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AMATEUR RADIO

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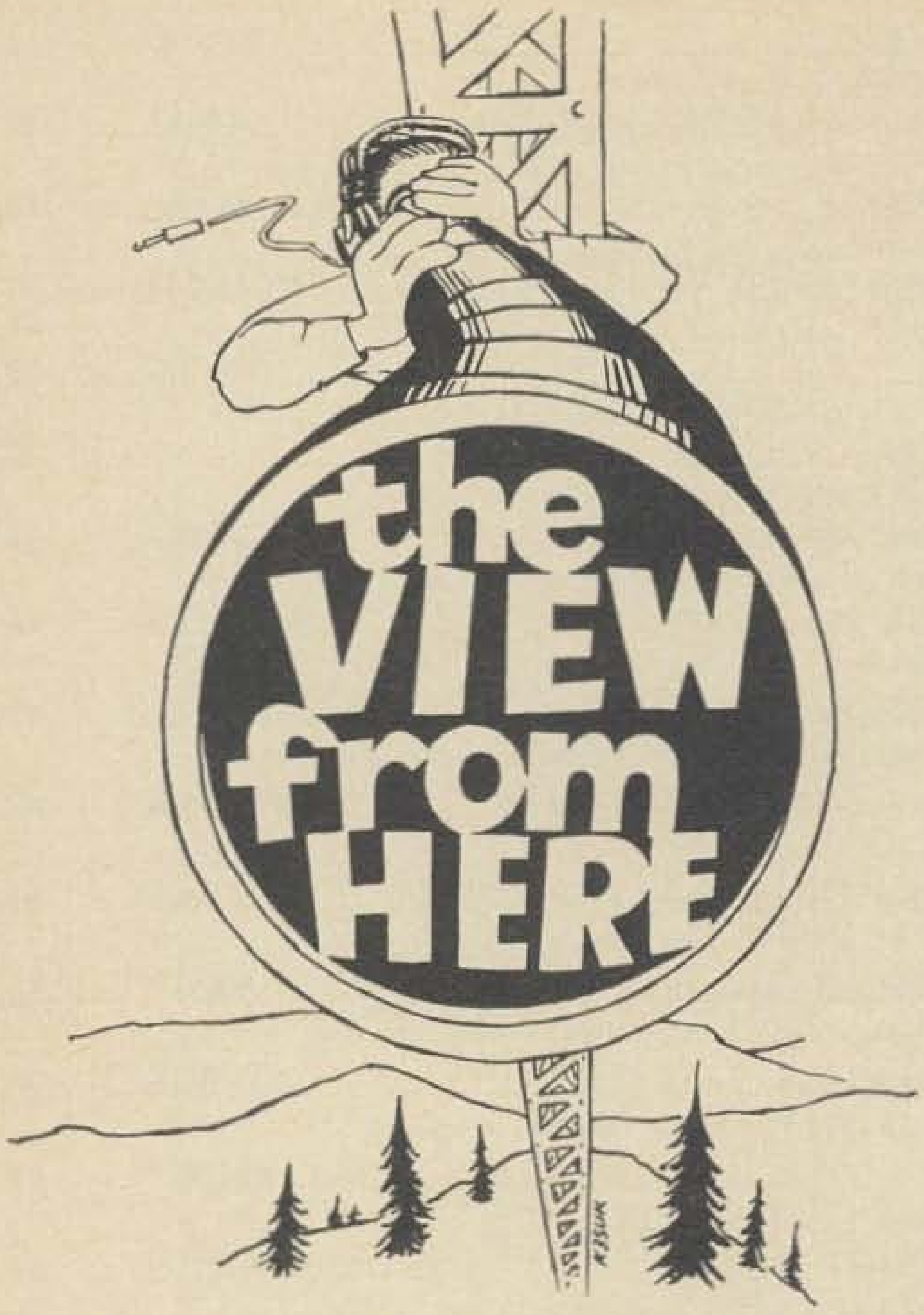

It has been pretty well publicized lately that the growth of amateur radio is slipping badly. The total number of hams is not keeping pace with the overall population. In addition, the average age of the ham is increasing while the average age in the country is on the decline.

Although some parties theorize that this decrease is a direct result of the incentive licensing proposal, license fees or some other controversy, a closer look will reveal that our decrease in numbers actually started several years before incentive licensing was even mentioned. Interestingly enough, the first decline closely followed the FCC's announcement of the 27 MHz citizens' band in 1959. Since then we haven't been able to hold our own.

Youngsters used to join ham radio in droves—now they're going to CB. In many high schools it's not unusual for the CB club to outnumber the ham club by fifty to one! It's not hard to explain either. Look at how much easier it is to get a Class D Citizens License—no code and no theory. This state of affairs is not only detrimental to the future of ham radio, it seriously effects the critical shortage of electronics technicians.

The shortage is so critical in some areas that firms are scouting for technicians in other parts of the country. This was unheard of a few years ago. The federal government has tried to curb the shortage of technical people in part by providing financial aid to electronics programs at technical schools and colleges. You can appreciate their concern when you realize that the demand for skilled technicians in our highly technological society is increasing every year.

Thirty years ago the majority of radio technicians was introduced to electronics through amateur radio. This is not true now, nor is it apt to be again in the future—electronics is too diversified. However, if we can interest more youngsters in amateur radio, we will not only offer them an interesting hobby, we will introduce them to the fascinating world of electronics. Some of them are sure to pursue careers in this field.

I'm sure that most hams will agree that the toughest part about amateur radio is getting started. If you don't live in or near a big city, you aren't even exposed to ham magazines. Your public library doesn't have much to offer either. In fact, there is probably a pretty good chance that there isn't even an active amateur in your town. How then, can you be interested in a subject that you're not even exposed to?

If a youngster surmounts these obstacles, locates a local amateur and goes to a meeting of the local radio club, all he meets is indifference. Not always, but usually. Even if he isn't greeted by indifference, he has to sit through a two-hour business meeting before they bring on the star attraction. If he ever comes back after this experience, he has more fortitude than most teenagers. He is more likely to join the local CB group where he can get on the air right away.

To encourage new hams, we have to expose more people to our hobby. At the present rate, in another twenty years ham radio will be all but extinct. In the days of wireless, the big attraction was the uniqueness of sending messages through the *ether*—even if it was from one end of the block to the other. And when you made it, everybody in town heard about it. In this age of transoceanic television, the fascination of radio is somewhat limited. To get in the public eye you have to do something new and unique—be newsworthy. The only time we get in the newspapers today is when we provide communications during an emergency. We aren't going to attract many new hams if we must depend on natural disasters to get in the public eye. (Turn to page 116)

Meet The Dividers!

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They are new from International. Use them for crystal controlled time bases, scope calibrators, and clock sources.

International ICD units are totally integrated circuit frequency dividers. They are smaller than a pack of cigarettes (1″ x 2¼″ x 2⅜″). All have two separate outputs. They are packaged in nine types providing divide ratios 2 thru 10. No tuning or adjustment is required. The output pulse has the same stability as the driving pulse. Voltage required, 3.6 vdc ± 10%.

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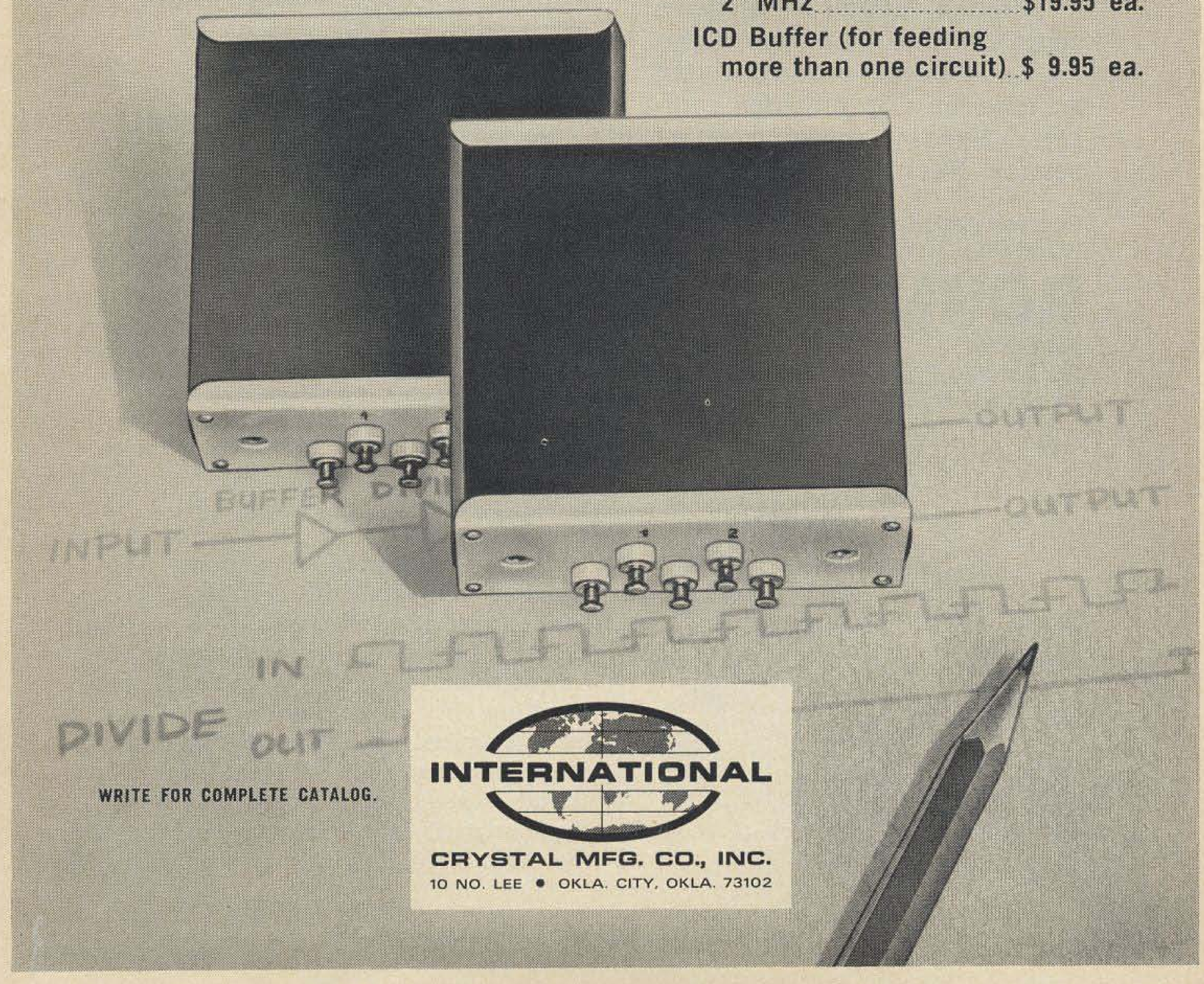

WRITE FOR COMPLETE CATALOG.

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de W2NSD/1

Don Miller Hassel

never say die

It is reported that well over half of the latest ARRL board of directors meeting was taken with clearing up the Don Miller hassel. Since this matter has been obscured by much misleading information, perhaps we should take the time to look at it and bring out all the facts. Here's what happened.

The entire DX world was shocked to its core when on February 20th the ARRL Awards Committee published an announcement that Don Miller W9WNV had been suspended from DXCC and that many of his recent DXpedition stops would not count for ARRL DXCC. This announcement was sent to the League directors and assistants, to all IARU societies worldwide, to DX clubs worldwide, to all DX bulletin editors and to the DXCC honor roll. Don's reputation worldwide looked to be completely ruined by the claims of impropriety and outright cheating made in the announcement.

Don, who had wind of this, had talked with John Huntoon just two days before it was issued by overseas phone from Mombasa, asking him to hold up until he could furnish documents to answer all ARRL allegations. Don was not given the courtesy of facing his accusers with the proof which he had in hand.

The ARRL announcement was ten pages long, filled mostly with generalities. Specifically they claimed that Don was guilty of poor sportsmanship, issuing QSL's for contacts which never took place to amateurs who had made substantial donations, and even avoiding contacts with leading DXers who had not sent contributions. Don was further accused of misrepresenting certain foreign consulate activities to the award committee, resulting in a decision which later had to be reversed (HC8E and TI9C). Further, the committee claimed that Don's Navassa Island expedition damaged the prestige of amateur radio in government circles and thus the K1IMP/KC4 trip must be disqualified.

(Turn to page 112)

To guarantee you'll get the gear you ask for . . . Waters announces a new policy . . .

We have been concerned for quite some while at Waters over the inability of many hams to find our products readily available in the general market. Many letters of complaint attest to this.

The amateur radio picture has changed greatly in recent years. Ham shacks simply ain't what they were! And neither are the old time, full-service amateur dealers. Many have fallen by the wayside. Many more have switched their major efforts to CB, TV, appliances and the like with ham radio relegated to somewhat scanty stocks on hand. Modern, full-service dealers are relatively few in numbers today and are located almost without exception in the larger metropolitan areas.

So we had to conclude that if we were to provide the amateur operator with service and good products, we must also provide easy access to this service and our products. A major change in our marketing set-up was necessary.

As of July, 1967, Waters products may be purchased in the United States through 9 reputable dealers. Orders may also be placed directly with the factory. Each of these dealers will maintain complete stocks of ALL Waters products at ALL times.

If you reside within the area of a dealership, you should order from that dealer. If you live outside of dealer areas, you may order directly from Waters using our catalog and order forms. Installment credit may be arranged.

With this new system, Waters products are as near as your mailbox. You will no longer be subjected to Brand X switching and the fast sell! Your QSL card or a postcard will bring our new catalog by return mail.

BOB WATERS W1PRI

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George Cousins 3C1TG
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North of the Border

The story of amateur radio in Canada.

On January 1st 1967 the ears of the amateur world were somewhat startled by the appearance of a whole series of strange-sounding calls beginning with the prefixes 3B or 3C, and for a few days we in Canada spent almost as much time making explanations as we did in actual QSO's. The reason, of course, was the advent of our Centennial Year, and as part of a whole series of celebrations we were given the privilege of changing from our normal VE and VO calls to the new prefixes selected from the list of internationally assigned call letters. Thus VO1 became 3B1, VE1 became 3C1, etc., and this state of affairs will continue throughout 1967. This might be a good place to point out that these new prefixes are not obligatory; those of us who would prefer to carry on with the normal VE or VO call may do so, so you will find quite a mixture of calls from up this way during the year.

Because of this call-sign business and the other celebrations we have planned, no doubt we'll be getting a lot of ham visitors during the months ahead, so perhaps you would like to know a little about our ham radio structure. A few years ago I spent over a year in California—very enjoyably I might add—and regularly attended meetings at a local radio club. I found that whenever I announced my call I was greeted with rather surprised looks, and one night I even had one chap ask me just how radio conditions were in Australia! All of which makes me believe a little information about Canada would be helpful.

Since we're such close neighbors, it's only natural to compare our set-up here with that of the United States, and the first big difference is in the number of amateur licence classes in Canada. We have only two—Amateur Radio Operator and Advanced Amateur Radio Operator—with nothing similar to the Novice or Technician classes. Our regulatory body is the department of Transport (DOT), whose telecommunications branch maintains offices in major centers across the country. Like the FCC, these are the gentlemen who conduct our examinations, issue our personal and station certificates and monitor our activities. Our rules of conduct are contained in the General Radio Regulations of the Radio Act, which among other things tells us the frequency allocations and modes of transmission which we may use. Depending upon the class of licence held, we may or may not use all the available frequencies or modes, but more about this in a moment.

When a chap in Canada gets the urge to become a ham, his best bet is to drop a line to the nearest DOT office and get a copy of the *Syllabus of Examination* which gives all the details and outlines the proper procedure. Since we must all crawl before we can walk, the first step is the straight amateur licence, and for this a number of preparations are necessary. Our lad must be a British subject, or, he must be a Landed Immigrant for not more than six years, in which case his application must be approved by the Minister of Transport. He must also be at least 15 years old, so you won't (or shouldn't) find any real young fellows on the airways up here. There's no upper limit of course, and the inspectors are also very sympathetic towards those with physical limitations. The "really big" step, which is an absolute must, is the learning of the International Morse code. At the time of his examination our budding ham has to send and receive code at not less than 10 words per minute for three consecutive minutes in each case, and consisting of plain language, figures, punctuation marks, and possibly some Q-signals and distress signals. Since this is the first part of the exam, and because he must pass this test or discontinue the exam immediately, it's best to be capable of close to 15 w.p.m. before making the attempt. I'm sure we all remember our moments of uneasiness when we sat down at the table and everything seemed to go completely blank just at the wrong time! Inspectors are human too, and a kind word and few minutes of warm-up practice at the key have saved many of us from beating a too-hasty retreat.

Having negotiated the code test, the world seems a little brighter, and our lad now must face an oral exam and answer questions on operating procedures, adjustment of his equipment, and such highly practical things as the elimination of key clicks, BCI and TVI. He will also have to know his frequency allocations.

Whether an oral or written exam is easier makes little difference, since he now has to sit down and write a paper on the fundamental theory of electricity, radio and operation of ham equipment in general. He also has to prove his knowledge of Canadian regulations regarding amateur stations as well as international regulations and procedures.

One might think he would be finished by now, but he still hasn't shown that he could recognize a tube from a toothbrush, so he must now draw a series of diagrams of simple equipment: an amateur type transmitter and superhet receiver, some form of frequency meter, an overmodulation indicator, a wave-trap, a key-click filter and finally, a power supply operating on ac and using full wave rectification and filter. The inspector has the option of asking questions about specific components on the diagrams, so our boy should have a pretty good idea of just what the resistors and capacitors are actually there for.

He must make 100% on his code tests to pass, but he can get by with 75% on the oral and written exams and 50% on each of his diagrams. Still, by the time he's finished he can use a breather.

If he has failed, he can come back and try again, usually at three month intervals, but let's assume he was a good fellow and came through with flying colors. His certificate and his station licence will be along in a short while, complete with the all-important call sign. The frequency allocations for this class are basically CW only for all bands from 30 MHz down, and either CW or phone on the bands above 10 meters. The actual frequencies are almost identical to yours in the USA, and even though we are permitted to operate on CW over the whole band we try to stay within the generally accepted CW "portions" and not come galloping up through the SSB and AM stations. For instance, I think it will be a very rare day that you'll find a bunch of VE or 3C stations calling CQ or running CW QSO's up above 14,200—or even above 14.100 for that matter—and the only reason I single out this band for particular mention is because of the steady increase in the CW invasion of the 14.1 to 14.2 foreign phone allocation. Let's think a little more about the "gentlemen's agreement"!

Now that our friend can call himself a real ham, he is free to operate to his heart's content on CW (or VHF phone if he wishes), and after six months, his diligence can be rewarded by the endorsing of his station licence to permit phone operation on 10 meters. No exam is necessary for this, but he must prove that he has actually been operating his rig on CW for these six months. While ten meters was dead and almost forgotten this might not seem of much consequence, but there have been many cases where hams have gotten this 10 meter endorsement and just never got around to going any further. Of course this can be pretty restricting, but just as a VHF man can go along for years without even thinking about the lower bands, a confirmed 10 meter man can spend the same number of years watching the sunspot cycles come and go.

However, our friend has more ambition than this, so even though he has some phone privileges he keeps on improving his CW speed, learning more about procedure, and doing some study on the technical end of radio. He should work diligently because after he has been on the air one full year he is eligible to write his second exam. If he is successful he will receive his Advanced Amateur licence and full phone privileges. At the advanced exam he must sit down at the table again and pass his code test at 15 w.p.m.; again he must achieve 100% copy for three consecutive minutes. After this comes a written test on advanced radio theory and equipment operation, with special emphasis on telephony, and another test on regulations and procedure.

Although the main advantage of successfully passing this exam is the granting of phone privileges on 15, 20, 40 and 75 meters, there is a little more than this. As you probably know, our phone allocation is somewhat different than in the USA and starts at 3725, 7100, 14100, 21100 and 28100 kHz. Therefore, we have the benefit of a few more kHz to enjoy. Of course, don't think this is all peaches and cream—we find ourselves competing with most of the rest of the world on these "extra" frequencies. Remember too that our bands on 80 and 40 meters, especially our lower phone allocation, are the same as your CW allocation. We have to live together in one piece of the spectrum and learn to like it. I didn't mention anything about 160 meters, but perhaps I should at this point. Our allocations are in four steps—1800-1825; 1875-1900; 1900-1925; and 1975-2000 kHz. We can use both CW and phone. The big difference lies in our geographical location. In Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, Quebec, Ontario and the Districts of Keewatin and Franklin we can operate in the segments 1800-1825 and 1875-1900 kHz. In the rest of the country we must use the last two segments.

Now that our new ham has received his licence and call sign, he can start to operate and put his efforts to good use. He is allowed a maximum dc input to the final of 1000 watts except on 160 meters, where he can run 375 watts during the day and 150 watts at night. The transmitter must be equivalent in stability to crystal control on any frequency below 220 MHz with sidebands not exceeding plus or minus 300 Hz. He may use any language during his QSO's, but must sign on and off in either English or French. If he wishes, he can allow another licenced ham to operate his station and a third party may speak over the transmitter providing the licencee is present and retains physical control of the station. We have a "forbidden" list of countries, which in general is slightly greater in number than in the USA and we have similar arrangements in regards to third party traffic. At the moment we can run third party traffic between Canada and the USA, Venezuela, Costa Rica, Honduras, Mexico, Chile, El Salvador, Bolivia and Peru. Our basic station licence also allows operation of one portable station and one mobile unit in a car, on board a pleasure vessel operating in Canadian territorial waters and registered under the Canada Shipping Act, or on a private aircraft. If the ship or plane is operating ouside Canadian territory limits, permission must be obtained from the master of the ship or the command pilot of the plane, and application must be made to the DOT for special permission to install and operate the station. A seperate call sign is issued. The best examples of this are the VEØ stations on board ships, with VEØN for naval ships and VEØM calls for civilian ships. All such marine or airborne stations may use the normal frequencies except no operation is permitted on 160 meters (because of possible interference to Loran navigation). Also, the band 7.0 to 7.3 MHz cannot be used outside of ITU Region 2.

You can see that we have just about the same privileges here in Canada as you have in the States except for the extra phone frequencies. Our station licences are only valid for one year and must be renewed each spring. The fee for the licence is $2.50 per year, and to be truthful, I got quite a kick out of the furor which erupted when the FCC first proposed charging a fee for stateside licences. We have been doing this for years and years, and I doubt very much if any of us have ever begrudged this small amount of money for the year of enjoyable ham radio which we get in return.

How do we spend our hours in hamming? If you took a poll you would probably find we have just about the same proportions of DXers, traffic men, rag-chewers, etc. as in any similar group. There is a possibility that we may have more fellows using lower power and perhaps a few more using home made equipment, but remember, a great percentage of our ham gear is American-made and imported, and you know what *that* means! Take the price of a piece of gear in your country and add about 30% to it and that's the price we have to pay. If this happens to be something like a KWM2 or similar item you can see how much extra it costs to put together a commercial-built station. So, like everyone else, if we can afford to buy, we buy; if not, we build, but either way we manage to keep a pretty fair percentage of our licencees on the air.

Because of the freedom of travel between Canada and the USA, a lot of W and K hams visit Canada each year and during 1967 probably still more will come to see us. With the reciprocal licencing agreement —which has been in effect for many years— American hams can come to Canada with their mobile or portable gear and enjoy their stay even more. If you would like to do so, just drop a line to the DOT, Ottawa, Ontario, and let them know your proposed time of arrival and length of stay. You'll receive the necessary forms in return and your path will be smooth sailing all the way. Try to allow a couple of weeks for the paperwork to sort itself out before you have to start out, and it's a good idea to have a record of your equipment serial numbers and proof of ownership. Get hold of some of us on the air and find out the net frequencies for the province you're going to visit as well as the operating times, and you'll enjoy checking in with the gang as you drive along. One note—you must hold at least a General ticket to get in on a reciprocal licence arrangement.

How about our numbers and organization? Well, we've about 12,000 licenced amateurs at the present time with the biggest concentration in Ontario and Quebec, which follows the population density. Every city and a great many towns have some sort of local club or association, and there are Provincial organizations such as the Nova Scotia Amateur Radio Association, Radio Society of Ontario, etc. At the moment the only national (or international) affiliation is with the ARRL which has about 4000-odd members in Canada. Canada is a vast country in physical area with a comparatively small population, so it is very difficult to weld together a tightly-knit National group, but we're gradually working towards that end. Already some of the preliminary work is being done between the provincial groups and perhaps before long we will make the grade. In most areas there are conventions and hamfests each year, usually publicized pretty well in advance and open to anyone who wants to attend. This year we're also having the ARRL National Convention in Montreal, the first time this event has been held outside of the USA. For the July 1st weekend at least, we should have the chance to meet quite a few of you. The same weekend will feature the annual meeting of the Radio Amateur du Quebec, Inc.

Before closing, I should perhaps mention that we have a lot of very interesting awards offered for various operating achievements. Some like WAVE (Worked All VE) are well known and have been around for years, but there are quite a few more recent ones, especially some which have been inaugurated just for Centennial Year. In all cases, we've tried to make them as attractive as we can, with requirements which are tough enough to be a challenge but not so tough as to be impossible. In working for them you'll meet a lot of interesting fellows, particularly the gang in the far north. A lot of them are on some of the most isolated outposts in the world—weather stations and police posts, military sites and Eskimo villages. To them, ham radio has always been a very real link with civilization and home.

I've been asked at times if there is such a thing as a VE9. Yes, there is, but not on the ham bands. These are stations which are licenced for experimental or business purposes such as university projects and commercial point-to-point circuits, and there aren't very many of them.

This wraps up this little glimpse of ham radio here. It's by no means as complete as it could be, but the purpose is to enlighten without boring you, so if you want to know more, meet us on the air or come visit us sometime. . . . VE1TG

John Janssen VE7PQ
Box 254
Comox, British Columbia
Canada

Suppressed-Carrier Amplitude Modulator

If you've been procrastinating about getting on sideband, why not try this simple double-sideband adapter for AM rigs.

This rig originated one day several years ago. VE6BT, Bill, was visiting with us and I was explaining this idea to him. He became enthusiastic and said, "let's build it." As I was working on my scope at the time, I drew up a diagram for the adapter designed to work with my Ranger, rounded up some parts, and Bill proceeded to build the thing in the workshop. I got the scope ready about the same time as he finished the adapter, so we were able to check its output when we got it hooked up to the Ranger and fed into a 52 ohm dummy load. The patterns were as pretty as a picture and on the air results were so good that numerous people have requested diagrams and information. VE6MM is running one at about 10 watts, VE6PZ has one on a Viking 1, and VE5GH is putting one on a TBS-50.

Development of the suppressed-carrier Amplitude Modulator requires the following:

1. A source of rf—the oscillator and multiplier chain in the AM rig.
2. A source of audio—an AM modulator.
3. Appropriate power supplies—contained in the AM rig.
4. A balanced modulator.

The balanced modulator is the only item that we do not already have—so we build it as follows:

Take a look at the circuit diagram and then gather up the necessary parts. This model is suitable for use with rigs having a pair of 6L6's, 6146's or equivalent in the modulator. The parts list in **Table 1** looks impressive but the unit is very compact.

A 5" x 6" chassis will do fine. Mount the coil centered near one end of the top plate. Mount the tube sockets symmetrically across the width of the top, leaving enough clearance for the coil. Wire the unit up, keeping leads close to the link on the tank coil, and the rf input connector close to the grids of the tubes. Use the extra octal socket to bring in the two audio leads from the modulator, filament power from the transmitter, and a ground lead.

Now it is necessary to bring out the audio and rf from the transmitter. Locate the leads from the secondary of the modulation transformer and disconnect them from the B+ line and the line feeding the final. On the Viking Ranger, this is simple, as it is only necessary to pull the plug in the accessory socket on the back. Now arrange to connect the two modulation transformer secondary leads to points A and B on the adapter through the connecting cable and plug. On the Ranger I used an extra plug that fit into the accessory socket.

Set the adapter aside for a moment and take the transmitter out of its case. Locate the grid pin of the final amplifier and mount a two terminal tie point as close as possible. Disconnect the lead which feeds the rf drive to the final grid and connect this lead to one tie point. Connect the final grid to other tie points. Run two short pieces of coax from these tie points to two rf connectors on the back panel of the transmitter. Ceramic centered audio jacks are OK. Keep the coax as short as possible. Use high impedance coax, preferably an old car antenna lead-in, in order to avoid adding parallel capacity.

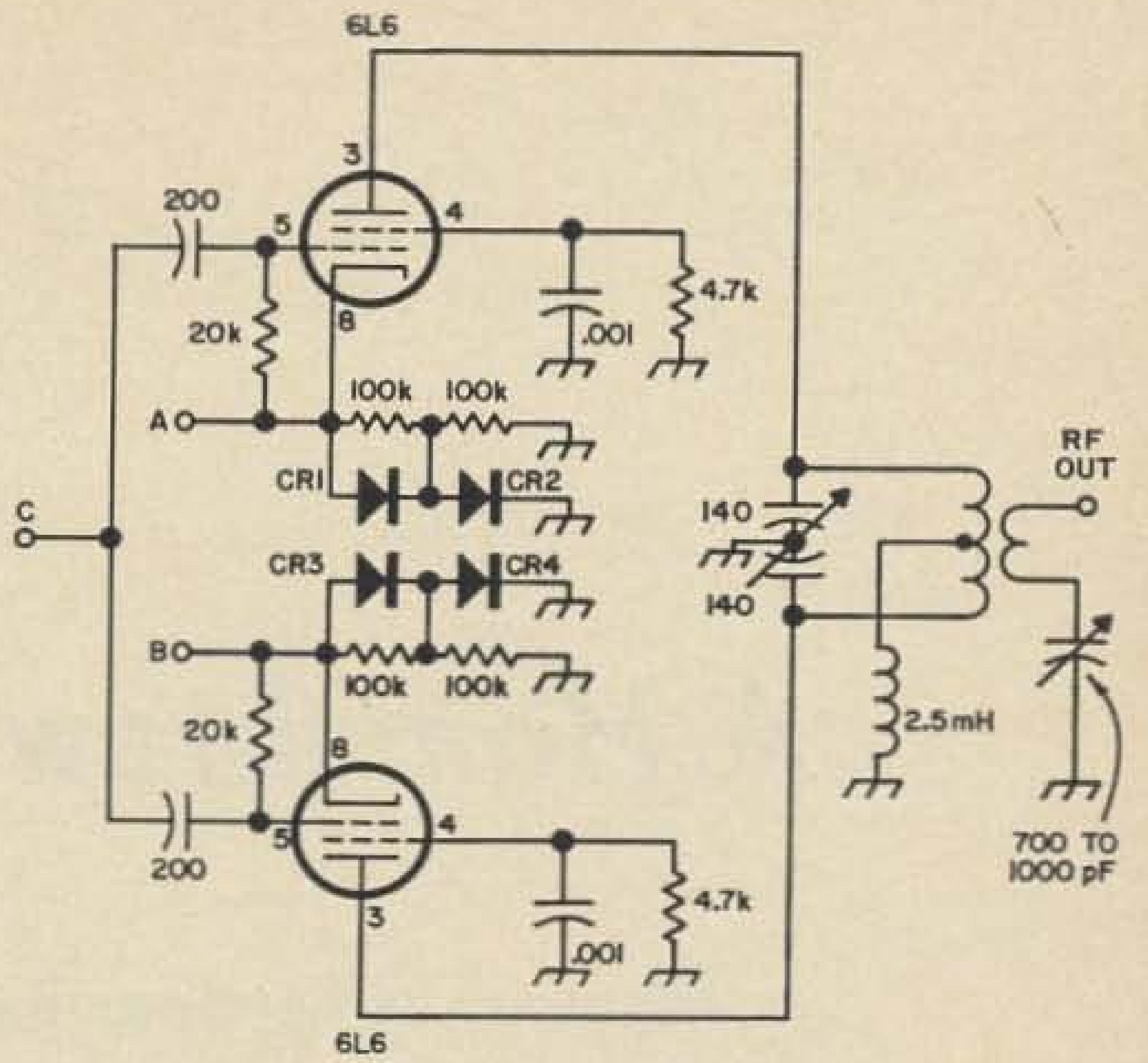
Fabricate a coax jumper lead which can be connected across the two rf connectors to distinguish them apart, as you only use the rf output connector with the adapter. Make up a coax cable to reach from the rf output jack to the rf input of the adapter.

The changes you have just made in your transmitter would be necessary if you intended to use an SSB adapter such as the SB10, so you are now also prepared for such an eventuality.

Now connect the adapter to the transmitter and connect a dummy load to the output of the adapter. Hook up your scope across the dummy load, or use a VTVM if no scope is available. The purpose is to indicate maximum output. Turn on the equipment, and after a suitable warmup period, put the transmitter on tune position. Adjust the transmitter controls to provide the desired rf drive. Feed an audio tone, preferably about 1000 Hz, into the mike input, either from some form of audio oscillator, or even a calibrator heterodyne from your receiver. Increase the rf drive in steps and raise the audio gain each time until flattopping occurs. If a light bulb load is used, the point just below maximum brightness would be the correct point of adjustment in each case. You will find that with a small amount of rf drive you can only use a small amount of audio *before* flattopping occurs. These amounts increase in step with one another until you reach a point where providing more rf drive will not allow you to increase the audio before flattopping occurs. You have now reached the maximum capability of the tubes in the adapter, and the correct operating point is just below this point. Set rf drive just above the point necessary to allow reaching the maximum tube point, and then reduce the audio drive to just below this so that flattopping will not occur. Now remove the audio tone and try a bit of speech. If all is well, remove the dummy load and connect up to resonant antenna. You are now on suppressed carrier AM. Have fun.

The temptation to use the centre tap on the secondary of the modulation transformer, when provided, in place of the silicon diodes, should be rejected. We found both the audio quality and the power output were much improved by using the diodes rather than the center tap.

The final tube in the transmitter is not used. In the Ranger it is protected by a



This simple suppressed carrier adapter may be used with many popular AM rigs. Points 'A' and 'B' are connected across the secondary of the modulation transformer. Point 'C' is connected to the coaxial cable which taps off rf excitation from the transmitter.

clamp tube but in any case, you should make sure that there is no plate or screen voltage applied to your final if it is not protected by clamp tubes while using the adapter.

To go back on AM, merely connect the rf jumper lead on the back of the transmitter, connect the modulator transformer secondary leads to the original connections by putting in a jumper plug or similar means. Tune up in the usual manner.

This adapter could be designed for any power level. Use a pair of tubes equivalent to those in your modulator, and be sure the PIV rating of the diodes will not be exceeded by the voltage output of the modulation transformer. Otherwise, nothing is very critical. We have two mobile transmitters under construction using this circuit and preliminary tests are very encouraging.

. . . *VE7PQ*

Parts list

- 2 6L6 tubes or equivalent.
- 3 octal sockets.
- 4 500 mA, 400 PIV silicon diodes.
- 4 100K 1 watt resistors.
- 2 20K 1 watt resistors.
- 2 4.7K 1 watt resistors.
- 2 .001 μF ceramic capacitors.
- 3 200 pF mica capacitors.
- 1 140-0-140 dual tuning capacitor, 1000 volt spacing.
- 1 dual BC variable.
- 1 push-pull centre linked coil (B & W Baby Inductor type MCL, for band desired).
- 2 rf coax connectors.
- 1 5 pin socket for coil.
- 1 2.5 mH RFC.

Harold S. Ramsey VE6KS
Box 365
Olds, Alberta, Canada

A Homebrew 50 Foot Tower

A tilt-over, self-supporting tower of simple construction.

Here it is—a fifty foot tower with *no* guy wires. It tilts over with the weight of your hand and fits into a foot and a half of space. The only thing it has not been in is a "twister"—which Canada does not have.

First of all, you need some used steel well casing. Two 20 foot sections four inches in diameter; ten feet of three inch, ten feet of two inch, and ten feet of one and a half inch. You will also need several swedges. If you do not know what a swedge is, and I did not, any pipe fitter will tell you.

Now to get the pipe. That could be a long story. It depends on whether you want to spend the money for new sections. It took me about two years of nosing around, but I finally got the pipe for a tank of gas. Then, if you can find a ham who is a welder you've got it made. The next best bet is to catch a welder in an off season.

After you get the tower welded together, set it in the ground at least six feet. Better yet, eight feet. The pipe will never break off, so set it deep in good concrete. If you are able fill the first stand of pipe with concrete—it will add to the strength—but, I really don't think it is necessary.

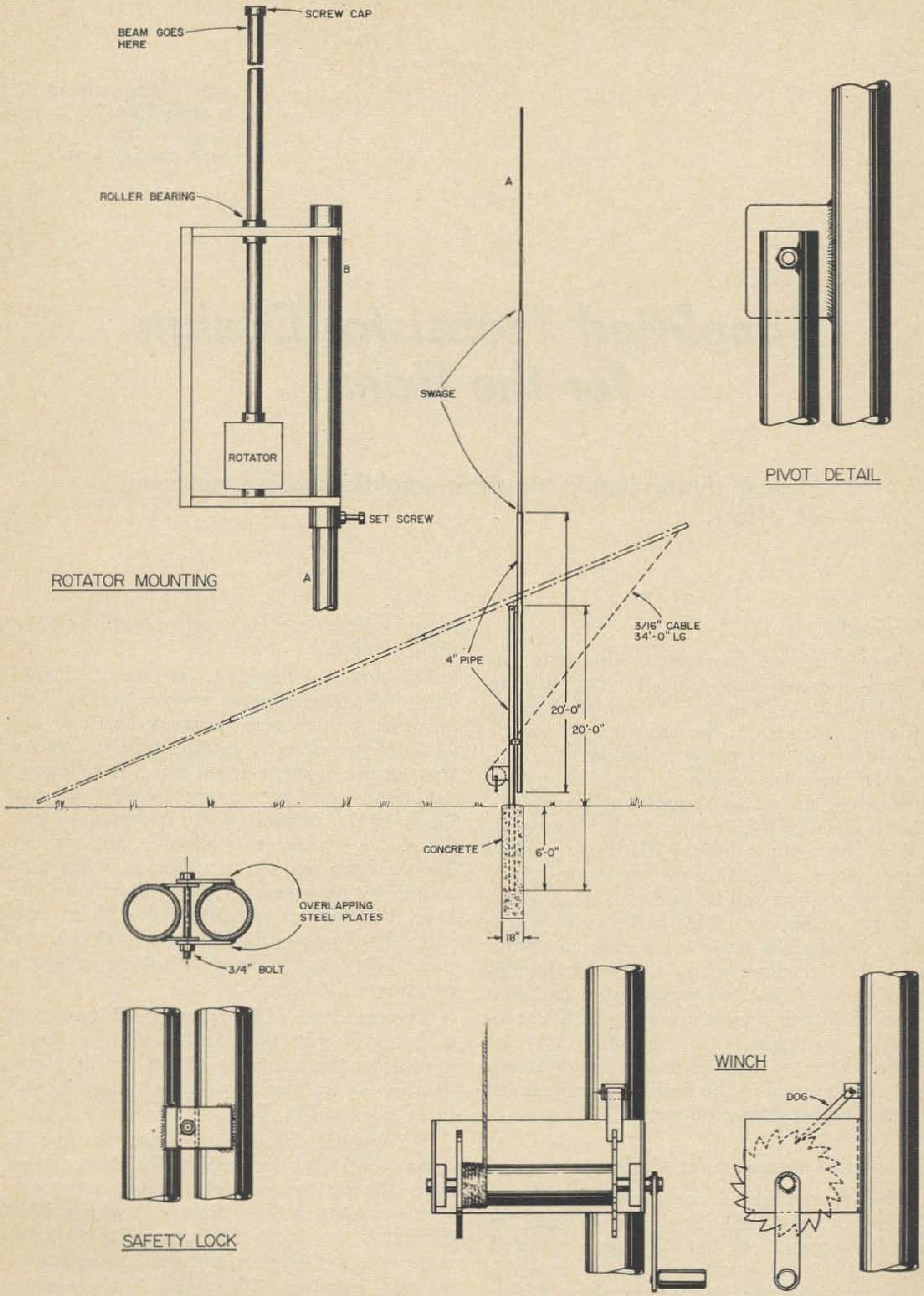
Make the hinge out of three-quarter inch steel plate and hinge it on a three-quarter inch steel bolt. Arc welding is the best and will minimize the tendency for the steel to warp. Your welder well see through the whole business in a minute. Put the hinge right at the point where the upright balances. When you put the beam, rotor and the bracket on the top, you can slide enough scrap pipe into the four inch pipe until it balances with a match stick.

The frame that holds the rotor is just a piece of pipe that slides over the last two inch pipe on the tower and is held in place with a lock nut. The roller bearing is from an old piece of machinery that will accept the 1½" pipe from the rotor. My welder made the whole frame out of steel so it weighed about 60 pounds or more. I am quite sure that you can shade that to about 30 pounds without danger of weakening the structure. Keep the top roller bearing dry—a graphite lubricating powder is all you need. I took a large tin funnel, cut the bottom out of it and slipped it over the 1½" mast. When it is pushed down over the roller bearing and soldered (or taped) in place, it keeps the rain, snow and ice off the bearing.

VE6GK put one of these towers up to over 70 feet. He started with 6" pipe, put the rotor on the ground and put a rod up through the whole thing to the beam. It's quite heavy but it sways very little in the wind.

The structural design and actual construction credit must go to VE6AKA. Jack is a welder by trade and he can use the torch like an artist. I would also like to thank Chester, WA7CJS/VE6, Superintendent of construction for the Fluor Corporation in Alberta, for his help and advice. What did I do? Well, somebody has to stand around and look important on any job!

. . . VE6KS



Construction of the home-made tilt-over tower built by VE6KS. Similar models have built by other Canadian hams with heights up to 70 feet.

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Simplified Transistor Design for the Ham

How to design simple transistor amplifiers with a minimum of effort.

Foreword

Over the past few years, emphasis has shifted more and more toward the application of solid-state devices in amateur equipment. Most new circuits in the ham magazines are transistorized, and many valuable tube collections and heavy power supplies gather dust while their owners scrounge transistors, diodes and small batteries. Such is progress.

For the serious builder the time usually comes when no existing designs quite satisfy what is required and he begins to think about a design of his own. This is the point where many worthwhile projects come to an abrupt halt; this is where many hams decide that transistors are just too complicated and that all solid-state designers are wizards. The procedures I propose here are satisfactory for all but the most rigorous design requirements and may be used in the design of professional as well as amateur equipment.

Information required for design

The characteristic curves of the device (transistor or diode) should be at hand before any proper design can be attempted. While some information may be available from transistor manuals or transistor testers, only manufacturer's curves describe how the device will work under any given conditions. Manufacturers will usually supply curves upon request.

For practical thinking, an intimate knowledge of semiconductor physics serves little purpose. In terms of design, transistors are as simple as tubes. A vacuum tube is a valve, the current flowing from cathode to anode being controlled by varying the relative amplitude of the control-grid to cathode voltage. Simple. A transistor is a valve, the current flowing from emitter to collector being controlled by how much current flows into the base. Field effect transistors should be considered solid-state triodes for our simple approach—just as simple and just as adequate for design thinking.

The operation of NPN and PNP transistors is identical—only the polarities of the voltages applied to the transistor (bias) are different. Transistors are biased with the following rules in mind (see **Fig. 1**):

Moving the base level closer to the B minus level (by decreasing R_B) causes more base current to flow, and therefore more collector current to flow. Note that with a PNP transistor the base must be negative with respect to the emitter, and the collector must be *more* negative with respect to the emitter than the base.

The valve principle may be clearly illustrated by examining the collector curves for a typical transistor in **Fig. 2.** These curves could describe the operation of *either* a PNP or NPN transistor.

A constant collector-emitter voltage (V_{CE}), is chosen by drawing a vertical line through any desired V_{CE} on the scale (7 volts). Whenever this vertical line intersects with a base current curve, a horizontal line is drawn from that point to the collector-current scale.

Point X3 is the point where, with a V_{CE} of 7 volts, a base current flow of 0.3 mA causes a collector current of 10 mA. Increasing the base current to 0.4 mA moves our operating point to X1, and causes the collector current to increase to 20 mA. Note that these curves describe the transistor operation for a given set of conditions.

Design procedures

Power output

For a safe design, use a transistor which is rated at ten times the required power output (at room temperature of 25°C). This seems extreme, but transistors are derated quite sharply (dissipation-wise) as temperature rises.

Frequency

The upper frequency limit of a transistor is usually specified as f_{hfe} or f_{β}. If the frequency rating given is "f_{hfb}", divide the f_{hfb} figure by the h_{fe} rating for the transistor to obtain f_{hfe}. This is the point where the stage gain will be down by 3 dB (half-power point). For reliable design use a transistor whose minus 3 dB frequency is ten times the maximum frequency of operation.

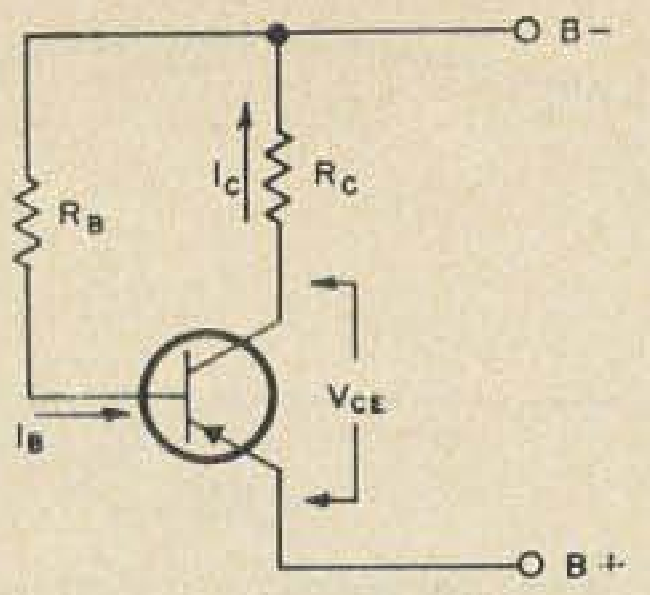

Fig. 1. Simple biasing circuit for a PNP transistor. I_C is the collector current, I_B is the base current, and V_{CE} is the voltage between the collector and emitter. Since I_B is much smaller than I_C, the base-biasing resistor R_B is much larger than R_C, the collector resistor. This circuit may be used with NPN transistors by simply changing the polarity of the supply voltages.

Supply voltage

Most amateurs feel more at home with a positive supply voltage so let us use NPN designs. The available supply will determine the transistor. The transistor rating to con-

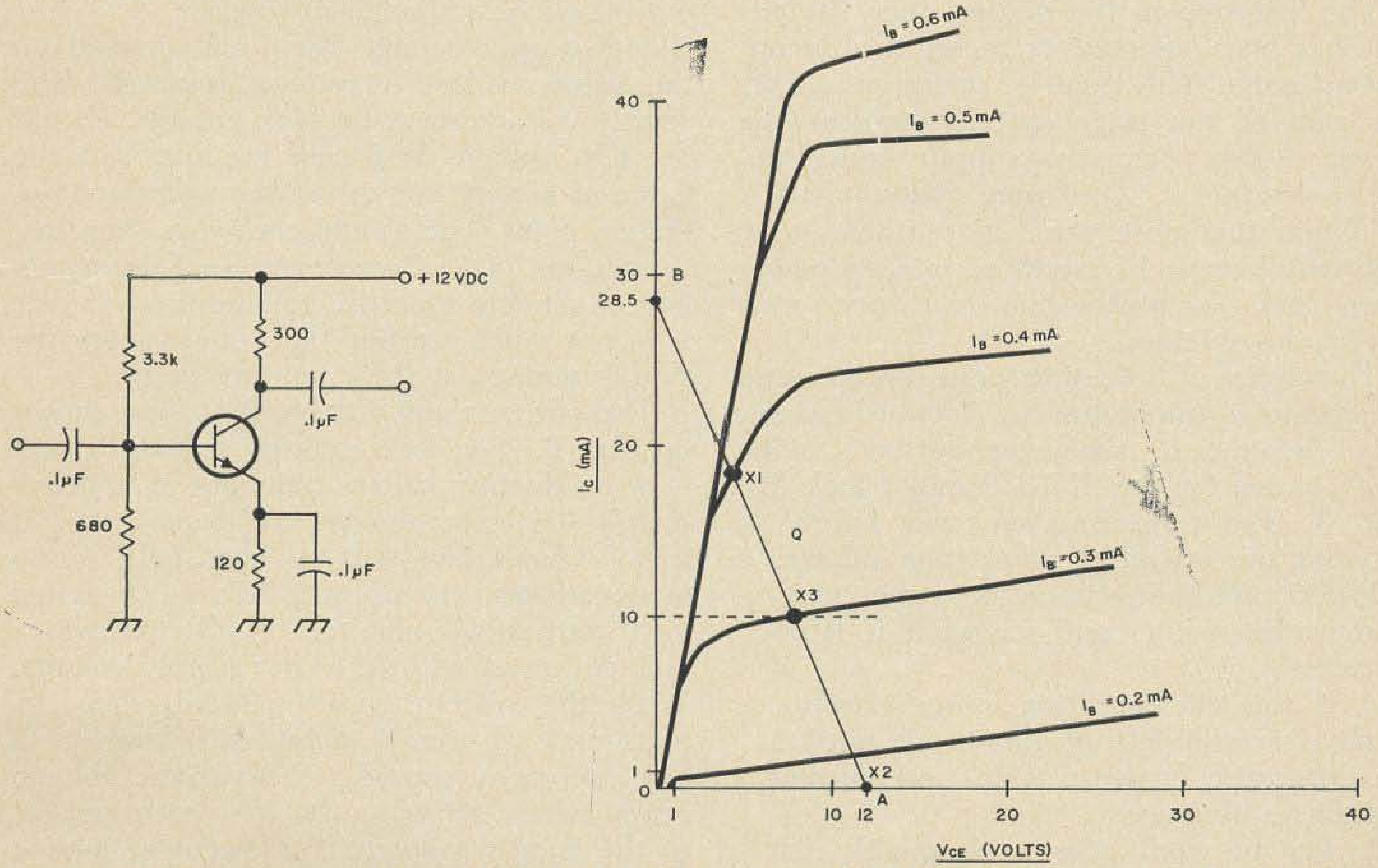

Fig. 2. A PNP transistor amplifier and its dc (static) load line. Point X3 is the quiescent point determined by the emitter-collector voltage of 7 volts. Saturation occurs at X1, cutoff at X2.

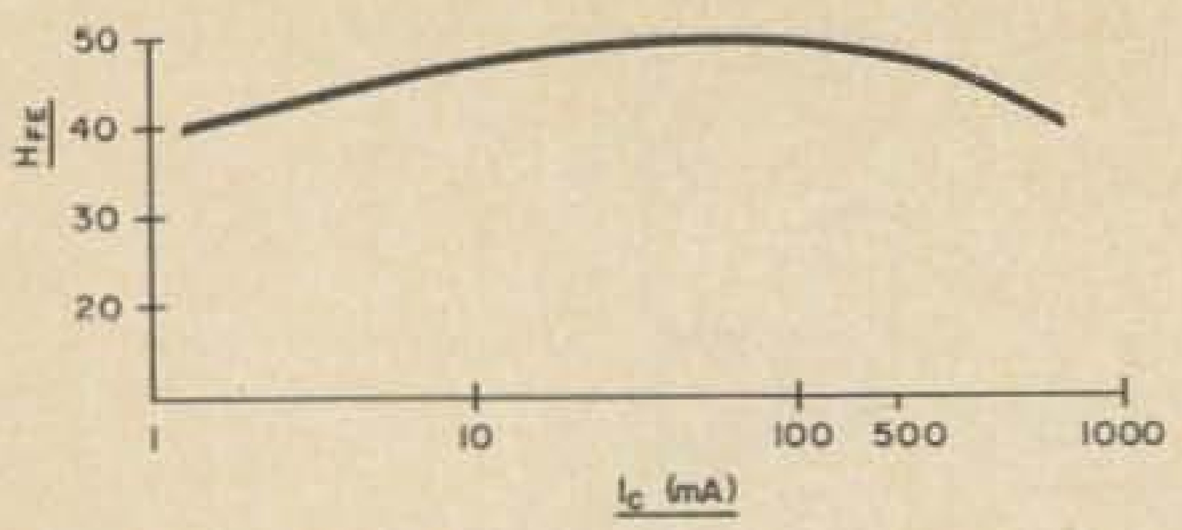

Fig. 3. Plot of the forward current gain, H_{FE}, as a function of the collector current. The maximum H_{FE} of 50 coincides with I_C = 100 mA, but moving up or down from this point does not alter it appreciably. To maintain linearity in amplifiers, the quiescent point is chosen on a reasonably flat portion of this curve.

sider here is BV_{CEO}, the collector-emitter breakdown voltage. If the amplifier has a resonant circuit in the collector circuit, the BV_{CEO} rating should be four times the supply voltage (V_{CC})—indeed, if the stage is being modulated, the BV_{CEO} *must* be at least 4 V_{CC} or breakdown of the collector-emitter path may occur. These large safety factors may seem extreme, but are desirable for trouble-free designs.

Our design examples will use the *2N7388*, a fictitious silicon 100 MHZ NPN transistor, rated at 0.5 watt at 25°C; BV_{CEO} = 50 volts and I_{CMAX} = 1 Amp.

Setting the operating point:

The first step in the design—once the circuit has been selected—is to set the dc operating point. This point of operation affects the gain of the stage, and determines the power drawn from the supply under no-signal conditions. The usual requirement is to obtain the most gain. In portable gear, gain may have to be sacrificed to keep power drain low, or higher-gain transistors may have to be obtained.

The choice of operating point can be made by examining the plot of h_{FE} (forward current gain) against I_C (collector current). The h_{FE}/I_C curve for the 2N7388 might look like **Fig. 3.** The procedure we will follow in choosing our operating point is as follows:

1. Examine the peak of the curve (maximum h_{FE} point) and see what I_C it requires.
2. If this current drain seems extreme, move to the left of this peak until a compromise between gain and current drain is obtained.
3. Try to work over a reasonably flat portion of the curve so that changes in I_C around the chosen operating point do not affect the stage gain very much.

Choosing our operating point from the curves of **Fig. 3,** we see that a maximum h_{FE} of 50 occurs at I_C = 100 mA. If we choose I_C = 10 mA, h_{FE} is still about 45. Moving I_C either way from the 10 mA point does not change h_{FE} appreciably. We will therefore set our dc operating point with no-signal input (quiescent or "Q" point) at I_C = 10 mA and h_{FE} = 45.

Once the operating point is set, we can quickly establish the rest of the dc conditions in our circuit by examining the plot of I_C versus V_{CE} (**Fig. 4**).

While looking at these curves, it would be a good idea to examine the circuit we ultimately hope to design, and how Messrs. Ohm and Murphy can combine to confuse our thinking.

The simple, basic amplifier circuit shown in **Fig. 5** will work. The "practical" circuit shown is the same basic amplifier, but R_E has been added and R_B is now the parallel combination of R_1 and R_2. The ac operation of the two circuits is identical, but the practical circuit is stable and reliable with changes in temperature. Let's look at the dc operation of this amplifier, with its various currents and voltage drops. To simplify things we shall assume that I_E (emitter current) is equal to I_C (collector current). We can do this without introducing significant error.

The supply voltage itself will depend on the value of load resistance required. The supply voltage must be high enough so that the I_CR_L voltage drop does not approach the value of supply voltage at the quiescent operation point. This would cause the transistor to "run out of V_{CE}"—with resultant distortion. Try to arrange the I_CR_L voltage drop so that it is not much greater than one-quarter the supply voltage at the operating point.

The currents and voltage drops are shown in **Fig. 6.** The base-emitter voltage (V_{BE}) of a conducting silicon transistor is approximately 0.7 volts, and we will assume that it is so. Ohm's law tells us that I_CR_E (drop across emitter resistor) plus I_CR_L (drop across load resistance) plus V_{CE} (collector-emitter voltage) must add up to our supply voltage. While the collector curves will only show the placement of the Q point with respect to V_{CE}, we must consider the various voltage drops when choosing the V_{CE} with respect to the supply voltage. For example, with a 6 volt supply, if we choose a V_{CE} of 5.5 volts, only 0.5 volts will appear across the

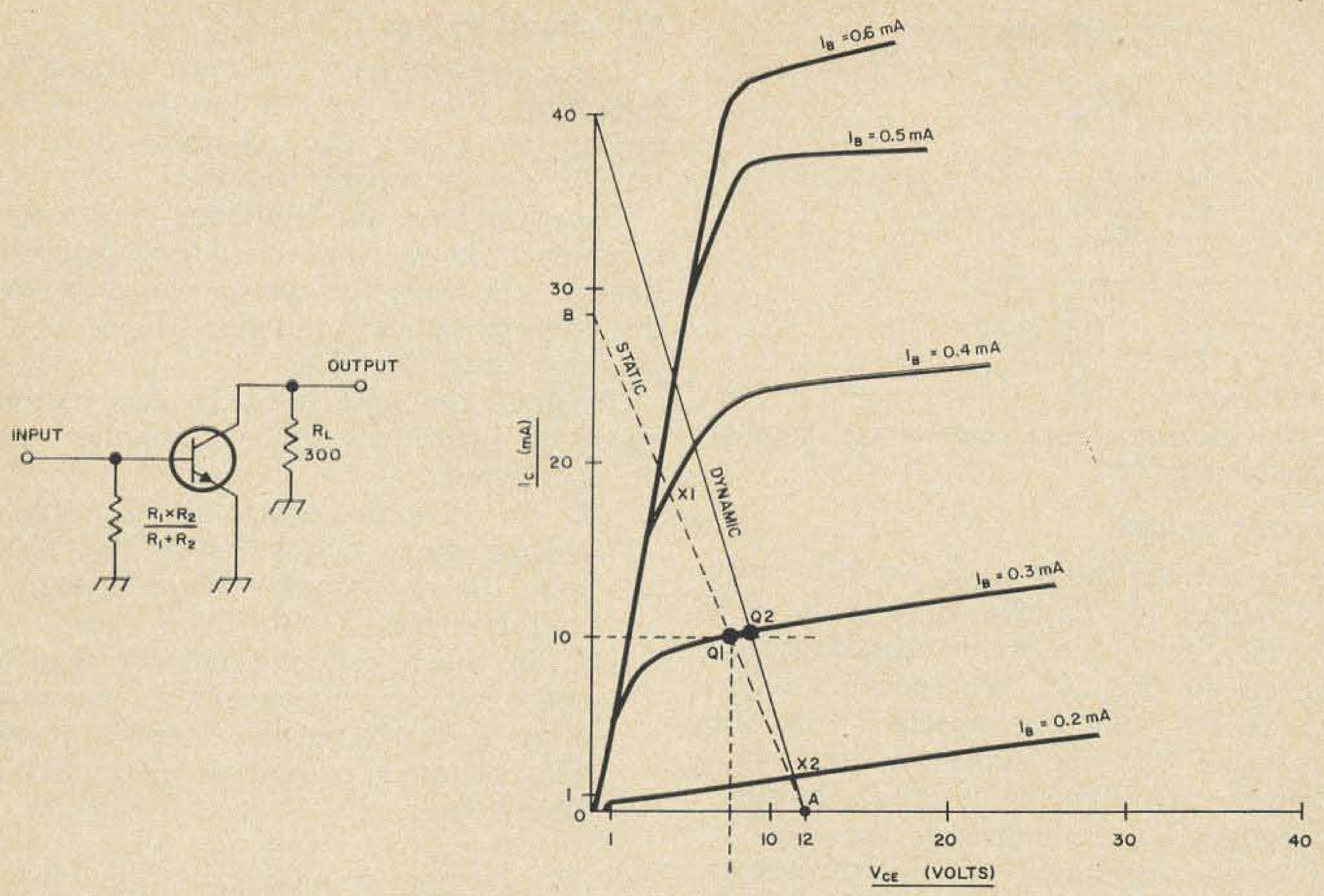

Fig. 4. Comparison of the static and dynamic load lines of a transistor amplifier. Note that going from dc to ac shifts the position of the load line. The circuit of the amplifier is shown on the left. The base-bias resistor is shown as a parallel combination of the two resistors that are actually used because this is the resistance 'seen' by the signal.

load resistance and R_E; with a 3 k load (a practical value), the I_C would have to be less than 200 μa. Keeping these various pitfalls in mind, let's look again at the collector curves (**Fig. 4**).

We want to place our Q point on the 10 mA I_C level (shown dotted horizontally). Let's assume a 12 volt power supply and a 300 Ω load. What value of V_{CE} do we choose to fix our Q point?

A general rule to follow is to have 1/10 the supply voltage across R_E; with a 12 volt supply this leaves 10.8 volts. With 10 mA I_C, the drop across R_L is 3 volts (10 mA x 300 Ω). Our V_{CE} then is 12 V − (3 V + 1.2 V.) = 7.8 volts (shown dotted vertically). The point of operation of our transistor will be the intersection of the 10 mA I_C level and the 7.8 volt V_{CE} position. Marking this intersection as Q_1, it is seen that under these conditions our base current will be 0.3 mA. The power drawn by the transistor at the Q point (with no signal) is 7.8 V x 10 mA = .078 watts, or 78 mW. Since the 2N7388 transistor is rated at 0.5 watts, this is an adequate margin of safety.

As a check on the base current (I_B) we can use the approximation $I_B = I_C/h_{FE}$. In our case, this works out to be 0.22 mA (10 mA/45). Considering the fictitious nature of our curves, this puts us in the right ballpark. For reference at the operating Q point:

I_C = 10 mA
V_{CE} = 7.8 volts
P_{Diss} = V_{CE} I_C = 0.78 watts (no signal)
I_B = 0.3 mA

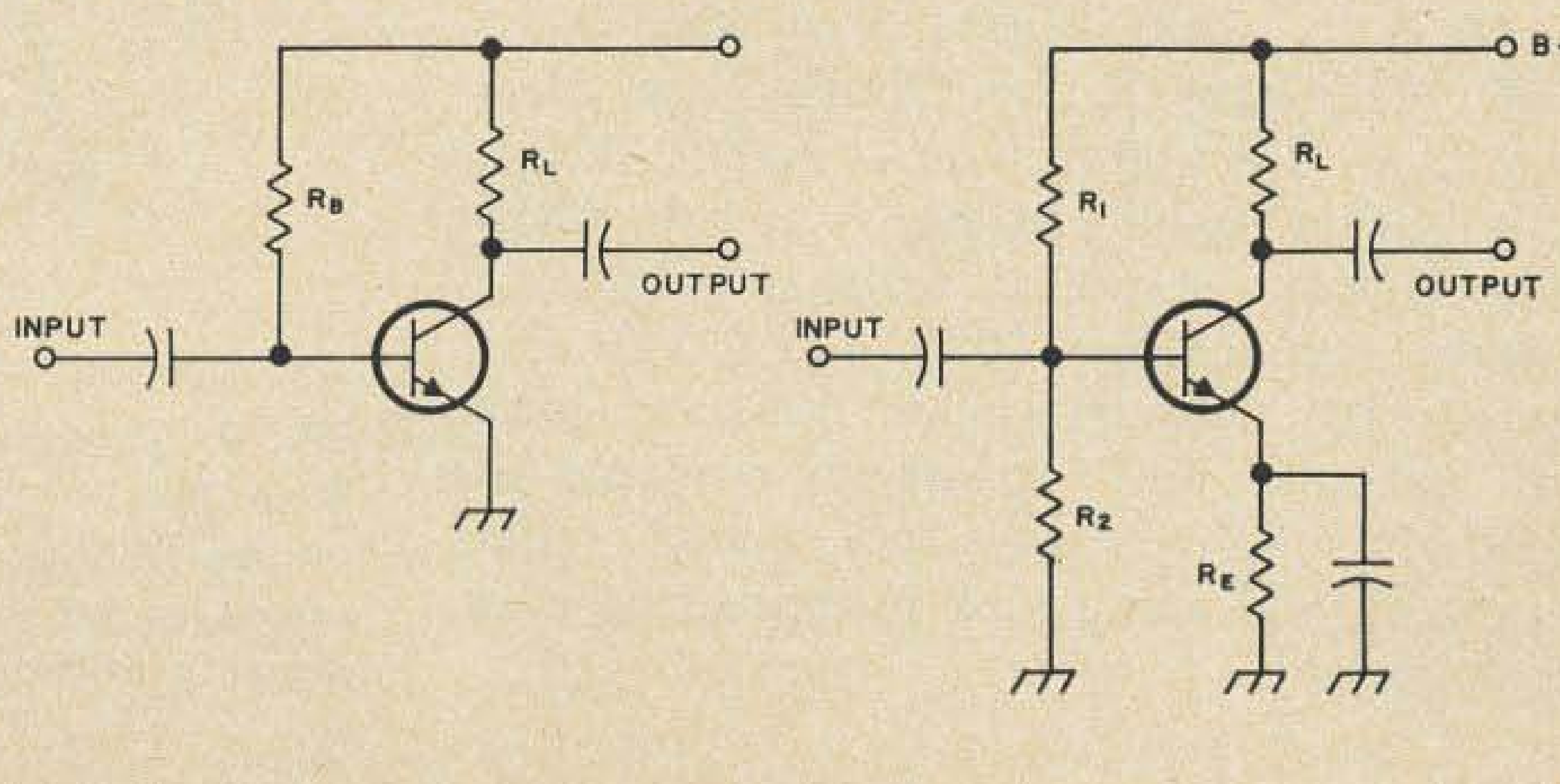

Fig. 5. The simple transistor circuit shown on the left will work, but the more practical circuit on the right is more stable and reliable with changes in temperature.

