly equal to the square root of inductance divided by capacitance—and in *rf* lines the wire resistance is low enough and the leakage resistance great enough that we don't get into trouble.

However, the wire and leakage resistances *do* exist, so we can't ignore them completely. They contribute to losses in the line, and so provide a characteristic of the line which is called attenuation. Attenuation in any type of transmission line increases as the signal frequency goes up, because the wire resistance goes up and the leakage resistance goes down with increasing frequency. In most practical applications the attenuation of any line is given as a "decibels per 100 feet" figure; a line rated for 3 db/100 feet attenuation will lose half its power in every 100 feet of length. If you pump a kilowatt of *rf* into a 300-foot length of such a line, you'll get out only 125 watts. The first 100 feet of the line will lose half the input power or 500 watts, leaving only 500 to go on. The next 100 feet will lose half of that remaining 500, and the final 100 feet will dispose of half of the 250 watts which had survived the middle portion.

The attenuation of a line is at least as important as its impedance. The attenuation figures tell you how much power is going to make it through the line, and they also will affect the way in which the line looks to your transmitter—as we shall see shortly.

In Fig. 1, we assumed that the power going through our short section of transmission line was all going from a source to a load. That is, the line was carrying power only one way.

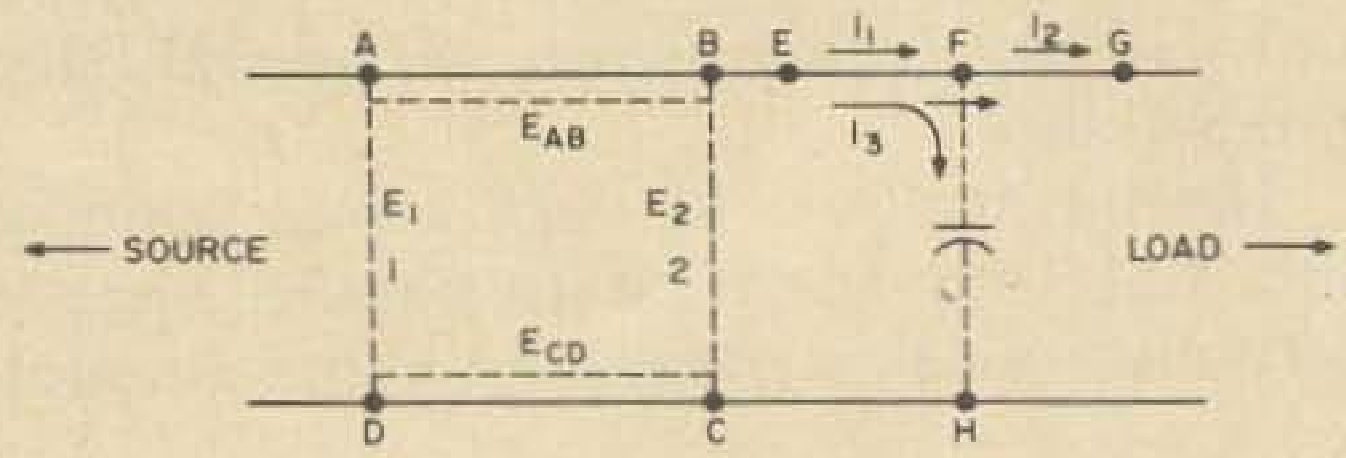


Fig. 1. The most basic physical characteristics of a transmission line are shown here. Assume that current is flowing from the source direction toward the load. The voltage from A to D must be the same as the sum of that from A to B, B to C, and C to D—but current flow through the wires means that the voltage drop from A to B and from C to D will be greater than zero, so the voltage between the two wires at A-D is greater than that at B-C. Similarly, current at point E includes that flowing to charge capacitance F-H, and so must be greater than that at point G. These voltage and current relationships define the impedance and attenuation of any transmission line.

In practice, this is seldom true. The nature of the fields and waves which make up *rf* energy (or any ac energy for that matter) being what it is, a one-way travel of any set of waves will stay one-way only so long as that set of waves stays in the same medium. When any boundary is reached—that is, when anything gets in the way—some of the energy is reflected at the boundary, and at least some of the reflected energy comes back in the direction exactly opposite to its original direction.

It happens to be possible, from a mathematical point of view, to account for *all* the reflected energy in terms of just two sets of waves. One set is considered to be the original set, going "forward" or in the original direction, and the other set is considered to be going in the exact opposite direction. This is known as the "reverse" or "reflected" wave, while the original set is called the "forward" or "incident" wave.

Note that this way of accounting for the energy does not claim that all the energy is actually contained in the forward and reverse waves; we actually do not know for sure exactly what does happen. It merely says that if we consider only the two sets of waves, we can account for what happens.

If we can account for what happens, and

our accounting method lets us predict what will happen in any normal set of circumstances, then it's a workable tool whether it's a correct one of not—and the concept of incident and reflected waves in a transmission line is just that, a workable tool. We don't need to know more than that in order to make use of it, any more than we need to know the atomic structure of steel in order to cut a hole through metal with a cold chisel.

Terman says the same thing in a different way on page 84 of his "Electronic and Radio Engineering" (fourth edition): "The voltage and current existing on a transmission line as given by equations 4-6 can be conveniently expressed as the sum of the voltages and currents of two waves." Notice that his sole reason for doing so was *convenience.*

Now that we've established the incident and reflected waves on a transmission line as convenient tools—without going any deeper into whether they actually exist as such—let's see how we must define each of them in order to make it into a useful tool.

The incident wave starts at the source and goes toward the load. It is the wave we considered in **Fig. 1**, in which both the voltage and current get smaller as we go farther from the source. Since the wave takes a definite time to go any given distance down the line, the instantaneous phase at any point along the line must lag as we get farther from the source. That is, the part of the wave most distant from the source must represent a part which left the source *before* any nearer part did.

There's nothing in the transmission line itself to alter the relationship between voltage and current in the incident wave, because the retarding effects of the distributed inductance along the line are cancelled by the advancing effects of the distributed capacitance and the net reactance is zero. Therefore the voltage and current at any point in the incident wave have the same phase relationship to each other that they had at the source.

All this means that we can describe the incident wave as a voltage accompanied by a current that is everywhere in phase with, and proportional to, the voltage. Because of the continual decrease of both voltage and current we saw in **Fig. 1**, both the voltage and current decrease as we go away from the source, and drop back uniformly in phase.

This description corresponds to that of a travelling wave, propagating away from a source, and so we say that the incident wave travels *toward* the load.

The reflected wave, on the other hand, is identical with the incident wave except that it is travelling in the opposite direction. This means that it is largest at the load and gets smaller as it nears the source; its current goes toward the source rather than away from it, and its phase advances rather than dropping back.

The reflected wave comes into existence because of a reflection at the load end of the transmission line. Keeping in mind that the whole idea of incident and reflected waves is a *tool* based on a mathematical accounting for events, and not necessarily an accurate description of the events themselves, it's not too surprising to find that the generation of the reflected wave is dictated by equations in the mathematical accounting. Five separate sets of equations must be satisfied simultaneously to make the reflected wave account for events; we'll ignore the separate sets of equations and examine only their merged result:

The final result of the simultaneous solution determines a factor known as the "reflection coefficient", which boils down to be the ratio of voltage in the incident wave at the point of reflection to voltage in the reflected wave at the reflection point. If voltage in both is zero, as in the case of a short-circuit (which we shall examine before long) then the current ratio may be used instead–and since impedance is a quantity determined by voltage and current, it's possible to define reflection coefficent in terms of the ratio between impedance of the line and impedance of the load.

In a perfect line–one which has no losses and thus no attenuation–the reflection coefficient is the same anywhere on the line,

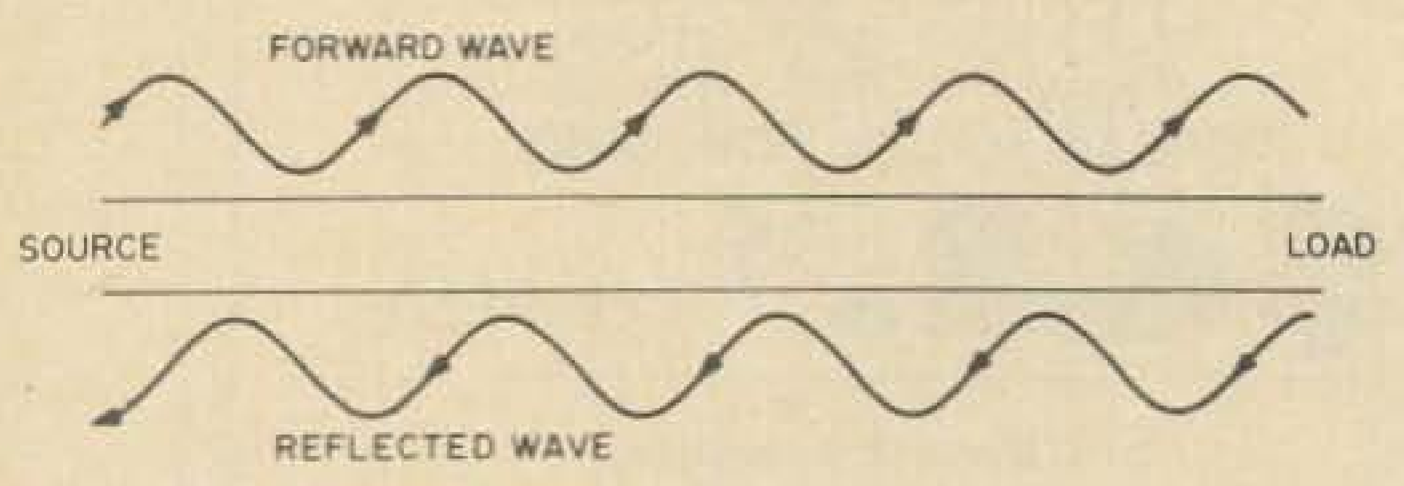


Fig. 2. Actual wave upon transmission line can be accounted for by two special waves called "forward" and "reflected" waves, each traveling in a single direction as shown here. Actual wave is then the net total of forward and reflected, at any point. Perfectly matched line has no reflected wave and forward wave is equal to actual wave; mismatch puts in "reflection" and modifies this situation. See text for details.

and is determined by that at the load. Any actual line, however, has attenuation; this attenuation acts oppositely upon forward and reflected waves because they go in opposite directions. Looking back at the source from the load, the forward wave gets larger as the source is approached because it has been affected less by attenuation, while the reflected wave gets smaller because attenuation is affecting it more. This means that on such a line, reflection coefficient is highest at the load or reflecting point, and becomes ever smaller as you move back toward the source. We'll see some practical implications of this fact, in the next section.

For now, though, let's back up a bit and look again at the relationship between the incident and reflected waves, and the actual voltage and current existing upon the line. It's actually very simple: the actual voltage at any point upon the line is the sum of the incident-wave voltage at that point and the reflected-wave voltage at the same point, and similarly the actual current at any point is the sum of incident and reflected currents at that point. If the two voltages (incident and reflected) are equal in value but opposite in sign, the "sum" would of course be zero since the two would cancel out.

Since the line is carrying ac, the voltage (at any one instant) is differenct at different points along the line both in value and in polarity. When we want to examine the situation all along the line rather than just at a single point, we speak instead of the voltage (or current) "distribution" on the line.

To see the part played by the incident and reflected waves in determining voltage (or current) distribution on a line, let's look at several examples of extreme cases. In all these examples we'll assume a perfect line with no losses just to simplify the situation. A little later we'll include the effects of losses upon similar examples.

For our first extreme, let's look at an open-circuited line which simply stops with no load of any sort connected to it.

With no place for any current to go, the current flow at the load end of this line must be zero.

But by our definition of incident and reflected waves, to account for this situation we must assume that both the incident and reflected waves do have current flow in them, of equal value but opposing sign. This is the only way in which the incident and reflected waves can cancel each other out to produce an *actual* current of zero.

In other words, the open circuit reflects all the current which reaches it back down the line, reversing its polarity as it does so.

Our definition of reflection coefficient– the ratio of incident voltage or current to reflected voltage or current– tells us now that the reflection coefficient of an open circuit must be 1.0.

We can measure a voltage across this open circuit, which shows us that the voltage polarities at this reflection must remain unchanged although the current polarity reverses (had the voltage polarity as well been reversed, the measured voltage would have been zero).

At this point we have defined a reflection coefficient of 1.0 for an open-circuited transmission line. Let's move back along the line from the open circuit and see what happens to the actual voltage and current distributions.

At a point exactly ¼ wavelength from the open circuit, we are examining a part of the incident wave which is 90 degrees earlier in phase than that at the open circuit. The voltage of the reflected wave is 90 degrees *later* in phase than that at the open circuit, which means that from where we now stand the voltages of the incident and reflected waves are 180 degrees out of phase with each other. That's 90 degrees early for the incident combined with 90 degrees late for the reflected.

But in any ac waveform, any two points 180 degrees apart in phase have equal value and opposite sign. That means that, at this point, the voltages of the incident and reflected waves must always cancel each other out and the actual voltage at this point must always be zero.

How about current here? The reflection introduced a 180 degree phase shift in the current at the open circuit. The current of the incident wave is 90 degrees earlier than that, and that of the reflected wave 90 degrees later, so the currents of the incident and reflected waves are 90+180+90 or 360 degrees out of phase right here. But a 360 degree phase shift amounts to no shift at all in a periodic waveform–so at this point the current is maximum while the voltage is minimum.

Let's more another ¼ wavelength back so that we're examining a point a half wavelength back from the open. Now our voltage phase shift is 180+180 degrees, which amounts to no change at all, and we

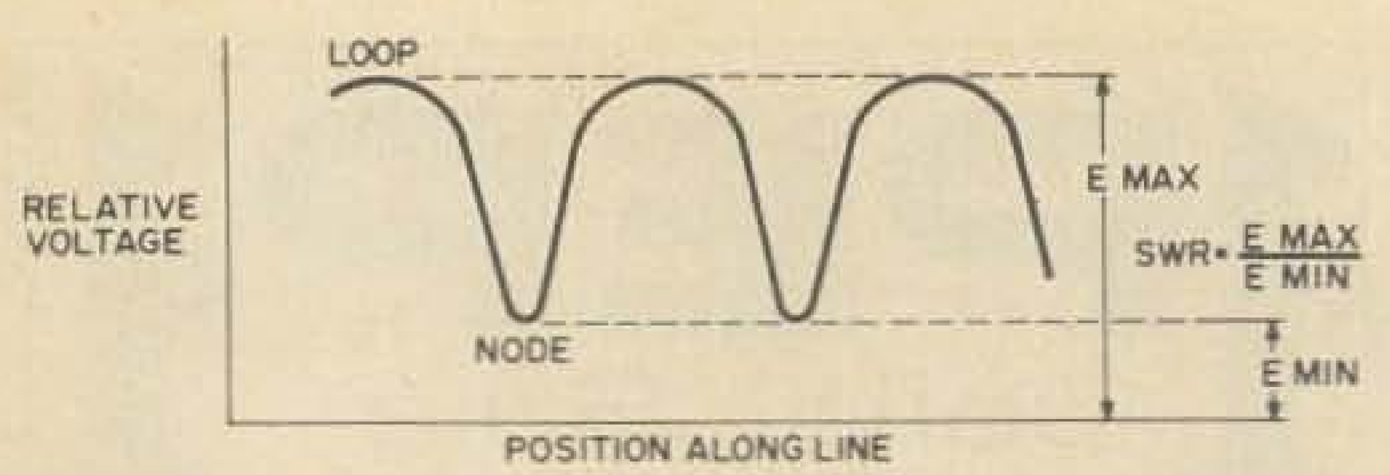


Fig. 3. Voltage distribution on transmission line having measurable standing wave ratio looks like this, if measured at various points along the line. Maximum-voltage points repeat every half-wavelength along line, as do minimum points. Ratio of maximum voltage to minimum voltage is one meaning of SWR; other meanings are equally valid as discussed in text. Note that voltage distribution does not follow a sine-wave pattern.

will find the same actual voltage as that which exists across the open circuit. The current phase shift is 180+180+180 or 540 degrees, which corresponds to a 180 degree change. The incident and reflected currents cancel each other out. Once again we find the same condition that existed at the open circuit.

As we move back on the line, at every ¼-wave interval we will find these conditions alternating. Every half-wave the conditions of the open circuit–full voltage with zero current–are duplicated, and at the intermediate ¼-wave points (usually called "odd quarter-wave" points) the opposite condition–zero voltage with maximum current–exists. It's brought about entirely by the phase relationship between incident and reflected waves, which is determined in part by the reflection coefficient at the open circuit and in part by the distance from our measuring point to the open.

Let's try another example. Instead of an open circuit, let's short the line out.

This gives us zero voltage across the short, together with maximum current. Curiously enough, that's the same condition we found at a distance of ¼ wave in from an open circuit.

To get the zero voltage, we must have again a reflection coefficient of 1.0 at the short, with 180 degrees phase shift for voltage and 0 degrees phase shift for currents at the reflecting point. That's the only way we can make the incident and reflected waves come out to match the measurable conditions at the short.

If we now move back a quarter wavelength on the line, we'll find a voltage phase difference between incident and reflected waves of 90+180+90 degrees, which amounts to no shift at all, and a current phase difference of 90+0+90 degrees, or 180 degrees, which produces cancellation. Full voltage and no current! The open-circuit condition, no less.

Regardless of our termination, we find that the terminating condition is repeated at half-wave intervals back from the load end of the line, and that its "opposite" occurs at the intervening ¼-wave points.

Let's look in a little more detail at that "opposite". When we terminated in an open circuit, which featured high impedance and almost no current flow, at the quarter-wave point we apparently had a short circuit, with low impedance and maximum current flow. When we terminated in a short, or low impedance, we found at the ¼-wave point an apparent open, or high impedance. We found, in effect, that a ¼-wave length of transmission line acts as a *transformer* to change high impedances to low, and vice versa.

Before we explore this idea any deeper, let's take one more example. What happens if we terminate a transmission line in another, identical, infinitely long transmission line?

Reflection coefficient, you'll remember, we defined as the ratio of incident to reflected voltage–and we added that it could be described in terms of the ratio of impedances also. If the two impedances are identical, the reflection coefficient must be zero. And if it is zero, then the reflected wave cannot exist; the actual voltage on the line and the incident wave must be equal to each other. In such a case, the line is said to be "matched." As it happens, we could substitute a resistor in place of any part of the infinitely long line, and if the impedance remained identical, nothing would change. This is the principle behind efforts to "match" antennas–and the success of our efforts to match impedances is measured in terms of a standing wave ratio or SWR.

We'll get into SWR in detail just a little later, after cleaning up a few loose ends about the major characteristics of a transmission line. We have determined that a line has capacitance, inductance, resistance, impedance, and attenuation, and that the energy in it at any point can be accounted for by incident and reflected waves travelling in opposite directions along the line. We have also determinded that any change of impedance along the line will cause a reflection, and that the amount of reflection is indicated by the reflection coefficient,

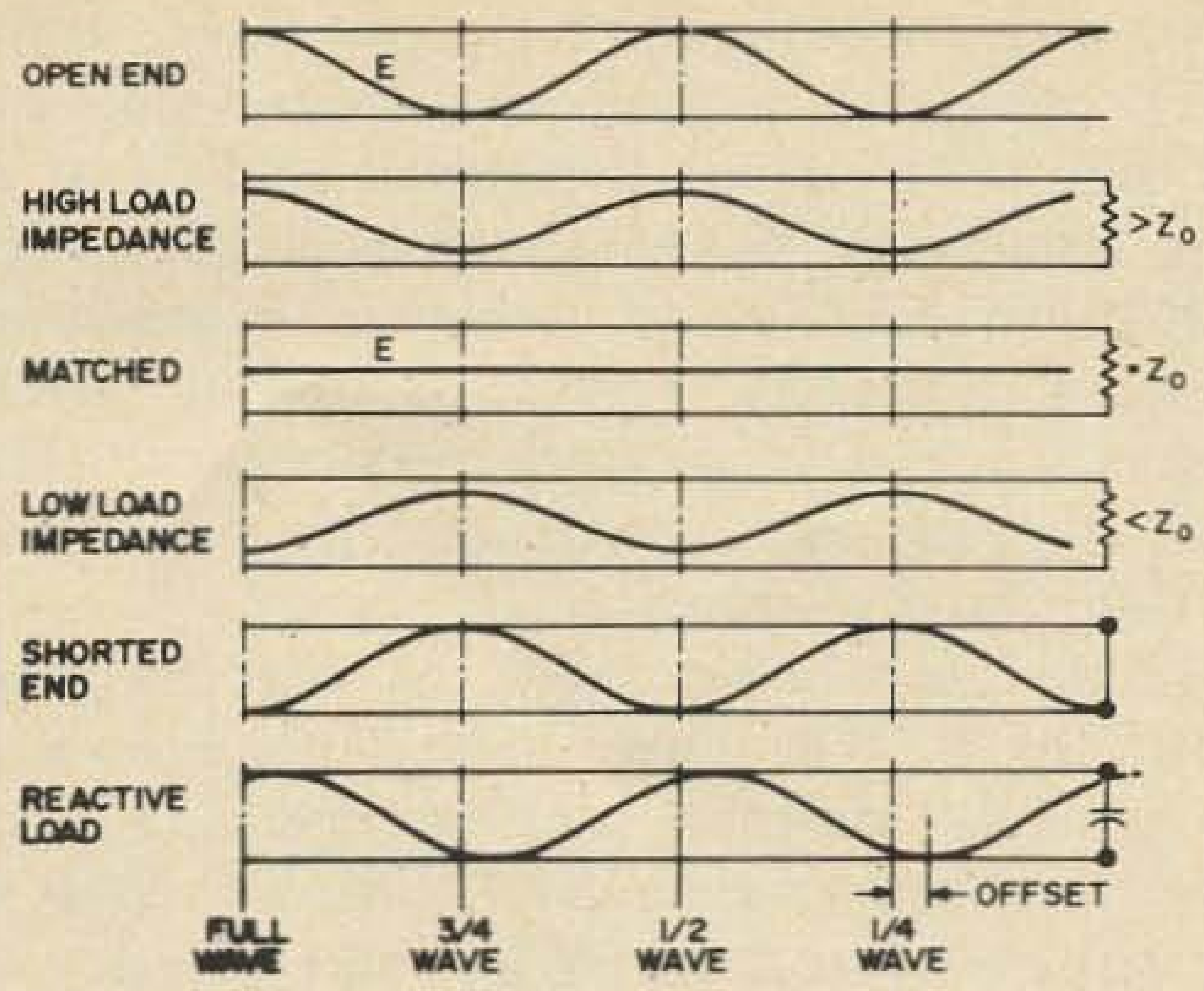


Fig. 4. SWR voltage patterns, similar to that shown in Fig. 3, for a number of different types of line terminations. Note range and phasing from open circuit (top) through matched condition (third from top) to short circuit (next to bottom). Effect of reactive loads is similar to open or short, with reflection coefficient of 1.0 for pure reactive loads; capacitance makes line appear longer and inductance shorter than physical length. Mixture of reactance and resistance changes phase (like reactance) and SWR (like lines 2 and 4) both.

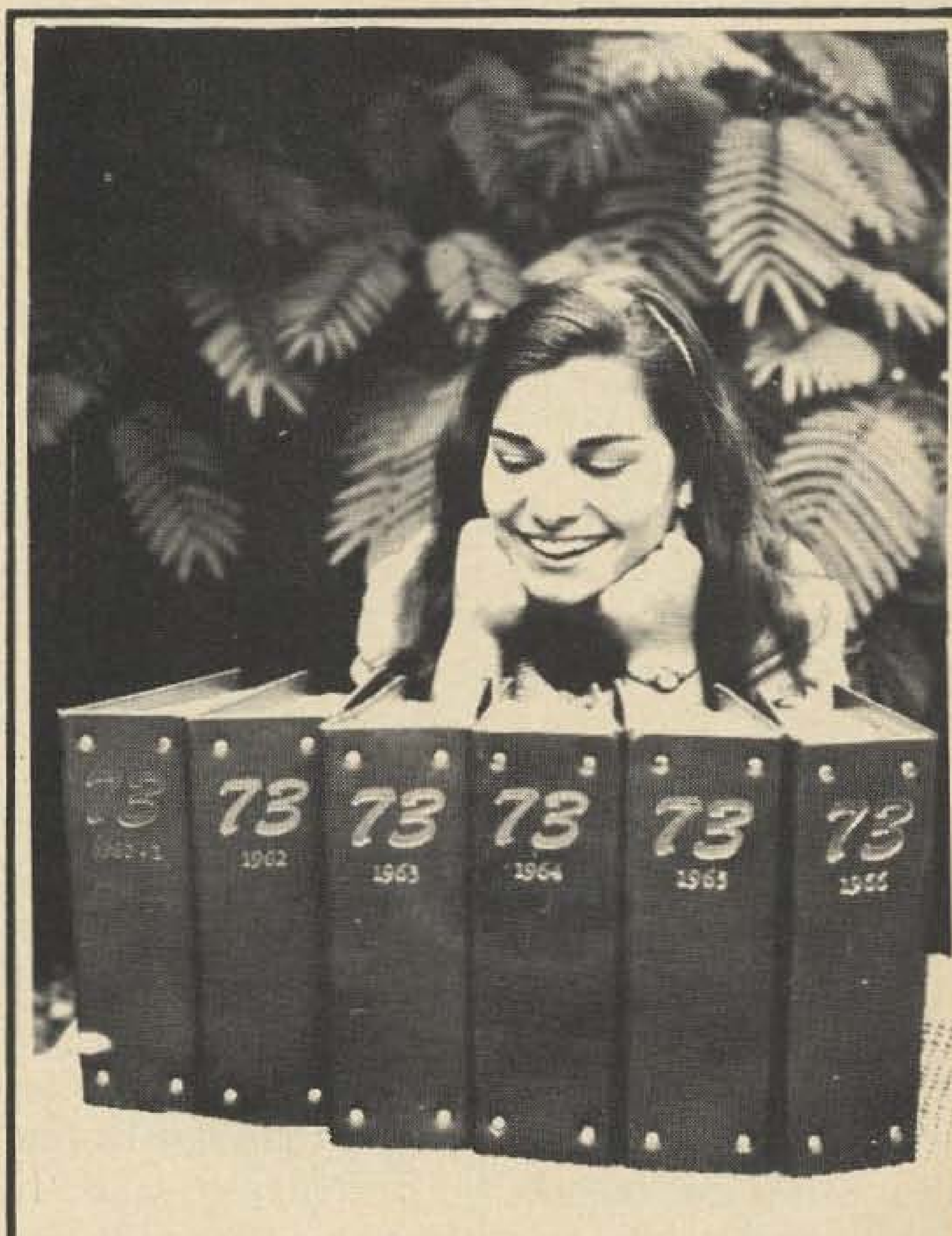
which in turn is determined by the impedance ratio present at the reflection point.

We found that a reflection coefficient of 1.0 exists with either a short circuit or an open circuit as the load on the line, and that in either case the load condition repeated itself every half-wave back from the load, while the opposite condition occurred at the intermediate quarter-wave intervals.

But our examination of what happens when incident and reflected waves get together examined only a few extreme cases, and completely neglected the effects of line losses (attenuation). Let's see what happens when we plug the losses in too, and check out some in-between cases.

Remember that we found a complete cancellation between incident and reflected waves at the intermediate points, in our examples. This could not happen with any losses at all in the line, because the energy making up the reflected wave must always go farther along the line—out to the reflection point and back—than does the incident wave. The result is an almost, but not quite, complete cancellation instead—which leaves us a very small voltage or current in the incident direction, instead of zero. This is the only effect of small to moderate values of attenuation.

If we terminate a line in an impedance



greater than its own, but smaller than an open circuit–just to get a figure. let's say one three times as large as the line impedance–the result will be similar to that when we have an open, but not as extreme. The reflection coefficient in this case would be ½ instead of 1, which would make the reflected wave half as strong as the incident wave. When a cancellation would occur with an open circuit, only half of the incident wave would be cancelled in this case and the other half would remain. When a reinforcement would occur, the resulting sum would be a full-strength incident wave and a half-strength reflected wave, or 1-½ times the "matched" value. Both voltage and current would vary from half normal to 1-½ times normal, for a 3-to-1 variation.

At the quarter-wave point, the current would be 1-½ times normal and the voltage would be only half normal. This higher-current/lower-voltage condition defines an impedance LOWER than that of the line although the load impedance in this case is greater. We would expect this because we have already seen that a quarter-wave line transforms an open circuit into a short. The value of this lower impedance, though, bears the same ratio to the line impedance as the line impedance does to the load; in each case it's 3 to 1. That's necessary in order to keep the reflection coefficient constant all along the line. We can step up as well as down this way, and it's widely used.

What is a Standing Wave Ratio? We have just seen how any reflection upon a transmission line produces an interaction between the incident and reflected waves to create a pattern of high and low voltage points (loops and nodes) from that reflection back to the generator, and that this pattern does not vary with the instantaneous voltage or current of the outgoing energy.

Such a stationary pattern of voltage or current distribution is called a "standing wave" since it is not travelling. The amount of standing wave present on any line is measured by the "Standing Wave Ratio" or SWR, which is the ratio of maximum voltage to minimum voltage along the line, or alternatively the ratio of maximum to minimum current. This is very similar to the definition of reflection coefficient, and in fact SWR and reflection coefficient are related so closely that either can be converted to the other by a little arithmetic. The major difference is that reflection coefficient compares values in the forward wave with those in the reflected wave, while SWR compares actual maximum value on the line with actual minimum value and is thus somewhat easier to measure directly. Reflection coefficient, however, is easier to measure indirectly, and most of our "SWR meters" actually measure reflection coefficient instead, making the conversion to SWR by their scale calibration.

Some authorities speak of the "voltage SWR" or VSWR when they mean the ratio we have just defined, and use the bare term SWR to mean "power SWR". Power SWR is the square of voltage SWR, since the power in any resistor is proportional to the square of the voltage (or the current) applied to that resistor.

Fig. 3 shows a waveform view of what we've been talking about for so long, now that we have most of the words. While the illustration is based upon voltage waveforms, the same sort of thing is true of current waveforms as we saw a while back. Fig. 4 compares voltage and current waveforms in the SWR patterns created by several types of loads on the same type of line.

We saw last month that the presence of a standing wave upon an antenna structure made it easier for radiation to occur, and that also holds true of transmission lines. A high SWR will increase the likelihood of radiation from the line–which is usually an unwanted situation, since radiation is one major source of line losses.

A high SWR will also increase both leakage and resistive losses within the line, since it will increase current at the high-current points along the line ("current losses") and will increase voltage at the high-voltage points as well. Higher current means more power loss in a given resistance ($P=I^2R$), and higher voltage also means more power loss.

Most operators who take pride in a "good" operation, for these reasons, strive to achieve the lowest possible SWR in their transmission lines.

As we have indicated, SWR can be measured by actually measuring either voltage or current all along the line and then determining the maximum-to-minimum ratio, or by measuring the reflection coefficient with a "reflectometer" or "directional coupler" and converting to SWR. It can also be calculated by a much simpler rule: If the load impedance is known, and is a pure resistance without reactance, then the VSWR is equal to the ratio of load impedance to line impedance (or line impedance to load impedance, whichever yields the highest figure). Our 3-to-1 example a few paragraphs back shows this, and how it comes about.

The VSWR, incidentally, can never be better than 1-to-1, since this says that the load and line have identical impedances and under this condition the line is perfectly matched. An SWR figure less than 1.0 simply says that you have a pretty bad SWR and have calculated it the wrong way; divide 1 by the figure you have to get the real SWR.

The VSWR of an open or a short circuit is infinite—but you can never measure it to be such a high value, because of line losses. The more loss in the line, the more the reflected wave will be reduced. The more the reflected wave is reduced, the less effect it can have upon actual net voltage or current an any point, and the smaller effect will produce a lower SWR. A long, lossy line is one of the best dummy loads available, because it can present a near-perfect SWR at its input end even when the load end is open circuited. For the same reason, SWR measurements should be made as close to the load end of the line as possible to escape this "swamping-out" effect of line losses.

Let's take as an example to calculate most of the things about SWR which the FCC wants you to know the case of a 52-ohm line terminated in a 104-ohm resistive load. We know immediately that the VSWR is 104/52, or 2 to 1. We also know that if 10 amperes are flowing in the antenna terminals, either twice as much or half as much will be flowing at a point ¼ wave back from the load because the VSWR is 2 to 1. Since the antenna's impedance is higher than that of the line, the ¼-wave point will have an impedance lower because of the transformer action—and in a lower impedance, more current must flow. This tells us that twice as much current will be flowing, and also that the point ¼ wave back is a current loop. Therefore 20 amps will be flowing at the loops, and 10 amps at the nodes.

Had the load resistance been less than that of the line but with the same VSWR (which would have required a 26-ohm load), the current at the ¼-wave point would have been only half that at the load. This would mean, in turn, that the load represented the highest current point or loop, and the other loops would have been at the ½-wave intervals back along the line.