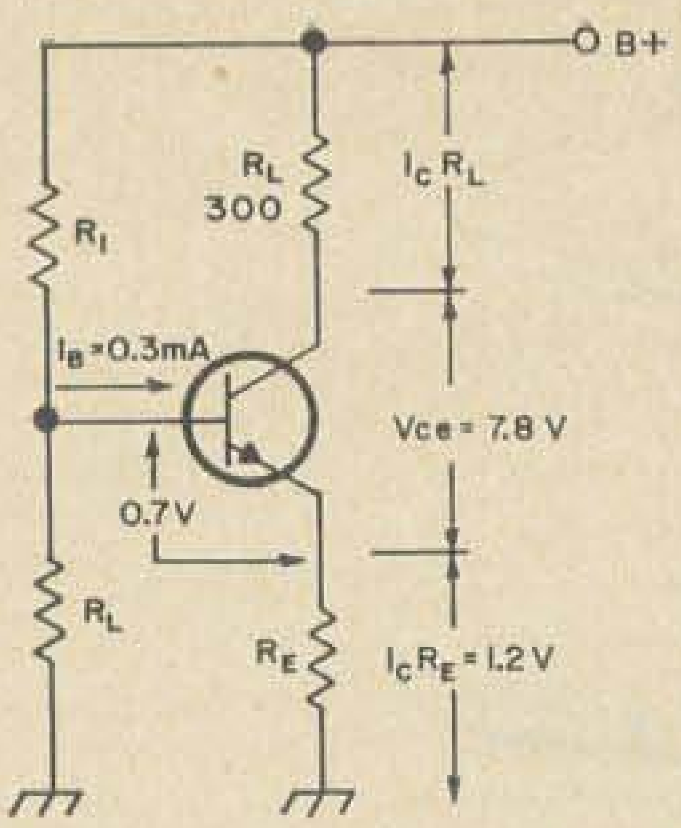

Fig. 6. The element currents and voltage drops of the transistor amplifier.

DC circuit values

Having defined the Q point, we can easily specify values for R_L, R_E, R_1 and R_2. For clarity, let's show the known conditions on the dc circuit (**Fig. 6**). We specified R_L as 300 Ω. If R_L cannot be specified, use the largest value that the transistor and available supply will allow. This results in minimum loading by the following circuitry.

For stable operation with temperature changes, it is desirable to have 1/10 of V_{CC} across R_E. By Ohm's Law, R_E = 1.2 V/10 mA = 120 ohms.

We can calculate the values of R_1 and R_2 by following a few simple rules.

A. To prevent changes in the transistor from affecting the circuit, the current through the series string of R_1 and R_2 should be at least ten times the desired base current. The current through R_1 is greater than that through R_2 by the amount of the desired base current. By Ohm's Law: $R_1 + R_2$ = 12 volts/3 mA = 4000 Ω.

B. The voltage (with respect to ground) at the base is approximately the sum of the R_E voltage drop plus the voltage across the base-emitter junction (0.7 volts).

V_B = (1.2V + 0.7V) = 1.9 volts.

C. V_B appears across R_2, which by Ohm's Law is 1.9 volts/3 mA = 634 Ω.

D. R_1 = 4000 − 634 Ω = 3366 Ω.

E. Checking R_1 by Ohm's Law, R_1 = (12 − 1.9 volts)/3 mA= 3360 Ω. This is within 1% of our previous calculation.

The nearest standard resistor values will be quite satisfactory (680 and 3300 ohms respectively). Discrepancies between calculated currents and operating currents are caused by reading curves inaccurately, slide-rule errors and variations in transistor characteristics.

AC circuit values

The capacitors used for input, output and by-passing should have a low reactance at the operating frequency. Values of 0.1 μF to 0.01 μF are usually suitable.

Once we have the amplifier designed, it is handy to know what it will and won't do. Back to the collector curves we go again—this time to examine the "load lines" of the amplifier (**Fig. 2** and **4**).

To draw the load line, the two extreme operating conditions of the amplifier must be considered.

1. No collector current at all. With no voltage drops across R_E or R_L, V_{CE} is equal to the supply voltage (point A on the curves).

2. So much collector current that the entire supply voltage appears as voltage drops across R_E and R_L, and V_{CE} is zero. This collector current is calculated by Ohm's Law:

$$I_C = \frac{V_{CC}}{R_L + R_E} = \frac{12\ \text{volts}}{420\ \Omega} = 28.5\ \text{mA}$$

This point is at B on the curves.

Once points A, B and Q are located on the curves, a straight line is drawn joining the three points. This is called a load line; since it was derived from the dc operating conditions, it is the dc or "static" load line.

The static load line describes the dc operation of the amplifier. For example, if we drive the amplifier with more than 0.4 mA base current, the transistor operates above point X1 on the load line, and goes into saturation. If we put in less than 0.2 mA base current, the transistor goes into a "cut-off" state. Operation must be between X1 and X2. Note that if this is the case, equal changes of I_B either side of 0.3 mA produce equal changes in collector current. This is

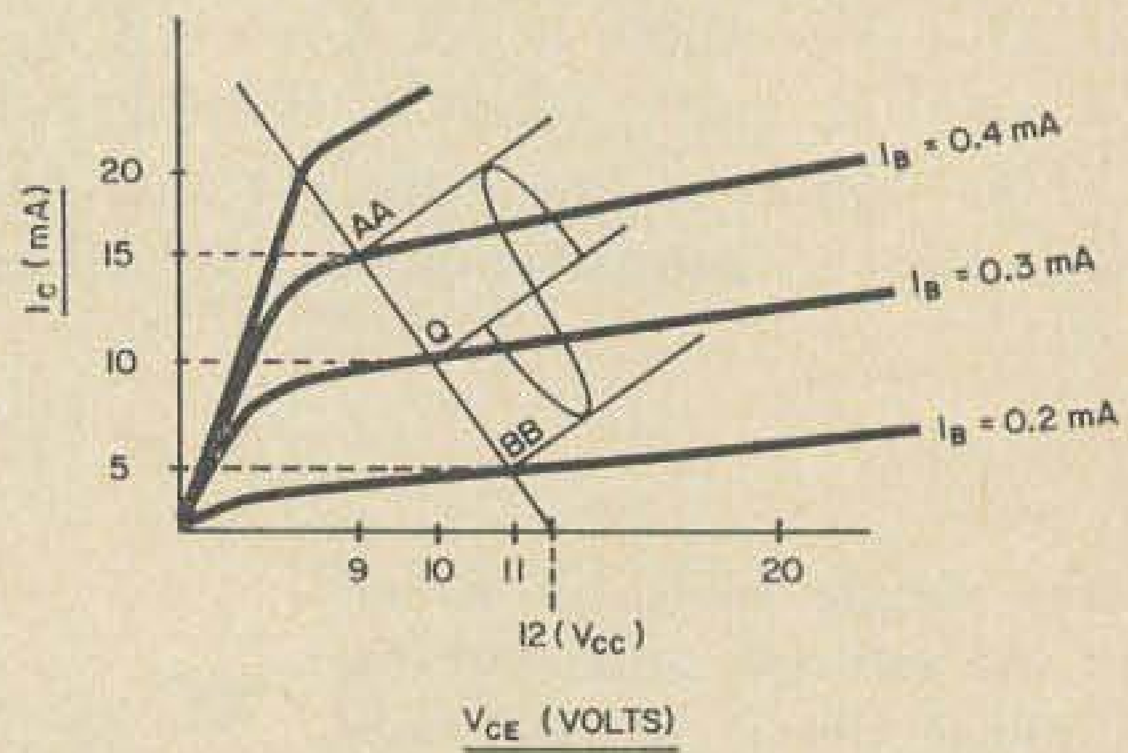

Fig. 7. Expanded view of the operating area with imposition of the base-input signal. Past the limits set by 'AA' and 'BB', the change in base current ceases to be linear and distortion will result if the signal is driven beyond these points.

the requirement for linear, distortion-free operation.

The ac or "dynamic" load line can be drawn just as easily. For ac, the bypassed R_E does not exist; the maximum collector current (ac) is now V_{CC}/R_L or 40 mA.

Note that the Q point has shifted slightly to the right along the $I_B = 0.3$ mA line, from Q1 to Q2. This slight shift in operating point can, for practical purposes, be ignored.

We now have our load lines. So what? We can obtain quite a bit of information from them. We are interested in the ac operation of our amplifier, so let's use the dynamic load line. An expanded view of the operating area is shown in **Fig. 7.**

First, let's check the power dissipation. From the load line we see the ac operating point sits at $I_C = 10$ mA, $V_{CE} - 10$ volts. This means a Q point dissipation of 100 mW, well within the rating of the transistor.

Next, let's mark the operating limits on our load line. These limits must be so set that equal changes in base current around the Q point (up and down the load line) produce equal changes in collector current. Past the limits shown as AA and BB in **Fig. 7** this condition is not met and distortion will occur. **Fig. 7** shows a sine-wave input centered about the Q point, producing the following results:

Collector current swing of 10 mA (5 mA to 15 mA)

Base current swing of 0.2 mA (0.2 mA to 0.4 mA)

Current gain is approximately 50 (10 mA/0.2 mA)

Output voltage of 2 volts peak-to-peak (9 volts to 11 volts)

Maximum power developed in the load under these conditions is $(0.707\ I_C\ \text{peak})^2 \times R_L$. Substituting the figures from our curves:

$P_{out} = (3.525\ \text{mA})^2 \times 300\ \Omega = 3.73\ \text{mW}$.

Fig. 4 shows that in the ac circuit the bias network equivalent resistance is in parallel with the input to the transistor. The transistor input impedance is approximately equal to 26 h_{FE}/I_C (mA). The 4000 ohm equivalent resistance of the base bias network does not alter this impedance appreciably.

The *input impedance* of the circuit is about 117 ohms and the *driving power* required is approximately equal to the product of the square of the input (base) current and the input impedance

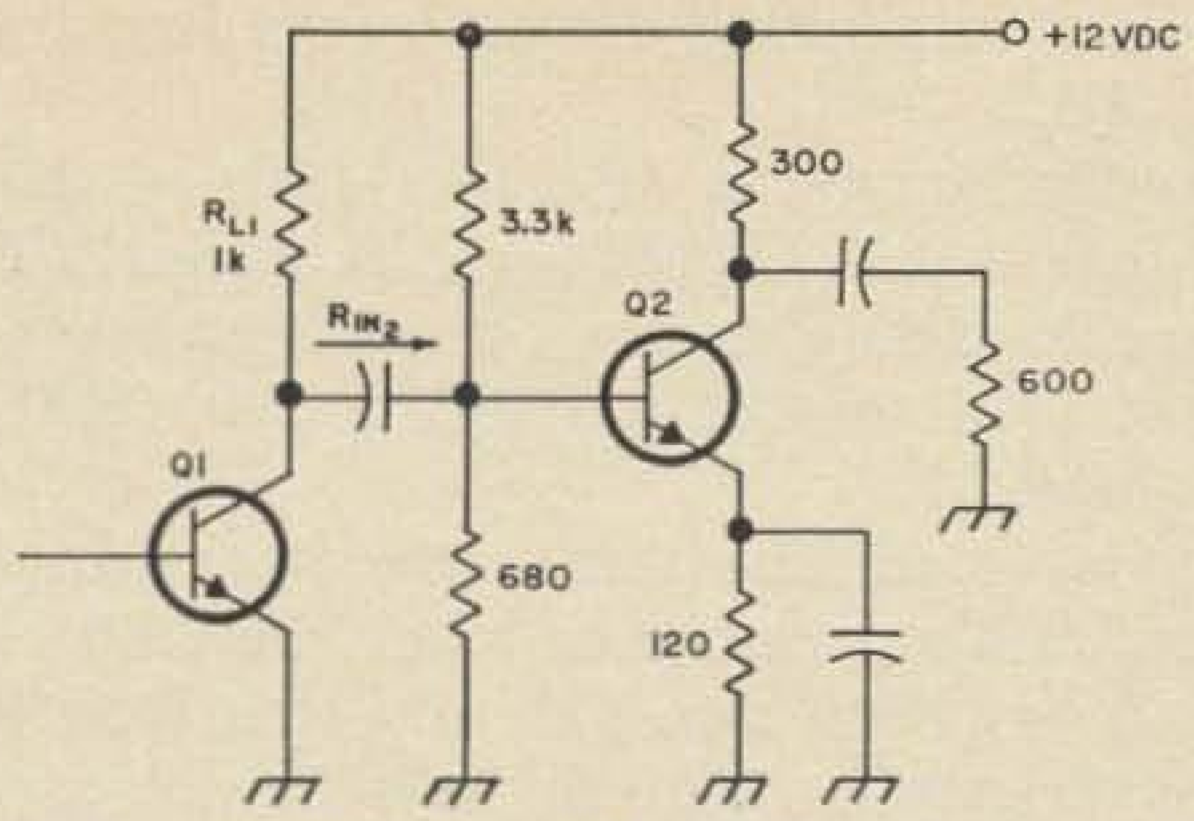

Fig. 8. To construct the ac load line of an amplifier, both the input and output circuits must be included. For example, to draw the dynamic load line of amplifier Q2, the effect of the driving transistor, Q1, and the 600 ohm load must be considered as illustrated in the text.

$P_{in} = (I_B)^2 \times Z_{in} = (0.3\text{mA})^2 \times 117\Omega = 10\mu W$

The *power gain* is P_{out}/P_{in} or $3.73/.01 = 373$

Note that these results only apply if a 300 ohm ac load is presented to the transistor. If this circuit drives other circuits, a new ac load line must be drawn, and new results calculated.

With our two load lines as an example, it might be a good idea to discuss the effects of various load impedances presented to the amplifier. **Fig. 2** shows the amplifier with no external circuitry attached: we saw that the dc load was 420 Ω ($R_E + R_L$) and the ac load was 300 Ω (R_L). What happens to the amplifer when it us used to drive another circuit?

To consider the ac loads on an amplifier, we must consider all coupling and bypass capacitors as short circuits and direct short circuits across all dc power supplies. To illustrate this, examine **Fig. 8.**

Fig. 8 shows the amplifier driving a 600

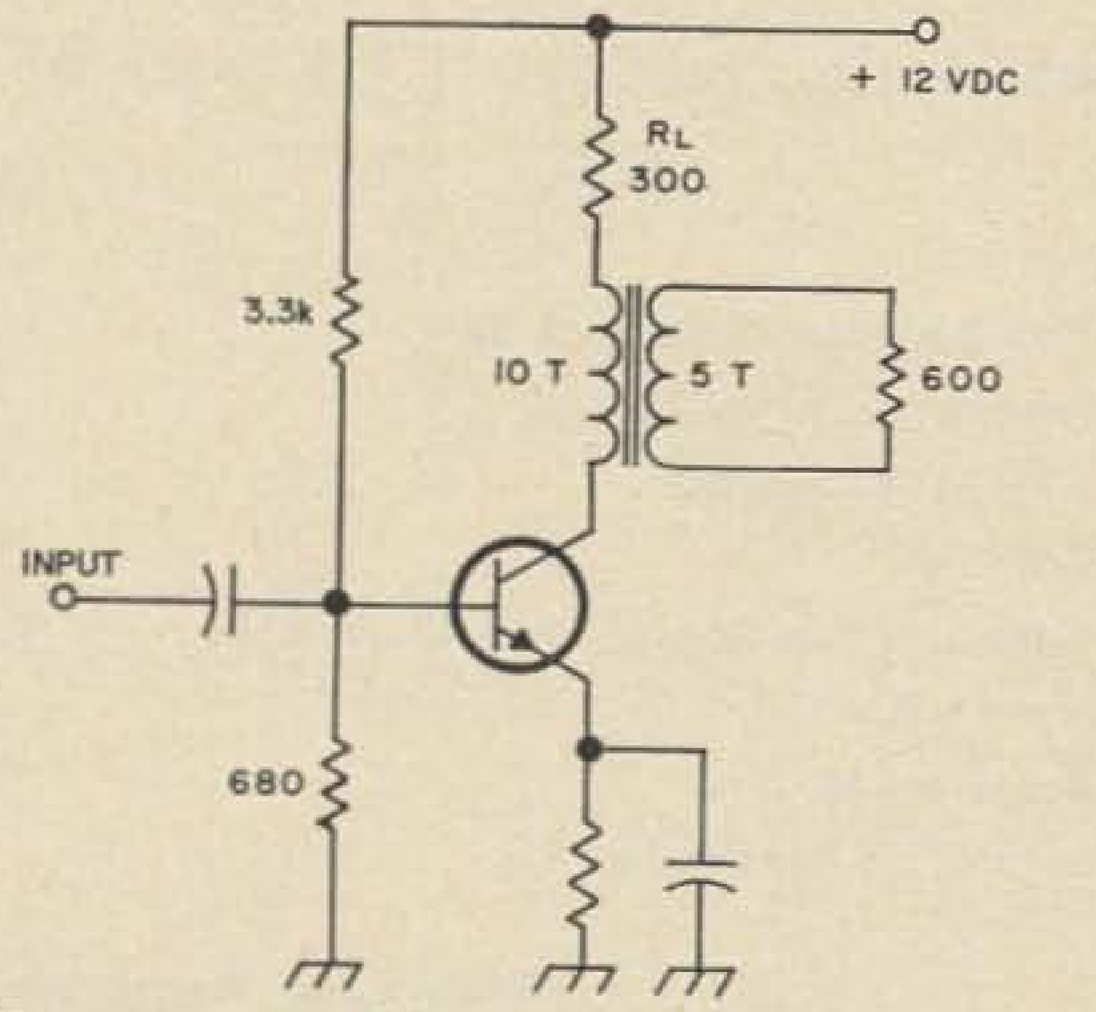

Fig. 9. Transistor amplifier with a transformer-coupled load. When constructing the dynamic load line for this amplifier, the impedance transformation ratio of the transformer must be included in the calculations.

ohm load, and being driven by another transistor, Q1.

The load on Q1 is $(R_{L1} R_{in2})/(R_{L1} + R_{in2}) = (1000 + 117)/1117 = 100$ ohms. A 100 ohm ac load line would be required for Q1. The ac load on Q2 is (300 x 600)/900 or 200 ohms.

The ac load line must now be re-drawn, using 200 ohms as the ac load. The 300 ohm ac load has been shunted, and that load line no longer applies. The dc load line of course still holds.

Let's consider an alternative—**Fig. 9** shows the amplifier coupled to the load through a transformer. Ignoring the dc resistance of the transformer winding, the dc load line remains as before. The ac load has changed drastically.

Remembering that transformers can transform voltage, current *and* impedance,

$$\text{Primary impedance} = \left[\frac{\text{Pri turns}}{\text{Sec turns}}\right]^2 \times \text{Secondary impedance} = \left[\frac{10}{5}\right]^2 \times 600 \text{ ohms}$$

$$= 2400 \text{ ohms}$$

Thus the 600 ohm load is presented to the transistor as a 2400 ohm load. In addition, the 300 ohm load resistor is in series with this, making a total ac load of 2700 ohms. By bypassing the top of the primary winding with an 0.1 μF capacitor, we can eliminate R_2 from the ac load line.

The point which this load impedance discussion should make is that the ac load impedance presented to the transistor must be decided by the "most likely to succeed" ac load line. The load impedance this load line represents is the *total* ac load, and must include all non-bypassed bias circuits, transformer-coupled loads, and what have you. The dc circuits in the collector, and any collector transformer turns ratios must be adjusted so that the transistor sees this load impedance. In other words, the load line is first established, and *then* the output circuit is designed to present the proper load impedance.

With the information presented here it should be possible for the average ham to design simple transistor circuits at low frequencies. A treatment of high-frequency design should be covered as a separate topic, but the basic ideas and biasing methods would certainly apply. ■

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VE0 AHOY!

The story of the Canadian maritime mobile stations.

Have you ever worked a VEØ? Well, congratulations, for you have logged one of the rarest call signs in the world. But I wonder if you know just *what* you worked? "Why, sure", you say, "It was a Canadian ship", and that's true, but perhaps you'd like to know a little more about your QSO. It could have been a sleek Naval ship, or the reincarnation of an 18th century British ship-of-the-line. It might have been a ship of science or a tough deep-sea tug. Or perhaps a schooner, the replica of a legend, created with love and care in memory of a champion of yesteryear. Each one is unique, and I'd like to tell you more about them. Care to come aboard?

H.M.C.S. Iroquois, VEØNA. This was the first of the official VEØ stations. Ham activities were carried on from one of the radio rooms aboard, using the whip antenna at the rear of the ship. The Iroquois was the beginning of organized ham radio activity on Naval ships and proved so successful that other ships quickly followed suit.

Here in Nova Scotia we're never far from the sea, and I suppose we look to it much more than most people in our land. The Port of Halifax has been home base to almost all the VEØ ships at one time or another, many of the operators have been VE1's when ashore, and when at sea most of them have spent much of their time in traffic with us. So, knowing a little of the background, come along for a closer look-and perhaps, smell the tang of the sea.

Many times when a ham works a VEØ he thinks this is something new, but it isn't actually so. For many years, radio has been a most important part of any well-equipped ship, but there was little amateur operation before World War 2. It became a little more prevalent after the war, and in Canada it was the Navy which carried the ball more than anyone else. To them should go the credit for the creation of the VEØ calls.

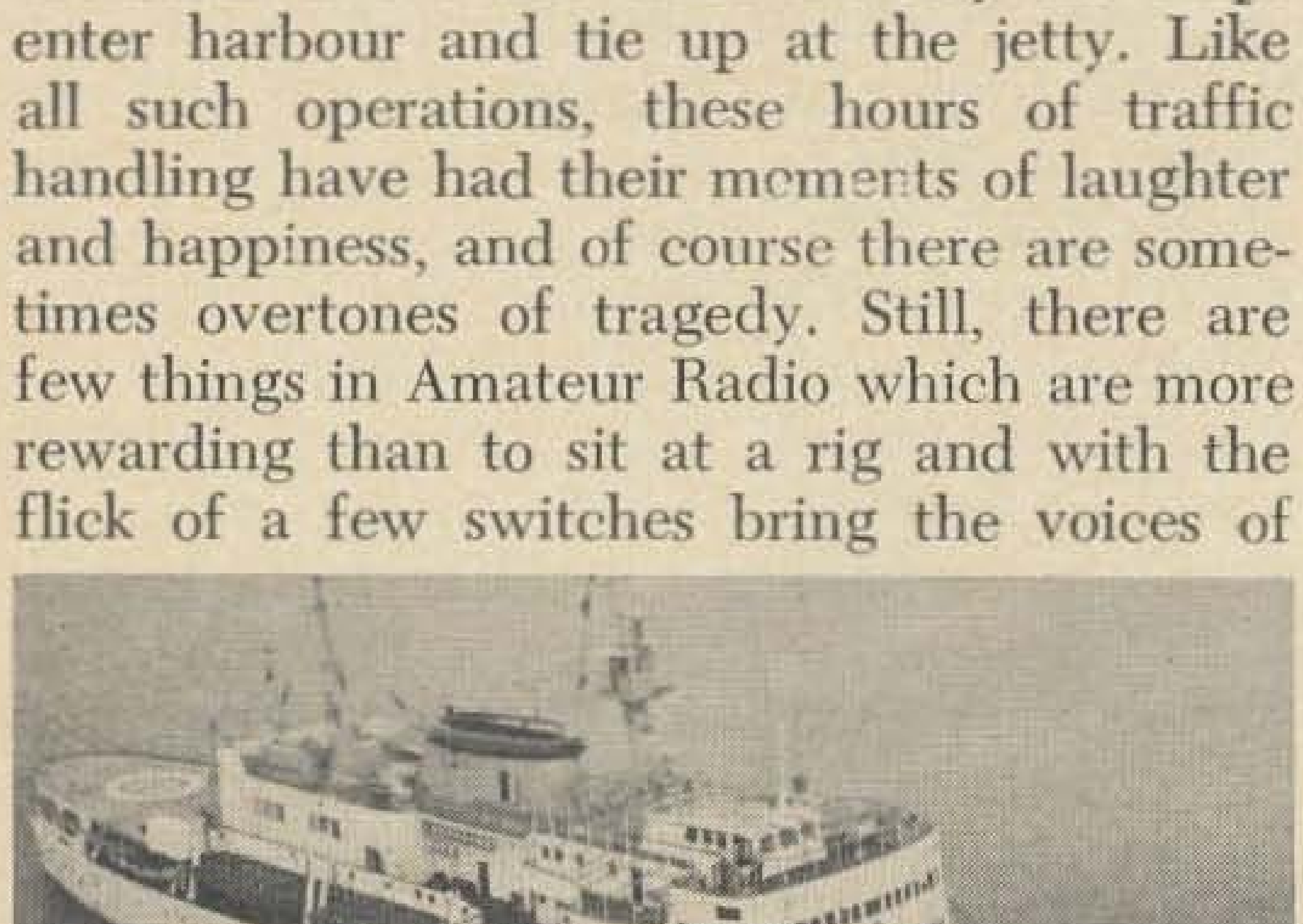
Around late 1948, the Royal Canadian Navy began allowing ham operation aboard ship, using either personal or club calls. Although this privilege didn't last too long, stations did get into operation on HMCS Ontario, Magnificent, and Nootka. Operation was never very continuous, but it resulted in the formation of the R.C.N. Amateur Radio Society in 1951. As a result of requests by this group and by other interested persons, the Department of Transport allocated the zone figure Ø to shipboard amateur stations, with VEØN—for Navy stations, and VEØM —for stations on government, merchant and pleasure craft.

For the Navy boys, the requirements were not too difficult. Application had to be made to the Department of Transport by the senior licenced ham on board and he also had to submit an application to the Captain of the ship, who, if he agreed, would forward it through official channels to Naval Headquarters. If the application was approved, a VEØ call was assigned to the ship on behalf of HMCS (name of ship) Amateur Radio Club. The senior ham was holder of the licence and responsible for it, but any qualified ham on board could operate if the Captain approved. Only the one VEØ call could be used by all hams on the ship, and the licencee paid the regular yearly licence fee.

The Navy then went one step further and allowed the use of only official Naval radio equipment, provided it complied with regular

H.M.C.S. Bonaventure, VEØNE. Probably the best known and most active of the Navy stations, the "Bonnie" has run hundreds upon hundreds messages and phone patches between her home base at Halifax and her cruising areas in many parts of the world. Presently undergoing a refit, the big gray lady will be back on the air again before too long.

amateur rules of operation. Over the years the Navy has contributed far more to the continuance of the VEØ calls than have any other group. The advantages have been obvious; just the boost in morale gained by contact with families at home has made it all worthwhile. When the ships are at sea, hours upon hours have been spent with traffic back home to Canada, and many of us on this coast have been on the receiving end from the start of a cruise until the day the ships enter harbour and tie up at the jetty. Like all such operations, these hours of traffic handling have had their moments of laughter and happiness, and of course there are sometimes overtones of tragedy. Still, there are few things in Amateur Radio which are more rewarding than to sit at a rig and with the flick of a few switches bring the voices of



The Canadian Scientific Ship "Baffin", VEØMJ, one of the world's most advanced ships for the study of all phases of oceanography. Because she is often on extended cruises, there is usually a good chance to work her on 20 meter CW.

loved ones to men crowded into a radio room somewhere on the high seas.

But I've digressed too much . . . let's get back to the story. After the VEØ calls came into being, the first officially licenced station was VEØNA on HMCS Iroquois, back in 1954. Aside from this distinction, the Iroquois was one of the most famous ships in the Navy. From her completion in 1942, she was always in the thick of things, sinking or assisting in the sinking of fifteen enemy ships and the damage of others, as well as tours of duty on the famous Murmansk run. To wind up her career of honour she escourted Crown Prince Olaf of Norway when he returned to Oslo from exile.

After the war, she went through alternate periods of active and reserve duty, including three tours in Korean waters, returning home in 1955. In November 1957 she was retired at Halifax, then re-commissioned and remained on the seas until Octber 1962. This was the end of her active service, and after several years of retirement she finally went the way of all ships, no matter how distinguished.

Just after the assignment of VEØNA to the Iroquois in 1954, HMCS Algonquin came on as VEØNB (the first of several ships to eventually hold this call) and on the West Coast, VEØNC was assigned to HMCS St. Stephen. All these ships operated fairly regularly on the ham bands, but the biggest effort came in 1956 when VEØND was allocated to the aircraft carrier HMCS Magnificent. The "Maggie" was involved in transporting troops to the Middle East during the Egyptian crisis, and a steady flow of traffic passed between the ship and the East Coast on each passage between the home port and the eastern Mediterranean. Probably more than any other event, these trips of Maggie pointed out the morale value of amateur radio and tightened the bonds of co-operation between the Navy and the hams back home.

In 1957, the Maggie left our service and HMCS Bonaventure took over her job. With the call sign VEØNE, the Bonnie has become one of the most active of all the Navy ships as far as ham radio is concerned. No one knows exactly how many phone patches and pieces of traffic have been passed back and forth between her crew and their families, but it must run into the thousands.

Besides the Bonnie, quite a few others are licensed at the present time—VEØNB,

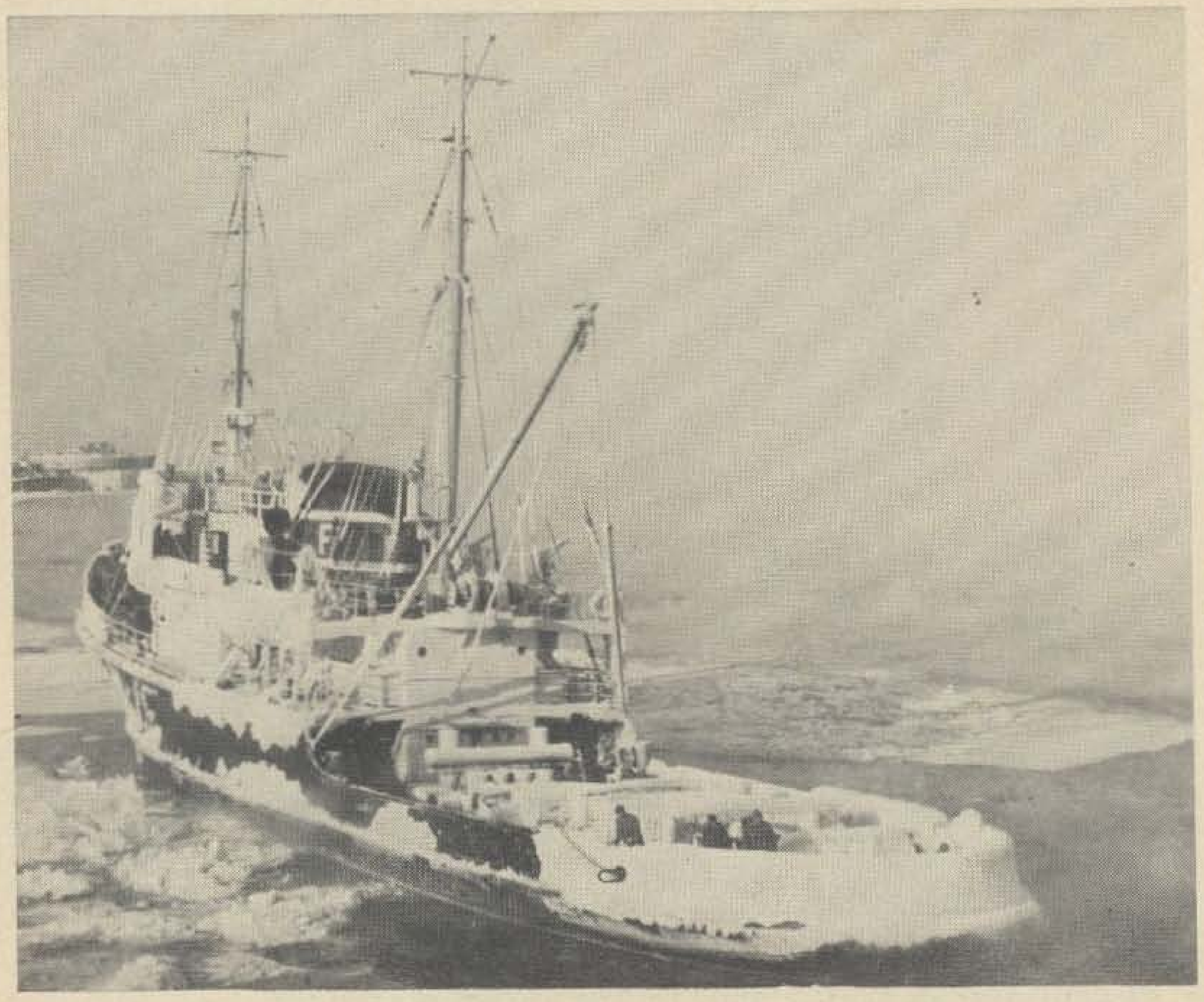
QSL card from VEØMO, HMS Bounty. Built expressly for MGM's "Mutiny on the Bounty", she is a duplicate of the famous ship on which the mutiny occurred in 1789. The "Bounty" is presently on display in Tampa Bay, Florida.

the Gatineau; VEØNC, the Columbia; VEØNG, the Kootenay; VEØNI, the St. Laurent; VEØNM, the Cape Scott; VEØNU, the Terra Nova and VEØNP, the Margaree. Over the years, operation on the Navy ships has run hot and cold, but one of the most extensive uses of ham radio was during the Easter Island medical expedition of 1964-65. The Cape Scott was the transportation ship, and VEØNM ran dozens of patches back to Halifax, especially over the Christmas season. VE1LZ and VE1AGH were the fellows on this end. In addition, VE3DGX set up a station on the island and operated as CEØAG, not only giving the island it's only real communication with the outside world, but also putting a new country on the air. This whole operation was a real credit to ham radio, and the Cape Scott has been in continuous operation ever since.

Since the VEØN-boys use Navy equipment, they always have been able to put out pretty good signals. Top-quality apparatus is always an asset, but more so when trying to keep phone patch and traffic schedules for weeks at a time. During the 1965-66 goodwill cruise to South America, ham operation was continuous, sometimes with two or three stations here in Halifax working together to handle the volume of traffic. One evening sticks in mind particularly, as two ships cruised along side by side off the coast of Uruguay and ran hour after hour of phone patches into Nova Scotia.

VEØ calls are all issued on a club basis, and in the order of request. No ship has any permanent call, and if operation is not maintained the call is simply passed on to another. With morale being the prime consideration, most operating time is devoted to traffic, and very little to rag-chewing. This is frustrating to a lot of people, especially since the VEØ call is quite rare, but despite their problems the boys have always managed to make up QSL cards and have tried to answer all the cards received. Like call signs, the operators change often, so perhaps some have gone astray. If you have even one such QSL, be content, for it's almost as rare as any QSL can be. Ham radio is now firmly established in the Navy, so keep listening and you'll come across them. Please, though, a word of caution-remember they are on the air for the purpose of traffic handling. Until their schedules are finished and they declare themselves open for general contacts, be the type of gentleman that every amateur should be-don't break in! Your co-operation will be appreciated.

Thus we see the Navy's story of VEØ, but what of the other ships? Let's go back in history to the British Navy of the 18th century and one of the most famous ships of all time—HMS Bounty, the ship of Captain Bligh, the subject of one of the great classic stories of the sea. When MGM Studios decided to make a movie of this story, they needed a ship, and here in Nova Scotia we



The "Foundation Vigilant", VEØMK. The "Vig" is a deep sea salvage tug, shown here coming into harbour on a bitterly cold winter day with her sides and decks heavily coated with ice. One of the toughest jobs she ever undertook is described in the text.

build pretty good ones. In Lunenburg town, in 1960, a new Bounty was built, launched and fitted out with 18th century regalia and 20th century equipment—including ham radio. With a KWM-1 and a long wire, Spud Roscoe set up VEØMO, and made many an operator happy with a QSO and later, a QSL that was a thing of beauty. The Bounty travelled the South Seas and many ports of North America, finally coming to rest as an exhibit in the waters of Tampa Bay, Florida.

The Canadian Scientific Ships Baffin and Hudson, VEØMJ and VEØMX, are the pride of the Bedford Institute of Oceanography, one of the most advanced scientific centers in Canada and a world leader in ocean research. These ships look more like luxury yachts or small cruise ships, but inside they are crammed with laboratories and the latest devices for unlocking the ocean's secrets. Their work takes them from the tropics to the Arctic and they're quite active on the ham bands. 80 and 20 meters are preferred with more CW than phone. They handle some traffic, but not as much as Navy ships, so the chances of a casual QSO are much better. Be on the lookout for them, and when your QSL arrives you'll have a souvenir of one of the most technologically advanced ships afloat.

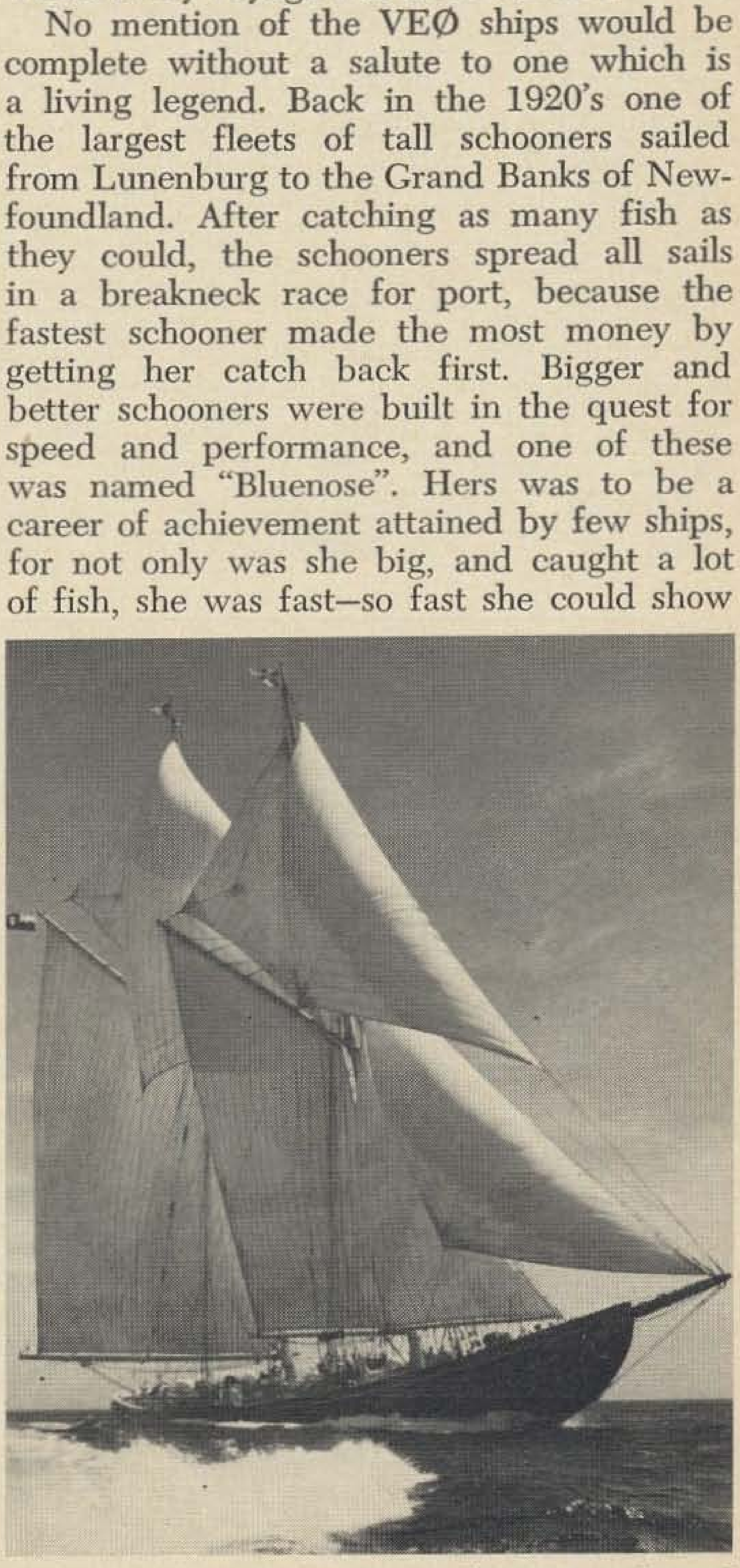
There are several other VEØM stations which are sporadically active. There's VEØMH and VEØMI on the icebreakers Sir William Alexander and N. B. McLean; VEØMP on the Royal Canadian Mounted Police cutter "Wood", operated by VE1RX; VEØMS, the icebreaker D'Iberville; VEØMM, a private cruiser owned by VE1ARY; and VEØMB operated by Captain Louis Romaine on the Lurcher Lightship off the south tip of Nova Scotia. This one is quite active on 75 meter phone, keeping regular schedules with friends on shore.

There's always a tale of adventure associated with any VEØ station, and any of us who have operated with them have our favorite stories and memories. My fondest thoughts are for the "Foundation Vigilant", a big, brawny ocean-going tug with the call VEØMK. In December 1964, the "Vig" left Halifax to cross the Atlantic with a huge old grain-carrier in tow, bound for the scrapyards of Bremerhaven. "Mick" McWilliams was the operator, and we agreed to keep schedules each morning on their way across. The trip wasn't supposed to take more than a few weeks, but the rough old Atlantic had other ideas. As the days went by, the seas became higher, the winds stronger and progress slower. The casual morning chats soon became traffic, as the Captain and crew began letting the folks at home know the situation. Trouble developed with the radar and we spent hours trouble-shooting by 20 meter CW. After a day or two the radar was fixed and then the real storms began. Day after day of towering seas and howling gales, and then—the tow-line broke—and the bulk of the grain-carrier disappeared in the storm. Chasing after it, with her radio on constant watch to warn other ships of the danger of the drifting mass of steel, the Vigilant tried desperately to "hook up" again, but each attempt met with failure. Day after day I met Mick on 14.022 and hoped they had met success, and each day was the same—"No change, George, still gale force winds. Can you take some traffic?" I kept thinking, I wonder what thoughts would be going around all these homes if this schedule hadn't worked out? The ship was already overdue at her first port of call in England, and she was still only half way across. For eighteen days the gales drove the Vigilant and her wallowing target back across the Atlantic, until at last a line was secured and the long hard pull began again. Food was almost gone and fuel was low, so they headed for the Azores while we cleared every message we could before they docked. I stood by every morning for a week and a half, and one morning signals came pounding through again. Because of some problem with local communications, they had had no success in getting messages back to Canada, so that morning there was a lot of traffic on 20 meters!

Off they headed again for England, and into another succession of gales and winter storms. Christmas and New Years had come and gone, and it was the end of January, and I had become acquainted with the families of every man aboard. There's always something very wonderful about putting this amateur radio of ours to good use, and Mick and I found a lot of personal satisfaction in keeping these schedules without a hitch.

Finally, in mid-February. The Vigilant reached Falmouth, England, then up the English Channel, through the Straits of Dover and the North Sea to the River Elbe finishing the long voyage at Bremerhaven. Right to the last day, our schedules went through, and after the hulk was turned over to the scrapyards the Vigilant turned homeward. Misfortune struck again, for as she headed down the channel her Captain became seriously ill and she raced for the nearest port and hospital. Messages flew back and forth to Canada, and his wife flew to England to be at his side. A relief Captain also flew over, and the ship headed for home with a different hand at the helm. Again the storms, but this time there was no great weight to hold her back, and she hurtled along with the wind and waves. The message total by this time was over one hundred and fifty, and every family at home knew of her day-by-day progress. On a brisk day in mid-March she finally slipped up Halifax harbour to her home berth and the arduous voyage was over—one more story to a ship whose every voyage was an adventure.

No mention of the VEØ ships would be complete without a salute to one which is a living legend. Back in the 1920's one of the largest fleets of tall schooners sailed from Lunenburg to the Grand Banks of Newfoundland. After catching as many fish as they could, the schooners spread all sails in a breakneck race for port, because the fastest schooner made the most money by getting her catch back first. Bigger and better schooners were built in the quest for speed and performance, and one of these was named "Bluenose". Hers was to be a career of achievement attained by few ships, for not only was she big, and caught a lot of fish, she was fast—so fast she could show



The schooner "Bluenose 2", VEØMY. A replica of the undefeated champion of the North Atlantic fishing fleet.

her heels to almost anything that dared try to outsail her.

It was inevitable that she be challenged to race against her competitors, and so began the famous International Schooner Races, in which Bluenose met and defeated every candidate. She was the toast of a town, a Province and a nation, but she was still a working ship. As the years went by, the tall schooners gradually succumbed to the intrusion of engines and one by one they disappeared. Bluenose kept working, but in the early 1940's she struck a reef off Haiti and swiftly slipped beneath the sea of which she was so much a part. There were black headlines and sorrow in Nova Scotia, but she lived on in memory and for many years there was talk of building a replacement—someday.

Finally the Halifax firm of Oland and Son Ltd. decided this should be done, and in the summer of 1963 Bluenose 2 was launched from the shipyard which had built her famous ancestor. In early 1964 she made her maiden voyage from Nova Scotia to Cocos Island, where a ham station was set up under the call T19FJ. On her way home, her engineer became ill and was replaced by VE1AGM. He has been with her ever since. That fall she was assigned VEØMY, and with a KWM2 and 30L1 linear, she has become a familiar voice on the airwaves. She spends her summers cruising the waters of North America and the winters in the Caribbean. Hundreds of hams the world over have enjoyed a QSO with her. Every where she goes, she carries the pride of Nova Scotia—black hull, white sails, golden spars shining in the sunlight—the embodiment of grace and beauty.

This is, in a very brief way, something of the story of the VEØ ships. To anyone who loves ships and the sea, or has ever had the old dream of sailing away to far horizons, I hope it's been a little insight to the men and ships who put these calls on the air.

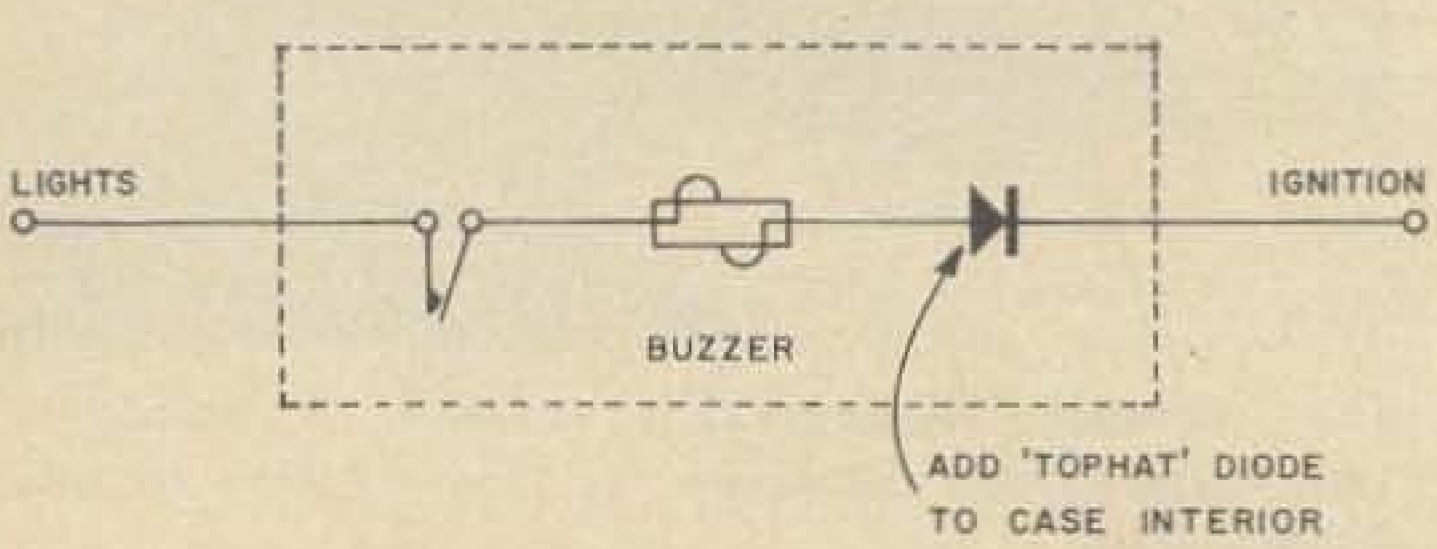
For their help and cooperation, I'd like to thank the people from Foundation Maritime Ltd., the Bedford Institute of Oceanography, the Navy's Atlantic Region Information Office, Oland and Son Ltd., R. W. McMilliams and VE1AGH, VE1AKO, VE1AX,, VE1FQ, VE1LZ, VE1PW and VE1PX. With their help and the memories of many hours in front of my own receiver, I've tried to take you aboard for just a few minutes. I hope it's been enjoyable.

. . . VE1TG

Auto Battery Saver

There are some pretty "kooky" circuits around, considering that they are often engineered for the sake of engineering rather than provide a most efficient means for doing a thing. Electronic gadgets that remind you of your headlights are in this category.

Try the one in the figure. The buzzer is a door buzzer, not a code practice buzzer whose voltage rating is too low for the purpose. The door buzzer is quite loud, too. You mobile hams won't mind building this very simple thing unless you are quite sure you never walk from your car with the lights on. Put the diode inside the buzzer case, put the whole thing in a "Baggy" to insulate it, and tape it to a cable under the dash. I hate to insult your intelligence but I'll tell you how it works anyway. If you have your headlamps or parking lamps on, and the ignition switch is off, there is a 12-volt difference at the ends of the series circuit and the buzzer sounds off; the diode is happy with the arrangement. If you leave the lights on and turn on the ignition, there is 12 volts at each end of the circuit and the buzzer shuts up. If you turn off the lights and leave the ignition on, the diode prevents operation of the lights or buzzer. The thing with the 12 volts at each end is called "inhibiting"; isn't that interesting?



For the "lamps" connection, tap into any of the instrument lamps since many cars permit these to be pulled out for access. For the "ignition" connection, tap into one of the ignition switch energized loads and these are most accessible at the fuse bank. You do have a fuse bank don't you?

. . . Ray Stellhorn WAØNEA

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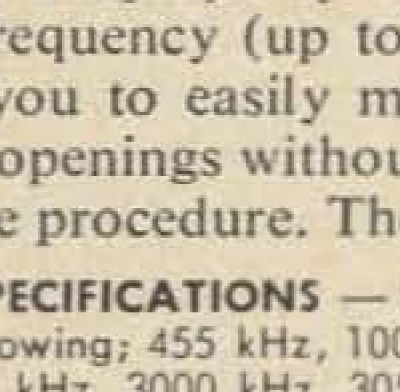
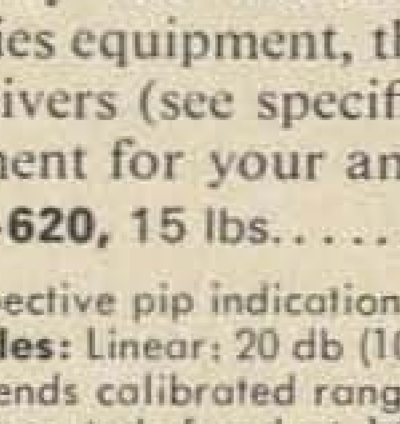


Analyzing Function — 10 kHz preset sweep width — indicate carrier 100% modulated by 2 kHz tone-log scale.



Scanning Function — approximately 250 kHz sweep width — indicates two signals above and three below the received signal, the strongest signal about 30 kHz down the band, down frequency being to the right.

The New Heathkit "Scanalyzer" Boasts Up To A Full 500 kHz Wideband Display — Plus 10 kHz Single-Signal Display. Displays up to 250 kHz either side of receiver tuned frequency (up to 100 kHz for 455 kHz IF's) . . . allows you to easily monitor band activity during contests or openings without going through the tedious hunt-and-tune procedure. The new SB-620 also brings accurate signal analysis to amateur radio . . . allows measurement of carrier, sideband, and distortion product suppression. A quality test instrument. Styled to match the Heath SB-Series equipment, the SB-620 operates with practically all receivers (see specifications). Here is a useful prestige instrument for your amateur station.

Kit SB-620, 15 lbs. **$119.95**

SB-620 SPECIFICATIONS — RF AMPLIFIER: Input frequencies: One of the following; 455 kHz, 1000 kHz, 1600 to 1680 kHz, 2075 kHz, 2215 kHz, 2445 kHz, 3000 kHz, 3055 kHz, 3395 kHz, 5000 to 6000 kHz. **Frequency response:** ±0.5 db at ±50 kHz from receiver IF. **IF frequency:** 350 kHz. **Sensitivity:** Approximately 10 uv input signal provides a visable signal (40 db mark) at full pip gain setting. **Spectrum analyzer:** Test signal input frequencies up to 50 MHz. **HORIZONTAL DEFLECTION: Horizontal sweep generator:** Sawtooth sweep produced by neon lamp relaxation oscillator. **Sweep Rate (Approximate frequencies):** 10 kHz preset: 0.5 Hz. 50 kHz preset; 2 Hz to 2.5 Hz. Variable: 5 Hz to 15 Hz. **Preset sweep width:** 10 kHz preset: 10 kHz. 50 kHz preset: 50 kHz. **Variable sweep width:*** 455 kHz (10 to 100 kHz); 1000 kHz (50 to 100 kHz); 1600 kHz (50 to 500 kHz); 1680 kHz (50 to 500 kHz); 2075 kHz (50 to 500 kHz); 2215 kHz (50 to 500 kHz); 2445 kHz (50 to 500 kHz); 3000 kHz (100 to 500 kHz); 3055 kHz (100 to 500 kHz); 3395 kHz (100 to 500 kHz); 5200 kHz (100 to 500 kHz); 6000 kHz (100 to 500 kHz). **Resolution:** 1 kHz. Note: Resolution is defined as the frequency separation between two equal adjacent signals such that the intersection between their respective pip indications is 30% below the apex amplitude. **Amplitude scales:** Linear: 20 db (10:1) range. Log: 40 db (100:1) range. —20 db Log: (Extends calibrated range to 60 db). **POWER SUPPLY: Type:** Transformer operated; fused at ½ ampere. **Low voltage:** Full-wave voltage doubler circuit, using four silicon diodes. **High voltage:** Full-wave voltage doubler circuit, using two seleium diodes. **Bias voltage:** Full-wave bridge circuit, using four silicon diodes. **Power requirements:** 120 or 240 volts AC, 50/60 Hz, 40 watts. **GENERAL: Tube complement:** (1) 3RP7 CRT, high persistance (yellow trace with screen filter). (1) 6AT6, detector vertical amplifier. (1) 6AU6, IF Log amplifier. (1) 6EA8, sweep oscillator, mixer. (1) 6EW6, RF amplifier. (1) 6EW6, IF amplifier. (1) 12AU7, horizontal, push-pull amplifier. **Diode complement:** (8) Silicon diodes, low voltage rectifier, DC filament rectifier. (2) Selenium diodes, high voltage rectifiers. (1) Silicon diode, voltage-variable capacitor. **Dimensions:** 10" W x 6⅝" H. x 10½" D.

*These sweep widths are minimum values. Actual sweep width ranges will be greater than those listed, depending on the receiver IF frequency for which unit is wired.

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World's Fair—1939

A look at the W2USA Radio Club at the New York World's Fair.

With Expo '67 in full swing, it's an opportune time to look at amateur radio participation at a similar event nearly thirty years ago. The W2USA Radio Club, under Managing Director W2DKJ, actually started operations in 1938, months before the New York World's Fair opened its gates. At this time operation from the fair grounds was limited to five meters—with a 400 watt phone rig and National 1-10 receiver donated to the cause by W2DKJ. The five-meter transmissions were picked up and relayed on all the other bands by other stations.

By the time the gates were opened there were complete stations on all bands from 160 through 5 meters. One of the high points occured on January 1, 1939, when a message from Grover Whalen, President of the New York World's Fair was put out—on the hour, every hour—for twenty-four hours on five meters. Within a short time after the first message was sent, a congratulatory reply was received from a Llama in Tibet.

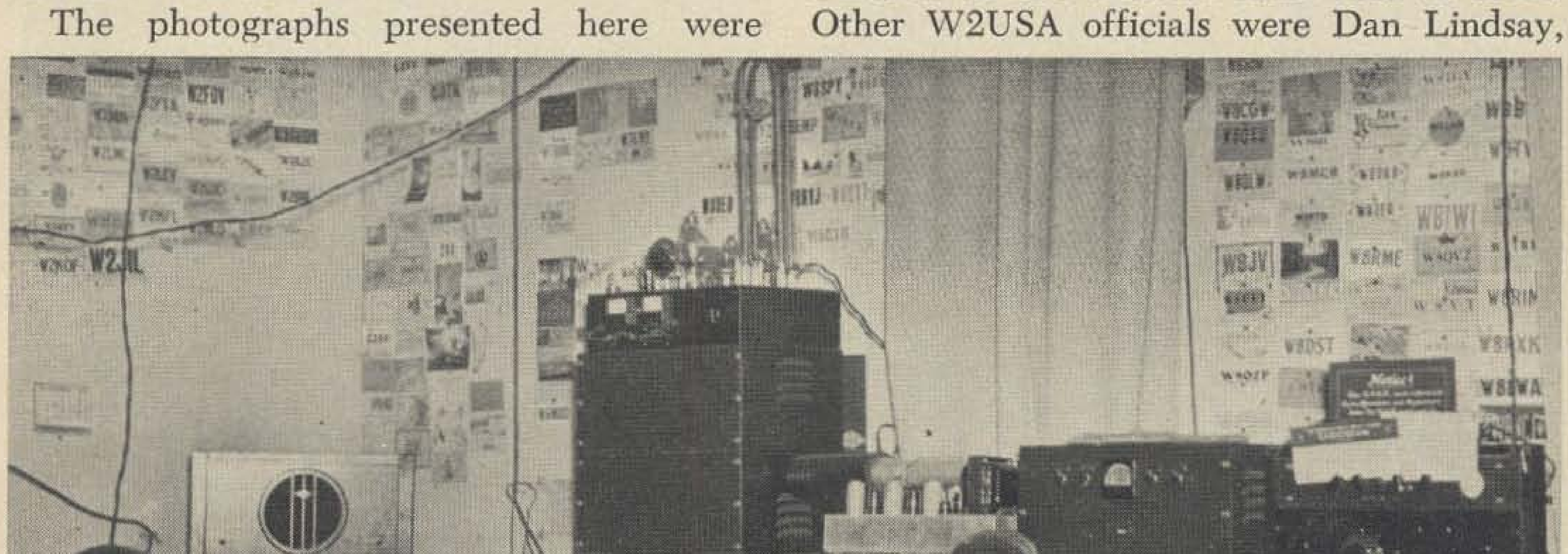
The "Forty Traffic System", FTS, originated by W2LSD, handled thousands of messages from fair visitors to all parts of the world. In addition to Nils Michaelson, W2LSD, Joe Meditz, W2CKQ, Dan Lindsay,

Kay Kibling, W2HXQ, secretary of the W2USA Radio Club, *mans* the 80 meter CW rig. This station consisted of a transmitter supplied by the Kenyon Transformer Company and a National receiver. Although Kenyon did not manufacture transmitters, several were made especially for W2USA. To Kay's right, Dan Lindsay, W2PL, has taken over the "Forty Traffic System", using one of the transmitters and receivers supplied by the National Company. Both these fine folks, Kay and Dan, were among the most active at W2USA. We are sorry to relate that both have become silent keys.

Many famous amateurs used the facilities at W2USA. Here Helen Leonard, W6QOG, and her husband Harry, W6MBD, of Los Angeles, are operating two of the complete stations. Helen is using the 10 meter phone station while Harry is busy at the 80 meter CW position.

W2PL, Kay Kibling, W2HXQ and many others put in many hours running the FTS station at W2USA.

The photographs presented here were made available through the kind assistance of Art Lynch, W4DKJ, who was Managing Director of the W2USA radio club in 1939. Other W2USA officials were Dan Lindsay,



Here Kay Kibling, W2HXQ, custodian of the W2USA license and Chief Hostess, is shown operating the 20-meter station. This position consisted of the national HRO receiver shown here and a glass-enclosed National NC-600 transmitter which is out of the picture to the left. The heavy wires running up the walls are actually the solid number 12 electric light wires used for lead-ins from the antennas, including the one on five meters. Some of these feedlines were several hundred feet long, much to the dismay of some engineers! The gentleman at the 40 meter station to Kay's right is Joe Meditz, W2CKQ.

There were more cards on this section of the wall than anywhere else in the W2USA shack—right above the 75 meter phone rig. At first the cards were displayed by district, but as the QSL's accumulated,

Actually, operation of the amateur station at the New York World's Fair began in 1938, long before the fair opened. At this time all transmissions from W2USA were sent out on five meters and picked up and relayed by other stations on all the other bands. Here Ed Dunn, W2ETD, is operating the 400 watt five-meter phone station donated by W2DKJ. Directly in front of Ed is the Hallicrafters 5-10 receiver and National speech amplifier. The five-meter antenna was an extended double Zep, designed by Frank Lester, W2AMJ, and fed with a long hunk of electric light wire. Note the great number of QSL cards from the 8th district which acknowledged the 5-meter transmissions—either direct or by relay.

Every Friday evening at eight a broadcast of amateur radio activity at the fair, as well as throughout the country, was put out by Art Lynch, W2DKJ, Managing Director of the W2USA Radio Club. In addition to going out from all the W2USA phone transmitters at the fair grounds, it was picked up by many other stations and sent out automatically on a network which gave W2USA world-wide coverage. Six transmitters were in simultaneous use during these broadcasts as may be observed from the number of microphones. The photos in this flash-back to the W2USA operation at the New York World's Fair were made available through the kind assistance of Art, who is presently W4DKJ in Florida.

they were mounted near the equipment to which they responded. It would be interesting to know if anyone has a duplicate of one of these cards.

On New Year's Day, 1939, the famous "round-the-world round-the-clock" message from Grover Whalen, president of the New York World's Fair 1939, was put out on five meters, every hour, on the hour for twenty-four hours. Within a short time after the first message was sent, a congratulatory reply was received from a Llama priest in far-off Tibet. The original message was recorded under the personal direction of Harvey Simpson, president of Harvey Radio Corporation, with equipment loaned by him. This equipment, nearly as good as new, is presently in the archives of W4DKJ.

To the right in this photograph Bert Uthe, W2JZO, is operating the 160 meter station. Bert, who was Assistant Chief Operator and Host at W2USA, put in many hours of operating, entertaining visitors, and making some remarkable photographs. The 160 meter station—a Kenyon transmitter and RCA AR-77 receiver—was operated a large part of the time by Robert Gunderson, W2JIO, famous for his work at the New York Institute of the Blind and in providing technical information to other blind amateurs through Braille.

George Bailey, K1KH, then Vice President, ARRL, was a frequent visitor to W2USA and always had a message for the Friday night broadcasts. Behind him "Tubby" Smith, Vice Director of the Hudson Division, watches the meters on the glass-enclosed National NC-600 20-meter transmitter. Standing are Dr. A. L. Walsh, W2BW, of the W2USA Radio Club and Dan Lindsay, W2PL.

W2PL, Assistant Manager; Oscar Oehman, W2KU, Chief Operator and Official Host; Bert Uthe, W2JZO, Assistant Chief Operator; Stanley McMinn, W2WD, Official Photographer and responsible for many of the fine photos presented here; and Kay Kibling, W2HXQ, Secretary, Chief Hostess and custodian of the W2USA license.

Nils Michaelson, W2LSD, originator of FTS, the "Forty Traffic System", is in the foreground with two of his crack operators behind him. FTS did a masterful job of handling messages from visitors to their home folks throughout this country and overseas. ■

Robert Hillman VE7BBM
2125 Bridgeman Avenue
North Vancouver, British Columbia

Plain Ground Plane Antenna

For effectiveness and low cost, it's hard to beat the ground plane antenna.

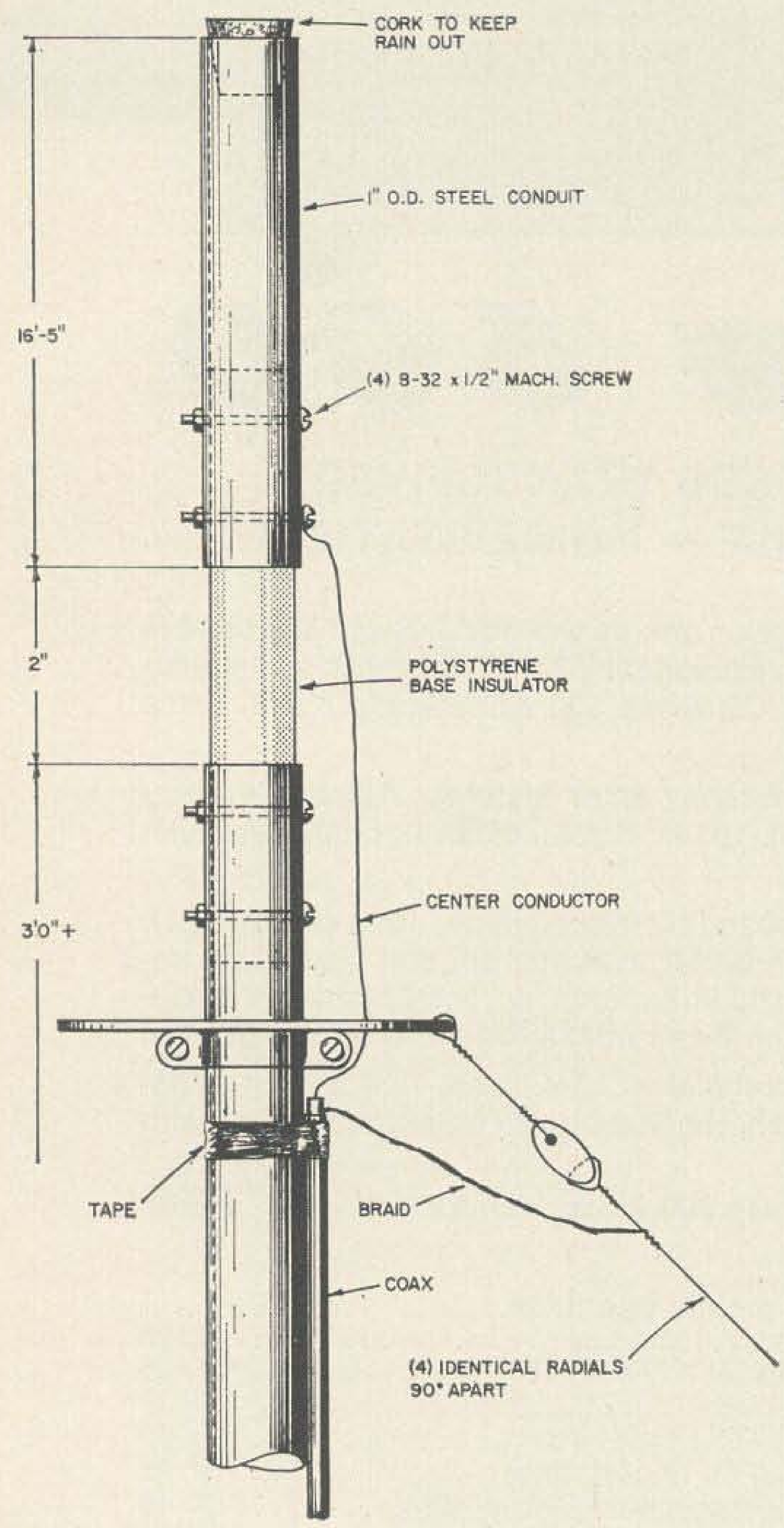


Fig. 1. Construction of the twenty-meter ground-plane antenna. The polystyrene base insulator has proven to be very strong and has held up under all extremes of weather.

The tremendous number of stations now on 20 makes working DX, at best, difficult. Under these conditions, an effective antenna is a must. A rhombic is ideal if you have several empty acres out back. A 2, 3, or 4 element parasitic beam works well too if you have the time, money and patience to install it and its companion rotator. However, thanks to the ground plane, all is not lost. The ground plane is simple, inexpensive, good looking, and best of all, effective. Any of the handbooks will tell you that this effectiveness comes from the ground plane's low angle of radiation.

Probably the main reason for the lack of homebrew ground planes is the problem of insulating the vertical radiator from the support section. The insulator must provide mechanical rigidity if the ground plane is to be mounted on a standard TV mast or similar. These problems can be simply cured by insulating the support mast from the vertical radiator with a 12 inch piece of polystyrene rod. Referring to **Fig. 1**, this rod is inserted into both support and radiator to a depth of about 5 inches. If polystyrene rod is not available, wood doweling can be suitably varnished and substituted. Since the base of the ground plane is at a low impedance point, the wood, even when covered with condensation, will perform quite adequately. If you doubt the mechanical strength of either material, try breaking it over your knee.

Two lengths of 1 inch OD conduit were used as both the supporting section and the vertical radiator. No dimensions are given since it is a simple matter to insert the design frequency in the following formulae:

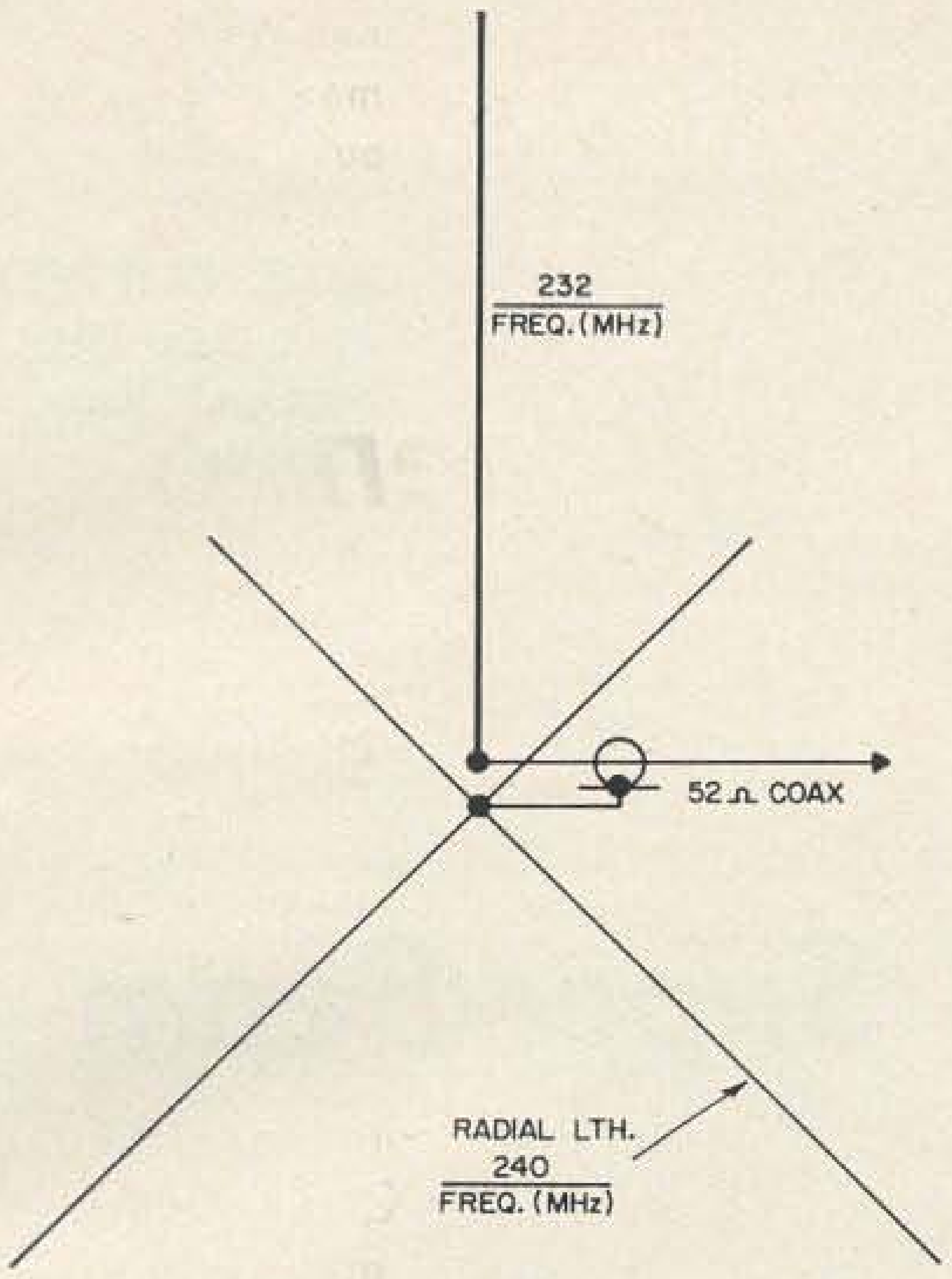


Fig. 2. Electrical layout of the ground-plane antenna. All dimensions are in feet. The match to 52 ohm coaxial line can be improved by letting the radials droop slightly.

$$\text{Length of radiator} = \frac{232}{\text{Freq MHz}}$$

$$\text{Length of radials} = \frac{240}{\text{Freq MHz}}$$

All measurements from the above formulae will be in feet. While the 1 inch OD steel conduit stands approximately 17 feet unguyed, it has shown no signs of falling in winds of up to 40 mph. However, if 1 inch OD aluminum tubing were used, the weight would be considerably reduced, and consequently reduce strain on the base insulator. As far as the cost goes, the installation cannot be beat, since the entire structure, complete, except for feedline, comes to less than $10.00. The antenna should be fed with 52 ohm coaxial cable.

Having never enjoyed the advantage of a really effective antenna at this QTH helped in evaluating this antenna. Previously a 40 meter dipole and a G5RV-multiband flattop were used with poor results, mainly on 20. However, upon completion of the ground plane, 10 new countries were quickly worked. I now have the immense pleasure of working almost every DX station that I call. Sample reports are: DU7SV 599, UA4KYA 579, VK5EH 579, and VR4CV 589. The rig here uses a single 6146 at all times, running about 90 watts. Interestingly enough, the antenna will fit the upper level of most average sized split-level dwellings. See you on 20 CW.

. . . VE7BBM

A. E. Blick VE3AHU
P.O. Box 204
Amherst View, Ontario
Canada

The Hybrid G4ZU Super-Beam

A new construction approach to the famous G4ZU three-band beam.

Any ham who has built and used the G4ZU mini–or super-beam*, knows the advantages of these antennas–cheap, light, readily tuned elements and 20-15-10 meter operation. The disadvantages–special clamps, insulators, and feeding problems.

First, a re-cap of the G4ZU element tuning principle (see **Fig. 1**). AB and CD are two lengths of aluminum tubing arranged in dipole fashion and insulated from each other. The lengths are such that, if B and C were joined together, AD would be a half-wave on 15 meters. The problem of electrically joining BC together, but only on 15 meters, is readily done by inserting a quarter-wave open stub across the two points. On 20 meters this stub appears as a small capacitive reactance, on 10 meters as a small inductive reactance. AD can be electrically lengthened on 20 meters by adding a small closed stub across BC and adjusting its length for resonance; this will also give (almost) a resonant fullwave length on 10 meters.

The original G4ZU mini-beam employed this method of tuning and automatically switching. A director was used as a half-wave element on 10 and 15 meters and a full-wave element on 10 meters. The driven element consisted of a 15 meter dipole, centre fed by 300 ohm twin-lead or 450 ohm open-wire line. A special antenna coupler was inserted an electrical half-wave on 20 meters from the element and this was coax fed from the transmitter. This minibeam's performance and spacing is outlined in **Table 1.**

The super-beam was an attempt to improve performance on all bands, especially on 20 meters, and it certainly succeeded. It's detail is also found in **Table 1** and this is the beam used for the constructional details to follow.

To construct this antenna, a twin boom is used with the quarter-wave stubs made from 300 ohm twin-lead and inserted inside the boom, centrally locating them by use of corks or plastic inserts and using the boom elements as the tuned shorting stubs, (**Fig. 1**). This method of stub loading works very well for the passive elements but is not suitable for the driven element. The original design used a 24′ driven element fed at the centre by balanced line through an antenna coupler. This method works, but the difficulties of rotating the beam and the constant manipulation of the controls in the coupler for changes in frequency or weather led to a search for a better method. G4ZU had suggested a trap-loaded, coax-fed

*CQ, March 1957 and August 1958.

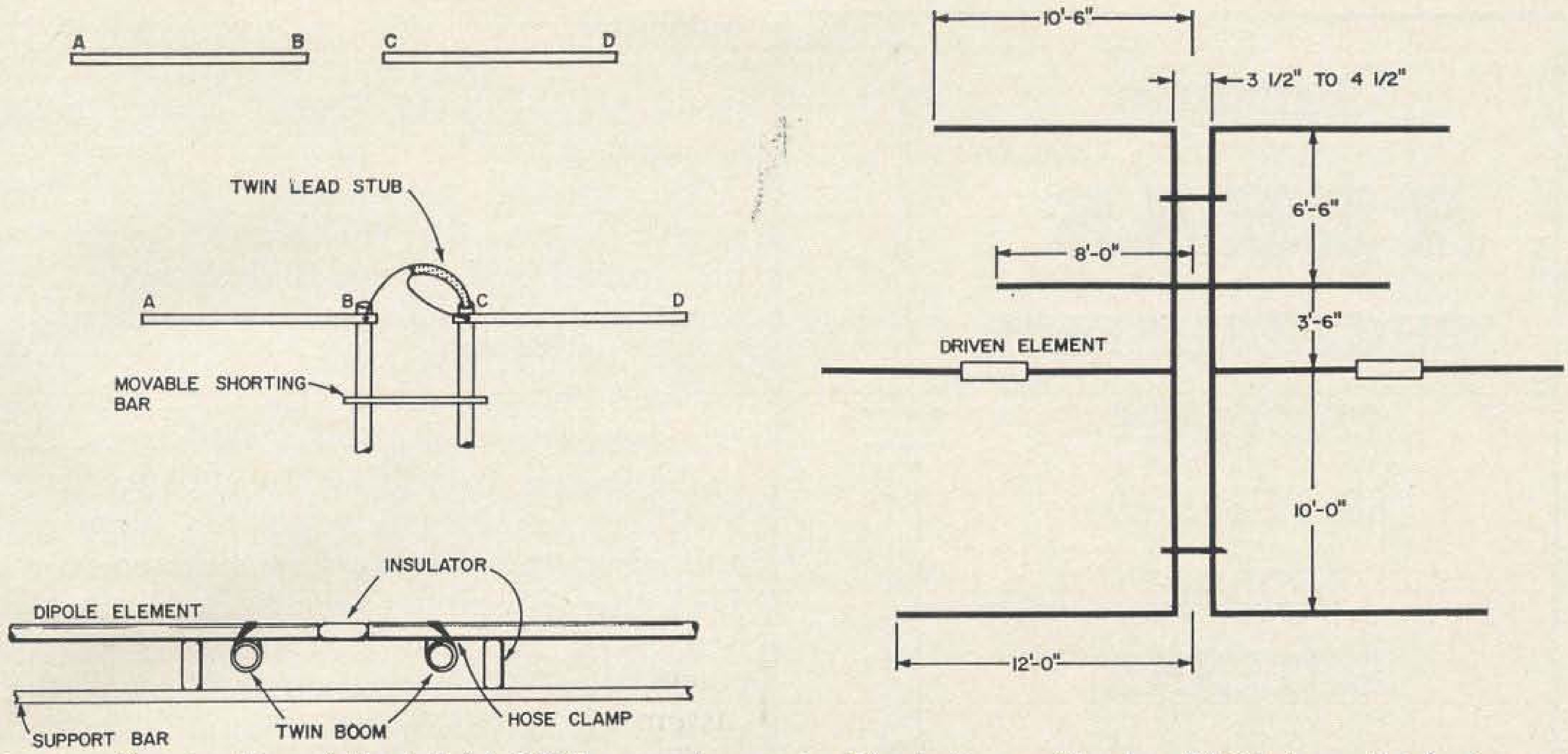


Fig. 1. Construction of the hybrid G4ZU super-beam. In this design a Moseley TA-31 trap dipole is used as the driven element.

driven element might be suitable, so one was built and tried. This idea worked but, with home-brew construction techniques, was not mechanically strong and suffered from weather effects. Digging into the catalogues provided the answer—the Moseley TA-31 trap dipole. The results obtained proved the value of this investment.

The completed beam has the configuration shown in **Fig. 1.** Note the *extra* 10 meter director. The passive elements are made from ¾″ OD aluminum tubing with 24″ end inserts of ⅝″ tubing for length adjustment. The outer tubing is notched with a hacksaw for approximately 1″ and stainless steel hose clamps are used to hold the two pieces firmly together once the tuning has been completed. Large stainless steel clamps are also used to hold the passive elements to the twin boom, see **Fig. 1.** One clamp per element is satisfactory (mine has withstood heavy icing and winds up to 60 mph), but two, arranged in "X" fashion will add more strength. These clamps are readily available. from auto supply houses (gear-type hose clamps, price 20 to 50 cents). The elements are reinforced with an additional 5′ length of ¾″ tubing insulated from the element and positioned under the boom. Any good grade of plastic insulation can be used—I prefer nylon rod for its extra strength and easier working.

To attach the boom to a mast, use a piece of ¼″ aluminum plate, 8″ x 8″, drilled and attached to the boom by four TV U-clamps. Bolt a six inch piece of 4″×4″ (or 6″×6″) steel angle to the aluminum plate, using ⅜″ cadmium-plated, flat-head, counter-sunk machine screws, and drill the angle bracket for two TV U-clamps so that the top of the

Band	Reflector Spacing	Director Spacing	Comparable to
Mini-beam			
20M	0.1		2 element narrow spaced beam
15M	0.15	0.1	3 element beam
10M	0.2	0.15	5 element beam
Super-beam			
20M	0.15	0.15	3 element beam
15M	0.2	0.2	3 element wide spaced beam
10M	0.3	0.1	
		0.3	6 element wide spaced beam

Table 1. Performance comparison between the G4ZU mini-beam and super-beam.

supporting mast will end up against the steel angle. Plate all steel parts or give them two coats of porch enamel before assembling.

The tune-up procedure is simple. Erect a stub mast so that the beam is parallel to the ground and about 10 feet high. Feed about five watts into the antenna through a length of 52 ohm coax, and pick up the radiated energy with a field strength meter or receiver located at least 120′ away. Start on 15 meters and adjust the director length for maximum output; rotate the beam 180° and adjust the reflector for minimum output. Lock the adjustable element lengths in place and check the twin-lead stubs by shorting across them when tune-up is finished—there should be no change in output. Tune the director and reflector on 20 meters by adjusting the shorting bars on the boom and lock in place. Tune the extra 10 meter director length and position for maximum output. Attach a small tuning capacitor, 50 pF, across the tri-band director and tune for maximum output.

Permanently weatherproof and install the variable capacitor or replace it with a fixed capacitor (two concentric lengths of aluminum tubing separated by polystyrene sleeving). If the additional gain and front-to-back ratio is small, forget the whole thing! Note: if more than about 20 pF must be added, recheck the director tuning on 15 and 20 meters.

Useful information: all stubs are made from 300 ohm ribbon. The director stub is resonant between 22 and 23 MHz, approximately nine feet long. The reflector stub is resonant between 19 and 20 MHz, approximately ten feet long. Shorting bar settings on the twin boom: director—30 to 40 inches; reflectors—35 to 45 inches. The twim boom uses 1½″ to 2″ diameter tubing with 3½″ to 4½″ centre-to-centre spacing. Follow the instructions given for the TA-31 dipole regarding method and type of feed and liberally coat all fittings with the liquid plastic supplied.

Two beams of this construction are in use in the Kingston area, mine and 3C3EME's. Judging from the reports and comments received over the air, the beams are performing very well. Performance on 20 meters is as good as any 3 element trap beam. On 15 meters it out-performs the trap type of beam and on 10 meters it is in a class by itself.

. . . VE3AHU

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Pictures courtesy of:
Capt. Thomas Polloc KH6BXS/4, NØRUH

An Economical Slow-Scan Television Monitor

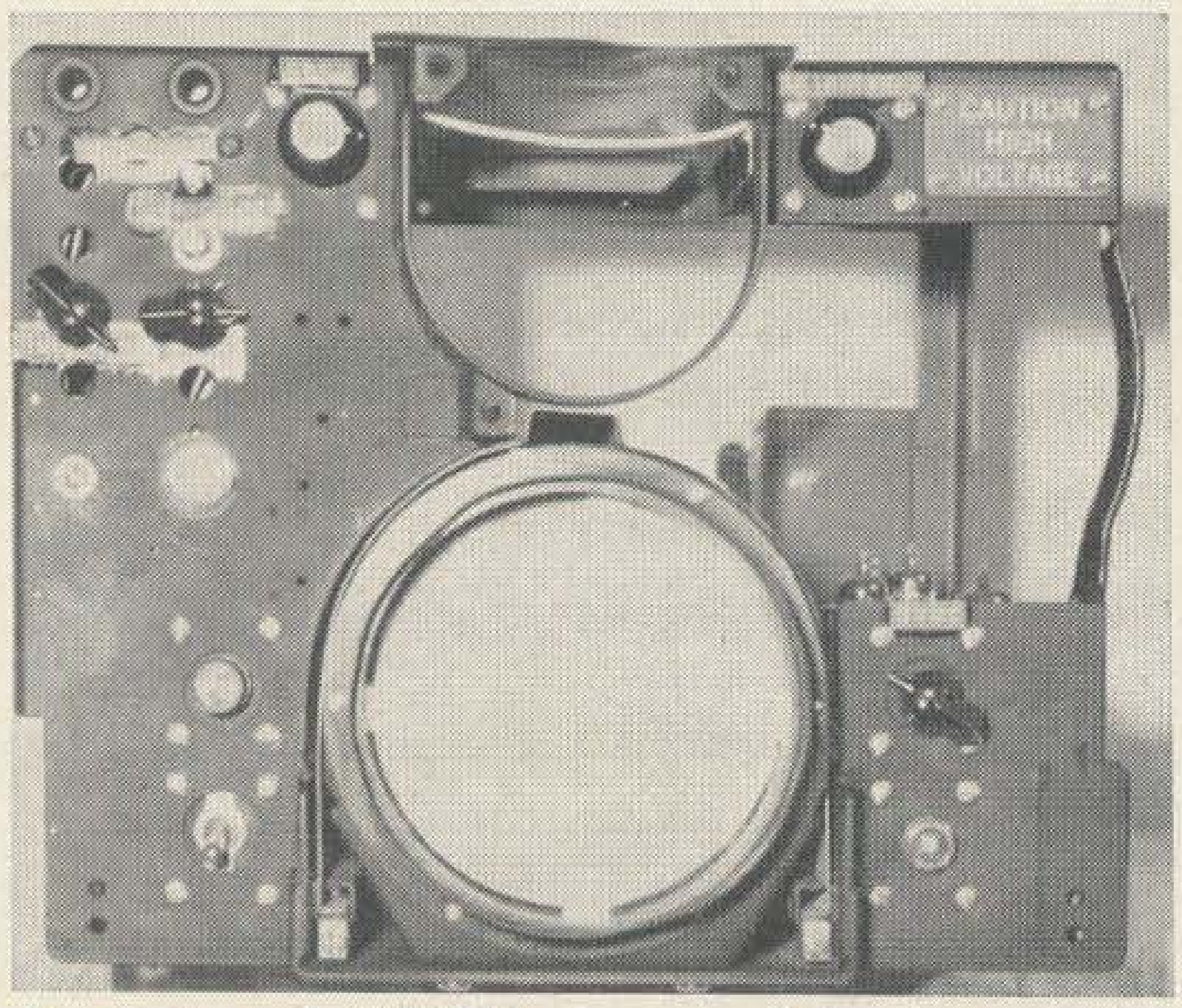
The recent upsurge in slow-scan television activity presents the amateur with increased opportunities for experimentation in this mode. In addition to the Navy MARS SSTV nets (6970 kHz; 1700 EST Sunday, and 2200 EST Tuesday) and the Slow-scan Information Net (14265 or 21425 kHz, 1400 EST Saturday), twelve US amateurs are now authorized to exchange SSTV pictures with KC4USV, McMurdo Sound, Antarctica, on the 7, 14 and 21 MHz phone bands.

Perhaps the best way to enter the SSTV field is to construct a monitor. An excellent construction article for a monitor has appeared in *QST** and several amateurs have built this unit. However, the cost of components, as well as the trouble in locating them, has undoubtedly dissuaded many—it is for this group that this article is written. Using readily available surplus components, and following the hints given here, it is possible to construct a reduced-cost subcarrier FM monitor. And though somewhat heavy, and by no means a winner in the "looks" department, the unit, which closely follows WA2BCW's circuit design, is capable of producing high-quality slow-scan TV pictures.

The monitor described here uses components from a PPI Range Indicator for the T-9 Tracker Radar Set An/GPG-1. This indicator, available from Fair Radio Sales, provides a wealth of components:

Punched steel chassis and front panel
5ADP7 CRT, socket, shield and mounting hardware.

* "A Compact Slow-Scan TV Monitor," WA2BCW, *QST*, March, 1964.



Front view of W9VZL's slow-scan television monitor. For location of the controls shown in this photo, refer to Fig. 1.

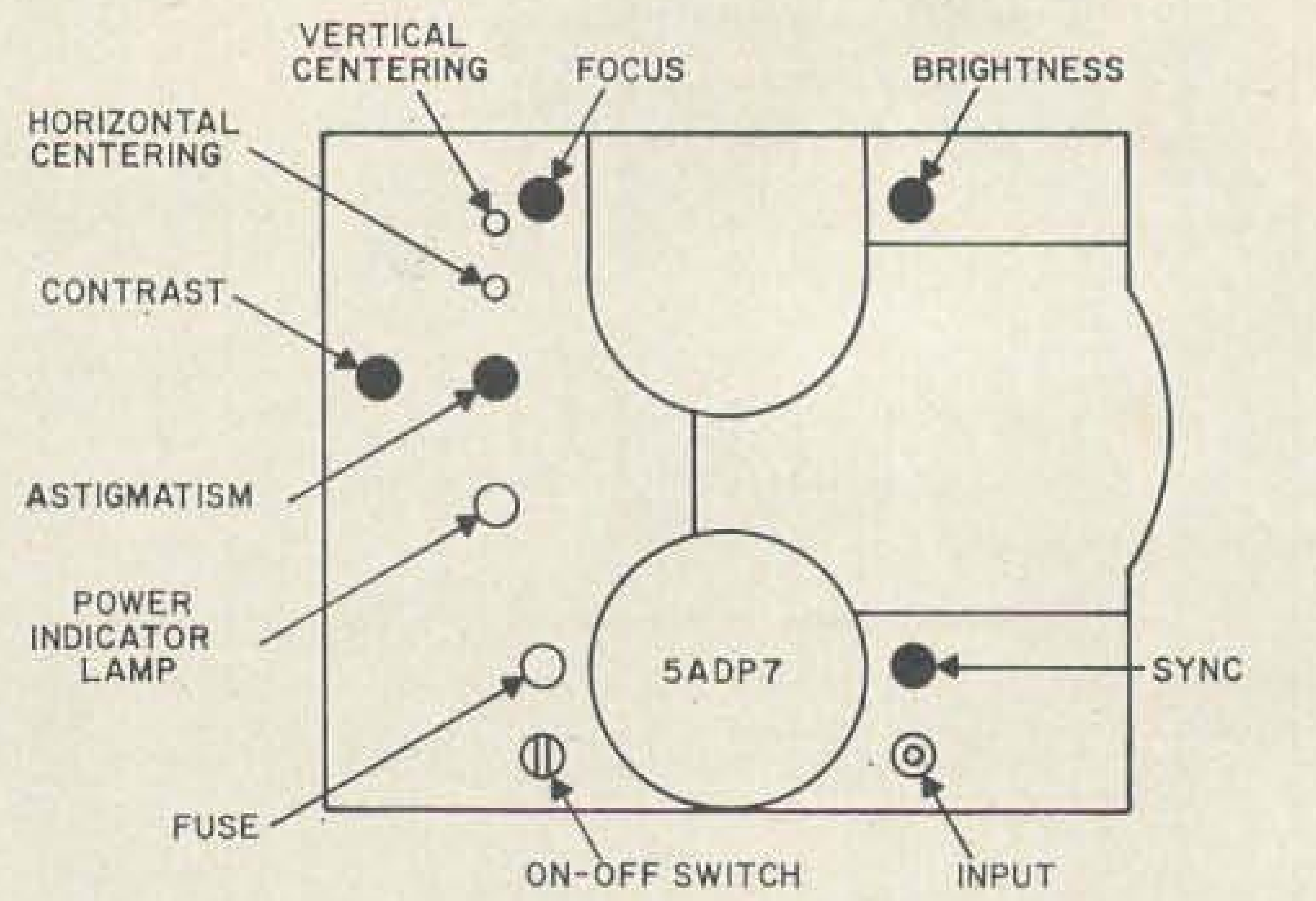


Fig. 1. Front view of the slow-scan TV monitor. This drawing shows the location of the various controls.

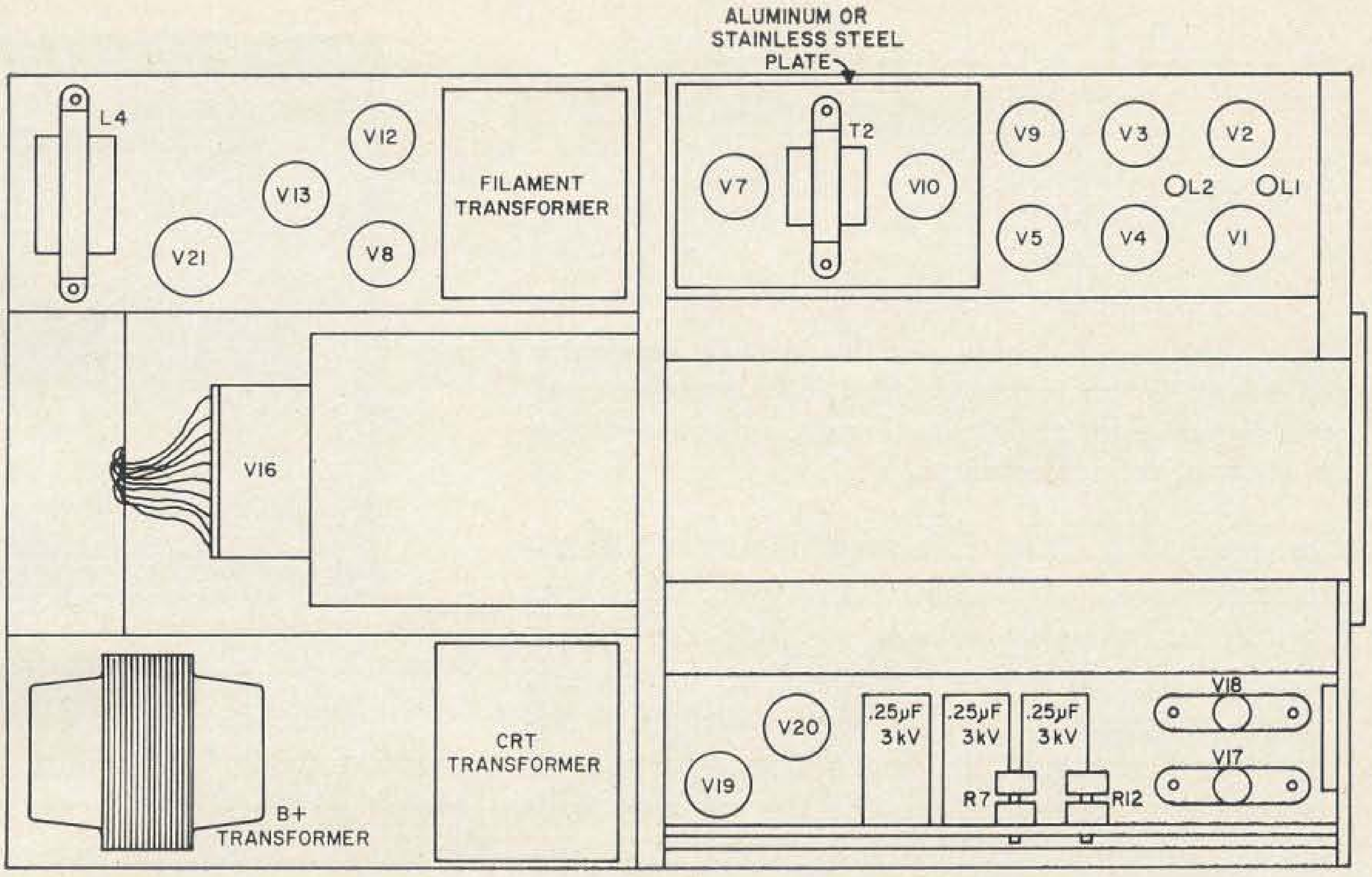


Fig. 2. Chassis layout of the slow-scan television monitor built from a surplus PPI Range Indicator. Existing chassis holes were used where possible.

CRT and filament transformers.
High-voltage rectifier sockets and plate clamps.
Oil-filled capacitors for the CRT supply.
Fiber mounting boards.
7- and 9-pin miniature tube sockets.
6J6 Tubes.
Pots, including those used for the focus and brightness controls, together with their fiber enclosures for HV insulation.
Miscellaneous resistors.
High voltage wire.
High voltage standoffs.
Miscellaneous machine screws, nuts, washers.
Fibre boards for buttom protection.

The chassis measures 13 x 11 x 24 inches and provides just enough room for construction of the monitor. When ordering the PP1 unit, it might be a good idea to include a note, cautioning Fair to check that the CRT in your indicator is the 5ADP7—about 1 in 10 of these units contains the 5SP7 CRT, which is of no use here.

No attempt is made to use any of the circuitry in the PP1; the entire unit is stripped prior to construction of the monitor. Starting on top of the chassis, carefully remove the 5ADP7 CRT and its shield. Also revove all front-panel components (save the **danger** plate and the small bracket which mounts behind the left side of the front panel); the 3JPI, its socket, associated gears and front-mounting hardware; all tubes; the front-most .25 µF, 3000 volt capacitor; and

The PP1 Range Indicator for the T-9 Tracker Radar Set AN GPG-1 is available for $24.95 plus postage from Fair Radio Sales Co., P.O. Box 1105, Lima, Ohio 45802.

Right side of the slow-scan TV monitor. The limiters, sync circuitry, horizontal trigger and vertical trigger are located toward the front of the chassis. The horizontal and vertical amplifiers and video amplifier are at the rear of the chassis just in front of the 5U4G rectifier.

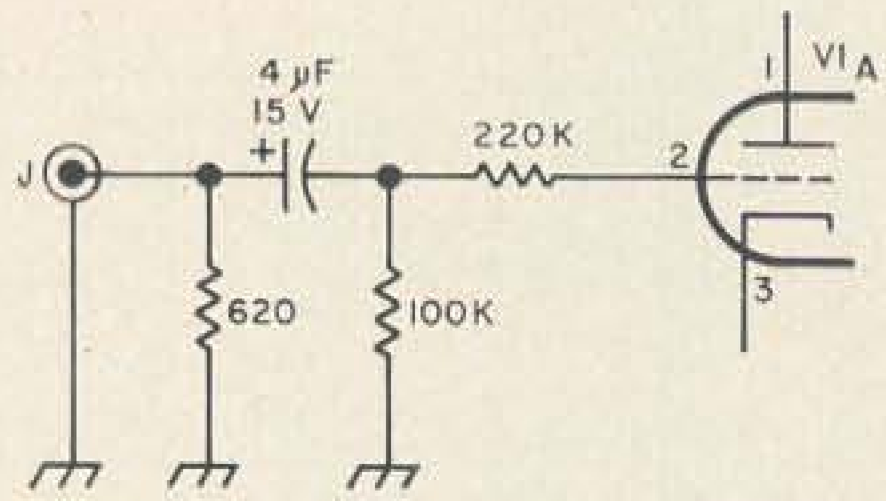


Fig. 3. This input circuit used by W9VZL eliminates the necessity for a transformer, and performs well with signals from a vidicon camera, a tape recorder or communications receiver.

the dual 6.3 Vac, 1.2 amp filament transformer (No. 7629809). Remove the two hinged subchassis which mount on either side of the indicator. Strip the subchassis which mounts over the high voltage rectifiers, and remount it. With the addition of the perforated board on the top of this subchassis, some protection from the CRT supply is afforded; additionally, this subchassis will serve as a mount for the vertical and horizontal size controls. Leave the socket for the 5ADP7 intact with sufficiently long leads for subsequent wiring.

Under the chassis, carefully remove all mounting boards, components, and hardware. Cut the high voltage wires as long as possible so that they may be used again. Once the fiber mounting boards are stripped of components (be careful not to break the soldering pins off), these boards can be remounted. All tube sockets, with the exception of the CRT HV rectifier sockets, should also be removed.

With the chassis stripped down, it can now be painted. The front and side panels on the author's unit, for example, were

Video reception on the slow-scan monitor. This frame is of a test slide and was taken from a tape recording.

painted with *Krylon* flat black spray enamel. Make certain all parts to be painted are clean and dry. Some of the areas to be painted may require sandpapering to remove taped labels.

With the exception of circuit details described below, the circuit for the monitor is the same as that designed and described by WA2BCW. Though no unique mounting scheme exists, that shown in **Fig. 1** and **2** is recommended. Following the layout shown assures maximum utilization of holes which already exist in the chassis—and with a ⅛ inch steel chassis, this is important. Some drilling, punching and reaming is necessary, however, so be prepared for a blister or two, as well as a dulled hole punch.

Prior to considering some circuit modifications in detail, a cross reference of major components is presented (**Table 1**). This list is included not so much in the interest of saving money, but to give the amateur a quick reference to parts he or his supplier might have. The list is not complete, and some may wish to further consult the cross reference sections of their supplier's catalogs.

Now for those circuit modifications. As the discussion proceeds, it would do well to have a copy of WA2BCW's article for reference.

Limiter and sync section

Since, in almost all cases, at least 0.1 volt of signal is available, and if one is careful to stay away from circuits carrying dc, the input transformer, T1, can be eliminated. In its place, the circuit shown in **Fig. 3** is suggested. Note that the input is now single-ended; this, however, presents no problems, whether the signal is derived from a SS vidicon camera, a tape recorder, or a com-

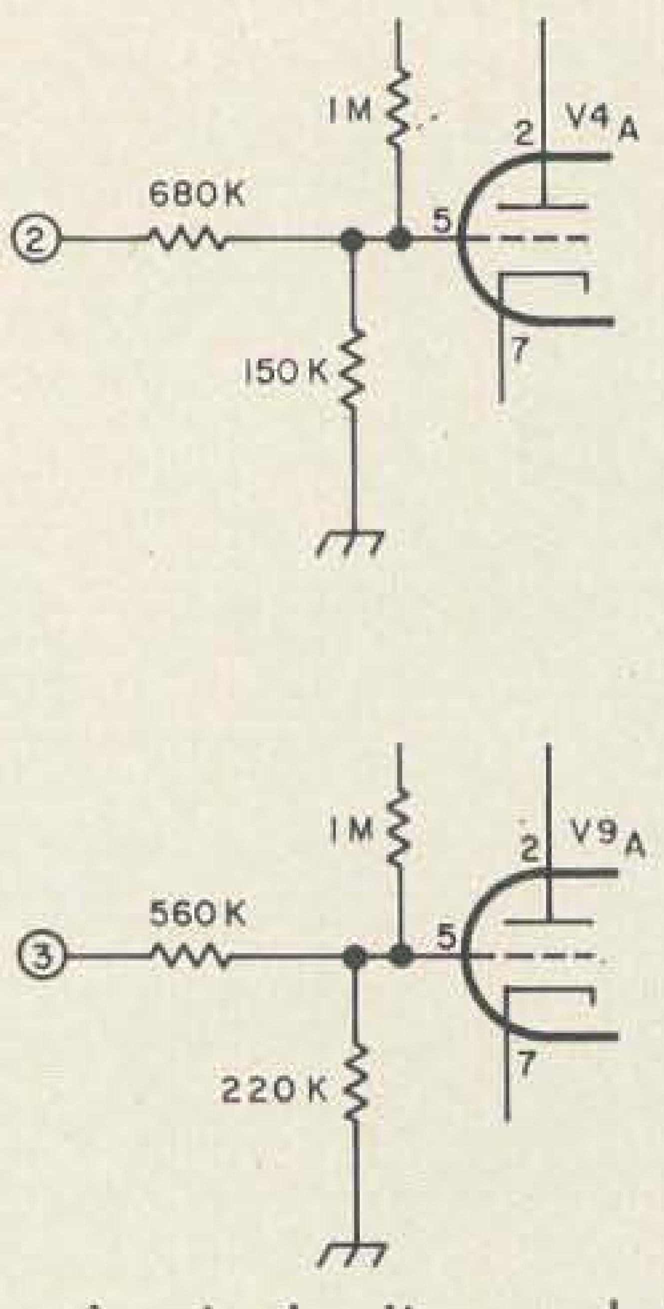


Fig. 4. Trigger input circuitry used by W9VZL in his slow-scan television monitor.

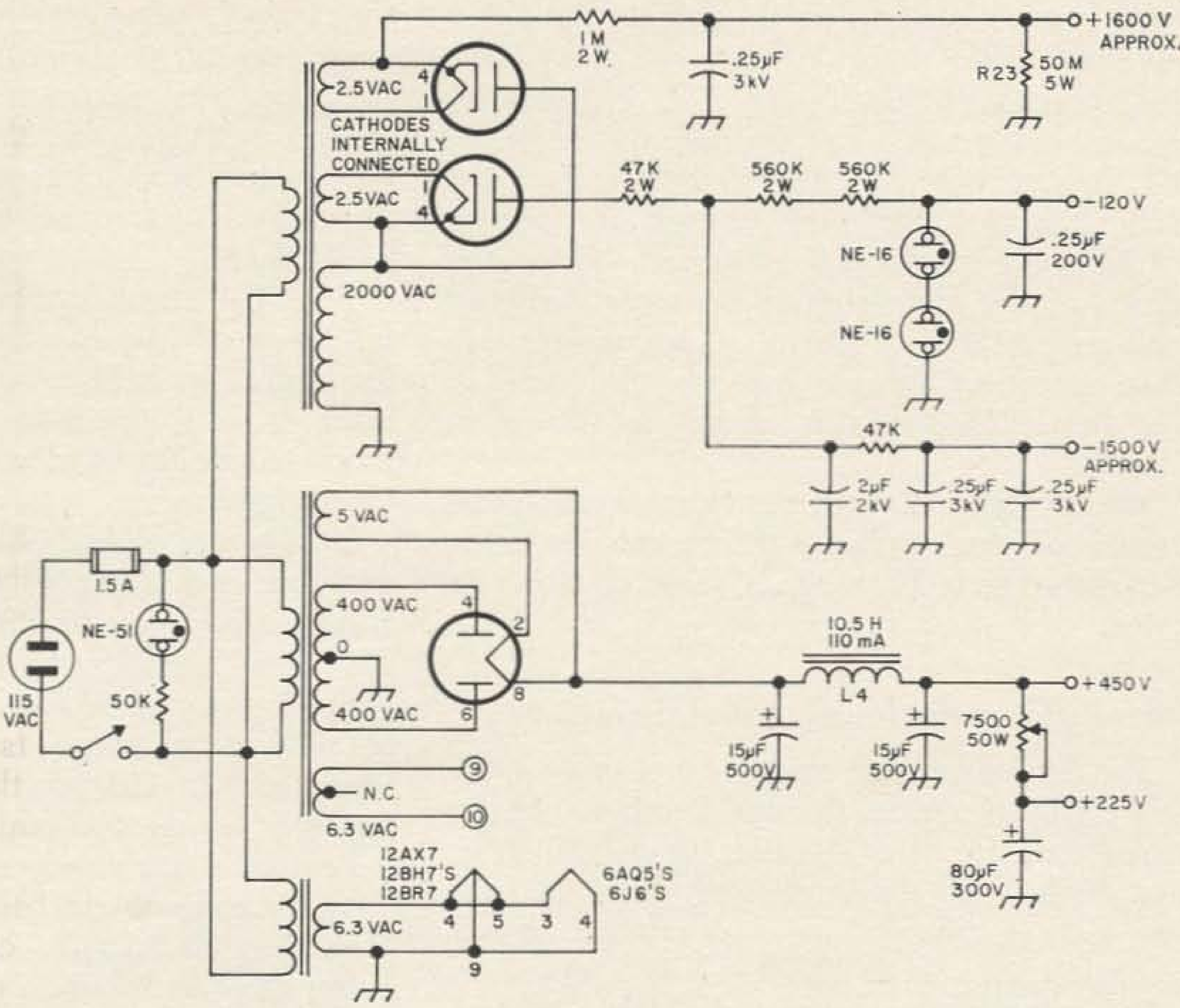


Fig. 5. Power supply for the PPI Range Indicator slow-scan television monitor. This design is based on the use of parts from the surplus unit.

munications receiver.

It is also to be noted that only L1 should have its slug fully inserted (approximately 200 millihenrys); L2 should be set at about 84 millihenrys.

Vertical and horizontal deflection circuits

One of the problems encountered in operating the monitor is that of obtaining positive tracking of the trigger circuit; that is, in obtaining a range of settings for R1 (sync) over which the horizontal and vertical trigger ranges overlap. This problem could have been circumvented by using precision components, but even WA2BCW chose not to do this. Instead, the values of resistors R4 (horizontal trigger input) and R9 (vertical trigger input) were varied until proper track-

Part and WA2BCW's No.	Part Suggested	Part Used	Other
L1, L2 45-215 mh	Stancor WC-14	Miller 6330	
L3 10 hy	Thordarson 20C52	Thordarson 20C52	
L4 10.5 hy, 110 ma	Standor C-1001	Stancor C-1001	Knight 54D2139
T1 600 ohm line-to-grid	UTC A-12	None	Stancor WF-22 Thordarson 25A18
T2 Audio PP plate to PP Grid; 3:1 Sec. to Pri.	Thordarson 20A19	Stancor A63C	Knight 54D1460 Thordarson 20A93
T3, T4 Universal audio output	Thordarson 24S60	Stancor A3856	Knight 54D2023 Triad S-51X
T5 CRT and B+	Triad R-41C	PPI CRT Xfmr and Stancor PC-8412	Thordarson 24R75 PPI CRT Xfmr and Stancor P-6143
T6 6.3 VAC, 6 Amp. filament	Stancor P-3064	PPI Xfmr	Knight 54D2325 Thordarson 21F72

Note: Knight numbers are from Allied's Industrial Catalog No. 670. Units shown in the "Other" column are cross-referenced equivalents; though the author has no knowledge of them ever having been used in the monitor's circuit, all should be satisfactory.

Table 1. Major Component Cross Reference

put) were varied until proper tracking was obtained. Alternatively, as was done in the author's unit, pots (250 K) can be placed between pin 5 of the horizontal trigger (V4) and ground, and between pin 5 of the vertical trigger (V9) and ground, and varied until proper tracking is obtained. Then, the values of the pots should be measured and replaced with fixed ½-watt resistors. If available, a resistor decade box may be used in this step. The author's circuit is shown in **Fig.** 4.

The 50 meg, 2 watt resistors in the plate circuits of the discharge tubes can be made by wiring five 10 meg, ½ watt resistors in series.

Video and cathode-ray tube circuits

The less expensive and more readily available 2C6OH diode (Sarkes-Tarzian) can be substituted for the 1N1224 diode. Actually, any diode with minimum ratings of 100 piv and 50 mA average forward current should be satisfactory (i.e. 1N38, 1N39B, etc.).

Referring to the focus and brightness controls, these pots, both 1 meg, are obtained from the PP1, as are their fiber enclosures and shaft extensions. Place a 1 meg, 2 watt resistor across the terminals of the brightness control to bring the series resistance of this circuit element down to the required 500 K ohms.

Power supply circuits

Of all the circuits, the power supplies as described by WA2BCW underwent the greatest alteration. The circuit employing the PP1 transformers is shown in **Fig. 5** The CRT voltages shown are approximate; slight adjustments of series resistors may be necessary to obtain sufficient brightness. As for the B+ voltages, the 10% reduction in the author's unit had no adverse affect on operation. All .25 μF, 3000 volt capacitors are those which came with the PP1. Large resistors, such as R23 (50 meg) and the 1 meg, 10 watt dropping resistor were made up of combinations of other values (e.g., use two 20 meg, 2 watt and one 10 meg, 1 watt resistors in series for R23). The fuse value was changed to 1½ amp after the circuit was found to draw about 1 amp under load.

The B+ transformer is mounted to the left rear of the chassis, using but three of its mounting holes. The fourth hole is not used so as to facilitate mounting the 2 μF, 2 kV capacitor under the chassis, beneath the transformer.

Following WA2BCW's construction suggestions and those presented in this article should allow you to construct an economical slow-scan monitor capable of producing excellent pictures. However, as with any piece of new gear, some initial adjustments are required. To aid in these adjustments, it is strongly suggested that the builder have access to a tape recording of SSTV signals. Tape recordings can be made using on-the-air transmissions simply by recording directly from the headphone jack of a communications receiver. Most any audio-type tape recorder can be used for this purpose, though to date, only capstan-drive recorders have been used (it would be interesting to see if battery-driven types with zener regulated power supplies will prove satisfactory). Recording speeds of 3¾ and 7½ ips are preferred. As most SSTV signals are transmitted on ssb, care must be taken in adjusting the carrier-insertion frequency. For the initial recording, the ssb signal should be tuned to produce the most natural sounding voice reception. In making subsequent recordings, visual and aural monitoring at the same time the recording is made will enable you to make fine-tuning adjustments on the receiver.

Finally, the author would be most interested in corresponding with others who are interested in SSTV and have built, or are building, equipment for this mode.

. . . W9VZL/3

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FET Preamplifiers for 144 and 432 MHz

Using the 2N4416 and TIS-34 FET's.

In recent months, numerous articles have described VHF rf amplifiers using encapsulated FET's. Unfortunately, they are usually unavailable at the local electronics store. This article is about an FET that's not quite so cheap, but which is available off the shelf at any Union Carbide transistor distributor. The only drawback, if there is one, is the cost of the 2N4416. They were $7.10 apiece in February, but since have come down to about $5.00 each in small quantities.

The manufacturing data sheet for the 2N4416 says that it has a gain of 18 dB with a noise figure of 2 dB (maximum) at 100 MHz, tapering off to a gain of 10 dB and a NF of 4 dB (maximum) at 400 MHz. There is also a set of curves that indicates that the average 2N4416 is about 1 dB better than the specification.

Almost as soon as the development of the transistor became known to the general public around 1950, amateurs started working on ways and means of pulling the tubes out of existing equipment and replacing them with these new and more efficient devices. The main difficulty was that the conventional bipolar transistor is a low impedance device and does not readily fit into circuits with inductances wound to accommodate high impedance circuits such as the grid of a pentode. The advent of the FET has changed all this.

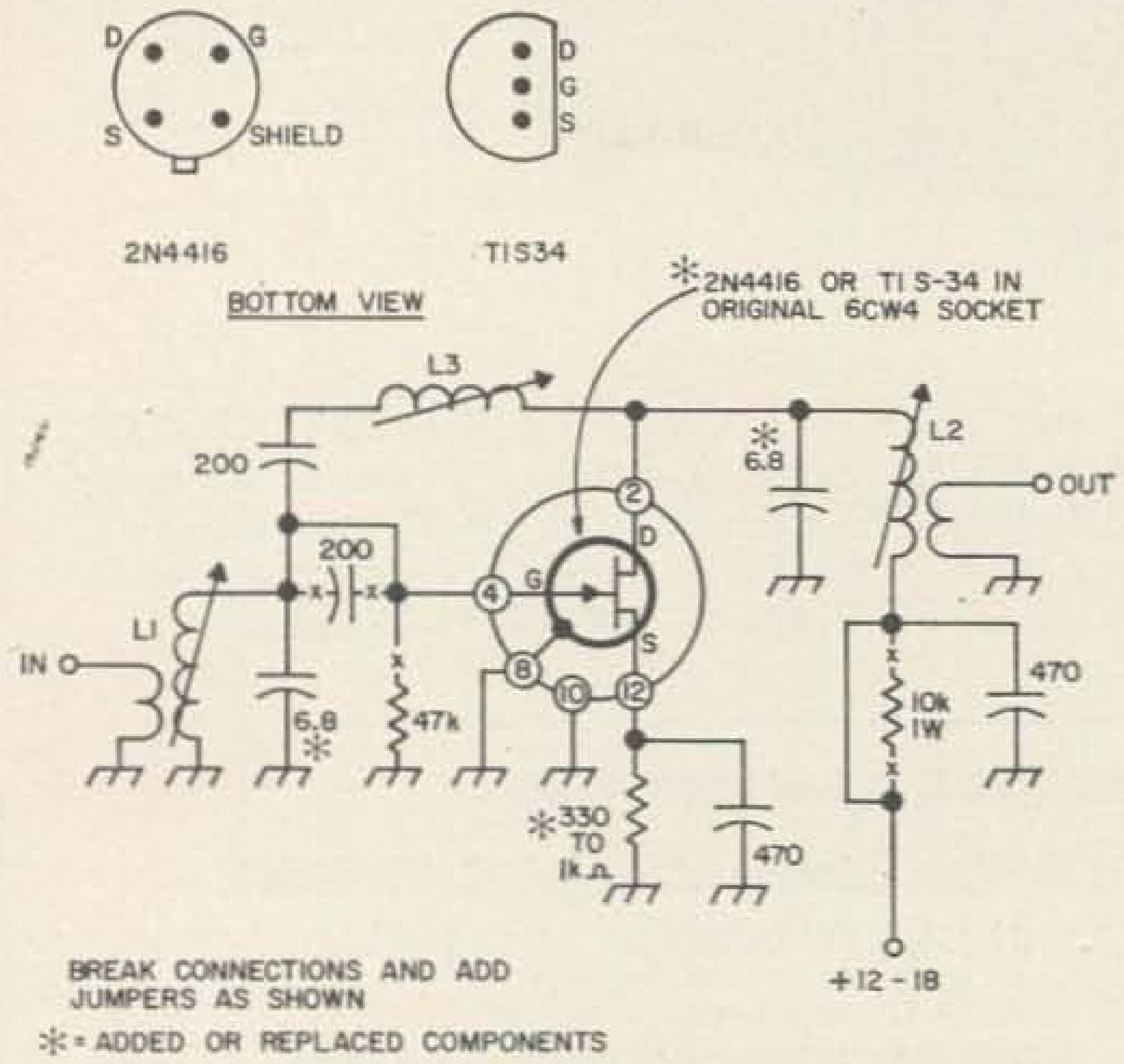


Fig. 1. Installation of the 2N4416 or TIS-34 FET in a two-meter nuvistor converter. The 330 ohm source resistor shown here is a typical value only—the correct value is determined experimentally for the proper amount of drain-to-source current and best noise figure as explained in the text.

144 MHz preamplifier

Recently two 2N4416's were obtained and plugged into an existing International Crystal 144 MHz preamplifier in place of the original nuvistor. Three simple wiring changes were actually needed and one more was added as a slight improvement.

Fig. 1 shows the International Crystal circuit with the added jumper wires. The N-channel FET can be plugged right into the nuvistor socket if care is taken to get the right leads on the transistor into the right slots in the socket. The drain goes to the nuvistor plate connection (pin 2), the gate goes to the nuvistor grid connection (pin 4), and (here is the tricky one) the source goes to the nuvistor *filament* connection (pin 12). The shield goes to any ground connection on the nuvistor socket.

The reason for connecting the source to the filament lead was to take advantage of the 470 pF by-pass capacitor already installed at the nuvistor socket. Now all that remains is to ground the source (old filament lead) through a suitable bias resistor. Note the use of the word "suitable". The 2N4416 data sheet says to adjust the bias to obtain a source current of 5 mA–of the 2N4416 transistors that I tried, one required 330 ohms bias and the other required 1000 ohms bias with the same 12 volt drain supply.

The manufacturer actually shows a variable voltage in series with the gate in their

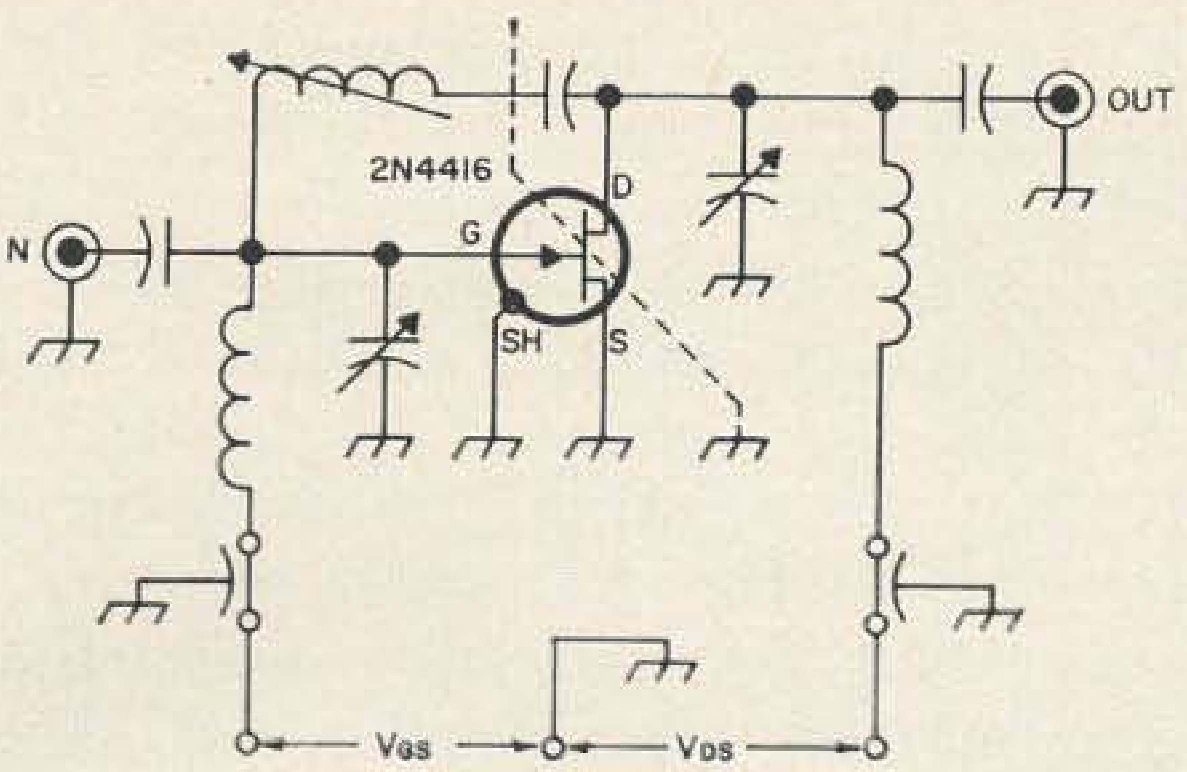


Fig. 2. 2N4416 400 MHz rf amplifier circuit recommended by Union Carbide.

experimental 400 MHz circuit (**Fig. 2**). Once the bias is set for the correct source current (5 mA), there appears to be no significant difference in the performance of the transistors that I have tested to date.

Referring again to **Fig. 1**, you will note that the following changes were made to the original circuit: short out the grid bypass capacitor, short out the 10 kilohm plate (drain) dropping resistor and add a source bias resistor (correct value determined by trial) between the old filament input terminal and ground. Clip one end of the 47 kilohm grid bias resistor loose since this will now appear directly across the old grid input coil L2 and serves no useful purpose except to lower the Q of L1. Finally, connect a source of B plus (12 to 20 volts) to the shorted-out 10 kilohm resistor with the negative to ground.

If you don't own an International Crystal preamplifier, you can build up the same circuit from scratch leaving out unnecessary parts and using a standard transistor socket. I suggest that a shield be placed across the middle of the transistor/nuvistor socket to separate the input from the output to prevent instability.

It is interesting to note that the only remaining difference between the Union Carbide test circuit (**Fig. 2**) and the modified nuvistor preamplifier (**Fig. 1**) is the relative position of the neutralizing coil L3 and the 200 pF blocking capacitor.

For some reason, all the published circuits of FET VHF preamplifiers that I have seen show the coil on the gate side of the capacitor. The nuvistor style preamplifer shows the coil on the plate (or drain) side of the capacitor as in **Fig. 1.** I left the neutralizing coil on the drain side of the capacitor to facilitate conversion. Neutralization was relatively easy but there is some interaction between L2 and L3. Every time you adjust one it is necessary to touch up the other.