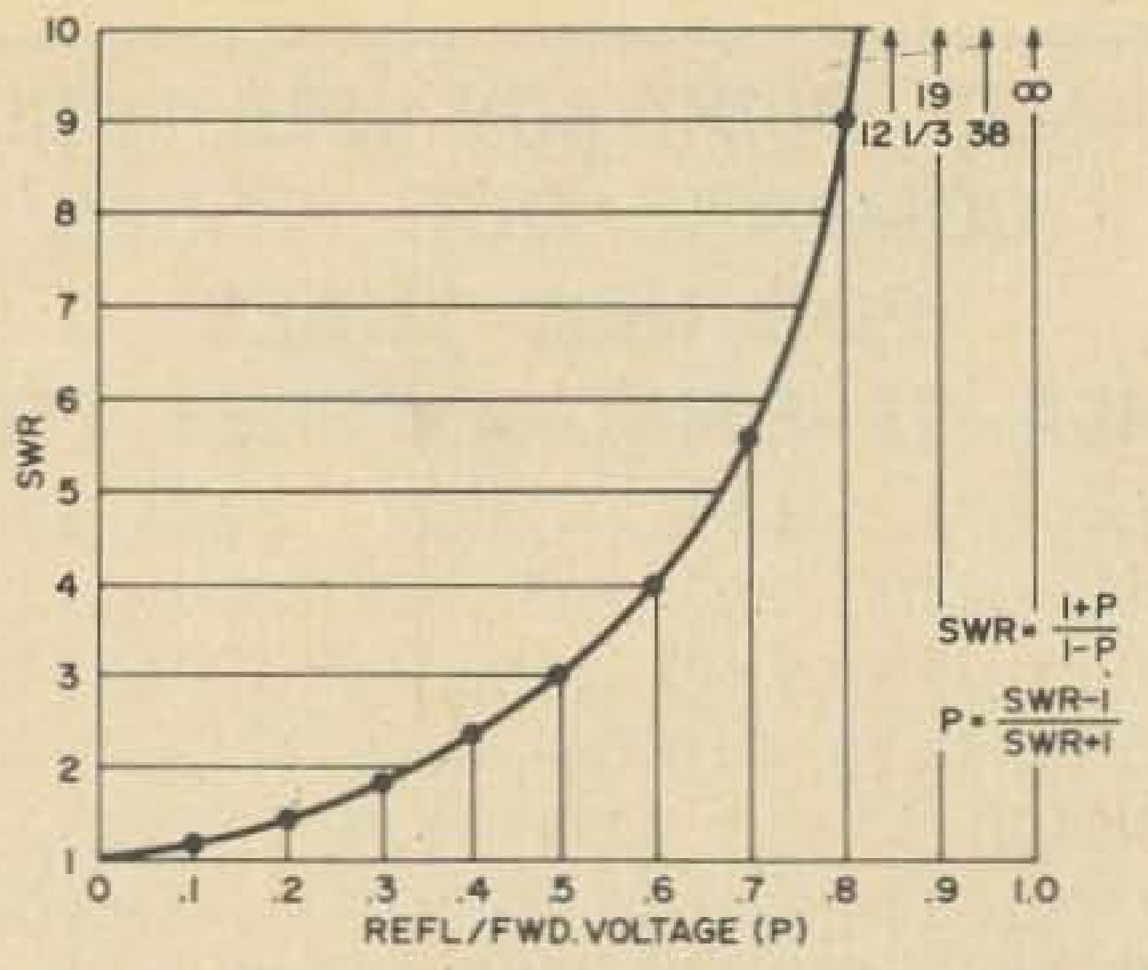


Fig. 5. Conversion from reflection coefficient to SWR and vice versa can be done by either this graph or the two equations shown here. Common SWR bridges and directional couplers measure reflection coefficient; any meter which is set to full scale with "forward" voltage or power and then read using "reverse" or "reflected" quantities probably works the same. Any meter movement can be calibrated for use with such devices by using horizontal scale here and taking SWR reading from vertical scale.

Getting the conversion from VSWR to reflection coefficient is fairly simple arithmetic. **Fig. 5** shows the formula, together with a graph which permits reasonably close reading of the values (the formula is exact). With an SWR of 2, the formula tells us that reflection coefficient is (2-1) / (2+1), or 1/3. For every ampere or volt going up the line, 1/3 amp or volt comes back. But since actual energy is only that part of incident versus reflected which does not cancel out, it's quite possible to have 26-2/3 amps going up, 6-2/3 coming back, and find only 20 amps in the line! Either a forward power or a reflected power reading is meaningless alone so far as telling you what the actual power in the line may be; you must have both, and the actual power is the difference.

Just as VSWR is determined by voltage, and must be squared to get an SWR figure relating power, so is the reflection coefficient determined by voltage, and it too may be converted to a power figure by squaring it. This means that our VSWR of 2, produced by a 2-to-1 load-to-line impendance ratio, is a power SWR of 4, a reflection coefficient of 1/3, and represents a power reflection coefficient of 1/9. To get an actual power of 100 watts out, we must send 111.1 watts forward up the line because 11.1 watts (1/9 of 100) will be reflected back. Actually, it's a little more complex than that because the reflected power will be 1/9 of our forward power; this means that we must send more than 111.1 watts up. It works out to be 112.5 watts forward; 1/9 of this or 12.5 watts is reflected, and the remaining 100 watts is the actual power in the line. The percentage of reflected power is sometimes taken as the ratio reflected-to-forward times 100, and sometimes as reflected-to-total times 100. In the first case, the percentage of reflected power would be 11.1 percent (which is our original 1/9 figure); in the second it would be 12.5 (which is 1/8, and can be gotten by merely subtracting 1 from the denominator of our original figure). In practice, VSWR is met so much more often than is percentage of reflected power that you're not likely to have much trouble.

We've said that a high SWR was normally to be avoided. While this is true in transmission lines used to carry *rf* for considerable distances, there are exceptions. A quarter-wave section used as a transformer, for instance, must have upon it an SWR equivalent to the transformation ratio it is providing. If such a section is being used as a resonant circuit rather than as a transformer (that is, with one end open-circuited to produce the effect of a series-resonant circuit at the other end, or short-circuited to produce the effect of a parallel resonant circuit at the other) the SWR will be extremely high. While "infinite" is a bit too strong a term to apply to the SWR in such a case, it will be in the thousands or higher. VHF addicts who are familiar with the high currents to be found in coaxial or parallel-line tank circuits can attest to this fact.

In addition to the effects the SWR has upon line losses, the interaction between the forward and reflected waves modifies the line's input impedance. A 50-ohm line will only look like 50 ohms at the input end if it is matched to a 50–ohm load. If the load is 100 ohms instead, then the input impedance may be as low as 25 ohms resistive (for an odd number of quarter-waves of line length) or as high as 100 ohms resistive (for multiples of half-waves of line length).

But in between these extremes, even if the load itself is a pure resistance, the line won't look like pure resistance at all. Instead, it will show both reactance and resistance. **Fig. 6** shows how the impedance varies along such a line with a VSWR of 2 to 1.

This fact helps explain why the pi-network transmitter output circuit, with its reputed ability to "match almost anything", sometimes comes a cropper for no apparent reason. If the line length from transmitter to antenna just happens to fall in a region which emphasizes reactance, and with even a moderate SWR, the input impedance can become so reactive that no physical component in the pi-net can possibly provide proper adjustment. For instance, while loading is usually minimum with the output capacitor set for maximum capacitance, a pi-net in such an unhappy circumstance as we are examining here may already have far too little capacitance even when the capacitor is set at maximum. With critical line lengths and SWR as low as 2 to 1, it's possible to run into a need for *negative* capacitance (not inductance, which has opposite reactance sign but behaves differently with respect to frequency!). quency!).

It's also possible, at a critical line length on the other side of resistive point, to find that even with the loading capacitor set to minimum the circuit just won't load. This is because most of the capacitance of the circuit is being supplied by the line's input impedance.

In both cases two cures are available; one is to reduce the SWR, and this is the one usually recommended by most authorities. It's fine for a commercial, single-frequency operation, but hams must operate over the limits of a band rather than on a spot frequency and SWR necessarily changes from one end of a band to the other. The other cure is simpler—just adjust the line length by adding a 1/8-wavelength extension to the line. The SWR remains the same, but the length is no longer critical and the transmitter can once more be loaded. It will seem to act normally, for a change.

How Are Operating Frequency and Antenna Design Related? Any wire antenna is a circuit with "distributed" constants. That is, its inductance, capacitance, resistance, etc., are distributed throughout its length rather than being lumped into concentrated areas. Because of this, the current distribution in the antenna which results from applying a voltage at just one location depends upon, among other things, the length of the wire—which is measured in wavelengths. This is one of the most fundamental relations between operating frequency and antenna design, because operating frequency and wavelength are simply two ways of measuring the same property.

Last month we made the acquaintance of both "resonant" and non-resonant or "travelling wave" antennas. In both cases, the directional pattern of radiation was determined by the current distribution upon the antenna in conjunction with the relative phasing of the radiated fields from each tiny part of the antenna structure—and phasing also is related at least indirectly to operating frequency, because the frequency is a measure of the time between points of identical voltage in the signal, and phasing is a measure of the same quantity but in a different context. Frequency is measured in terms of the time to reach an identical voltage at the same point is space, while phasing is measured in terms of the time difference between points of identical voltage at different points in space.

Last month we concentrated largely upon the action of the non-resonant amtenna; this time let's turn our gaze to the resonant case.

A resonant wire corresponds to a transmission line that is an exact number of half wavelengths long and is open-circuited at both ends (a non-resonant antenna also corresponds to a transmission line but it is matched at both ends). We have already seen that such a transmission line will repeat the conditions at its end every half-wave along its length. If the wire is only a half-wave long, it will repeat the open-circuit of one end precisely at the open circuit which is the other end. If it is a full-wave long, again the open from one end will repeat at the other, but now both the opens will repeat at the

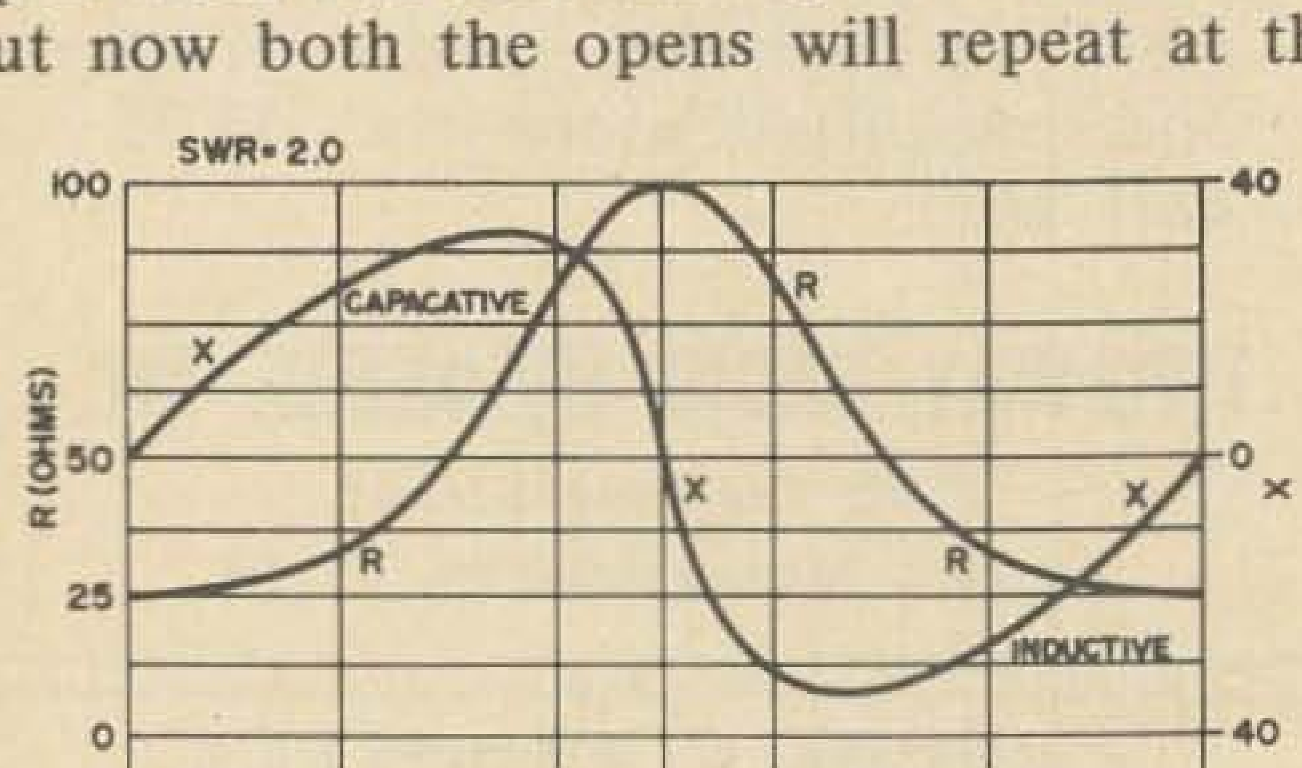


Fig. 6. Variations in both resistance and reactance along transmission line with SWR of 2.0 over any half-wave interval are shown here. Source of line is at left, and load is toward right. At 0 and ½ wavelength points, resistance is lowest and reactance is zero. At ¼ wavelength points, resistance is highest but reactance is also zero here. All other points have intermediate resistance, but also reactance. Patterns are similar for other values of SWR but variations are more extreme when SWR is higher. With extremely high SWR, resistance approaches infinite values.

midpoint of the wire as well.

A half-wave length of wire is two quarter-wave lengths back to back. But a quarter-wave length of transmission line open-circuited at one end will appear to be a short circuit at the other end. This would indicate that a half-wave length of wire open at each end should have an apparent short circuit at its midpoint—and except for the fact that the wire does have some "losses" (the radiated energy is lost so far as the standing wave upon the wire is concerned), it well might! The impedance is very low at the midpoint, at any rate. This low impedance provides a feedpoint for the antenna which matches a low-impedance feedline, and is known as a "current-fed" system.

The low-impedance points produced by quarter-wave transformation of the open circuits at the antenna ends will coincide only when the operating frequency is such as to make the antenna an exact half-wave long, electrically. If operating frequency departs even slightly from this one single spot, the two low-impedance points will not coincide, although the impedance at the center will still be low over an appreciable band of frequencies.

As we saw in **Fig. 6**, when even a moderate SWR exists upon a transmission line the impedance is pure resistance only at exact quarter-wave intervals along the line. At all other points reactance is present also. An antenna, being a pair of quarter-wave transformers, operates with a very high SWR upon its structure, and the variations shown in **Fig. 6**, are exaggerated still more in this case. This means that if operating frequency is not precisely that for which the antenna was cut, the antenna cannot be a pure resistance to its feedline. Again, reactance will remain low ever an appreciable spread of frequency. Bandwidth depends upon the particular antenna design; some have wider usable bands than others.

Outside this usable band of feedpoint impedances, the mismatch between antenna and feedline is so great that more power is reflected than is radiated. We say that the antenna in such a situation "refuses to load."*

For any single length of wire fed at its midpoint, there is a single lowest frequency

*(*Ed. note: A purist will quarrel with this terminology. An antenna does not "load." It presents a load to the transmitter. The transmitter will refuse to load into a mismatch. The antenna will refuse to radiate.)*

at which it can operate in this manner; that's the frequency at which the wire is electrically one half-wave long. If operation at twice this frequency is attempted, then each side of the antenna acts as a half-wave repeater rather than a quarter-wave transformer and it will refuse to load.

As we go up in frequency to three times the original value, though, we reach a point at which each half is three quarter-waves long, and the wire again acts as a pair of transformers. The loading conditions of the first frequency are essentially repeated here, and the antenna radiates nicely.

At four times the original frequency, we have repeaters again instead of transformers. In fact, at any even harmonic of the first or "design" frequency the halves will act as repeaters and a minimum of energy will be accepted. However, at any odd harmonic of the design frequency the halves will act as transformers and operation will be similar to that at the design frequency. The radiation pattern will, of course, be different at each frequency because of phasing interaction—but the antenna will accept and radiate the energy from the feedline.

The antenna we've been examining is, of course, the familiar half-wave dipole which appears in many variations such as the folded dipole, the inverted vee, etc. The same principles apply to all; at the design frequency and odd harmonics operation is excellent, and at even harmonics essentially no energy is accepted or radiated. Such an antenna is said to reject even-harmonics. If cut for operation at 7 MHz, it can also be used on 21 MHz.

Current feed is not the only possible way to feed an antenna. It could be fed at a high voltage point instead, with a transmission line of sufficiently high impedance. This would change things, since the high voltage point is at one end of the line. At the second harmonic, now, the line is a full wave long—and the antenna is still matched. At the third, the length is one and a half waves, and the matched condition persists. An end-fed half-wave, then, will accept all harmonics either—odd or even. Often called a "Zepp" antenna (such antennas were used on early Zeppelin airships), this type of antenna is popular with operators who like to use all bands and have only limited space in which to erect antennas.

Similar operation can be achieved with current feed by connecting several antennas in parallel and feeding them all at once from the same line. Each antenna is cut for a different frequency. Those which are offering high impedances take little energy and so have little effect, while those which offer low impedance take most of the power and do most of the radiating. In such a case, the composite antenna will exhibit at least some SWR at all frequencies, because the "idling" antennas will put some reactance into the line, but operation is highly satisfactory. The major disadvantage—as for any all-band antenna—is that harmonics are radiated as well as is the fundamental frequency, if they should happen to reach the antenna in the first place.

Directive antennas achieve their effects by intricate phase relationships which we examined last time around. These are all frequency-sensitive, and most types of directive antennas are even more sensitive to operating frequency than is the simple dipole. The traveling-wave and reflective antennas are exceptions, since their effects are achieved differently.

In fact, the non-resonant traveling-wave antenna is almost independent of operating frequency, although its directional pattern changes slightly with changes in frequency. Such antennas, then, radiate harmonics as well as fundamentals, but can be used over frequency ranges as great as 2-to-1 or more without adjustment.

While our example so far has been the half-wave center-fed dipole, all that we have found applies equally well to a quarter-wave wire or whip mounted vertically upon a reflecting ground plane. The reflection from the ground plane acts as the missing half of the structure. Such antennas are used throughout the HF and VHF range, for both home and mobile stations.

What Are The Most Popular Types of Antennas in Ham Use? The number of different types of antennas is almost limitless, because virtually any structure which is capable of reflecting or refracting a radio wave and which can be coupled to a feedline of any sort *can* be used as an antenna. used as an antenna.

However, only a relatively few types have any major popularity. Preferences differ depending upon the frequency range of interest: the UHF addict for instance will almost never be found using a simple dipole, while the 40-meter enthusiast seldom sports a quad Yagi array.

The two major categories into which antennas can be divided when discussing popularity are "non-directive" and "directional". The major difference, in most cases, is that the directional antenna is usually set up so that it can be pointed in the desired direction, while the non-directive antenna is installed in a fixed location.

But at low frequencies, and in some other special cases, directional antennas may be permanently mounted in a single direction, and any "steering" that is to be done is accomplished by switching to another antenna rather than by moving the single structure.

Most hams operate primarily in the HF range from 3 to 30 MHz; those who use the three lower-frequency bands frequently stick to non-directive antennas, while those who operate primarily at 14 MHz and higher use some type of movable directional antenna.

VHF and UHF enthusiasts, almost without exception, perfer movable directional antennas. Occasionally they will use a non-directive antenna as a "backup" installation for local rag-chews.

The non-directive antenna classification includes three major types, each of which has many variations—each with its own name. The major types are the long-wire, the resonant horizontal, and the vertical.

The long wire, as its name implies, is a random length of wire. It is exceptionally popular among beginners because of its ease of installation. As experience with antennas is gained by the operator, the long wire is usually replaced by some other type which is easier to live with. A long wire's directive pattern is unpredictable, and it may or may not accept *rf* energy properly at any specific frequency. It offers little or no reduction of harmonic radiation—but the accompanying antenna tuner which frequently is necessary in order to get the antenna to accept *rf* energy does help reduce harmonics.

The most popular example of the resonant horizontal antenna is the half-wave dipole—which is possibly *the* most popular ham antenna. This antenna tends to reject all even harmonics of a signal, but will radiate odd harmonics almost as well as it will the frequency of its fundamental resonance.

A group of half-wave dipoles all connected together at the feedpoint, and each cut for a different ham band, is known as a fan antenna. Each dipole acts individually. The harmonic-rejection capability of the single dipole is lost, but such an antenna will operate on all ham bands and so is popular with many operators.

A single dipole may be loaded with

lumped-constant traps so that it automatically adjusts its effective length to fit several fundamental frequencies. Such an antenna is called a "trap" antenna and is in wide use as an "all-band" antenna for operation on the bands from 3.5 through 30 MHz. Its harmonic-rejection capability depends upon the exact design of the traps and upon the particular frequency in use.

A dipole antenna fed at the end rather than in the center is known as a "Zepp" antenna and is moderately popular. This type of antenna will radiate all harmonics of its fundamental frequency, in contrast to the center-fed dipole.

An offset-feed resonant horizontal antenna which has enjoyed moderate popularity from time to time is known as the "Windom" antenna. When cut to appropriate dimensions and fed from the proper off-center position, it provides a resonable match to 300-ohm twinlead on all the HF ham bands and so permits all-band operation. The trap antenna has displaced the Windom for many operators since it offers the same type of operation but permits use of coaxial feedline. Like any all-band antenna, the Windom has little harmonic reduction inherent in its design.

The most common vertical antenna in the HF range is the Marconi or quarter-wave vertical, which is simply a center-fed dipole cut in two at the feedpoint. The missing portion is supplied by ground reflections. Such an antenna is often used for 80 or 40 meter operation.

The corresponding design for 20-meter or higher-frequency operation is the ground-plane antenna, in which a metallic structure of rods replaces the actual ground to provide the reflections. This is a popular antenna up through the 50 MHz band.

Either the half-wave dipole or the Marconi may be "folded" to increase its feedpoint impedance. The dipole gets the name "folded dipole" while the Marconi becomes a "folded monopole" antenna. The "folding" consists of connecting another wire to the open end or ends of the antenna. In the dipole, the added wire connects the two open ends; in the monopole, the added wire connects to ground or the ground plane at the lower end.

Both the fan and trap variants of the dipole may be found in vertical versions as well, and both are moderately popular.

Among directive or "beam" antennas, far and away the most popular is the parasitic Yagi design. It comes in single-band, multi-band, and trap versions. The single-band corresponds in characteristics to the plain dipole, the multi-band to the fan dipole, and the trap to the trap dipole. Since Yagi has many more critical dimensions than does a simple dipole, it is inherently less apt to radiate harmonics. If a multi-band or trap version is in use, however, and a harmonic happens to fall within a region which is one of the antenna's higher-band operating regions (as, for example, a 10-meter harmonic of a 20-meter signal), it will be radiated.

Running the Yagi a close second in popularity is the "quad" antenna, which is a parasitic array of loops rather than rods. It is found in both single-band and multi-band designs; actually, a multi-band quad consists of several single-band quads sharing the same supporting structure and a common feedline, and so somewhat corresponds to the fan dipole.

VHF and UHF operators also make wide use of colinear arrays, most of which are variations of the Franklin colinear antenna and include both endfire and broadside array principles.

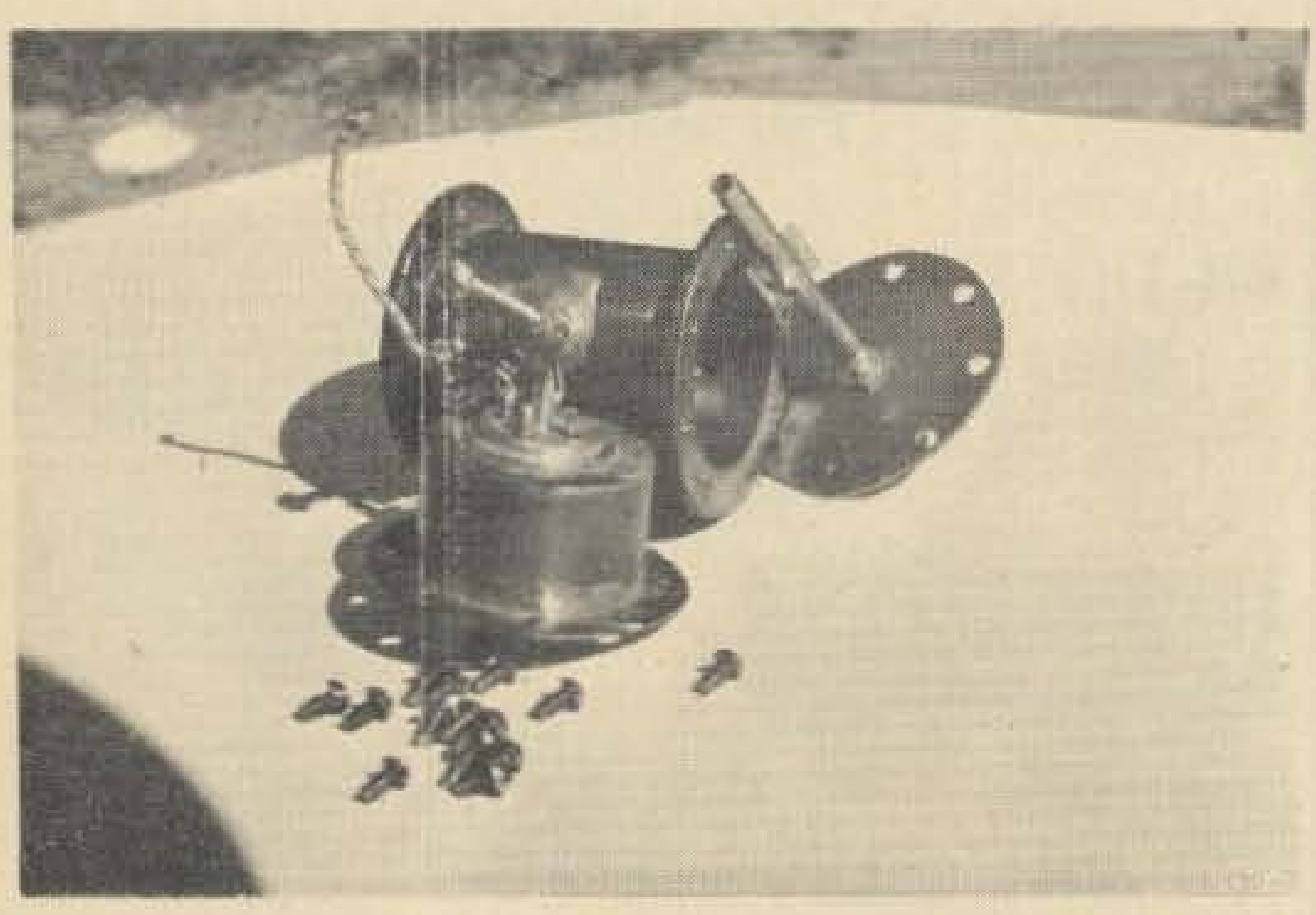
UHF operators, in particular, are employing parabolic-reflector "dish" designs for advanced work, as well as helical-beam antennas. These, however, are "popular" only in this limited area of interest.

We're a long way from exhausting the list, but it's long enough to more than accomplish the purpose of answering FCC questions. If you're really fired up with interest, check the various books we recommended last month—they'll keep you so busy studying antennas that you'll have time for very little else, and even then you won't be keeping up with the state of the art because it's changing too rapidly!

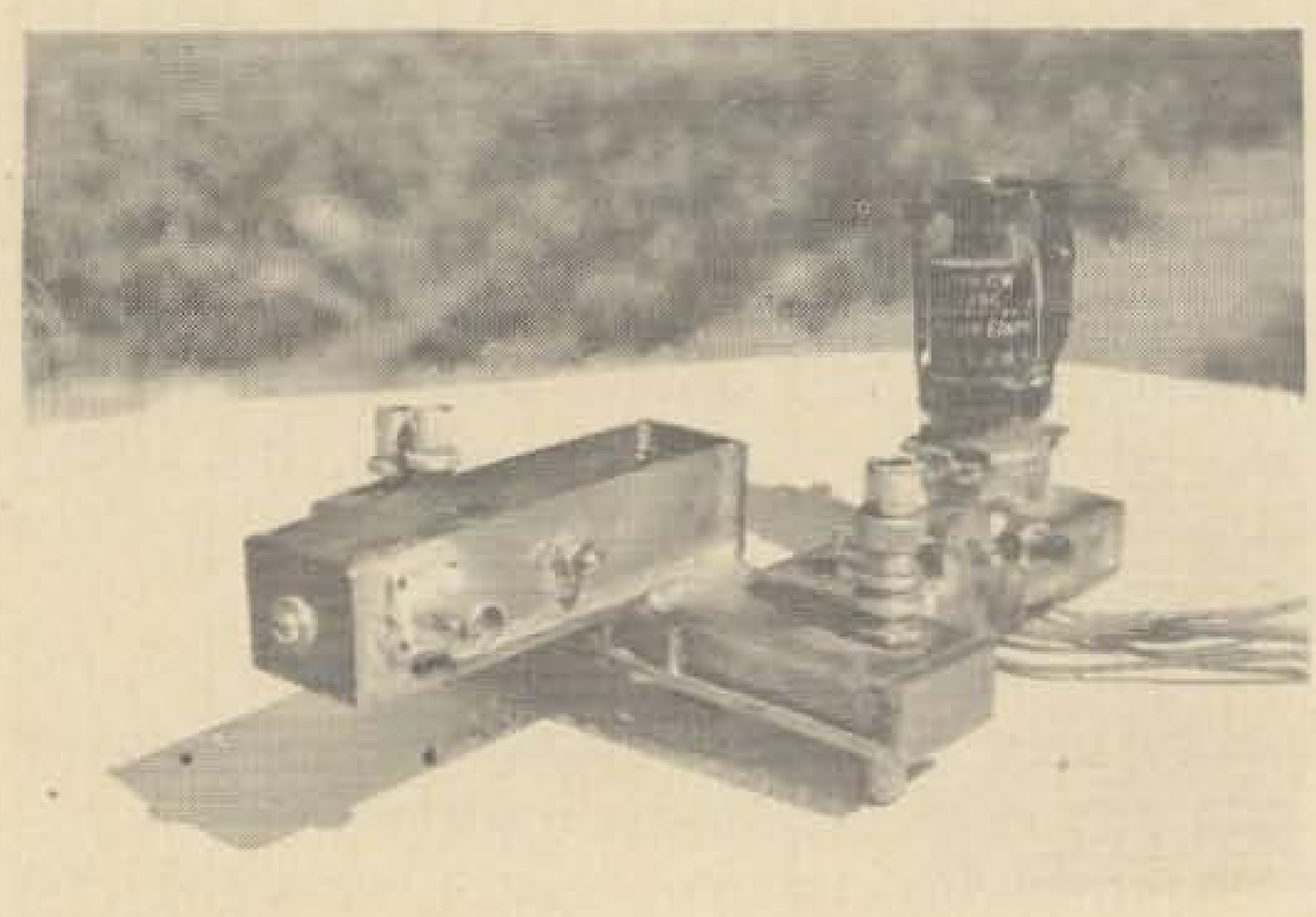
Soft Solder Construction of Cavities and Lines

Silas S. Smith, Jr., WA9VFG
2308 McCord
Murphysboro, Illinois 62966

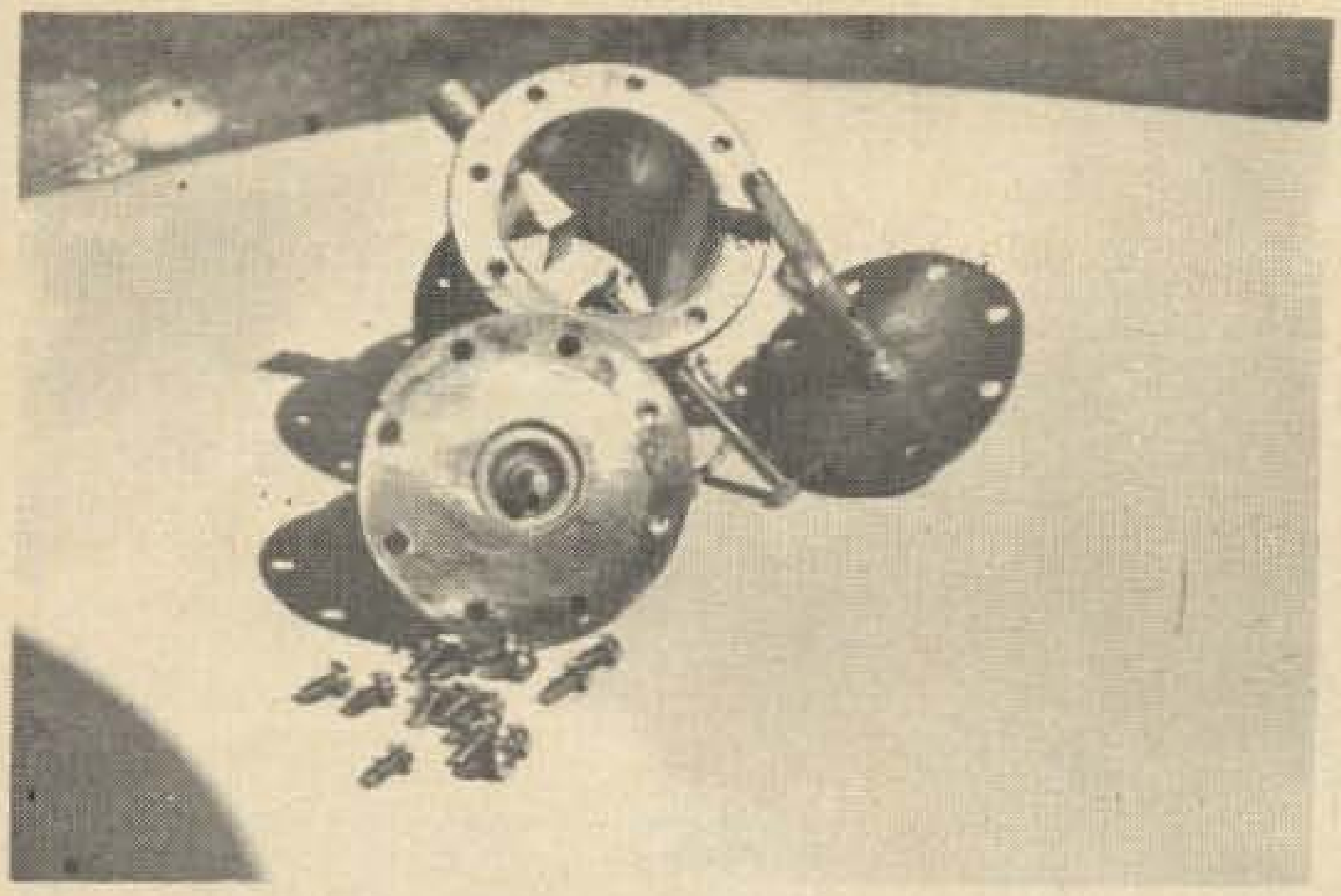
Most every piece of information on microwave equipment is either line drawings, or pictures showing very complex machined parts. It would be nice to have the proper skill and a machine shop. This isn't always practical however. Here then, is the next best construction method that any experimenter can use. Soft solder construction uses ordinary solder, either core or solid, and the only tools needed are simple hand tools found around any ham shack. So simple is the first method of construction described here, that line drawings can be followed almost exactly. I have repeatedly used this method. An oversized end plate, or what have you, is soldered to the line or cavity and then filed down to fit. Although a perfect fit is insured there are some disadvantages. A complex design cannot be built easily by this method, as any excess heat will cause all the parts to fall apart. The cathode cavity for the 416-B was constructed by this method. One secret for keeping things together is to start by soldering the larger and heavier pieces first, then progress to the smaller items. Along with this method, one of my favorite ways of construction uses ordinary copper or brass pipe with flanges made of large heavy washers. The large washer centers are laboriously filed out to the outside diameter of the pipe with a rat tailed file. Fortunately I found a friend to turn some out on a lathe. I used steel washers, but I would advise the use of brass if you can find a supply. After filing out the washers, the washers were then soldered to the pipe. Holes were then drilled and tapped. The ends are then draw filed to insure a good fit. The file is ordinarily used lengthwise but in draw filing, the file is held by each end. The file is then drawn over the material in a flat horizontal fashion. The ends could also be "lapped," using a good grade of emery cloth over a flat surface. The end plates were made of 1/16 inch stock. It's a good idea to mark the end plate and washer so they can be aligned, just in case the holes are not evenly spaced. The plate line for the 416-B uses this type of construction. This type of construction has several advantages: (1) material is cheap; (2) the line can be shortened easily; (3) easy access can be gained to the inner cavity; (4) can be used for any shape of line, round, square, etc. Lines or wave guides can be constructed of 1/16 inch or heavier flat stock by allowing enough extension to form a good solder bead. "C" clamps can be used to hold the sides in place. After soldering, the joints may be wiped. Wiping is a method whereby the solder is brought up to the melting point and wiped with a cloth. The purpose is to give a neat look and to remove the excess solder. If the solder is too cool the appearance will be rough. "Fanning" with the blaze of a torch until the solder is just about ready to flow will give a smooth surface. Oftentimes the cavity or line will become



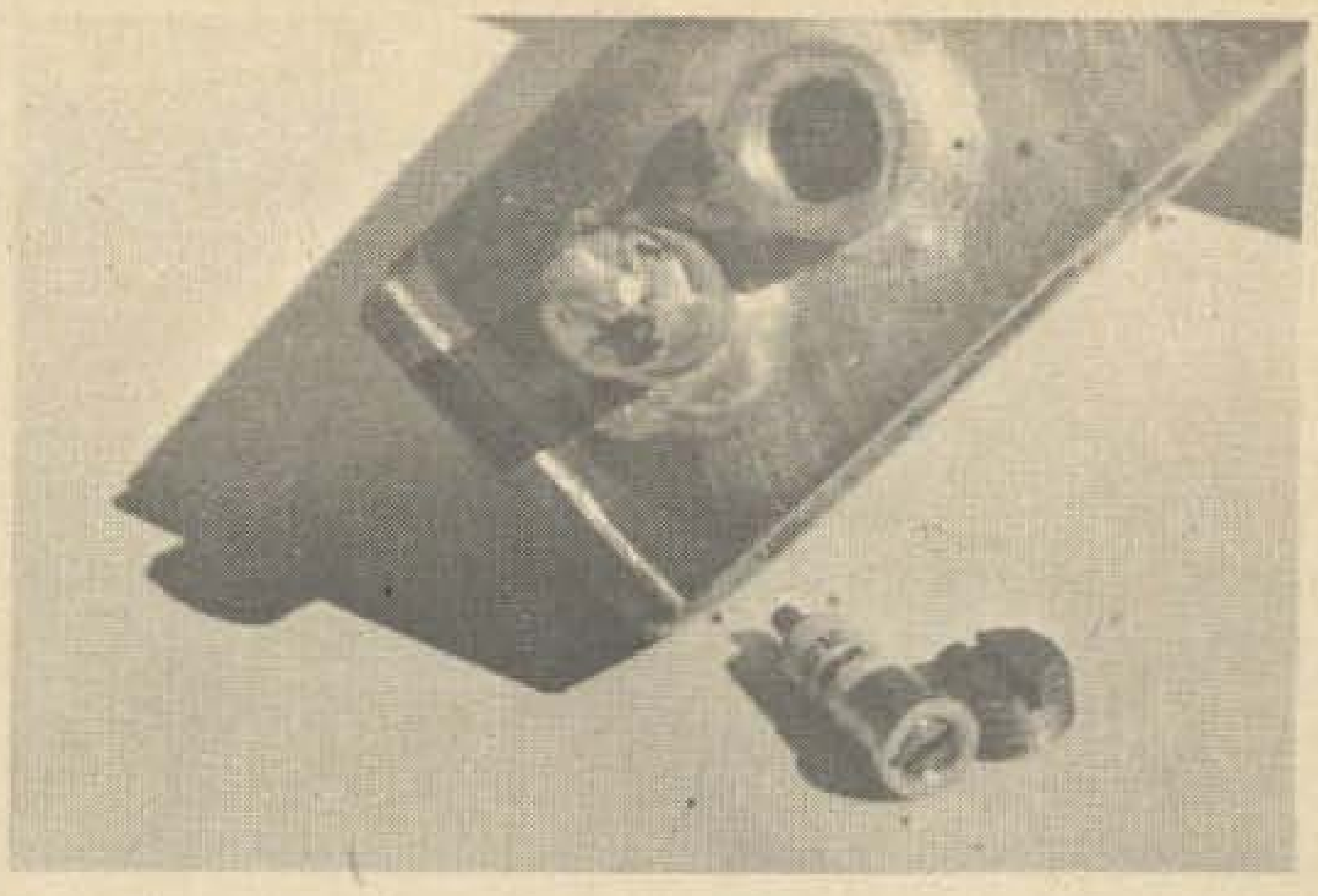
Soft solder construction.