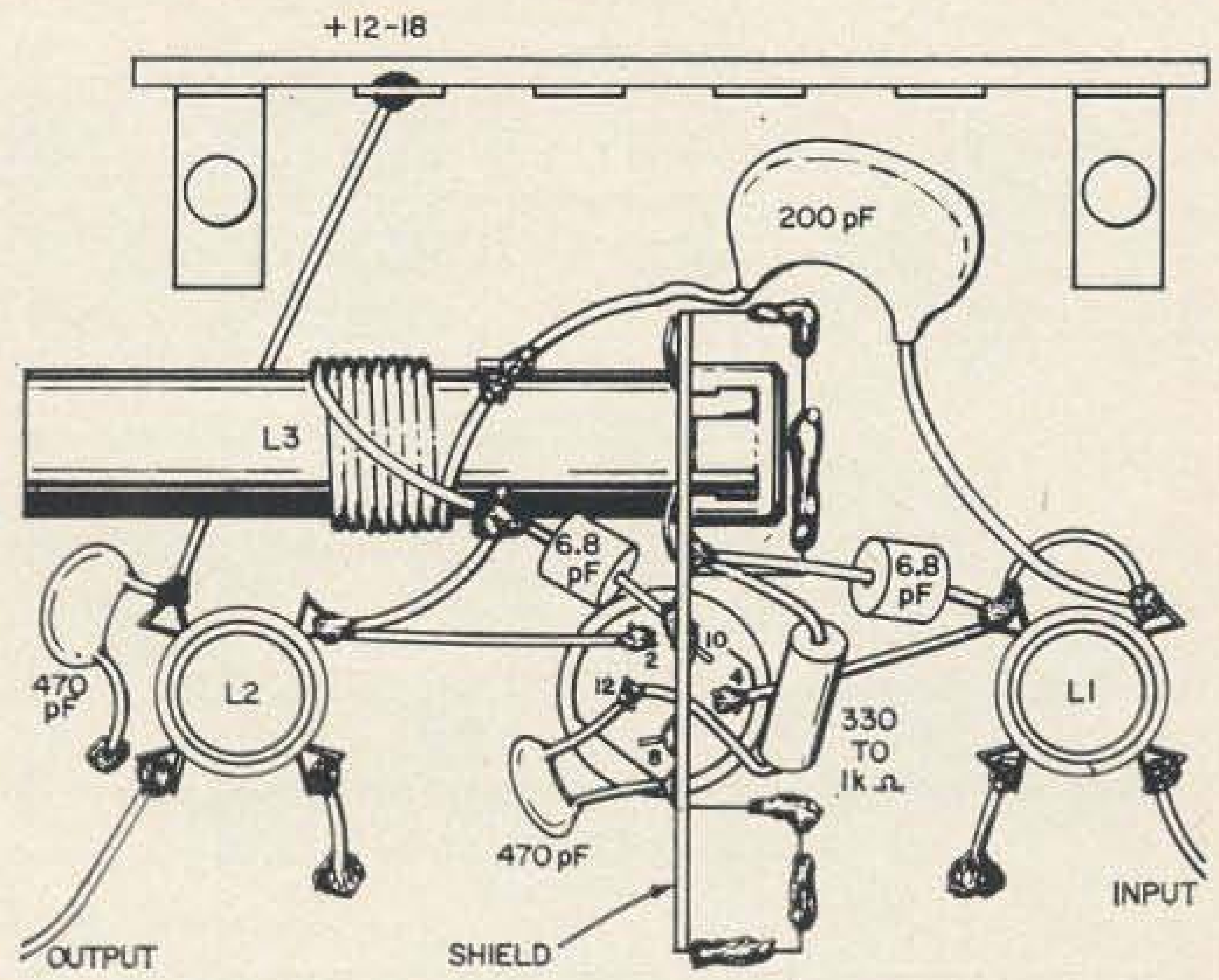


Fig. 3. Layout of the two-meter FET preamplifier.

This might be improved by moving the neutralizing coil to the other side of the blocking capacitor.

I also tried a couple of TIS-34 FET's in my converted nuvistor preamplifier and found that the gain was about the same but the noise was about one dB higher.

Any N-channel VHF FET will work in the circuit shown in **Fig. 1** with only slight differences in gain and noise figure. If you use a different make of transistor, do a little checking before you make your purchase and compare manufacturer's data sheets.

432 MHz preamplifier

Since I had such good luck with the 144 MHz preamp, I decided to try a similar approach on 432. The result is both state of the art in performance and about the ultimate in simplicity at one and the same time. Because I couldn't believe what I thought I was hearing, I took the thing all the way up to Sonoma and we plugged it in ahead of Frank Jones', W6AJF, latest 432 MHz transistor converter. The result was a .9 to 1.2 dB improvement, depending

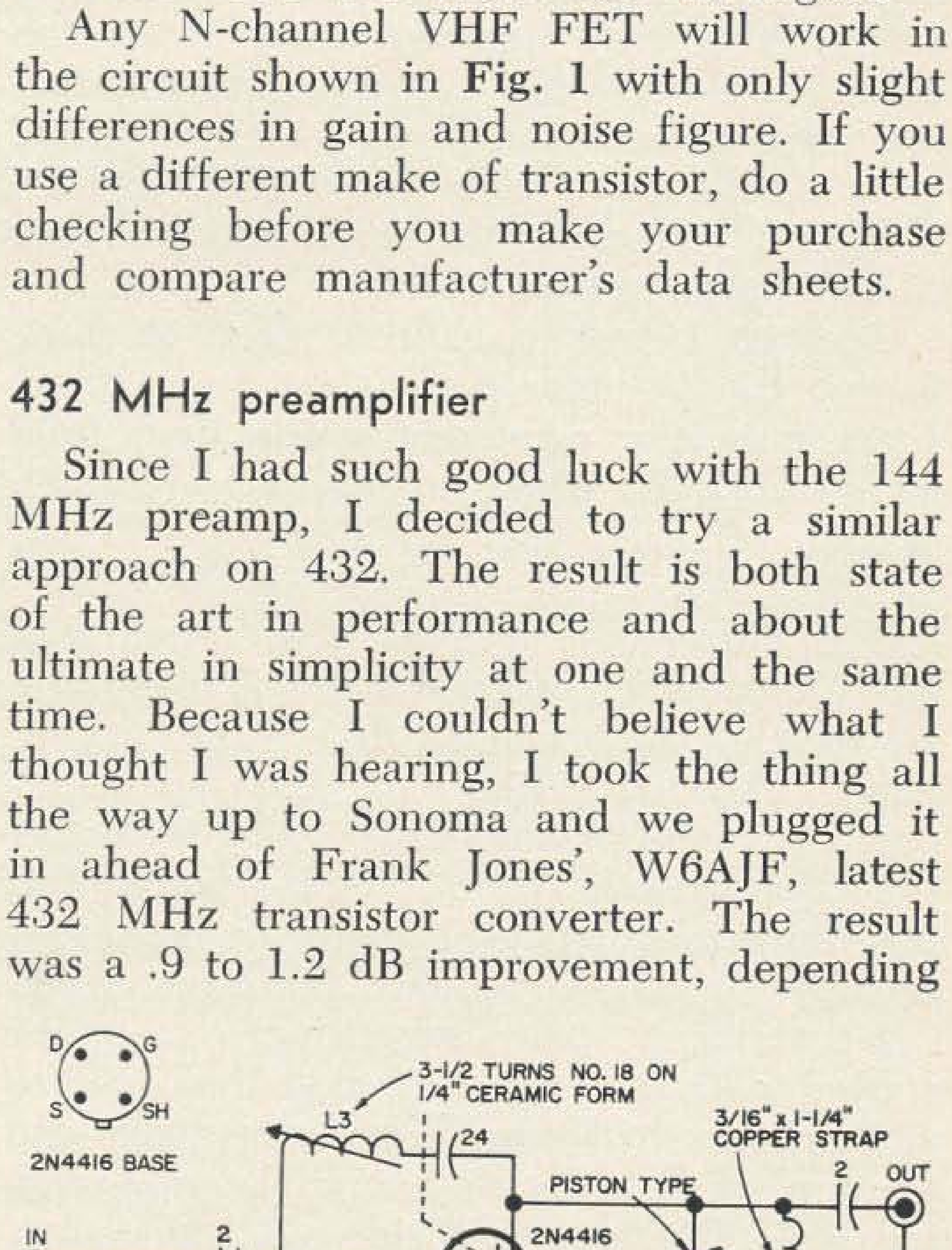


Fig. 4. 432 MHz preamplifier using the 2N4416 FET. This amplifier provides a noise figure of approximately 2.5 dB at 432 MHz with 12 dB gain.

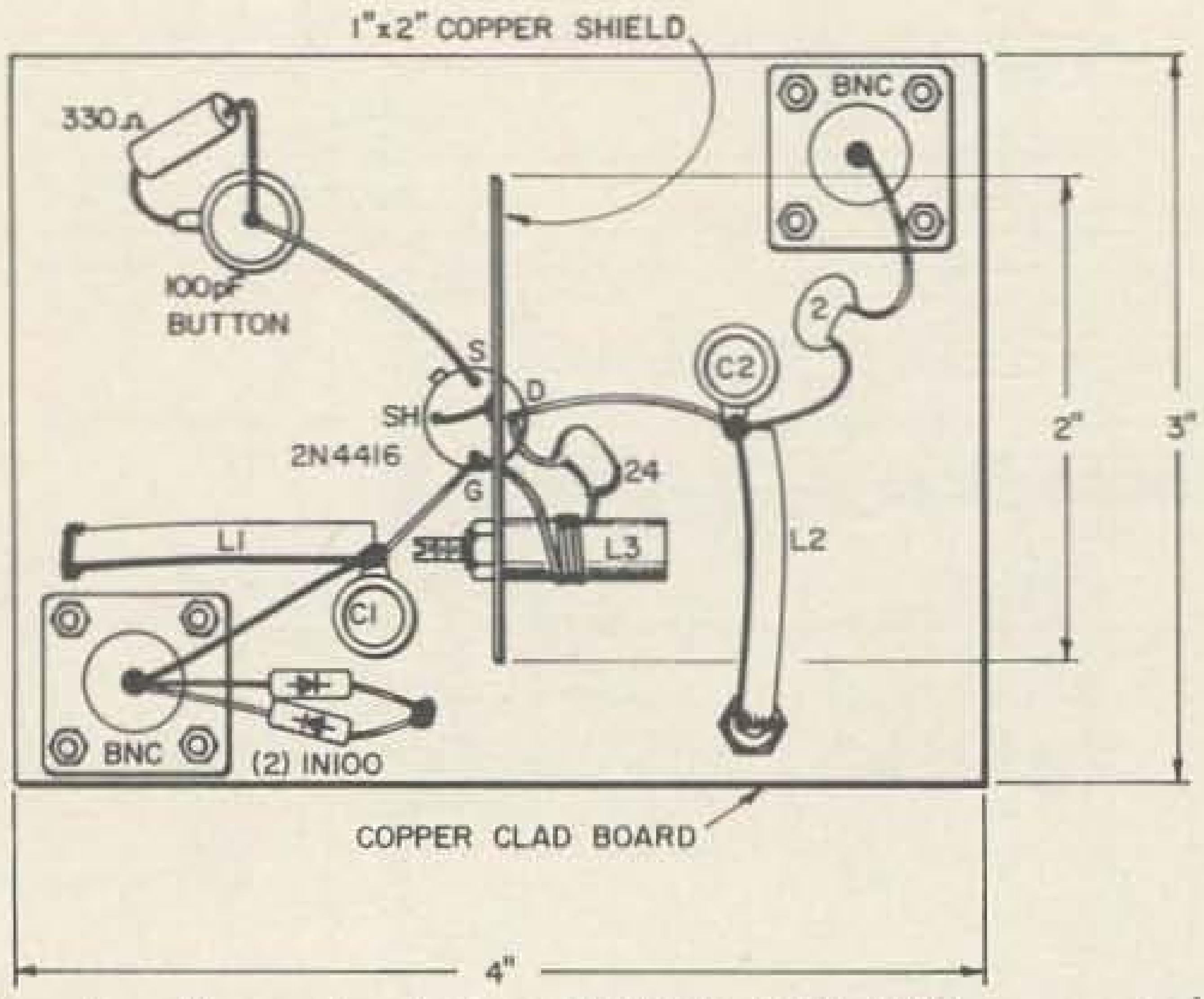


Fig. 5. Layout of the 2N4416 432 MHz preamplifier built by W6OSA. The neutralizing inductor L3 should be shown on the gate side of the shield.

on which test set-up we used. To quote the maestro himself, "that's pretty good." Practically speaking, the noise figure can't be much worse than 2.5 dB.

This circuit was taken directly from the test circuit shown on Union Carbide's data sheets. The only unusual thing about the circuit is the method of impedance matching used in both the input and output circuits. This consists of a pair of 2 pF capacitors, and you can't get much simpler than that. What's more–it works.

Because I had to have a place to start, I used the inductor dimensions from Frank Jones' transistor converter in the June 1966 issue of 73. As it turned out, I had to lop ¼ inch off each one. Following the Union Carbide directions, I adjusted the drain-source current for 5 mA. This required a 330 ohm source resistor for one 2N4416 and 1k for the other one of the two I had on hand. The noise figure of the device requiring only 330 ohms bias is slightly better than the second. I don't know whether this is a universal rule, but I would be interested to hear if others experience the same effect.

Neutralizing was surprisingly easy. I started with a three turn coil and had to add another half-turn. I can now make the preamp oscillate by de-tuning the neutralizing coil, L3, to either side with the slug.

The gain of the preamp is 12 dB, plus or minus one. This is probably not enough if you are planning to run it directly into a diode mixer, but when added to the front end of an existing converter, either tube or transistor, the results are sensational. My own line up consists of a 2N4416, followed by two 6CW4's, into a 2900 hot-carrier diode mixer. Not only is the 2N4416 preamp highly stable and nonregenerative, it had a most beneficial effect on that first 6CW4.

For those who have not worked with FET's before, here are a couple of hints. The drain to source junction is almost a dead short with zero bias between source and gate. You can confirm this with an ohmmeter *not* on the X1 scale, please). This is why they are normally operated with reverse bias for class A operation. The required bias is most easily obtained by putting a resistance in series with the source. This is the same idea as cathode bias in vacuum tube circuits. The amount of bias can be adjusted for best noise figure. However, the rule of thumb is to set it up for half the rated I_{DSS} (saturated drain-source-current). In the case of the 2N4416, this works out to be about 5 mA I_{DS}.

When using an FET as a mixer, the I_{DS} should be very low with no local oscillator injection–less than 1 mA. The best place for injection is the source, but this does require more local oscillator power. You will, in fact, probably need an extra transistor in your L. O. chain to get the necessary power compared to what you can get away with if you put the injection on the gate. However, bipolar transistors are pretty inexpensive these days.

Getting back to our 432 MHz preamp, the construction is simple even if you are a mechanical "drop-out" like me. I used a socket for the FET because I wanted to be able to plug in different ones. Apparently there is no need for those "zero-length" leads that we used to read about in connection with bipolar transistors on 432 MHz. The output tuning is quite sharp, the input is broad. This is why I used the high quality piston capacitor on the output and the ordinary trimmer on the input. You can use pistons in both places if you desire. I used the 70 pF feedthrough bypass capacitor because it was the first one I could find around the shack. Any value up to 500 pF should work equally well.

If you are running any kind of power on 432 MHz, like a 4X150, Frank Jones recommends using two 1N100 diodes back to back from the input connection to ground. It is pretty cheap insurance.

The ground end of the gate inductor, L1, is soldered directly to the copper circuit board base of the preamp. The ground end of the drain inductor is soldered to the top of the 70 pF feedthrough capacitor.

Any value of drain voltage from 12 to 18 volts can be used—I use a 12 V battery eliminator. I suspect that if you go much under 12 V you will start to degrade the performance. Everything else pretty much speaks for itself.

Postscript

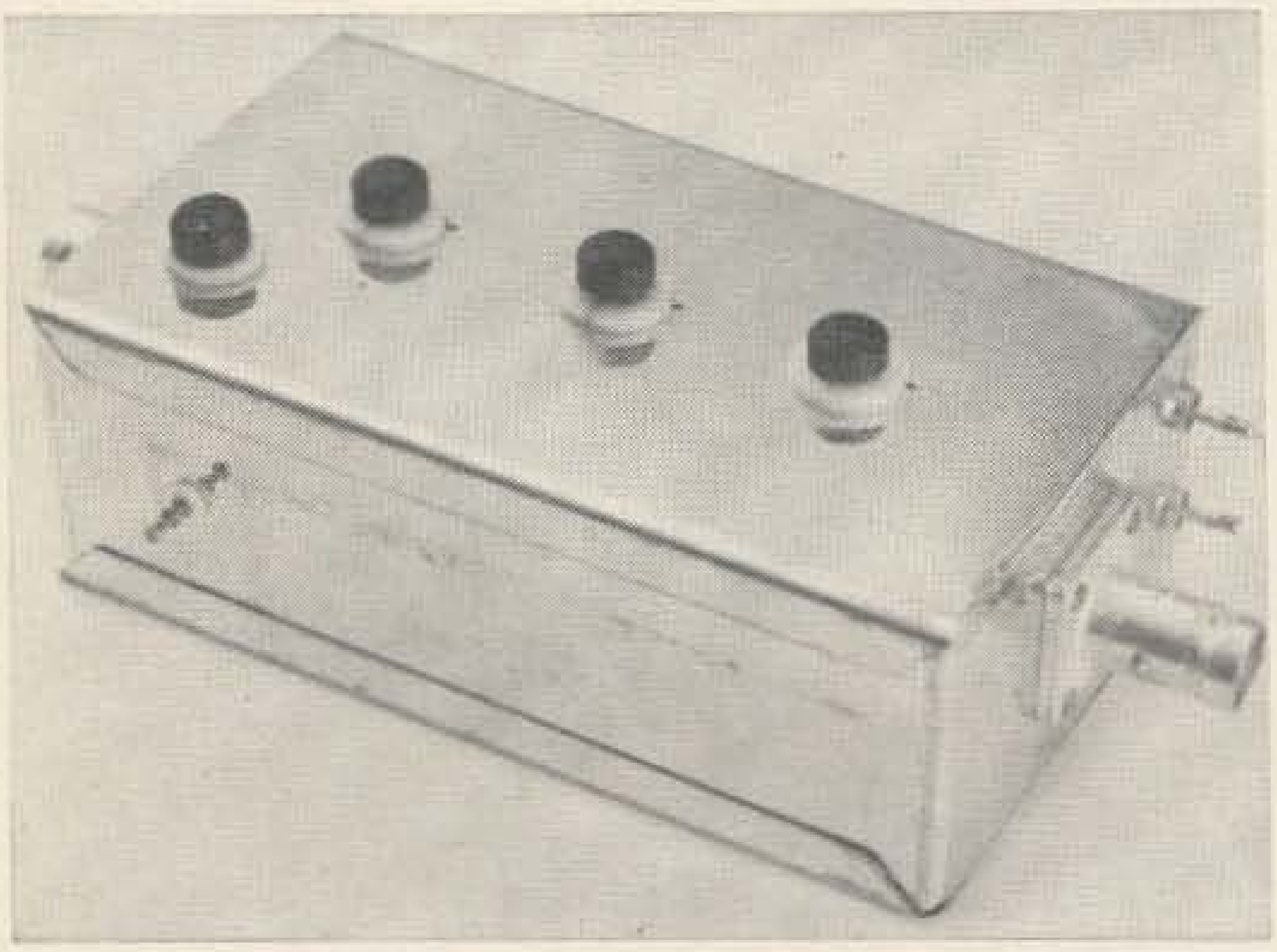
During my experiments with these FET preamplifiers, one curious fact came to light that is worth passing on. I got to wondering what the proper bias for the TIS-34 should be, so I dug up all the past articles I could find using TIS-34's as rf amplifiers. I discovered to my amazement that out of five previous articles in *73 Magazine*, the designers had used values of source bias for their rf amplifiers ranging from zero to 22k. Finally, I consulted some technical publications and learned that the rule of thumb for class A amplifiers is to use $I_{Dss}/2$ (drain-source-current-saturated divided by 2), and whatever amount of bias it takes to arrive at that condition. I next conducted a little experiment with the four TIS-34's that I had on hand to see what the variations between individual FET's might be. The results of that survey are rather amazing too (see **Table 1**). The funny thing is that all four samples work equally well when placed in the circuit and adjusted for the proper current. The above rule of thumb does not apply to mixer applications, incidentally. In that case, the I_{DS} should be much lower, about .35 mA.

		Source Resistance					
	TIS-34	0	100	200	300	500	1000
	#1	8.5	5.8	4.9	4.0	3.8	2.2
I_{DS}	#2	11.0	8.0	6.4	5.5	4.2	2.4
in	#3	5.9	4.4	3.7	3.4	2.3	1.2
mA	#4	16.0	11.5	8.1	6.5	4.9	3.1

I tried running one TIS-34 at zero bias and found that the I_{DSS} started out at about 8.5 mA when first turned on and drifted down to 6.5 mA after about 15 minutes. (Note that FET's draw less current as they heat up—sort of reverse thermal runaway.) In any event, I don't recommend the zero bias mode of operation. I tried grounding the source as recommended by K6HMO* and pinned the needle on my meter. My advice is to experiment until you get the best results, but start out with at least 500 ohms for the TIS-34 and 1k for the 2N4416.

. . . W6OSA

* "A Low-cost FET two meter converter", K6HMO, *73 Magazine*, October 1966.



G. B. Estep W7AKS/6
Integrated Circuit Engineer
Fairchild Semiconductor
Mountain View, California 94040

A 30 MHz IF Strip Using Integrated Circuits

85 dB gain at 30 MHz with a 7.5 dB noise figure.

Price reductions brought about by increased production and improved manufacturing techniques have brought the use of integrated circuits within the financial grasp of every serious amateur. Most of the available units have been for digital circuits, but a new group of linear devices has been rapidly expanding. These circuits include almost all the more versatile circuits—audio amplifiers, video amplifiers, and most recently, rf amplifiers. Since these devices are often as low in price as discrete transistors, and performance is substantially better, it is advantageous to consider using them in home projects.

To see how easily the devices may be used and to provide a useful circuit application, a 30 MHz *if* strip was built using the Fairchild rf *if* amplifier, the μA03E. This device is a six-lead, epoxy, monolithic (single-chip) integrated circuit that has five transistors and two resistors connected in an emitter-coupled configuration. The amplifier can be used with transformers as interstage coupling elements; has all the biasing internally; and does not saturate for large overloads. Neutralization of the stages is not necessary because of the very low internal feedback of the circuit. Such an amplifier could be used with existing microwave converters or radar equipment.

Fig. 1 shows the schematic of the emitter-

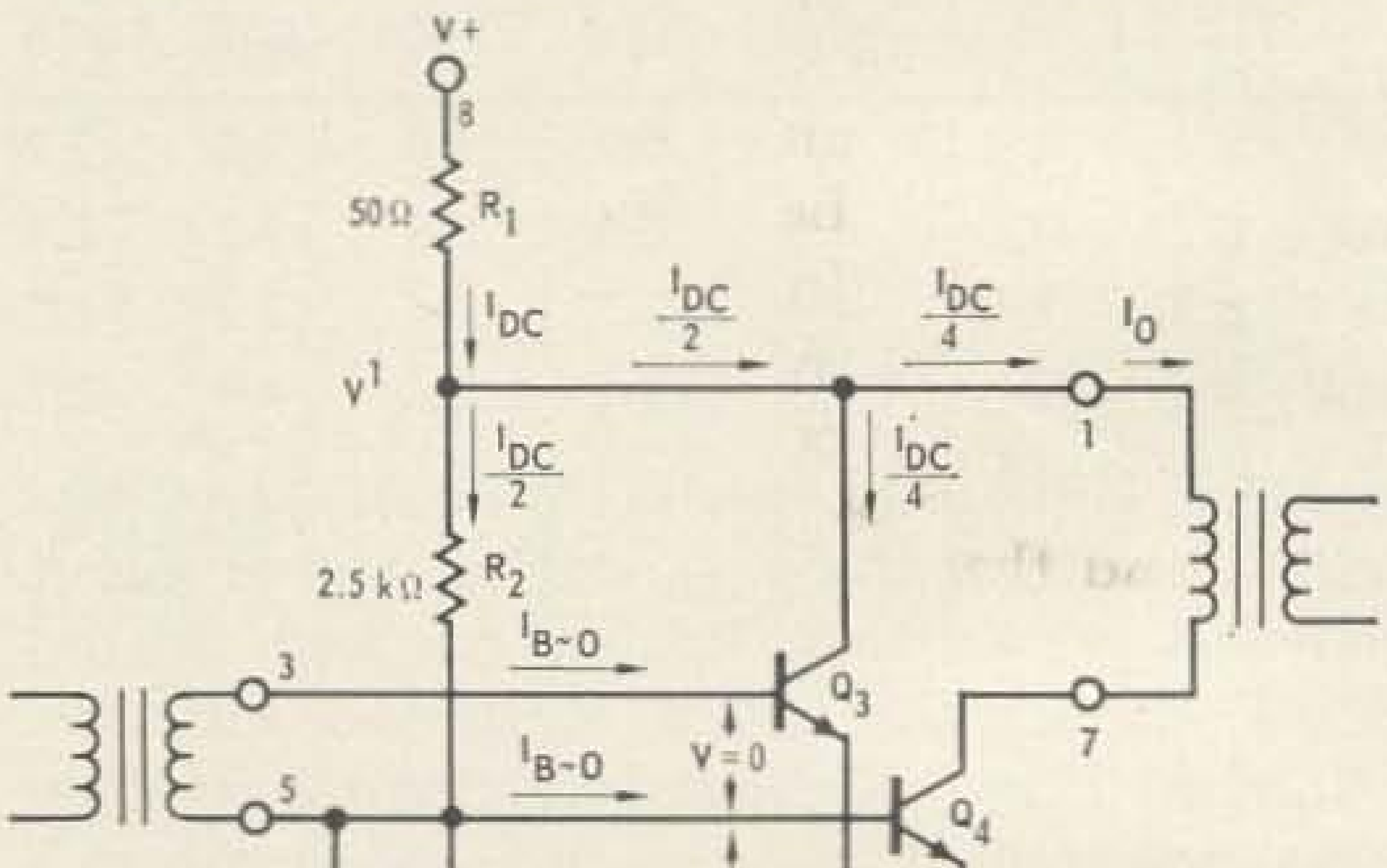


Fig. 1. Schematic diagram of the Fairchild μA703E integrated circuit, including bias currents.

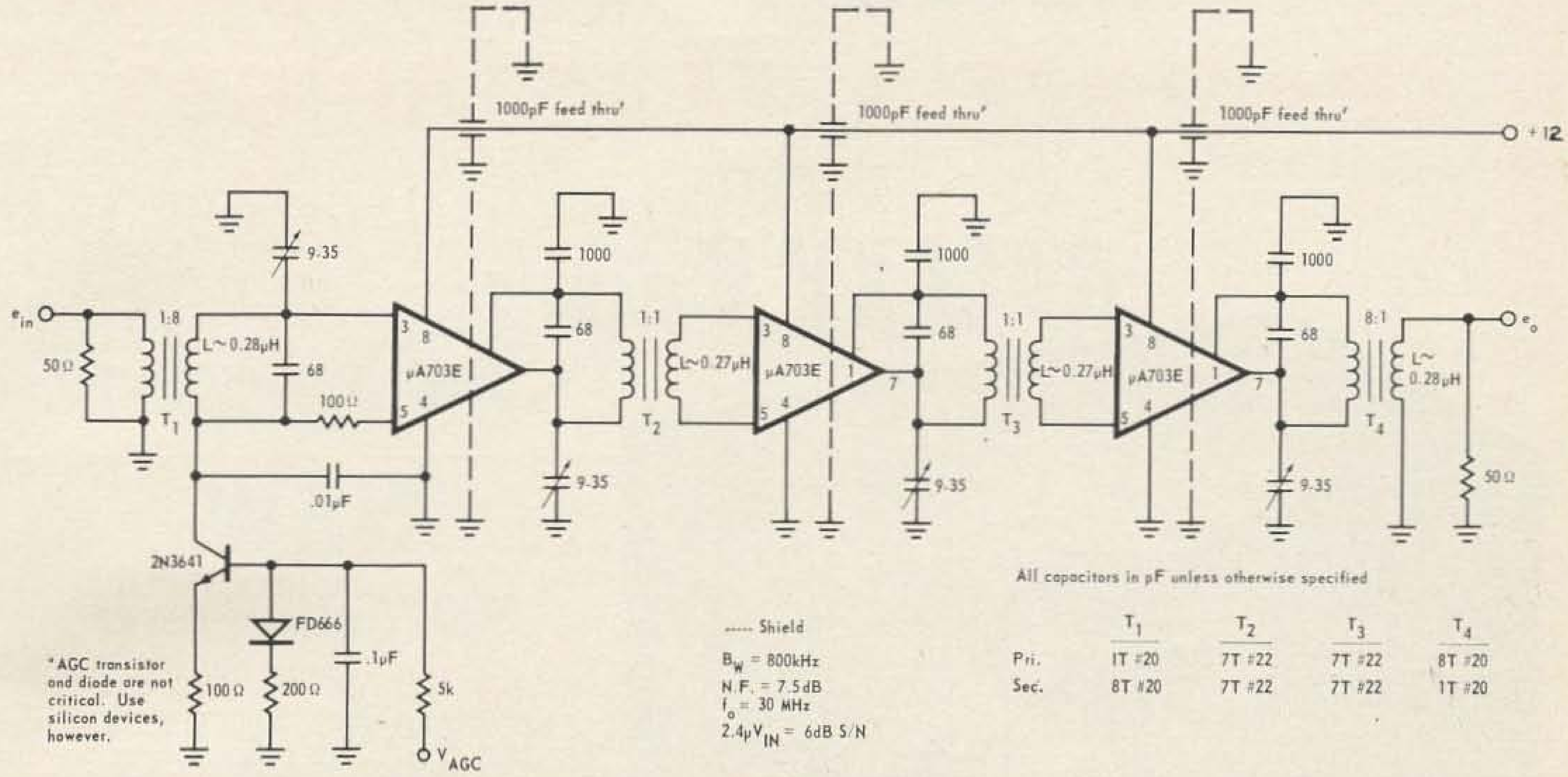


Fig. 4. Schematic diagram of the 30 MHz *if* amplifier. The interstage transformers are bifilar wound on cores similar to the T-37-10 cores available from Ami-Tron Associates.*

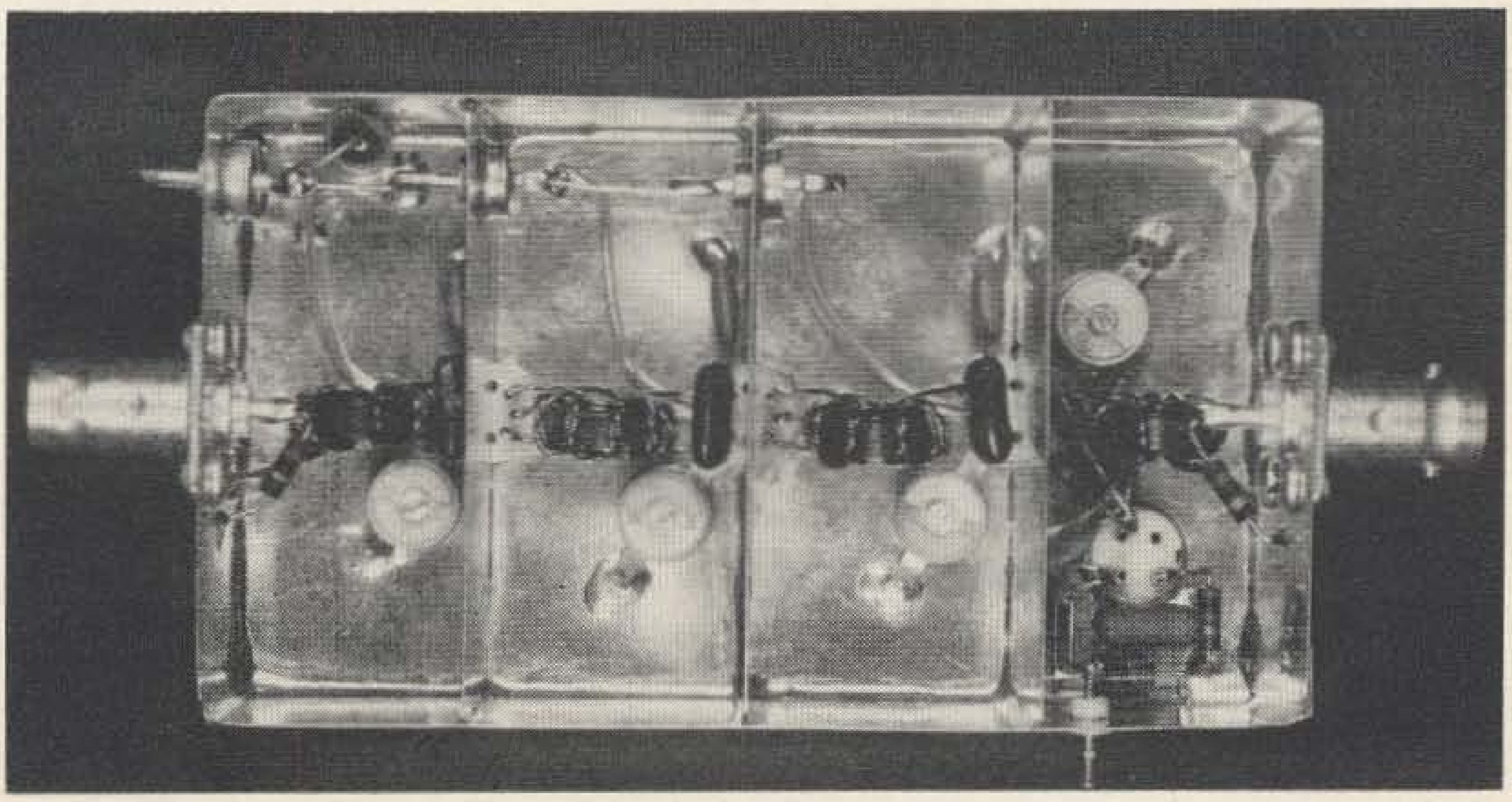
coupled amplifier and its associated bias network. The biasing of the amplifier may be understood by assuming that all parts within the circuit are well matched and the transistor current gains are high enough that the base currents can be neglected. It is also assumed that the transformer windings, particularly in the input circuit, have negligible dc resistance.

From **Fig. 1** it can be seen that the current in the output transistor Q_4 will be approximately equal to one-fourth of the supply current. Since the emitter current of Q_5 is invariable and equal to one-half the supply current, any change in collector current of Q_4 will be reflected in the collector current of Q_3. In other words, the output current will be switched from zero to one-half the supply current. The output current, I_o, is shown as a function of input voltage, V, in **Fig. 2**.

Quantitatively, the collector current of the biasing transistor, Q_2, is substantially independent of the transistor characteristics and is simply a function of the supply voltage and a single resistor.

All of the transistors are assumed to be identical, hence the collector current of the current source, Q_5, is equal to that of Q_2 because their bases are fed from a common voltage point[1]. The collector current of Q_5 splits evenly between Q_3 and Q_4 with zero input signal. When the amplifier is driven, this current is alternately switched between Q_3 and Q_4. To prevent saturation of Q_4 when the amplifier is driven with a large signal, the load resistance must be low enough that

*Ami-Tron Associates, 12033 Otsego Street, North Hollywood 91607.



Below panel view of the integrated circuit 30 MHz *if* amplifier. Note the extensive shielding between stages and position of the toroidal interstage transformers.

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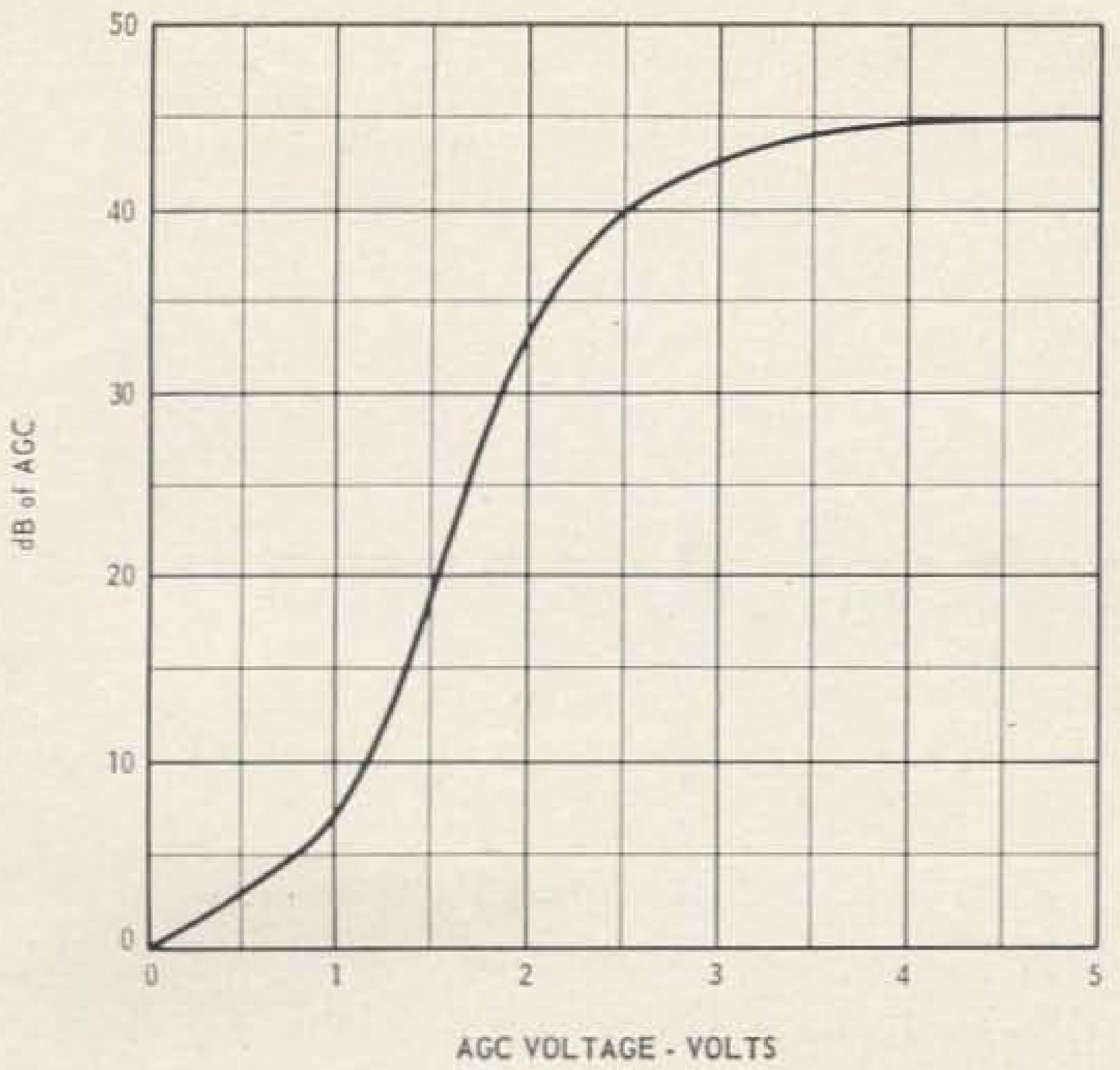
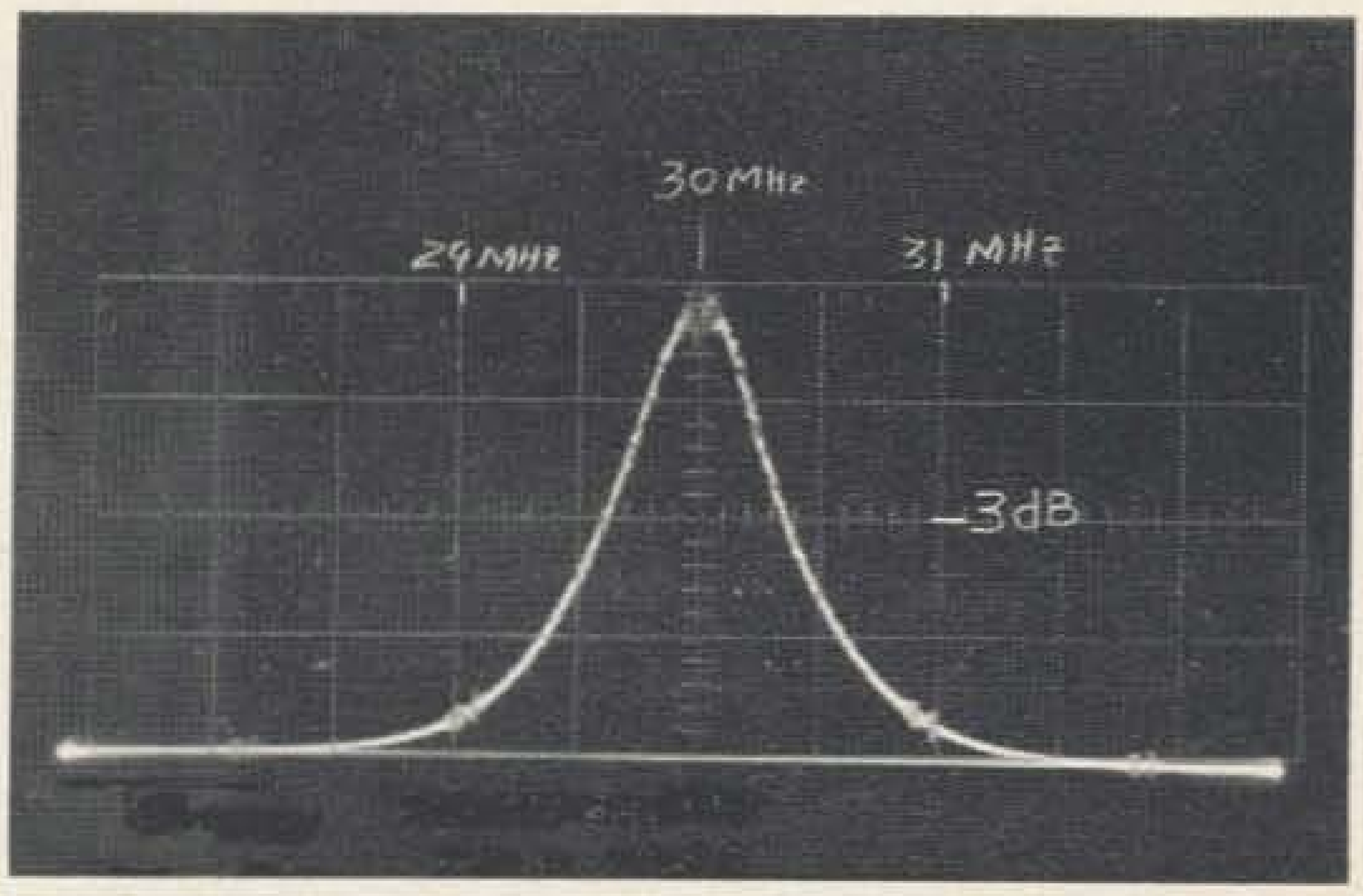


Fig. 2. AGC characteristics of the 30 MHz *if* amplifier.



Frequency response of the 30 MHz *if* strip. The −3 dB points in the response curve result in a bandwidth of 800 kHz. With a positive 12 volt supply, this amplifier provides 85 dB gain at 30 MHz with a noise figure of 7.5 dB.

current limiting occurs before the output voltage drops to $2V_{BE}$. For a transformer coupled output, the load resistance (R_L) must be less than or equal to $2R_2$.

This type of amplifier is referred to as a "differential pair" and is somewhat analogous to a seesaw—if one end of the seesaw is moved, the other end moves a corresponding distance but in the opposite direction. The biasing transistor, Q_5, acts like the fulcrum of the seesaw. (see **Fig. 3**).

A complete analysis of the μA703 is available as an application note entitled "Designing with the μA703 Monolithic RF *IF* Amplifier" from the applications group, Fairchild Semiconductor, Mountain View, California 94040.

Fig. 4 shows the schematic diagram of a 30 MHz *if* strip using the μA703E. This amplifier has a gain of approximately 85 dB, a noise figure of 7.5 dB and a bandwidth of 800 kHz. The input signal required for a 6 dB signal to noise ratio is 2.4 μV. Interstage transformers are bifilar wound on Micro-metals T44-10 cores, and have Q's of the order of 125. Placement of parts should follow the photo or be very close in order to realize the full gain of the amplifier without running into oscillation. In general, use care, and be careful, the results will be worth the effort.

The author wishes to acknowledge the effort of Dave Capella, whose patience and ability were required to build and test the amplifier. ■

1. "Some Circuit Design Techniques for Linear Integrated Circuits", Fairchild Technical Paper #33.

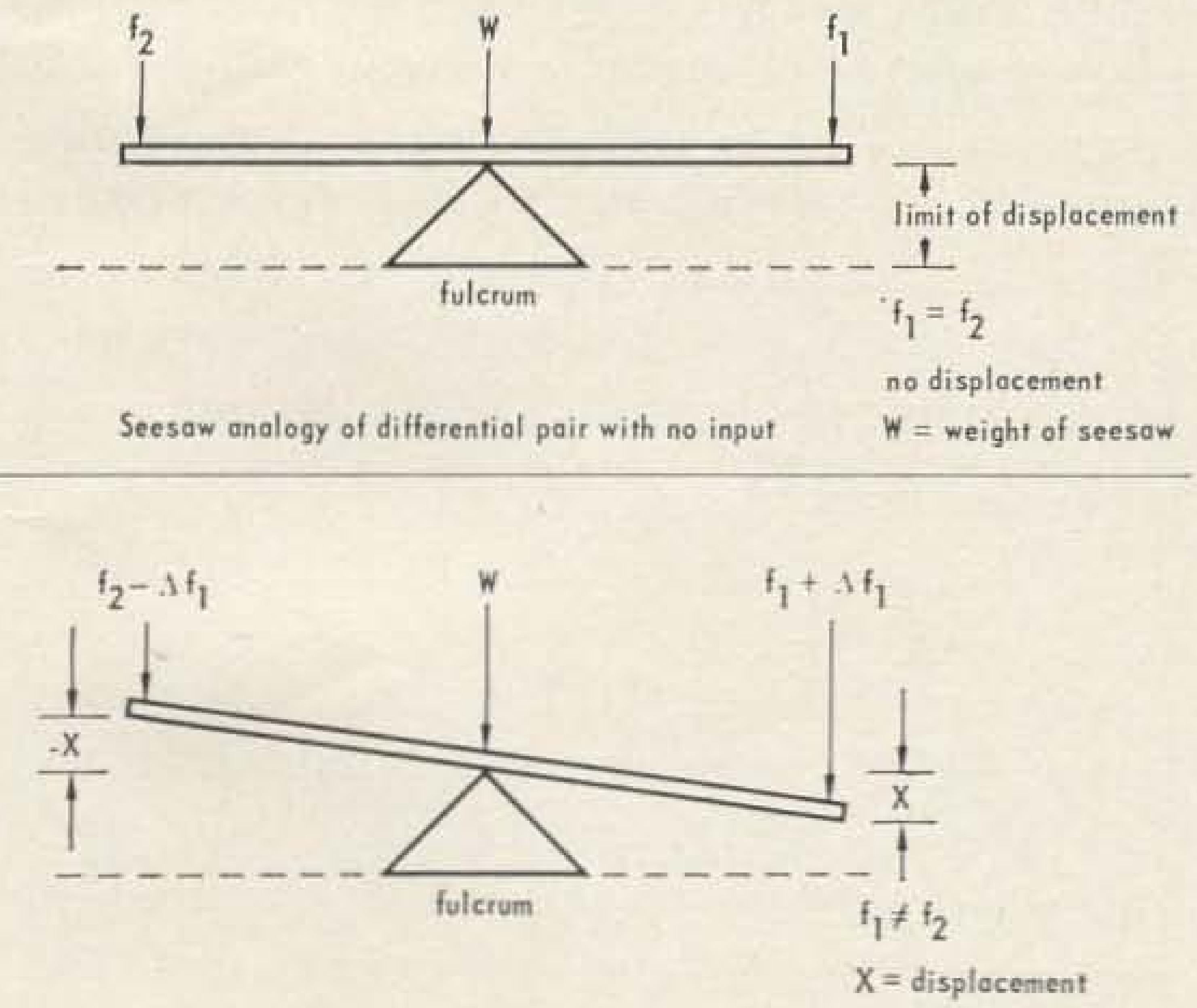


Fig. 3. Simple see-saw analogy of the differential pair with signal applied.

Sam Kelly W6JTT
12811 Owen Street
Garden Grove, Calif.

An Un-Guyed Vertical Antenna

The base of the un-guyed vertical antenna.

Living in a flat windy location has many drawbacks—not the least of which is periodically removing the tumble weeds from antenna guy wires. I decided to experiment with a vertical antenna based on a shipboard installation I had seen. The antenna is made from three 10 ft. sections of 1¼ inch plated steel TV masts. A tuning box at the bottom houses the loading coil. Total cost of the installation was about $13.00.

The box at the base of the antenna was made from a BC-375 E tuning unit. New sides and panel were cut from 0.060 inch aluminum. A two inch hole was cut in the top for the MP-22 mast base. These mast bases are available surplus for from two to three dollars. A standard 3 inch cast iron pipe flange was mounted to the bottom with ¼ inch stove bolts.

After assembling the box the inside seams were sealed with masking tape. A three foot section of galvanized iron pipe was threaded into the flange and imbedded in concrete. Use a level to insure that the sides of the box are vertical. After the concrete has set it is very difficult to correct any tilting!

An adapter for mounting the TV masts to the MP-22 base is made from a MS-24 mast section by cutting off the male end two inches above the ferrule. Drive a wooden plug into the small diameter end of the

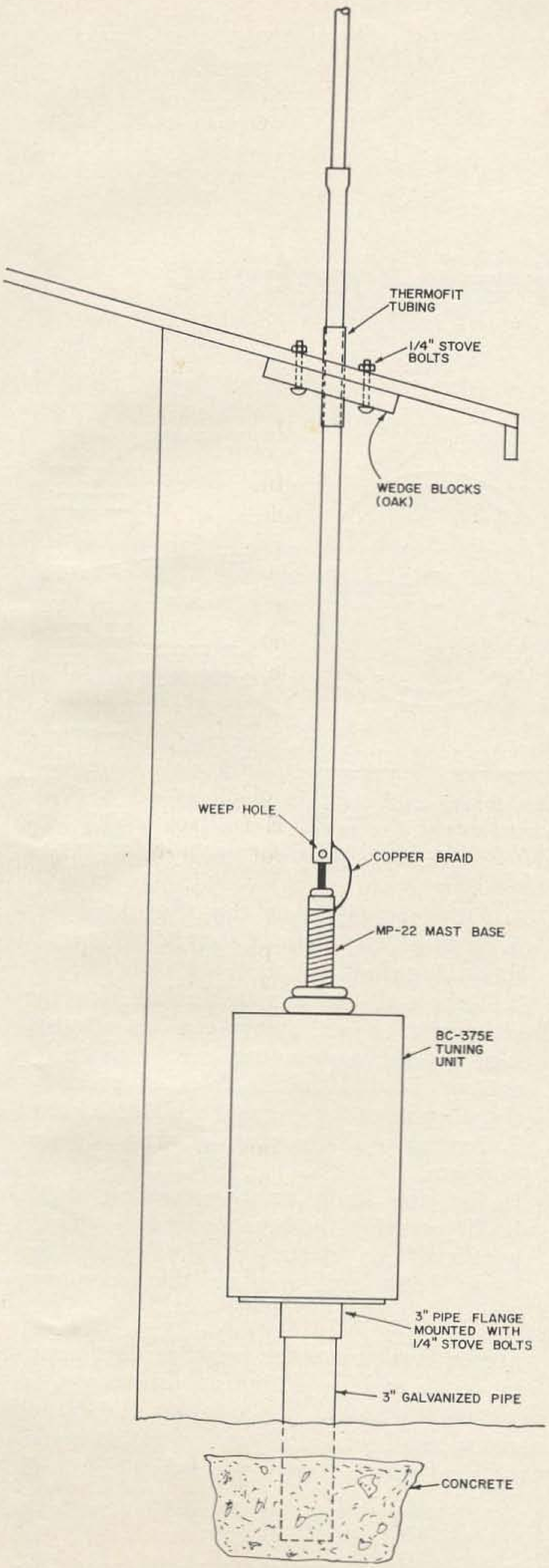


Fig. 1. The un-guyed vertical antenna.

TV mast and drill a hole through the center of the plug to accept the tubing. Drill a ¼ inch weep hole just above the wood plug.

A 1½ inch hole is bored through the eave of the roof. Assemble the low section of the antenna as shown in **Fig. 1** so you can mark it where it goes through the roof. Remove it, and build up the insulated bushing using thermofit tubing shrunk on with a small propane torch.

Build up the bushing until it is at least ¼ inch thick. A length of 8 inches is adequate. The top clamp is made from a 1 x 4 x 8 inch piece of oak drilled for a snug fit over the bushing. Mount the lower section to the MP-22, then install the top clamp.

The rf connection from the TV mast to the MP-22 is a ½ inch copper braid soldered to the TV mast with a propane torch. A large copper lug is soldered to the free end for bolting to the MP-22.

The remaining sections are assembled together and dropped into the socket end of the base section. A large ground lug was installed on the base box for connecting to the station grounding system.

This antenna has been in use for over a year in a wide variety of wind conditions and shows no sign of permanent set.

. . . W6JTT

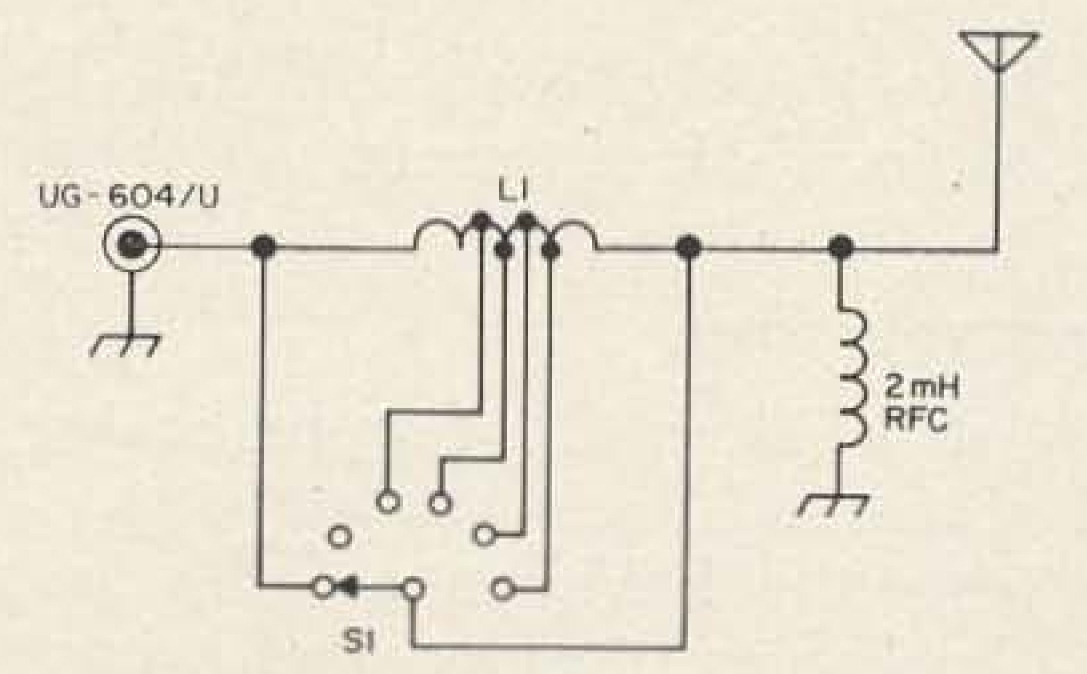


Fig. 2. Loading coil assembly. Switch S-1 is from tuning unit TU-5B. The loading coil L-1 is also from the TU-5B. The taps are set by experimentation for your own operating frequencies.

D. E. Hausman
16 Wellington Street, South
Kitchener, Ontario, Canada

Two Cheap Crank-Knobs

As the amateur bands get more and more crowded, manufacturers of gear are decreasing the number of turns per kHz in their receivers and VFO's so that bandspread will be greater and tuning simplified. Some rigs, however, have no cranks on their main tuning knobs. One way to wear out your arm is to roam around the band looking for a contact. If you use your tuning hand for tapping out Morse, the quality of your CW won't be any better either!

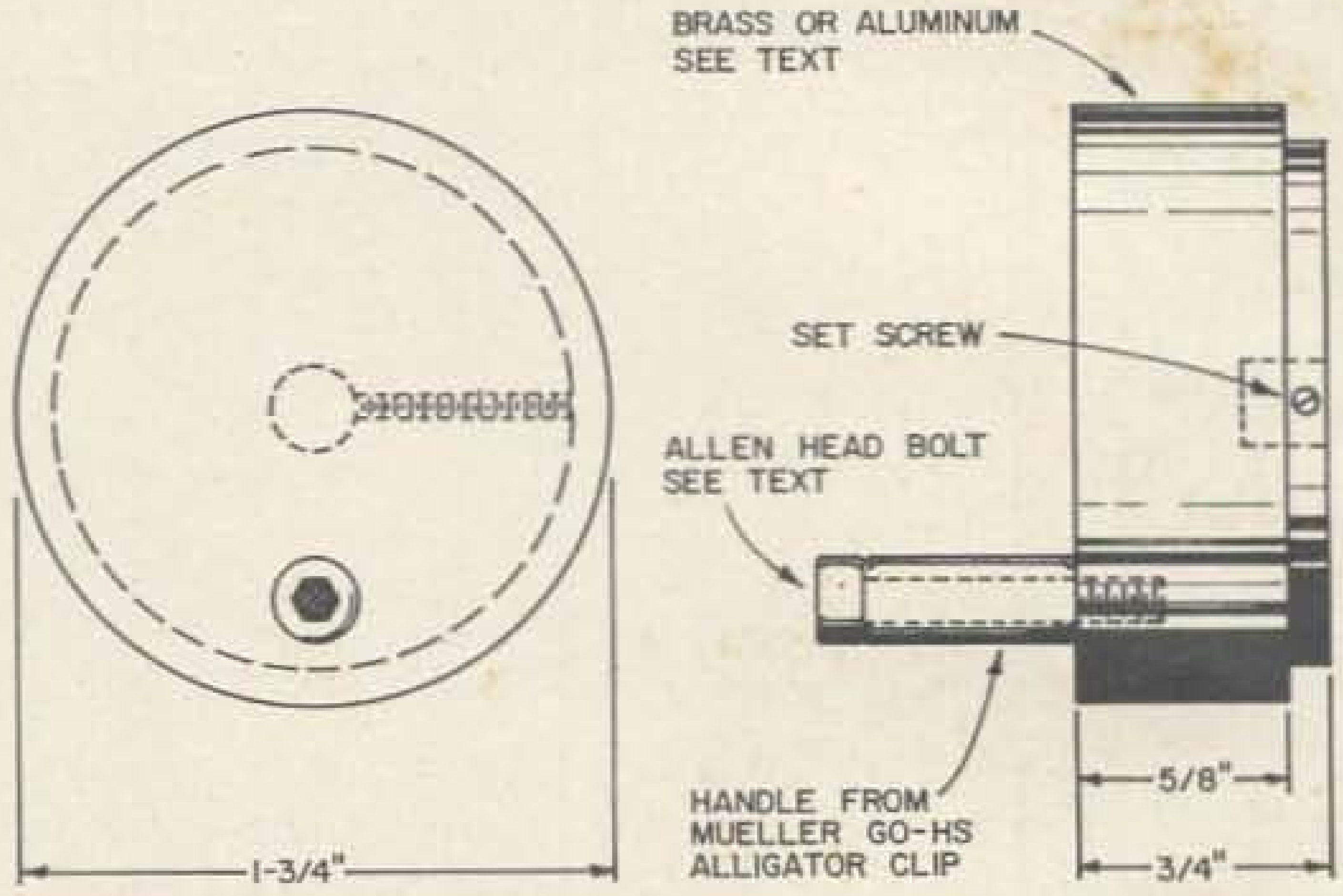
Substitution with a crank-knob couldn't be simpler. Just follow the step-by-step directions and soon you'll find how effortless tuning can be! You have two choices; add a crank to an existing knob or roll your own.

Adding a crank

1. Find or buy a suitable crankless knob. Don't use the original knob if you intend to trade in your rig at a later date.
2. Get a sleeve (handle from Mueller 60-HS alligator clip, toothpaste cap, etc.) and a bolt or machine screw that fits it loosely.
3. Drill and tap a hole for the parts in step 2 on the face of the knob as shown in the diagram.
4. Assemble the parts and put them on the tuning shaft of the rig.

Rolling your own

1. Get a ¾" x 2" (approximate) piece of cylindrical brass or aluminum.
2. Turn the knob on a lathe as shown. My knob was diamond knurled for "fine" tuning. A straight knurl should do the job as well.
3. Get the sleeve and bolt as in the other knob.



The cheap crank-knob. To use a normal 6-12 set-screw, extend the depth of the knob slightly; the ⅛" shoulder is not quite large enough for tapping a 6-32 hole.

4. Drill and tap as in the other knob.
5. Drill a ¼" hole about ½" deep for the tuning shaft.
6. Drill and tap a suitable hole for the set screw. A set screw can be secured from an old knob or one can be made by cutting ⅜" of thread from a machine screw and slotting one end with a hacksaw.
7. Assemble all the parts as shown in the diagram.
8. Put the knob on the tunning shaft.
9. If you wish, the homebrew knob can be anodized* or electroplated** (plate the brass knob and anodize the aluminum one).

If you don't have the facilities, the homebrew knob and/or plating/anodizing can be done commercially. Fix a radio or TV for a machinist friend and you've got it made. One final word—happy tuning! ■

*R. A. Kidder, "Passivating Aluminum Alloys", *73*, September 1965, pages 74-80.

**W. B. Ford, "Electroplate or Anodize your Electronics Projects", *Popular Electronics*, June 1965, pages 55-9, 105, Amendment—August 1965, page 8.

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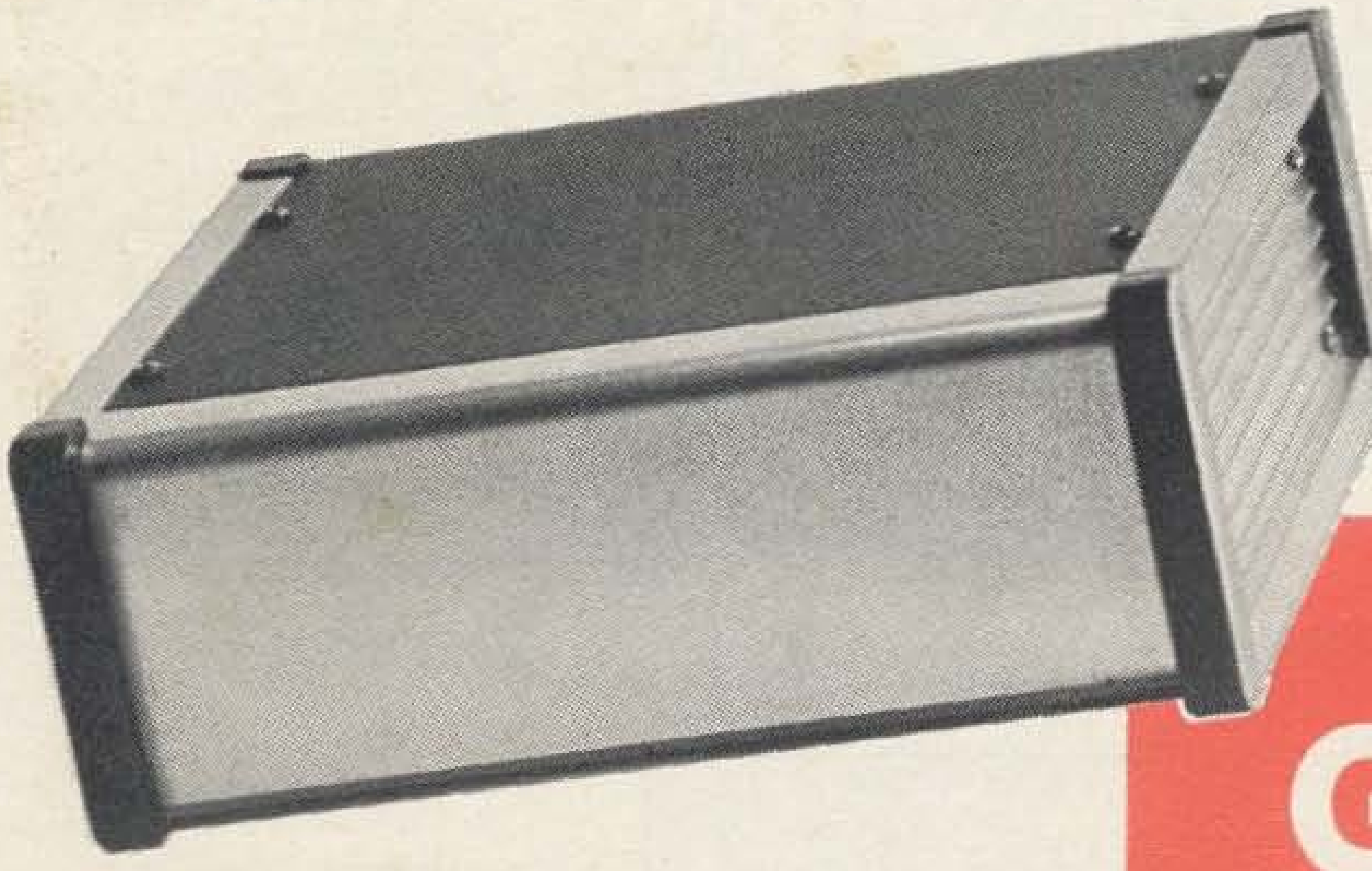

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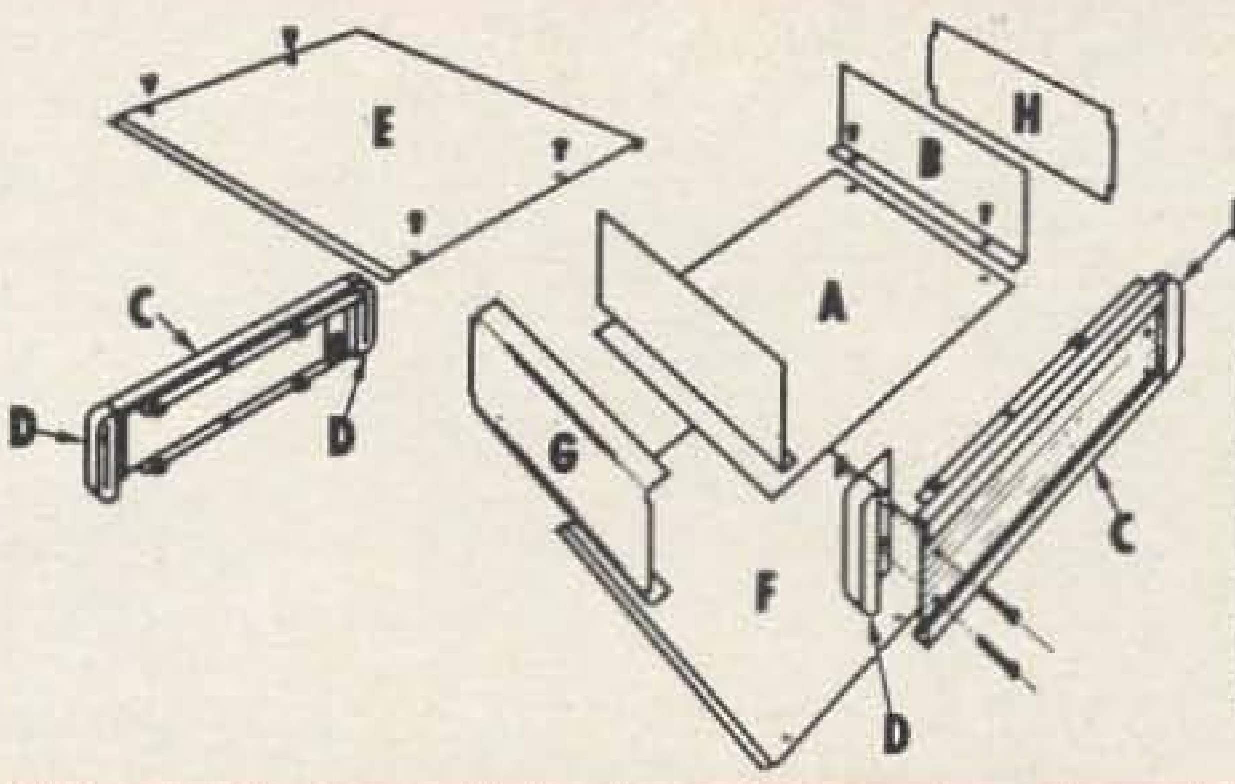

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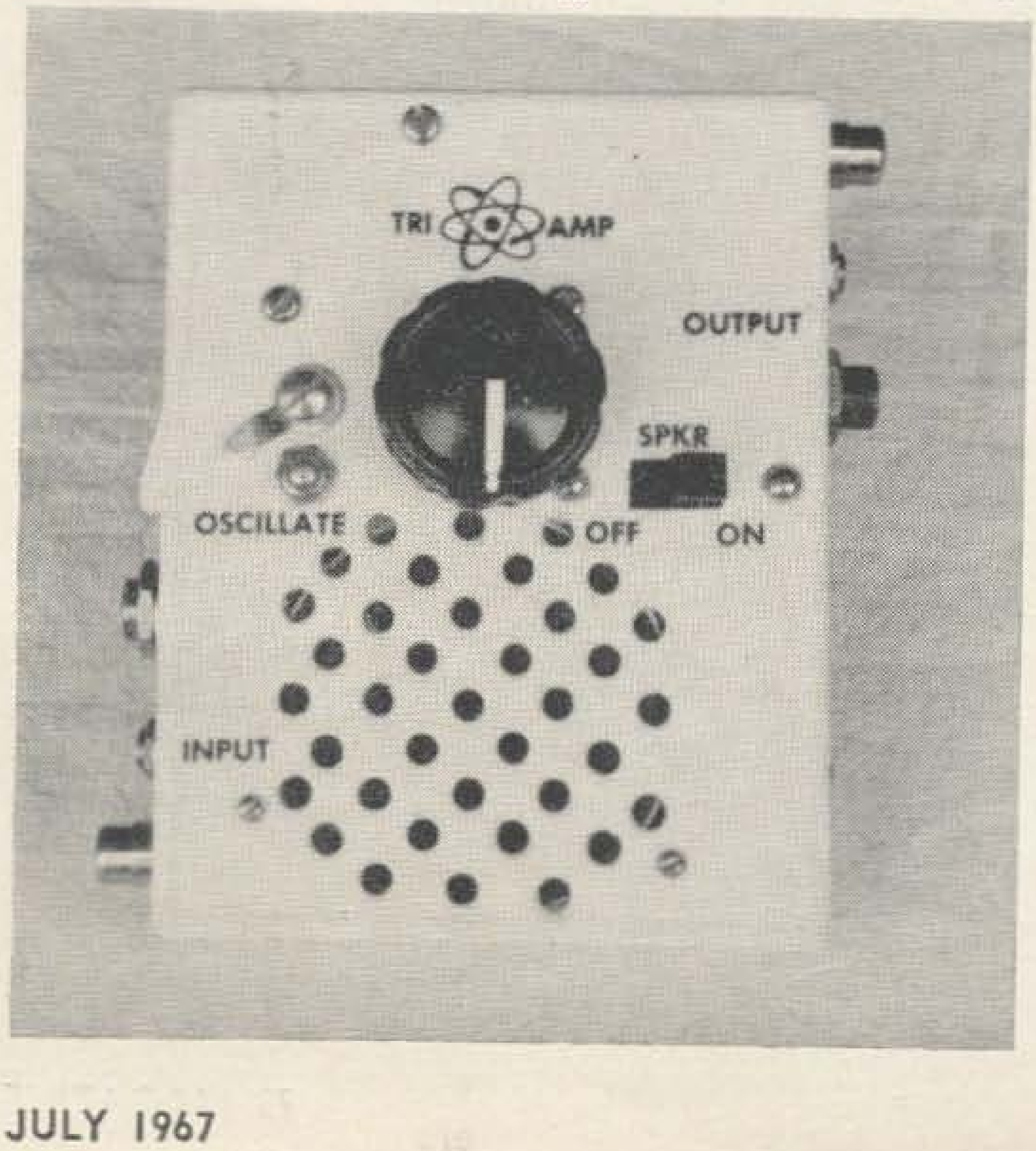
The schematic and photos tell most of the story. A Lafayette Radio PK-522 Three-transistor Subminiature Audio Amplifier is the heart of the Tri-Amp. The three different types of paralleled input and output jacks (J1–J6) allow you to use common audio connectors without the bother of adapters. The potentiometer (R1) is used as a volume and frequency control, with its attached switch (S1) used to turn the battery off when not in use. Switch S2 is the oscillator keying control. Switch S3 controls the built-in speaker, and resistor R2 is a minimum "dummy load" for the output transformer when the speaker is disabled.



The author's unit was built into a convenient-sized plastic box. You may prefer to use an aluminum Minibox, a wooden cigar box or an inverted baking tin. Next decide the types of connectors you want to use; you may prefer, for example, a coaxial microphone connector in place of one of the types shown. Also, there's no reason you can't have additional types of jacks. Mount the desired jacks, being sure to wire their shells together if the box is not metal. Decide where you'll mount the potentiometer, amplifier, speaker and the two switches. Drill numerous small holes in the case to act as a speaker grille, or cut out a 2" hole and mount a grille made from screen or perforated aluminum. Mount the speaker. Mount the potentiometer and switches in the conventional manner.

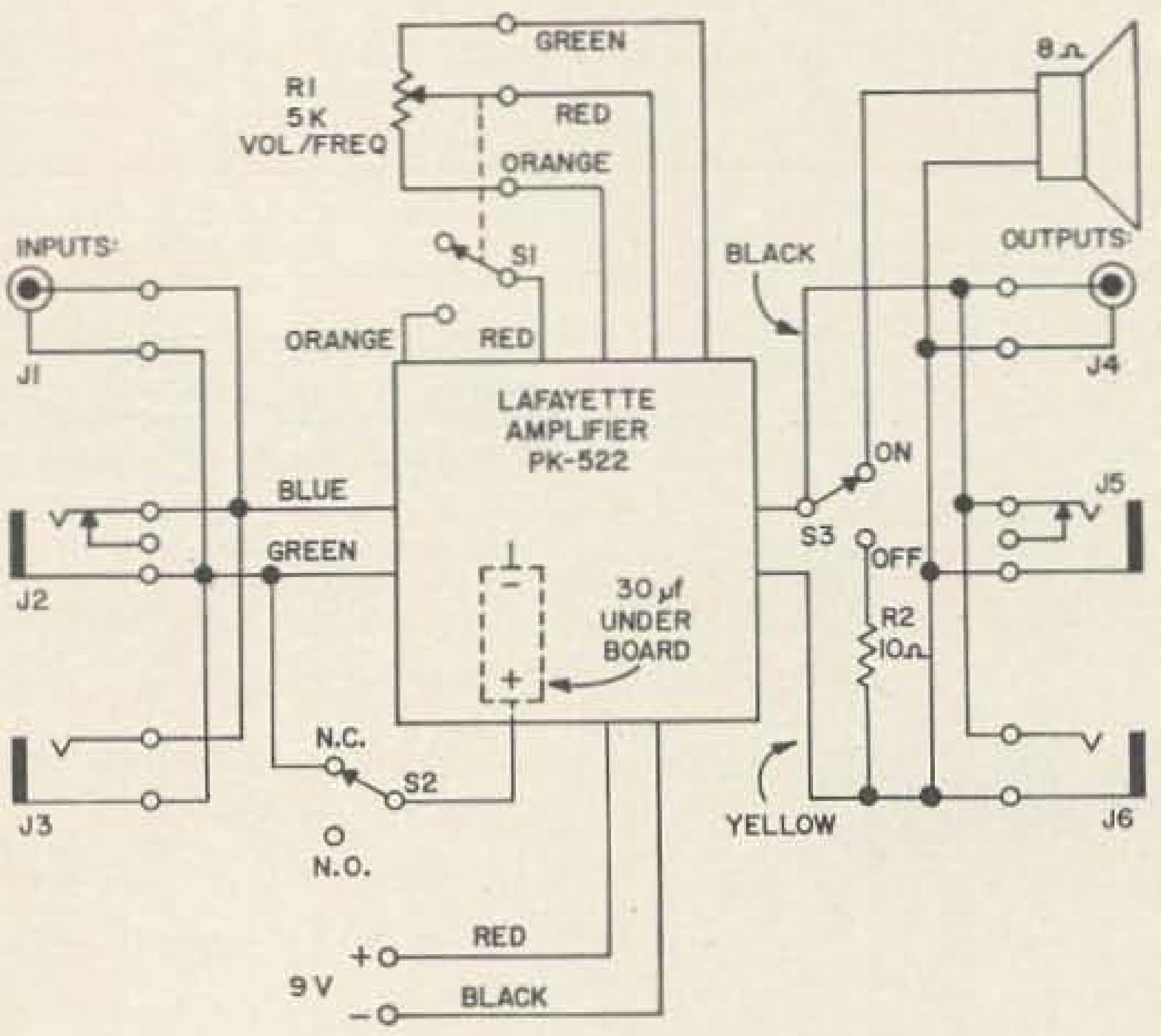
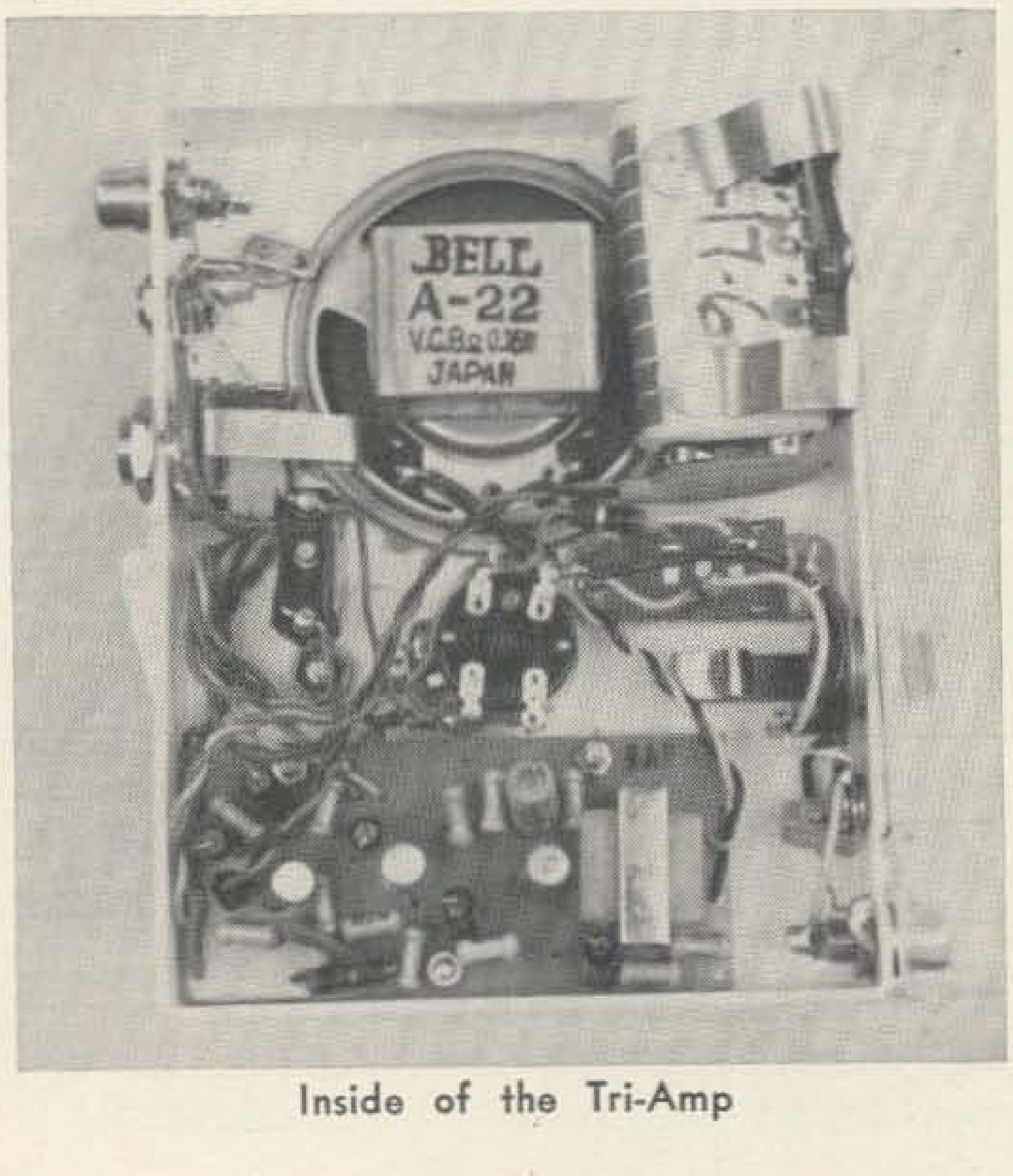


Fig. 1. Schematic of the Tri-Amp.

Now turn your attention to the amplifier. Look at the bottom of the unit. You'll find a lone 30 µF electrolytic capacitor soldered in position. This bypass capacitor is necessary to keep the unit from oscillating due to the internal battery impedance. Unsolder the positive end of this capacitor from the printed circuit board, and solder on a short lead, which goes to the common terminal of S2. The normally closed terminal of S2 is then wired to the green input wire of the amplifier, which is also wired to the input connector shells. The amplifier is mounted with three short screws and spacers, drilling small holes in the circuit board as required. The spacers may be made by cutting short lengths of metal or plastic tubing. The blue amplifier input wire goes to



Inside of the Tri-Amp

the "hot" terminals of the input jacks. The green, red, and orange wires are soldered to the potentiometer terminals, as illustrated in the PK-522 instruction sheet. The other red and orange wires go to the switch on the back of the potentiometer. The black output wire goes to the common terminal of switch S3, and to the "hot" terminals of the output jacks. The yellow output lead is then wired to the shells of all the output jacks, to a 10 ohm ½ watt resistor, and to one terminal of the speaker. The other end of the 10 ohm resistor is connected to the "off" side of switch S3; the "on" terminal of S3 goes to the other speaker terminal. Mount a 9 volt 2U6-type battery in a bracket made from sheet metal and connect it to the amplifier snap terminals. Put a knob on the potentiometer shaft, add panel labelling (decals or dry-transfer labels) and you are finished building the Tri-Amp.

Audio Amplifier: Normally the speaker is left "on". Turn the unit on with switch S1 on the potentiometer. The signal is connected to any of the input jacks (J1, J2 or J3) and the speaker is the output. Alternately, you can connect an ac voltmeter, oscilloscope or an external speaker to any of the output jacks; the internal speaker can be disabled by placing S3 in the "off" position. The output level is controlled by the setting of potentiometer R1.

Audio Signal Tracer: When troubleshooting an audio amplifier, the Tri-Amp, used as an amplifier, can tell you where the signal is getting stopped. Start at the front end of the "sick" amplifier, checking the grid of tube circuits, or the base of transistor circuits; go through each stage in succession. The signal strength should increase with each stage; if it decreases or disappears completely, you can look for the trouble in that stage.

Code Practice Oscillator: Turn the unit on and depress switch S2. Rotate R1 until the unit oscillates. You can control the frequency within a limited range by the setting of R1. When S2 is released, oscillation will stop. An external key can be used, but it must *break* contact to make the tone —just the opposite of the regular code oscillators.

Variable Frequency Signal Generator: A small solder lug may be placed near S2, mounted so it can be swiveled over S2 to hold it depressed. With S2 depressed and R1 set to the desired frequency, the output from jacks J4, J5 or J6 may be fed to any audio amplifier or modulator for troubleshooting. Start at the speaker of the "sick" unit, and work toward the front end, applying the Tri-Amp signal only to the grid or base of each stage. The Tri-Amp speaker should be disabled with switch S3. While the signal generated by the Tri-Amp is anything but a sine wave, it is nevertheless perfectly useful for this purpose.

Microphone Tester: Connect the mike to an input jack. When the Tri-Amp volume is turned up, and the mike held in the vicinity of the Tri-Amp speaker (S3 "on"), you'll get "feedback" (howling or screeching) if the mike is good. Also, you can talk into the mike and listen to the speaker to compare the strength and quality of different mikes. Remember, this little amplifier is not hi-fi, and neither is the small speaker, so don't be surprised if the microphone doesn't sound like the price you paid for it! Also, this test will not work with carbon mikes, which require excitation.

Phono Cartridge Tester: A crystal or ceramic phono cartridge has sufficient output to drive the Tri-Amp. Connect it to the input jacks (clip leads are fine) and lightly pass your finger tip over the needle(s). You'll hear your fingerprints if the cartridge is good! Some cartridges may require a full volume setting.

Telephone Amplifier: Using a suction-cup or flat type of inductive pickup attached to the telephone, the Tri-Amp will allow those around you to hear the whole conversation —especially useful for family long-distance phone calls, or business conference calls. Use the Tri-Amp as an amplifier, feeding the pickup to the input. In this use, a larger external speaker is desirable. Control the volume with R1.

You are bound to find other uses for the Tri-Amp. The author has used it as a tape recorder monitor, a low-power PA system and as a second channel amplifier for testing stereo equipment. It's inexpensive, easy to build, and much more useful than single-purpose devices. Build the Tri-Amp and find out for yourself!

. . . K6UGT

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Wide-range VHF/UHF Dipper

From 130 to 1300 MHz with transistors

Most dippers for amateurs that I have seen so far, not counting the $400 ones, stop around 200 MHz just as you are about to enter the fascinating UHF region. We do have the 432 and 1296 bands, so let's become more familiar with them.

After all these years of "grid-dipping" we find ourselves without a grid; so it just becomes a "dipper". To retain the prestige of a hyphenated name we can call it a "dipper-generator". Most grid-dippers have been used as generators, but this one has built-in modulation, variable input-output coupling, controlled Q, and several other interesting features. Best of all, it goes all the way up to 1296 MHz.

When this little unit is completed it may be used as a dipper for determining the resonant frequency of VHF and UHF circuits, as an indicating frequency meter with an adjustable Q-multiplier, a field strength meter and modulation monitor, a sensitive regenerative receiver, or a CW and MCW signal generator. You can also use it as a harmonic monitor or as a frequency transfer unit from one transmitter to another.

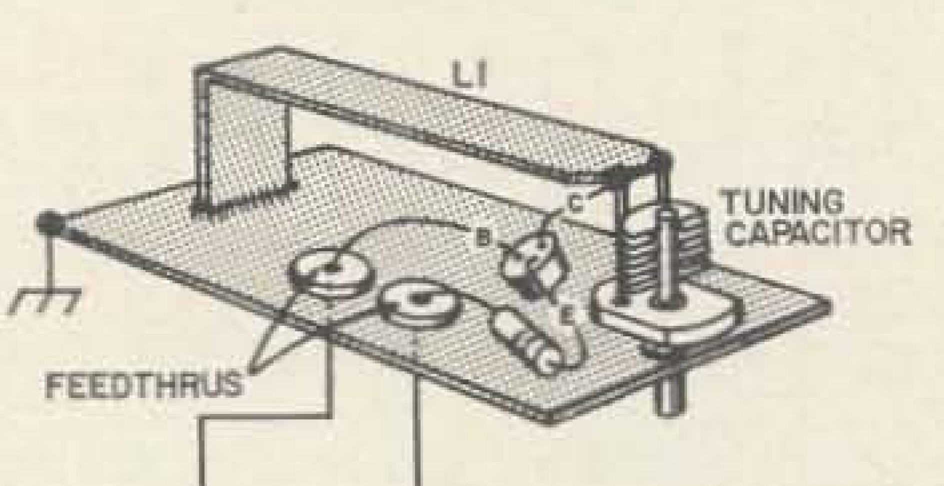

Fig. 1. Basic VHF/UHF oscillator circuit.

Several circuits must be considered when building a wide band instrument such as this. For example, you should change circuits around 100 MHz and again at 600 MHz, give or take a few hundred. Below 100 MHz coils are good; from there to 600 MHz you can use ¼ wave resonators, and after that the ½ wave job becomes rapidly the best method, up to 1300 MHz.

Plug-in rf heads

I have made no attempt to cover the complete range from 130 to 1300 MHz with one oscillator. By using plug-in tuners you may vary the components to suit the frequency. On 50 MHz for example, you may use a low cost transistor, a coil, and a 25 or 50 pF capacitor. From 100 to 600 MHz you use a better transistor, a ¼ wave strap, and a 10 or 15 pF capacitor. In the microwave region up to 1296 MHz you use the best transistor you've got, ½ wave lines, and a small butterfly capacitor of 3 to 5 pF.

If you break the circuit at the right point, it simplifies things—then the two halves may be connected through a miniature 7-pin socket and plug as shown in Fig. 2. All four leads are reasonably dead to rf. You can leave out some of the audio if you like, but it's very handy to have a modulated signal. If you're running triple or quadruple conversion, it's nice to know by it's modulation which is the signal and which might be a *birdie*. As far as dials are concerned—it makes calibration and reading a lot easier to have only one band or range per dial.

130 to 300 MHz oscillator

Fig. 1 shows the basic ¼ wave circuit; Fig. 2 the complete rf unit with control, af output and modulation.

The circuit itself is very simplified, as seen in Fig. 1; there being only one inductance, L1, and no choke coils. This should make for a flat tuning oscillator without power dips as it is tuned over a 2 to 1 range in frequency, and it does just that. With a 2N1726 in the circuit there is a smooth power output curve from about one volt rf at 130 MHz down to ⅓ volt at 300 MHz.

The rf coupling jack J1 couples the rf energy both in and out. This is because L1 acts as either a detector resonator or an oscillator resonator, as required. Actually this rf jack can be used as shown in Fig. 2. P1 is a variable link to L1 and is plugged into J1; J1A has a few inches of cable between the white ABS plastic front panel and the copper clad bakelite sub-panel. Because the phono plug is rotatable, a nice variation in rf coupling can be obtained. The coax cable and J1B get the rf out to the front panel for easy use with antennas, probes, cables, etc.

The emitter goes to a 1K resistor then through a coaxial bypass capacitor which gets the dc in and out and leaves the rf behind. These feed-through type bypasses are very necessary—do *not* skimp on this item.

300 to 600 MHz unit

Fig. 3 shows that this unit is essentially the same as the last, except for dimensions. I used a 2N1141 here although many others will work too. It tunes smoothly from 300 to 600 MHz; use the variable link feature as in Fig. 2.

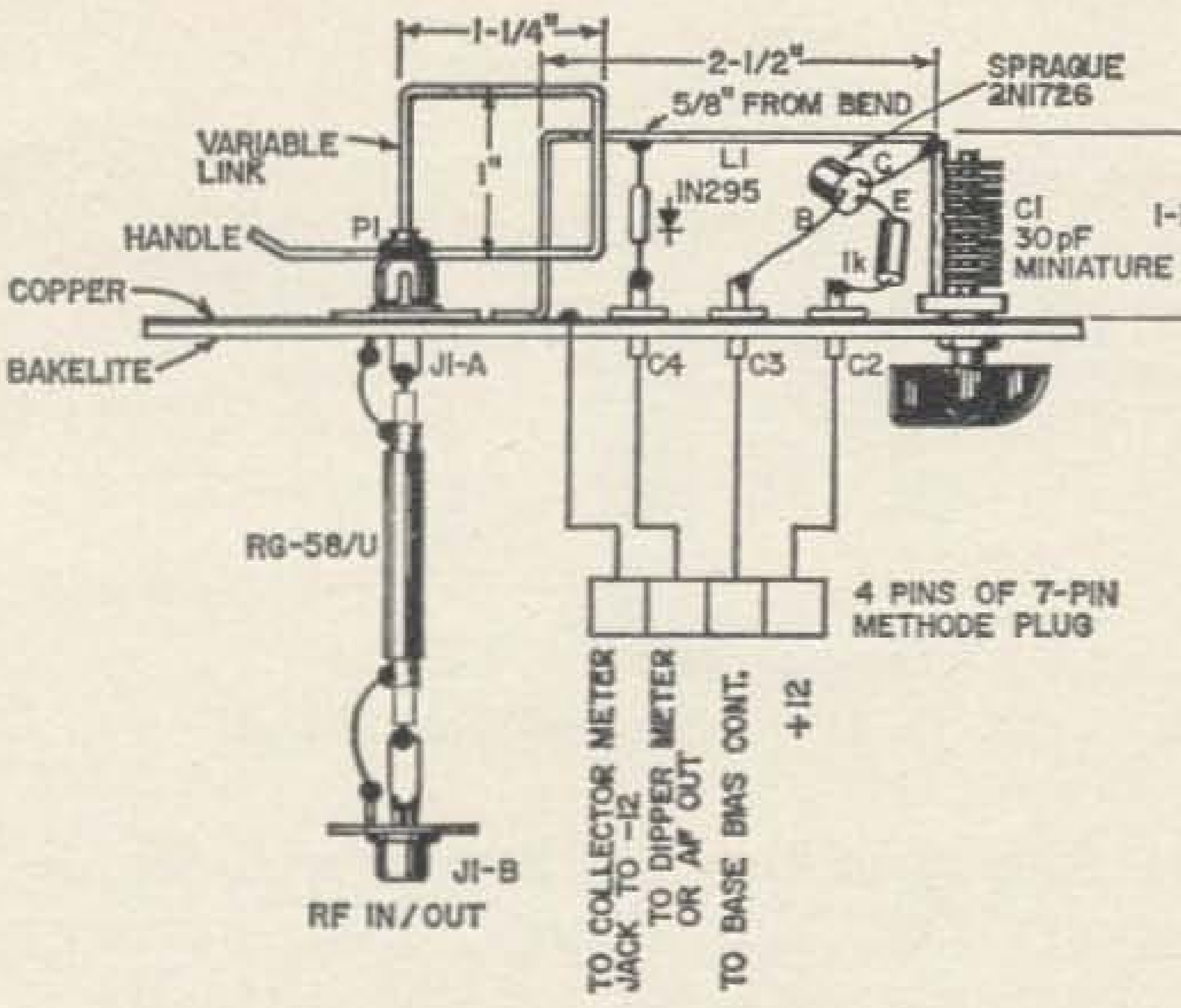

Fig. 2. 130 to 300 MHz tuning head.

900 to 1100 MHz

For this frequency range we need a little different approach. From Fig. 4 we can see that we now have two ½ wave lines on which low-voltage points can be found to attach the base and collector resistors. Most of the ¼ wave portion of the lines on the transistor end are actually inside the case. The places where the base resistor and the 500 ohm collector resistor are attached to the ½ wave lines can be found, or checked, by watching the rf meter and touching the lines with a pencil. At the proper point no change occurs in the rf output; sometimes it even increases.

The diode circuit of Fig. 6 is not ideal but it works. I have several of these around

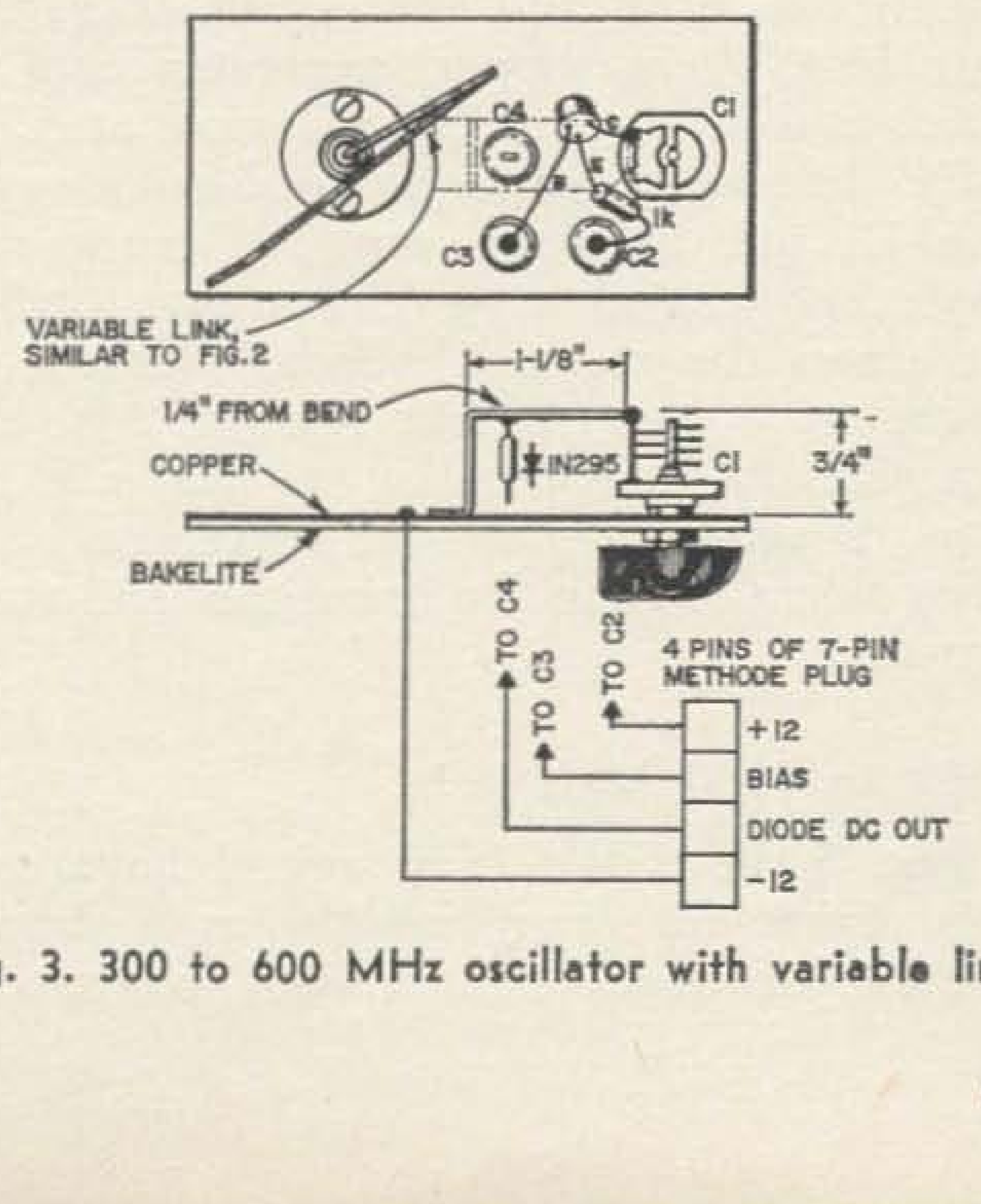

Fig. 3. 300 to 600 MHz oscillator with variable link.

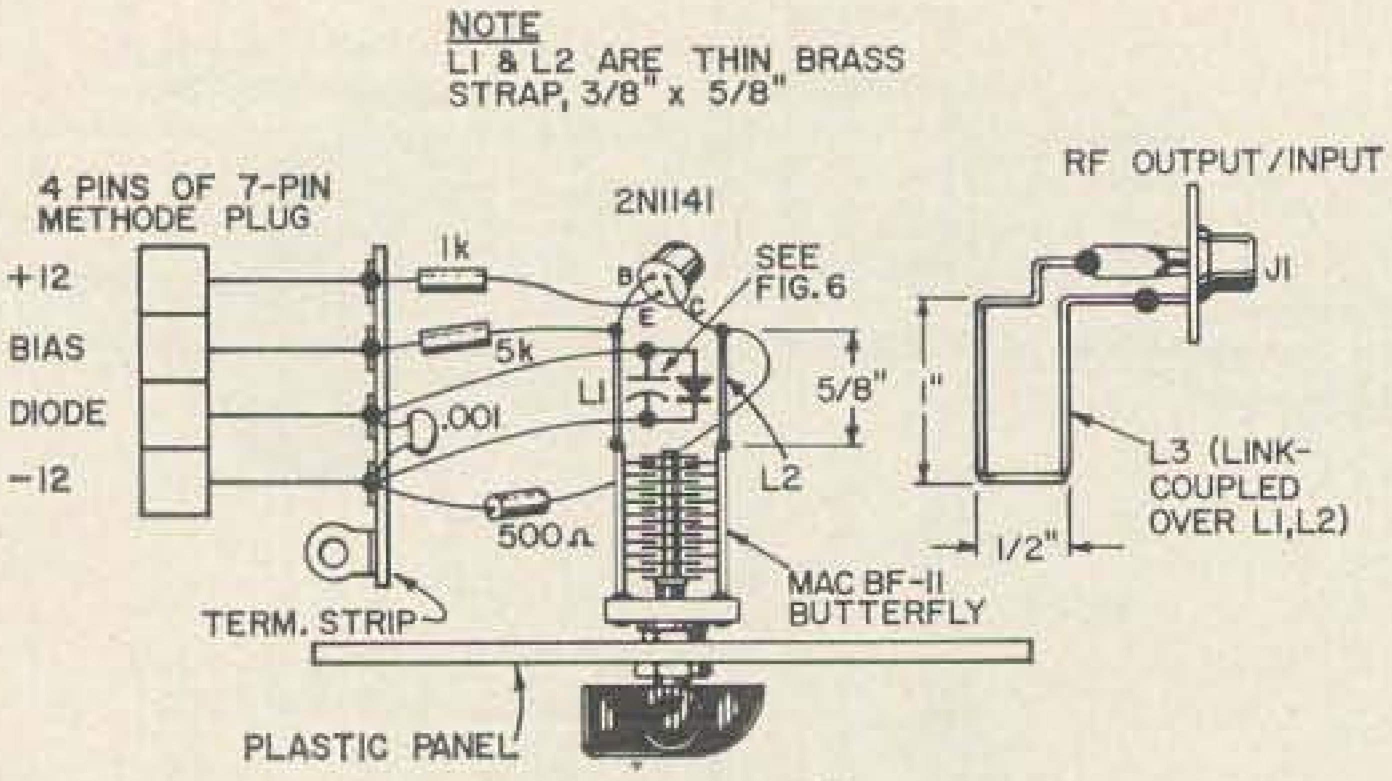

Fig. 4. 900 to 1120 MHz oscillator circuit.

the shack and they work very well for detecting 1296 Mhz energy. Even ordinary hook-up wire will support the assembly of Fig. 6 about ¼ inch below the rf lines; you will soon find the best spot with the unit oscillating. The rf input jack and associated loop L3 are fastened so that L3 is in place over L1 and L2, and it's coupling can be varied in a semi-fixed fashion.

At this point we should mention that as a "dipper" the circuit is still working fine; also as a signal generator. It also serves as an rf detector but as the frequency gets up into the microwave ranges it is not quite as good as the tuned rf detectors featured in another article in 73 Magazine. Ideally, you should use the dipper on microwaves as a modulated generator and couple it into the unknown circuit; then a probe attached to *another* tuned detector should be coupled into the unknown circuit. There are quite a few variations using the dipper as an oscillator that you will find useful if you use a little ingenuity.

In the microwave detector line, my experience indicates that the plunger tuned coax cavity line is the best, the tuned trough line next, and the circuit of Fig. 5 next best. As a dipper, generator and regenerative receiver it is still good at 1296 MHz. Just to check, I plugged an antenna into J1, put an audio amplifier across the diode and copied a small transistor oscillator across the room. The base bias control works as a very smooth regeneration control. Smooth regeneration, as we will see later, is very important for maximum sensitivity when looking for harmonics and weak signals.

1200 to 1300 MHz unit

Fig. 5 shows the 1296 unit; I have used this circuit for many months as a dipper, variable-frequency generator, modulated-oscillator source, and as a regenerative receiver for 1296. In this circuit I used a negative dc grounded collector return. Don't short the base plate to the modulator base. Note that one end of the diode is tied to the base plate; this lead is brought out as the minus 12 volt lead. You can also use it ungrounded as in Fig. 4—you can use a 5th lead in the 7-pin plug and keep the diode isolated from the minus 12 volts. Suit yourself, just remember that *all* units have to use the same leads, as they all plug into the single modulator rf unit.

I just plugged a little 12 element Yagi antenna into this dipper and it works nice and smooth as a regenerative receiver. Please note, this is only for test purposes around the shack. You can hear with it, but not *that* good!

I had to put a choke in the cathode lead on this one, and tune it (the choke) with a piece of copper foil. A choke was needed in the collector lead too; after all this is the L-band microwave region.

The rf input jack J1 is mounted on a bakelite upright. Be careful of vertical metal pieces attached to the base plate; they only need to be two inches long or so to become Marconi antennas on 1296! Bring the base resistor and the collector choke away from the lines in a perpendicular fashion—it helps.

The total length of the diode and it's two leads, from ground to the tiny .001 capacitor C2 is about 1½ inches; it is spaced about 3/16 from the ground plane. The bottom edges of the lines are about ½ inch

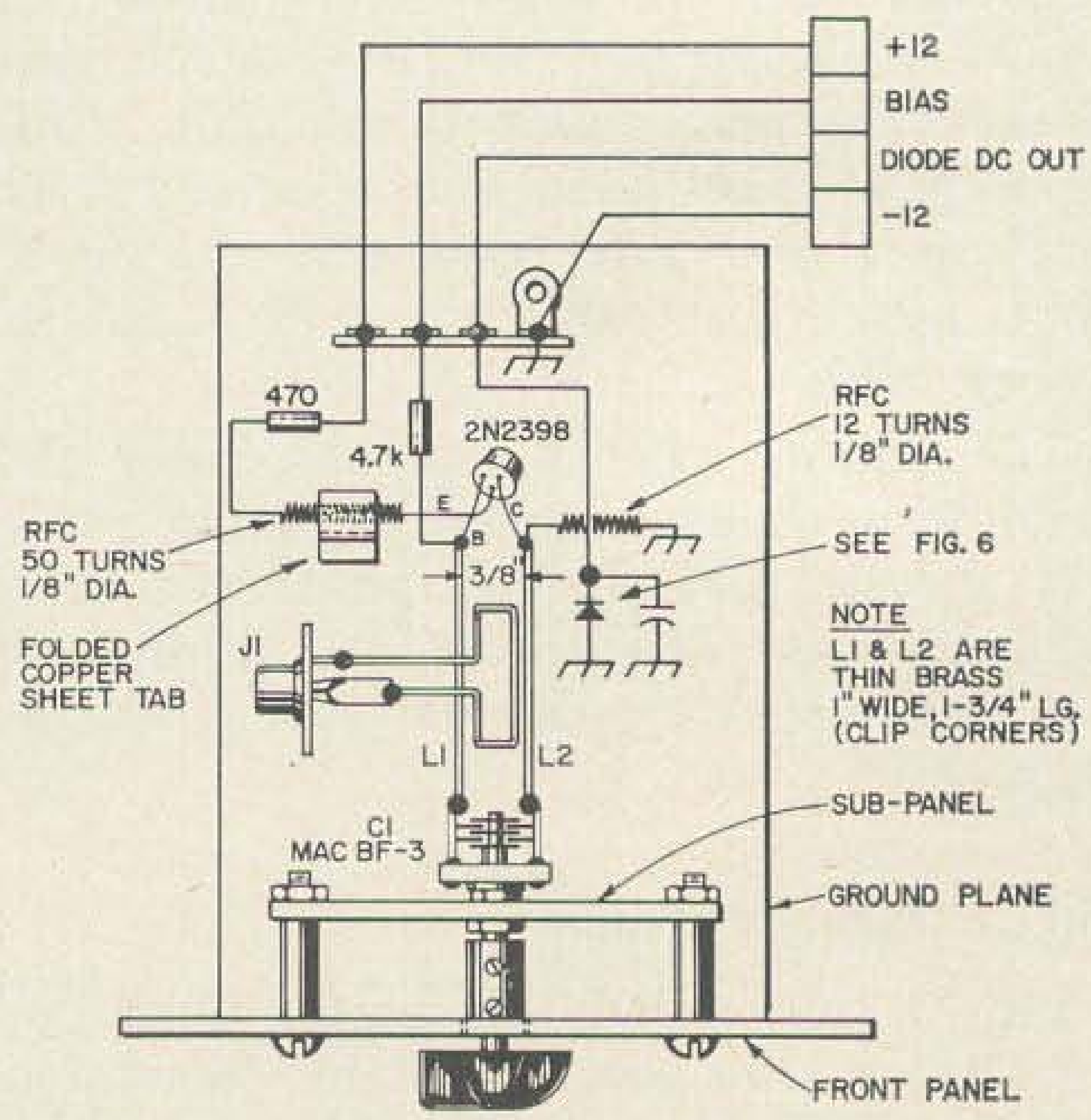

Fig. 5. 1200 to 1300 MHz oscillator and layout.

from the ground plane.

The transistor presently in the unit is a selected 2N2398; about half of the dozen or so I have here go to 1300 MHz, a couple go to 1400, and the rest to 1100 or 1200.

Don't be alarmed that L1 and L2 are longer than those of Fig. 5, the smaller butterfly capacitor does that. You can make a choice as to capacity, length of brass, and desired rf range. You can use a 5 or 10 pF capacitor for C1, shorter lines, and tune over 1300 MHz. In fact, I have reached 1600 MHz with this circuit!

Modulation and control

Fig. 7 shows the circuitry for bias control, modulation and audio. Don't let it scare you. It's just the same old deal of doing what has to be done for control purposes, and from then on just turning the knobs to get what you want.

I have found that a very good plug and jack can be made by using an ordinary 7 pin socket and a Methode 7 pin bakelite plug. Unfortunately, I have never found a miniature tube with a bakelite base; they are always made of glass, so you will probably have to buy the 7 pin plug.

The minus 12 volt lead goes to the collector meter jack and then to the minus 12 volt of the power supply. This puts the rf panel ground at minus 12 volts and the audio af panel at plus 12. Of course, you don't have to ground the plus 12 on the audio panel, I just have that habit.

The base return goes through a 5K resistor and then to the bias control potentiometer. The diode dc/af output goes to af jack J2 and the meter M1 through the meter sensitivity control. This potentiometer is selected to suit the meter; I have used a 10 K unit with a 500 microampere meter. Note that part of this resistor should be used when af output is desired, otherwise the meter shorts out the af.

Audio modulation

You might think that just about everyone knows how to build an audio oscillator. Mine did oscillate, but the tone! And the wave-shapes, hoo-boy! I used an af transformer with the collector on one side and the base on the other. So, once again to the handbooks and once again practically zilch. I did get the idea for a phase shift oscillator out of one of them, even if the

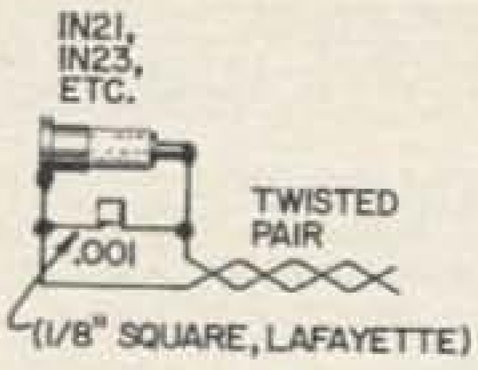

Fig. 6. RF detection loop for half-wave oscillators.

circuit didn't work at first. After considerable experimentation I can recommend the circuit shown in Fig. 7. It works! In addition, the modulation may be adjusted to exactly 1000 MHz. This is very useful as many microwave test amplifiers have built-in narrow band af audio filters centered on 1 KHz. There is also a modulation gain control. This helps if a nice tone is desired.

Almost any small transistor output transformer will do the job for the af transformer, but don't go over 400 ohms impedance in the collector winding. Note the 1K resistor between the collector and the phase shift network; this reduces feedback to the base and may have to be increased or decreased depending on the gain of your transistor at 1000 Hertz.

I usually run the rf current (collector dc) between one and two mils with the 2N1726 transistors; other transistors may take more. A number 48 bulb in the collector lead may save you a $3 transistor. With the 2N1141 the rf output keeps climbing up to 4 or 5 mA collector current. You will readily find the best place to operate. When the collector mils keep climbing and the rf output starts to drop off, back off!

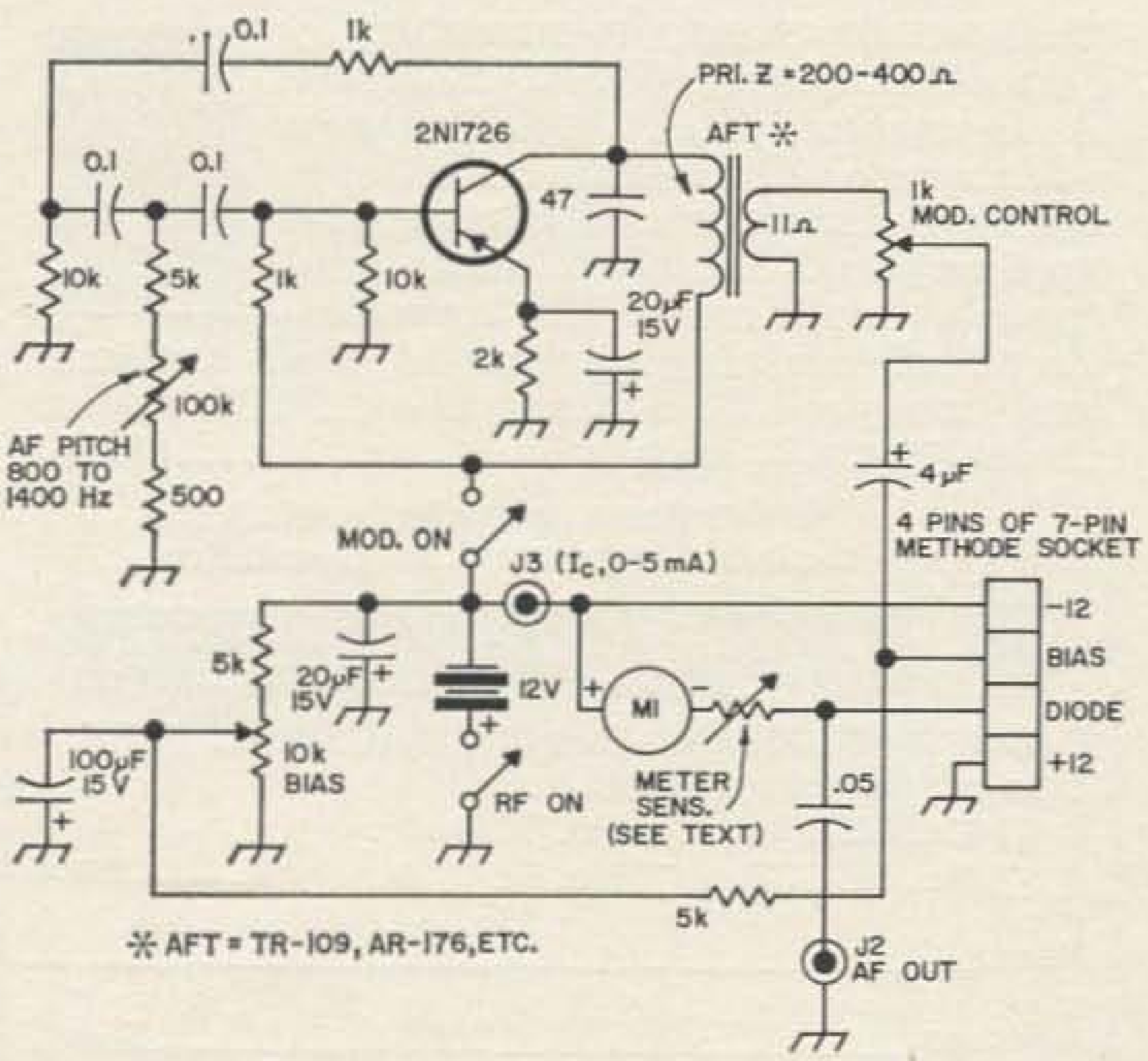

Fig. 7. Power control, modulation and audio circuitry. This circuit is used with all the rf heads.

Operation

Dipper

As a general rule "dipping" is easier in the VHF region and gets more difficult as you go into the microwave region. On HF you couple one coil end on to the other; on VHF you bring it near, and on UHF you have to work to get the necessary coupling or use a probe.

With nothing near the dipper, swing the dial through the range to make sure it has no dips of it's own. The VHF/UHF units without chokes described here do not generally have such dips. Unwanted dips can be caused by chokes, resonant feed wire lengths, metal supports, and rf links and cables among other things.

When you do get a dip after coupling to the unknown circuit be sure and change the resonance of that circuit for a final check while watching the dipper meter. If the test circuit is a tuned circuit vary the tuning and see if the dipper will follow it—it *should*. If all else fails, use the dipper as a generator. Since it is very difficult to get the far end of a cable matched exactly over much of a frequency range, *expect* to find external dips in the dipper when using a cable.

Indicating frequency meter

Always keep the transistor plugged in and the base bias at zero so the diode is doing the work. When you advance the bias, collector capacity will cause the dipper frequency to change a little—more with some transistors than others.

For finding a weak signal you can use regeneration by turning up the base bias, but watch out for slight frequency changes. This regeneration can be very handy for finding weak oscillators or hard-to-find rf energy. Use the rf input loop with care; the least coupling is the best. Remember that some cables and terminations will detune L1.

Field strength meter and modulation monitor

The first part is obvious; use a small antenna or probe, get some signal in, and go ahead. Do not use any base bias to start with. If you are working with a very weak signal you might have to push the bias up for regeneration.

The modulation monitor is simply our

often-described system of diode detector, transistor amplifier, and padded ear-phones. You can actually hear what your own transmitter sounds like to others. I use it on every new rig and after every circuit change. You don't need much of an antenna or probe when listening to your own rig; don't overload the diode when checking modulation. In fact, use light rf coupling and plenty of audio gain to hear yourself as others hear you.

Regenerative Receiver

Plug an audio amplifier into J2, Fig. 7, advance the bias control, and tune. I have heard several UHF TV stations from Massachusetts up here in Peterborough, so it is really sensitive. One nice feature of this circuit is that the regeneration turns into oscillation very smoothly. Stability is good too. You can heterodyne a crystal controlled two meter signal and copy CW with it. Not bad for a 144 MHz blooper!

To transfer signals from one transmitter (A) to another (B), just tune in A, then shut it off; listen for B and tune it in. That's all. Harmonic monitoring is easy; just tune over the suspected range in the regenerative condition. It is particularly good because only *one* frequency is present in the receiver. This is *not* the case when using a super-het receiver for monitoring harmonics.

Signal generator

One of the big features of this circuit is the presence of an rf meter right in the proper place circuit-wise. The modulation also helps, especially when running triple or quadruple conversion in a receiver. The modulation control is very convenient, at full on its spreads the signal across 20 or 30 kHz on a selective receiver. For checking a difficult to get at circuit, use a cable and probe, either capacitive or inductive, to get the signal into the unknown circuit.

I often use one of these units for antenna and receiver tests. I just plug a little two element beam into the rf jack and set it out away from the shack; often one or two hundred yards away. There is nothing like tuning up pre-amps with your antenna system connected. For antenna tests it is used in reverse.

These are most of the uses that I have found for these dippers; if you can find any more, let me know. . . . KICLL

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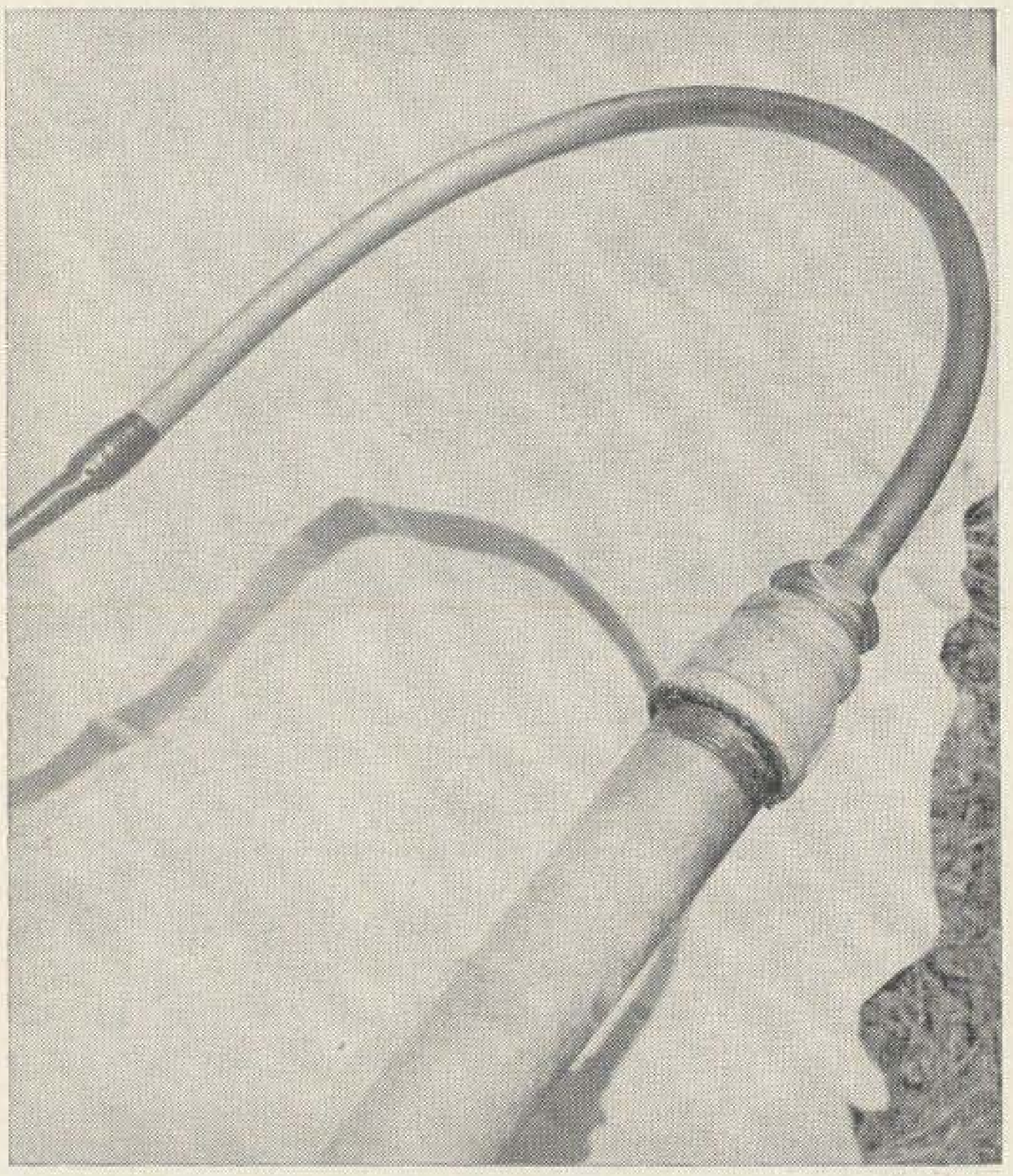
A Few Tower Hints

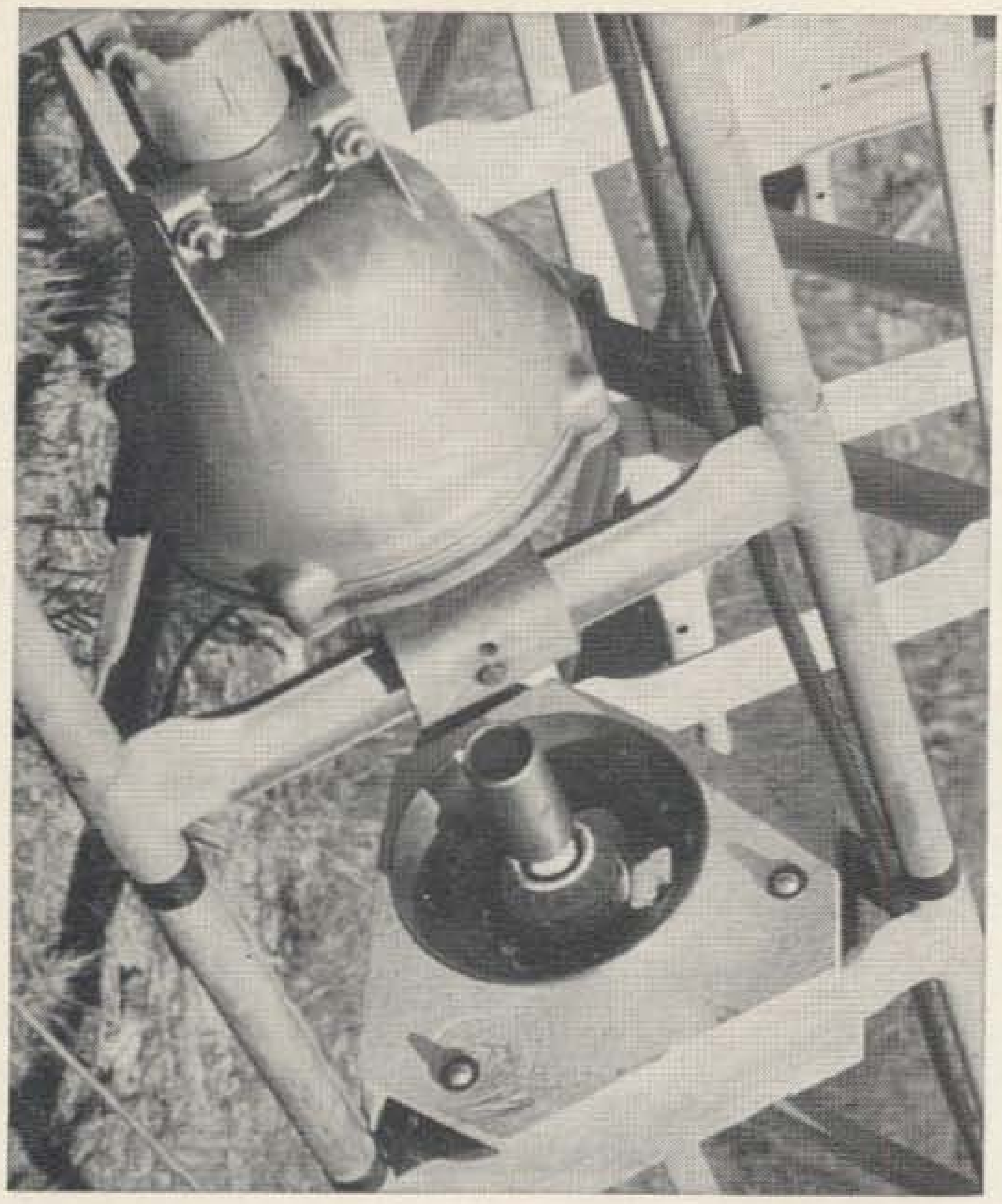
to improve your antenna installation

If you are troubled with freezing and rusty rotators, sticky masts or damaged cables at the top of your tower, this neat solution by Ted Woolner WA1ABP may be helpful. Ted has included just about everything but the kitchen sink in this installation to make sure that the rotator and wiring stay high and dry during all types of inclimate weather. With this type of protection, almost no moisture can get into the rotating parts, the control wiring doesn't corrode and the coax stays dry. What little



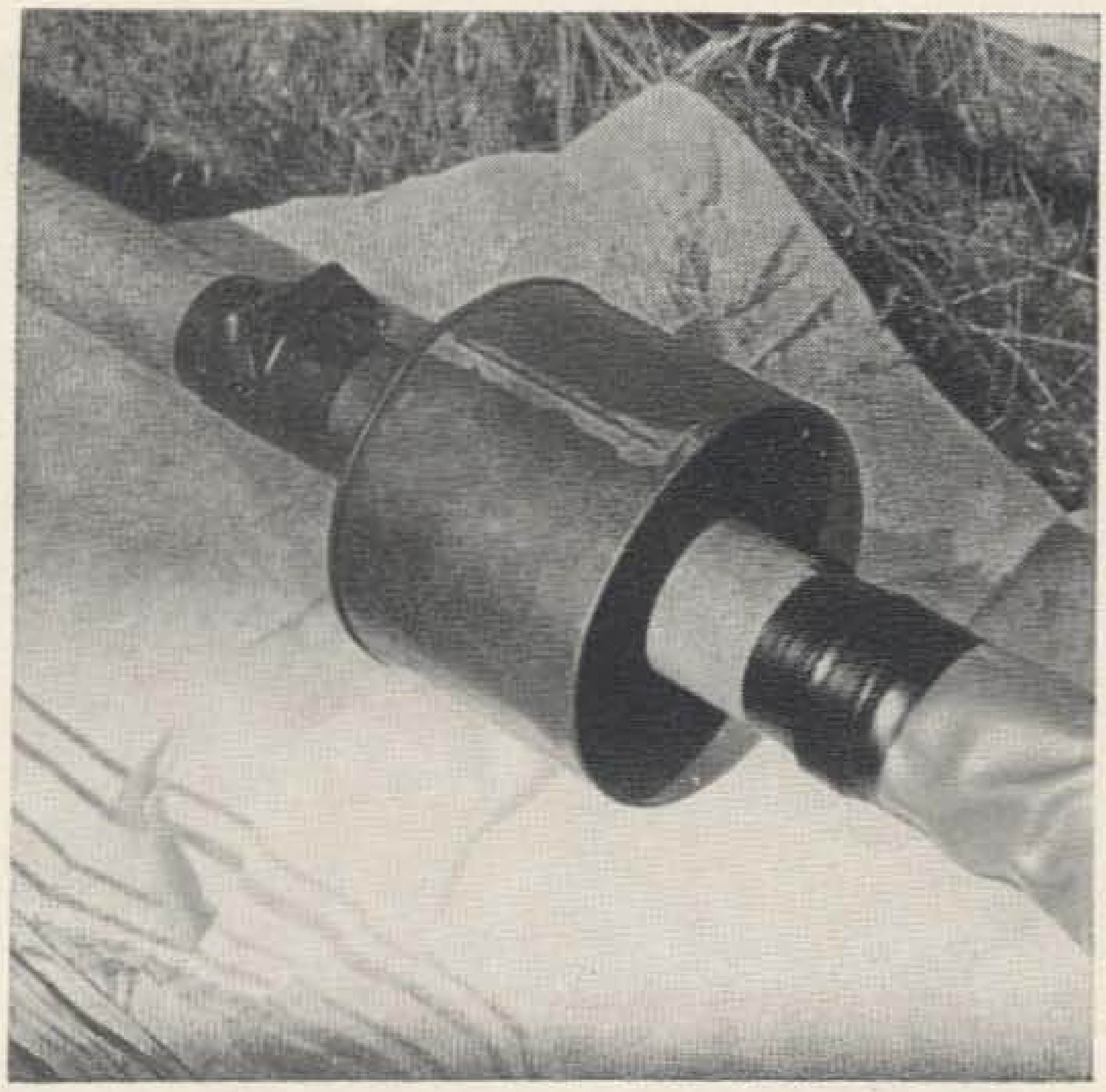
Here's the top of the mast with a piece of ⅝ inch copper water tubing through which the coax passes from the driven element, down through the mast to the rotator with slack left, then is taped to the side of the tower.