Parametric amplifiers.



Using washers of steel or brass soldered to the pipe.



Crystal diode holder.

the support for other components. One component, the crystal diode, for instance, can be rather easily mounted. A suitable crystal diode holder can be constructed from a nut. The i.d. should clear the body of the crystal centered and soldered over a hole in the wall of the cavity or line. The hole is drilled to fit the main body of the diode crystal. A cap to hold the crystal in place is cut from a bolt with the same thread and size as the nut. The cap need only be approximately 3/16 inches long with a screwdriver slot cut at the top.

I usually use threaded BNC fittings. Soldering a threaded nut to the walls of a cavity or line presents a special problem. During the soldering process, the threads of the nut fill up with solder. The simple solution would be to use a 3/8 -32 tap to clean the nut, but trying to find a tap that size is a still bigger problem. In the meantime, I dirty up an old BNC or the threaded portion of an old pot, and use it to hold the nut in place and keep my fingers crossed that it doesn't get soldered. I suppose that I have about 50% luck. Tubes are often mounted within the cavities. The gold nugget, 416-B, is one such tube. Mechanically there are two problems in using this tube. One, the grid requires a threaded hole 3/4 inch 40 threads per inch and two, the cathode requires a mount. I had a machinist turn out some rings 1/8 inch thick with a 3/4 inch hole 40 threads per inch. I soldered these rings in place for the grid connection. As for the cathode mount, I used finger stock made from brass weather stripping. This is an excellent material for finger stock as it has lots of spring and is easy to cut and shape. One way of cutting the weather stripping is to sandwich it between two pieces of hard wood. Hold firmly in a vice or with "C" clamps. Use a hack saw to cut slowly, evenly spaced slots. The finger stock can then be shaped. Literally speaking, the next method is cooking in oil. This is a useful method used in soldering large parts where heat is not of consequence. This is the oil bath method. Oxidation becomes a big problem when parts are being heated and usually requires the use of flux. Flux does one of two things: one, it will etch away oxidation; or two, it will flow over the heated area and prevent oxidation. Larger parts require a lot of heat; thus, oxidation will occur, so an etching flux is necessary. In the oil-bath method, the parts to be soldered are assembled in a tray or shallow pan filled to a level sufficient to cover the area to be soldered with a high ignition point oil. The oil and parts are heated enough to cause the solder to flow freely. The oil acts as the flux in the fact that it keeps the air from the heated parts. Although the soldering is actually done in the oil, very good results are to be expected. A simple household detergent can be used to remove the oil and you will have very bright soldered parts. This method is also useful in salvaging parts from printed citcuit boards, or from "can" type structures in which parts are sometimes mounted. The XYL's cooking range can be used as a heat source. As a word of caution: safety precautions should be taken. It would not be unreasonable to use goggles and gloves. There is always a danger of reaching the ignition point, thus a fire. Keep a box of ordinary baking soda close at hand. In case of fire sprinkle the baking soda over the fire and avoid breathing the fumes. This is a trick the XYL has probably used many times when cooking. Here are a few ideas which I hope will dispel the notion that one cannot build cavities, lines, or wave guides without a machine shop.

...WA9VFG

Police Converter

W. G. Eslick, KØVQY
2607 E. 13th
Wichita, Kansas 67214

Besides having the fun of building this police converter and listening to the exciting calls, this circuit has other possibilities as shown in Fig. 2, as a 2-meter oscillator for your 2-meter converter (ugh on using a transistor oscillator into a diode harmonic generator as of old).

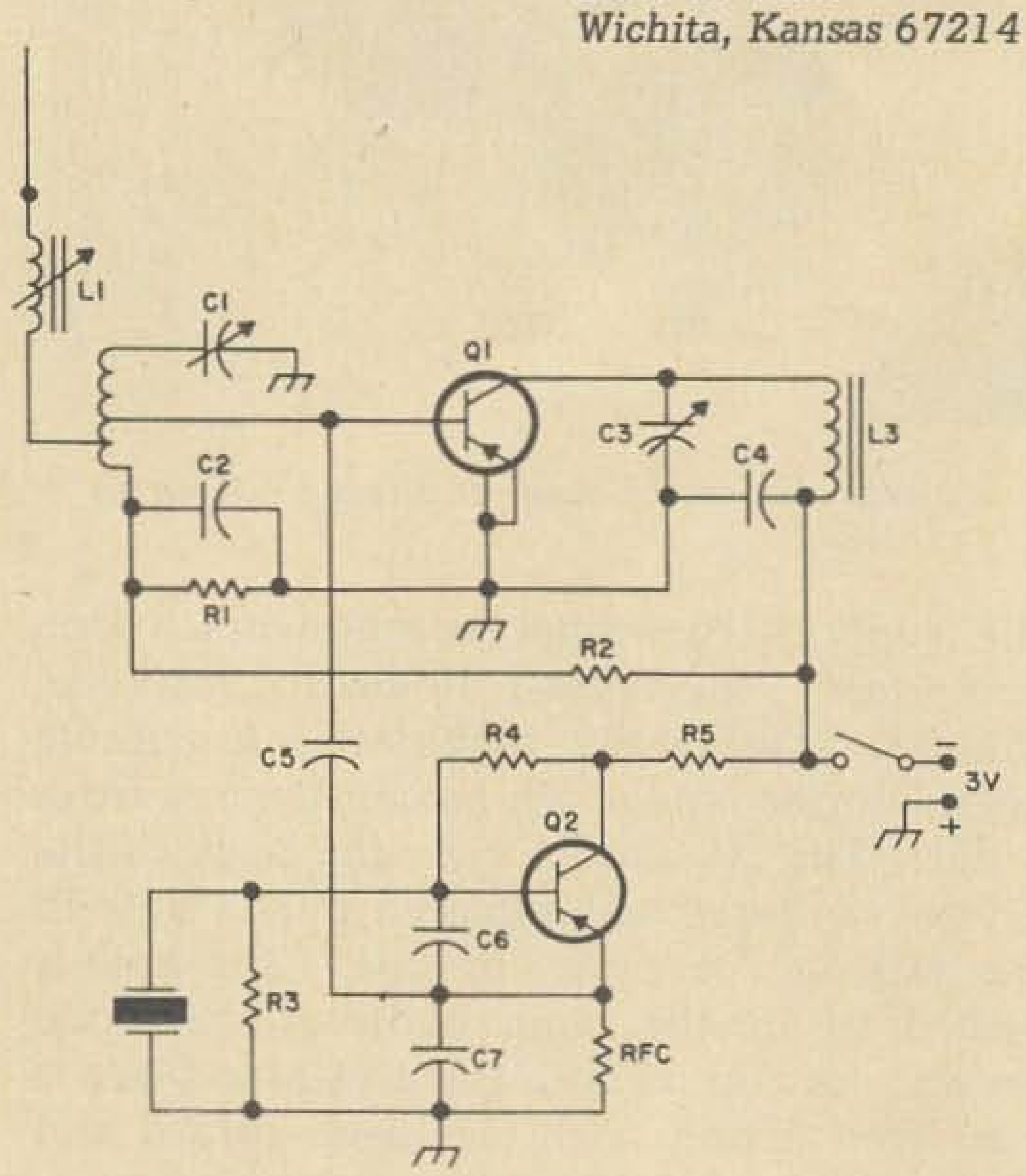
I also made up a one transistor oscillator using a 48.383 MHz. HC18/U third overtone xtal to see what kind of a signal it would put out on 2. On my bench, about 15 or 20 feet from my receiver, it put out almost as good a signal as my Millen grid dipper. There was also 48.383 signal present about ½ the strength of 145.15 MHz. I didn't try to trap it out. This will make a good signal source for 2M and with proper crystal, a cheap frequency standard for club or MARS frequency.

I also tried modulating it as a modulated oscillator (not on the air) it FM'd quite a bit, but could be read. I am sure that with a cheap final stage it would make a nice low-power transmitter for transmitter hunts on 2M, etc. A 2N1141 would work as a final here, but I can't say how much output you'd get.

A few of you may not of ever seen this oscillator circuit. It is Scotch for sure, using one transistor third overtone oscillator/tripler. What more do you want? I am sure there are others like me who lift part of a circuit from a magazine and use it.

I hope this will suggest many circuits to you. Another thought would be a small signal generator and a good hot check for third overtones (provided the output coil was tuned to the 1st, 2nd or 3rd frequency marked on the crystal. All overtone crystals (I think) are marked with overtone frequency. In other words, a 48 MHz crystal could put out 48 MHz (without a tuned circuit—if you wish), 96 MHz and 144 MHz. I haven't tried this oscillator to see if it will work higher harmonics of the crystal.

Getting back to the police converter; some commercial jobs use Japanese transistors and I used 10K in the base circuit of the mixer back to ground and I lost a 2N2996. I had to use a 2.2K. I mention this as a point to check carefully when you use different types of transistors.

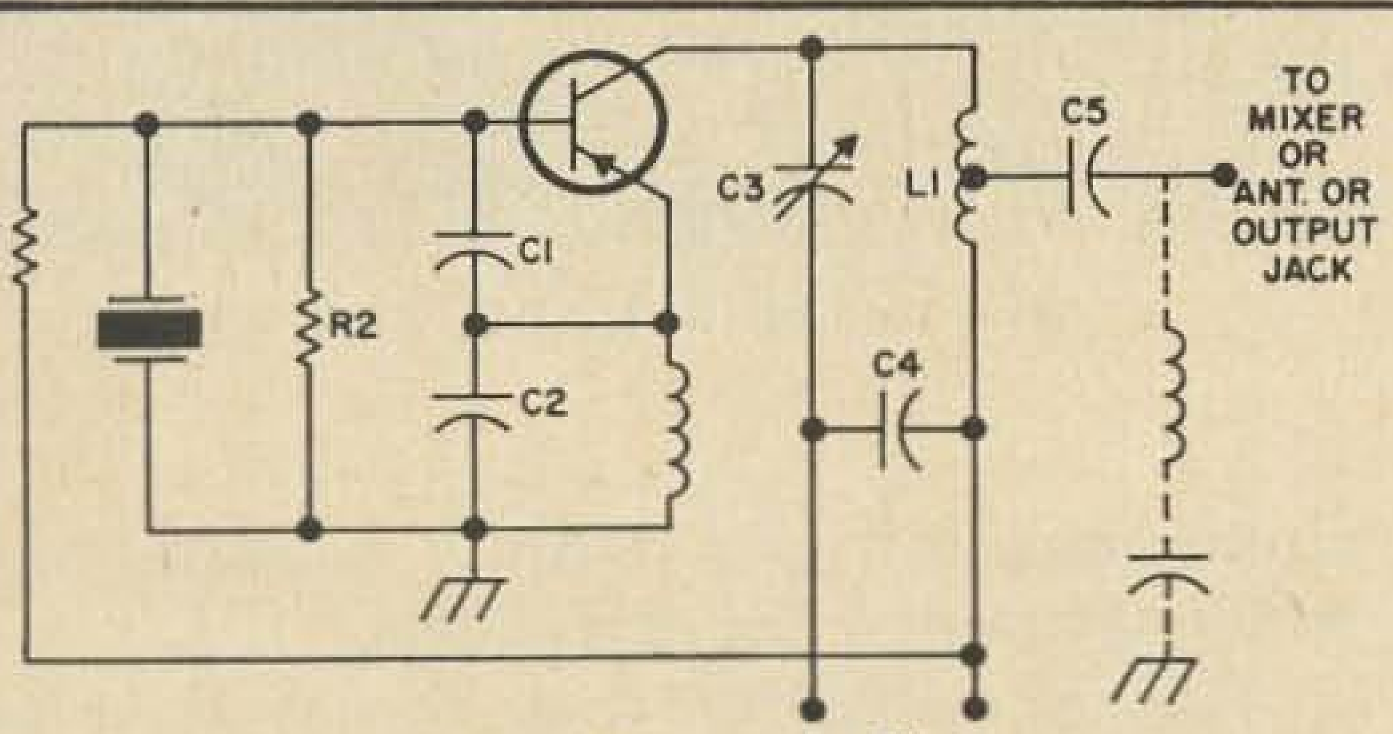


Parts List

C1 = 2-15 pf trimmer
C2 = .001 mfd.
C3 = 10-200 trimmer
C4 = .01 to .05 mfd (Iused .05)
C5 = 5 pf.
C6 and C7 = 33 pf.

L1 = 6T #24 on ¼" slug form
L2 = 4T #14 3/8" dia. ½" long tapped at cen- for base of Q1 and 3/4T from cold end for antenna.
RFC = aircore 17T #24 ¼" dia.
L3 + Loopstick ant. from junk transistor radio.
R1 = 2.2 k
R2 = 27 k
R3 = 10 k
R4 = 18 k
R5 = 15 to 27 ohms
Q1 = 2N2996 TI
Q2 = 2N1141 TI
xtal: see text.

The police frequency here is 155.15 (I understand this may be true over the USA, but I'm not sure—better check) and as in any superhet, the oscillator can be above or below the incoming signal. Crystal frequencies between 51.9 to 52.250 (being on the high side of the received signal) will permit the broadcast radio to tune to the converter and,



Parts List

R1 = 18 k
R2 = 10 k
C1 = 27 pf
C2 = 27 pf
C3 = 1-12 pf trimmer
C4 = .01 mfd.
L1 = 3½T #14 3/8" dia. 5/16" long
L2 = 16T #24 aircore ¼" dia.

L3 and C6 can be a 48+ Mc. trap
Xtal = 48+ mc. (depends where you want on 2 M)
Q= 2N1141 TI

crystals between 51.183 to 51.533 (low side of signal) will also permit converter to work into a BC radio. Compute it thus:

155.15 MHz - .550 MHz (low end of BC band) = 154.6/3 = 51.533 MHz

155.15 MHz - 1.6 MHz (high end of BC band) = 153.55/3 = 51.183 MHz, which is the crystal frequency for each end of BC band.

155.15 MHz + .55 MHz = 155.7/3 = 51.9 MHz

155.15 MHz + 1.6 MHz = 156.76 3 = 52.25 MHz

Select any crystal frequency between these points, but be sure there isn't a local or a strong station picked up on your BC radio at this point or you will have a squeal or garbled output.

Three volts powers this nicely. If you use 9 volts, resistors will have to be changed and that means metering each transistor and checking oscillator output and checking the gain of the mixer.

This converter placed near (3 or 4 inches) or laid on a transistor radio so both loops are coupled somewhat is all that is needed.

A word to save some of you young 'uns some grief, if you get this idea! You select the proper crystal and this circuit to listen to a club frequency on two meters.

Happy listening to police or ham frequencies with this and may it furnish you with other project ideas to build. ...KØVQY

The Neglected Mini Vee Beam

Stan Johnson, WØLBV
855 So. Fillmore Street
Denver, Colorado 80209

Many of the current crop of hams do not have even a nodding acquaintance with the Vee beam – yet it is an antenna with some very positive advantages: it will provide excellent gain on three or more bands; is easy to build and tune up for real efficiency over a wide range of frequencies; and it is so neat and inconspicuous that it will be a lot more popular with the neighbors than the usual quad or tri-bander.

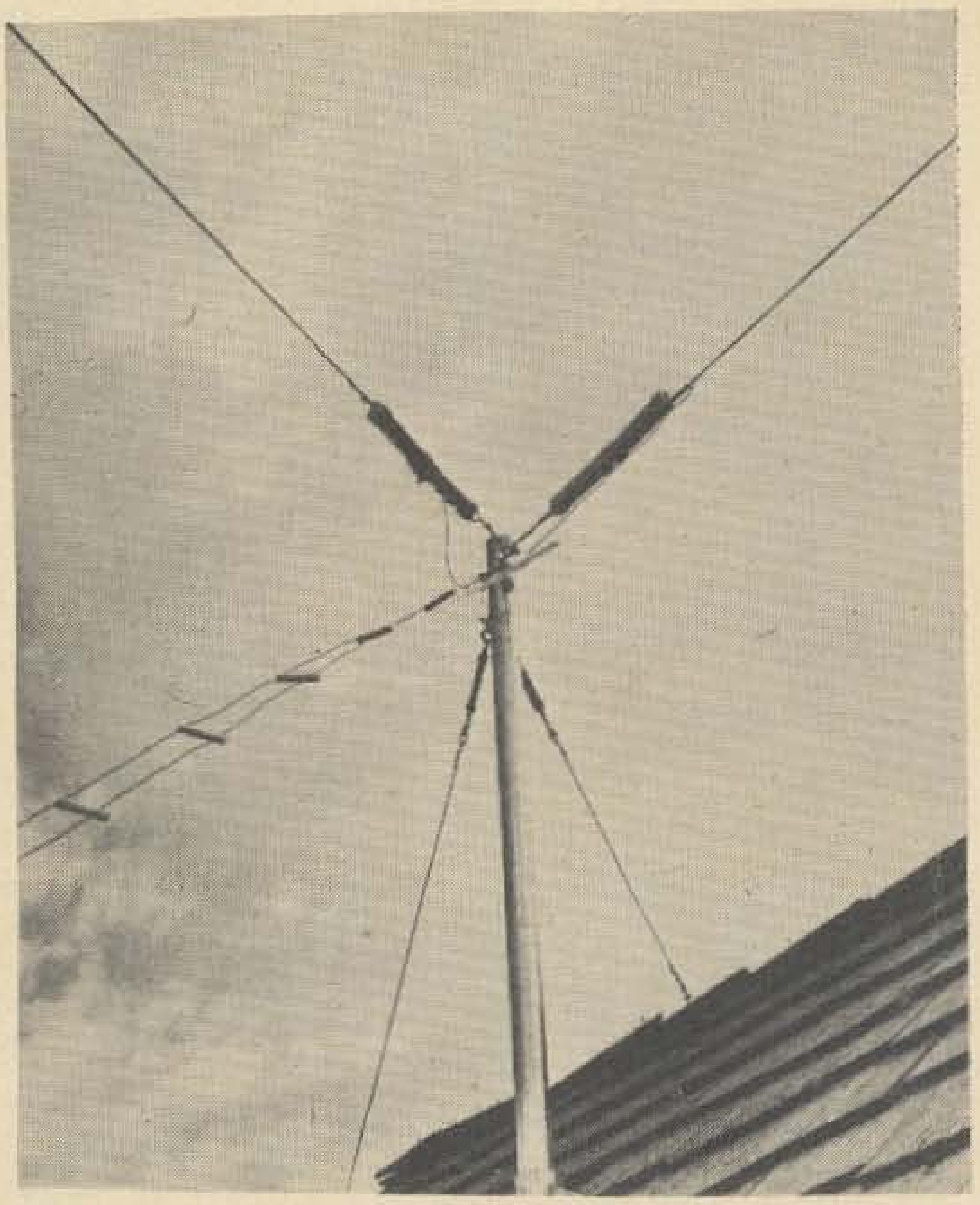
Probably one of the reasons that the Vee beam has been so neglected is that those hams who do know something about the configuration usually feel that the antenna is not practical unless you live in the country – or at least on an acre of ground.

Happily, this point of view is not quite true. Size does help, of course, but it is possible to build a Vee beam which provides very worthwhile gain on 20-15-10 meters, yet can be put up on the average city lot, particularly if you have an understanding neighbor who will allow you to run a small portion of it over one corner of his property.

And such an antenna does perform effectively. The one illustrated was first put on the air on 28 megacycles. In actual use, a flattering number of CQ's resulted in three and four station pile-ups on the frequency – from stations 1500 to 2500 miles away.

On 10 meters, of course, this is no great trick, ordinarily. But the transmitter used for test purposes was an ancient, modified Heathkit At-1, running about 40 watts input, *AM Phone*, and doubling in the final amplifier, which meant that there was something less than 20 watts in the antenna. Despite the low power, reports of "10 db over S-9" were commonplace, and one CQ was answered by a station in northern Japan.

The theoretical gain of a Vee beam of the dimensions shown is approximately 6 db on 10 meters, or about that of a typical 3 element beam. On 15 meters, gain is somewhat less, approximately 5 db, and the gain is in the neighborhood of 4 db on 20 meters. In the writer's opinion, though, and the opinion is shared by others, a long wire antenna of any type will deliver more in actual communication gain than a parasitic array which is rated at the same level.



Mini-Vee beam for 10, 15 & 20.

This is *probably* true for at least two reasons. First, long wire antennas do not seem to require as much height, to deliver low angle radiation, as is needed for the smaller beams. Second, receiving "efficiency" – if there is such a thing – seems to be markedly better. At any rate, a Vee beam or other long wire type of antenna, will often dig out DX which other local stations are having difficulty receiving, and pull in that DX with less QSB. This could be accounted for by the fact that the long wires develop both vertical and horizontal polarization – and in addition, the larger capture area provides for a kind of diversity reception.

Perhaps *none* of these theories is entirely correct – but there is no question about the results; long wire antennas, particularly Vee beam and rhombics, have justly earned a reputation for generating outstanding signals.

A Practical Vee Beam

The drawing, Fig. 1, shows the layout of a Vee beam which is small enough to be practical for many hams. It is fed by a tuner, the circuit of which is shown in Fig. 2. Regular readers of "73" will recognize the tuner as being a modification of one described in a past issue by W5DWT. It is simpler than the W5DWT version because it is designed for only three bands. Despite its simplicity, the tuner will bring the antenna to exact resonance at any frequency in the three bands, and will provide a virtually perfect load for the transmitter, allowing standing wave ratios as low as 1.1 to 1, or beyond the accuracy of the usual swr meter.

The antenna is likewise very simple, consisting of two wires, mounted parallel with the ground, and as high as local conditions permit. The antenna shown in the photograph is approximately 25 feet above the ground, higher, of course, would be better.

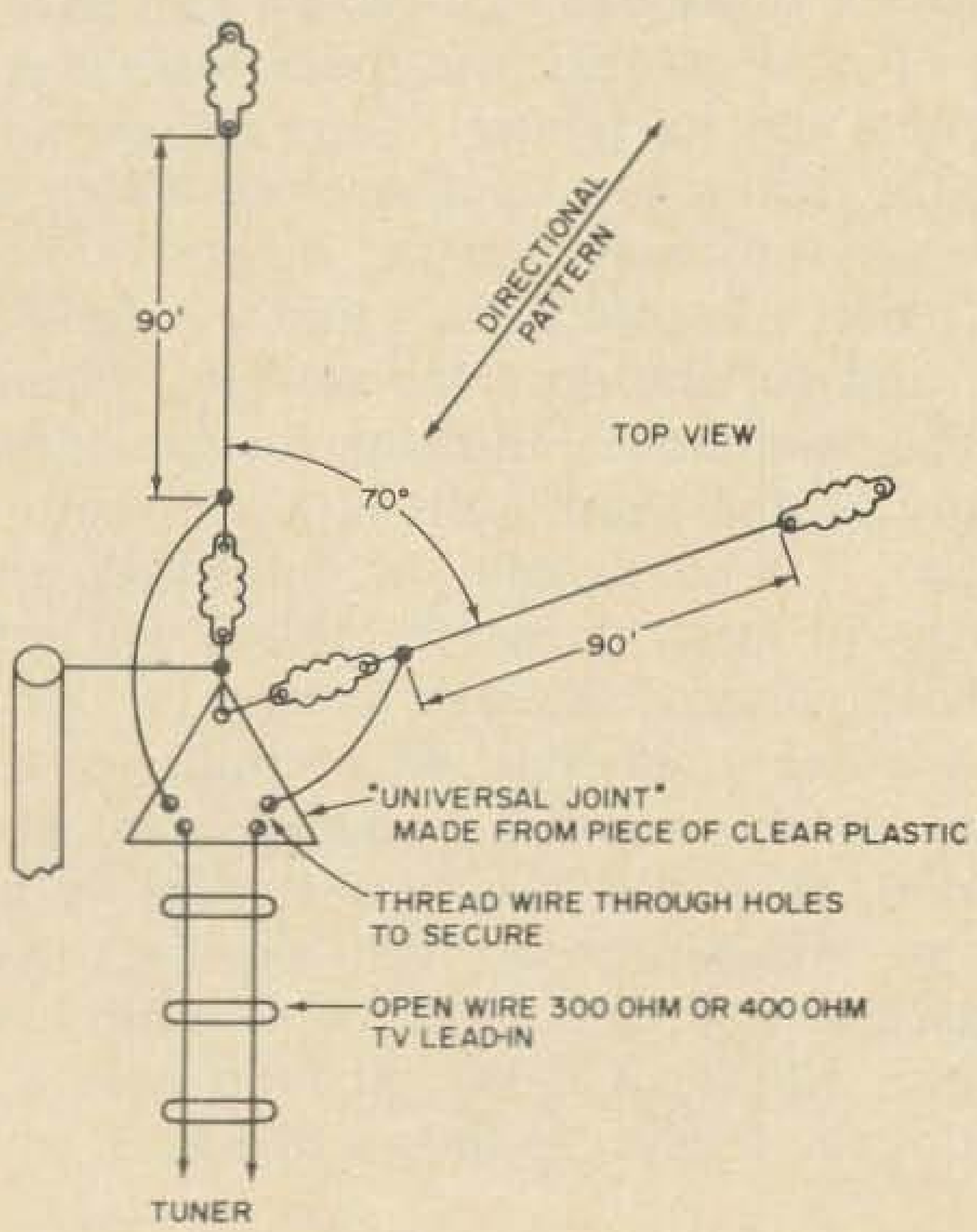


Fig. 1. Small Vee beam layout.

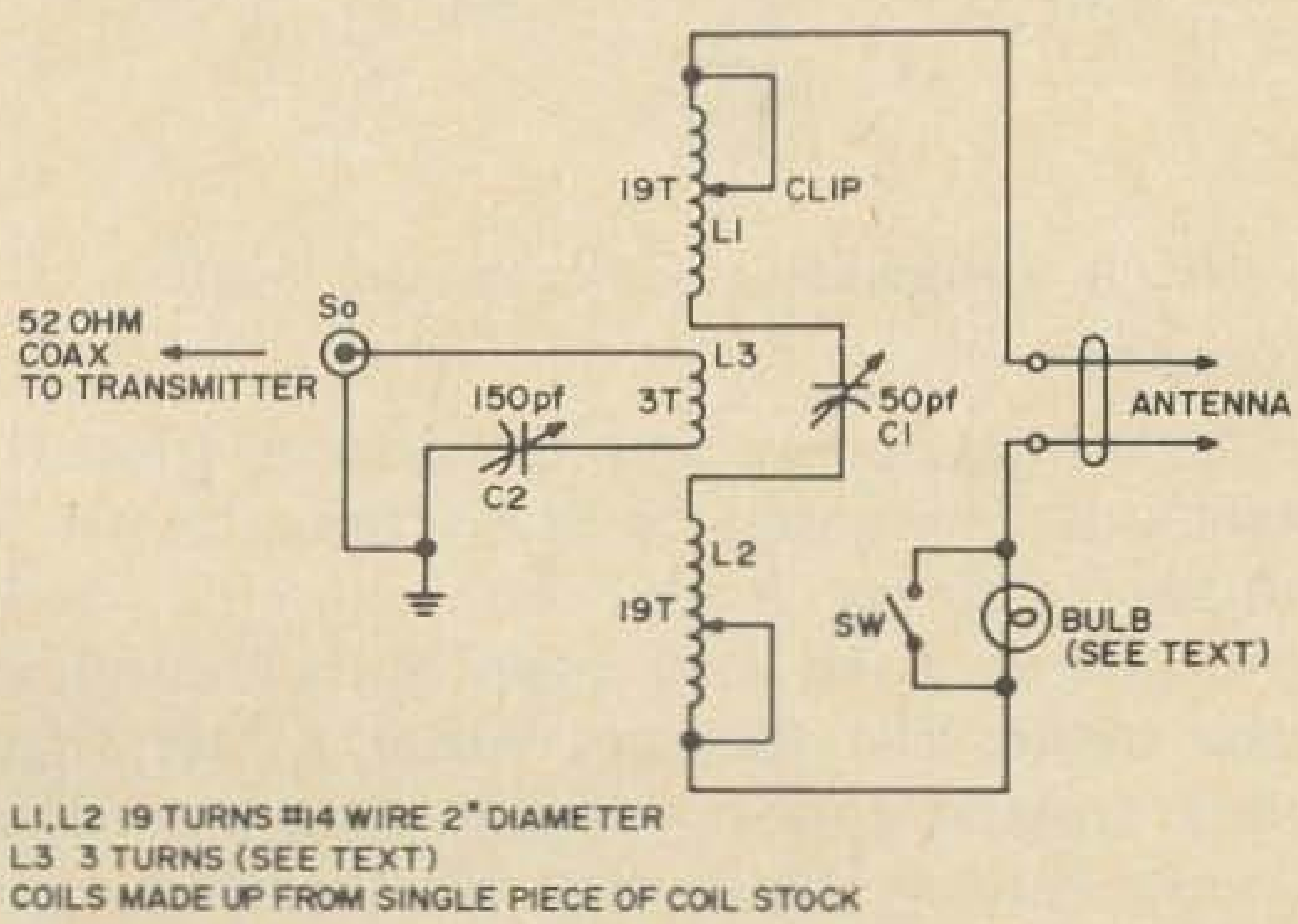


Fig. 2. Antenna tuner circuit.

Ideally, the feed line would drop down from the antenna at right angles, however in practical application this frequently is not possible. Both the photograph and Fig. 1 show a kind of "universal joint" made up from a piece of clear plastic, which serves as the termination point for the feed line, and allows the feed line to leave the antenna at almost any convenient angle.

The feed line itself is the open wire "ladder" type of TV line, either 300 ohm or 450 ohm (preferably the latter). This line is adequate for any SSB rig which does not have a linear amplifier – or for a CW rig up to 200 or 300 watts. For powers above that, the line should be made up with number 14 wire, and either ceramic or clear spreaders.

Remember that even a 90 foot wire, loaded up with ice, can become pretty heavy, so if you live in W1 land be certain to use strong turnbuckles, screws, etc. The same thing applies for W4's, who on occasion experience what they call "atmospheric disturbances" that blow down palm trees.

The 70-degree angle is about optimum for an antenna to be used on three bands. However, if this angle isn't possible, you can narrow it to 50 degrees, or, preferably, use a larger angle, up to as much as 90 degrees. The last-named angle will reduce gain somewhat on 10 meters, but will give better results on 20 meters.

The Vee beam provides a "figure 8" bidirectional pattern. With the dimensions given, the pattern is quite broad.

Building the Tuner

The tuner for the Vee beam is made up on a 5 x 7 x 2 inch chassis. Building the tuner requires a minimum of parts: two tuning condensers, one length of coil stock, a switch, a dial light bulb, some insulators, and miscellaneous hardware.

The smaller of the two variable condensers, (50 pf.), should be double spaced. Since it is used at a low voltage point, even a midget variable like that shown is adequate for a fair amount of power. A single spaced variable condenser, 150 pf. or larger, likewise should do the job even for the more powerful SSB rigs run barefooted. If you go in for a gallon, use condensers with more spacing at both points.

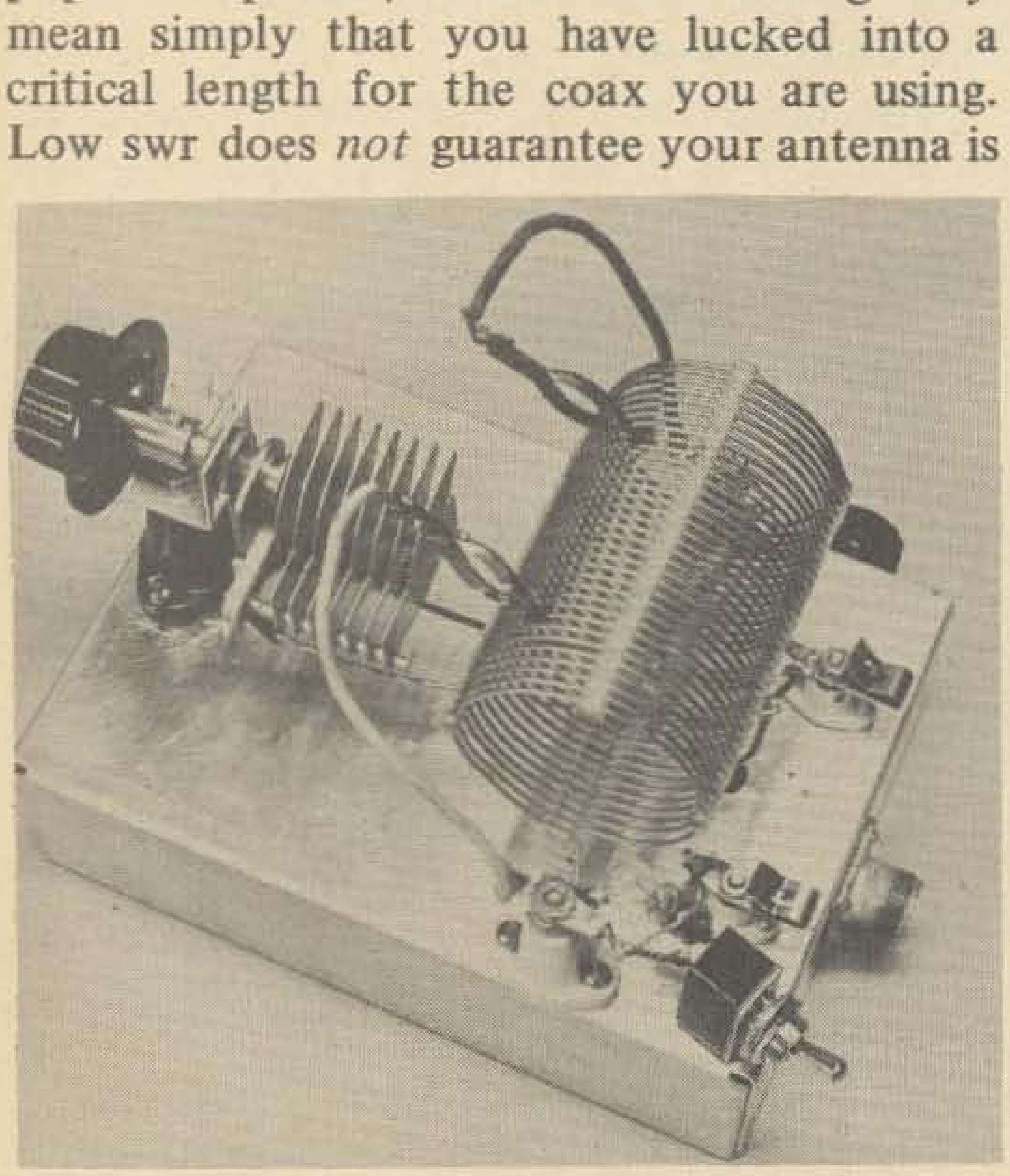
The coil can be of standard coil stock (B+W 3900). If you have difficulty in obtaining coil stock, you can roll your own, as detailed in the writer's book, "Ham Antenna Construction Projects," which is available from any Howard W. Sams' distributor.

Notice that the coil is actually *three* coils. This is accomplished by clipping the coil stock at the proper point with sidecutting pliers as shown in the photo. I found that clipping the coil is easy, but following the turns by eye to make certain which winding is which can be confusing. The best answer is to use an ohmmeter as a continuity meter – or a flashlight bulb and a battery. It sounds ridiculous, but the tuner illustrated failed to work properly, and it took me, a ham for over 30 years, all afternoon to discover that the connections to the clipped-apart-coil were wrong!

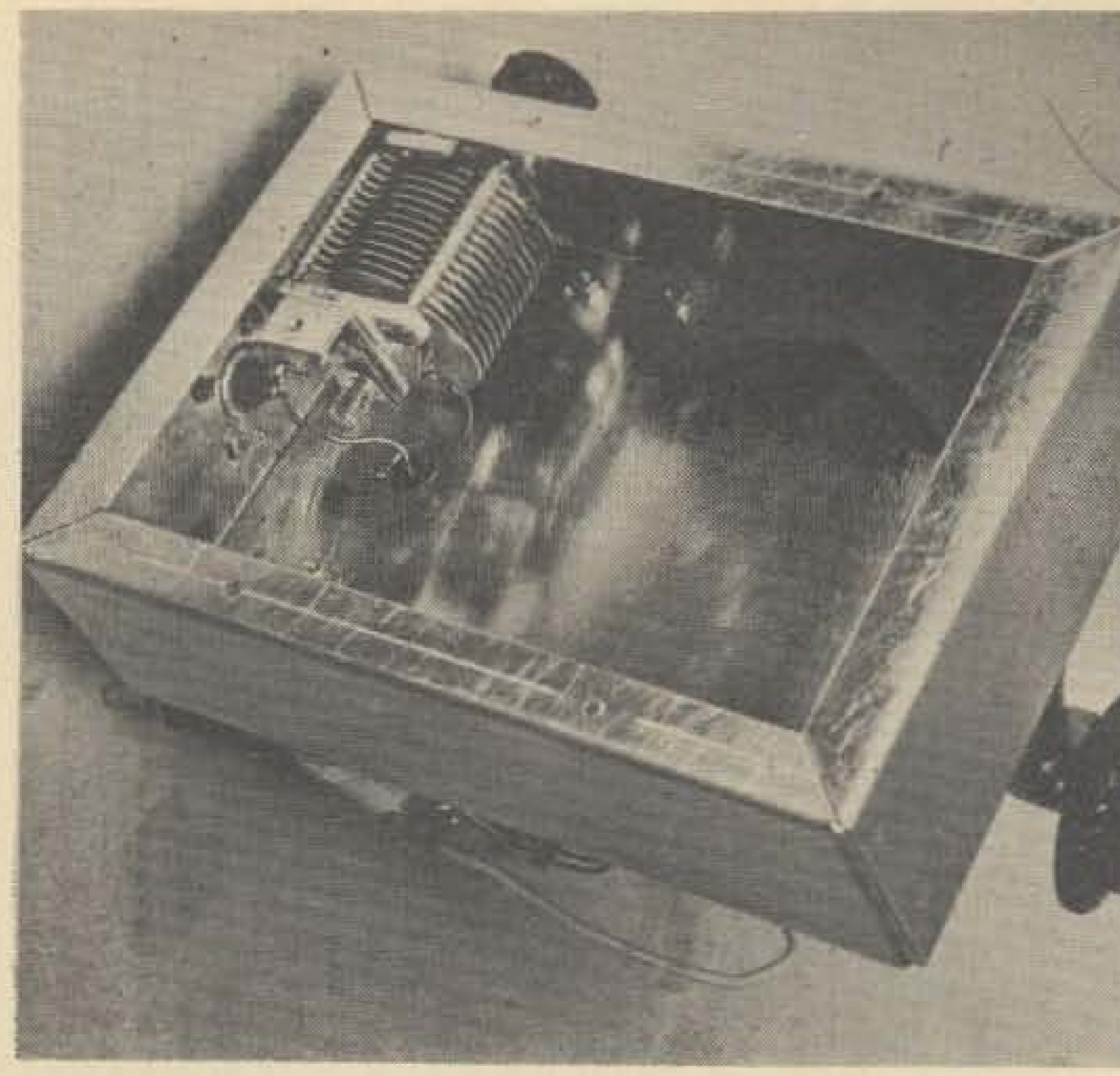
The tuner is so simple that the actual wiring is at most an hour's job – and if you are handy with a soldering iron, you can do it in half that time. Use some scrap lengths of No. 14 wire, if possible, for the leads. Note that the variable condenser above the chassis is mounted on an insulator so that both the rotor and stator are "above ground." The variable condenser below the chassis can be mounted directly to the chassis, since the rotor is grounded.

Tuning Up The Antenna

The Mini Vee beam, like any center fed antenna fed with a tuned line, can utilize a simple resonance indicator which shows when there is actually power in the antenna. And this is what counts – *not* the swr ratio. A low swr is a fine idea, especially with an antenna fed directly with co-ax, but contrary to what appears to be an unfortunate popular opinion, a low swr reading *may* mean simply that you have lucked into a critical length for the coax you are using. Low swr does *not* guarantee your antenna is



Top view of tuner.



Bottom view of the tuner.

working efficiently – a brutal fact explained in an earlier "73."

With a tuner like that shown you have the best of both worlds: the tuner resonates the antenna and its feeder – *and* allows tuning out the reactance on the coax which runs between the tuner and the transmitter. An swr meter inserted in this line *will* show low swr, and furthermore the reading is honest!

The resonance indicator on the tuner is simply a dial light bulb in series with one feeder. (The system is balanced, so in theory, at least, the same current will appear on both wires of the feed line.)

A number 44 bulb will handle up to 35 watts or so – and if two bulbs are put in parallel, they will handle considerably more power. Higher power will require use of a Christmas tree light bulb, or, if *it* blows out, simply clipping a flashlight bulb over a portion of the feeder, as shown in Fig. 3.

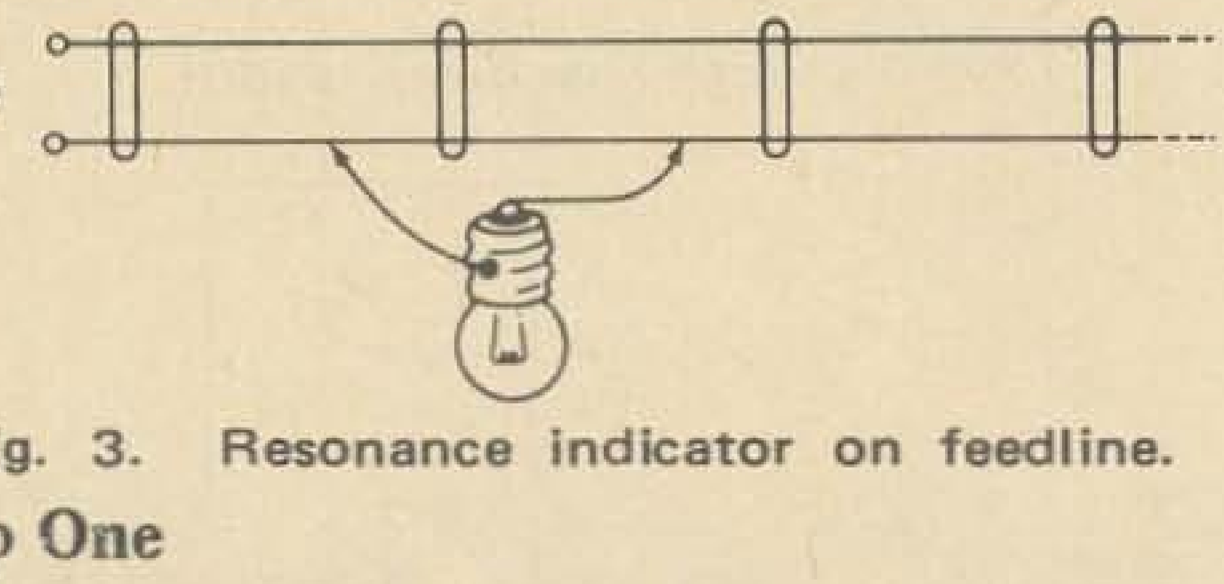


Fig. 3. Resonance indicator on feedline.

Step One

In tuning up any antenna system, I like to start out by tuning up the transmitter to a suitable dummy load. For example, with low power, a 40-watt oven bulb (the clear glass makes the filament easier to see than on a frosted bulb). As the first step it is always nice to know that the transmitter is putting out power.

Next, let's tune up on 28 MHz. Remove

the dummy load from the transmitter and hook up the coax to the tuner. Place the clips on the tuner coil in approximately the position shown in the photograph.

Set condenser C2 at approximately one-half capacity (assuming 150 pf).

Adjust the load controls on the transmitter so that meter readings indicate the antenna appears to be taking some power. Now rotate C1, and watch for the bulb to light. If it does not, throw the switch, and try again. If you still get no indication (chances are you will) move the clips either closer to the center, or further out. Try to have the same number of turns on both sides.

You may make a few false starts, but in a couple of minutes you should arrive at a point where tuning condenser C1 through resonance will cause the bulb to light. Now adjust C2 for maximum brightness of the indicator bulb, and "touch up" the tuning of the transmitter. The name of the game is to achieve maximum brightness on the indicator bulb without, of course, overloading the transmitter – which probably has a plate milliameter to indicate proper input.

If you want to insert an swr meter into the coaxial line, now is the time to do it – and chances are very, very good that the swr will be quite low, although careful adjustment of C2 may bring it still lower.

Once you have discovered the proper tap points for 10 meters, indicate them with a dab of paint (or finger nail polish) alongside the clips so that it will be easy to return to the same spot.

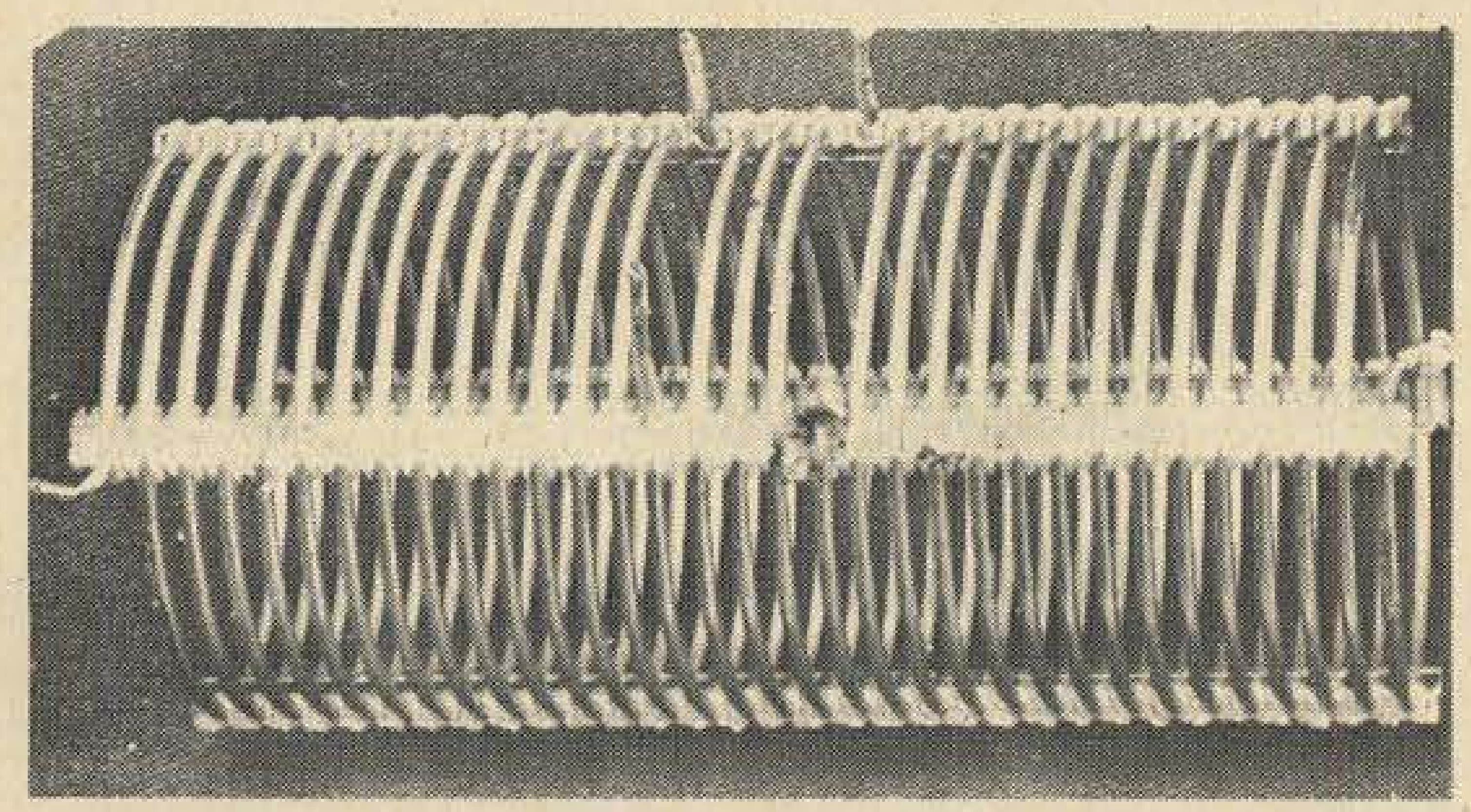
Tune up on 15 meters and 20 meters follows exactly the same procedure. When you have maximum brilliance on the bulb you have the system in resonance and virtually a written guarantee that you will "get out."

Additional Bands?

Yes, the Mini Vee will tune up on the other bands as well. It will tune up on 6 meters with the coil shown, and you may get it to tune up on 2 meters as well, although most of the coil will have to be shorted out and it would be better to use a smaller coil. The radiation pattern will not be a bi-directional "figure 8" (as will be true on the lower frequency bands) but rather a figure 8 plus a number of other lobes, many of which will be highly useful, and tend to give coverage in all directions.

In addition, the antenna can be used as a random length long wire (fed with an L network) on 80 meters and 40 meters so the Mini Vee is actually an all-band antenna. All of this can be done with a somewhat more complicated tuner plus a simple switching arrangement. But that is a story for another time – and perhaps the subject of another article!

...WØLBV



Coil stock is clipped to form three coils.

Technical Aid Group

Please refer any questions of a technical nature to one of the following members of 73's Technical Aid Group. These are dedicated amateurs who really want to be of help and do so without compensation. Be sure to state your problem clearly and enclose a S.A.S.E. for a reply.

John Allen, K1FWF, high school student, 51 Pine Plain Road, Wellesley, Mass. 02181. HF and VHF antennas, VHF transmitters and converters, AM, SSB, product data, and surplus.

Bert Littlehale, WA1FXS, 47 Cranston Drive, Groton, Conn. 06340. Novice transceivers, test equipment and homebrew projects gone wrong.

Bob Groh WA2CKY, BSEE, 123 Anthony Street, Rochester, New York 14619. Specializes in VHF/UHF solid-state power amplifiers, but will be glad to make comments on any subject.

G. H. Krauss, WA2GFP, BSEE, MSEE, 70-15 175 Street, Flushing, New York 11365. Will answer any questions, dc to microwave, state-of-the-art in all areas of communications circuit design, analysis and use. Offers help in TV, AM, SSB, novice transmitter and receivers, VHF antennas and converters, receivers, semiconductors, test equipment, digital techniques and product data.

Charles Marvin W8WEM, 3112 Lastmer Road, RFD #1, Rock Creek, Ohio 44084. Will help with any general amateur problems.

Stix Borok WB2PFY, high school student, 209-25 18 Avenue, Bayside, New York 11360. Novice help.

PFC Grady Sexton Jr. RA11461755, WA1GTT/DL4, Hedmstedt Spt. Detachment, APO New York 09742. Help with current military gear, information from government Technical Manuals.

Sgt. Michael Hoff WA8TLX, Box 571, 6937th Comm. Gp., APO New York 09665. Help with all types of RTTY both commercial and military. Also data techniques. Covers conversion of military RTTY equipment.

J. J. Marold, WB2TZK, 279 Farmers Ave., Lindenhurst, New York 11757. General.

Ira Kavaler, WA2ZIR, BSEE, 671 East 78 Street, Brooklyn, New York 11236. SSB transmitting, color TV, computer programming and systems, digital radio and remote control, rf transmission lines, dipole design, audio amplifiers, linear and class C rf amplifiers.

Fred Moore, W3WZU, broadcast engineer, 4357 Buckfield Terrace, Trevose, Pa. 19047. Novice transmitters and receivers, HF and VHF antennas, VHF converters, receivers, AM, SSB, semiconductors, mobile test equipment, general, product data, pulse techniques, radio astronomy, bio-medical electronics.

Walter Simciak, W4HXP, BSEE, 1307 Baltimore Drive, Orlando, Florida 32810. AM, SSB, Novice transmitters and receivers, VHF converters, receivers, semiconductors, mobile, test-equipment, general.

James Venable K4YZE MS, LLB, LLM, 119 Yancey Drive, Marietta, Georgia. AM, SSB, novice gear, VHF, semiconductors, and test equipment.

J. Bradley K6HPR/4, BSEE, 3011 Fairmont Street, Falls Church, Virginia 22042 General.

Wayne Malone W4SRR BSEE, 8624 Sylvan Drive, Melbourne, Florida 32901. General.

Bruce Creighton WA5JVL, 8704 Belfast Street, New Orleans, Louisiana 70118. Novice help and general questions.

Douglas Jensen, W5OG/K4DAD, BA, BS, 2505 Broadway, #1704, Houston, Texas 77012. Digital techniques, digital and linear IC's and their applications.

Louis E. Frenzel, Jr., BAS, 11287 Columbia Pike, Silver Spring, Maryland 20901. Electronic keyers, digital electronics, IC's commercial equipment and modifications, novice problems, filters and selectivity, audio.

George T. Daughters, WB6AIG, BS, MS, 1560 Klamath Drive, Sunnyvale, California 94807. Semiconductors, vhf converters, test equipment, general.

Glen H. Chapin, W6GBL, 3701 Trieste Drive, Carlsbad, Calif. 92008. HF and VHF antennas, novice transmitters and receivers, VHF converters, semiconductors, receivers AM, SSB, general, surplus.

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

Steve Diamond WB6UOV, college student, Post Office Box 1684, Oakland, California 94604. Repeaters and problems regarding legality of control methods. Also TV, novice transmitters and receivers, VHF antennas and converters, receivers, semiconductors, and product data.

Orris Grefsheim WA6UYD, 1427 West Park, Lodi, California 95240. TV, HF antennas, SSB, VHF antennas and converters receivers, semiconductors, and general questions.

Hugh Wells, W6WTU, BA, MA 1411 18th Street, Manhattan Beach, Calif. 90266. AM FM receivers, mobile test equipment, surplus, amateur repeaters, general.

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D. E. Hausman, VE3BUE, 54 Walter Street, Kitchener, Ontario, Canada. Would like primarily to help Canadians get their licenses. Would be able to help with Novice transmitters and receivers.

Frank M. Dick WA9JWL, 921 Isabelle Dr., Anderson, Indiana 46013. Will answer queries on RTTY, HF antennas, VHF antennas, VHF converters, semiconductors, mobile, general, and microwave.

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Ronald King K8OEY, Box 227, APO New York, New York 09240. AM, SSB, novice transmitters and receivers, HF receivers, RTTY, TV, test equipment, general.

Charlie Marnin W8WEM, 3112 Latimer Road, RFD 1, Rock Creek, Ohio 44084. General technical questions.

Michael Winter DJ4GA/W8, MSEE, 718 Plum Street, Miamisburg, Ohio 45342. HF antennas, AM, SSB, novice gear, semiconductors.

Paul Gorrell, high school student, P.O. Box 228, Mashpee, Massachusetts 02649. Novice transmitters and receivers, hf equipments, CB to ham gear conversion. Marine to ham gear conversion, Civil Air Patrol Communications, all aspects.

David D. Felt, WB6ALF, 79 East Highland Ave., Sierra Madre, California 91024. Semiconductors, IC's, television, test equipment, product data.

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The Guerilla

The life of an editor is fraught with many crises. Virtually upon the eve of my wedding day, I received an antenna in the mail. This was for evaluation and review. It comes from Dusina Enterprises of Melbourne, Florida. I have to admit that I asked for it.

In my term as Editor of *73*, I have tried to maintain a high degree of integrity in our advertising. If you look back a year or so, you will find many advertisers in the pages of 73 who no longer appear in the magazine. A few were voluntary "drop-outs." Most of them just didn't meet my rigid standards for honesty in their ads. After receiving complaints from some readers about false and misleading advertising, I began to scrutinize the ads more carefully. We lost a few good old customers in the process.

When an ad came in from Dusina, I was more than skeptical about their claims. I came close to not accepting their ad. I made an agreement that we would run the ad for one month, but I wanted to see the antenna. The antenna arrived on Monday. Tuesday morning dawned, cold and rainy. Being partially editor and partially idiot, I often refer to myself as "Idiotor" of 73. Today I really earned the title. At 10 A.M., I was up the tower at 75 feet tying the center of the "Guerilla" to match my existing dipole. Since the dipole is strictly for 75, and the Guerilla is for 40 *and* 75, I then spent the next hour and a half cutting another dipole for 40, tying it at the 75 foot level, and tossing rocks at tree limbs to tie up the ends of the whole mess.

I am first of all a woman, I'm also a grandmother (albeit a young one) and have a degree of arthritis in my throwing arm.

By noon I was cold, damp, and tired. I had been up and down the tower four times and had thrown innumerable rocks over numberless branches. I took a martini break and, after checking resonant frequencies on all antennas concerned, started making some on the air tests.

What was I trying to prove? Well, the "Guerilla" is essentially a trapped dipole which claims 50% power gain (2 db) over a conventional dipole. My question was, "How can a dipole have *gain* over a dipole?"

Now, I pride myself on having an efficient antenna system. I am an incurable QRPer. I never run over 100 watts, so if I am going to communicate, I have to do it with the antennas. I consistently get good reports. I do a lot of operating on the top end of 75 meters and compete with kw stations all the time. So, I know my 75 meter dipole is good. At 3.999 my SWR is 1:1. At 3.999 the Guerilla showed 2:1 SWR. A station in Washington, D.C. gave the Guerilla 10 db over my antenna. A station in New Jersey gave it 1 S unit over my dipole, and a station in Buffalo (not in a favorable direction) said both were the same. On 40 meters, the resonant point of both dipoles were much closer, and the Guerilla topped my dipole on every report.

I have not answered the question of how a dipole can have gain over a dipole. For the time, I can only say that the Dusina "Guerilla" does have high efficiency to at least 2 db gain over my conventional dipole.

Basically, the Guerilla is a twin lead folded dipole, fed with twin lead feeders with a built in balun at the transmitter end. The overall length is 120 feet. The feedline is 50 feet. I found it necessary to go to RG58/U coax to reach the shack, but this still looked like 50 ohms at the transmitter. I can only assume the 2 db gain comes from the low loss in the twin lead over a coax feedline of over 100 ft.

The Guerilla comes with green nylon cord, built-in eyelets at the ends of the dipole, and lead weights for throwing over tree limbs. (The rocks were for my 40 meter dipole.) It is lightweight, easy to erect, and works! It is rated to take two kw PEP. The SWR curve is very flat on 40 meters, but has a more pronounced dip at resonance on 75. It is cut for 3.9 and maximum SWR is 2:1 on the phone band.

Available for $33.75 from Dusina Enterprises, 571 Orange Ave. W., Melbourne, Florida.

...W1EMV

Modifying a Tube Converter for FET Operation

L. C. Maurer, W6OSA
209 Nob Hill Way
Los Gatos, California

With the advent of VHF FET's, such as the TIS-34, at $1 or under, it becomes practical to remove the tubes from old style converters or receivers and replace them directly with Field Effect Transistors. The unit that I chose for my first experiment along these lines was a rather ancient VHF-152, 10, 6, and 2 converter (see **Fig. 1**). I decided to start with the ten meter band but in order to be certain of having plenty of signals for tests I moved the lower limit down to 11 meters, the C.B.'ers being very active in these parts. A 4 pf capacitor across each of the three ten meter coils did the trick, (dotted lines in **Fig. 2**).

It can be seen from the schematic that the VHF-152 is not wired like a conventional receiver front end. I don't say the VHF-152 is better, just different. Note the 18K resistor which serves as a plate choke for the 6AK5 *rf* amp. Obviously that will have to go before we can substitute an FET for the 6AK5.

Next comes the problem of neutralization. A typical VHF FET has about 1.5 pf capacity between its input and its output as compared with the .02 pf capacity of the 6AK5. There would seem to be two possible routes. Either use a conventional tapped plate (drain) coil and a neutralizing capacitor, or employ 2 FET's in place of the one 6AK5 in a cascode arrangement.

Because of the band switch consideration, it was decided to use the cascode approach. L1 will serve as the gate inductance for Q1 and L2 will serve as the drain inductance for Q2. It will be necessary to lift the bottom end of L2 from ground and feed the plus 21 volts through it as in **Fig. 2**.

This particular model converter never did work well on 2 meters. One look at the band change switch will explain why. But, it was thought that the transistorized version would cover 10 and 6 meters in good style. Therefore, the band change switch was preserved. For 2 meter operation, a separate *rf* preamp which I already had on hand (refer to 73 Magazine, July, 1967, page 48) can be wired into the band change switch as shown in **Fig. 2**.

Because this was my first attempt at con-

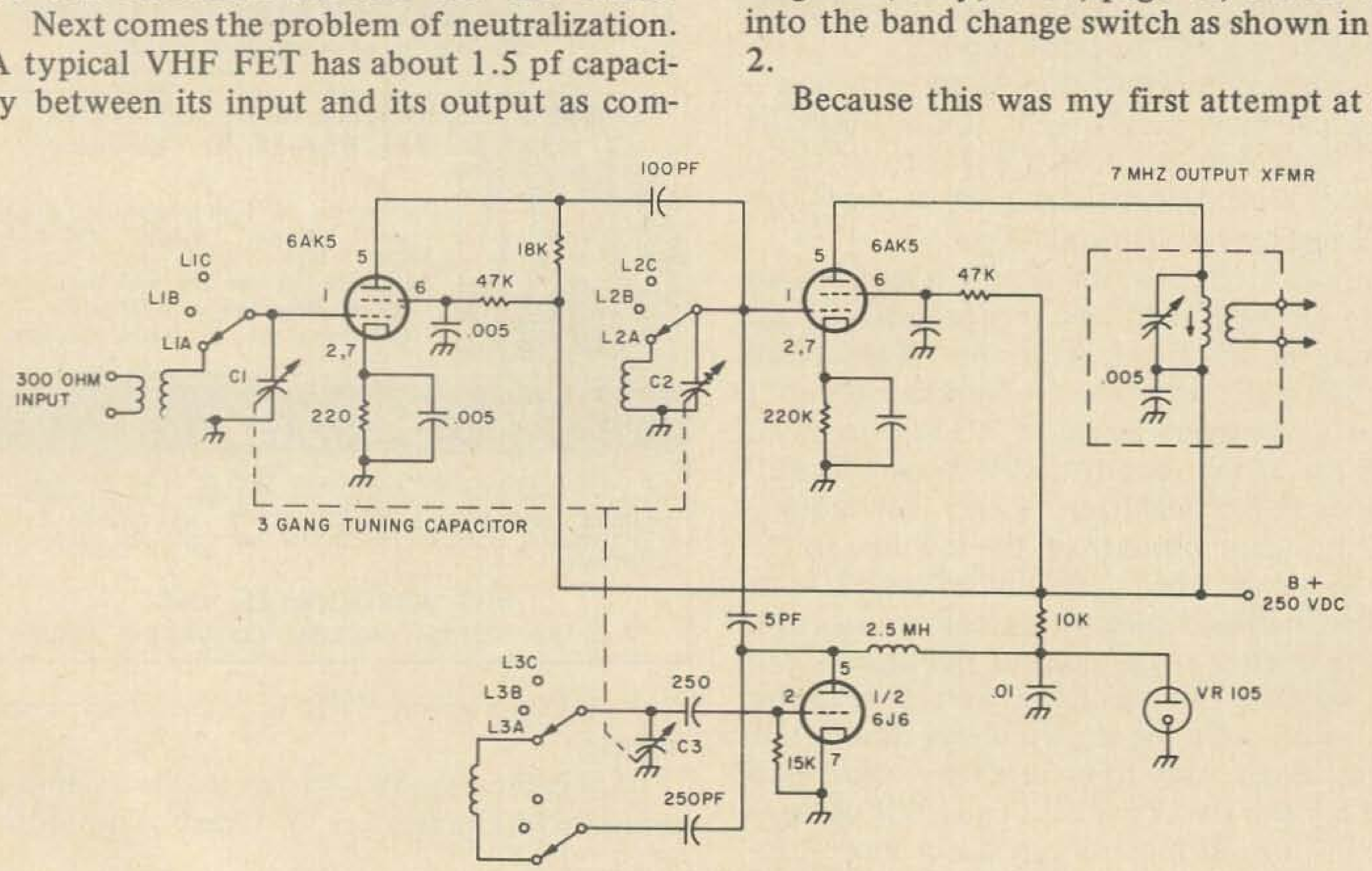


Fig. 1. Schematic for the 10, 6 & 2 converter.