I used one and one-half inch electric conduit for the mast and found that for it to run true through the tower top, it was necessary to have a piece of aluminum machined to fit inside the mast where I bolted it in two places at 90 degrees. I found that the right size aluminum to use on my AR22 rotator was 2-1/16 inches in diameter and not 1½ inches as suggested by C.D.R.

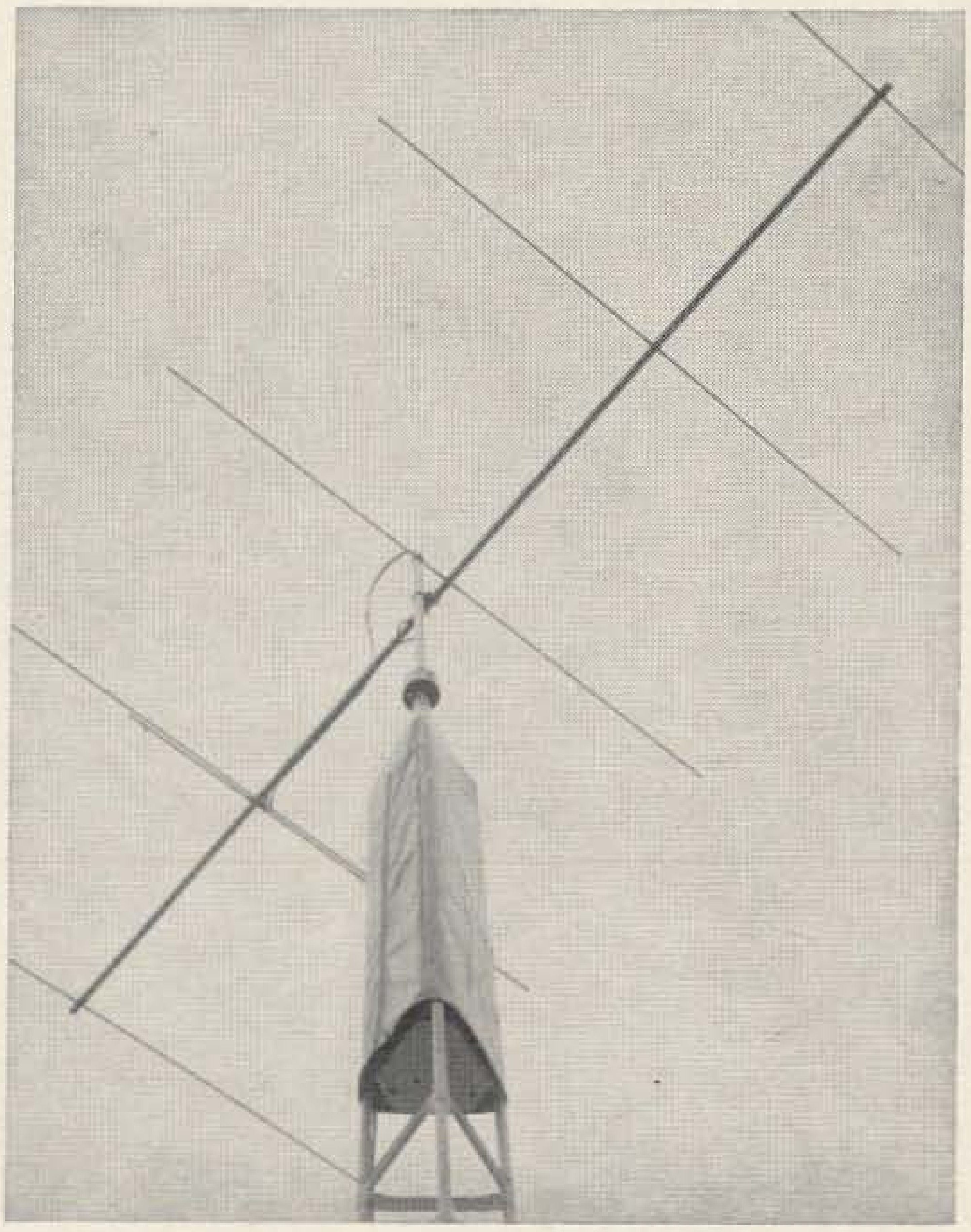


Here is an electrical heating unit made by the Wiegand Co., 7500 Thomas Blvd., Pittsburgh, Pa. It is called the Chromalex and operates from 115 V ac at 150 watts. It uses a standard screw base and is best mounted in a porcelain socket. The power line can be the outdoor plastic-insulated Romex normally used for outdoor lamps, etc. Inside the shack, an electric light bulb can be placed in series with one leg for cutting down on the amount of heat and a fuse could be placed in the other line. A fuse in each line would give full heat at the unit.

This is the nice wind, rain, and ice-proof tent or glove I had made by the Rayco Automobile Top Co., here in Shrewsbury. It is equipped with a full-length zipper to allow work or removal of the rotator. It fits the top of the tower snugly and is taped to further insure that water does not leak inside, though it can't since the copper shield is over the top of it. At the time these photos were taken, I had not installed the eyelets at the bottom of the hood, where it will be tied in with shoe laces.



A copper umbrella that is made to fit snugly over the top of the mast keeps water and ice out of the top bearing of the tower. It is held in place with an automobile radiator clamp and taped as well.



Here's the whole tower installation.

condensation there may be is taken care of by the built-in heater; Ted has thought of just about everything in his *Tower of Babylon*—1966. The photos tell the whole story.

. . . WA1ABP

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Monitoring with an Oscilloscope

Do you own an oscilloscope? Do you use it to monitor your transmitter? One of the questions I hear most often follows the lines of "I've got a Fuzzyline Oscilloscope Mark II; how can I use it to monitor my transmitter?" This is a good question, but the answer isn't too easy because it depends on what you want to see.

Basically, there are two types of pictures that an oscilloscope can show of your transmitted signal and two types with a received signal. The first, and easiest to obtain, is the *envelope* pattern, so called because it shows the limits of rf voltage with all changes in amplitude. The second, and harder to get pattern, is the trapezoid (AM) or *bow-tie* (SSB), which shows the relationship between modulation voltage and carrier voltage. Fig. 7 shows examples of these patterns (see 73 Magazine for July, 1963, page 80 for more typical patterns). When the oscilloscope is connected to a receiver, it may be used to obtain a display that follows an amplitude to radio frequency relationship.

The envelope pattern shows how much rf your transmitter is putting out, what audio signals are doing the modulating, the percentage of modulation, and any hum, noise, or distortion. It's not very useful for SSB. The trapezoid, or bow-tie pattern, tells you nothing of your audio wave forms; it just shows the relationship between the af and rf voltages, modulation percentage, and the modulation capability of your transmitter. It can also tell you if your transmitter is tuned properly or if it is a faulty design not capable of good modulation.

The panadapter display obtained with receivers shows a portion of the frequency spectrum horizontally and signal strength vertically. It displays nearby signals, sidebands, and can provide approximate readings of modulation percentage.

Obtaining the envelope pattern is easy with nearly all oscilloscopes, but few will give

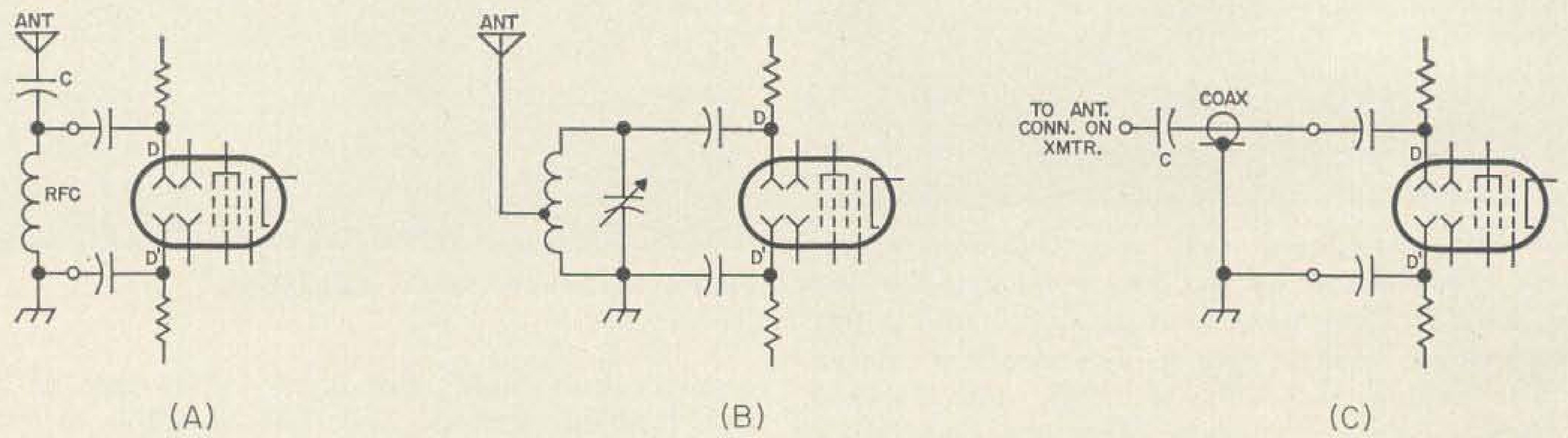


Fig. 1. Methods of connecting directly to the deflection plates of the oscilloscope. The value of the coupling capacitor C should be adjusted for proper pattern size. The deflection plates are indicated by D and D'; the resistors and capacitors associated with these plates are for isolation and are usually built into the instrument.

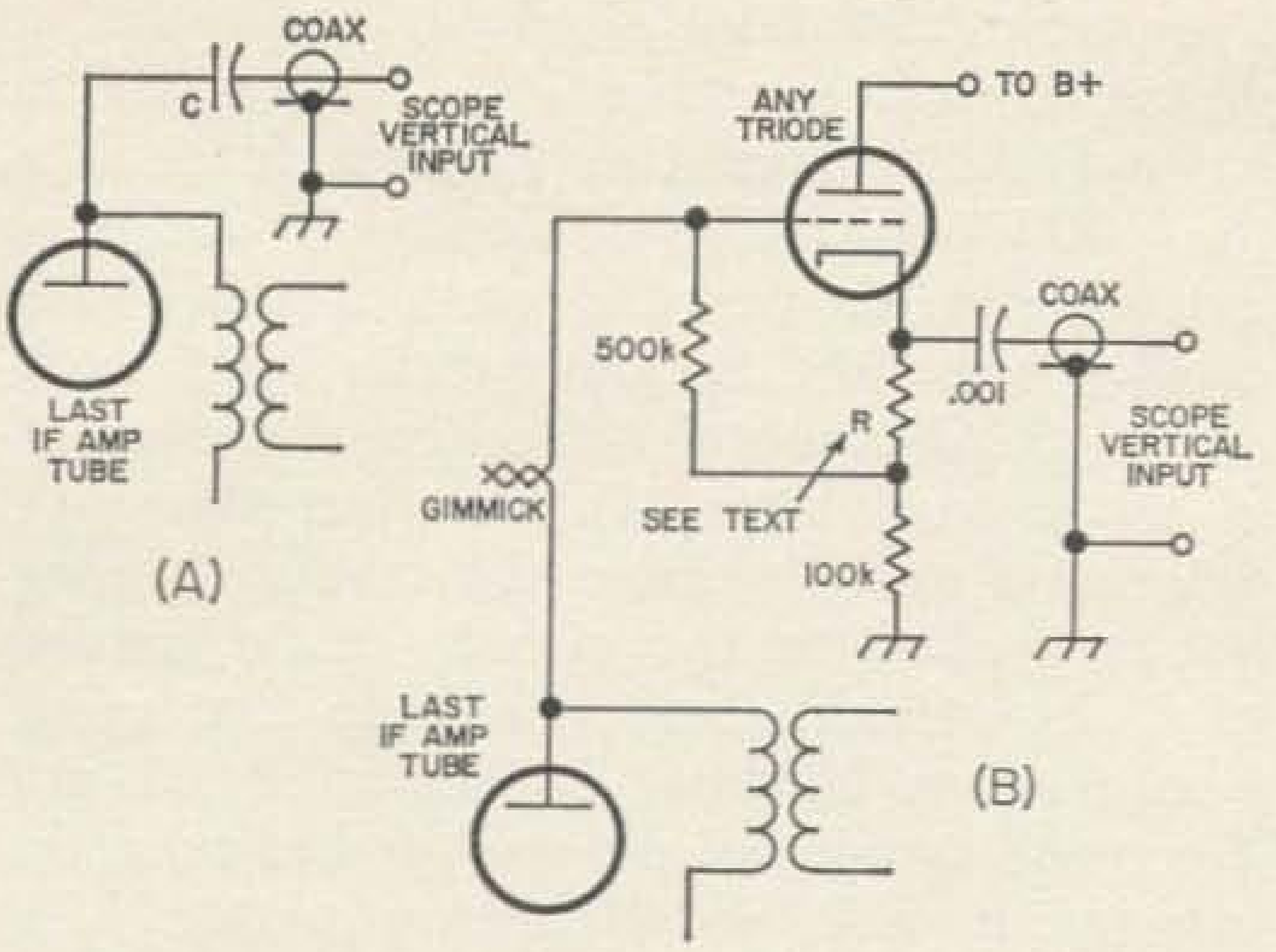


Fig. 2 Connecting the oscilloscope to a receiver for monitoring purposes. In A the coax cable should be as short as possible and permanently connected into the receiver. The triode cathode follower shown in B effectively isolates the receiver *if* stages from any loading due to the cable into the scope.

the trapezoid without some added work. Practically all scopes provide direct connection to the vertical deflection plates and a sweep voltage for the horizontal plates. If we feed some of the transmitter rf directly to the vertical plates and set the horizontal sweep for full screen width, we have our envelope pattern! Where do we get the rf? There are various ways to pick up the necessary rf, but the arrangement in Fig. 1A is the easiest. If the capacitor C can be readjusted for pattern size when changing bands, this is an all-band circuit. However, if the antenna is very long, you may find yourself monitoring a neighbor's CB transmitter! Fig. 1B solves this problem by using a tuned circuit instead of an rf choke—it requires less pick-up antenna and pattern size can be adjusted by tuning—but, it is a one-band affair. RF for the circuits of Fig. 1A and 1B may also be obtained by loosely coupling the pickup wire to an antenna tuner. Do not try to get the rf from the transmitter tank circuit—it is dangerous and may cause problems with TVI.

Fig. 1C shows a direct pickup from the feedline. This is more difficult and low-power transmitters (under 75 watts) may not have enough rf for a good size pattern. For high power the size of the coupling capacitor must be determined by experiment. The blocking capacitors shown in Fig. 1 isolate centering voltages present on the deflecting plates from the rf pickup circuits. They are usually included in the oscilloscope —if not, add them.

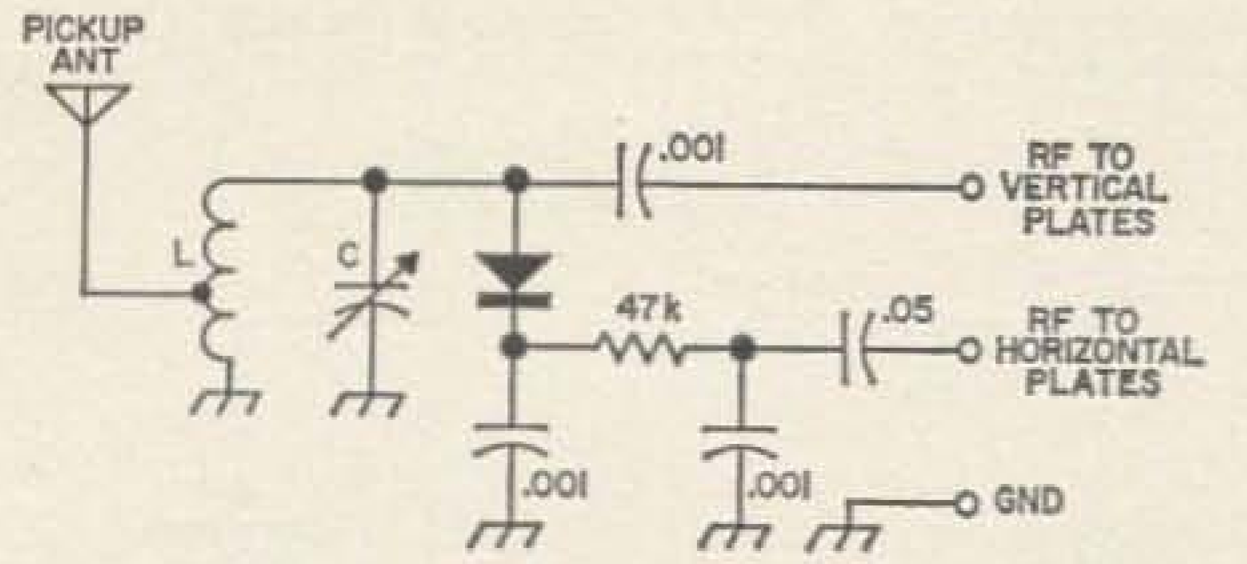


Fig. 3. This circuit provides a trapezoid pattern without any direct connections to the transmitter. However, it has several serious limitations as noted in the text.

Any good commercial oscilloscope may be used with a receiver to obtain an envelope display, provided the vertical amplifier frequency response includes the receiver's *if* frequency. The necessary connection to the receiver is shown in Fig. 2A. The value of the capacitor C should be as small as possible to give a readable pattern on the screen. If it is much larger than 10 pF the *if* circuits must be re-aligned. A much better scheme is shown in Fig. 2B, but it requires the addition of an extra triode to the receiver. With the cathode-follower output the shielded wire to the scope can be fairly long and the circuit has a negligible effect on the *if* stage. The cathode resistor depends on the tube type used and should provide normal class A bias; the gimmick coupling capacitor is just large enough to provide a usable pattern.

It should be pointed out that any received modulation pattern is subject to errors due to both receiver selectivity and selective fading. In both cases significant sidebands may be cut off or drastically reduced. For the most accurate pattern only broad selectivity (10 kHz or more) and a non-fading signal will do. In spite of this, severe modulation faults can be detected with restricted bandwidth and the effects of selective fading can be averaged out.

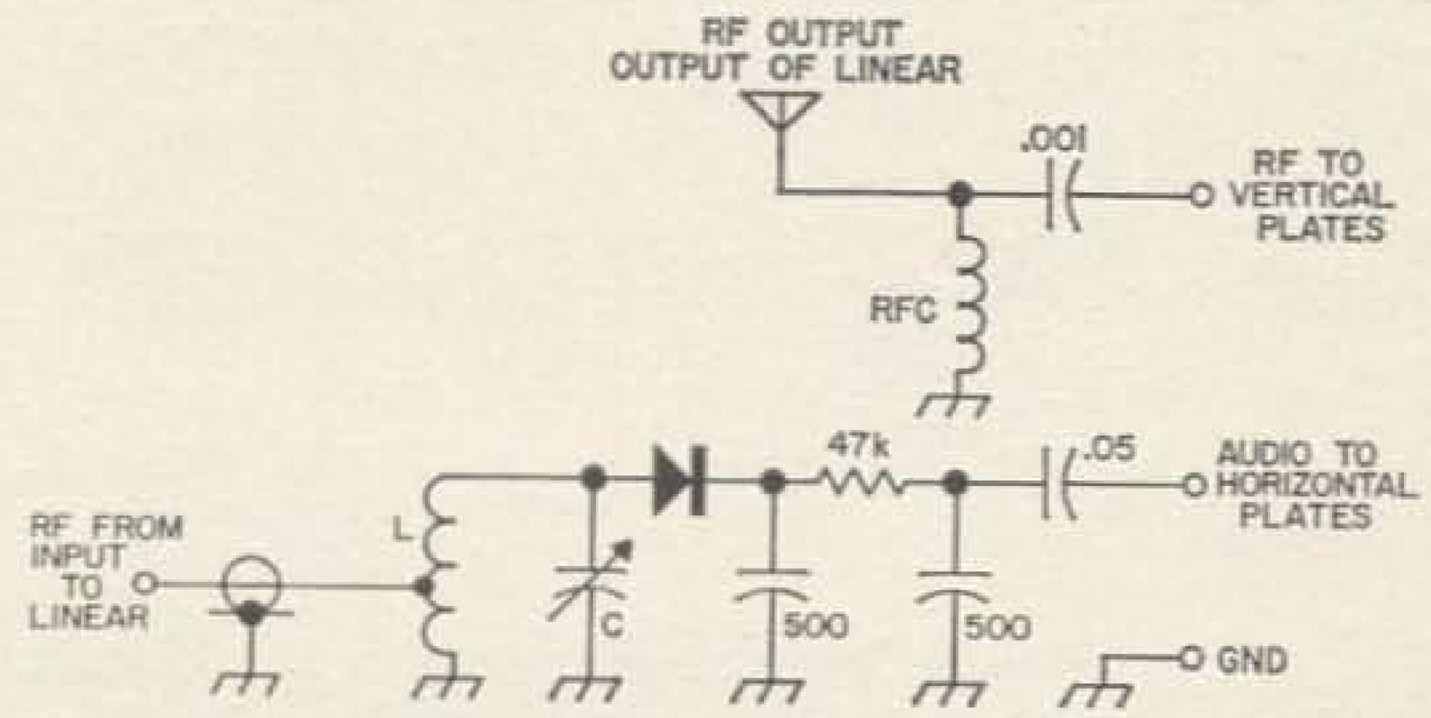


Fig. 4. This trapezoid circuit is very useful for checking the linearity of linear sideband amplifiers.

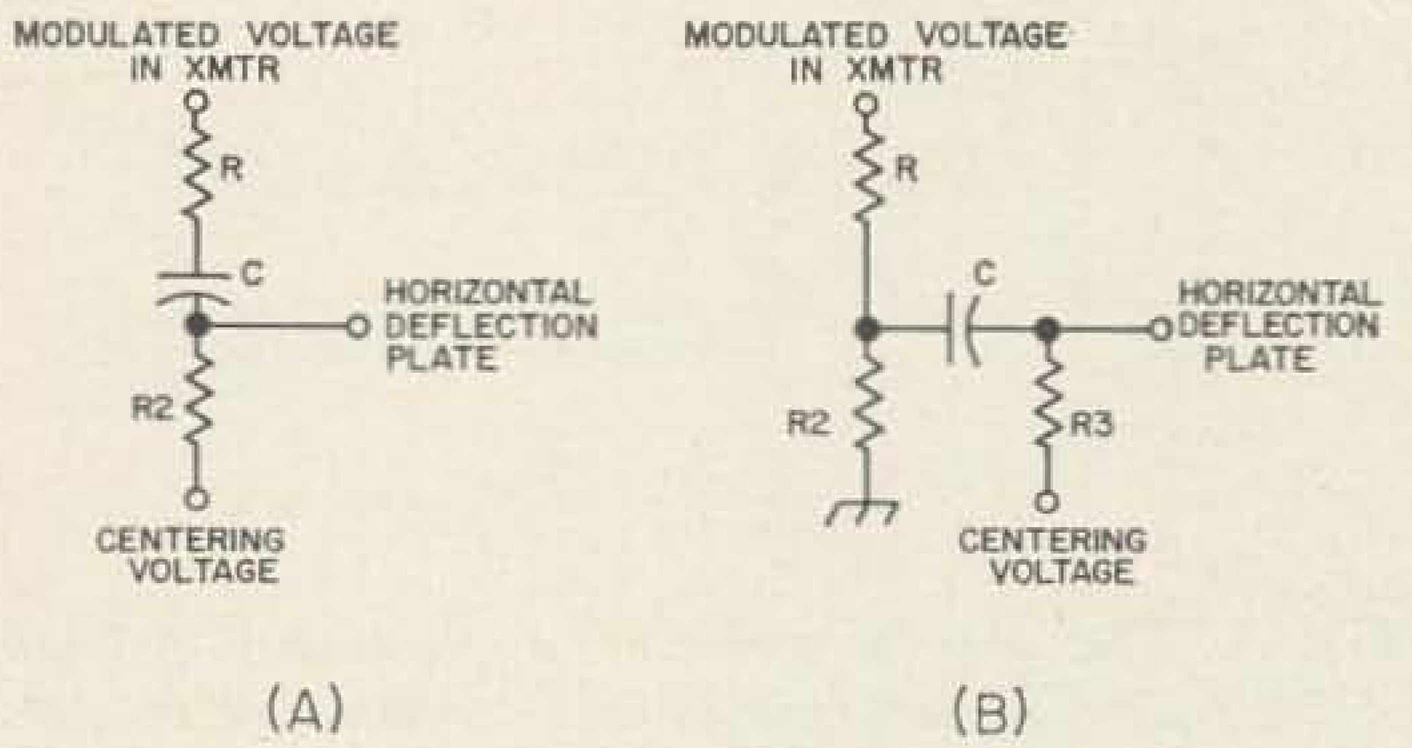


Fig. 5. Both of these circuits have been used for getting audio signals into the oscilloscope, but the circuit in B will introduce phase-shift.

Now let's consider the trapezoid type of display and the difficulties in obtaining it. The circuit of Fig. 3 has had some popularity in providing an "rf trapezoid" without any direct connections to the transmitter. Actually, all you can say for this circuit is that it *does* provide a trapezoid pattern. However, since the audio is derived from the signal itself, the af/rf ratio must always be linear, and it will not show when the modulation is non-linear due to under-excitation or over-coupling. Also, since the audio voltage on the rf output cannot exceed the rf voltage, this circuit will not show how much the carrier is being over-modulated. In effect, then, this circuit can only tell you if you are putting out rf and if your modulation is less than 100%.

The rf trapezoid circuit shown in Fig. 4 is very valuable in checking the linearity of linear amplifiers. It compares the audio modulation of the linear's input with its output, and any non-linearity shows up as a curvature in the leading edges of the trapezoid. This circuit, like that of Fig. 3, will not show any modulation faults except under-modulation.

The real trapezoid pattern compares the modulating audio with the audio envelope of the rf output. If the two are in phase and the modulation is linear, the sloping edges of the pattern will be straight. Negative overmodulation is clearly indicated in degree by the length of the horizontal line beyond the tip of the triangle formed at the 100% point. The difficulty in obtaining a trapezoid, or bow-tie, pattern with most oscilloscopes lies in getting the audio voltage to the horizontal deflection plates exactly as it modulates. To do this you must determine exactly where the modulating signal is applied to the circuit (plate, screen, grid, or cathode) and wire into that point. Use a series blocking capacitor of .01 mF. We must avoid any phase-shift between this tap point and the deflection plates. Very few oscilloscopes provide a direct connection to the horizontal deflection plates, and only the most expensive ones have direct-coupled shift-free horizontal amplifiers. To avoid phase-shift, which turns the leading edges of the pattern into ovals, we must avoid resistance-capacity coupling. The circuit in Fig. 5A must be used for coupling audio voltages to the deflection plates, but the R2-C-R3 combination of Fig. 5B (common in R-C amplifiers) will cause phase shift.

Try using the connection shown in Fig. 6A for the horizontal input along with the vertical input circuit used for the envelope pattern. The series resistor should be non-inductive and high enough in resistance so the audio will not overload the oscilloscope input. Normally a value of ten to twenty megohms is used for plate modulation. If you still get phase shift you will have to remodel your scope or be content with the pattern obtained. If you can make a direct connection to the horizontal deflection plates, try the circuit of Fig. 6B.

In all these diagrams the output is fed to a single deflection plate. It is assumed that this deflection plate is isolated from the power supply with at least a ½ megohm resistor while the other plate is by-passed to ground

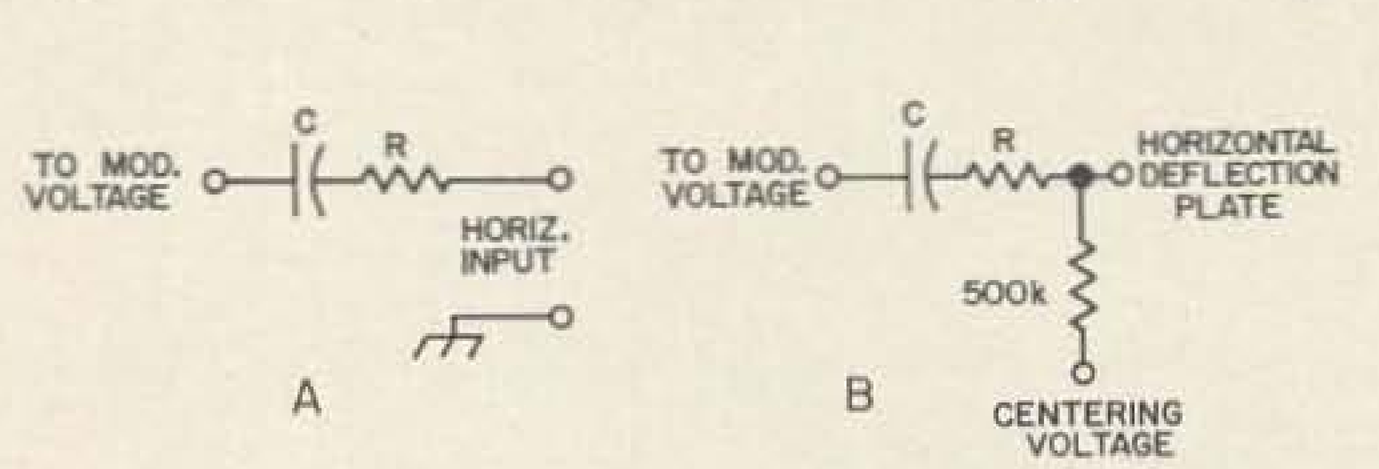


Fig. 6. If you experience problems with the circuits shown in Fig. 5, try the circuit in A. The circuit of B is useful when it is posisble to make a direct connection to the horizontal deflection plate.

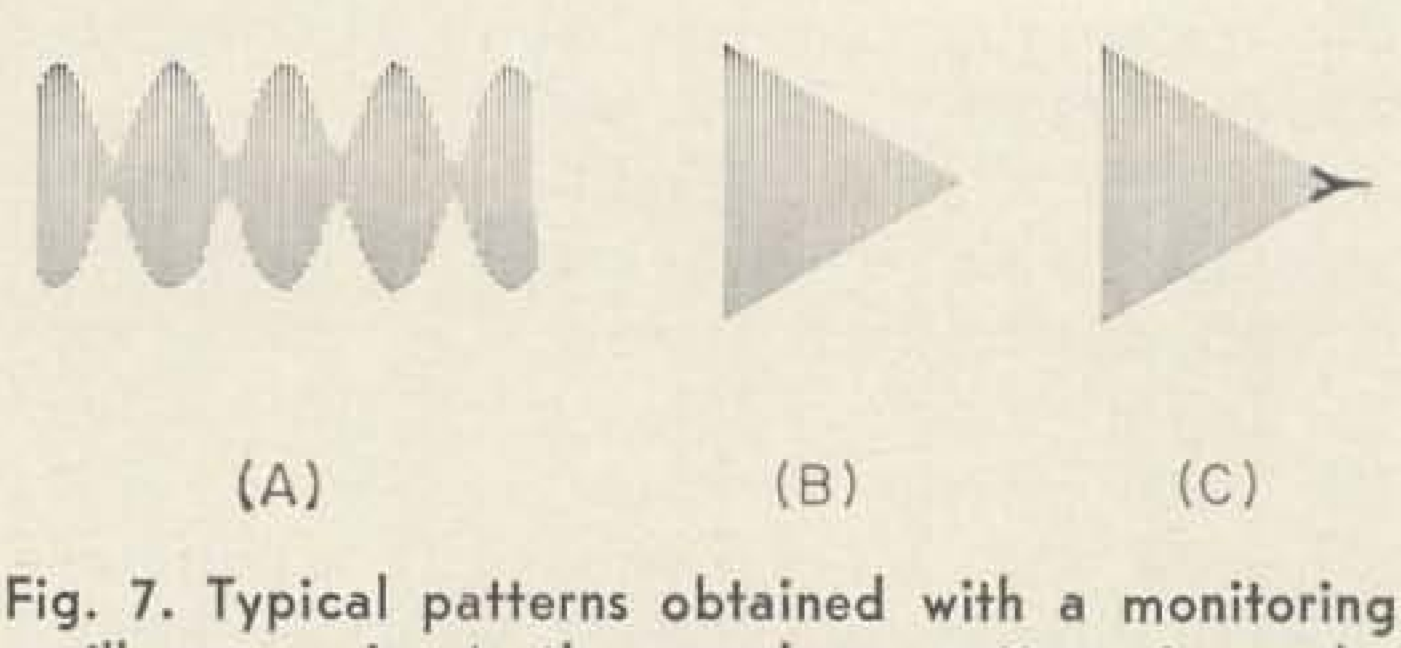


Fig. 7. Typical patterns obtained with a monitoring oscilloscope. In A the envelope pattern is modulated nearly 100%—at the 100% point, the pattern will go to zero at the nulls. The trapezoid in B is exactly 100% modulated while the trapezoid in C indicates an overmodulated condition.

with an adequate capacitor. While push-pull operation is the best for scope deflection, it is impossible to obtain in most monitoring circuits and single-ended feed is perfectly adequate. Any oscilloscope that provides direct connections to the vertical plates can be used as a transmitter monitor, and any instrument with a wide-band vertical amplifier can monitor received signals. The same scope might be used for both purposes if a relay is used to switch the vertical plates from direct to internal amplifier when going from transmit to receive. However, the trapezoid pattern can only be obtained when using specialized oscilloscopes, or by making special adaptions to regular instruments.

When viewing the envelope pattern the best horizontal sweep speed is either 60 or 30 Hz. Either of these frequencies will *stop* any 60 or 120 Hz hum, making it easy to identify. A sweep rate of 15 Hz or so makes it possible to see the keying characteristics of a CW transmitter, especially if a bug or electronic keyer is used and it is synchronized with the sweep frequency.

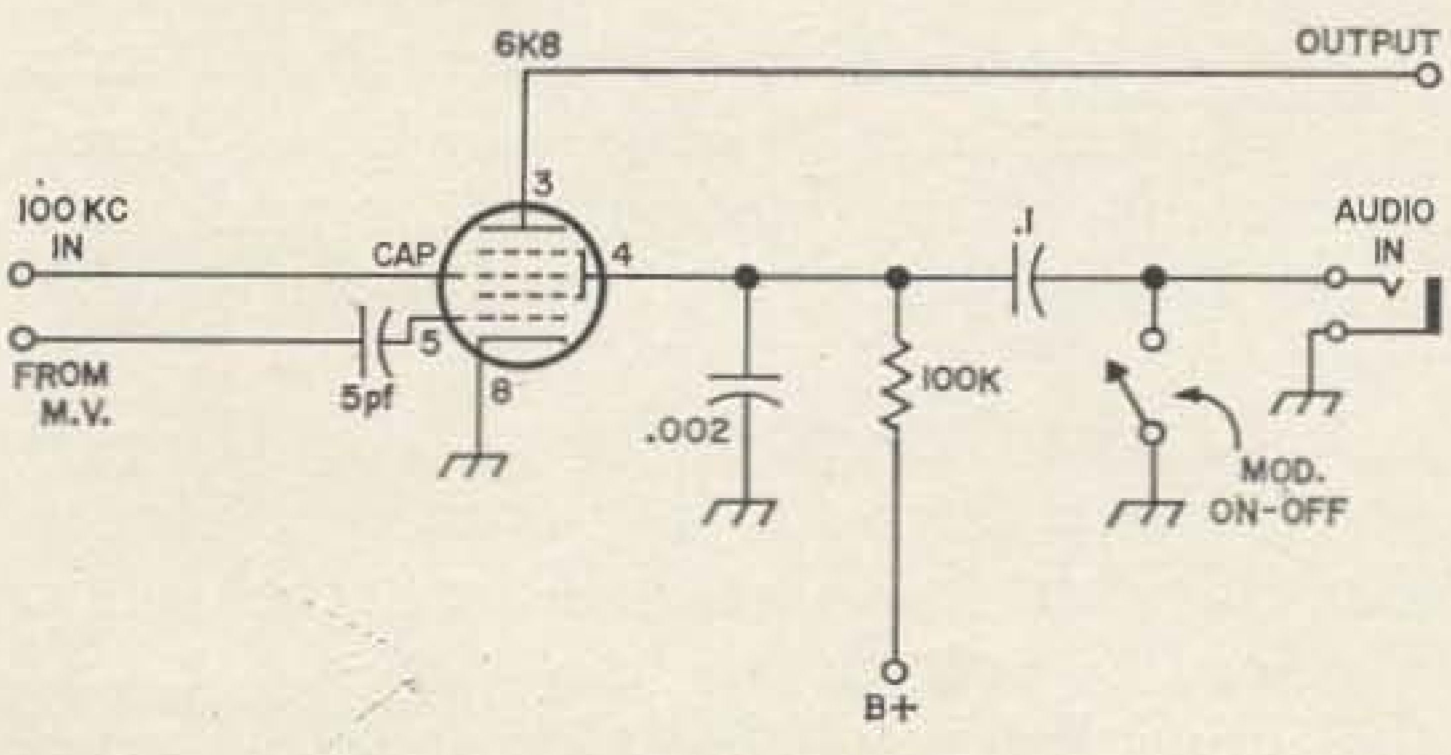
Many scopes provide internal synchronization and this may be used to advantage when the scope is used with a receiver to stop the audio wave forms. If you own an oscilloscope and are *not* using it as a monitor you are missing out. Use your scope and *know* what your modulation characteristics are; when receiving, pride yourself on accurate hum and modulation percentage reports.

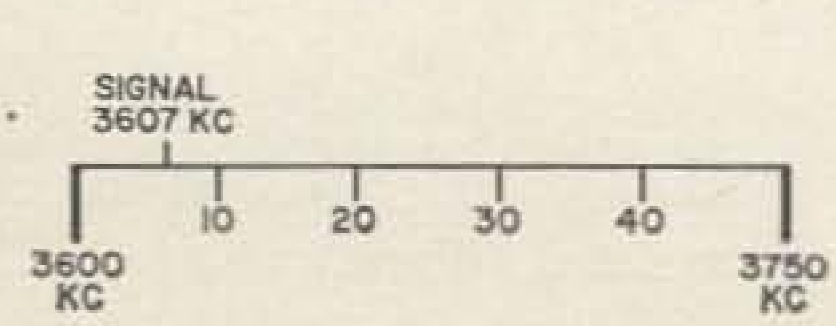
. . . WØOPA

A Frequency Measuring Refinement

For measuring frequencies many of us still use the somewhat antiquated but still accurate procedure entailing a 100 kHz standard and 10 kHz multivibrator with associated variable audio oscillator. The secret then, if there still is one, is that a signal falling between a pair of 10 kHz markers will generate a beatnote of not more than 5000 Hz with the closest marker.

Thus, for example, from the receiver dial it can be determined which marker the signal is closest to. The resulting beat note, when matched with the audio oscillator, comes out to 3000 Hz. Then 3610-3 equals 3607 kHz. Some frequency measurers perform this feat with an earphone attached to the audio oscillator on one ear and a receiver earphone on the other. Others feed the audio signals into an oscilloscope and watch for the circular pattern which indicates zerobeat. But there is a simpler way—simpler yet yielding an important additional advantage. Rather than diddle with neon bulb oscillators and the like to modulate the standard markers for easy and positive identification, why not use the audio oscillator? Each crystal marker will then have a distinctive musical tone, the pitch of which can be varied to suit the operator's taste. Then when the rf signal to be measured is located on the dial and the nearest standard marker identified, the audio oscillator dial is varied until the audio note matches the heterodyne and Voila!—there's the answer, quickly and painlessly.





My somewhat outmoded frequency standard employs a 6K8 mixer tube, but with obvious modifications this scheme would work as well on a variety of models of all ages. The only components I had to add to the original circuit for screen grid modulation were a .1 μF coupling capacitor, a modulation off-on switch and a phone jack to plug the audio into. The output attenuator on the audio oscillator is adjusted to give the best heterodyne with rf signals of different strengths. An alternative method which will work with any tube is cathode modulation. Just insert the low impedance secondary of a plate to voice coil transformer in series with the cathode of the tube to be modulated and impress the audio across the primary.

. . . Robert Kuehn WØHKF

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A Basic Desk

Having lived in thirteen different houses and apartments in four states and two DX countries in the short time I have been a ham, I have probably encountered the problem of setting-up-a-shack more often than many of my more stable friends.

At each move I have faced three major problems: Antennas. . Where to locate the shack. . What to use for a desk or table at the operating position.

Antennas are the subject of another article.

Location of the shack depends on the architecture of the house, and in my case, has been in such places as a hall closet, the toilet, the garage, and even, in one instance, a spare bed room. (Imagine! A whole room to myself!—Shared only with two years supply of staple foods, ski equipment and winter clothes in the summer, and bicycles and summer clothes in the winter.)

Each time, a desk for the operating position was a new problem to be met and solved. A folding card table (usually available and used) is too flimsey. A large desk is too heavy to move between cities and countries and often space is not available (I wonder how a big roll-top desk would have looked in that hall closet). After ten years a decision was made—"Something Must Be Done."

What are the desirable characteristics of a ham desk? Strong enough to hold the gear, but light enough to move (if only to clean behind it). Small enough to adapt to available space, but large enough to hold the receiver, transmitter, and associated gear. Inexpensive enough to gain, yet attractive enough to hold the XYLs approval.

A glimpse of a small, old fashioned, drop-front secretary started me on the general design and some doodling on paper finalized it.

The result is a functional desk, occupying only six square feet of floor space, but offering nearly nine cubic feet of space for operating equipment and 15 cubic feet of space for storage.

A single sheet of ¾" plywood provides the complete basic framework. Eight feet of 1x8 and six feet of 1x4 white fir, a 20" x 44" piece of ⅝" plywood, a 36" piano hinge, four cabinet hinges, two drop-stops, and assorted nails, screws, and glue complete the bill of materials.

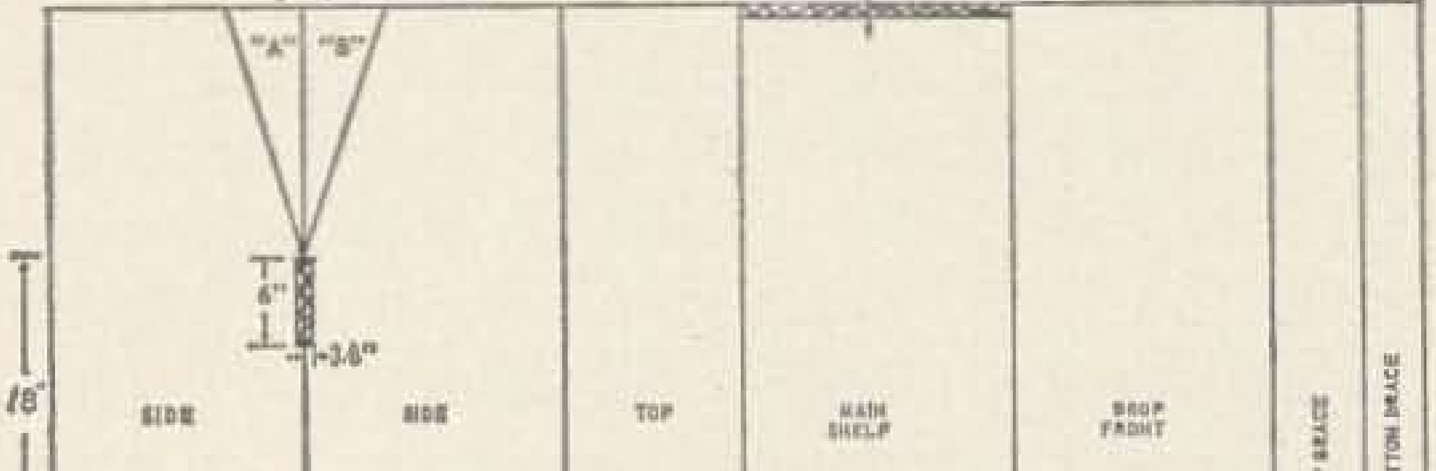

Fig. 1. Pattern layout for the basic desk operating cabinet. It's laid out on a 4' x 8' sheet of ¾" plywood.

Construction

The cabinet maker-carpenter should skip the following step-by-step which is offered as a result of my hindsight—It would have been much simpler if I had done it this way!

1. Layout the pattern (**Fig. 1**) on the plywood sheet. Plywood is normally clear on one side but has knotholes on the other. Juggle the pattern so the drop-front and the upper halves of the sides are clear wood on both sides.

2. After cutting the plywood (Caution: Keep your cuts square) smooth all cut edges with a plane or sand block.

3. Fasten the main and bottom shelf supports (A & B **Fig. 1** for the main shelf and two 18" pieces of the 1x4 for the bottom shelf) to the sides with at least four 1½" wood screws in each. (These pieces must hold the entire weight of all equipment installed.)

4. Assemble the top and bottom front braces and the door divider (the door divider is made from the rest of the 1x4) and fasten the assembly to the front of the desk sides in the cut-outs. (Add a temporary brace across the back and keep all corners square.)

5. Attach the main shelf, the top, and the bottom shelf, in that order. (The front edge of the main shelf should be flush with the slanted edges of the sides and joined carefully to the top front brace—this area will be exposed when the drop-front is closed and care in fitting now may save a pound of wood filler later.)
Keep the corners square!

6. Attach one side of the 36" piano hinge to the inside bottom edge of the drop-front and hold the piece in position against the front of the desk frame. Carefully mark the spots for the screws—insure the drop-front will open *and* close—and then fasten the other side of the piano hinge to the front edge of the main shelf. The top edge of the drop-front will overlap the top. Sand and plane the top and the top edge of the drop-front to a flush fit when the front is closed.

7. Fasten the drop-stops to the inside of the drop-front (the exact position will depend on the type of stop) and, with the drop-front horizontal, mark the positions for the screws on the desk sides. AFTER you are sure the drop-front will open *and* close without binding, fasten the drop-stops in place. (Be careful here, some of these gadgets have a real tricky action.)

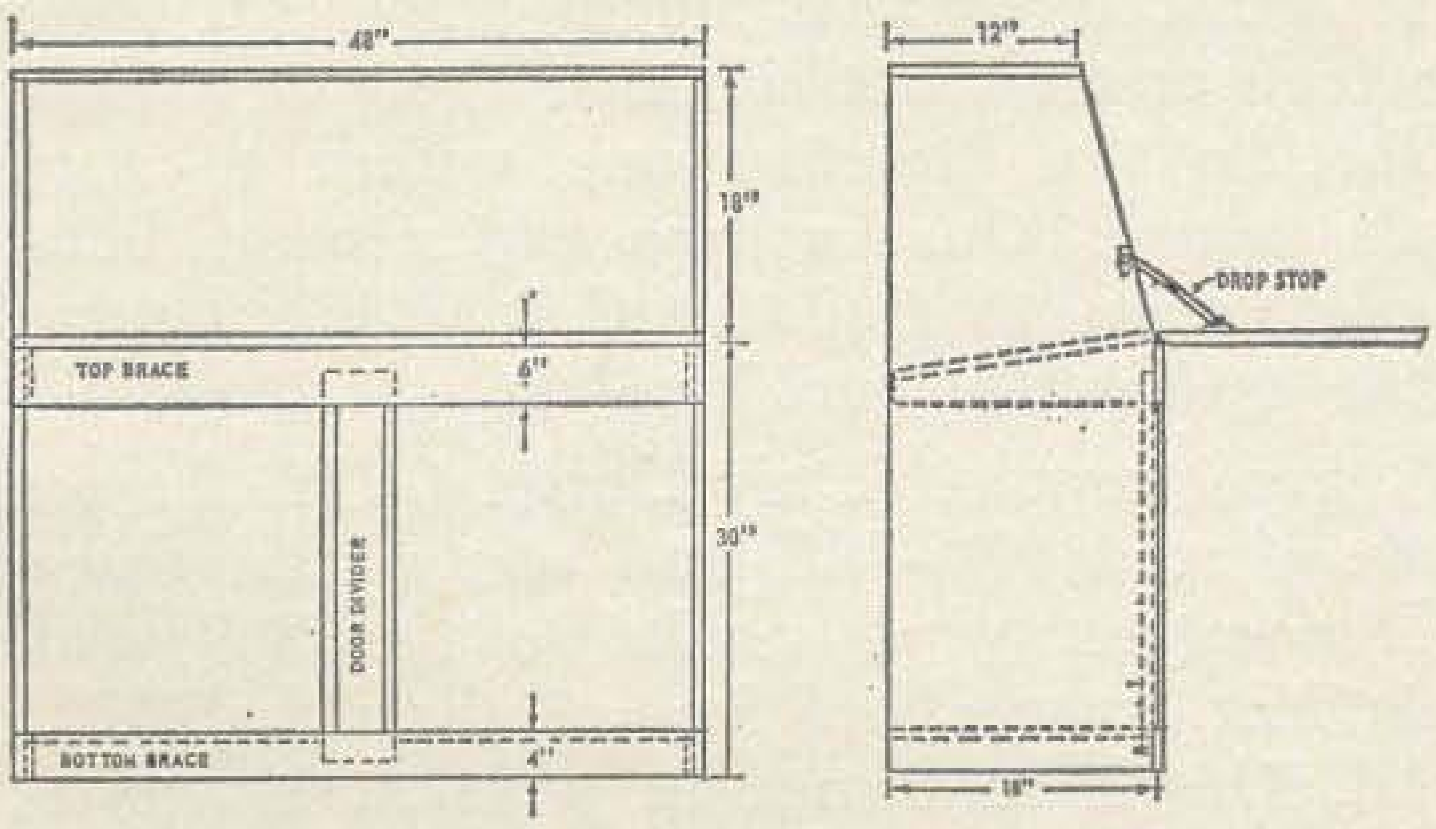

Fig. 2. Front and side views of the desk.

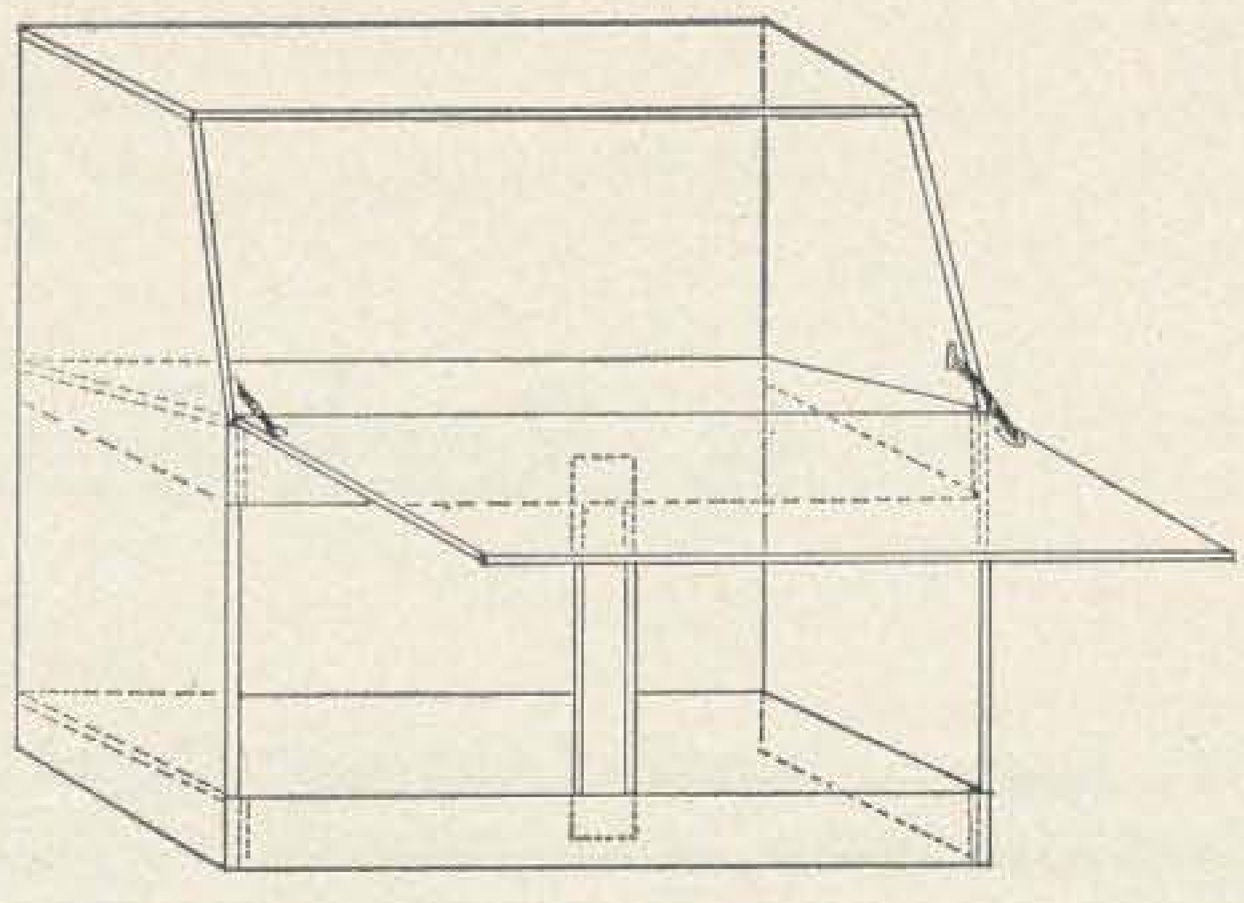

Fig. 3. Overall view of the desk.

8. Cut the ⅜" plywood to fit the door openings and fasten with the cabinet hinges.

This completes the basic assembly.

Pigeon-holes, outlet strips, master switch, etc., and the finish—paint, stain, or self-adhesive plastic in color or woodgrain—will depend on the individual builder and the equipment to be installed.

At my shack, I have (when it's cleaned up) my clock and globe on the top; SWR bridge, antenna switch, and a multiple ac outlet fastened under the top; xmitter, power supply and receiver sit on the main shelf; my key is fastened to the inside of the drop-front; and I am storing a kW power supply (not in use) and an oversized MOPA (awaiting a novice-in-need) on the bottom shelf—all with plenty of room left over.

I intend to install pigeon holes under the top and add a master switch that cuts all ac when the drop-front is closed.

Consideration has been given to adding a detachable leg (to be stored behind the desk) between the drop-front and the floor to brace the desk while trouble-shooting heavy equipment on the drop-front, but, so far, this has not been necessary.

The final result is a compact, attractive operating center that I need not apologize for when showing my shack to a stranger.

The total cost—under $15.00

Postscript

Since designing and building my "basic" desk, I have retired from the Army, bought a home with an extra room for the shack, and settled down in Ogden. Anybody got a good blueprint for an impressive, unitized, builtin, corner console?

. . . WØQOJ

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Is Rock-Bounce Practical?

We have all heard of the magnificant results which have been achieved on VHF, both 2 meters and 70 cm with Moonbounce; is it possible to get results by Rock-Bounce? We all know the effect of ghosting on TV receivers which can be brought about either by a mismatch in the feed line resulting in delayed signals reflected back on the feeder or by reflection off other objects.

This effect can also be observed on the VHF FM broadcast transmissions when a signal is reflected by a distant object and arrives at the receiving antenna after a delay. This ghosting on VHF FM broadcast is not as easily observed as TV ghosting, as there is no "visible" shift in the signal, but bad quality reproduction results from two or more out of phase signals being received.

I had a very good example of this effect when I was installing a VHF FM receiver for hi-fi broadcast reception at my Dorset QTH. I am virtually line of sight to the VHF FM transmitter across the sea, and I erected a dipole to receive the signal. Stupidly, and without adequate thought, I connected the dipole to the receiver with a coaxial cable. The quality of reception was bad; I could not understand why.

I was also interested to get reception of the VHF FM Broadcast signal free from interference from my own amateur transmitter. Here too I was in trouble.

To clear the interference from my own transmissions I substituted shielded twin balanced feeder for the coaxial lead on the broadcast receiver fed through a balun. This not only cured the interference from my transmitter but also brought about a startling improvement in the quality of the broadcast signal.

It appeared that the broadcast VHF FM signal was being received over two paths; one the direct signal, and the other by reflection from Portland Bill, a large rocky promontory jutting out into the sea at right angles to the direction of the broadcast station. Little of the reflected signal would have been picked up by the dipole, as Portland Bill was off the end of the wire, but apparently the outer conductor of the coaxial feeder was picking up the reflected signal off Portland Bill and mixing it with the direct signal. The use of shielded twin balanced feeder completely cured the distortion.

Can similar effects be found on the high frequencies? This was a question which has often intrigued me. It is, of course, far more difficult to establish whether a signal rereceived is the result of a "bounce" or not, since at high frequencies it is possible for the signal to be received by normal propagation, reflection from the ionosphere, sporadic E, etc. It will, therefore, take longer to reach definite conclusions. Meanwhile the development of mobile operation enables certain experiments to be initiated.

Much experimentation has, of course, been going on by mobile operators with regard to good and bad locations for mobile operation. Some operators have been experimenting on VHF, others on the HF Bands while others have experimented on the LF Bands—G6GR has done much work on 160 meters and comes to the conclusion that low lying locations give him better results than the tops of hills. He attributes this to getting nearer the water table.

My own experience on the HF Bands, 14 and 21 MHz tends to favour the hills. It is not the actual height above sea level which matters but whether there is a clear shot in the direction one wishes to send the signal. One or two experiences, however, seem to indicate that a hill behind the transmitter could be an advantage.

For example, at my Dorset QTH, the sea shore runs NW—SE and one would therefore expect good results to the SW and, in fact, everywhere from S through SW to W. This is confirmed in practice. However, a hill runs parallel to the coast line about

500 feet high and about half a mile back from the coast. From here a magnificent view is obtained to the S, SW and W, and one might imagine that with 500 feet of height even better results would be obtained. This has not proved to be the case. Results at sea level, or 30 ft above sea level at the coast have consistently been as good as those from 500 feet up with an even better shot. This could be due to the proximity of the salt water and the salt impregnated land—which is G6GP's theory—or it could be due to reflection from the hill behind. As yet I have no means of proving which is correct—it may be due partly to each effect.

This year I obtained licenses to operate in several countries in Europe (Holland, Belgium, Luxembourg and Austria) and was able to carry out experiments in varying country. Austria is a very mountainous country and it was, therefore, very interesting to be able to experiment in various mountainous locations. On one occasion we were at Obermoos, just above Ehrwald at the foot of the cable car railway which goes up to the top of Zugspitze. Here we were parked on a small plateau at about 4000 feet above sea level almost completely surrounded by mountains. Only towards the NW were the mountains a little less high. I faced the car towards the NW (the polar diagram of the car is not completely omni-directional—there is a definite lobe towards the front of the car) and switched on the rig. We were running a Drake TR3 to a Mark Mobile HW3 Tribander. A few east coast W's were coming in and I worked a few W1's and W2's.

Then I was called by a W6! This surprised me. I worked him and he gave me 4/2 report and was just as surprised to hear me. When I signed I was called by a W5; then I went on working W1's and W2's. How was it that I suddenly worked out to the W6 and W5? As I was closing down to drive home I looked at the car and the location and I noticed that immediately behind me, exactly opposite to the direction in which I was firing was the huge, almost vertical, 5000 foot rock face of the Zugspitze. Were the W6 and W5 QSOs due to rock-bounce?

The next day I again chose a site with a good 'shot' to the NW with a rock face behind me. This time it was a smaller rock face but much nearer the car. We went straight through to Detroit!

It is, of course, far too early to draw any conclusion from the crude initial trials, but it does look as if rock-bounce is possible, and I hope this article will stimulate others to carry out further experiments along these lines. Mobile operation presents an excellent opportunity for such tests on an amateur basis.

. . . G3BID

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Moonray

Amateur operation from the moon.

When will we hear the first amateur radio station from the moon? It may be sooner than you think. With plans presently being formulated by the Nassau Satellite Tracking Amateur Radio Society, NASTAR, the first lunar rig could be on the air minutes after the Apollo astronauts make their third successful landing in the Lunar Excursion Module (LEM for short).

NASTAR, a group of amateurs at Nassau Community College on Long Island, bases its thinking—and hopes—on several important facts. First of all, the unofficial word from NASA and other sources indicates that there *could* be space for an amateur transponder on the third LEM trip to the moon. The possibility is further enhanced by the fact that NASA has agreed to study a NASTAR proposal for a Moon Amateur Relay—Moonray—which will be submitted to them later this summer. The proposed unit will serve as a long-term site beacon and, if needed, act as an emergency communications package for the astronauts. The present plans call for the first Moonray prototype in 1969 and the NASTAR group has already secured commitments for environmental testing help from NASA, Grumman and RCA.