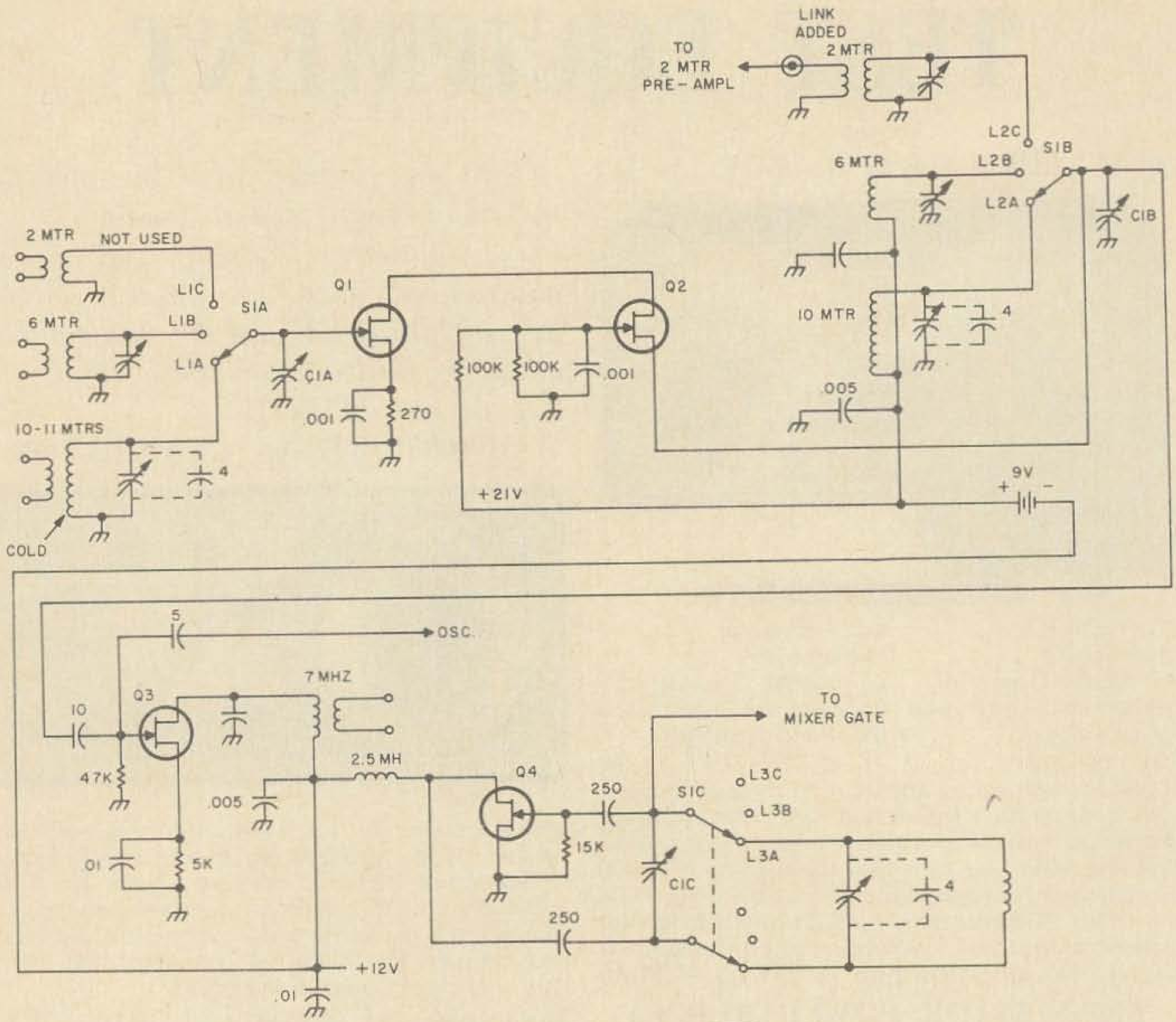


Fig. 2. Modification to FET.

verting from tubes to FET's, I used a cautious three-step approach. The idea being that if something didn't work, I would have a better idea where to look for the trouble. The 6J6 oscillator tube was removed first and a TIS-34 soldered to pins 2, 5 and 7 of the tube socket. I had expected that the injection voltage from the new FET oscillator might be a little low for a tube mixer but this did not seem to follow. The converter worked as well as ever with improved stability.

Next, I removed the 6AK5 mixer and soldered another TIS-34 to pins 1, 5 and 7 on the mixer tube socket. It was necessary to change the grid leak and cathode (source) bias resistors. Operating again as a hybrid with two FET's and the 6AK5 *rf* amp., the old VHF-152 performed better than it ever had in its life. I was almost tempted to "leave well enough alone."

The final step was to remove the 6AK5 *rf* amp and replace the tube with two FET's. In this type of cascode circuit, the FET's are in series so it is desirable to increase the voltage to some value between 18 and 24 volts. What I actually did was to add a small 9 volt transistor battery in series with my 12 volt regulated power supply. In the original VHF-152 circuit, the bottom of L2 was grounded (refer to Fig. 1). It was merely necessary to lift the ground, bypass it, and supply the 21 volts as shown in Fig. 2. The ideal situation would be to have the voltage drop across Q1 and Q2 approximately equal. If you use transistor sockets, you might try swapping Q1 and Q2 back and forth to get the best arrangement. The gain of the stage is determined almost entirely by Q1. You can even use an NPN bipolar transistor such as the 2N706 for Q2 if you wish. The voltage divider for the base bias should consist of two 6K resistors instead of the pair of 100K resistors shown in Fig. 2. No other change is necessary.

Now comes the part that is a real pleasure. The power transformer, choke, rectifier tube and VR tube can be removed from the VHF-152 chassis and deposited in the junk box. The new VHF-152 is ten pounds lighter than

DX Quiz . . . Answers

Here are the answers to the country quiz on page 56.

1M4	Minerva Reef*	7G1	Republic of Guinea
1S9	Spratley Island*	7P8	Lesotho
		8F4	Indonesia
3W8	North Viet Nam	9A1	San Marino
		9F	Ethiopia
4M	Venezuela	9H1	Malta
4Z	Israel	9K3	Neutral Zone, Kuwait/ Saudi Arabia
5B4	Cyprus		
5L2	Liberia		
5R8	Malagasy Republic**		
5T	Mauritania	9M2	West Malasia
5U7	Niger		
		9X5	Rwanda
		9Y4	Trinidad & Tobago

*As far as we know, no operator has legitimately operated from these countries as yet.
**Madagascar is not correct.

the old one used to be. It is more stable and its signal to noise ratio is improved. It can be operated entirely from small inexpensive batteries if desired.

Although the above remarks appear to be aimed entirely at the VHF-152, I want to emphasize that any converter, or receiver front end for that matter, can be converted to FET operation by following the same basic procedure. One word of caution; if you use the step by step approach, be sure to remove all wiring from the "B" plus 250 volt supply which might come in contact with the new FET before attempting to operate in the hybrid mode. Also, be careful about the battery polarity. It is sudden death to reverse the battery on an FET stage.

The TIS-34 is an N-channel FET and there are several other types which would no doubt work equally well. Make certain that the one you select is rated to operate at the highest frequency that you intend to operate the converter. A bipolar transistor can certainly be used in the oscillator stage. I don't recommend bipolars for Q1 or for the mixer stage because I like to preserve the hi-Q and image rejection of the tuned circuits in L1 and L2. It would be difficult to tap down on these coils due to the band change switch.

...W6OSA

(...de W2NSD/1 continued from page 2)
stay CB'ers...or Technicians. Keep after them. Get them into your club and keep them coming to meetings. We've certainly published enough information on how to make club meetings interesting and valuable so you have no excuse for letting your club fail.

The United States twenty years from now will reflect the interest and effort that *you* show today. Electronics will be reaching into every aspect of life then. Schools will be using computers and television more than we even envisage today. Communications satellites will put every home and business in instant touch. Every person, for that matter, may well have a personal phone right with him at all times. Well...almost all times. Credit cards may be used for even the smallest purchases. Just stick it in the slot and your account will be debited from anywhere in the country.

Both on the military and economic fronts, the strength of our country in the future will depend heavily on electronics. We have a lead right now, but can we hold it? You know darned well that Russia is aware of this for they are organizing amateur radio on a level that is leaving us behind. They emphasize the fun over there. They have elevated amateur radio fox hunts to a national craze, with regional championships and then enter national championships. Thousands of clubs participate in this.

In a large measure the future of the country is in your hands. If you have a club, get it into action. If you have no club in your area then start one. If you can't do that, elect yourself a committee of one to go to your local high school and sell ham radio. Get those classes started. Call the school principal today and see if you can arrange to bring down some equipment and QSL cards for a talk in assembly or to the science classes. You certainly can take one night a week off for an hour or two of classes. Or even a Saturday?

...Wayne

Ham Hospitality

Some years ago an organization sprung up in Europe called the Ham Hop Club. The basic idea of this club was a good one, but the effort floundered as the paperwork grew with the size of the club and no one could be found to do the work for no fee.

The Ham Hop Club was set up to enable hams visiting other countries to meet and stay with the local hams. The club, on getting a copy of your itinerary, would. write to members in the countries you planned to visit and arrange accommodations for you. This was a lot of work and took a lot of time.

I made very interesting personal contacts in Paris, Rotterdam, Amsterdam, and other cities as a result of the club, though I preferred to use hotel accommodations rather than put people out with overnight visits. It was through the Ham Hop Club that I met Pierre, F2BO, who later came to New Hampshire to work at 73 and went on to successful work at the University of New Hampshire.

In almost all of the 80 countries that I have visited so far I have been met and entertained by hams. I can testify that ham hospitality is first rate. For some time now I've been wondering what I might be able to do to help get local hams together with visitors. Setting up an office like the Ham Hop Club was obviously out of the question. Perhaps I now have an idea that will work. It seems worth a try.

It has been my experience that when I visit DX amateurs that I benefit tremendously. First of all, the warm welcome makes the city or country seem much more friendly. Secondly, my host is able to explain the customs and mores of the people so that I can understand them. Thirdly, I love to try new foods and often I am treated to a dinner of local specialties which are exciting and fun. In return I find that there are an almost infinite number of questions about the United States that are waiting to be answered. Foreigners read about us all the time, but they have no way of knowing how we look at and understand our own country. They want to know about how our people really feel about the racial problems...Vietnam...how we think of their country, etc. What do we think about our changing morality...big business...politics ...revolt. They want to know about all of those things that QST says you shouldn't talk about on the air.

The DX amateurs that I have visited and talked with seem most enthusiastic about entertaining us W's. I might just offer a warning though that invitations be worded explicitly. I have known U.S. amateurs to accept carelessly offered hospitality by turning up with wife and two children, hitch hiking with full back packs, intending to stay for some weeks.

It seems worth while to me for us to make a try at getting hosts and travelers together through the pages of 73. If you are interested in extending hospitality to a visiting amateur, write and let us know the details of your offer. We will in turn publish it, and from there on it will be between you and the travelers. Please keep your Ham Hospitality notices brief. I suggest you start with your city and state or city and country for DX. U.S. amateurs should specify DX or W/DX. Specify OM/XYL/children. Few families do much traveling with their children, but if kids would spoil the visit just say OM/XYL. If you and your wife have any other interests you might list them...travel, photography, skiing, occult, etc. Give your address and phone number. Users of our Ham Hospitality service will be requested to write or call as much ahead of time as possible and to recognize that all of us have plans that we don't want to break and that all offers are contingent upon the time being open. Try and keep your offer to 30 words or less please.

Sample:

Peterborough, NH. DX OM/XYL, overnight/dinner, local sightseeing and rag chewing. Interests: travel, photography, skiing, skin diving, Mensa, art, occult, UFO's. Wayne Green W2NSD/1, Peterborough NH 03458. 603-924-3873.

...**Wayne**

Gentlemen's Agreement

Many AM holdouts on our 20M band keep bringing up a "gentlemen's agreement" which guarantees them permanent exclusive use of lower half of the 20M phone band. For the information of those of you who have entered amateur radio during the last ten years, there was indeed at one time such an agreement.

Back in the early years of sideband the pioneers were not interested in working DX. Indeed, attempts at it were rather futile, since very few DX operators even had an idea of how to tune in a sideband signal. I remember visiting OE1ER in Vienna back in 1958 and finding that he was under the impression that his receiver (AR-88) wouldn't tune in sideband. I showed him the technique and broke in on my good friend W2CFT, calling on AM. Al said hello to us immediately and it wasn't many moons before OE1ER was heard with a rather potent sideband signal.

Since they couldn't work DX, most of the sidebanders congregated on the non-DX end of 20M, the high end. At first they took up the top 20 kHz (they were kc in those days, alas). Then, as more fellows found out about the advantages of SSB, they gradually expanded...30 kHz...40...50! At about this time, the phone band was extended from 14.3 to 14.35 and the SSB crew filled the 14.25-14.35 segment almost immediately, leaving the 14.2-14.25 segment for AM.

But by now more and more DX stations were getting into the act and learning how to work the sideband stations. And even worse, from the AM point of view, every now and then a DX station would change over to SSB. Even the unthinkable happened...a DXpedition operating on SSB instead of AM! The sidebanders found that they had to tune up on the low end of the band to work these DX stations and that was when the gentlemen's agreement went out the window.

With some intelligent leadership the AM-'ers might have rescued the situation for themselves by regrouping on the high end of the band. Their opportunities for working DX were fading away and there really was no good reason for sticking to the low end other than stubborness.

Unfortunately for the health of our hobby, the same personality traits that kept fellows sticking to AM when the rest of the world was changing to sideband, also kept them on the air bitching about things and generally trying to make as much of trouble as they could. This, of course, does not apply to all AM ops, but it does to enough for us to make a good general case.

When I operate I try very hard to be as polite and helpful as I can. Sometimes, I feel quite a strain and I discover that I feel like quitting for a while. I wonder if it is really necessary for us to make it so difficult for the FCC to take the licenses away from fellows who have serious psychological problems and insist on venting them on the air.

I digress; as usual.

Perhaps it is time for us to initiate a new "gentlemen's agreement" for the AM'ers on 20M. It would make life a lot easier for them...and certainly for the rest of the resident 20M ops, if they started working from the 14.35 end of the band, as the SSB'ers did when they were as rare as the AM ops are today. I'm open to any good reasonable arguments for or against this...but if you find yourself hot under the collar, wait until you cool off and can write an intelligent and well thought out letter which will be of interest and value to us all. We have enough emotional harangues on the air and they are not needed in print.

Z-1000 Certificate?

Would there be any interest in a new type of certificate? I have in mind something the reverse of the A-1 Op certificate. Should we have some permanent memento that we can send to ops who demonstrate on the air their stupidity, their thoughtlessness, their lack of consideration for others, and other lousy characteristics which go to sour the average amateur?

A nice big certificate, edged in black, could be sent to any operator who has made such an ass of himself that a bonafide amateur radio club has taken the effort to submit an official censure memorandum to us. We could then issue the certificate, printing the detailed complaint on it and the calls of the club members who have lodged the complaint. We might also send a copy to the local FCC office for their information.

What is your reaction to this? If you don't like the idea, what can you offer as a positive suggestion that we might all be able to do to help straighten out these either thoughtless or "sick" ops that are botching things up?

Wayne

Covers?

We need interesting and colorful covers for 73. Perhaps some of our readers are artists and can paint some good covers? Or can you photographers come up with some cover ideas that will help us sell more magazines on the newsstand? Our newsstand distributor is most adament that we should have a person on the cover as well as equipment, parts, a tower, or whatever. And if this person happens to be gorgeous so much the better.

Keep in mind the aspect ratio of our cover format. We can vary from this, but we tend not to. We can work from color slides of the regular 35mm type, or from larger color positives or negatives. We can work from color enlargements too. And of course we can work from original oil or watercolor paintings or pastels. Paintings should be about three times the finished size.

Cover ideas are hard to come by, so see what you can come up with. Remember that we run special issues now and then devoted to surplus, antennas, vhf, dx, transmitters, receivers, and such. RTTY, ham-tv slow-scan tv, moonbounce, dishes, and other ham developments are all worth while for covers.

We are paying a fortune to reprint color pictures on the cover so be sure that your entries are colorful...have good composition ...and are sharp and clear.

FCC Action

Perhaps "action" is an exaggeration. At any rate the FCC on March 11th announced that they had extended the time for receipt of comments on the petition by John Attaway, K4IIF, to hold up on extending the Extra Class CW bands on November 22nd since the present allocations had yet to be adequately used. The extension was until April 7th. Since the next possible issue of 73 that we could get the news of this extension in would not be in the hands of readers until April 25th or so, we did not fall all over ourselves to get this notice into print.

If you feel that the FCC is rushing things a little with their intention of opening up another 25 khz to the Extra Class for CW, come November this year you might sit down at a typewriter and compose your thoughts on the matter, giving all of the arguments you can think of to back up your proposals. Address these to the Secretary of the FCC, Washington, D.C. 20554, and send along the usual 15 copies to make it official. It does not hurt to get a notary on the original copy.

The FCC will continue to slough us off as long as we remain disinterested enough in our own fate to keep our opinions to ourselves. If the FCC doesn't get any more mail than I do about these things then they are absolutely right in dismissing us as unworthy of much consideration. If anybody cares much about what is going on they are keeping mighty quiet about it. The squeaking wheel gets greased. Office copiers are just about everywhere now so there is little excuse in not making up those silly 15 copies and filing your opinions officially.

Wayne

Ontario QSO Party

All amateurs are invited to participate in the Ontario QSO party sponsored by the Radio Society of Ontario, Inc. The contest will run for a 31-hour period from 1700Z July 19, to 2400Z July 20. There are no power or band restrictions. Ontario stations score 1 point per contact and multiply by the number of ARRL sections and foreign countries worked. Others score 3 points for each Ontario station and multiply by the number of countries worked on each band. Ontario stations send QSO number, report and county. Others send QSO number, report and section. Logs must be postmarked no later than August 31, 1969, and sent to: Contest Chairman, Radio Society of Ontario, Inc., P. O. Box 334, Toronto 18, Ontario.

LETTERS

Last year, at renewal, I wrote a somewhat critical note stating that I thought the quality of 73 had degraded. As you can see by my 3-year renewal I don't feel that way anymore. Although I do believe that your magazine is not as "good" as it was 2-3 years ago—I think it's improving qualitatively issue by issue.

I would like to give you some of my thoughts regarding the state of amateur radio.

First of all, after I received my latest renewal from ARRL-*QST*, I decided the hell to the ARRL. I am discouraged Wayne, that a bunch of 70 year olds—living in a consciousness of the 1940's (at best)—are trying to run a (the) ham radio organization and amateur radio itself. When I read those assinine editorials—as I have in the last few issues of *QST*—about restricting freedom of speech on the air to nice safe, non-controversial topics I become upset for the future of our hobby. As you are well aware, the average QSO is the most repulsively dull conversation imagineable. Further, I am discouraged that these same 70 year olds—with the help of many fuddy-duddy engineer types—railroaded thru that damn incentive licensing giving the granddaddies lots of privileges and effectively "wasting" the lower 25kc of our bands (listen how void they are of use). Third, I am discouraged about the racism that I hear on the air and that I sense when I meet fellow hams. Amateur radio appears to me to be one of the most segregated hobbies in American culture. At a time when our hobby is hovering near increasingly faster (sharper) declines in new applicants—and perhaps air space—we should go to Boys' clubs, etc., in the inner cities and help set up at least club stations. But I sense that many hams are afraid that such communication potential may be used in riots for other than avocational purposes—such a ridiculous argument presumes of course that other forms of two way communication are not available—and they are. But, I guess that the real reason inner city kids are not introduced is because hams are fuddy-duddy—old and mainly traditional, solidly middle class, and scared. (Lack of equipment availability I do not see as a problem.) In fact, if you peruse the pages of *QST* you see lots of lines devoted to trivia, i.e., what Joe Ham is doing in the Midwest section with his new Drake Line, etc., or gobs of stuff on that puffed up public service bit called civil defense (excepting natural disasters), but little of social significance.

And, yes, Wayne, even you have been quiet on the turmoil in our society—focussing instead on safe stuff like USO nets, etc.

At a time when long distance telephone rates are cheap, telephone accessibility is so widespread there is little public service left that hams do, excepting certain overseas patches. Traffic is a slow farce; civil defense can be better (and has been) handled by CB'rs; and contributions to the electronics industry and our national defense is a delusion we allow ourselves but which is actually groundless when one considers how laggardly the state of ham technology (homebrew) is and how few young people participate in our hobby.

All in all—hams need a good kick in the butt, and probably deserve to lose frequency space considering the outmodedness of our hobby.

Gerhard J. Hanneman, WA8VBN
Michigan State University
East Lansing, Michigan 48823

While I am unhappily acknowledging Kayla's happiness, I will take the opportunity to say I'm sorry to know you are losing such a fine editor. She has a unique way of putting a feeling of friendship into "73." I suppose it is achieved simply by being friendly. She will be missed.

I am very glad to learn from your editorial how well you have succeeded with "73" in so short a time. You are to be congratulated, indeed. I rather doubt that it is getting too big for you as I am sure you are growing with it and are capable of handling its future growth, which, I hope, will be somewhat more than considerable.

While I am at it, toss my thanks to Zaranski for his article, "Minimum Cost Semiconductor Survey."

Also, I have for a long time wanted to thank Robert Suding for his article, "A Cheap and Easy Frequency Counter," November "73," 1967. I note in the current issue of "73" "Looking Back," refers to Votipka's counter, Nov. 1968 as being "over-simplified," and difficult to build. As I am about to revise my counter constructed from Suding's article with a few modifications, such as wave former and input gate and reading for one second, displaying one second, then repeating to update, I would appreciate it if you will use the enclosed SASE to forward the material mentioned on Votipka's counter (Nov. 1968).

If I recall corrently there was one omission but no errors in Suding's article, which remains the simplest and cheapest counter I have seen to date. It worked perfectly the first time I connected it up.

Again, congratulations on your excellent publication, the excellence of which its growth will continue to show. And, again, my regrets that the world, you and me, have lost our fond "Editorial Liberties."

C. W. Pate
Bryte, California

I know letters like this must be a pain, but if you would print this, I would appreciate it. It's to ask if there are any Swedish or English hams with whom I could exchange correspondence, cause om-a-goin' there. Naturally I would like them to be near my age (17), and longhairs, (you know, radical trouble-making whipper-snappers like I obviously must be). I write to you because of all the magazines, yours seems to have the readership with the largest number of people like me. I mean that as a compliment, you know. Thank you.

Richard Klein, WB22TN

(Sorry, can't help you leftist fellow-travelers—ed.)

Your March 69 issue of 73 *Magazine* was especially pleasing to me. The W1EMV and W2NSD/1 editorials continue to be outstanding; however, it was a most pleasant surprise to find an *open letter* to the editor by our old friend, A. David Middelton, W7ZC (page 71). In his typical straight-from-the-shoulder style, without repetitious "gobblygook," Dave conveyed his message to the reader. To the best of my memory this is the first public article by W7ZC I have seen in almost five years. What a void to hamdom!

I am appalled by the inactivity or loss of so many fine writers and club editors. In the past five years and particularly since the questionable "Incentive" Licensing action there has been a definite lack of controversial articles and "think" items for the amateur radio readers. As the result, amateur radio is suffering immeasurably by this loss of material. Since the innovation of the "incentive" ruling, radio amateurs are resorting to small independent cliques, uninterested in the overall picture because they have been subjected to one-sided information, or worse–no opinions at all!

During the promotional years of supporting amateur radio reciprocal licensing in this country, readers consistently found numerous excellent debatable reading matter in several magazines and club bulletins (but very few ever appeared in QST, I might add). These were the product of a great number of quality writers, many of whom were non-professional, but who have since chosen to remain dormant or have totally given up crusading in behalf of hamdom.

DX Magazine from Burlington, Kentucky, and The Monitor from Dallas, Texas, topped a long list of excellent periodicals, most of which have been discontinued. The Kentucky publication, edited by Don Chesser, W4KVX, and assistant editor Bob Knapp, W4OMW, was eagerly read by every *thinking* radio amateur. This same keen interest was directed to The Monitor, edited by courageous Joe Martin, W5RYP, and his talented staff of associate editors J. Foy Guin, W4RLS, A. David Middelton, W7ZC/W5CA, and Len Collett, KZ5LC; Oklahoma Editor, Doris Anderson, K5BNQ; Indiana Editor, Phil Hunsberger, K9PNT; Maryland Editor, Mari-Anne Payton, W3LQY; Nevada Editor, Leonard Norman, W7PBV; Circuit Board Editor, Walter Stevens, K5ICV; Virginia Editor, Van Wimmer, WA4BIX; Texas Panhandle Editor, Phil Patterson, W5SFW; and Mississippi Editor, Eddie Livingston, K5VOK.

The Institute of Amateur Radio, Inc. (IOAR), offered the hams outstanding "think" material by two well-informed writers: Wayne Green, W2NSD/1, and A. David Middelton, W7ZC. Dave also served for a time as the secretary of IOAR. Although sorely needed by all of hamdom, radio amateurs did not have the foresight nor the capacity to discriminate between facts and personalities–with the drastic result that the organization was not sufficiently financially supported. To concurring hams this meant that a sound and effective program was temporarily shelved. The Institute is amateur radio's solution to provide a much needed legitimate lobby in Washington, D.C. My personal opinion is that IOAR, properly supported will furnish the healthy competition required to "force" ARRL into providing a true democratic representation for its members and USA amateur radio. Reactivated and strongly assisted, the Institute of Amateur Radio can still provide the necessary liaison and lobby in our Nation's capital, a function vitally needed to improve and correct our present serious deficiencies. The end result will provide Congress and the amateurs with immediate factual and current information relative to Stateside as well as world-wide amateur radio activities.

You may remember other excellent writers during the pre-incentive licensing era: Dorothy Strauber, K2MGE/W4MYE, assisted by her energetic OM Irving, K2HEA, who edited The Sidebanders, published by the Single Sideband Amateur Radio Association. (Dotty also had a column going in CQ Magazine.) That vigorous staff included Ralph Mason, DL4PI; Harriet "Sunny" Woehst, K5BJU, as the YL Editor; Phil Carter, W1CRA; and James L. McCoy, K5GCE, who wrote under the by-line of "The Real McCoy."

From Europe came the extremely provocative articles of the very talented Frank E. Mortensen, W7HNT/WA6YNG, under his by-line "Let's Be Frank" which appeared in the SARA STATIC issues of the Spanish-American Radio Amateurs in Sevilla, Spain, and the QRZ bulletins of the Bitburg, (Germany) Amateur Radio Club. Both of these club periodicals were widely distributed world-wide. Frank's articles were directly responsible for the tremendous world support that resulted in the eventual passage of the reciprocal licensing bill into law.

What has happened to these fine writers? What has discouraged them from submitting timely articles? There are sufficient problems in today's USA amateur radio sphere to warrant and attract the controversial/think writers. Could it be our lack of interest? Least you forget, amateur radio owes a great deal of its development and progress to the polemical and "think" pieces from well-versed and qualified personnel whose written opinions over the years gave each of us the necessary background to weigh, with an open mind, the dialogue needed to reach a valid and realistic decision. Those writers, plus many more unmentioned in these comments, recognized the need during that period to provide hamdom with varied open-minded opinions.

Today, more than ever, amateur radio should find a place for the opinionated thoughts of its writers. Too, there is a place for the reporter-type who can publish in his own town or city newspapers or commercial magazines, the amateur radio events as they happen. But, primarily we need to recall all of those authors who, by writing their own thoughts can make us more knowledgeable and conscious of what is happening to amateur radio in our country. We must be shocked into thinking and acting immediately! This is no time to waste on those writers who are fearful of "rocking the boat."

I hope to see more inputs from David Middelton. Perhaps he can awaken the interest of those dormant authors. There are many of us who want to see their articles in the pages of our favorite magazines and other periodicals. With the continued absence of the journalistic efforts of qualified controversial/"think" writers, the USA radio amateurs cannot expect any improvement in present conditions–in fact, we will continue to live with token "representation" and degradation that is occurring in our ranks. Too, we must be cautious of accepting the opinions of "self-styled" journalists who author the "expert" overseas picture after one short visit to a foreign land. In the eyes of our DX friends, these writers create more serious harm than good. Instead, let us encourage those fine experienced penmen into reactivating their efforts in order that we may regain the courage to correct our own problems. Whether or not we recognize it, amateur radio in this country today is in greater jeopardy of surviving than ever before!

John F. Barrows, W6ECS
Fairfield, California 94533

I am a great fan of your magazine and wouldn't trade it for anything. But, for a long time I have wondered why you haven't started your own Field Day Contest. I feel this would help a lot of people to like the magazine a bit better. So, keep up the good work and think about this. You have a lot of good articles on contests, but you don't have any contests to use them on that I know of.

David Brittenham, WA0RVK
Monett, Missouri

No, no contests. Somehow we had the feeling that perhaps there already were enough contests. However, if a major radio club would be interested in volunteering to run a new type of field day event, complete with the scoring of the logs, we might just consider it. We had in mind a contest which would be short and unannounced to simulate emergency conditions...ed.

I think your technical articles are great. If possible, more on conversion of commercial FM gear in the VHF range (6M & 2M).

I am an E.T. by profession and rate 73 Magazine as high as any trade or hobby magazine on the market today.

Many thanks to all the fine engineering people who contribute articles in laymen terms.

S. L. Thompson, WA5NXT/0

One of the finest articles on antennas ever carried in any magazine was in the April 1966 edition of 73, by Robert Cooper, *Ascendency Curve Yagi*, p. 20. I built a 3EL Yagi for 20M based on his maximum gain curves and it was far superior to commercial beams. How 'bout an article dealing with Maximum Gain for Quads–element spacing lengths, etc. Keep up the good work.

Greg Milnes
Hillsboro, Oregon

I saw it first in your 73 Magazine in November 1966 on page 52. Next it shows up in "ham radio" for April 1969 on page 34, three years later. Can they get a patent on that?

I Am Curious

Dear Curious: Nothing to turn yellow over. W2-WLR does seem to have managed to rediscover a diversity antenna very close to that described by W4TDI in 1966. These have been popular for many years for point-to-point communications where fading is a problem (RTTY, etc.). The low angle radiation is deceptive in high sunspot times when signal reports can be most exciting from areas where the band is just opening. Unfortunately, once the band is open, a very low angle antenna will lose your signal in the qrm. Ask anyone using that most remarkable low angle Twin Three (or ZL-Special) antenna what happens after the band is open or when the sun spots are gone. When "ham radio" announced the W2WLR antenna for their April issue I thought that this was appropos and fought off the strong temptation to discuss it in our April issue.

Here are a couple of photos of my ham TV station which I spent about five years constructing and working out the bugs so now I have a *snow-free* picture up to seventy miles from here. More later, if you are interested. However, I will mention a few stations I work very often and always snow-free in any kind of weather such as K8TME, Damascus, O., WA8DZS, Mount Union, Ohio and also WA8-OKS, same QTH, K8EWX north of Alliance, K8WMA south of Alliance. All of us really appreciate your interest in ham TV but would like to see much more on TV in 73 from other successful TV'ers. Obviously, this is the coming mode in many amateur stations in USA. I think this is the King of all electronic hobbies. Sure is terrifically thrilling. By all means, keep up the good work in your 73 or we ATV'ers might have to throw in the sponge.

Les Miller, W8ACH
Alliance, Ohio

I would like to thank you for a job well done on "Amateur Radio Knows No Borders." It is this type of report that makes me proud to be a member of the amateur fraternity.

J. Stoutenburgh, WN0WDX
Minneapolis, Minnesota

An item of interest for your magazine is the fact that both houses of the Alaska State Legislature have passed by an overwhelming vote House Bill No. 103 which relates to the annual license tax on vehicles containing mobile amateur radio stations. Under the new law, rather than pay $30.00 for a license plate, an amateur holding an FCC license and with mobile capability of 75 meters through 10 meters may obtain his license and his call letter license plates for a total fee of $1.

The idea behind the Bill was to encourage amateur radio operators to equip for emergency use. You will recall that in the case of the Anchorage earthquake in 1964 and the Fairbanks flood in 1967, the power was off and regular communications were completely disrupted for a substantial period of time. In both cases radio amateurs provided an emergency link-up until power and normal communications were restored. In these days of zoning regulations which cramp amateur radio, TVI complaints and million dollar lawsuits, it is heartwarming to see the policy of a sovereign state of the Union recognizing the unique capabilities of the amateur radio fraternity, and I think an appropriate article in your magazine might well be an eye-opener for other parts of the nation. Truly, the entire country should support the principle set forth in Alaska's House Bill No. 103 for no one is completely safe from natural disasters.

Douglas L. Gregg, KL7FPA
Juneau, Alaska

The TIS34 is popular in Amateur construction projects, but is hard to locate "over the counter." It is available from TI Supply Company, 6000 Denton Drive, Dallas, Texas 75235, as a 2N5248/TIS34. The present price for 100 units is $1.10 each.

Ed Lawrence, WA5SWD
Plano, Texas 75074

A Variable Resistance VFO for 6 or 2

Roger H. Taylor, K9ALD
281 William Street
Champaign, Illinois

Another Stable VFO

Voltage tuned variable capacitance diodes have been with us for almost ten years. They have been featured in a few general applications articles, and they are showing up in a few commercial SSB transceivers. However for being such useful little animals, they have seen very little use in ham articles. A considerable effort is made in vfo designs to provide mechanical rigidity in the tunable element, whether coil or capacitor. Yet, here is a completely rigid device which has seen little application. Obviously, what follows is a vfo using the voltage tuned variable capacity diode, and also an encapsulated coil to eliminate mechanical problems.