For those of you not familiar with environmental testing, every part that goes on a space shot requires a rigorous program of test before it is "qualified". Qualification includes—besides normal functional testing—a complete series of environmental tests that include altitude, humidity, vibration, shock, heat, vacuum, and salt-spray. Successful completion of these tests fairly well insures that the part will successfully make it through launch, separation and the long flight through space. Why salt-spray you ask? Since the majority of our launch sites are located near the ocean, the parts on board are often exposed to the elements while waiting for the launch date.

NASTAR is an independent, three-year-old ham group which was given its own building and a mile of space for an antenna farm by Nassau Community College. Last year the group gave a ten-week course in satellite tracking, which was the first ever offered at a Long Island college and possibility the first of its kind in the country.

When NASTAR was organized three years ago, its first home was unique. Nassau Community College took over part of Mitchell Air Force Base as its campus and NASTAR's first shack was in the old glass-enclosed control tower. Last year the college gave the group its own building, a former field house. The building also provides quarters for NASTAR's astronomy section, formerly the Sperry Astronomy Club, a library alcove, and a workshop.

NASTAR headquarters houses kilowatt rigs for the high-frequency bands and two meters as well as other transmitters on 6 and 432, plus associated receivers, converters and recording equipment. In addition, the group recently acquired a completely operational SCR-584 radar unit for satellite tracking in a 24-foot trailer which will soon be towed to a location right outside the shack.

This past fall an anonymous *angel* installed five eighty-foot poles outside the building. Already on them are a 40-meter wire beam aimed at OSCAR headquarters in California and 4U1ITU in Switzerland for relay work; a wide-spaced 20 meter beam; a six-meter Squalo stack and two-meter Big Wheel for announcements and bulletins; a three-band beam to track OSCAR V's ten-meter transmissions; 44 cross-polarized elements plus two 11-element two-meter Yagi arrays for OSCAR tracking and an assortment of long V antennas. A forty-foot steel tower that formerly held an Air Force siren is waiting erection to hold 432 and 1296 MHz arrays.

Actually, the group does not plan to "go it alone" on the Moonray project. Nick Marshall, W6OLO/2, NASTAR president and former technical director for the OSCAR program, says, "We hope to involve amateurs all over the world in this project. There are many other organizations such as ours, as well as *individual* amateurs, who can contribute vital thinking and technical assistance."

The Moonray concept was originated by NASTAR's president. A ham for 31 years, Nick is an electronics consultant for NASA, the Lamont Geophysical Observatory and various electronics firms. He says, "We have the know-how to build a relatively sophisticated package like Moonray. We've proved that by the success of the OSCAR program. What we are hoping is that Moonray will be a truly collective ham effort, based on advice and help from hams everywhere. We'd like to be able to say that Moonray is a product in which the whole ham fraternity had a hand."

Leonard Victor, W2DHN, NASTAR executive vice president, added, "Right now we're worrying about keeping our bands. This project is the type we need to prove that amateur radio still has something to contribute to the state of the art." He also points out that, "A couple of transponders capable of allowing contacts between any two points on the half of the earth facing the moon at the time might even make a dent in the load on twenty!" One thing Moonray will do, he promises, is shorten QSO's because of the time lag caused by the signal's round trip to the moon and back.

Nick hopes for a flood of responses to help in solving some of the serious questions which must be answered before the preliminary proposal is submitted to NASA later this summer. For example, what bands should be used for reception and re-transmission from the lunar surface? NASTAR currently favors the use of 432 MHz, but they are anxious to hear from other amateurs who have another band in mind or would like to see multi-band operation. In addition, power output, bandwidth, the antenna system, and the type and extent of the beacon telemetry system must be decided.

Three parameters of the Moonray package are already fixed. In addition to its transponder capabilities, it must be operable as an independent backup emergency voice communications package for the astronauts in the event that they experience trouble with their regular radio gear. Furthermore, Moonray must serve as a low-power beacon to be used for locating the LEM landing site one or two years after the astronauts have returned to earth. These potential services as communications backup equipment for the astronauts and site marker beacon are the reasons NASA is willing to consider Moonray's inclusion on the flight.

The third fixed Moonray parameter is that it will be nuclear powered. This is to permit its use through the lunar night, when solar cells would be inoperative. NASTAR has an *almost solid* promise of a five-pound, ten-watt nuclear battery with a 25-year half-life. In addition to powering the Moonray receiver, transmitter and marker beacon, this battery will be used to heat the package during the −275 degree lunar nights.

Membership in NASTAR is open to all licensed amateurs who are seriously interested in—and willing to work at—some phase of the group's work. This ranges from equipment and antenna construction to operating VHF and UHF equipment and recording gear. If you are interested in helping out on this program, why not write to them?*

If nothing else, you may be able to offer suggestions for the pending Moonray proposal. If you're within two-meter range of Long Island, their members meet weekly on Monday nights at 2000 EST on 145.85 MHz. Better yet, check in on their regular Sunday morning work sessions.

If Moonray is to be on the third lunar landing sometime in 1970, it's going to take a lot of work and planning now on the part of the entire amateur fraternity. OSCAR was our first step into space, Moonray could well be our second. Amateur operation from Mars, Venus, and even Jupiter may be possibilities in the future. However, one step at a time. If we all pull behind NASTAR now it will be a step in the right direction.

. . . W1DTY

* NASTAR, Post Office Box T, Syossett, Long Island, New York 11791.

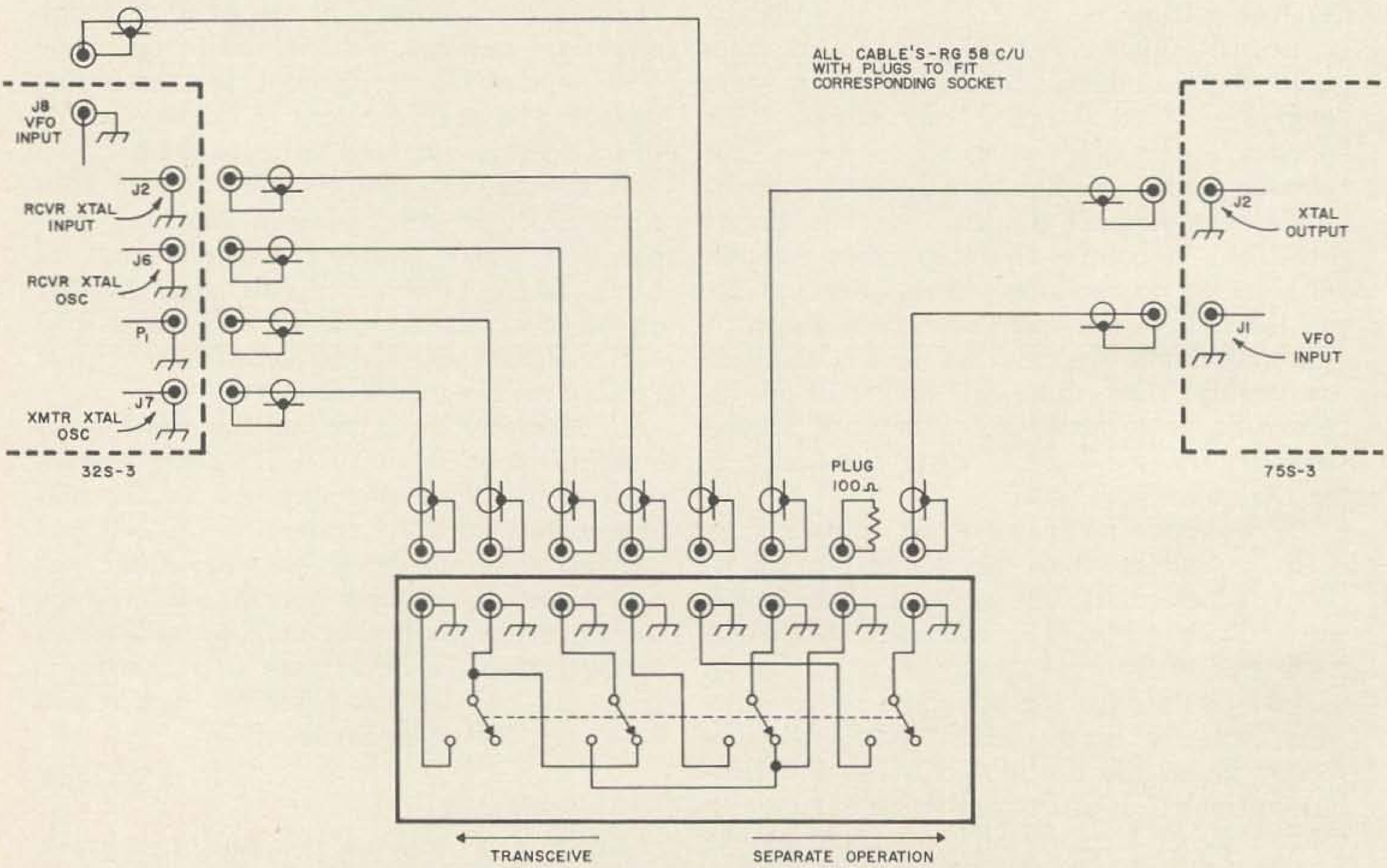
Maurice Hindin W6EUV
8920 Wilshire Blvd.
Beverly Hills, Calif.

The switching box on top of the SWR bridge.

A Simple Switch to Separate the 32S-3 and 75S-3 for Cross-Band Operation

The Collins 32 S-3 exciter and the Collins 75 S-3 receivers are designed to be operated either in transceiver operation or each unit may be operated separately. If the units are to be used in transceiver operation, connecting plugs and cables are used to connect the exciter and the receiver together. The 100 ohm dummy load plug is removed from the receiver and inserted in the exciter. When the units are connected together in this way, it is possible to operate them separately but only within the same 200 kHz band segments. If it is desired, however, to operate the receiver and exciter cross band at more than 200 kHz frequency differential, then it is necessary to completely disengage the two units. This means that mechanically it requires the operator to unplug the connecting cables and reinstall the dummy load in the receiver.

To overcome this mechanical inconvenience of changing cables and making the other changes needed to switch from transceive to separate transmit and receive function, the writer constructed a very simple switching unit which remains in the circuit



Schematic of switching box for disengaging the 32S-3 and 75S-3 for cross-band operation.

at all times. By a simple flip of a single switch either function is instantly available without connecting or disabling any cables, or making any other changes.

The whole unit consists simply of a single four pole double throw switch such as a Centralab PA 1010. and eight tip jacks, a suitable box and seven connecting cables.

The wiring of the switch and connection of the cables is also shown on the attached diagram.

The reason that all this is necessary is that with the patch cables connected for transceiver operation the receiver hf crystal oscillator controls the injection frequency to the transmitter second mixer. In order then to restore the units to independent operation from each other, the 100 ohm dummy load plug which was inserted in the 32 S-3 Xmtr Osc. jack J7 for transceive operation, is again restored through the switch to its original place in the 75 S-3 circuit, and the cables are electrically disengaged.

. . . W6EUV

Indian Traps

Here is one of the simplest TVI traps that a six meter ham can use. Sure it doesn't cost much to buy a low-pass filter that will take care of everything above 52 MHz, and a coaxial filter works even better as it will also reduce the "sub-harmonics" generated in the driver stages. But just where on the operating table are you going to mount one of those big coaxial tanks; and how much room do you have for it in a mobile set-up?

I had a simple home-made AM rig that I built primarily for mobile. Though it did put out a nice six meter signal, it caused a little cross-hatching on channel 5. My tv set doesn't have a high pass filter, but I doubted that it needed one, since my higher-power six meter sideband rig didn't cause any TVI at all. What I neded was something quick and easy to cut down the 75 MHz energy that was being generated in the 25 MHz doubler and was being fed through the final. Since late Saturady night is no time to go to the radio store to buy filters or parts, I needed something that could be built from accessible parts.

Remember your transmission line theory? A half-wave open line looks like an open circuit and a quarter-wave open line looks like a short circuit. Also, a three-quarter wave open line looks like a short circuit. I carefully measured off 77¼ inches of RG 59/U coax and put a PL259 connector on one end. This is ½ wave at 50 MHz, looking open; and ¼ wave at 25 MHz, ¾ wave at 75 MHz, 5/4 wave at 125 MHz, all appearing as short circuits. I removed the antenna lead from the transmitter, put on a coax "T", then put the antenna lead on one branch and my coax trap on the other branch of the "T". A few checks showed that this removed all traces on the TVI!

I cut the coax for a center frequency of 50.2 MHz and later checked it on some lab gear: attenuation of the desired 50 MHz signal was under ⅓ db. Attenuation at 25 MHz was 27 db.; at 75 MHz it was 26½ db.; at 125 MHz it was 21 db. I can cover the lower megacycle of the six meter band with not over ⅓ db. insertion loss and still get at least 25 db attenuation on 25 and 75 MHz. Thus for the price of a few minutes time, a few inches of coax, one PL259 connector, and one coax "T" connector, I had obtained over 25 db. attenuation of my channel 5 harmonic. Naturally, there is no problem finding space for the small length of coax. It can be tucked out of sight behind the transmitter.

If you find you have 100 MHz energy leaking out, it would be a simple matter to add a quarter-wave shorted stub in the same manner. This would have no observable effect on the desired 50 MHz signal, but would do a fine job of knocking down 100 MHz energy. (Also 200 MHz, etc.)

This is not a cure-all, and it won't help a bit if your rig is radiating the interfering signal directly or feeding it through the power lines. Since I had checked that there was no interference at all when my transmitter was feeding a dummy load, I knew that I only needed a filter or trap at the antenna lead.

This coax trap is about the simplest method of reducing harmonics. It takes up little space, and is about as cheap as you can get. It would be very easy to coil up the coax inside the transmitter and connect it directly to the antenna terminal to eliminate the coax "T" and the PL259 connector. Incidentally, it also cleared up TVI on channels 4 and 5 when used with my Gonset Communicator.

. . . Jospeh Sheffer W9KLR

Greg Schlender WAØNDV
611 North Hartup
McPherson, Kansas

Construction Project: A High School Amateur Radio Club

Are you alone in your hobby of amateur radio? Would you like to interest other high school age guys (and gals) to the fun of hamming? After all isn't any hobby more fun if you have someone to share it with? As you can probably see by now, I am trying to talk to the high school age set. You OT's can go on to the other articles, but you teenagers stick with me. I will try to show you how easy it is to start this club. Every high school should have an amateur radio organization.

Maybe you are asking yourself right now, "Why a radio club in a high school?" I know for certain that many prospective hams are scared out of trying for a license by the expense. The high school club would overcome this by having a station for its members. Also, what better way is there to find out whether a person really likes electronics and radio than by trying it out? Enough of that. Let's find out how to start this club.

A club always needs a sponsor to see that things are run right. Science or math teachers usually are the easiest to get. The person picked should be well-liked and respected by the members. If he is already a ham, you're very lucky. If he is not, then try to interest him in becoming one. The club will run much smoother if the sponsor is familiar with hamming.

To start a club you need to have hams. The best way to get hams is to teach them yourself. Start a code class. Code is the hardest part in getting a novice ticket, but it is usually made much harder than it has to be. When being taught in a group by a competent instructor, it is much easier. To be any good, the class should meet every day. A good time is about a half an hour before school starts when everybody is fresh. The code source can be a code oscillator although code records or tapes are less work. At any rate make sure this class is held regularly, well instructed, and NOT BORING!

A meeting place for the club and a room for the club station is also needed. Even a corner of a room is suitable for the station. It often works out that the room is the sponsor's classroom. Just be sure that it will be a safe and convenient place for the equipment.

Getting a club station is sometimes the largest obstacle. But it is also one of the most important aspects in that it is sometimes the only place the younger members have to operate. The first year the club is in operation, the school probably will not put up any money for a station. If the club goes well, the second year they will probably set aside some for that purpose. But that still leaves the first year open. This is where your state MARS program can help. Contact your state MARS coordinator. With his help try to get some surplus ARC-5 equipment. In many states the MARS youth program will give ANY new novice free ARC-5 equipment. Also look into getting a MARS affiliated club station. If (and when) the club does get some money, get the best receiver you can afford. The club members can always build some transmitters or you can use surplus. Where there's a will, there's a way.

The club station will need a license. This is no problem. All that is needed is a general class operator to sign a Form 610 as trustee of the club. Of course, it would be better if the trustee were a member, but any local ham will do.

After the club is going well, and you have graduated your first code class into novices, keep the club going by making your meetings interesting and fun. Remember, we younger hams like action so give us plenty of it. Hold numerous contests. Show films at meetings. Hold fund raising activities. Get some good speakers. Have initiations for new members. Operate Field Day and in nationwide contests. But keep things moving. Do not let the club bog down or it will fold. This is good advice for any club.

This makes six steps to starting a good high school amateur radio club. They are as follows:

1. Get a good sponsor (preferably a teacher).
2. Start a code class.
3. Find a meeting place and a room for the club station.
4. Try to get a club station.
5. Get a license for the station.
6. Keep the club interesting.

Conquer each one of these steps separately and well, and you will have a firm foundation for a good club.

Alright you teenage hams. I have done what I can. The rest is up to you. Watsa we double the number of high school radio clubs in the next year. Let me know how many of you do start a club. I do not know whether I have struck oil with you or not, but I am going to quit boring.

. . . WAØNDV

New Medical Service via Ham Radio

A new and much needed medical service began last fall when Duke University Medical Center Amateur Radio Club began PROJECT MED-AID (Medical Assistance for Isolated Doctors) to provide up-to-date medical advice, consultation and encouragement to doctors working in remote areas throughout the world.

To provide this service the Club station, WA4BLK, is manned daily, and the frequency of 14,250 kHz is monitored continuously. Doctors on duty from 0900 through 1700 EST can pick up the nearest telephone and confer with distant MDs whenever they call in, and, when MDs are busy or off duty, the inquiries are taken down on a tape recorder and the replies similarly recorded as soon as possible and transmitted back to the overseas station.

Dr. E. Croft Long, Director, Project Med-Aid, Professor of Community Health Sciences and Lee Williamson one of the operators.

The project was sponsored by the Mary Reynolds Babcock Foundation, of Winston-Salem. Although funds cannot be provided for stations at distant points, lists of equipment are available to help other interested groups do this. Those interested in supporting this work may obtain copies of these lists (describing complete field installations from 200 to 1000 watts) by writing to the Director, Project MED-AID, Box 3005, Duke Hospital, Durham, North Carolina, 27706. Telephone 919-684-8111, Extension 2498.

Amateurs working near the frequency of 14,250 kHz are urged to check carefully to see that they are not interfering with this vital work. By the end of the year it is expected that from 40 to 50 isolated medical and hospital outposts will be set up to participate, so there should be increasing business on this frequency, and this should be another means of demonstrating to some of the newer countries how very useful to them amateur radio can be.

Wayne Montague VE3FYL
1190 Atwater Avenue
Port Credit, Ontario
Canada

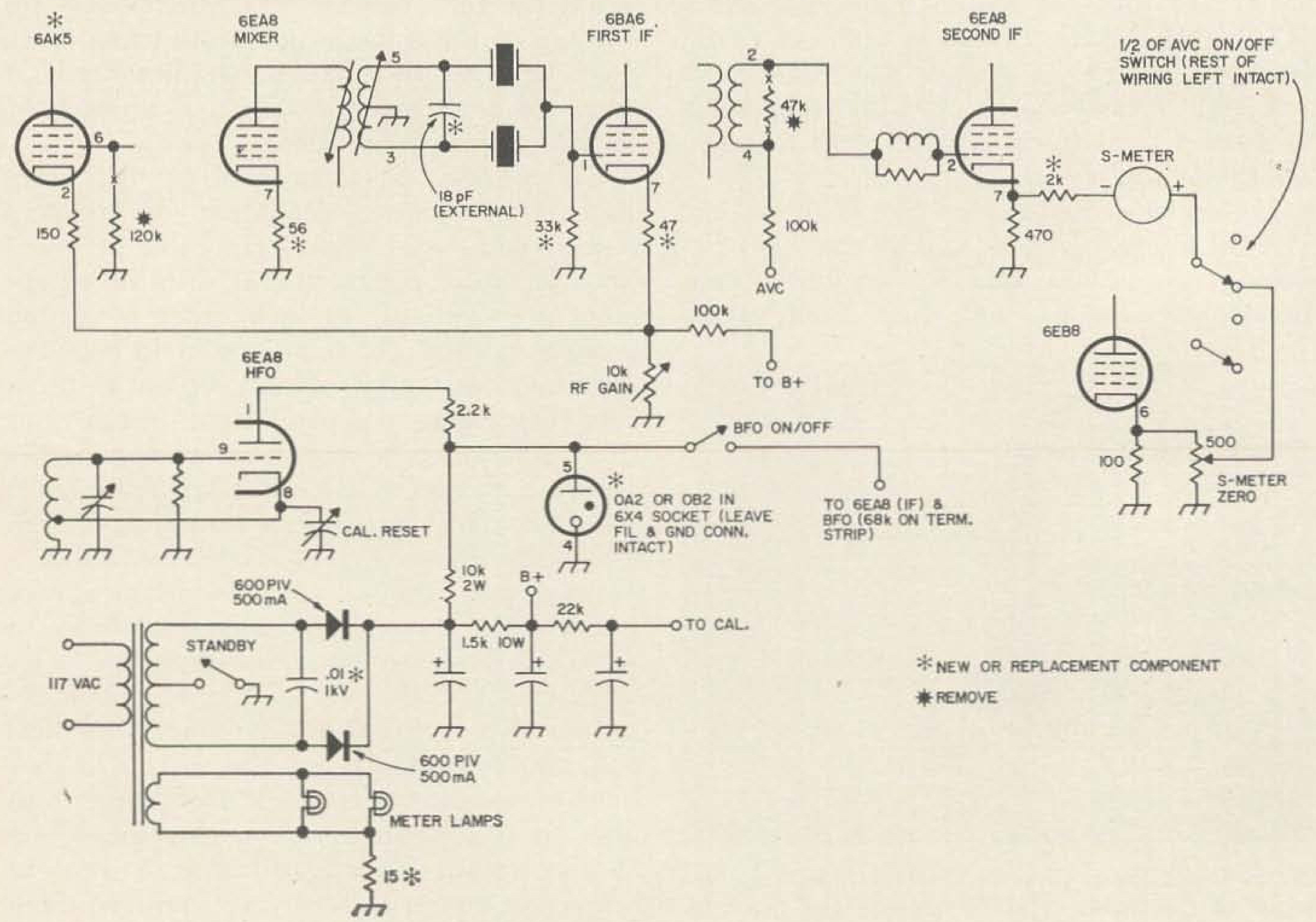
Heath HR-10 Modifications

The Heath HR-10 receiver is an excellent choice for the novice, but with our crowded bands these days, improving the selectivity of any receiver is a worthwhile project. The modifications described here include increased selectivity and sensitivity and make the set act as if it cost much more than the total outlay for the circuit changes—a mere twelve dollars.

Since the HR-10 appears to be a very popular receiver with novices and generals alike, these modifications will be for the mutual benefit of all. In addition to the sensitivity and selectivity improvements, I added voltage regulation, rearranged the rf gain control, put in a new S-meter circuit, and added a solid-state rectifier.

In the front-end I replaced the 6BZ6 rf amplifier with a 6AK5. Before installing the 6AK5, remove the 120k screen-grid resistor from the circuit and lift pin 7 of the tube socket from ground. The increased sensitivity is well worth this simple modification.

To improve the stability for SSB and CW operation, I added a voltage-regulator tube. I used an OA2 because I happened to have it in the junk box, but an OB2 should work just as well. Since the 6X4 rectifier is re-



Modified HR-10 circuitry. These changes result in improved sensitivity, selectivity and stability.

placed by two 500 mA, 600 PIV silicon diodes, the 6X4 socket is used for the VR tube. In addition, you will need some additional solder lugs. This can be accomplished by installing a 3-lug terminal strip in place of the 2-lug strip which is mounted near the 6EA8 in the mixer section.

In this modification most of the harness cable can be rewired and rerouted to the new point, saving wire and preserving overall neatness. To install the new S-meter (Lafayette 99R2514), remove the pilot light in the left-hand corner, remove the old S-meter and the black metal bracket and cut a 2⅛" hole through the front panel. Cut the hole so the old S-meter calibration points are removed in the waste plastic.

Alignment

The HR-10 in its modified form is a very sensitive receiver, and since we are squeezing the last bit of performance out of it, the alignment of the various stages is a little painstaking. The first step is the alignment of the *if* stages. If you have a signal generator, all well and good. If not, use a beat note from the crystal calibrator. For proper selectivity the *if* transformer slugs are set for the first peak after the slugs are screwed all the way out and back in again.

If you encounter oscillation in the *if* stages, it can be cured by lowering the value of the 6BA6 grid resistor, slightly detuning the second or third *if* or shunting the second *if* transformer with a 68k resistor. After you are satisfied that the *if* stages are properly aligned, proceed with the alignment of the rf stages.

Results

After these simple modifications, the set works like a charm. In fact, it is too selective for AM work, but just dandy for CW and SSB. In addition, frequency stability is excellent, and it takes a pretty large fluctuation in line voltage to make it jump off frequency.

Setting the rf gain control has no bearing on S-meter position—it just decreases sensitivity, lowering the reading, but not pinning it up scale. I find that on forty meters I seldom have the rf gain control much above the one o'clock position.

I would like to thank Ted, VE3ABN for typing, and John VE3FWX, for his constructive criticism.

. . . VE3FYL

A. E. Hankinson WAØNQL
6642 South Pearl
Littleton, Colorado 80120

Glub, Glub, I'm Drowning

After an evening of listening to the hash on 80, the average amateur may or may not, dependent upon his age, recall bygone days when the noise level seemed lower. Maybe this falls in the category of remembering the snow storms which seemed heavier, or the air which was purer.

At any rate, all this was triggered off by a recent article in one of the Denver papers entitled more or less "Is Denver Drowning". In this instance, the reference was to the air which on occasion gets a bit thick, particularly on days when the wind forgets to blow. By coincidence, this article appeared during the same week that an interference committee had a scheduled meeting. Possibly with the question of air pollution in the back of his mind, the guest speaker raised the question in retrospect as to whether or not we, meaning those involved in communications in one way or another, are drowning in our noise.

Unfortunately, as the meeting developed, the problem is not a temporary one which can be forgotten with a chuckle. And as the meeting and discussion progressed, some of the bits and pieces which may come back to haunt us started to show up.

The type of noise discussed and mentioned here is "random noise". It is the type of noise that is generated anywhere a measurable amount of electric power is consumed. In particular but not exclusively, it is something every one of us citydwellers contributes to in one way or another. The "random" designation is to separate if from the deliberately generated noise such as that of the frug or the watusi on the local AM broadcast. Naturally since this noise is generated in fashion or another, we as individuals generally feel that this is the problem of: a. The Government b. The State c. The Power Company d. Somebody Else. But not necessarily in that order. Strangely enough, we may even break down and admit that we as individuals might be just a little bit responsible, but unfortunately, we are not about to change our way of living just to knock down a bit of noise. Or are we? This "noise" thing is like the statements made by the friendly neighborhood bank about the compounding of interest on your deposit only this time, we do the paying.

So then how do we as individuals contribute to the random noise figure? Turn on a light, the switch arcs, presto-noise! Start the car, run a drill, a grinder, electric beaters, the lawnmower and on and on with each item feeding in a little more random noise. Not much on an individual basis but when you examine the amount of rotating equipment alone in the average metropolitan area, the not much suddenly becomes the very much.

The increase in the random noise level over the years can be related to the increase in kilowatt hour consumption, and of course the increase in automobiles and its ignition system, compounded even here by transistorized ignition systems with the higher voltages and on and on.

Stop! You got me there! Great strides have been made in decreasing ignition noise by shielding, by filtering, by grounding, and even by switching over to a Diesel engine. The efforts, the tricks, the articles all concerning taming a wild ignition system are many. The use of the carbon type resistance wire might be cited as one of the steps forward, or is it? I wish I could mention the name of the individual who ran some tests on this type of ignition wire but since I do not know how he would feel about it, I shall pass on that.

At any rate, this individual, according to my sources, made a series of checks on the carbon wire and found that after eight to twelve thousand miles, the effectiveness of the wire showed a definite decrease. Evidently something was happening after this amount of mileage that had a detrimental effect, however, no major change in the appearance took place, just a change in the effectiveness. A bit of investigative analysis by some other interested parties turned up what would appear to be a super simple answer. The ignition system was originally installed on a new car, after the stated mileage, the "trouble" appeared. What if anything happened at this time out of the ordinary? Nothing except the routine change of plugs by the careful car owner. So here is wire of carbon composition, after months of exposure to the elements, it is suddenly clutched by a mechanic, jostled, tugged, bent, and so the trouble appears. Sounds like a plug for the do it yourself mechanic.

More on cars, not from the point of quieting one for use as the transporter of mobile equipment, but instead viewed as a culprit. Are any particular brands of horseless carriage more responsible for noise than others? Two makes that received particular mention were the popular VW and the Jaguar. Of these two, the discussion concerning the Jag was by far the most interesting. One individual who was a combination amateur, sports car fan, and employed in communications, made several remarks concerning of all things, the hood on the Jag. The hood is metal. It is apparently grounded via the hood hinges, or is it? He indicated that from experience, the Jag ignition system in operation, is a fine source of corona display. So effectively, we have a source of random rf under a metal (grounded) hood. However, since in the interest of anti-rattle, the hood is equipped with rubber bumpers, we find instead that the dimensions of the hood very handily couple energy from the "source" to the surrounding space. How Now Brown Cow? Back to the grounding straps, provided of course you own the car. If you don't, then suffer!

Well cars are found in the greatest volume around cities. So lets fool them! Move out to that hill on the outskirts and enjoy suburbia with a view of the city lights. Sound fine, but then again is it . . . Some measurements on random noise made by a private concern over and around a major west coast city (not Denver, thank heavens) indicated that the "noise signature" of the city could be read up to 40 miles away. The measurements were conducted primarily in the area of 15 kHz to 30 MHz. Care was taken not to measure as "noise", broadcast stations and other legitimately operating services. The pattern found did not work out to be a smooth line soaring to the top of the graph, but instead, showed a definite scalloping tendency with peaks which might be attributed to harmonics of power line frequency in connection with rotating equipment. Working on the basis of an average curve from the measurements taken, it was noted that there appeared to be a decrease in the noise level of approximately 28 dB for each 10 MHz increase in frequency, up to approximately 30 MHz.

Keep in mind that this figure is in connection with the overall random noise picture and susceptibility of a particular frequency to say ignition noise is just a small part of the overall noise picture.

The irony of the situation seems to be that the United States, as one of the world's leading producers and consumers of electrical and electronic equipment is feeding this sea of noise at an ever increasing rate while bemoaning the problems. In some cases, communications problems are solved by a power increase which increases power consumption which increases noise and so on. With the complex power distribution systems in use throughout the country, it is small wonder that noise generated in one area pops up miles away. It might be an eyeopener to find out how many men and how much equipment is maintained by the power utilities in the nation now as compared to ten years ago. Certainly cooperation by power company personnel is easier than ever to obtain when power line noise problems arise. Chalk it up to nice people, desire to maintain a noisefree system, or just public relations, the amateur is the one who benefits.

Bills to enlist government support have been introduced and died. Well, it took a while for the pressure to be put on TV set manufacturers to conform to minimum radiation standards. Maybe one of these days, when the noise builds up to a roar, the opportunity to pressure people in the position to obtain such legislation may present itself. In the meantime, the cheapie heating pads, "budget priced electric blankets" add to our woes. As a last grabber, the state of the art moves on and we find ourselves with hotter receivers which immediately latch on to the increased noise making it sound even better, which forthwith calls on the noise blankers, which consume more power, which. . .

. . . WAØNQL

Virgin Islands Semicentennial Week

Photo by Winifred A. Scott

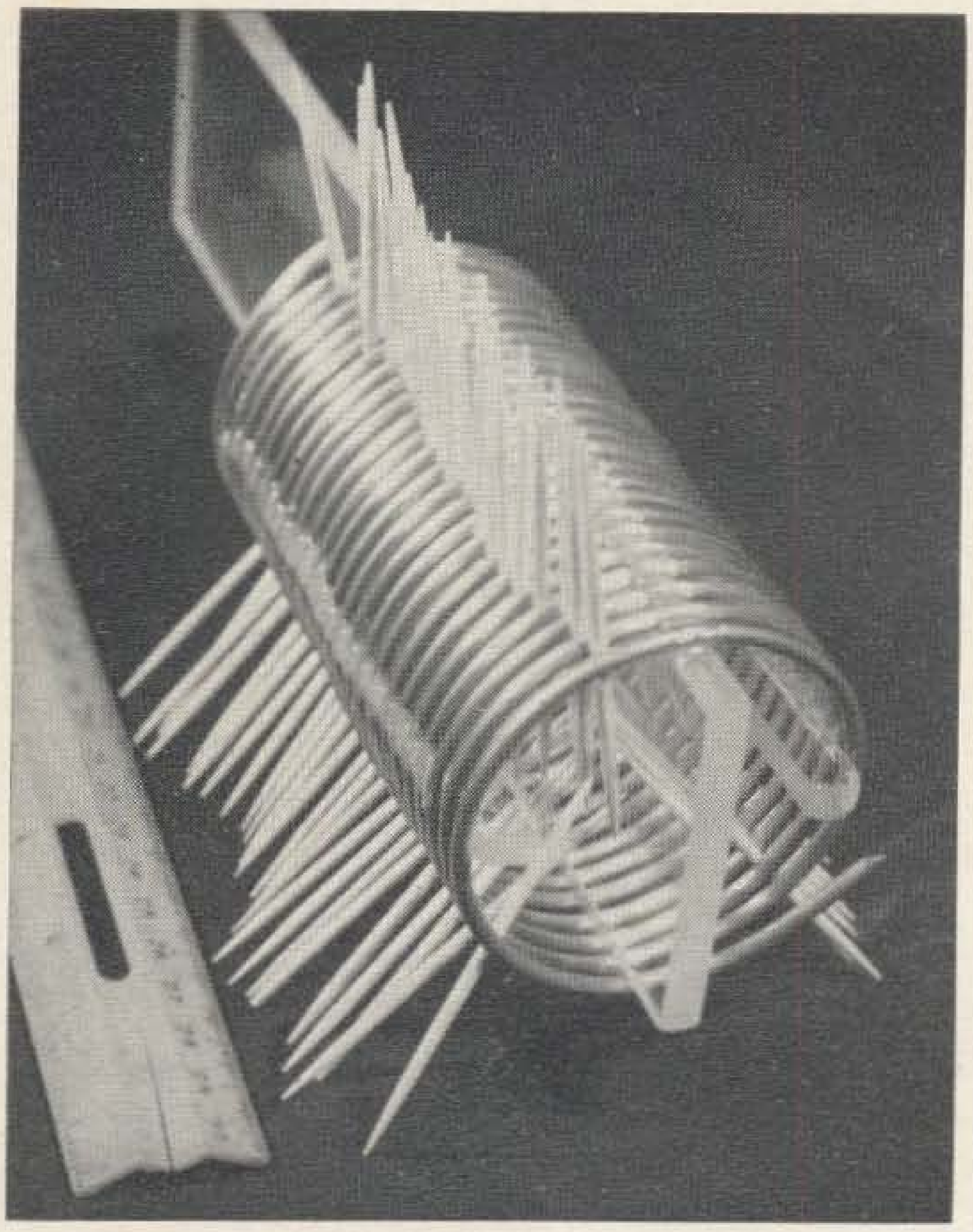
An amateur radio station established by the Virgin Islands' Semicentennial Commission and operated in conjunction with the islands' 50th anniversary observance will be donated to the St. Thomas branch of Boy Scouts of America and run as the official B.S.A. Amateur Radio Club. During Semicentennial Week the station attracted many residents and visitors and over 500 contacts were made with hams throughout the mainland and the world. In this photo, left to right, Antonio Benvenutti KV4BA, Pat Miller KV4CI and Les Scott KV4EY demonstrate the operation of the station.

RSGB Welcome to London Scheme

Overseas visitors to London who wish to meet British radio amateurs are invited to telephone any of the numbers on the following list, so that suitable arrangement for their reception may be made. It would be of assistance if a preliminary letter, giving the dates of their trip and details of any special interests or needs could be sent to the Publicity Officer, Radio Society of Great Britain, 95 Collinwood Gardens, Clayhall, Ilford, Essex, England. The RSGB regrets that they are unable to undertake any accommodation bookings, although they are able to advise visitors who have difficulty in finding hotel rooms. They strongly advise visitors not to come to London unless they have made definite accommodation arrangements.

Direct inquiries from visitors to RSGB Headquarters will be re-routed to one of these numbers: 550-0882, Colindale 1443, Colindale 4770. Laburnum 5733, Wordsworth 5723 or SM8-5866. Your cooperation would be appreciated.

Spacing Homemade Air Wound Coils



After trying several methods for spacing the turns in air wound coils, I have come up with this method. It is cheap, easy, and almost fool proof. First wind the coil "tight" with the turns touching. Push the pointed end of the toothpicks between the turns at approximately 120 degree intervals around the coil and the spring tension of the coil will hold the spacers in place while the glue or epoxy sets firm. Either round or flat toothpicks can be used, depending on the spacing desired. Nails, or other metal spacers will scratch the enamel and should only be used on bare or tinned wires. The toothpicks can be easily removed when the glue sets.

. . . Chuck Miller DL5AF/K4SEL

External SWR Bridge Meters

When using an SWR bridge with an external meter (such as for one man adjustments at the antenna), connect suitable rf chokes inside the bridge at the meter connections. Otherwise the meter leads may act as pick-up atennas and give erroneous meter readings.

. . . Richard Mollentine WAØKKC

PLEASE INCLUDE YOUR ZIP CODE WHEN YOU WRITE 73.

Technical Aid Group

The members of *73's* Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a question about ham radio which can be answered adequately through the mail, write to one of the Volunteer TAG members whose specialty encompasses your query. Please write legibly and include a self-addressed stamped envelope with your request.

If you feel you are qualified to help other hams and would like to join the Technical Aid Group, write for complete details. To do the most good and to provide the best coverage, we need TAG members in all parts of the country. Right now all US call areas except W1 are represented as well as Europe and South America.

Although 73 will help the Technical Aid Group with organizational help and publicity, we want it to be a ham-to-ham group helping anyone who needs help, whether they are 73 readers or not.

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.

Jim Ashe W2DXH, R.D. 1, Freeville, New York. Test equipment, general.

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.

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

Stix Borok WB2PFY, high school student, 209-25 18 Avenue, Bayside, New York 11360. Novice help.

Richard Tashner WB2TCC, high school student, 163-34 21 Road, Whitestone, New York 11357. General.

J. J. Marold WB2TZK, OI Division, USS Mansfield DD728, FPO San Francisco, California 96601. General.

Clyde Washburn K2SZC, 1170 Genesee Street, Building 3, Rochester, New York 14611. TV, AM, SSB, receivers, VHF converters, semiconductors, test, general, product data.

Theodore Cohen W9VZL/3, BS, MS, PhD, 261 Congressional Lane, Apartment 407, Rockville, Maryland 20852. Amateur TV, both conventional and slow-scan.

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 W8JRC/4, BSEE, 3120 Alice Street, West Melbourne, Florida 32901. General.

Bruce Creighton WA5JVL, 8704 Belfast Street, New Orleans, Louisiana 70118. Novice help and general questions.

Louis Frenzel W5TOM, BAS, 4822 Woodmont, Houston, Texas 77045. Electronic keyers, digital electronics, IC's, commercial equipment and modifications, novice problems, filters and selectivity, audio.

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

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, 1411 18th Street, Manhattan Beach, California 90266. AM, receivers, mobile, test equipment, surplus repeaters.

Howard Krawetz WA6WUI, BS, 654 Barnsley Way, Sunnyvale, California 94087. HF antennas, AM, general.

Howard Pyle W7OE, 3434–74th Avenue, S.E., Mercer Island, Woshington 98040. Novice help.

Charlie Marnin W8WEM, 3112 Latimer Road, RFD 1, Rock Creek, Ohio 44084. General technical questions.

Michael Wintzer DJ4GA/W8, MSEE, 718 Plum Street, Miamisburg, Ohio 45342. HF antennas, AM, SSB, novice gear, semiconductors.

Roger Taylor K9ALD, BSEE, 2811 West Williams, Champaign, Illinois 61820. Antennas, transistors, general.

Michael Burns Jr. K9KOI, 700 East Virginia Avenue, Peoria, Illinois 61603. AM, SSB, receivers, transmitters, digital techniques, novice help, general.

Robert Scott, 3147 East Road, Grand Junction, Colorado 81501. Basic electronics, measurements.

PFC Grady Sexton Jr. RA11461755, WA1GTT/DL4, Helmstedt Spt. Detachment, APO New York 09742. Help with current military gear, information from government Technical Manuals.

Eduardo Noguera M. HK1NL, EE, RE, Post Office Box Aereo 774, Barranquilla, Columbia, South America. Antennas, transmission lines, power and audio transformer design and construction, general amateur problems.

The Galaxy V Mark 2

Jim Fisk W1DTY
RFD 1, Box 138
Rindge, New Hampshire 03461

A quick glance at the new Galaxy V, Mark 2, five-band SSB transceiver leads you to wonder what changes were made from the previous model. The front panel certainly doesn't look very much different. The only changes evident here are the new vernier logging scale and removal of the "zeroing" knob. However, a look inside and a quick check of the schematic show that this new transceiver from Galaxy has actually been modified a great deal.

The most obvious difference is the large number of semiconductors that have taken the place of tubes. In the Mark 2, semiconductors are used in the VFO, high-frequency crystal oscillator, speech amplifiers, AVC rectifier and amplifier, CW sidetone generator, and receiver audio stages. In addition, the optional plug-in VOX accessory is completely transistorized.

The solid-state VFO is really exceptional —no less than four transistors are used: the oscillator, a two-transistor buffer stage and an output stage. The people at Galaxy are so proud of the stability of this new VFO that they run a frequency-stability check on each transceiver and include the curve with the unit. The frequency drift on my Galaxy V, Mark 2, is less than 100 Hz in any fifteen minute period, and most of that takes place in the first thirty minutes after it's turned on. After forty-five minutes or so it's difficult to detect *any* drift at all. This was borne out when I had the opportunity to see the Mark 2 VFO run into a digital frequency counter—once you set it on frequency there were occasional 1 Hz drifts to one side or the other, but that's all.

In addition to its excellent stability qualities, frequency readout is extremely linear. When you zero in on the nearest 100 kHz point and set the vernier logging scale, you can read the frequency directly in kilohertz. With a little practice you can interpolate to within about 100 Hz. If a DX station says that he's listening on 14206 kHz, you can hit it right on the money with no effort at all.

Other new, more subtle features of the Mark 2 are 400 watts on SSB, sidetone audio for CW, optional CW break-in and an optional CW filter. Many of the transceivers on the market leave a lot to be desired for the CW operator; not so with the Mark 2. With the break-in and filter options, and the built-in sidetone feature, it's a dream to use on CW.

If you have ever tried to work the CW section of a DX contest, or tried to snag a rare one in a pileup on twenty meters, you know exactly what I mean. The *if* filters designed for sideband just don't do the job on CW. However, the optional new Galaxy F-3 filter provides the extreme selectivity required in CW work. The selectivity is nominally 300 Hz wide at the −6 dB points, with some broadening as the signal level increases. In fact, the selectivity is adequate to split the mark and space signals from an RTTY signal shifting only 170 Hz! To compensate for insertion losses, a one-stage transistor amplifier is built in. With this little nicety it is possible to switch the F-3 filter in with no change in the audio output.

Transmitter circuit

In the Mark 2 the microphone signal is amplified by two transistor audio amplifiers and then applied to a 12AT7 balanced modulator. A carrier signal from a 6GX6 crystal-controlled carrier oscillator is also coupled into the balanced modulator—the frequency depending upon which sideband is selected, upper or lower. The output from the 12AT7 is a double sideband, suppressed carrier signal.

This D.S.S.C. signal is coupled into the six-crystal lattice filter. This filter is only 2.1 kHz wide at 6 dB down and its excellent shape factor results in a very clean SSB signal with unwanted sideband suppression of at least 55 dB. The SSB signal from the output of the filter is amplified by a 6EW6 *if* stage and then coupled into a 6EJ7 transmitting mixer.

The 5.0 to 5.5 MHz signal from the VFO is coupled directly into the transmitting mixer stage for operation on 20 and 80 meters. On 40, 15, and 10, a signal from the high-frequency crystal oscillator is mixed with the VFO output in a 6EA8 mixer and then applied to the 6EJ7 transmitting mixer. This signal is coupled into the 6GK6 driver—then to the parallel 6HF5 output stage.

For CW operation the carrier oscillator is shifted so that the carrier is centered in the bandpass of the crystal filter. This is helpful because you are transmitting on exactly the same frequency where you're listening, and not hopping across the band with every "over." In the CW mode, the 6EJ7 transmitting mixer is grid-block keyed.

The internal ALC system consists of two semiconductor diodes in the final grid circuit. Whenever grid current flows in the power amplifier, it is rectified and coupled as a negative ALC voltage to the 6EW6 *if* amplifier, reducing the gain to maintain linearity.

Receiver circuit

In the receiver the incoming signal is amplified by a 12BZ6 rf amplifier and then coupled into a 6HG8 receiving mixer. The mixing signal is supplied by the same VFO and 6EA8 mixer used in the transmitter. The output of the mixer is fed into the crystal filter and then to a 6EW6 *if* stage. It is further amplified in the second *if* amplifier, a 12BA6, and coupled into the 6GX6 product detector. The low-level audio output from the product detector drives the solid-state AVC rectifier and audio amplifier stages. The negative AVC voltage is applied to the rf stage and the first and second *if* stages.

Galaxy V Mk 2 Specifications

Frequency coverage:	3.5-4.0 MHz, 7.0-7.5 MHz, 14.0-14.5 MHz, 21.0-21.5 MHz, 28.0-28.5 MHz, 28.5-29.0 MHz.
Types of emission:	Selectable upper or lower sideband, CW.
Power input:	400 watts PEP SSB, 300 watts CW.
SSB generation:	Crystal lattice filter, bandwidth 2.1 kHz at 6 dB points. Unwanted sideband suppression −55 dB. Carrier suppression −45 dB.
Receiver sensitivity:	0.5 μV for 10 dB signal to noise ratio.
Features:	Push-to-talk or optional VOX, ALC, automatic carrier insertion for CW, break-in CW operation with VOX accessory, grid-block keying on CW, tuning dial with vernier logging scale provides 1 kHz frequency readout—interpolation to within 100 Hz, optional 300 Hz CW filter.
Tubes and semiconductors:	12 tubes, 16 transistors and 9 diodes. Parallel 6HF5's in the power amplifier.
Accessories:	AC35 117 Vac power supply, G35A 12 Vdc mobile power supply, remote VFO, crystal calibrator, F-3 CW filter, VOX.
Size and weight:	6" x 10¼" x 11¼". 13 pounds.
Price:	$420.00.

VOX

In the optional VOX unit, an audio signal is picked up at the second speech amplifier and fed into a two-stage VOX amplifier. The output of the VOX amplifier is used to drive a Schmitt trigger. The base to emitter junction of a transistor is used as a level reference zener diode in the trigger circuit. When the input reaches the level preset by this diode, the trigger quickly conducts and drives a relay amplifier. The trigger circuit is much more positive than the usual VOX circuitry and minimizes undesirable relay chattering. In the CW mode the keying circuit operates the sidetone oscillator which injects a strong audio signal to operate the VOX for break-in operation.

When you combine all of these features with a 0.5 μV sensitivity for 10 dB signal to noise ratio, selectable sideband, 400 watts PEP and complete five-band coverage, including a full megahertz on 10 meters, you have an all-around transceiver that is hard to beat.

. . . W1DTY

The Transistor: A Primer

It is inevitable that successful new devices such as the transistor are the subject of controversy, the victim of misconception, and the target of sour-grapes-type tube guys who are poor losers. Now we've got to go back to year 1 and clear the air so that both the neophite and the hoped-for converts will understand the transistor's history, it's uses, and its limitations.

1. It is not true that transistors were invented by a fashion plate and thief because the tubes he stole made his pockets bulge and ruined his crease.

2. The question, "Where are transistors found"? is somewhat a contradiction in terms. Once a transistor is lost it stays lost.

3. The practice of plating transistors with precious metal and using them as shirt studs and cuff links was a natural outcome after the discovery that they cannot be found if they roll under the bed or the bureau.

4. It is not true that the Japanese make transistors because they don't know how to make tubes. They simply don't have room to make tubes.

5. It is not true that Japanese transistor rigs are packaged by their fishing industry and the parts are not packed like sardines. Soy bean oil, cottonseed oil, mustard sauce, and catsup are all corrosive to transistors. At least the transistors have not appeared with every other one inverted on the board.

6. It is not necessary for the casual experimenter to stock a multitude of transistors for his home projects. You usually find only two types on his bench; the ruptured junction PNP and the open collector NPN.

7. Transistors are definitely interchangeable. The problem is to get them exchangeable at the store where we got them.

8. No, we don't have a sample transistor to show you. We did have but lost it on the way here.

9. No, dropping a transistor is not harmful. It always finds a soft spot in your cuff where it is lost.

10. Yes, we can define the words, "epitaxial planar passivated". They are discouraging words.

11. No, do not use RG-8U to interconnect monolithic chips containing 60 transistors and diodes. Use 5U4's (in the darlington connection for transistors) instead to benefit from the large signal handling capability.

12. Yes, if you repair a transistor rig and have to leave the vtvm connected to sustain oscillation, you can charge the customer for the vtvm.

13. Yes, the boxes that transistors come in where designed to contain transistors—why do you ask?

14. No, there is no shock hazard involved in servicing transistor rigs other than the initial one upon removal of the cover and having peered inside.

15. Yes, transistors last a lifetime. They usually survive the serviceman who works on them since he usually shoots himself by-and-by.

16. No, this isn't a biased opinion. That depends upon what you mean by bias. I used to know but I don't any more.

17. Watch it! Don't anyone move. No, this isn't a stickup. I just dropped my last 2N697.

. . . Raymond Stellhorn WAØNEA

Resurfacing Plastic Faces on Meters

Did you ever try to take a reading by squinting through the face of a meter that has been marred by a molten drop of solder? I did for a long time until I decided to sell the instrument and found that I could not even give it away because of that ugly mark. Since I could not lose anything, I decided to try and fix it.

With some very fine steel wool, I rubbed the whole plastic face in such a way as not to leave any noticeable gouges and the face was evenly frosted. When this was done the face looked like the inside of a frosted light bulb, and the mark left by the solder had disappeared. After this operation I sprinkled a bit of powdered kitchen cleanser on the face and rubbed it on with care, avoiding any large grit. After a few minutes of this, the face became clear again, and a final buffing with a cloth did the trick. To prevent any static electricity from affecting the accuracy of my meter after this work, I spread a thin film of a liquid dishwashing detergent on the face of the meter and let it dry. Now my meter looks like it did when it was brand new. I found that this also works well on wristwatch crystals.

. . . E. Babudro VE3ECU

Testing Silicon Diodes

It has been my fortunate experience to have acquired a number of silicon diodes as well as signal diodes and transistors. The problem of course is to evaluate these units so as to make proper use of them without exceeding their inverse peak values, i.e., non-destructive testing.

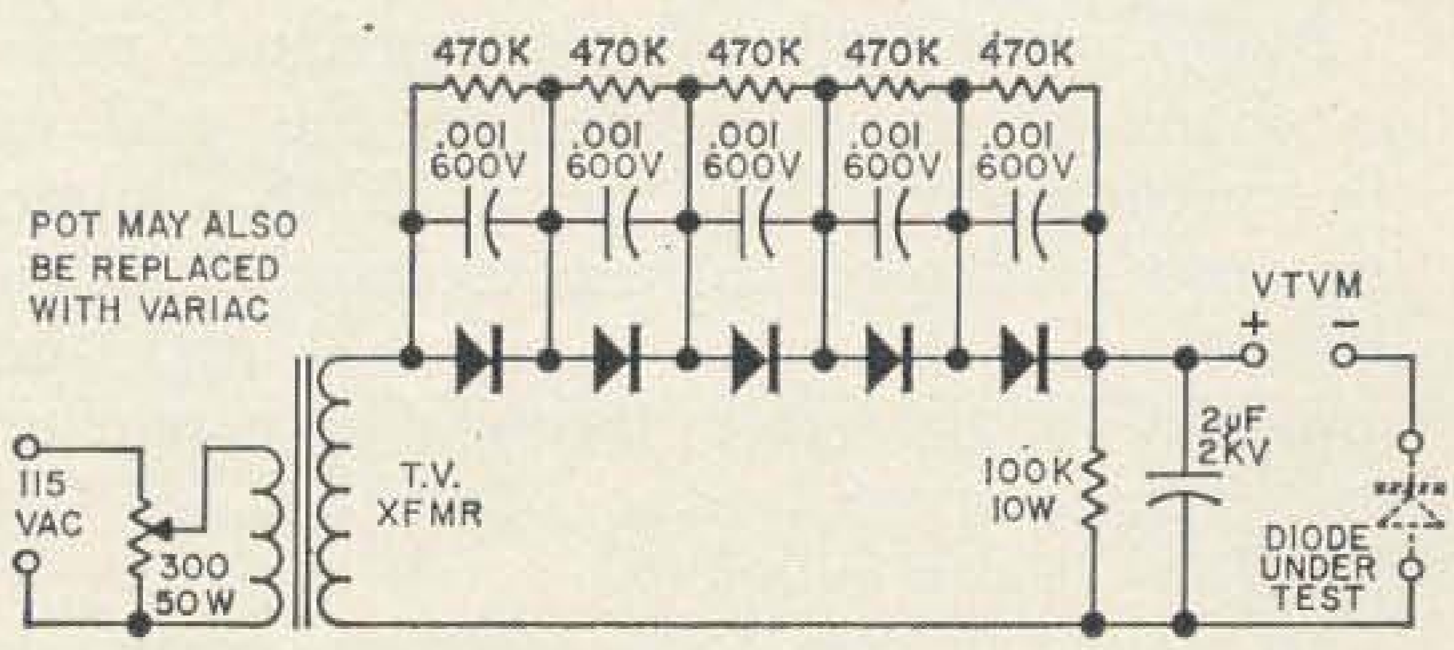
The first problem was in obtaining a burn-out proof micro-ammeter. Surveying the equipment on the bench I spotted a VTVM. A little further thought led me to realize this was exactly the instrument I searched for. Its input resistance is 11 megohms and in operation it is actually measuring the current through this resistance. All this means is that for each 11 volts read on the meter there is 1 microamp of current flowing through the meter. 10 microamps—110 volts etc. Therefore: using a VTVM for a dropping resistor in conjunction with a variable voltage dc power supply of on the order of 1000 volts, it is possible to "avalance" both diodes and transistors without damaging them.

In evaluating silicon diodes for high-voltage power supplies, etc., the diodes should have less than 1 microamp of leakage. The maximum peak inverse voltage that can be safely used on a particular diode would be that voltage with produces 1 microamp of leakage or less. This would be the diode's "PIV" rating.

It has been said that once a manufacturer sets up his equipment to make "good diodes", it's fairly difficult to make poor ones. That is to say that a great many 200 volts PIV diodes have actual PIV ratings of 600 volts and some even better.

In using these diodes for high-voltage power supplies there are several rules which should be rigorously adhered to. 1. There should be a .001 μF disc capacitor across each diode. 2. There should be approximately ¼ meg resistor across each diode in the string. (These resistors equalize the reverse voltage drop across each diode compensating for individual leakage resistances. The capacitors tend to round off most high voltage transients from the power line). 3. Allow, at least, 20% safety factor in initial design, i.e., a 2400 volt dc supply with 2400 volts AC each side of center has a inverse peak voltage of 6720 volts. 2.8 X 2400. With 20% safety factor the diodes should be capable of with standing 8024 volts. Ref: 37th Edition ARRL handbook, page 221.

. . . John McFeters KØOLG



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The Heathkit SB401 Transmitter

Companion to the SB301 receiver reviewed here last month, the SB401 is, like its partner in receiving, a modified and improved version of an older piece of gear, in this case the SB400, an exciter which lost no time in establishing a good reputation.

Frequency coverage is from 10 to 80 meters in eight 500 kHz segments, four of which are required for the full spread from 28 to 30 MHz. The operator has a choice of upper or lower sideband and vox activated CW on all frequencies.

Circuit

Make no mistake—nothing's missing from the SB401. A fistful of controls make you master of any situation. Tracing out the circuit will make this clear.

Audio input, either high-impedance mike or phone patch, is applied to the grid of the preamplifier, half of a 6EA8. Audio response is shaped to restrict bandwidth to 350 to 2450 Hz, plus or minus 3 dB. The amplified signal goes through a capacitor and level control to the other half of the 6EA8, a cathode follower.

In either of the SSB positions—upper or lower—audio from the 6EA8 is also applied through the vox gain control to the vox amplifier. When operating CW, however, a 1000 Hz sidetone is generated by a 6J11 tone generator and amplified by a 6D10 tone amplifier; this feeds the grid of the vox amplifier, allowing vox to be used in all modes. Output from the vox amplifier is rectified by a diode and coupled to the grid of the relay amplifier. Vox sensitivity and drop-out time are adjustable, as is anti-vox level.

In addition to keying the vox amplifier, the tone oscillator also provides a monitoring sidetone. This can be obtained by feeding the receiver audio into a rear panel jack on the transmitter, then plugging the station loudspeaker into another jack. Thereafter, the received signal is heard normally until the transmitter is activated; at that point, the receiver is muted and the sidetone is heard in the speaker instead, each time the key is closed—a very convenient arrangement which will be appreciated by CW hounds. A level control inside the cabinet, but easily accessible, adjusts sidetone volume.

A triple-triode Compactron, a 6AV11, is used as follows: one triode is the lower sideband carrier generator, at 3393.6 kHz. Another triode section is for the upper sideband carrier at 3396.4 kHz, and in the CW mode, uses another crystal at 3395.4 kHz. Only that triode selected by the mode switch receives plate voltage. The third triode is a cathode follower in all modes.

Audio from the speech-amplifier cathode follower and carrier from the sideband generator are fed to a diode ring balanced modulator whose output is the sum and difference of the audio and carrier frequencies. When operating on CW, a small dc voltage upsets the balance of the modulator, producing output on the CW carrier frequency.

The signal is then coupled through a transformer to the grid of a 6AU6, which isolates the balanced modulator from the crystal filter and provides for the proper impedance matching. This stage is also partially controlled by ALC (automatic level control) voltage which will be mentioned later. From the isolation amplifier, the signal next goes to a 2.1 kHz crystal lattice filter, emerging to be coupled to the grid of the 6EW6 mixer.

The SB401's VFO operates over a range of 5 to 5.5 mHz, its output passing to the cathode of the 6EW6 mixer, which produces the sum and difference of the VFO and previously generated frequencies. The sum frequency is then coupled through a bandpass coupler (8.395 to 8.895 MHz) to the grid of the heterodyne mixer, another 6EW6.

The triode portion of a 6AW8 is a heterodyne oscillator whose plate voltage is regulated, and whose frequency is determined by one of the eight switch-selected crystals. Its output is also coupled to the grid of the 6EW6 heterodyne mixer. In passing, note that the sole function of the pentode section of the same 6AW8 is to amplify the heterodyne oscillator input from the companion receiver, the SB301, when operating transceive. Only when the mode switch is in the "transceive" position is plate voltage applied to this part of the tube. In the "independent transmit" posiion, voltage is applied instead to the plate of the 6AW8 heterodyne oscillator.

The signals from the bandpass coupler and heterodyne oscillator are mixed in the 6EW6 heterodyne mixer. Only the difference frequencies reach the grid of the 6CL6 driver tube. A trap in the driver grid suppresses a spurious signal at 8.6 MHz which might otherwise appear in the output on the 7 MHz band.

Driver output is applied to the grids of a pair of 6146's in parallel, operating in Class AB_1. An internal pot sets bias at −50 volts to hold the no-signal plate current at 50 mA.

Peak driving voltage for the finals is variable with the CW level control, which is in tandem with the microphone gain on the front panel. In SSB operation, the limiting action of the ALC circuitry also affects the driving voltage.

A conventional pi network couples final output to the antenna. Impedances of approximately 40 to 150 ohms can be matched. A built-in relay automatically transfers the antenna from the transmitter to the receiver.

SB-401 Specifications

Frequency Coverage:	3.5 to 4.0; 7.0 to 7.5; 14.0 to 14.5; 21.0 to 21.5; 28.0 to 28.5; 28.5 to 29.0; 29.0 to 29.5; 29.5 to 30.0 MHz.
Emission:	Selectable upper or lower sideband, CW.
Input power:	180 watts PEP SSB, 170 watts CW.
Output power:	100 watts on 80 through 15 meters; 80 watts on on 10 meters.
Output impedance:	50 to 75 ohms.
Frequency stability:	Less than 100 Hz drift per hour after 20 minute warmup period. Less than 100 Hz drift for 10% changes in line voltage.
Sideband generation:	Crystal lattice filter. Carrier suppression 55 dB down from rated output. Unwanted sideband suppression 55 dB down from rated output at 1000 Hz and higher. Third order distortion 30 dB down from rated PEP output.
Dial accuracy:	Visual accuracy within 200 Hz on all bands; Electrical accuracy within 400 Hz on all bands after calibration to nearest 100 kHz point.
Features:	Noise level at least 40 dB below rated carrier; audio frequency response from 350 to 2450 Hz; 10 dB audio compression; high impedance microphone and phone-patch inputs.
Power requirements:	105-125 Vac, 50/60 Hz. 80 watts in standby; 260 watts CW (key down).
Size and weight:	14⅞" x 6⅝" x 13⅜". 26½ pounds.
Price:	$285. (Optional crystal pack $29.95).

In either LSB or USB modes, when the final tubes are driven into grid current, a voltage appears at the junction of a resistor and capacitor in the final grid circuit. This voltage, which follows the audio peaks, is rectified by a pair of diodes and appears on the grid of the 6AU6 isolation amplifier as a bias. Thus, should the finals be overdriven, gain is reduced immediately to prevent splatter. In one of its several switchable positions, the panel meter displays the ALC voltage. By keeping an eye cocked at it, drive may be effectively controlled by holding voice and gain at the level where the needle stays where it's supposed to.

The meter also reads final grid and plate current and plate voltage, as well as relative output and is very useful in tuning up and operating within the proper parameters.

The lineup is completed by a solid state power supply furnishing 720 volts dc under full load of 250 mA. Lower voltage dc—250 volts—is also provided for other stages, and there is −170 volts of bias too.

Comparison with the SB400

The major difference between the new rig and its rather young ancestor is "instant transceive". Owners of the SB400 will recognize the value of this new feature immediately; you no longer have to open the cabinet and change the output cable from the VFO to switch modes. It was never a big deal to do so, but there's no doubt that the convenience is well worth having. So many SB400 owners have home-brewed conversions that will do the same thing that a number of articles have already found their way into the magazines. At least one unpublicized version this writer knows of (K2UUJ fathered it) was based on the fact that the heterodyne oscillator is activated only in the transceive mode. The plate voltage was picked up at a convenient point to power a relay that performed the actual switching of cables. Other schemes have been used successfully.

An added driver coil is an important but less noticeable improvement which results in more 10 meter drive. The single driver coil in the SB400 was tuned for 28 MHz. As a result, drive was insufficient in the upper reaches of the band. Now, with the extra coil peaked at 29 MHz switched into the circuit better results are assured.

The VFO mixer stage, although still using a 6EW6, has been completely revamped. Even a casual comparison shows the difference at once. A 21.1 MHz trap is now included in the circuit. There are many minor revamps elsewhere; the mere fact of their existence is a pretty good indication that the boys at Benton Harbor are satisfied with nothing but the ultimate and continue to improve their product even when it is already well accepted.