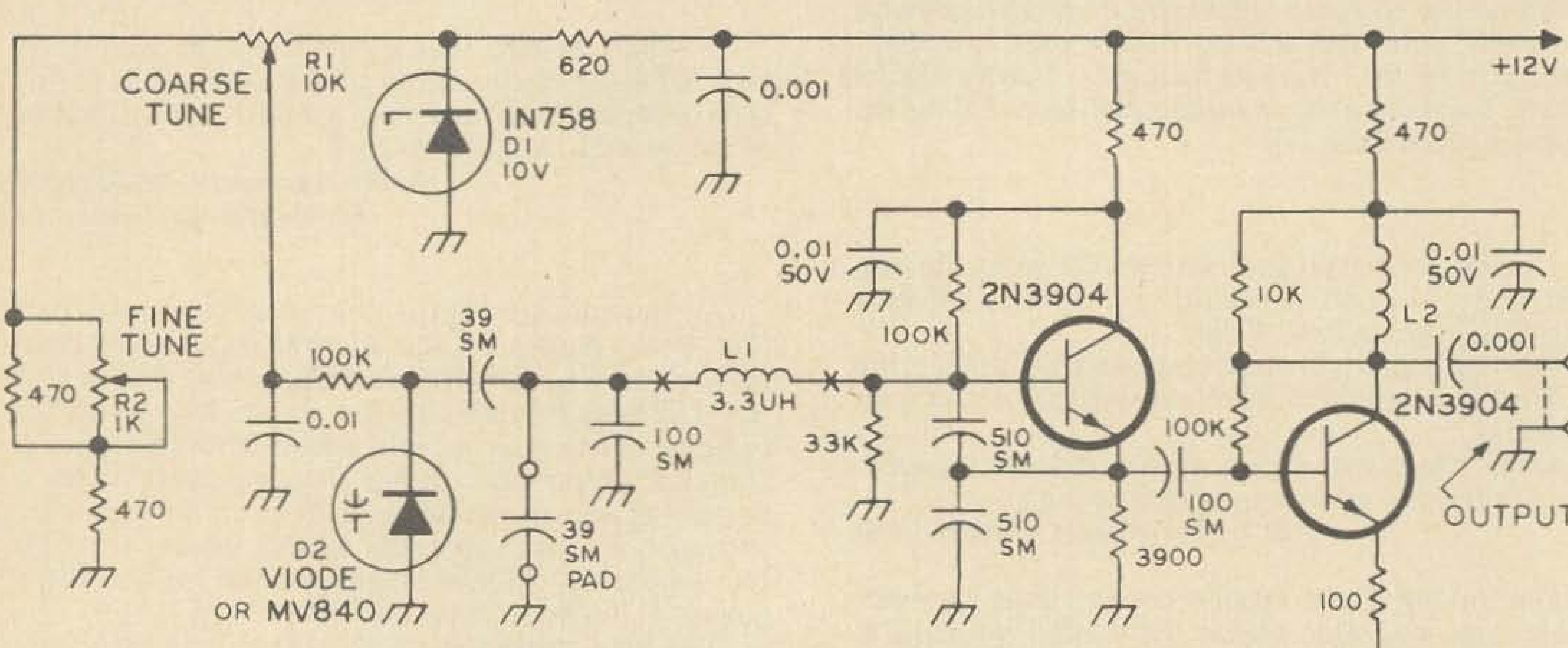


Fig.1. Schematic diagram, Colpitts oscillator.

Two models of the vfo were constructed. One features two miniature potentiometers for coarse and fine tuning. The other has only one standard, a lower cost pot. for the economy minded. The circuits are identical except for the added pot. The schematic shows the standard series tuned colpitts os-

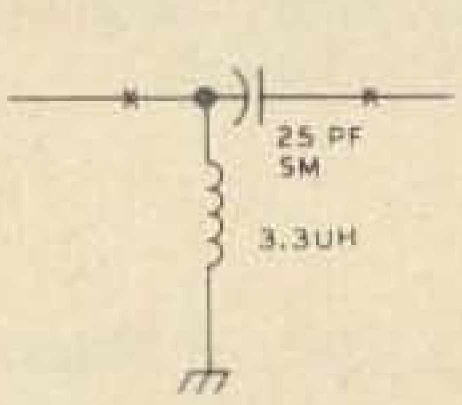
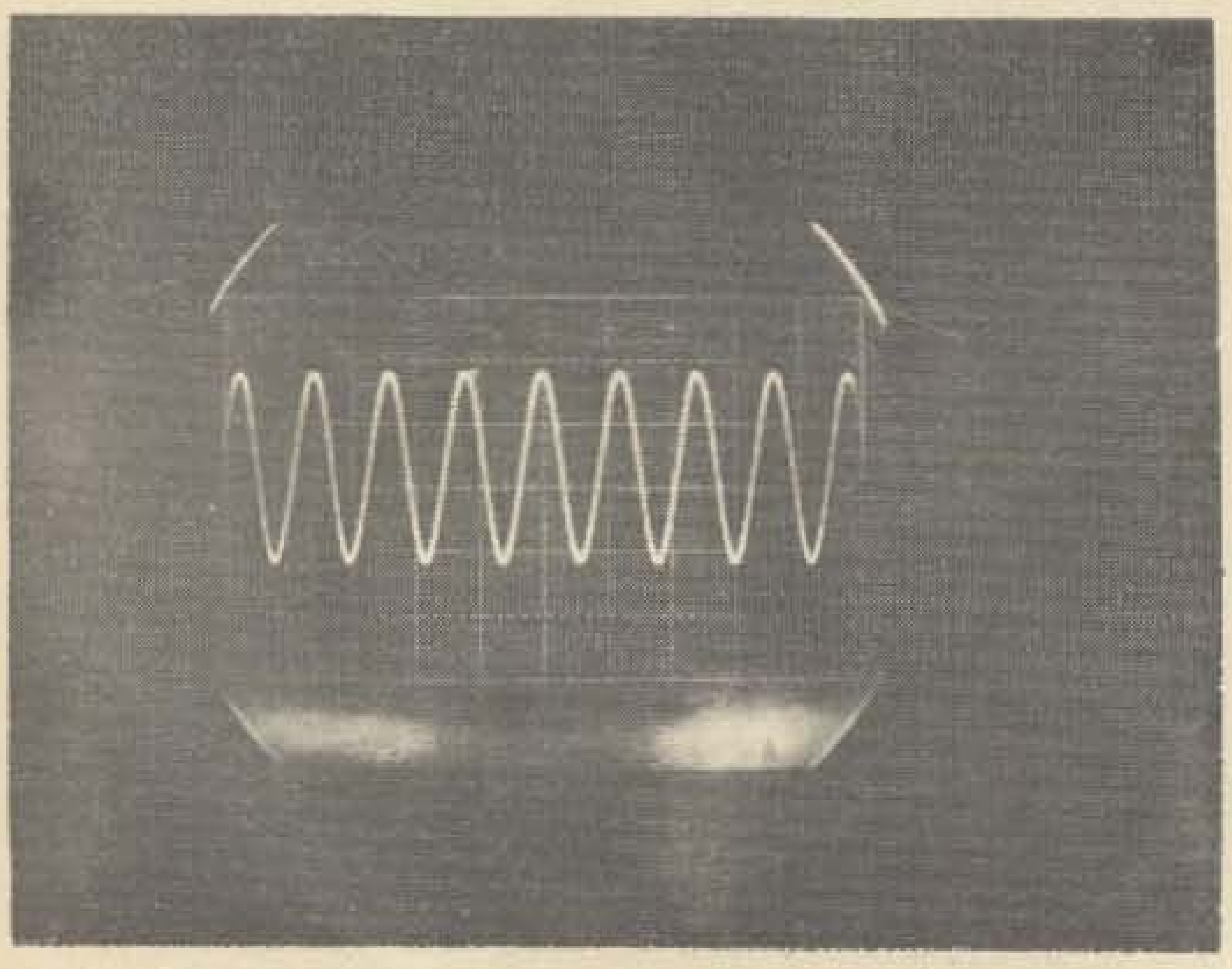
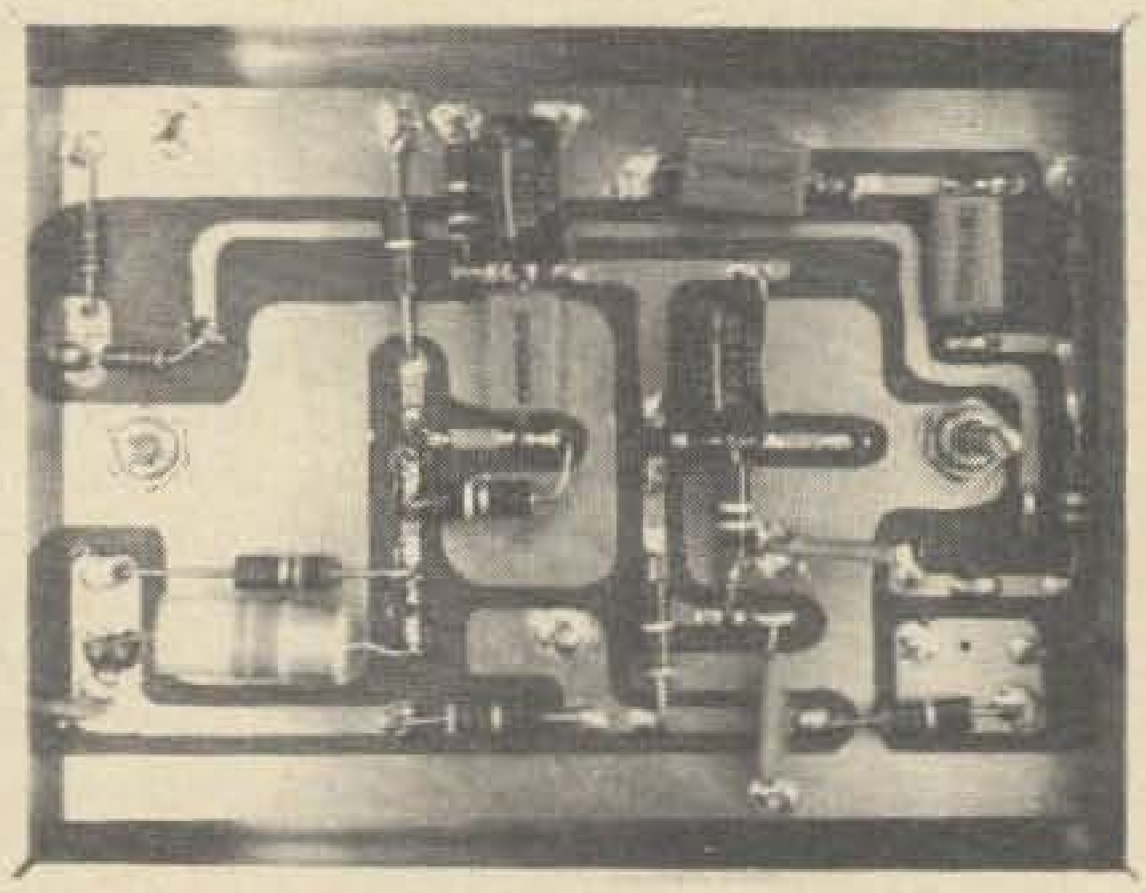


Fig.2. Parallel tuned version.



Look at those nice sine waves.



Bottom view.

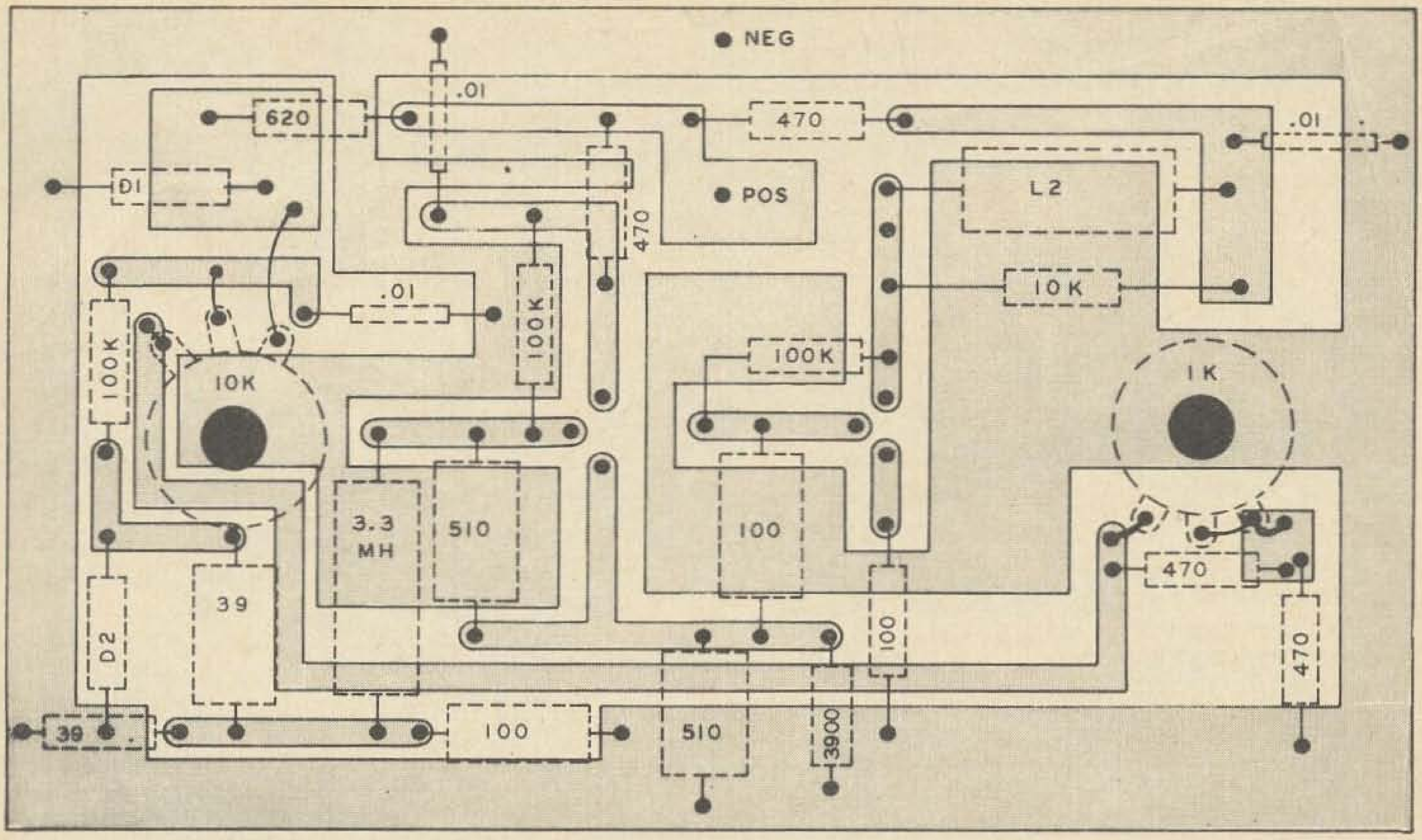


Fig.3. One side of printed circuit board.

cillator in **Fig. 1.** If you prefer the parallel tuned version, simply modify it according to **Fig. 2.** The series tuned version seemed to give slightly better stability with supply voltage variation.

The voltage to the diode is regulated by the zener diode. The .001 capacitor is for filtering any ac or noise. It could be almost any value. The 100K resistor is for isolation of the diode. An rf choke could be used, but would introduce more reactive components into the critical tuned circuit. The output coil, L_2, is chosen to resonate with the length of coax to the next stage. If no coax is used, 15 uH is the correct value. If maximum output is desired, a smaller coil can be used and a trimmer capacitor added to tune the output rather than cut and try on the coax length. The 10K resistor across the output just loads it and broadens the response. The output should be at least 15 volts peak to peak into 10K ohms of good clean sinewave (unlike some other vfo's).

The values given are for a frequency of 8.3 to 8.5 MHz. Changing the padder quickly puts it in the two meter range from 8.0 to 8.2 MHz. The unit is quite stable with voltage variation from 10.4 to 15 volts or more. You can shut the oscillator off in several ways such as: grounding the base, opening the emitter, or simply switching off the supply voltage. Normally the latter is not too satisfactory, but no turn-on drift could be detected. Everything is rigidly mounted to the pc board. The components should be mounted on the back for easier soldering. I mounted most of them on the front to show their placement better.

The two pot. model is recommended for SSB since it is easier to zero beat, or the one

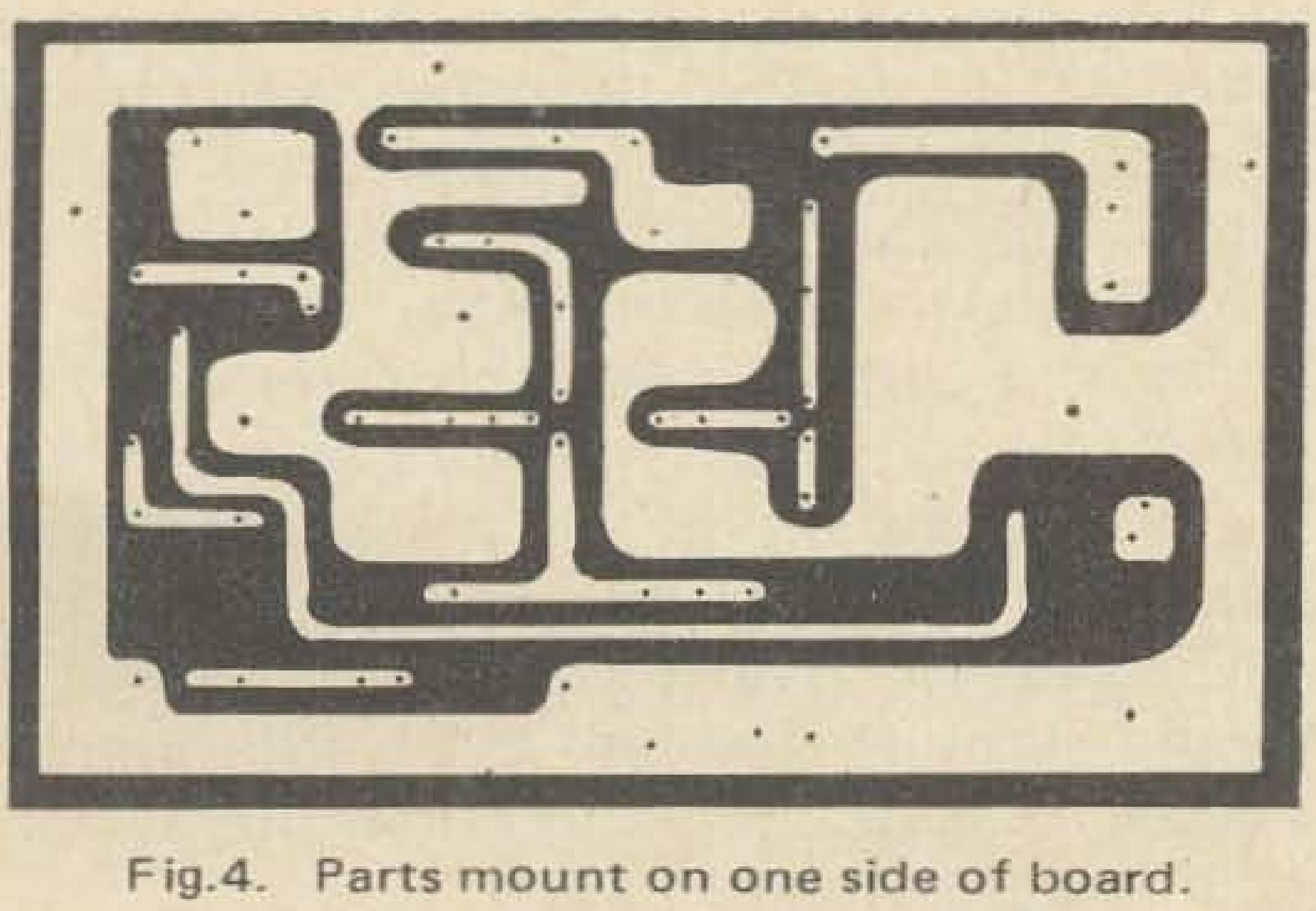


Fig.4. Parts mount on one side of board.

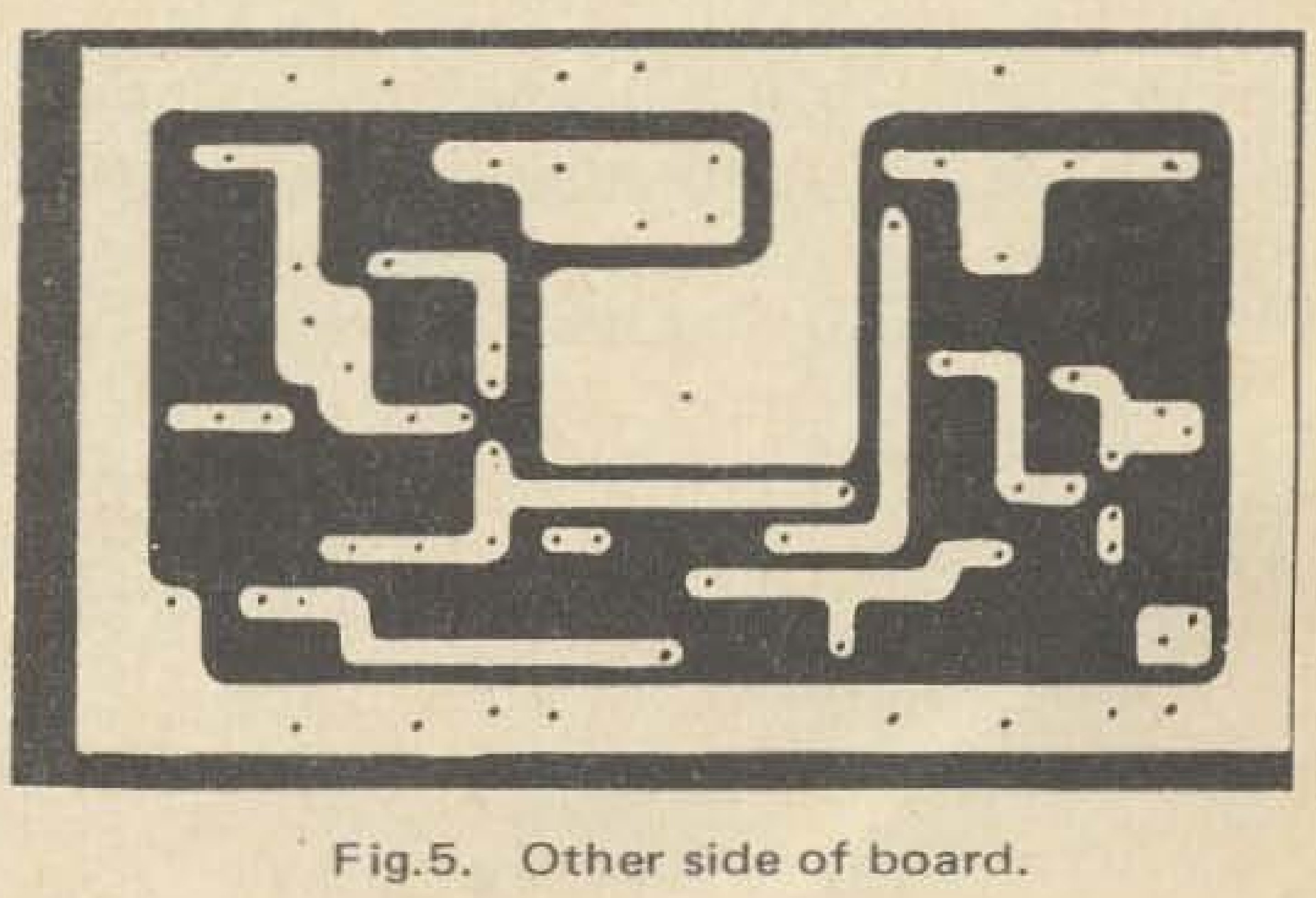


Fig.5. Other side of board.

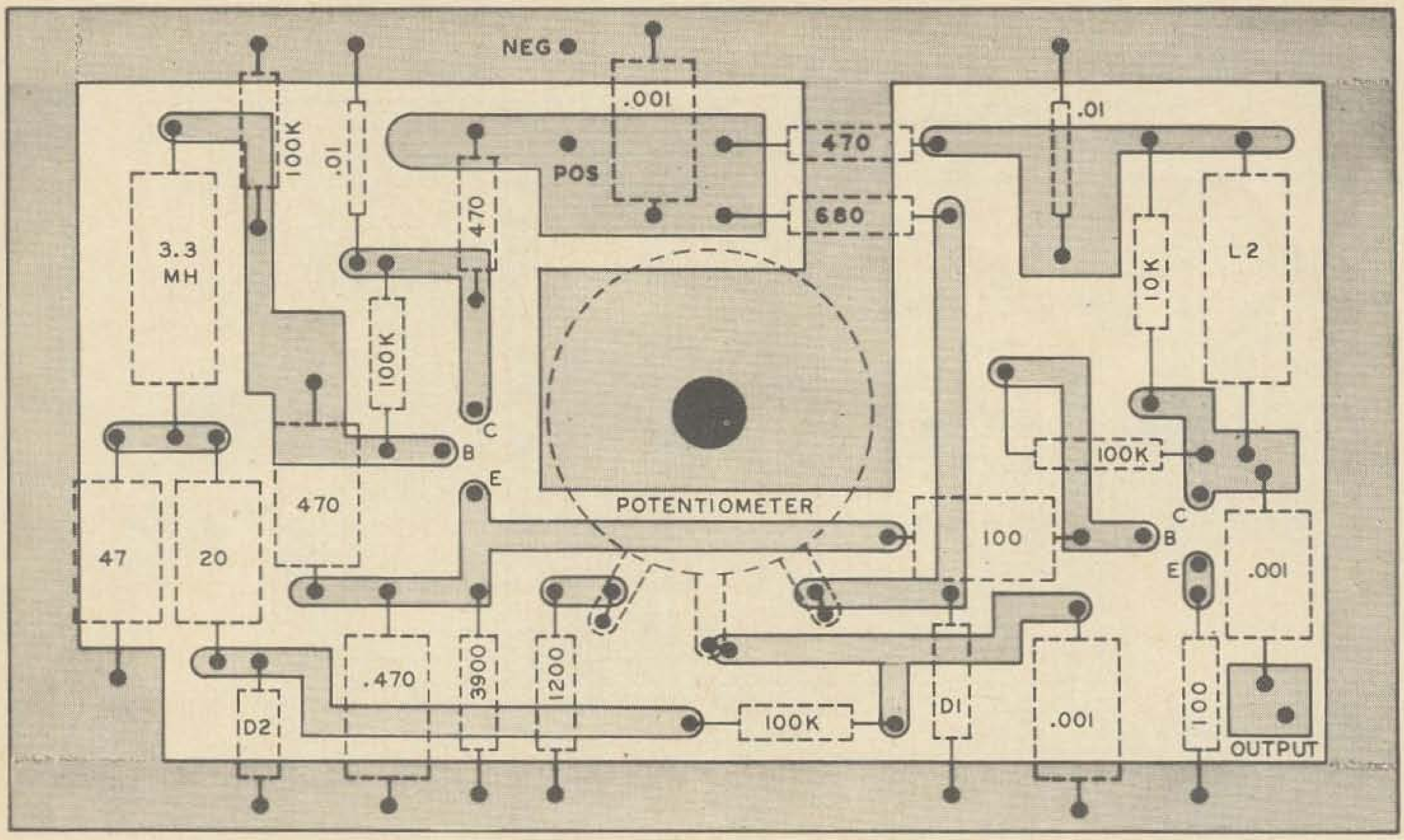


Fig.6. Parts placement on other side.

pot. version can be used with a vernier. You can make a vernier from the tuning capacitor in the "lunch boxes" or Lincoln transceivers. Lafayette also has a vernier (69 cents) on page 291 of their '66 catalog. Using most verniers will restrict you to 180 degrees rotation, while the pot. will provide 270 degrees. The single pot. is quite adequate for AM work without the vernier, and is considerably cheaper. ...K9ALD

Report from the Board of Health

TVI traceable to 6 meters and channel 2 can be difficult and it takes a little time to get rid of it. Sometimes it is incurable. But, TVI caused by 10 meter radiation interfering with channel 2 is hardly ever difficult to control. A trap known as the half-wave filter is illustrated. The components specified allow its use with transmitters up to approximately 500 watts pep output and the capacitors are most susceptible; especially if vswr is above 1.5:1. The formula for calculating safe voltage ratings for the capacitors is: $C = \sqrt{2P x Z_0}$ where 2P is twice power output and Z_0 the transmission line impedance.

There are hams who are off the air because of TVI, and it is not necessary since the filter will provide at least 30 db attenuation for the attenuation for the second harmonic and greater attenuation for the third, etc.

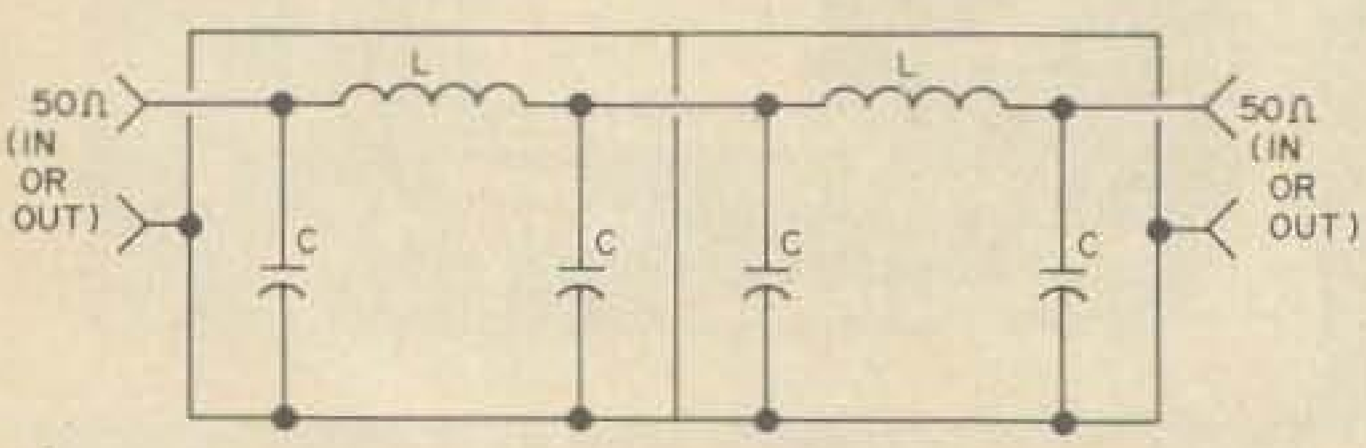


Fig. 1. A half wave filter for TVI.

Parts list:

C: 100 pf mica or ceramic "dogbone," 500 v–(up to 500 watt pep).

L: 5 turns 3/4" diameter self-supporting coil or tailor-made coil stock. Leave a partial turn for knifing to set desired center frequency with GDO; usually 28.6 mhz.

Box: 2¼"x2¼"x5" (more or less) with center partition. Make a small hole in the center partition for coupling the two sections, but don't use a feed-through by-pass.

Ray Stellhorn, WAØNEA

Official ARRL Bulletin 211

With the coming of the travel season amateurs will be taking advantage of reciprocal operating agreements. Amateurs traveling across the Canadian United States border should apply for an operating permit 30 to 40 days in advance. W/K licensees apply to the PO Dept., Century Bldg., Lisgar St., Ottawa, Canada, or its six regional offices. Canadians apply to the FCC, Washington, D.C. 20554. Travelers visiting elsewhere should allow at least two months for processing of requests. Write to ARRL HQ for details on a particular country.

Vernon Fitzpatrick WA8OIK
McLain Park, M203
Hancock, MI 49930

A VHF Band Scanner

The pan adapter has received a considerable amount of publicity and does a fine job for the HF (160-10 meters) ham. The pan adapter that covers 250 KHz is usually sufficient. The VHF ham, however, may want to observe 2 MHz or more of the band.

The band scanner to be described will cover the full 4 MHz of the 6 and 2 meter bands, if desired. The band scanner is sometimes referred to as a spectrum analyzer. Either term is ok but I prefer band scanner.

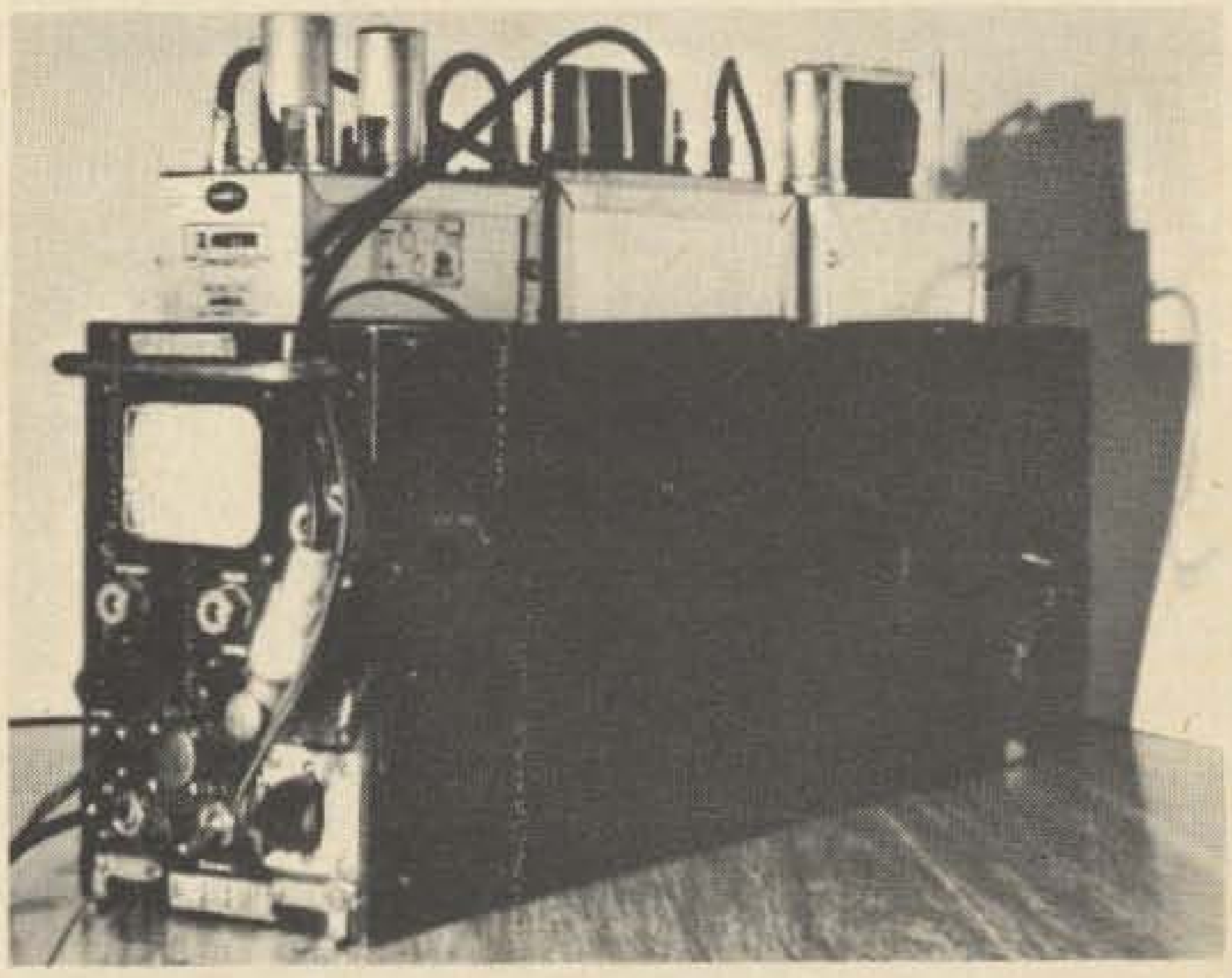
Pan Adapter vs Band Scanner

There is very little difference in the units. The pan adapter has the same input frequency as the *if* of the receiver and is usually connected to the receiver mixer plate. This arrangement keeps the received frequency centered on the shield of the cathode ray tube. The selectivity of the *rf* stages of the receiver reduce the signal strength of the signals either side of the center frequency. The pips, or displays, are progressively smaller as they are farther from the received frequency.

The band scanner uses a typical crystal controlled VHF converter with the same output frequency as the band scanner input. A two or three stage *if* amplifier is usually required between the converter and the band scanner to give a good distinct display of weak signals. An *rf* tap for the receiver can be made at the input or output of the *if* amplifier. The band scanner display is independent of the receiver tuning. If properly adjusted, the scanner will have nearly equal sensitivity over the entire band. The scanner cathode ray tube shield can be calibrated for direct frequency reading.

The Units

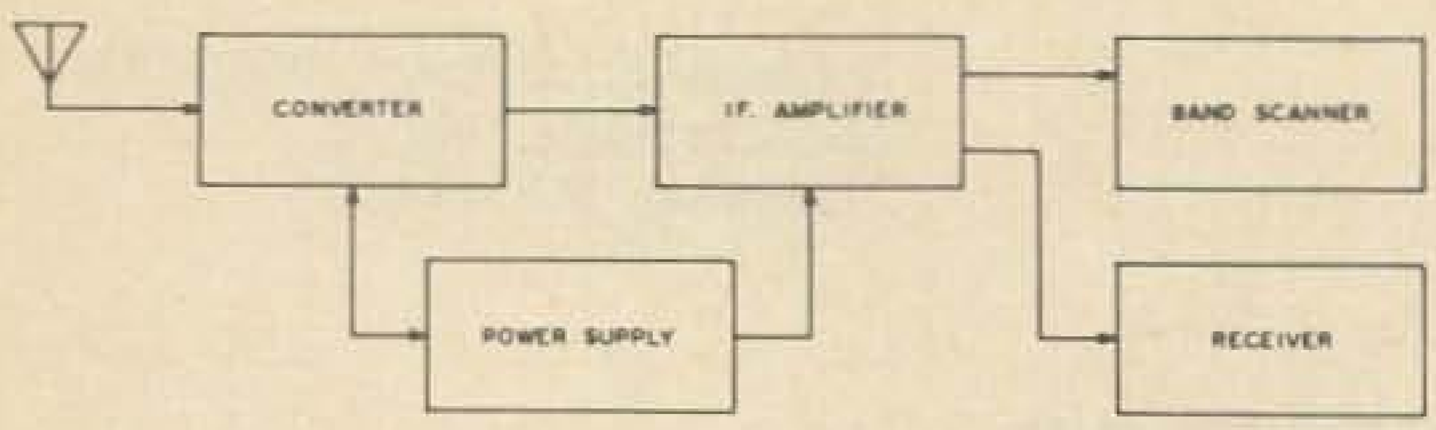
Band scanners are available on the surplus market so cheap that there is no advantage in constructing one. The scanner is easily repackaged to give it a neater and 'civilian' look, if desired. The conversion information



VHF band scanner. On top from front to rear are the converter, *if* amplifier and power supply.

that is sent with the IP 274/ALA10 or IP 69/ALA2 band scanner covers changing the power supply to 60 Hz (the original is 400 Hz) and changing the input to 14 MHz. All my VHF converters have 28-30 MHz output so I did not change the scanner input frequency. The IP 274/ALA10 and IP69/ ALA2 scanners have the four standard oscilloscope controls: intensity, focus, horizontal position and vertical position. The scanner controls are; sweep limit, width, center frequency and gain. I removed the front panel power plug and replaced it with a plate and an ac outlet. The outlet is connected through the switch so the converter and *if* amplifier will be turned on and off with the scanner.

If you want to cover only 2 MHz of the band (I scan 144-146 MHz) the center frequency control may not center the scan. I use a converter output of 28-30 MHz so I injected a 29 MHz signal into the scanner input then turned the center frequency control to bring the pip as close to the center of the shield as possible. I backed the control



Block diagram of band scanner and associated equipment.

off about ¼ turn to allow for calibration then adjusted L 104 (scanner sweep frequency coil) to center the 29 MHz signal on the cathode ray tube shield. Touch up the scanner input and *if* coils for equal sensitivity at 28 and 30 MHz.

The converter can be constructed or purchased. Articles are readily available in past issues of *73* or the handbooks for those desiring to construct the converter. A poorly built converter can give false pips as the scanner will show any *rf* signal in the sweep range. The most common sources are self oscillation of a tube or transistor or excessive oscillator injection. Be sure your converter is adjusted for flat response over the sweep range.

I used a surplus 30 MHz *if* amplifier. If you prefer to construct your *if* amplifier *73* has a construction article on an integrated circuit 30 MHz amplifier on page 52 of the July, 1967 issue. Stagger tuning this amplifier should give it sufficient band pass and still have enough gain to operate the scanner. There are transistor and tube 14 and 30 MHz preamplifiers in the handbooks. These preamps will, of course, work as an *if* amplifier. The *if* amplifier requirements will depend, to a considerable extent, on the quality of the converter. The *if* amplifier should be tuned for flat response over the sweep range. Generally, an amplifier with 20-30 db gain is sufficient. The schematics show both capacitive and inductive coupling for the receiver *rf* tap at the *if* amplifier input and output. I use capacitive coupling at the output. If your receiver does not have an *rf* stage the local oscillator may radiate enough signal into the antenna input to give a false pip on the scanner. Connecting the receiver at the *if* amplifier output will minimize this condition. The receiver *rf* tap at the *if* amplifier input would be used by those that have a high quality receiver and the *if* amplifier would not aid the receiver.

Assembly

Due to the variations in the converters and *if* amplifiers that can be used with the scanner, and the simplicity of hookup, step by step instructions would be of little value. The interconnecting *rf* cables should be as short as possible. Use good VHF practice and no difficulty should be encountered.

Power supply requirements will depend on the units used.

Operation

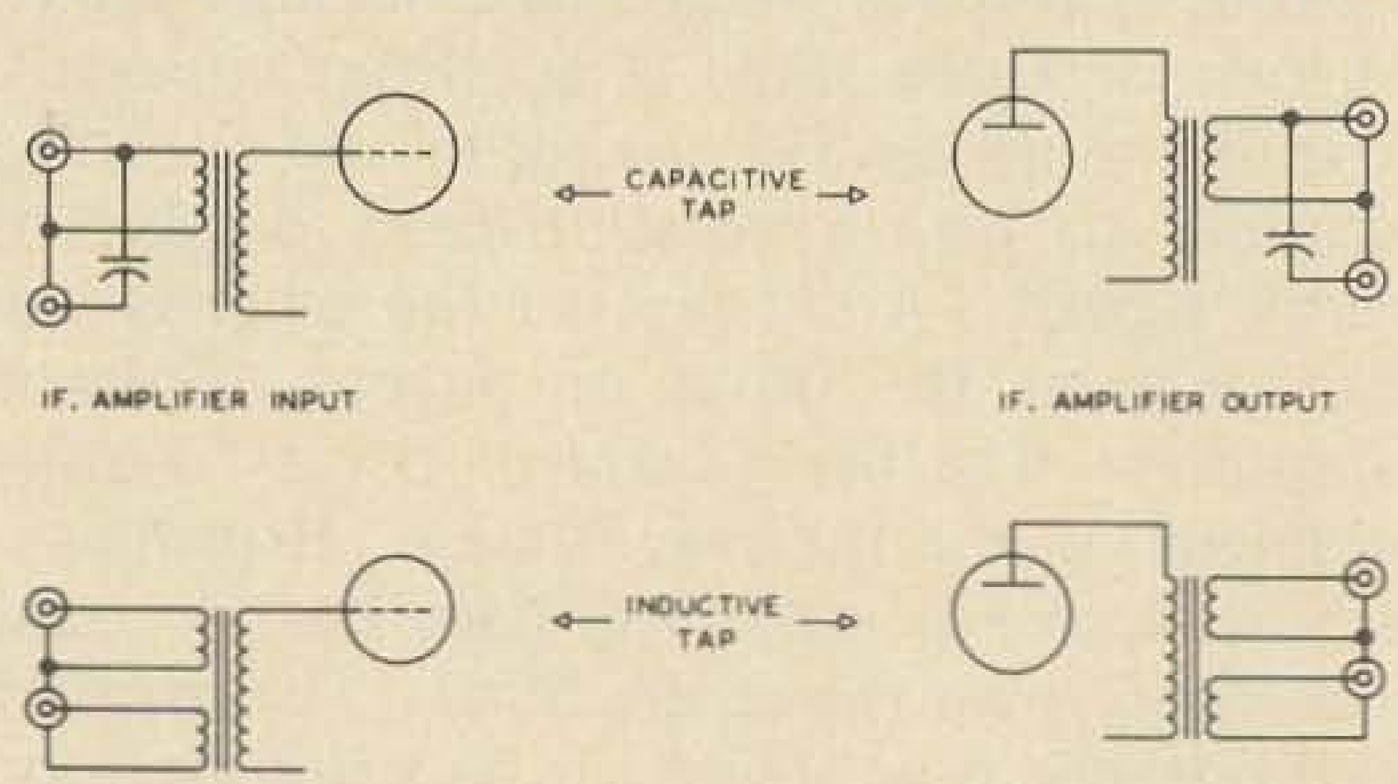
A band scanner will show the band activity, or lack of it, without tuning around and searching. The scanner can be used for analyzing signals as described in the panadapter articles. I find the scanner more convenient than my oscilloscope for aligning converters.

If you have more than one converter and antenna for a VHF band you may want to use separate converters for receiving and scanning. I use this system. The receiver coupled to the scanner lets me check out any other signals that I see without interfering with the QSO in progress. I put a relay in the scanner antenna lead and remove the converter B+ voltage when transmitting. The antennas are quite close together and the transmitter has a maximum output of 200 watts so I wanted to protect the converter from possible damage.

Some transmitters used in our local two meter net are crystal controlled and slightly off frequency so we have to tune for them. The scanner lets me see when they are on without wasting time tuning between transmissions to see if they are on.

Other Uses

For our CB friends who might be interested in a band scanner I would recommend a good *if* amplifier as no converter is needed. If, however, you plan to build a fancy scanner and calibrate the shield to show the



For capacitive tap use the smallest capacitor that will give adequate coupling. Start with about 20 pf and increase or decrease as required. For inductive tap make tap identical to the input or output winding and use minimum coupling. If input or output uses tapped coil use capacitive coupling. Some units may work better if band scanner and receiver tap are reversed.

channels, a converter is required. The converter will give you additional selectivity the same as a dual conversion receiver. Use a converter with a 14 MHz output and a 14 MHz *if* amplifier. There would probably be a small pip at 28 MHz from the converter oscillator. This would be out of the CB band so if you narrow the sweep to cover just the CB channels the pip would not show. Align the converter, *if* amplifier, and scanner for flat response over the sweep range as in the ham version. I would recommend a separate antenna. You might get enough isolation in the antenna relay so you could see your own signal when transmitting. I have not been able to do this with higher power.

Conclusion

Home brew construction of the converter and *if* amplifier is not recommended for the beginner as critical broad band alignment is required for satisfactory results. The band scanner has excellent broadband characteristics (max. 10 MHz) and alignment is not difficult if done carefully.

You will find a band scanner is an economical and fascinating piece of equipment for your VHF shack.

...WA8OIK

A Simple Inexpensive FM to AM Converter for Slow Scan TV and Facsimile

J. R. Popkin-Clurman, W2BK
134 Wheatley Road, Brookville
Glen Head, L.I., New York 11545

The heightened interest in slow scan TV and facsimile has brought forward a need for a converter to change the frequency shifted (FM) video or facsimile transmitted signal information into amplitude signals for feeding to a tape recorder, a slow scan TV monitor, a cathode ray oscilloscope (z axis modulated) with a photographing camera, or a facsimile machine. So far, the only available piece of gear appearing in surplus suitable for the above mentioned purposes has been the CV 172-172A/U, Frequency Shift Converter.

The CV 172-172A/U consists of the following elements, (**Fig. 1**):

1. Input
2. A band pass input filter
3. A limiter
4. Driver for the discriminator
5. A discriminator
6. A tuning indicator
7. A sound channel
8. Output

The tuning indicator, a dual "magic eye," defines the limits of the channel used, 800 cycle shift for black and white. The frequency limits in the CV 172 are 2300 (white) to 1500 cycles (black). A built-in monitor speaker is also included with the audio channel.

Analysis of the CV 172 reveals that many

View of satellite APT receiving equipment position: Tape recorder to right; FAX machine to far right; converter on right side of table.

of these elements can be dispensed with, since they are incorporated into a modern high selectivity receiver of the type used for SSB and RTTY. The irreducible minimum, then, consists of the input, limiter, driver, and discriminator (**Fig. 2**).

This simple converter is built from parts out of the junk box and uses two silicon diodes and one transistor (**Fig. 3**). In its quiescent state, it draws approximately 100 micro-amperes from the 9 V dc battery and approximately one milliampere under signal conditions. It would thus seem that the

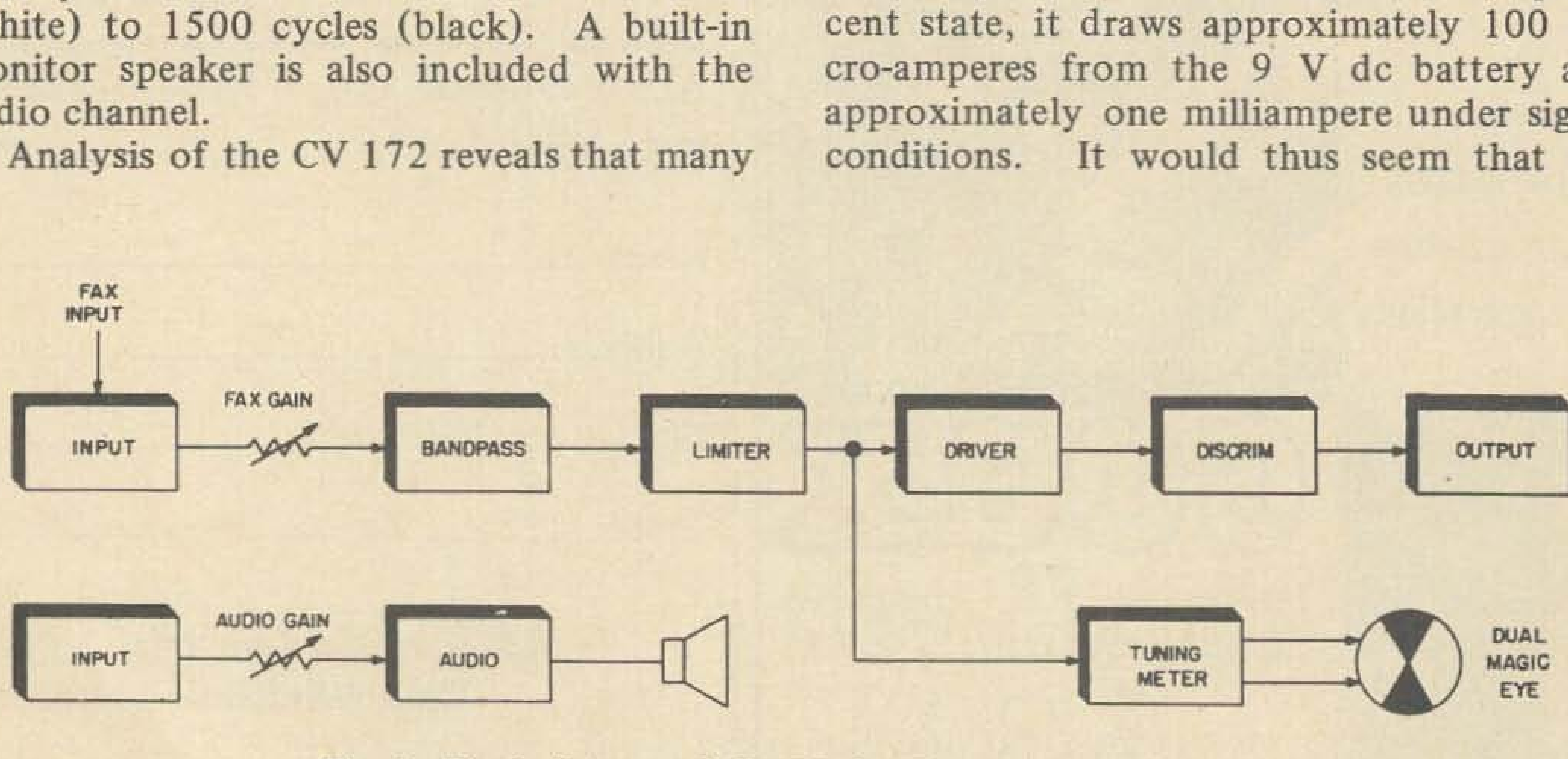


Fig. 1. Block diagram of CV172 showing all major elements.

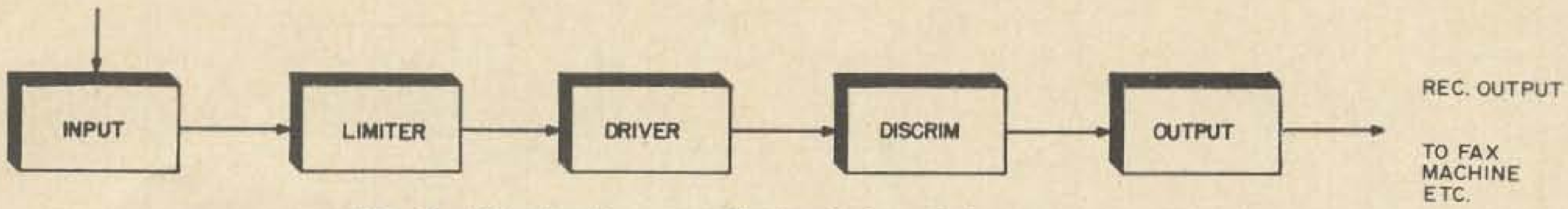


Fig. 2. Block diagram of absolute minimum components.

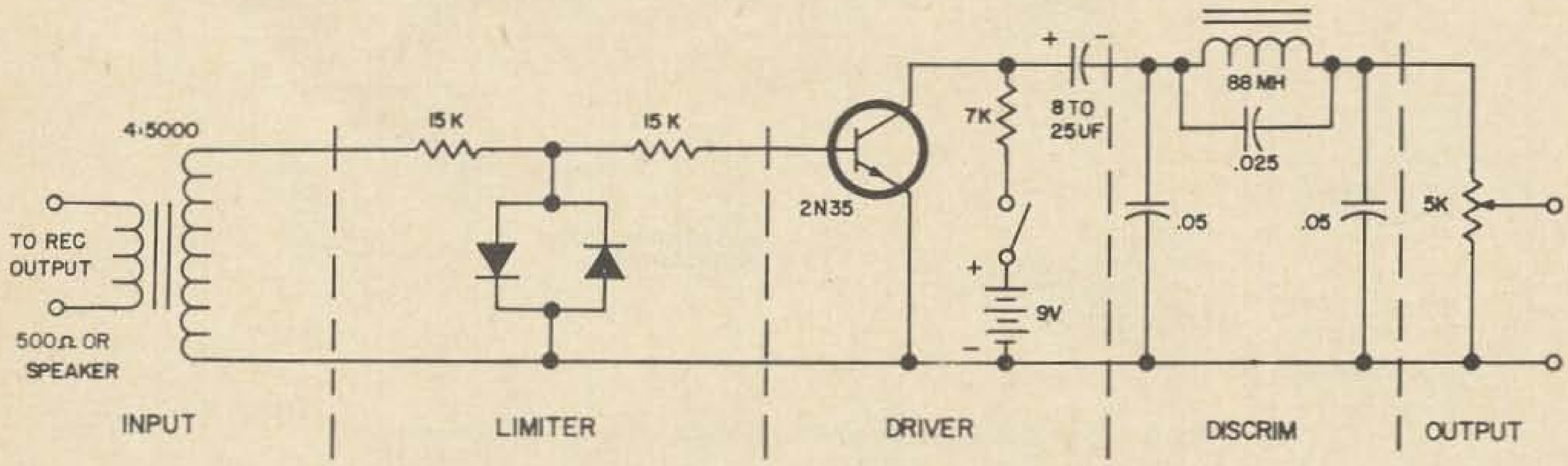


Fig. 3. Junk box converter using two diodes and one transistor.

switch incorporated into the unit might be an unnecessary luxury, since the life of the battery almost corresponds to its shelf life.

Any silicon diodes might be used, preferably those having similar characteristics. *Any* transistor may be used, NPN or PNP, with due care being taken to observe the polarity of the battery and the proper connections of the coupling electrolytic capacitor (Figs. 3 and 4). While this unit used one of the commonly available 88 mH surplus toroids, a horizontal width coil of the variable type, 45-215 mH (130 ohms), such as Stancor WC 14 or J. W. Miller type 6330 or 6324, might also be used. (All of the above parts were found in an old TV set, except for the silicon diodes, transistor, and 9 volt battery.)

The base (of 3/64 inch holed perforated metal) used was the cover for the horizontal deflection compartment of the TV set. 6-32 self-tapping screws lock in these holes nicely, (also from the TV set). The transformer used from the TV set was the speaker output wired backward 4 to 5000 ohms (estimated) and could be replaced by any transformer in the junk box having a good step-up ratio; even a 6.3 to 115 V filament transformer will work well.

In the author's particular case, being a RTTY enthusiast, and having full RTTY facilities, including a RTTY tuning indicator, the toroid of 88 mH frequency was tuned to 2975 Hz. When incorporated into the M derived low-pass filter used as a discriminator (Fig. 5), its frequency became slightly less than 2900 Hz. (If you wish to duplicate the CV 172, then more capacity is required across the trap inductance to tune to 2300 Hz.)

Connect the converter to the audio output of a receiver. Tune in a commercial RTTY station. As you tune through the RTTY signal (with bfo on), you will reach the point as seen on a scope (placed at the

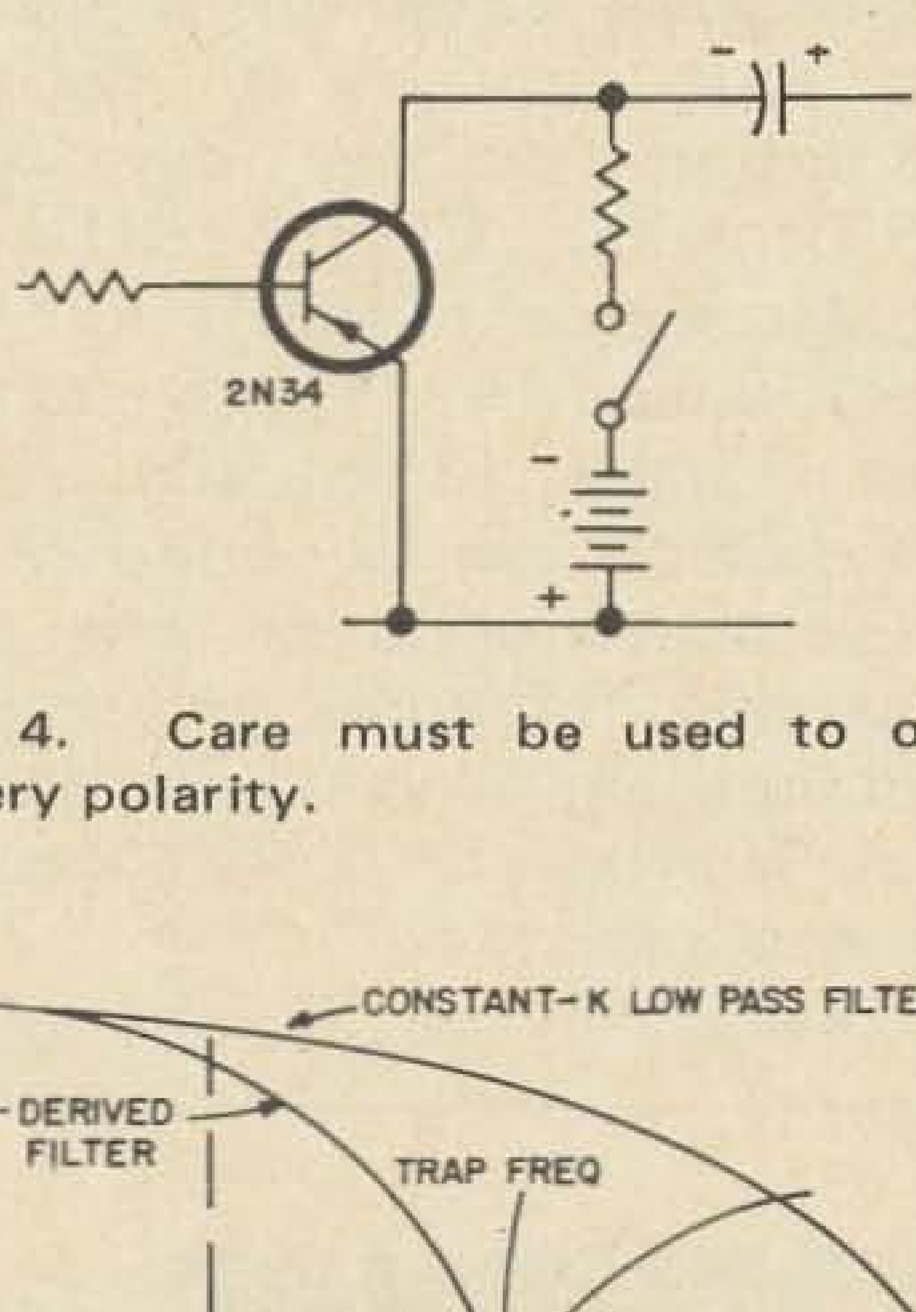


Fig. 4. Care must be used to observe battery polarity.

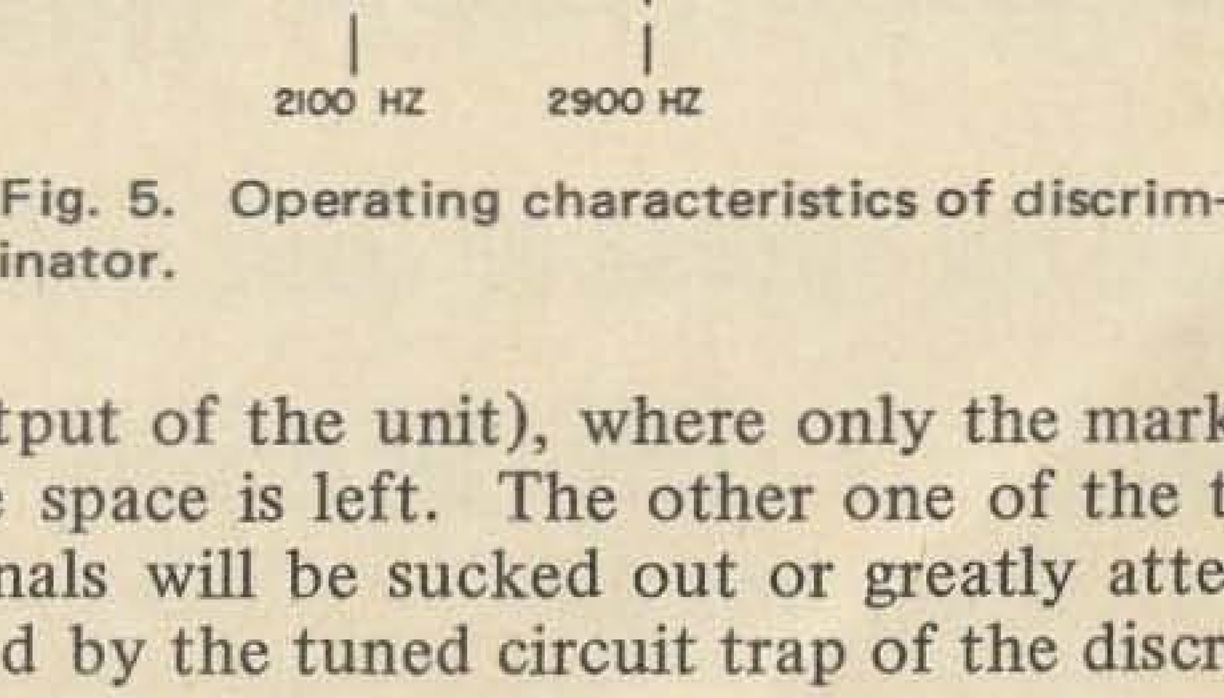


Fig. 5. Operating characteristics of discriminator.

output of the unit), where only the mark or the space is left. The other one of the two signals will be sucked out or greatly attenuated by the tuned circuit trap of the discrim-

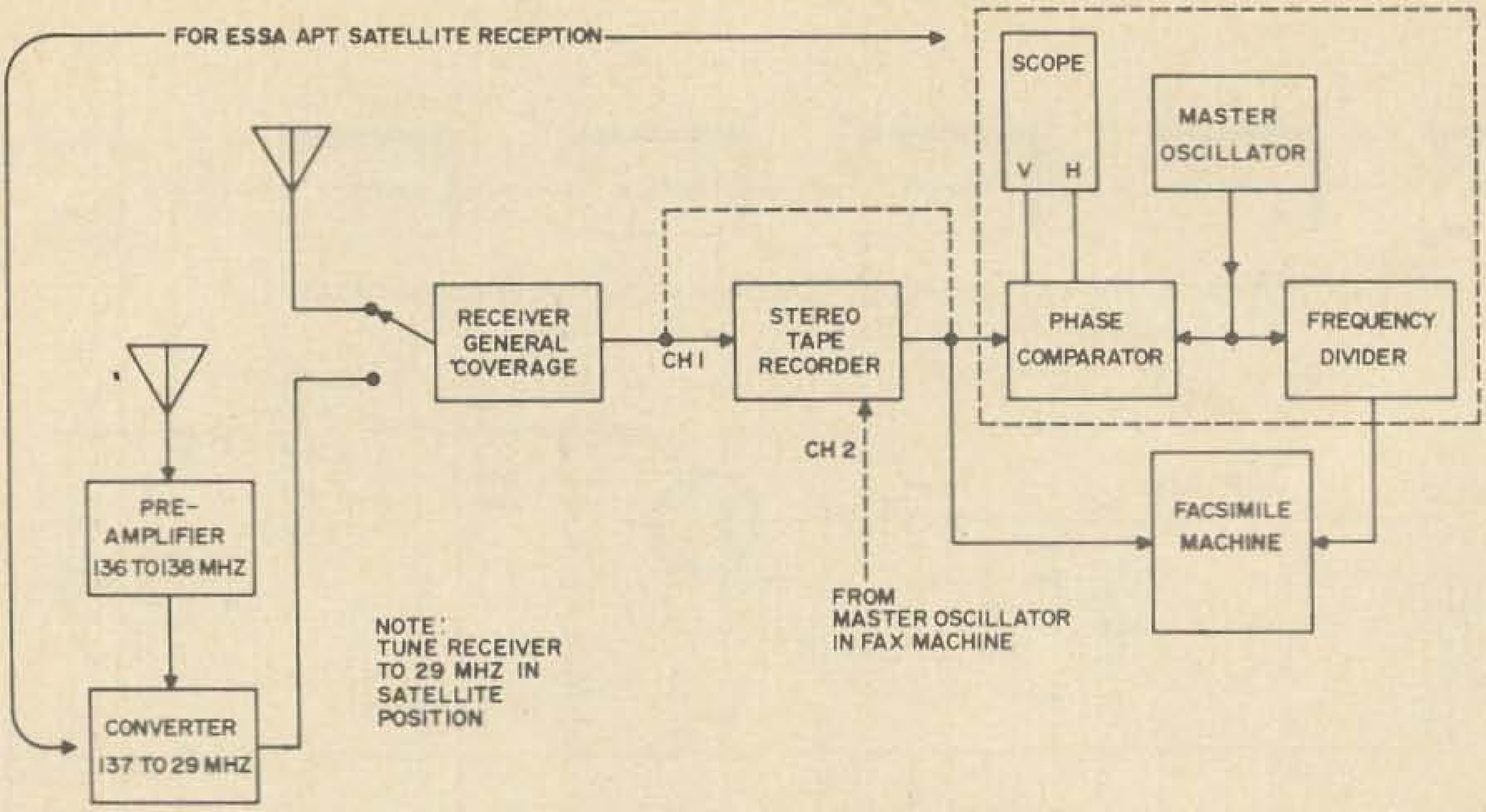


Fig. 5. Block diagram of the entire operating set-up.

inator. (Incidentally, this same converter, when combined with a rectifier and dc amplifier at the output, can be used to run a teletype machine.) The reason for using commercial RTTY signals is that they are far more numerous and easier to recognize, and their pulses are of longer duration than a station sending slow scan TV pictures or a weather map on facsimile.

When you have noted the correct positions of the tuning dial and the BFO for sucking out mark or space of the RTTY signal, you can then look for one of the reliable facsimile stations, such as Navy (NSS) on 3357, 4975, 8080, 10865, 16410, 20015 KCS or Air Force (KWAF) on 4502.5, 10185, 14550, and 19955 KCS (frequencies subject to change). These stations (when sending a picture) can be identified aurally by periodic tick-scratchings they make – like the sound of a phonograph record needle left running and repeating in the end-of-record groove of an *old* 78 RPM record with the volume turned up.

Often, when they are not sending fax pictures, they send "limit signals," one-half time black, one-half time white, at 800 Hz apart. These are ideal for tuning in the station. These limit signals are followed by phasing pulses, "ticks" only. They are then followed by a tone, then the picture. At the conclusion of the picture, another tone is sent.

The picture, as seen on the scope will be a series of pulses of audio at random times. (They will look like noise pulses.) Sweep of the scope should be set as slow as possible. If you are tuned to the wrong sideband of the signal, then you will see a kind of almost continuous signal with many dropouts. (This would give you a negative picture with white lines.) To reverse the situation, go over to the other sideband of the receiver and readjust the BFO. The tuning which gives you the cleanest baseline and maximum pulses is the correct one.

You will find this little converter every bit as satisfactory as the CV 172 and a lot cheaper! More fun too!

...W2BK

Confessions of an Appliance Operator

Or How to Ad Lib in Spite of the State of the Art

Edward R. Brace, W3ETQ
P.O. Box 372
Feasterville, Pa. 19047

Home-brew to me is what the XYL does with grapes. In fact, in my shack about the only home-brew addition is the junior op! This is not to cast doubt on the beauty of construction or testing. Nevertheless, because of the technical qualifications involved in "rolling your own" sophisticated electronic gear, I prefer to leave that excitement to members of the RCA net and those Ancient Modulation holdouts on 75. To me, the "stress interview" on 20 is much more enjoyable. Sadly enough, not enough hams feel comfortable when engaged in discussions other than those pertaining exclusively to their equipment.

I have often felt that such hams should be provided with a gentle guide to help them pump and drive their QSO's along – along lines that draw out the personalities hidden beneath the rubble of cliches and touch-and-go meaningless contacts which litter the ham bands. But this is not easy, for artificial guidelines restrict the natural blooming of the delicate flower or weed behind the mike. Be Maying like flowering is, why not try at least to offer a better and more fresh substitute than the dull weather report exchanges or information on the height of our antennas? This information may be important, but not as the sole nucleus of a QSO.

Each ham has his own specialized delight in amateur radio – curious as the specific choices may seem. Net operation and traffic handling for some, contests and county hunting for others, constructing and testing new antennas and home-brewing for still others. And then there is the hit-and-run DX man. Each interest is important and honorable, but without the personal touch ham radio can become dull and unprofitable as an exciting hobby. Without *personal interaction* and exchanging of cheek-tongued insults and information, viewpoints and prejudices, humor and confidences, sense and nonsense, we are not taking full advantage of the privilege we have open to us as licensed amateur radio operators.

Each amateur band ostensibly has a personality of its own. I, for example, have always considered 75 meters as tight and verbose and almost friendly; 40 meters is more open, but with copious quasiclosed Knights of the Roundtable; 20 meters is more brisk, because band conditions may change at the drop of a comment – thus necessitating economy of transmissions; 15 meters is generally considered a "DX" band, and it seems that more W's and K's call "CQ DX" on this band than all others (and it's amazing how often they succeed); 10 meters is volatile and especially sensitive to sunspots and low-power DX contacts. The remaining bands are not to be trusted. Especially by those of us who do not have the capabilities on 160, 6, and 2 meters. Moon-bouncers are an especially-especially seedy lot, and RTTY men should be placed under special observation. I refuse to mention those hams active in ATV!

But we return again to the old problem. Dull QSO's. Stereotyped. Mimeographed questions and planned answers. Let's rebel! Let's pin our next contact down and develop a line of conversation outside of that which might ordinarily be expected. Let's surprise him by being actually *interested* in where he lives, what he does to support his addiction to ham radio, what his opinion is on collecting dictionaries (only in English, of course!), how he feels about modern jazz in an oversexed society, what he considers the most important contribution the League has made in the last 50 years (QRX!), how he relates to the problem of the *skua* bird eating baby penguins (I learned that one from KC4USN), his etymological comment on why the 807 has been elevated from an electron valve to an edible-drinkable-item, et (basically) cetera. You get the point.

There are a lot a great guys hiding out

there behind mikes – let's try to draw them out. Let's find out what's happening – even on 75 meters! If the band stays open, let's not let them get away until we have had a meaningful exchange. And why not be more concerned about geography? Ham radio is the greatest "textbook" in the world, and most of us have never taken full advantage of it.

Although seemingly a contradiction in terms, reproduced below is a random sample – poorly developed – of the *Extra Top Quality Amateur Ad Lib Cheat Sheet.* The main idea is to be absurd but interesting. To spark something that virtually demands an answer – albeit a laugh or a groan. Like priming a pump, we may eventually put out-of-the-way remarks into the mouths of some of our more conversationally reticent ham buddies. At least we may make them QRT and thus clear the frequency for some hit-and-run DXers. We don't wish to encourage the "planned ad lib" – but let's at least attempt to emulate the open fun of our colleagues on that Grand Old Band – 75 meters. (And that's a lot of GOB, gang!)

1. What are you doing hiding out in a place like______?

2. If this vertical doesn't work out better, I'm going to melt it down and make a birdcage!

3. Your quad sounds fine; and it's great for drying sheets!

4. Your_______beam sounds great – if you don't mind a giant silver bird hovering over the roof!

5. Your audio sounds great – I didn't realize that mikes worked that well under water!

6. Don't worry about not getting out; your signal's probably healthy and clean, hiding out in Argentina.

7. I've always wanted to visit your state, but I could never get a visa (or: could never get clearance from the State Department).

8. Your quad sounds fine; they make great pelican roosts. But watch out for those 200-pound obese pelicans! The Department of the Interior frowns on this method of bird capture.

9. As the lumberjack said, see you a little later down the log.

10. I won't say the XYL here is against ham radio, but she did make me install the rig in a mobile home – forty miles away!

11. I own three SWR bridges – next month I'm buying an antenna to go with them.

12. I'm boning up for phone operation on 75 meters; I'm taking Caustic Remarks 305, followed by How to Squelch Breakers 103.

13. In order to get a QSO on 75, you have to be born there!

14. 75 meters is the St. Petersburg of the ham bands!

15. Did you hear about the robbery at the recent ham meeting in St. Petersburg? Someone stole 300 crutches!

16. Heard on 75: Your signal is weak here, OM. Only S9.

17. The roundtables on 40 meters are so involved and extensive that when one ham checked in, as a bachelor, he got married, his XYL had a son, and the son got his General in time to get into the QSO.

18. The QRM on 40 meters is very generous, politically – you have your choice of the Voice of America or Radio Moscow.

19. The rig here is a Kenmore washer, running about three horsepower into an aluminium clothesline up about five feet.

20. The antenna system here is 5,000 snails in cascade, fed by raw hamburger.

21. I won't say that I'm the epitome of Appliance Operators, but we *do* employ six First Phone men for general maintenance and equipment polishing.

22. I won't say the SWR here is unusually high, but it's true that the microphone radiates more than the antenna.

23. I realize that low angle of radiation can be desirable, but who told you to bury your antenna underground?

24. The antenna here is so high it was arrested by the narcotics squad.

25. I won't say the power here is low, but my nightlight draws more current than the rig.

26. Is it true that you have your DXCC certificate tatooed on your chest?

27. The antenna here is so low that it was knocked down by two angleworms playing leapfrog.

28. What are you doing playing ham, when it's obvious you'd be more qualified playing *bull*?

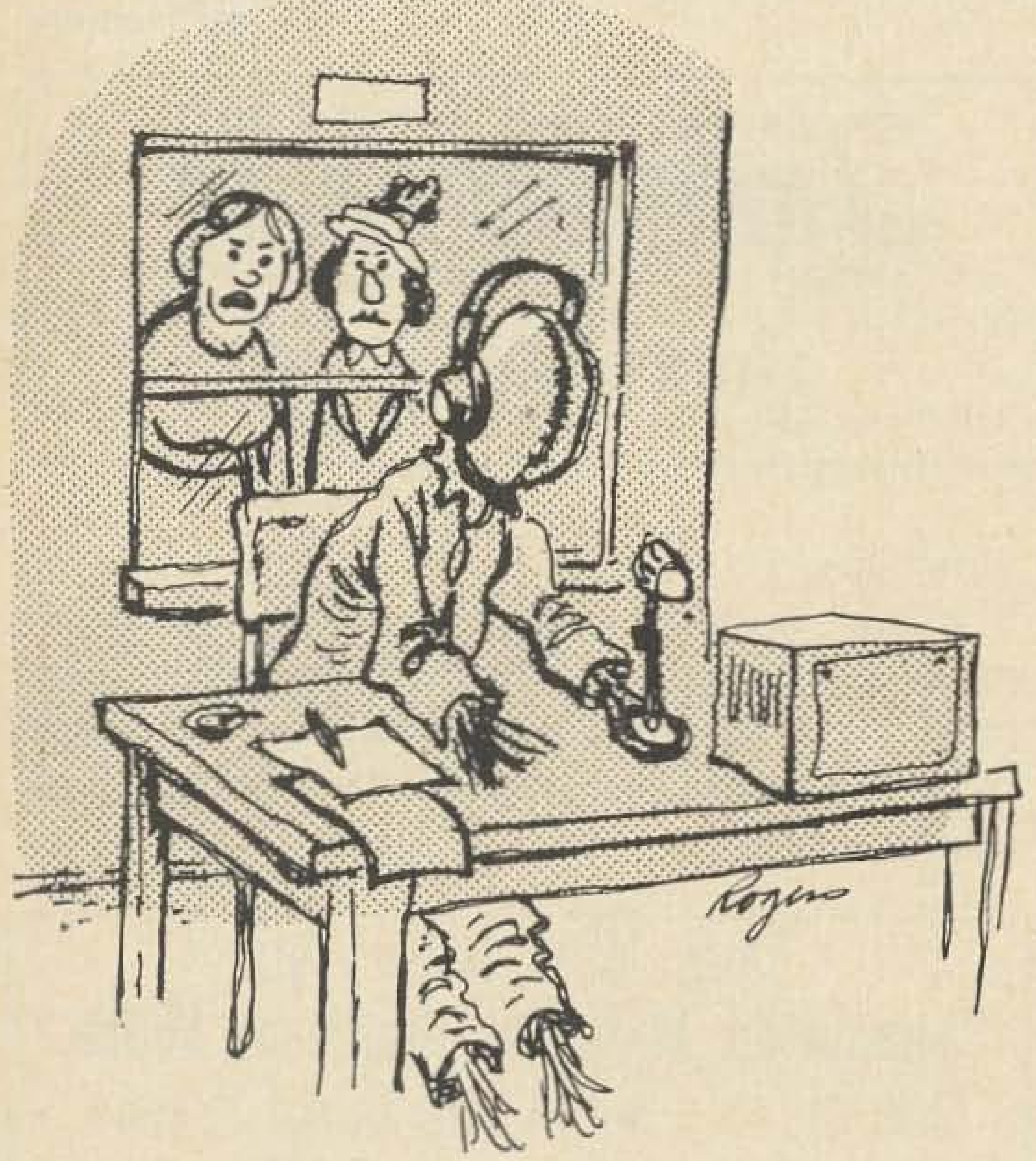
29. As Guy Lombardo said, see you around the band!

30. You should be pleased – just like the DX man who worked 43 countries in 26 minutes!

31. Yours is not to reason why; yours is just RTTY.

32. (Insert your best ad lib; Xerox; send to friends.)

And so it goes. The friendly fraternity of glib talkers. Truly interested in their fellow ham's scene and problems. Polished and poised, hesitant not to dash off the ultimate ad lib – duly practiced and recorded for tonal quality. Written and edited for punch. Eagerly awaiting the retort that stings, only to compose more clever spontaneous remarks at the next QSO. And, in spite of it all, perhaps something better will issue than the weather report or a detailed description of the antenna system. At least one would hope!



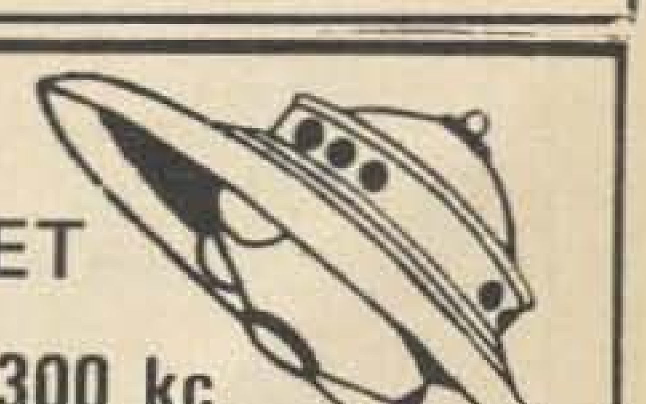
"I gotta keep an eye on him all the time or he's down at the radio shop spending money."

Household Helper In The Hamshack

A cleaning product known to housewifes as Scotch-Brite will find many uses in the hamshack. The exact parentage of this material is unknown to me, but it appears to be a form of plastic wool. It comes in several grades and sizes to fit the use to which it is put.

The homebrewer will find it excellent for cleaning printed circuit boards before soldering, polishing aluminum panels, and cleaning corrosion from antennas, ground rods, and the like.

I find the "ultra fine" grade to be the ideal filter for the blower on my linear. It not only catches the inevitable dust and lint, but also does a good job of silencing the noise of the air rushing into the intake. Try it! William P. Turner, WAØABI



Use of Frequency Charts

The selection of the optimum frequency is calculated from basic data published by ESSA, Boulder Colorado Research Center of the U.S. Government. The time is always in GMT, so 00 GMT is equal to 7 P.M. EST; 6 P.M. CST; and 5 P.M. PST; and so on across the chart. Due to our low power limitations we need to work as close to the maximum usable frequency as possible to reduce noise, so we bias the frequency selection toward the higher frequency bands when possible. During disturbances, try a lower frequency.

J. H. Nelson

What Am I Eating?

"King Sour Non-Butterfat Sour Dressing" made by American Whipped Products Company, Brooklyn. Alias ersatz sour cream. It is pretty good and you can hardly taste the quar gum.

PROPAGATION CHART

J. H. Nelson

June 1969

SUN	MON	TUES	WED	THUR	FRI	SAT
①	②	③	④	⑤	6	⑦
⑧	⑨	10	[11]	12	⑬	⑭
⑮	⑯	⑰	⑱	⑲	⑳	21
㉒	㉓	㉔	25	26	[27]	28
29	㉚					

Legend: Good O Fair (open) Poor □

EASTERN UNITED STATES TO:

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

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	14	7A	7	7	7A	14	14	14	14
ARGENTINA	21	21	21	14	14	7	14	21	21	21	21	21
AUSTRALIA	21	21	14	14	14	14	14	14	7B	7B	14	21
CANAL ZONE	21	21	21	14	14	14	14	14	21	21	21A	21
ENGLAND	14	14	7A	7A	7A	7B	14	14	14	14	14	14
HAWAII	14A	21	14	14	14	14	7A	14	14	14	14	14
INDIA	14	14	14	14	7B	7B	7B	7A	14	14	14	14
JAPAN	14	14	14	14	14B	7B	7B	14B	14	14	14	14
MEXICO	14	14	14	14	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14B	7B	14B	14B	14	14	14	14
PUERTO RICO	21	14	14	14	7	14	14	14	14	14	14A	14A
SOUTH AFRICA	7B	7B	7B	14	14B	14B	14	14	14	14	14	14
U. S. S. R.	7A	7A	7A	7A	7A	7	7A	14	14	14	14	14

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	7A	7	7	7	14	14	14	14
ARGENTINA	21	21A	21	14	14	7	14	21	21	21	21	21
AUSTRALIA	21A	21A	21A	21	21	14	14	14	7	7	14	21
CANAL ZONE	21	21	14	14	14	14	14	14	14	14	21	21
ENGLAND	14	14	7A	7A	7	7	7	7B	14	14	14	14
HAWAII	21A	21A	21	21	14	14	14	14	14	21	21	21
INDIA	14	14	14	14	14	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	14	14	7B	14	14	14	14	14
MEXICO	14A	14	14	14	14	7A	7A	14	14	14	14	14A
PHILIPPINES	14	14	14A	14	14	14	14B	14B	14	14	14	14
PUERTO RICO	21	21	14	14	14	7	14	14	14	14	14	14
SOUTH AFRICA	7B	7B	7B	14	14B	7B	7B	14	14	14	14	14
U. S. S. R.	7A	7A	7A	7A	7A	7B	7A	14	14	14	14	14
EAST COAST	14A	14A	14	14	7A	7	7A	14	14	14	14	14

A - Next higher frequency may be useful this period.
B - Difficult circuit this period.

Caveat Emptor?

★ **Price—$2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.**

★ **Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.**

★ **Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.**

★ **We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.**

★ **For $1 extra we can maintain a reply box for you.**

★ **We cannot check into each advertiser, so Caveat Emptor . . .**

DID YOU RECEIVE your QSL information rubber stamp? Six Lines, 2½ inches wide. Please send $2.00 to get yours. Other Stamps—$1.00 a line. Large Call Letter Stamp, $1.00—John D. Kirke Co. (K8SRA) 17711 Lakewood Heights Blvd., Cleveland, OH 44107. (See Dec. 73 adv., Page 102) All Stamps Postpaid. Guaranteed Value.

SWAN 500C, mint condition with power supply. Going to school. Asking $500. Best offer takes. Contact WA3JLY, John Martin, 804 W. Broad St., Quakertown, Pa. 18951.

THE AUGUSTA (MAINE) Amateur Radio Club will hold their 10th annual Hamfest at the Calumet Club, Route 104, Augusta, On 15 June, preceeded with an open house and get together on Saturday evening the 14th at the same location.

SELL HEATH HR-10B, calibrator, used very little, just factory aligned, overhauled. Asking $85 or cash offer. John Linn, Jr., 24 Stuart Place, Manhasset, N.Y. 11030.

HAMFEST sponsored by Lancaster & Fairfield County ARC at Derby Downs one mile south of Lancaster, Ohio on BIS Road, Route 793, June 8th. Gigantic Swap Shop. $1 registration with prizes every half hour. Main prize drawing. Good food at reasonable prices.

FOR SALE—One K.W. custom built transmitter. Pair 100ths in final, modulated by pair of 805s in class "B." Built in two matching cabinets measuring 40" wide, 68" high and 21" deep. Has 13 meters. Sacrifice $195. Hubert Ingalls, W1NQ, McCrillis Road, Nottingham, N.H. Tel. Epping 679-8862.

2-WAY MOBILE TECHNICIAN by S. Florida 2-way service corporation established 25 years. No beginners please! Minimum 5 years experience required on Motorola and GE. Send full resume including salary requirements and snapshot to Spencer Communications, 440 25th St., West Palm Beach, Florida 33407.

NORTH ALABAMA HAMFEST will be held August 17, 1969, in the cafeteria of John C. Calhoun State Technical and Junior College located north of Decatur, Alabama, on U.S. Highway 31.

WANTED ANTIQUE RADIO and wireless equipment. Also radio magazines of teens and twenties. Also buying supply catalogs, Duck, Manhattan, etc. Farrell, 2252 Dixie, Pontiac, Michigan 48055.

FOR SALE back issues—Radio TV/Electronic World magazines: 1953-1968; $1.50 ea. special issues $2. A.C. Gary, 378 W. Palisade Ave., Englewood, N.J. 07631.

B&W 5100s, 51-SB/B SSB generator, together $175. HR-10 excellent, just realigned $50. Want Heath supplies HP-23 or HP-13. Don Falk, Burton Hall; Oberlin, Ohio 44074.

FOR SALE—R392/URR receiver-mobile version of R390/URR-excellent condition with manual and accessories—$400. Brock, 2226 E. 28th St., Brooklyn, N.Y. 11229.

AMATEUR RADIO CERTIFICATE: Display impressive 8½"x11" personally endorsed certificate in your shack. Send $1 to Amateur Radio Certificate, Box 244, Miami (Kendall Br.) Fla. 33156.

SELL: COLLINS 51J-4 in Superior condition with cabinet 6KC and 3KC mechanical filters. $800. Warren Amfahr, WØ WLR/5, 3100 Brookview, Plano, Texas 75074.

REGULATED POWER SUPPLY KITS, .6-4 amp, $2.75 to $8.50. Zeners, thermistors, 25¢. 10A Triac, $1.75. Diodes, 5¢. Nixie, $5. Decimal Counter Kits, $3.50. Catalog. Murphy, 204 Roslyn Ave., Carle Place, N.Y. 11514.

FILTER-CONDENSERS: Aerovox Oil Filled 100 mfd. @ 3000 vdc condensers. $30 each. Basil J. Weaver, 1821-C-Ave M, Lubbock, Texas 79401.

SELL: NEW 4CX1000A with socket. Jennings 10KV 500 pf vacuum variable capacitor; Simpson plate and grid current meters; 5700 VCT plate transformer, 175 pounds. Package price $125 FOB. Pictures available, $1 refunded on purchase. WA6-THG, 6279 Stow Canyon, Goleta, Calif. 93017.

WANTED: Military, commercial surplus Airborne, ground, transmitters, receiver, testsets accessories. Especially Collins. We pay freight and cash. Ritco Electronics, Box 156, Annandale, Va. Phone 703-560-5480 collect.

HIGH VOLTAGE TRANSFORMERS wanted: Range 10,000 to 40,000 volts or higher. State voltage, current capabilities, and price. Bible, 409 Pennsylvania, Oak Ridge, Tennessee 37830.

ARCTURUS SALE

1700 transistor types at 39¢ each.

40 watt germanium power transistor, same as Delco 501, 2N278 (etc.), Cat: 349, 59¢ each.

Color TV cartridge focus rectifier 6.5 kv. Used in every color TV. Cat: CFR-20, 79¢ each.

Motorola 2500 ma. at 1000 piv, high voltage/current epoxy silicon rectifier, axial leads. Cat: HEP-170, 49¢ each.

2 Printed circuit I.F. transformers, 4 lug, 455 kc input and output, Cat: 1909P4, 99¢ each.

RCA UHF transistor type TV tuners, KRK-120 (long-shaft). Cat: UHF-20, KRK-120 (short-shaft). Cat: UHF-21, each $4.98.

RCA VHF transistor type TV tuners, KRK-146, Cat: VHF-74, $9.99 each.

Transistorized UHF tuners used in 1965 to 1967 TV sets made by Admiral, RCA, Motorola, etc. Removable gearing may vary from one make to another. Need only 12 volts DC to function. No filament voltage needed. Easy replacement units. Cat: UHF-567, $4.95.

UHF Tuner original units as used in TV sets such as RCA, Admiral, etc., covering channels 14 thru 82, as part no. 94D173-2. Complete with tube. Drive gearing is removable. Can be used in most sets. Cat: UHF-3, $4.95.

Color yokes. 70 degrees for all around color CRT's. Cat: XRC 70, $12.95. 90 degrees for all rectangular 19 to 25" color CRT's, Cat: XRC-90, $12.95.

Kit of 30 tested germanium diodes. Cat: 100. 99¢.

Silicon rectifier, octal based replacement for 5AS4-5AW4-5U4-5Y3-5T4-5V4-5Z4. With diagram. Cat: Rect-1, 99¢ each.

7", 90 degrees TV bench test picture tube with adapter. No ion trap needed. Cat: 78P7, $7.99.

Tube cartons 6AU6 etc., size. $2.15 per 100. 6SN7 etc., size $2.55 per 100. 5U4GB size $2.95 per 100, 5U4G size 3¢ each.

Send for complete free catalog. Include 4% of dollar value of order for postage. $5 MINIMUM ORDER. Canadian check, 8% dollar differential.

ARCTURUS ELECTRONICS CORP.
502-22nd St., Union City, N.J. 07087 Dept.M73
Phone: 201-UN 4-5568

PRICE WAR !!

WE BEAT ALL AND ANY OFFERS if you have the equipment we want! Urgently need any type of lab grade test equipment, and military electronics such as Gen. Rad., H-P, Tektronix, ARC, GRC, TED, PRC, VRC, ARN, URR, APN, etc. Tell us what you have and what you want in first letter! WE PAY FREIGHT!

COLUMBIA ELECTRONICS
Dept. 7 4365 W. Pico Blvd.,Los Angeles,Cal.90019

SURPLUS WANTED

Equipment with Prefixes:

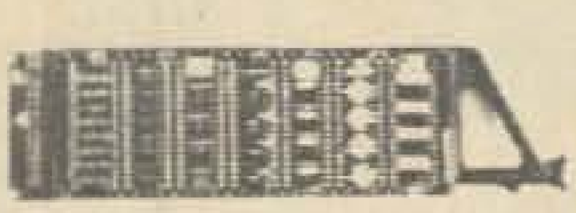
ARA, ARC, ARM, ARN, APA, ASN, ASA, APN, APR, ARR, ASQ, GRR, GRC, GRM, GPM, VRC, UPX, URA, URR, URM, USM, UPM, SG, MD, PRM, PSM, PRC, TMQ, TRM, TED, SPA, SRT, CV.

Commercial Equipment by:

ARC, BIRD, BOONTON, BENDIX, COLLINS, MEASUREMENTS, H-P, NARDA, GR, SPERRY, ETC.

TOP CASH DOLLAR PAID or TRADE
WE STOCK NEW HAM GEAR
WRITE-WIRE-PHONE
BILL SLEP, W4FHY
SLEP ELECTRONICS CO.
2412 Highway 301 N., Ellenton, Fla. 33532

COMPUTOR BOARDS

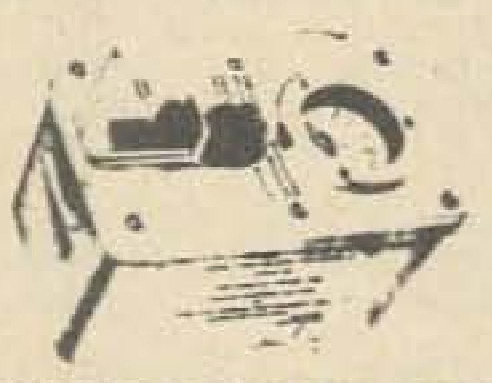


Here is a fine value for parts and a fine breadboard. Each computor board contains about 50 diodes in addition to transistors, high-quality, low-voltage electrolytic capacitors, trim parts and precision resistors. Components are easily removed and have long leads. Each board is different. The plug-in board makes a fine breadboard or component board. Dimensions: 16"x4"x1". Weight 1 lb.
HCB..$1.25 P.P.

DUAL TRANSISTOR IGNITION SYSTEM

This system was made by Canadian Tire to sell for $35.00. These are Brand New fully wired surplus, not rejects. The extra high voltage coil provides smoother running at high speeds and longer plug life, and the lower current through the points makes for longer point life and faster winter starts. Special connector allows instant changeover to conventional ignition. Fully guaranteed, with instructions ready to install for 6 or 12 volt negative ground car. **Closeout Special: DTI....... $10.00 P.P.**

GEIGER COUNTER -GOV'T SURPLUS



"CD" Type Radiation Survey Detectors are in like new condition, with instruction manual, and straps. Picture shows typical unit. Bright yellow plastic case, waterproofed. Meter readings may be made from 0.01r/hr. to 50r/hr. Units are clean, and are offered untested, as is at a low price of $10.00 less batteries, battery price about $1.50. With life of 400 hrs. or intermittent operation.
CD MD. No. 710.. $10.00 P.P.

BF **Enterprises**
P.O. BOX 44, HATHORNE MASS. 01937

WE PAY CASH FOR TUBES

Lewispaul Electronics, Inc.
303 West Crescent Avenue
Allandale, New Jersey 07401

SPECIAL ITEM SALE

VHF RECVR, Collins or Wilcox, 118-136 mhz, AM, 110 vac, makes first class net or monitor recvr, ex-FAA, was $125........................$60

DIGITAL COUNTER, 4 row, good condition..............$90

FREQ. METER, 100-500 mhz, .001% accuracy, excellent condition, heterodyne operation, 25 tubes plus crystal and original calibration book, 115/230 volts, civilian type LA-6 or military FR-6, was $495..............................$350

FREQ. METER, 10-100 mhz, similar to above instrument, rack mount, 115/230 volts with original calibration book and schematic, best quality made, was $495..............$250

PULSE GENERATOR, Measurements Corp type 79A, required for all digital circuit work, 115 vac, was $88.....$49

Send SASE for list.
THE R&C WILSON COMPANY
Box 393, Littleton, Colorado 80120

3000 V @ 3μf brand new GE Pyronal oil capacitors $3 each. Can mail, 3-lbs. each shipping wt., FOB. P. Wandelt, RR#1, Unadilla, New York 13849.

NEED A VARIABLE CAPACITOR for that homebrew project? We may have what you need at more than 50% below regular amateur net. Send for free flyer. A.R.C. Sales, 181 E. Wilson Bridge Rd., Worthington, Ohio 43085.

3 PLASTIC HOLDERS will frame and protect 60 cards, $1—or 10 holders $3. Prepaid & guaranteed. Patent 3309805. Tepabco, Box 198N, Gallatin, Tennessee 37066.

SPECIAL CLOSE-OUT SALE. Rectifiers, Transistors, and many other Electronic Parts. Lowest prices. Send 15¢ for Catalog. Electronic Components Company, P.O.Box 2902 S., Baton Rouge, La.

FOURTH ANNUAL Mini-Hamfest, sponsored by the Rockford Amateur Radio Assn., August 17, 1969, at the Boone County Fairgrounds in Belvidere, Illinois. Lunch and refreshments.

SELL: HW-30, GR-64, Globe Chief 90-A, HG-10B. All good. $30 each. No manuals. You pay postage. WA3HWI, 7940 Gilbert Street, Phila., Pa. 19150.

WRL'S USED GEAR has trial-terms-guarantee! KWM1-$299.95; Swan 240-$179.95; TR3-$399.95; SB34-$319.95; Galaxy V-$229.95; Galaxy V Mk 2-$279.95; HX50-$199.95; Invader 200-$249.95; Galaxy 2000 plus linear-$329.95; Ameco R5—$59.95; HR20-$79.95. Hundreds more. Free "blue-book." WRL, Box 919, Council Bluffs, Iowa 51501.

HT-32A and TURNER MIC, $225, 75A4 #3234, 3 filters, 312A1 station control with Patch, $450, Hq-129X and spkr $90; TS-382 A/U osc. $125; Eico 667 checker, mint. $80; all items exc. cond. Also misc. parts and test eqpt. SSAE for list, W5LA, 1725 Valmont St., New Orleans, La. 70115.

B&W 5100-B Transmitter for sale. Best offer. Excellent condition. Contact Central Amateur Radio Association, 15 Centerville Road, Warwick, Rhode Island 02886.

ATTENTION CANADIAN AND NEW ENGLAND HAMS! The annual convention sponsored by Radio Amateur of Quebec Inc. will be held in Granby, Quebec, on the 27, 28 and 29th of June. Information and advanced registration from VE2BLP, Box 523, Granby, Quebec.

WANTED HRO COILS—all bands—any year for 5-7 or 50. Also want an HRO 5 for spare parts. Name your price. Wells Chapin, W8GI, 2775 Seminole Road, Ann Arbor, Michigan 48104.

FOR SALE: Hallicrafter SR150 ACps $350; Pr 4x150 Linear ps $50; Heath 10-12 Oscilloscope EF2 text and chassis $85; switches meters antennas etc., reasonable offers accepted. Geo. Shoner next to Library, Dugger, Indiana, 5 miles from US 41 on Ind. 54.

SBE 33 CLEAN never used mobile—$160. Walt Williams, 1706 Parkridge Terrace, Arlington, Texas. 817-261-9653.

THE EAST COAST VHF Society will operate station WA2WEB/1 on 432 mhz from Mt. Equinox, Vermont on June 21 and 22, 1969. The express purpose of the expedition is to provide amateurs on the East Coast of the United States with the opportunity of contacting the state of Vermont on 432 mhz.

The station will be on the air for approximately 24 hours for scheduled and non-scheduled contacts. Schedules are requested from interested amateurs. Write: East Coast VHF Society, P.O.Box 1263, Paterson, N.J. 07509. All correspondence and schedules will be confirmed prior to expedition.

RTTY GEAR FOR SALE. List issued monthly, 88 or 44 mhy torroids 5 for $2.50 postpaid. Elliott Buchanan & Associates, Inc., 1067 Mandana Blvd., Oakland, California 94610.

WANTED: SCHEMATICS & instruction manual for Farnsworth model 600A camera & control monitor. Contact G.D.Petrizze, 2135 N. Allen Ave., Althadena, California 91001.

"TOWER HEADQUARTERS!" 11 Brands! Heights aluminum 35% off! Strato Crank-ups-low cost! Rotors, antennas and gear discounts. Phone patch $11.95. Catalog-20¢ postage. Brownville Sales Co. Stanley, Wisconsin 54768.

FOR SALE: HW32A in excellent condition, $89. with rugged homebrew power supply, $99.00. WA1IRU, Art Karis, 14 Caldwell St., Fitchburg, Mass. 01420 (617) 342-3469.

MINIATURE INVERTER Transformers, $5.50; Power your old-fashioned Toob Projects. Convert 6/12 vdc to 100/250 v @ 100 ma, diagram supplied, W6PJN, Box 611, Clovis Calif. 93612.

SALE/TRADE—POWERSTAT, 7.5 amp, 120V; Super Pro Power Supply; 4 mf @ 1500 v oil conds; Ham-Scan HO-13; Heath Scope #10-21; Drake 1A; 51J1; BC342 and P/S; Hugh Burnham, K6VNU, 2866 Magnolia Avenue, Long Beach, Calif. 90806.

FOR SALE: Ht-37 100 watts and HT-41 1000 watts, both $375; Heath SB-300 rcvr, $175. Telephone 516-295-5411.

BACK ISSUES QST, CQ, 73 and Pop Elect., 75¢ ppd. Galaxy 300 xcvr/power supply, $125. A. Assenza, 82 Florence Aven., Arlington, Mass. 02174.

TOROIDS 88 OR 44 MHY unpotted. 5 for $1.50 ppd, continental USA. SASE for list of other bargains. M. Weinschenker, Box 353, Irwin, Pa. 15642

FOR SALE: Heath HW-32, HP-23, SB-600, Cal., cables, manuals, $135. SX-101A, $225. HT-37, $225. Extras. All excellent. WA2VWG, 6029 56th Drive, Maspeth, N.Y. 11378.

SELL: Clegg Venus 6 mtr. transceiver, ac supply, mint condition. Original cartons, $300. WA8ZUA, 7230 Wilmington Pk., Dayton, Ohio 45459.

THE PALMETTO AMATEUR RADIO Club announces its Second Annual Hamfest to be held indoors at the State Fair Grounds, Columbia, South Carolina, on June 1, 1969. A dutch supper is in the planning for the night before. The Hamfest will feature swapping, a transmitter building contest, homebrew contest, antique radio display, FM and MARS Forums, and bingo for the XYLs.

FOR SALE: 75A4, Vernier knob, noise blanker, .8 & 3.1 khz filters, external compression amplifier 200 hz filter. $350. GPR 90 rcvr xtal calibrator, outboard product detector, vernier knobs, Tapetone converter 50-54 mhz. $250. Tristao galv. tower 54', 10-15-20 Hygain beam, rotator, you dismantle. $150. Shipping and packing receivers not included. Carl Thorsell, 1195 E. 77th St., Kansas City, Mo. 64131.

FOR SALE: HRO-7 with xtal calibrator. It made DXCC for me. $50 local only. Virgil Talbott, W6GTE, Monterey Pk, Calif. AN8-8868.

39TH-ARRL WEST GULF Division Convention August 15, 16, & 17, Amarillo, Texas. For an ideal summertime weekend of ideas, fellowship, entertainment, fun (and maybe good luck) you can't miss at $10.50 for registration. W5WX Panhandle Amateur Radio Club, Box 5453, Amarillo, Texas 79107.

TEST EQUIPMENT WANTED: Any equipment made by Hewlett-Packard, Tektronix, General Radio, Stoddart, Measurements, Boonton. Also military types with URM- ( ), USM- ( ), TS- ( ), SG- ( ) and similar nomenclatures. Waveguide and coaxial components also needed. Please send accurate description of what you have to sell and its condition to Tucker Electronics Company, Box 1050, Garland, Texas 75040.

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