As further evidence of this thinking, the SB401 has a 680 ohm resistor inserted in the screen voltage supply to the finals. It has been added because it reduces the already acceptable distortion products figure by 3 to 4 dB more.

Although the SB400 was designed to operate independently or transceive with the SB300 receiver (which it will also do with the new SB301), it was sold only as a complete unit. With the advent of the SB401, however, Heath has changed their marketing strategy and made the rig even more of a bargain for those who own the receiver. The new model is available complete, as before—which is what you'd need to use it with any other receiver—but, if you own either the SB300 or SB301, you can buy the transmitter for less without the crystals which are sold as a separate accessory.

The new transmitter's VFO has been modified, just as it was in the transition from one receiver to another. Minor circuitry changes and use of an industrial type 6BZ6 instead of the old 6AU6 is the story. At the risk of boring those who may have read the review of the SB301, this seems to be gilding the lily, because the original VFO was rock steady. The new one is at least as good, if not better.

Other minor but noticeable changes . . . a different type of socket on the rear panel to provide line voltage ac to operate external relays; the use of two terminal boards smaller than used in the SB400 for below chassis parts mounting, cleaning things up nicely.

Construction, alignment and operation

A total of 37½ hours was spent building the transmitter, including about two hours for photography. Alignment, for which you need a VTVM with an rf probe, a ham band or general coverage receiver, and a dummy load, took about 3 hours more.

Would-be builders may benefit from these suggestions:

Before soldering any connections from the cable harnesses, lay them in the most advantageous position. Twisting them here and there will make for a neater job. Take this precaution—where the manual specifically instructs you not to shorten leads breaking out of the harness, don't. Hear and obey!

Make every effort to achieve proper alignment of the dial mechanism. Set up right it is as smooth as the expensive spread; if not, it shrieks, groans and otherwise suffers.

Once construction, alignment and calibration are finished, you can begin to enjoy the fruits of your labor. This transmitter is everything you could want. SSB buffs will be proud of their clean, splatter-free signals, excellent suppression, freedom from drift, and natural audio quality. The vox is smooth and can be adjusted from instant dropout to holding in long enough so that you'll never know you worked Don Miller. This is no gag—I found myself cutting its hold-in time for fear I wouldn't hear his rapid-fire comebacks.

Brasspounders will revel in the clean, chirp free T9X note, to say nothing of the convenience of the built-in sidetone and vox-activated break-in keying. The scope in my shack displays a signal which is shaped good, like a CW signal should.

Add the undeniably good looks of the package, the fractional kHz readout, and you've got quite a piece of equipment.

Final comments concern transceive operation with the SB300 or SB301. Numerous interconnecting cables are required, as expected, but three of them—those which bring the VFO, BFO and heterodyne oscillator signals into the transmitter—must be cut from RG62 coax cable to exactly 2 feet. The cable is supplied with the kit.

When the transmitter and receiver are interconnected and CW operation is desired, the transmitter's mode switch should remain in the "transceive" position at all times, whether actually transceiving or operating split frequency. If the mode switch is set instead to the "transmit" position for CW, a constant beat note is heard in the receiver. This isn't too clear in the manual and it took a personal discussion with the Heath engineers before it was cleared up. As a result, they have issued a bulletin to clarify the matter, and are including a revision in current production. This also applies to the SB300/400 combination. . . . W2JDL

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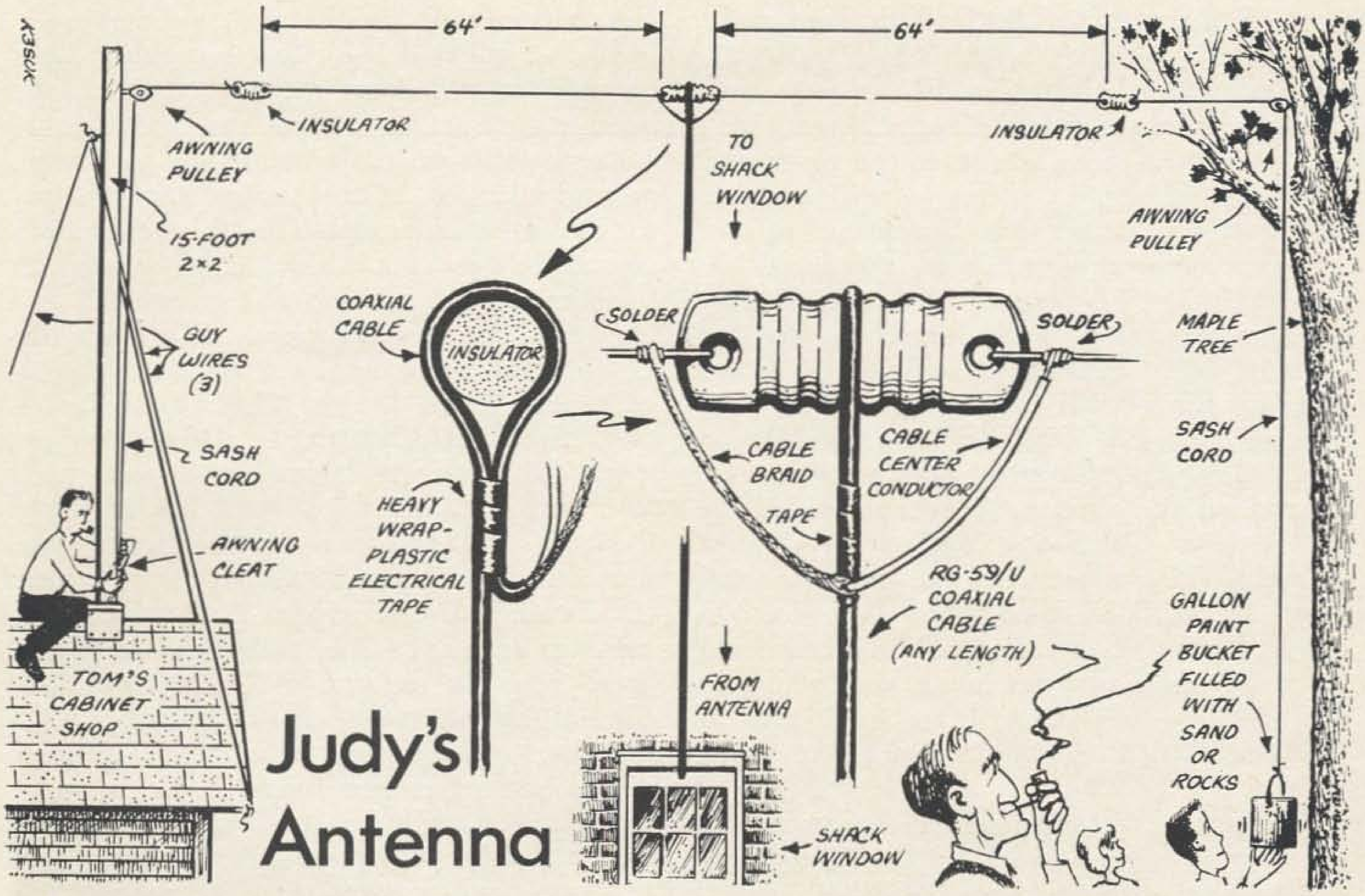
Climbing the Novice Ladder

Part VIII: Approaching the pinnacle of final achievement.

Five days after mailing her order, Judy's little *Adventurer* transmitter arrived; two days later Joe's Knight-Kit T-60 was delivered to his door. Judy immediately coaxed her Dad into taking her out to FN's place as FN had agreed to put her little rig on the air and give it the acid test. When they arrived, FN took the transmitter, set it on his bench and ran his eagle eye over it. "Looks pretty nice Judy . . . not a single scratch and no paint chipped . . . I'd say the former owner had given it good care. Let's hook her up to my test antenna now and see how she loads up." Using clip leads from the antenna and ground terminals on the rig to the terminal screws on his bench, FN plugged in his key, went in his shack, turned on the receiver and put it on the speaker. "We can't legally make an on-the-air test Judy, without signing our call letters at least every ten minutes. As you're not yet licensed, I'll have to do the actual keying of course and I'll use my own call letters. I put the receiver on in the shack so we can ask "QRM?" occasionally and we can then hear anyone whom we might be bothering on the frequency. Lucky I've got quite a store of crystals here; that's one thing we all overlooked when you ordered the transmitter; should have told you to order at least one crystal in the novice band at the same time." "I thought of that Gramps," Judy replied, but it slipped me when I placed the order. We won't have to send for a crystal though; all three stores down-town have a pretty fair stock including novice crystals so we can get one there; Joe will need one too." "That's right, Judy, and I suggest that you both get just one for the 80 meter novice band for a starter. Get a frequency well removed from either end of the band to insure that your operation will be well within bounds. Check at the club and see what frequencies other local novices are using. You can then get one a little off from any of those and you won't interfere with each other then but you can still communicate back and forth. For the tests we're going to make now though we won't need a novice band crystal as my Extra Class License gives me all amateur privileges, but let's pick a crystal as close to the novice band as my stock will produce. Let's see . . . here's one at 3520 . . . too low . . . 3610 . . . still a bit low . . . ah, 3685 . . . that's only 15 kilohertz from the low end of the novice band . . . let's give that a try" and so saying, FN plugged it in. "Now you can plug the AC cord into the outlet Judy . . . wait a minute . . . check the 'on-off' switch on the panel *first* Judy . . . be sure it is 'off'. That's right; now turn on the switch. The pilot light comes on and we can see the glow of the tubes through the vent holes in the cabinet . . . so far, so good. Let 'er 'cook' for a few minutes to warm up the tubes and then if no smoke, we'll tune 'er up." In a couple of minutes FN asked for the instruction manual and



Judy's Antenna

Judy handed it to him. "I'm looking for the tune-up instructions Judy; I know what to do but I want you to follow it in the book as I make the adjustments. First we'll put the band switch on 80 and the meter switch on 'grid'. Now we'll tune the oscillator dial until we get a maximum reading on the meter; this is the 'drive' to the grid of the final amplifier tube. Next we flip the meter switch to 'plate' and quickly tune the final amplifier dial, leaving it at *minimum* point at which it dips. We do this quickly so the current doesn't run away . . . could damage the meter or tube or both if we make a sluggish operation of this. And, I noticed but forgot to mention that the 'load' switch was already in the minimum position which it should be. There . . . see how great a difference in meter reading when you hit the dip point? From almost off scale the pointer fell clear back to about 30; good. Now we want about 100 on the meter . . . that's 100 milliamperes or normal load for the 807 amplifier tube. So . . . we'll advance the loading adjustment switch one point at a time. As we do the meter reading will go higher each time. We bring it back to the dip point with the final amplifier tuning dial . . . see? Notice that the dip point is now 45; we can load still more; let's take another step on the load switch, again dipping the final. Now we're reading 60; let's load it another point; ah, now we're getting close . . . reads slightly above 80 now; one more point. There, that's so close to 100 that we'll leave it . . . about 97 I'd say. The next point on the load switch would probably take it well over 100 which would be an overload on the tube which we don't want. As a final adjustment, we flip the meter switch to 'grid' again, and with the oscillator tuning dial, adjust the current so that it reads not more than 4 on the smaller scale; that's normal for the 807 tube. Finally, touch up the final amplifier dial if necessary to establish the dip point which should still remain around 95 to 98 . . . it does. Let me light my pipe now and then we'll send a few V's and my call, ask "QRM?" and listen to the speaker for a minute." After coaxing a few billowing smoke clouds from the old corn cob, FN made several V's . . . the generally accepted test signal, made the word 'test', asked "QRM?" and signed his call. Except for background noise and a little static, all was quiet from the speaker; apparently no interference was being caused to others. "Now," said FN, "suppose we try a 'CQ' call and see if we can raise anyone. Relax Judy, you're as tense as a fiddle string." FN laughed and turned to her Dad saying, "You too, Tom; you'd think we were about to set off a dynamite blast!" Both Tom and Judy released a deep breath which broke the tension somewhat while FN slowly and carefully made a conventional CQ call with the key. "Now Judy, let's go in the shack and tune around the frequency a little bit on either side; chances are against us raising a novice as we are outside of their band but one of the VFO equipped General class guys may answer pretty close to our frequency." FN tuned about 10 kilohertz either side of his crystal frequency but no response. He said, "OK, let's try again now and when I'm through calling, *you* tune around on the receiver Judy and see if we get a bite." Repeating the earlier process brought only silence in the speaker and Judy 's face fell a bit. Seeing this, FN bolstered her spirits a bit with, "Think nothing of it girl . . . not too many stations on in the daytime you know, but we'll give it another whirl; they say the 'third time is the charm'."

Once more the general call to anyone to answer . . . CQ . . . went out then Judy carefully tuned the receiver. "Whoah," called FN as she crossed a relatively loud carrier slowly making code, "back up and tune him in." As she did FN said, "He's calling us Judy; you get it?" "Oh no Gramps, I'm too excited to figure it out" to which both Tom and FN laughed. "Try writing down what he says anyway Judy" FN said as he listened to what the slowly sending station was saying. When the other station had completed his call, FN went back on the key equally slowly, gave him his signal report, FN's location and his sine then told him, "Just making a test here OM; can't stay with you this time but would like a signal report and your QTH and name please." Back came the other fellow, FN acknowledged and thanked him and then signed off with a "73." "Well Judy," FN queried, did you copy any of it?" "Well" she replied, "I got some of it but not enough to really make sense; what did he say Gramps?" "First off he gave us a signal report Judy; RST 579 . . . not bad. That means our signal was easily readable at strength 7 . . . 9 is maximum . . . and we have a good crystal note. Then he told us that he was in Beaver, Pennsylvania . . . that's just across the Pennsylvania-Ohio state line . . . about 200 miles from here roughly. Not exactly 'DX' but it's a good start. Now let's see what I've got in a forty meter crystal and we'll try for a contact there. Here's one right in the novice band . . . 7190 . . . where'd I get that I wonder? Let's try it." Crystals were quickly changed, the band switch set to 40 and the tuning process repeated until the antenna and tube were properly loaded. After setting the receiver to the same frequency as the transmitter crystal, FN put out a slow 'CQ.' Better luck this time . . .an answer on the first call and almost on the same frequency. When the distant station had completed his call FN announced, "Judy, we've raised a novice in the 7th call letter district . . . that's way out west; this little rig looks like it was going to do it's stuff in great shape." FN answered the call with the usual preliminaries then listened while Judy attempted to put down the return reply on paper. Much to her surprise and delight she got both his name, 'Paul' and his location in Cody, Wyoming! She missed the signal report figures but FN told her, "579 again, Judy; that's as good as we got from Pennsylvania. Wyoming is some six or eight hundred miles from here but remember, 40 meters is a better band for long haul contacts than 80; we're doing fine though. Now the only other novice band you can work is 15 meters but I don't have a crystal for any part of that band . . . seldom work it and when I do I use the VFO. No matter though; we've done enough to prove that the little *Adventurer* can dish it out. Why don't you leave it with me for a few days? You don't have your license yet so you can't use it and that way I'll have a chance to try it out with my regular dipole antennas and several crystals." "Fine Gramps; like you say, no need for me to just sit and gloat over it at home until I get my ticket so you go ahead and use it and see how much DX you can pile up" Judy laughed. "I wouldn't laugh yet Judy," FN returned, "you might be surprised at all the foreign contacts I might make." Judy looked a bit dubious but accepted FN's statement with, "Hope you do, Gramps . . . wish I could."

The little *Adventurer* having demonstrated it's worthiness, was then turned off for the present and FN turned to Tom saying, "Tom, you and Judy bought 100 feet of antenna wire and a couple of insulators for your temporary antenna a little while back. Why don't you get another roll of antenna wire . . . fifty feet will be more than enough this time . . . and another insulator and I'll drop over in a day or so and show you and Judy how to make up a good dipole antenna which will really give Judy's transmitter and receiver a chance. You will need an antenna about 130 feet long with an insulator in the center and some coaxial cable for a 'feeder' line from the antenna to Judy's shack. You can use the antenna wire you already have as well as the two insulators, and the extra wire and insulator will let you lengthen the sky wire and insulate it in the middle; I'll show you what it's all about when I come over. Wait till then before you get any coax cable too as we'll have to figure where you're going to hang the antenna and estimate the length of coax we'll need . . . it's sold by the foot so we won't have to waste any . . . the stuff costs about a nickel a foot. I've got a lot of surplus coax connectors so we won't have to get one for the transmitter end of the feeder. And by the way Tom, how you coming with learning the code yourself?" "Well Dad, Judy says I'm catching on but I don't have too much time to practice you know. Judy sends to me for awhile each evening and I'm beginning to recognize a lot of the letters now. I'm doing a bit of reading in her *ABC's* book and the *License Manual* too, and they both are beginning to make a bit of sense now. I'll make it before long . . . you'll see." Then, with appropriate farewells, he and Judy climbed in the station wagon and headed homeward; Tom would pick up the wire tomorrow.

That evening Judy phoned Joe to tell him of the arrival of her transmitter and results of the tests at FN's shack. "Gee, Judy, that's swell" Joe commented. "My rig hasn't come yet but I expect it any day now." Then Judy told him that FN was coming over to show her and her Dad how to make up and hang a good antenna. "Dad's getting some more wire and insulators in town tomorrow and then Gramps will help us." "Gee Judy," Joe came back, "how about me getting in on the antenna deal too? I'm going to have to have a good one too you know. I've just been using an old hunk of lampcord in the attic for my receiver but I'll need better than that for the transmitter." "'Sure Joe," Judy replied, "I don't see why not; I think Gramps is coming tomorrow afternoon but you'd better phone him to be sure. We can all work on it together and we'll all learn something." "Swell Judy; I'll give FN a call and we'll fix it up." "OK Joe, see you at the Judy Mansfield antenna farm then" was Judy's laughing rejoinder as she hung up.

Tom had picked up the wire and an insulator the next morning and FN had confirmed to Joe that he would be out at Judy's in the afternoon, so shortly after lunch the little group gathered. The first order of business was to decide where to stretch the antenna, and while Tom had a rather hurry-up kitchen cabinet project in his cabinet shop he was agreeable to taking a little time to do a bit of looking with them and catch up on his shop work in the evening. His shop was about 75 feet behind the house where Judy would have her shack in her room. About 60 feet from the front of the house a stately maple tree rose about 50 feet. To FN this seemed a natural. "Tom" he said, "you can stick a 15 foot hunk of 2x2 on the ridge of your shop with three light guy wires and that will make a good support for one end of the antenna and will put it about 35 feet above the ground . . . that's a good height. Then you can stretch the antenna between this mast and the maple out front . . . that's about 180 feet; all we'll need for the antenna is about 130 feet but we'll fix that by hanging the antenna itself in about the middle of the stretch and let the hoisting rope take care of the extra length. If you're willing to put up a stick on the shop for one end, I'll make up a dimensioned sketch from which to build the antenna. Put an awning pulley and a length of sash cord on the top of the mast, remember, and we'll need the same in the tree *so* I'd better get a couple of pulleys and a hank of sash cord while I'm in town. I'll pick up the coax cable for you too, then you can go right ahead. That sound OK to you?" "Yeah Dad, I've got lots of 2x2 stock in the shop and plenty of galvanized fence wire to use for guys. I'll make up a little saddle for the roof ridge and if Joe can stick around, maybe we can get the mast up yet today . . . it's still early . . . how about it Joe?" "Sure, Mr. Mansfield," Joe replied, "I'd like to help; let's do it." FN, satisfied with the arrangements, made up a rough sketch of the antenna make-up which they could do while he did a few errands in town, jumped in his Jeep and took off.

By 4 o'clock FN was back and found that the antenna 'crew' had made good progress. Tom was ready for the rope and pulley for the short mast and he and Joe made short work of erecting it in place. Joe, with the agility of youth, skinned up the old maple for about 35 feet and soon had the rope and pulley fastened in place, came down and prepared a gallon paint bucket full of sand for the lower end of the hoist cable. In FN's absence, Joe and Judy had taken down the old antenna and had one of the antenna legs laid out and spliced into both insulators. "Well," FN commented, "good team work. You people have done such a fast job I think I'll stick around and see it finished . . . I don't have to be home for another hour or so and it looks like you'll have her swinging in the clear before then." With this he uncoiled the coax cable he had brought and showed Judy how to attach it to the center insulator while Joe made up the other leg of the antenna. After soldering the joints at the center insulator, FN pronounced the sky-wire ready to hoist and with Tom on the shop roof and Joe at the base of the tree, the antenna was hauled in place with Judy keeping the coax feeder free from obstructions on the house. "There you go" said FN, when the hoist was completed, "a good looking, workmanlike job you've made of it and it'll work as well as it looks. I'm going to be pushing off for home now, but Tom, you can drill a small hole in the window sash of Judy's shack and push the coax feeder through. Judy can skin the end and hook the braided shield to the ground post on her receiver and the center conductor of the coax to the antenna terminal. You'll see quite a difference in the performance of your receiver Judy, but don't forget to adjust the antenna trimmer on the receiver to resonate with this new antenna." "Gee Gramps, thanks so much," Judy exclaimed, "I hadn't expected we'd *finsh* the antenna job today and I'm going to have a lot of fun listening around this evening." "Yes Judy, that's all you can do now until your license comes, so make the most of it. Joe, what about your antenna?" "Oh, I'm going to stop at Jim Turner's on the way home and pick up the wire and stuff and Larry and a couple of the guys from the club are coming over Saturday to help me put up an antenna. Gee. I'd better get going before Turner closes" and so saying Joe took off; FN was not far behind him as he drove off in his Jeep.

. . . W7OE

Next month: Judy and Joe reach the top rung of the ladder. They receive their licenses and are well launched on their novice career with some pertinent advice from FN.

Type N Connector for the APX-6

Tired of fighting with the type HN connector that comes on the front panel of the APX-6? Well, contrary to popular belief, it's relatively easy to change it over to a more conventional type N fitting. The whole operation only takes fifteen or twenty minutes and is well worth the effort involved.

First of all, remove the tuning knobs, pull out the tubes and remove the five screws holding the cavity assembly to the front panel. Remove all the screws that hold the cathode cavities to the rest of the cavity assembly; remove these cavities and the spring finger gasket underneath. If you look into the top of the T-R cavity, you will see a coupling loop into the transmitter cavity and the large round lead going to the coaxial connector.

The connector is held to the cavity by a split collar; it may be loosened by simply removing the screw which runs through the side. When this screw is removed, you should be able to rotate the connector in the collar. If you unsolder the connector lead from the coupling loop, the connector may be completely removed.

A type N cable jack, the UG-23D/U, fits nicely into this collar. A piece of ⅛" brass tubing from the hobby shop is used for the lead to the transmitter loop. Cut a piece of tubing 1 13/16 inches long and solder it to the center pin on the N connector. Discard the braid washer, gasket and nut from the connector; they are not required for this application.

On the rear end of the N connector you will see two flats which have been machined into the body. One of these flats will have to be extended toward the rear of the connector for ⅛ of an inch; this will provide clearance for the screw in the retaining collar. The flat may be enlarged with a few strokes of a good sharp file. Install the pin and brass tubing into the connector, insert the connector into the collar, tighten the screw and solder the tubing to the transmitter coupling loop. Make sure that the tubing has gone through the two holes in the loop.

If you don't want to go to the trouble of installing the type N connector, a more expensive solution is to use an HN to N adapter, the UG-1108/U. ■

Gus Browning W4BPD
Cordova, South Carolina

Gus: Part 25

In the very next apartment to Jack and Marge, ZS1RM and ZS1OU in Capetown, was the apartment of Jack's mother and father. They came over often and we had many chats about how things used to be in South Africa in the old days. Jack's father is now retired; he used to be a diamond buyer in Kimberly and knew the diamond business coming and going. His wife had some real dandies that I saw on her one night when she was going out to some sort of celebration. She had diamonds in her ears, around her neck, on her wrists, on her fingers, and a brooch or two just pinned on. I mean to tell you that none of them was a little old dinky 3 or 4 carat either. I immediately started calling her Diamond Lil. I tried my darndest to let her know that Peggy also loved diamonds, but I never did have any luck. I think she loved those diamonds even more than I did! When I was departing the country a few months later, I told her to be sure to put my name in her will!

Jack's father told me some very interesting stories about the diamond business; and about some of the very large ones that had been found years before. Also, some very interesting stories about people trying to slip out of the mines with diamonds. One was about a fellow trying to get out of South Africa and through customs with a big batch of diamonds. The story goes like this: someone tipped the customs officials that a man was leaving from the Jo-burg airport the next day, on flight number so and so, with his leg in a cast. The man claims the leg is broken, but in reality the inside of the cast is embedded with diamonds. The caller did not identify himself. Sure enough, the next day on that flight a man named Smith was pushed in a wheel chair up to customs; he had a one way ticket to Amsterdam, Holland. The customs people arrested him and took him into the little room they have there for such people. They very roughly tore and cut the cast from his supposedly broken leg. They were quite rough handling him and he was hollering his head off saying the broken leg was very painful and that he had nothing concealed in the cast. Of course, they didn't believe him at all, but when the cast was finally removed and examined there were no diamonds whatsoever. He threatened to sue the South African government for false arrest, painful injuries, delayed flight, and the works. The customs officers tried to excuse themselves for their mishandling of him; they even took him to a hospital and had his leg x-rayed—the bone was broken. They paid to have a new cast put on his leg. He said it was all OK; he knew that they had a job to do and that he would catch the flight tomorrow for Amsterdam. The next day he arrived at the airport, again in a wheelchair, the cast was on his leg and he left for Amsterdam—only this time the cast was loaded up with those diamonds. This was discovered later when the diamond market of Amsterdam was suddenly flooded with South African diamonds which were traced directly to the man with the broken leg.

Oh yes, Diamond Lil loved those diamonds and I never did get to first base in chiseling them from her! Later on, when I was in Kimberly, I was approached by someone on the street who had a handful of diamonds; he wanted $1,000 for the lot. As a rough guess there were about five 1 carat stones, two or three 3 carat stones. and one or two that looked like 5 carat stones. I darned near bought those stones and would have become a diamond smuggler myself, but I just plain chickened out. Also, I did not want to spend $1,000 of WRPSA money, possibly breaking up the entire DXpedition. I told Jack about this later on.

I asked Jack if those stones were the real stuff and he said yes, they probably were good ones; he added that if I had bought them the seller probably would have turned me in to customs, getting 10% of the actual value of the diamonds. The stones might even have been returned to him; he may have said I had stolen them from him. Then the $1,000 would have been gone, the diamonds gone, me in jail, the DXpedition blown up and the WRPSA broke because the money was all gone. I am sure glad that I was raised right by my mother and father to not go around breaking the law. I would have been in very deep trouble I am sure;

to this day I could still be rotting away in some South African jail.

One night the entire SARL invited me down to their meeting in Capetown, where I met most of the Capetown group. I had a very fine dinner with them and stayed up late with one of those large eye-ball QSO's that I seem to be having all over. Every place I stopped there was a group of hams getting together.

The day of the ships departure was gradually drawing nearer and I was taking it easy at Jack and Marge's apartment. I had really moved in; running around in my stocking feet, visiting Jack's mother and father a few times each day, and walking around the Strand. Jack and Marge took me all around Capetown—I was getting so I nearly understood how to get from the city to their QTH without getting too lost. I even went downtown on the bus a few times and got back to their QTH on another bus without any trouble. When departure day was about 4 or 5 days away, we paid a visit to the Norwegian Consul to tell him about my proposed trip to Bouvet Island. We explained about the permission I had received through LA5HE to operate from there. Of course he knew nothing about it, but said he would get off a cablegram to Oslo and let us know what he found out. A few days later he telephoned to say that all was OK and the call sign I should use was LH4C—this was great! We then went to the ice breaker that was to carry me there and I was introduced to the crew of the ship. I could see that they were all fine fellows and looked as if they would be an easy lot to get along with—even though most of them were seasoned seamen and a pretty tough looking batch. They had all made many trips to this part of the world and they knew what we were going to be facing when we were in the South Atlantic with those icy cold gales from Antarctica tossing the ship around.

After a close inspection of the ship, and being shown where I would bunk, Jack and I left and returned to his home. We had received a phone call while we were away telling us both to be sure to come to the Capetown SARL meeting that night in downtown Capetown. All the hams from that area were there. As near as I can remember there were about 35 or so ZS1's on hand. They discussed the things that hams all over the world discuss when they get together. All the CW fellows said that I used too much SSB; all the SSB fellows said I used too much CW. This is what a DXpeditioner has to face anytime there are meetings anywhere in the world, including the USA.

My system of operating from a rare spot has always been to start with CW and when there was a nice pileup going, switch to SSB and work them until the pileup grew small. Then go back to CW until the pileup grew low and then back to SSB. I like this system of operating and if I ever go on any more DXpeditions I think I would still use this system. The percentages of SSB to CW QSO's using this system usually ended up fairly close to 50/50 when the QSO's were counted after a stop had been finished.

I always stayed at any place I operated from long enough to give everyone a fair chance to work me. By this I mean at least one QSO on CW and one on SSB. I was sorely tempted a number of times to have a blacklist on account of some of the things I heard over the air and some of the unfair operating some of the fellows used. Then it crossed my mind that this was probably not being done knowingly. I well remember some of the things I had done on the air during pile-ups, in the excitement of the battle. I know I have been called a "lid" a number of times on account of some "dumb" thing I had unknowingly done. Lots of the fellows I have heard doing some of these same things I know personally and I know they are not the kind of fellows that they *seemed* to be on the air at *certain times.* I just did not have the heart to *not hear* them or to work them and *forget* to put their call signs down on the log page.

Maybe I am "chicken hearted", but I had made up my mind a long time ago that I would work every station I heard, *ABSOLUTELY* no preferred fellows. Not even any preferred countries. I worked what I heard when I heard it. I can sincerely say that I have never let someone "sweat it out" for a few days like I have heard that some DXpeditioners will do. It is easy to say, "I am sorry old Buddy but I did not hear you", but I could never say this to fellows who are high up in the Honor Roll of DX awards. These fellows are the ones you work in the first few minutes or at most the first few hours if there is one of those tremendous piles you have if you set up in a really rare country. All you have to do is look at the first 50 call signs up high in the Honor Roll and you can be sure that these are the ones

you worked in very short order. These fellows didn't get where they are with sloppy or unethical operating habits. I suppose "back home" I was too much of a DXer at heart to pull any shady things. I wanted everyone to still be my friend after my DXpedition was over—just as they were before I ever departed. I think that this is exactly how it all worked out too. I tried to be cool and calm at all times and I think I was successful at it but at times it was very difficult to keep my temper under control.

But back to the story—at the meeting of the SARL it seemed as though I was back in the USA since things went about like they generally do here, with the exception of the South African brogue that they all spoke. Everyone was very interested in the forthcoming trip. I am sure most of them would have liked to be able to go with me. Of course, practically all of them wanted me to listen very closely for their call signs in the forthcoming pile-ups. Naturally, I promised each of them I would do just that! Later on I found that I could not miss hearing any of those ZS1's—their signals were the loudest that were heard at practically any hour of the day or night. I received a lot of invitations to come around and visit each of them and for the next day or two Jack and I did pay a number of visits to most of their QTH's. I can verify that those ZS fellows liked their coffee, usually on the strong side.

Capetown is a large, modern city with all the conveniences found in any modern-day city—large department stores and some super markets. Their prices were quite a bit higher than similar stores back in the States. Imported items from the USA were very costly, especially receivers and transmitters. It seems their customs duties on radios and radio components carry a very high percentage. I was told that the stores did not cut prices on these items. Everyone around Capetown seemed prosperous, happy and well fed; fruit was very plentiful and reasonably priced. Meals at cafe's were not expensive at all and there were plenty of Cokes I am glad to say, but coffee was their favorite drink.

A few days before time for the boat to depart, Jack and I went down to the ship with all my radio gear (we had tested it out at his QTH before that day). We set it up in my little cabin and even erected the Hy-Gain 14AVS vertical ground plane with 2 ground radials for each band, from 10 through 40 meters. We went on the air and had a few QSO's signing ZS1OI/P. It worked right off the bat. I was all set for the forthcoming ocean trip.

My friend Ed Coleman, K8TRW, had even shipped me two pair of red handles. I had tried them on and they fit as far as they went. They felt as though they would keep the Antarctic cold from getting to me. After leaving the ship we stopped at a fruit store and bought a good supply of fruit. In that big pile of fruit I think I even had a small bunch of bananas which weighed about 100 pounds! Then we stopped at a small super market and I got a big box of canned foods—I didn't want to go hungry while I was operating on some of the islands coming up later on. Oh yes, I got 100 gallons of gasoline (their gallons are about 25% larger than ours you know). This was to be delivered to the ship from the supplier. We both stressed the importance of it being delivered the next day, telling them the ship was departing that night-which was a white lie, but I didn't want to hold up the ship while they delivered it later on. It was a good thing we did this because the gasoline was not delivered the next day; it took another phone call to get it delivered the day before we actually did depart. I think the gasoline was Shell, but maybe I am wrong about this. Anyway, it was good gas and I had no trouble later on with the putt-putt starting, even in weather around 10°F. I did get 10 weight motor oil so it would not be too thick in the cold weather we knew was on the way.

After two more nights with ZS1OU and ZS1RM, Jack set the alarm clock for 5 AM on the morning I was going to depart. After a very good breakfast with them, Jack drove me down to the ship, saw me aboard, and even hung around until the PA system announced, "All ashore that's going ashore."

The ice breaker backed away from the docks, the bells rang, the whistle tooted a few times, and we were away for one of the most unusual trips I have ever been on.

Tristan da Cunha was to be our first stop to drop off three fellows who had lived there before the volcano eruption, a year or so before, had chased them away along with all the other inhabitants. We ate breakfast on board the ship and this was one morning that I had two breakfasts. More next month fellows, this was one trip I won't forget.

. . . W4BPD

W2NSD (continued from page 4)

The committee also presented a copy of a letter from a VU amateur claiming that the Laccadive expedition was not officially authorized. They further pointed out that Don's logs in an ARRL Sweepstakes contest and a DX contest contained some entries not confirmable in cross checking, implying to me that he was being accused of blatently cheating in these contests.

So, on the basis of the above accusations, they "suspended" credit for six countries Don had visited . . . plus any further countries that he might operate from in the future.

The uproar in the DX world was immediate and thousands of amateurs rushed to Don's aid. The League was forced to send out a letter on March 10th saying that Don hadn't really been convicted, just that they wanted the facts. Shades of McCarthy.

Don got word of the first letter on February 26th as he was about to land at Geyser Reef. He immediately turned around and returned to the States as quickly as he could and asked for a hearing at Newington with the awards committee. He found himself facing Bob Booth W3PS, the League counsel, flown up from Washington for the "case". After five hours Don gave up trying to be heard, cursing himself for having appeared without his own lawyer.

Don immediately set to work to document his defense and, at his own expense, published an 85 page answer to the ARRL claims, clarifying and presenting photocopies of pertinent letters. This effort undoubtedly cost him well over $2000 by the time the book had been mailed to hundreds of overseas amateurs and societies.

The book is remarkable. It calmly takes each accusation made by the ARRL and refutes it completely. Where the League claimed that he sent QSL cards to donors without the benefit of on the air contacts, Don reprinted letter after letter from heavy supporters whose cards had been refused because of wrong dates or times. I gather that the League had just one chap who claimed to have received cards for non-contacts. Don comes up with many who did not get cards. It appears that Don even has witnesses to the fact that he did send reports to a station signing the call of his accuser.

Regarding the consulate activities he is supposed to have misrepresented, Don reprints a letter from the consulate accepting full responsibility and completely absolving Don.

Don has an answer on Navassa too. His letter from the Coast Guard would certainly put the lie to the claim of damaged amateur reputation. His published letter is from a legitimate Coast Guard rear admiral. Navassa is a strange situation anyway. There doesn't seem to be any real reason for not permitting a DXpedition to land there every few years . . . someone, probably in the State Department, made a decision sometime ago and we are forever after stuck with it. The bulk of the "damage done" seems to have been from ARRL demands for some official to either approve or disapprove of Don's visit. The coast guard attitude is one of we don't really approve, and sure wish you wouldn't do this again.

The VU letter about the Laccadives apparently was written by a chap in India who was hoping to be the first there and got beat out by Don. Don reprints letters which bear this out. And in reply to the nasty rumor that Don really wasn't there, I personally asked VS9MB in the Maldives just the other day about this and he says that the beam headings were absolutely right from him and that there is no question whatever in his mind that Don was actually there. Being just a few hundred miles away he should know.

Then there is the matter of the contest cheating. Don claims that the number of contacts that were unverifiable were small, well within the normal margin for error. It seems to me that this must be the true fact of the case since the League failed to do the obvious and point out that the "padding" would have materially affected the final score. If the bulk of the padding was new countries, this would be one thing . . . if it was just normal run of the mill contacts, that's something else. I have been amazed time after time to receive QSL cards for contest contacts where I had made a mistake in the calls . . . I had been so sure that I had gotten the call right!

Don, unable to get a fair hearing by the awards committee, asked that the board of directors review his case at the May 5th board meeting. John Huntoon sent a letter to all directors asking that they not review the case.

The basic concept here to me is that the ARRL *is* its thousands of members, not the few paid help at headquarters who are running the show and that the HQ gang should reflect the wishes of the members, not always try to mold it. This is the basic concept that has been irritating me for a long time.

At the Dayton Hamvention in Dayton, Ohio, the Long Island DX Association presented Don Miller, W9WNV, with a trophy for his outstanding contributions to DX for the year 1966-1967. Look for Don's new DX Column in future issues of 73.

Apparently at least one of the ARRL directors agrees with me. One wrote to his fellow directors on April 10th asking, "Do you represent Newington in your division, or do you represent your division in Newington?" He further states, "I highly resent this super-inflated ego of a general manager to take over our elected responsibility."

The board, despite some frantic last minute moves by Mr. Huntoon, did hear Don out. The verdict, after presentation of all the evidence by Huntoon and Don, must have rekindled Don's faith in the ARRL, for he was upheld by the board on every count against him. They ordered Don's reinstatement in DXCC and affirmed credit for all of his DXpedition operations except K11MP/KC4 and VU2WNV.

Both of these exceptions seem to be more face-saving decisions that anything else. I gather on the VU2 deal that Don lost a critical telegram somewhere in his travels. The KC4 deal is a very bad one and we'll try to bring out the full background on this when we can name the government man responsible for the mess. . . . *Wayne*

Letters

April Issue

Dear 73,

Congrats on April 1967 cover design. Could have been me many years ago but for the soldering gun!

Charles Hedrick W4WO
Arlington, Virginia

Dear 73,

Have been reading your magazine since the first few issues, and with few exceptions, find your articles to be excellent. In your April issue the article on "The Super Duper Super" really carried me away. I can hardly wait for you to add the second audio stage so a loudspeaker can be used with it . . .

John Mitchell K4MEM
Miami, Florida

Dear 73,

I have received my third issue of *73*, and am happy to say it is all that was promised—the articles are full of meat and not stuffy . . . In the April number I thought the Super Duper Super was really a gas—that photo of the elderly Ultra-Audion (or whatever you'd call that circuit) with the neatly right-angled bus bar and '01A tubes was really authentic. Don't ask how I know. But about young Mr. Newham—won't Mad be mad about this?

Alden Fowler WA9KHM
Greensburg, Indiana

Dear 73,

. . . "The Super Duper Super"—Ugh!

Samuel Melbourne WB2INC
Oakland, New Jersey

Dear 73,

. . . Considering the April issue, W4BRS's "A Toroidal VFO" contains some excellent ideas, but the article does not indicate a source of general toroidal information or a manufacturer which has a Tech-note or literature published that deals with toroids. By way of comparison and constructive criticism, W6GXN's "A Transistor Wien Bridge Oscillator" anticipated the demands of the more than casual reader. Also, may I state that I found W6FSM's "Ferromagnetic Beads" of value. Finally, K3SUK's stylistic lightness added much to the character of this issue.

Carl Podlesny Jr. WA1AYP
Amherst, Massachusetts.

Dear 73,

As I can readily see in the April edition, you are going in for fine technical articles, such as the Super Dooper. As luck would have it, I have a batch of UV201 tubes from 1924, a fine neutrodyne made in the same year, complete with basket-weave coils and a drip pan for the grid leak . . .

Martin Hellman K2TAJ
Staten Island, New York

Dear 73,

FB on the Super Duper Super—great. Hope to see more of this type.

Jerry Cunningham, W1MMV
Barre, Vermont

What are you going to use it for Jerry—WTW-200?

Dear 73,

The genius that is Al Freddy Newham's should never go unnoticed. The three pictures of him in the April issue was a kind gesture indeed on your part. After reading Mr. Newham's excellent report, we went right to work building this state-of-the-art goodie in our own rural paradise . . .

. . . We find the Super Duper Super to be an outstanding receiver in performance and it should compare favorably with factory-wired receivers costing 1/10 more. Maybe you have heard that a lab report on this fine receiver will be appearing in a future issue of **Undeveloped Electronics** (for advanced people) . . .

Mortimer Snerd WN6HCCE
Orange Crate Road
Napa Valley, California

Buried Antennas

Dear 73,

In reference to your April issue article on "Buried Antennas", after due consideration I have come to the conclusion that these antennas are for the birds. With the antenna buried in our back lawn, the earth worms would trip over the wire, giving the birds an early morning smorgasboard. Even when I fertilized the lawn to green it up, all my contacts claimed I had a lousy sounding signal. The experiment had to come to an end when the neighbors were kept awake at night by the mocking-gophers squeaking "CQ DX" in Morse code.

Jim Davis W6DTR
Fullerton, California

Dear 73,

Although I am invariably in violent disagreement with Mr. Green's editorial comments, I am sold on the rest of *73*. It's a pleasure to read an electronics magazine which doesn't fill its pages with exhaustively detailed plans for electronic coin flippers and the like. Keep up the good work.

John Gerhardt
La Jolla, California

Dear 73,

"73 Circuits" was tremendous. Through *73* I have progressed from "connect to 34A (NS)" to where I am working out my own circuits. You've managed to keep me out of the pool halls for the past few years. Thanks again for a fine magazine.

John Rattinger WB2BRA
Jackson Heights, New York

The Fabulous Drone

Dear 73:

My reason for writing you is because of the article you covered called, "Edison—The Fabulous Drone." It was alright except that it should have read, "Tesla—Greater Than Edison."

Maybe one of these days you will do a much bigger article on Tesla and the great work he did. Maybe when you find space you can list the address of a society that was formed after Tesla, **The Tesla Society**, Box 4058, Minneapolis, 14, Minnesota. Write for the "Tesla Bibliography" and other information—no charge for this.

Nick Basura
Los Angeles 65, California

We can only print what we receive—anybody have a good article on Tesla?

The View From Here

(continued from page 2)

On the other hand, there are many facets of ham radio that are worthy of newspaper stories, magazine articles, and radio and television coverage. All we have to do is capitalize on them. Take a look at some of the things we've accomplished in the past few years that have received far less publicity than they deserved—Oscar, phone patches to Viet Nam, slow-scan television to Antarctica and moonbounce.

To interest new hams, we have to offer something besides radio contacts across town, to the next state or across the country. That's possible, albeit illegally, for far less effort on citizens' band. We have to offer enough incentive, enough excitement if you will, to kindle the soul of the new ham and sustain him through the code and theory.

There are plenty of things going on in ham radio today that should interest any science-minded youngster. Things he can get his teeth into and expend his energies upon. With the big interest in space exploration, the new amateur relay on the moon proposal—Moonray—is an excellent starter. Here is a chance to actually take a personal part in space exploration. Oscar is another approach.

Regardless of the project, to add new members to hamdom, it has to be publicized—well publicized. If you know a newspaper man, or a radio announcer, or a writer, encourage him to do some articles on amateur radio. It would only take a few articles in a couple of the big magazines to get a lot of response. And then, when a youngster expresses interest, help him along instead of offering indifference. A tour through your shack and a quick contact across the country is one of the best salesman we have.

Jim Fisk W1DTY

NEW BOOKS

RCA Silicon Power Circuits Manual

This new publication from RCA is the newest member of a growing family of RCA technical manuals. Although this manual is slanted toward the transistor design engineer, there is a lot of useful information for amateurs, students and electronic hobbyists. The chapter on high-frequency amplifiers is well worth the price of the book; more than 100 pages are devoted to this subject alone. In this chapter there are sections on designing rf power amplifiers, matching networks, mobile radio, SSB transmitters, UHF and microwave amplifiers and oscillators and frequency multipliers. In many cases design examples are given, with practical circuits both illustrated and analyzed.

In addition to the extensive chapter on rf power amplifiers, there are chapters on silicon rectifiers, thyristors, power conversion, power regulation, ac line-voltage controls and low-frequency power amplifiers. Copies may be obtained for $2.00 from RCA distributors, or from Commercial Engineering, RCA Electronic Components and Devices, Harrison, New Jersey 07029.

Circuit Design for Audio, AM/FM and TV

This new book by the Engineering Staff of Texas Instruments is the fifth in a series of similar books on transistor circuit design and application. Originally published as a paperback, this new volume is an updated version detailing the most current design techniques and devices available.

Designed as a practical guide to audio, AM/FM and TV circuitry, the emphasis is on practicality. In addition to design examples, there are many practical *ready-made* circuits that should find wide use both in industry and amateur radio circles. The audio section of this handy book covers class A and B output and driver stage design with all types of coupling—transformer, RC and direct. Single-ended, push-pull and complementary stages design procedures are outlined with many practical examples.

In the AM/FM section there are chapters on *if* amplifier design, tuner design, and applications. In the chapter on FM tuner design for example, there are discussions of noise performance, spurious response, AGC, and other topics of interest to the home constructor. The AM chapter covers the same subjects on a lower frequency scale.

The television section probably will be most interesting and informative to the VHF/UHF enthusiast. This section delves into VHF and UHF tuners, video and video *if* amplifiers, and sound *if* amplifiers—much of this information is directly applicable of amateur applications. In addition, the chapters on sync separators, vertical oscillator and sweep output, horizontal AFC, oscillator, driver and sweep output circuitry should appeal to the ATV man.

There is a lot of practical information in this book, and although it was designed primarily for the broadcast industry, almost all of the information may be applied to amateur circuitry by the serious experimenter. Except for a few rare cases, the math isn't beyond the high-school algebra class. $14.50 from your local book store or write to McGraw-Hill Book Company, 330 West 42nd Street, New York, New York 10036.

Handbook of Electronic Instruments and Measurement Techniques

Here is a book that almost every ham should find useful in his shack. Harry Thomas and Carole Clarke, the authors, have prepared a complete reference on electronic instruments, measurements and techniques. The material has all been arranged in a manner so the data you want is easy to find. In addition to a complete rundown on all types of test equipment, the authors have included the latest methods and time-saving techniques used by industry.

In the first seven chapters they cover all the tools of the trade—meters, bridges, oscilloscopes, frequency, phase and time measuring instruments, voltmeters and instruments for testing tubes, transistors, receivers, transmitters and microwave equipment. In each case they describe the equipment with block diagrams, schematics and photographs.

The last seven chapters of the book dig into the intricacies of testing equipment and components. The chapters on receiver and transmitter testing should prove especially useful to the amateur. In the receiver sec-

SIDEBAND, UGH!

(IF YOU CAN'T FIGHT 'EM, WHY NOT JOIN 'EM?)

I am referring, of course, to the constantly heard complaint from the AM boys who argue about sideband. Now it is not my intention to argue as to which is best, "ancient modulation" or "silly sideband", as it is sometimes referred to. We all know that space in our spectrum is at a premium and that "Donald Duck" takes up less space and is inherently capable of greater gain and more reliable communication, but up in the relatively unsettled areas of our country, like the top of Maine or the center of Kansas, the AM boys can be heard sounding forth, and they do a surprisingly good job. I will concede this and I will not disagree when they way that SSB doesn't sound as good as AM.

Although there have been many advantageous sideband deals offered to the ham during the past 10 years, and I think I know my business well enough to write authoritatively, there has never been as sound a value as the offering I am making in this ad. Listen to this fellows: we will sell you a brand, spanking new Eico 753 kit (the latest one) with elaborately prepared instructions on building it yourself (it is really quite easy—it takes about 40 hours). This kit normally sells for $189.95. We will sell you the Eico 753 3-band SSB-AM-CW transceiver with a Solid State silicon transistor VFO and our "meat and potatoes" power supply kit for the original selling price of the set alone, $189.95 F.O.B. Harvard. You can not beat this value. You can compare every other price in the book and compare every other piece of equipment ever offered, and when you do you will understand that this is the lowest price for a 3-band sideband transceiver that has ever been offered. Consider its specs: The 753 will operate on 3490-4010 kc or 6990-7310 kc or 13890-14410 kc. On 40 and 80 meters it offers lower sideband, on 20 meters, upper sideband. You can inject carrier to obtain conventional AM. The set runs a PEP input of 250 watts with our "meat and potatoes" power supply kit, 180 watts with the Eico kit. The RF power output will be close to 150 watts when measured on a Waters watt meter. The output impedance matching range is 40-80 ohms. The sideband generation is accomplished by means of a 5.2 Mc crystal lattice filter with a bandwidth of 2.7 kc at 6 db. The stability is amazingly good, being less than 400 cycles after a 15 minute warm-up. Unwanted carrier is down 50 db, unwanted sideband down 40db. This set uses incremental tuning plus or minus 5 kc so that as you tune slightly for the other fellow you will not change your own transmitting frequency. The tune-up is conventional; the audio input provides for high impedance microphones. The receiver sensitivity is one microvolt for 10db signal-to-noise ratio. The over-all dimensions are 5½" high, 14" wide and 11¼" deep. The price on this interesting kit is so low that some people can afford to buy 2 units, one for the home and one for the car. We offer the Eico DC supply for **$59.95** as a kit, the original matching Eico AC supply for **$59.95** as a kit, or the Eico 753 kit at $149.95 by itself. The best value, of course, is the original quotation of $189.95 for both our "meat and potatoes" power supply and the Eico kit. You can find out more about the "meat and potatoes" power supply kit in our previous advertisements in 73 Magazine. It is a heavy bruiser of a supply which will positively meet the requirements of this transceiver and most other transceivers as well. We offer terms to those deserving of them and prompt shipment from stock on this extremely good value. You can work the world on 20, you can have lots of fun on 80 and 40, remember that you can operate CW or AM if you choose, but this is essentially a sideband rig and on-the-air reports compare favorably with the most expensive transceivers. The unit includes high level dynamic ALC circuitry so that you won't flat top even with extreme over-modulation. Boys, if you want to get into sideband, there is no easier way. You will have lots of fun building this kit. I guarantee the results personally, so why not consider this very inexpensive means of going on 3 bands.

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tion for instance there are discussions of sensitivity measurements, selectivity measurements, image rejection, backlash, overload, frequency stability, noise measurements, and audio fidelity and distortion.

The 54-page appendix covers those measurements and instruments that don't fit into the context of the other chapters, as well as several mathematical tables. All in all, this is a very useful handbook for the amateur who wants to know how to better use his test equipment. $16.00 at your local bookstore or write to the publisher, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632.

Servicing TV Receiver Circuits

If you're like most hams, you've probably been called on at one time or another to fix the family television set. And—if you're like most, if the trouble isn't the fault of a bad tube (or transistor) or burned out component, off it goes to the service shop. This new volume by the editors of *Electronic Technician* should solve all that. In addition to describing each section of the home television set in detail, circuit analysis and trouble-shooting techniques are outlined along with voltages and waveforms at the various stages. Transistor sets are described too, as well as a big section on color. This new book should be of special interest to the ATV group and ham handyman. Liberally illustrated with schematics and photographs. $6.95 from your local bookstore, or write to TAB Books, Drawer D, 1 Frederick Road, Thurmont, Maryland 21788.

Transistors: Principles and Applications

In this new book R. G. Hibberd, the author, presents a wealth of information on transistor circuits in a way that should appeal to many. His approach is almost completely free of math, and emphasis is placed on strictly practical considerations. The book starts off with a little semiconductor history and their physical properties, but quickly gets into dc operating conditions and bias circuits, low-level and high-power audio amplifiers, oscillators, receivers, switches, power supplies, solid-state techniques and use and handling of transistors.

In addition to the chapters on transistor circuits, there is information on integrated circuits, metal-oxide transistors, semiconductor lasers and FET's. For the ham who wants to know more about transistors, here is an excellent book to cut your teeth on. $6.95 from your bookstore, or write to the publisher, Hart Publishing Company, 74 5th Avenue, New York, New York 10011.

Antennen Praxis

If you can read German, and want a complete handbook on practical antenna design, this new book by Gunther Rothe and Eberhard Spindler is worth looking into. Propagation is thoroughly covered, along with antenna measurements and theory. All types of antennas are covered, including dipoles, verticals of various heights, Yagis, parabolas, log periodics, and multi-frequency units. In many cases practical antennas are outlined, complete with gain figures and vertical and horizontal pattern plots. For the antenna man who can't read German this text can still be very useful. It is liberally sprinkled with math—and that is universal throughout the world. For more information, write to VEB Verlag Technik, Berlin, Germany.

Troubleshooting with the Oscilloscope

If you haven't already found out that the oscilloscope is almost indispensable in the workshop, you probably will soon. Most authorities feel that in the future it will be extremely difficult to service modern circuitry without the extensive use of an oscilloscope. In his new book Robert Middleton provides a complete breakdown on the operation and use of this versatile instrument. If you read this book, you will have a pretty complete working knowledge of the oscilloscope, even if you haven't used one before.

He first shows you how to operate the instrument and how to pick the proper probes for various tests and measurements. Then you learn what types of test signals are required, the types of waveforms to expect and how to properly interpret them. The sections on trouble shooting include receivers, *if* amplifiers, audio amplifiers, solid-state devices, television and stereo multiplex equipment. This book tells how to isolate defective stages or sections by waveform analysis, and includes numerous pictures of typical waveforms associated with various defective components. If you want to learn how to use a 'scope or to put your instrument to better use, this is the book for you. $3.95 from your electronics distributor, or write to Howard W. Sams & Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.

Beautiful Binders

Keep your valuable copies of 73 neat and easy to find with inexpensive custom-made binders. These binders are sturdy, attractive and easy to use. Each holds twelve issues, a full year of your favorite ham magazine. Years available: 1960-61 (holds all of 1961 and the three issues we published in 1960), 1962, 1963, 1964, 1965, 1966, 1967. Only $3 each.

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Missed any full years of 73? Like a new set of any years to replace those old, worn-out, ragged, dog-eared 73's you keep using for reference? We can supply all 12 issues of 1962, 1963, 1964, or 1965 in good, unused condition at less than 30¢ per copy when you buy all 12. We reserve the right to substitute if any issue runs out. The price for one year, 12 issues, is only $3.50.

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All back issues of 73 are still available except January 1961. They cost 50¢ apiece except October, November and December 1960, which are $1 each.

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SWAN 240 transceiver and matching 117VAC power supply. 240 watts PEP & CW. $225 ppd. Excellent condition. Fountain, K6AFP, 1433 W. 48th St., Norfolk, Va. 23508.

WANTED: All types of aircraft, ground radios and tubes, 4CX1000A's, 4CX5000's, 304TL's, etc. 17L7, 51X 618S, 618T, R388, R390A, GRC units. All 51 series. All Collins, ham or commercial items. Any tube or test equipment regardless. For fast, fair action, Ted Dames Co., W2KUW, 308 Hickory St., Arlington, N.J. 07032.

WANT to borrow manual for Hallicrafter S-27 receiver so I can make photocopy. Will purchase manual if you want to sell. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

CAPE KENNEDY HAMFEST, sponsored by Platinum Coast Amateur Radio Society. Second annual hamfest, at the civic auditorium, Melbourne, Florida, August 26 and 27. Home-making and flower shows. Swap tables and equipment auction the hit of the 1966 hamfest. Give-away every hour, and of course BIG, BIG door prizes. Fun for the XYL, the kiddies and the OM himself. For information write Box 1004, Melbourne, Florida.

GROUNDED GRID FILAMENT CHOKES. 10 amp $3.00; 22 amp $3.50; 30 amp $4.00. RF plate chokes 800 ma, $1.95. PP USA48. Deane Co., 8831 Sovereign, San Diego, Calif. 92123.

COLLINS 75A-2, $190; Immaculate T-105A, $65. Want HW-32 or 10, 15 meter SSB homebrew transceiver, working or? WA7DXQ, Box 7668, Phoenix, Arizona.

GALAXY V AC & mobile supplies, speaker console, microphone, Hustler, 2 resonators. $425 or best reasonable offer. Paul Gough, 18 Eliot Ave., West Newton, Mass. 02165, 617-527-6599.

6288 FEET HIGH for 6 & 2 DX on Mt. Washington, N.H. Take your gear up on the Cog RR from Base Station. Food and facilities available at Summit House, aso bunks for overnight.

RTTY GEAR FOR SALE. List issued monthly. 88 or 44 mHy toroids, five for $1.75 postpaid. Elliott Buchanan and Associates, Inc., 1067 Mandana Blvd., Oakland, Calif. 94610.

PANHANDLE AMATEUR RADIO CLUB annual hamfest, June 24 and 25, at National Guard Armory on T Anchor Blvd. off Route 40, Amarillo, Texas. For more info., write Box 5453, Amarillo.

FINGER STOCK, silver plated, ⅜" x 16", six pieces $2.00 PP. Carl Thompson, 6250 Thole Rd., Cincinnati, Ohio, 45230.

SB-100, HP-23 AC supply, perfect condition, never mobiled, will deliver near Chicago. $375 or best offer. W9JDX, RR1, Box 510, Cary, Illinois, 312-639-7565.

NYC AREA: NCX-3 and HP-23 A.C. P.S. $200 cash and carry. Tel. 212-568-3557.

SOUTHWESTERN/PACIFIC DIVISIONS ARRL CONVENTION September 8-10, Ambassador Hotel, Los Angeles. Registration $2 (with banquet $10) until Aug. 15; thereafter $3 and $12. Checks to "ARRL Convention", and send to Box 3151, Van Nuys, Calif. 91405.

PACKAGE: SB-400 and SB-300 with CW filter. Perfect. First cashier's check for $525, best offer over $500, brings postpaid shipment. WB4BUQ, Marshall P. Williams, 1610-B, Fort Belvoir, Virginia.

THE LONG ISLAND HAMFEST will be held at Hempstead Town Park, Point Lookout, Long Island, N.Y., on Sunday, July 16th beginning at 9:00 A.M. Bring your family and enjoy the fun. For further information write Federation of L. I. Radio Clubs, Box 304, Long Beach, N.Y.

MAKE OFFER: Amateur telephone transmitter for 10, 20, 40 & 80 meters. Send postage for details. W6LNE, 1159 Loma Sola Ave., Upland, California 91786.

VIKING 500 transmitter complete with power supply, modulator. Excellent condition. Originally sold for $949.50. Will sacrifice for $275 or best offer. Also sell AC and AD coils for National HRO-60, best offer. Michael Sposato, K1NEK, 4 Northboro St., Worcester, Mass. 01604.

SWAP—NEED ROTATOR, VTVM: All parts for high power class B modulator, pr 805, 2A3 drivers with schematic. PS 1250 @ 300 with pr 866. Plate transformer 2500 @ 300/2000 @ 500 mils. Prefer local deal up to 75 mi. WA1BLY, 9 Lowlands Ave., Easthampton, Mass., Tel. 413-527-2344.

DX-60A. Superb condition. A steal at $55.00. Will ship reasonable distance. Richard Gelber, WB2WOI, 350 First Ave., New York, N.Y. 10010.

HY-GAIN 18-AVQ, brand new in original box. Going for full size 80-meter vertical. Delivered prepaid, $39.50. WØRA/1, Box 115, Greenfield, N.H. 03047.

WANTED: Copies of VHFER magazine, years 1963 and 1964 for personal collection. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

HEATH DX-20 WANTED. SSB mobile xmtr. Cash or? L. K. Flaherty, P.O. Box 3772, Anaheim, Calif., Phone 714-635-0150, Ext. 505.

TV CAMERA & MODULATOR: Packard Bell model 920, $315.00 incl. shipping in USA. R. Hage, 337 Glenwood Av., Ventura, Calif. 93003, 805-642-5329.

WANTED: Collins VFO unit for R390 receiver. Have defective unit for exchange or cash. Sell or trade lab gear Gen radio H.P. BC-221 Tektronix Bird TEDs 1 to 9. List? Sides Radio, 542 N. First St., Albemarle, N.C.

INTERNATIONAL FIELD DAY 9 A.M., August 13th, at Cliffside Country Club, Burlington, Vermont, sponsored by Burlington Amateur Radio Club, Inc. Busy day for OM, XYL and JRs. Contests, Bingo, Chicken barbeque at noon, Special Trio for the teenagers. Swap-shop and auction, Net meetings, Swimming, Boating, Eye-ball QSO's. Talk-in freqs. 3909 SSB, 3855 AM, 146.94 FM-146.34 FM (Rep.). Door prizes, Raffles. $3.00 at the gate, $2.50. Early Bird registration. Send early registrations to W1OKH, Lloyd Tucker, Box 16, Essex Center, Vt.

NEW UNUSED: Henry 2KD-2 linear complete, $595.00; Swan 500, $380.00; Heath SB-200, $190.00. Never been opened, factory sealed, warranty cards. Don Payne, W4HKQ, Box 525, Springfield, Tenn. 37172.

DUMMY LOAD, 50 ohms, flat 80 thru 2 meters, coax connector, power to 1 KW, kit $7.95, wired $11.95 PP. Ham Kits, Box 175, Cranford, N.J.

WANT: R278/GR or R278B/GR; also R391 receivers Thompson, 5 Palmer, Gorham, N.H.

WANTED: Tubes, transistors, lab instruments, test equipment, panel meters, military and commercial communication equipment and parts. Bernard Goldstein, Box 257 Canal Sta., New York, 10013.

TOOOOBES: 811A—4.25; 7094—26.90; 6146A—$2.55; 6CW4—$1.40; 5894—$15.50; Extra power 6146B—$4.00; 6360—$3.45; 8236—$9.50. All new, boxed, guaranteed. Free catalog. Vanbar Distributors, Box 444Y, Stirling, N.J. 07980.

SELECTRONIX AUDIO FILTER, use between receiver and speaker or phones, cuts monkey chatter and narrows band pass to about 1000 Hz. Some QSO's possible only with this in circuit. $24.95 pp. WØRA/1, Box 115, Greenfield, N.H. 03047.

WANTED: Instruction manual for the Hallicrafters S-27 UHF receiver or copy. I will make copies if there is a manual available for loan. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

PIPE SMOKERS: Three 1½ oz. sample pouches of the world's finest pipe tobaccos. $1.50 plus 50¢ handling charges. Smoke Rise, W4ANL, 13118 Thompson Rd., Fairfax, Virginia 22030.

LOUISVILLE HAM KENVENTION: September 8-9 1967. Beautiful Executive Inn Motor Hotel, Waterson Expressway at State Fair Grounds, Louisville, Kentucky. Participate in the technical sessions, forums, prizes, banquet and flea market. Bring XYL for day of women's activities. For information write Louisville Ham Kenvention, Box 20094, Louisville, Kentucky, 40220.

"SAROC" Sahara Amateur Radio Operators Convention 4-7 January, third annual fun convention hosted by the Southern Nevada Amateur Radio Club. Designed for exhibitors and participants at Hotel Sahara, Las Vegas, Nevada. MARS seminar, Army, Airforce and Navy representatives. Ladies luncheon with crazy hat contest, hat should convey amateur radio theme. Plus fabulous entertainment only "Las Vegas" can present. Registration fee includes three cocktail parties, Hotel Sahara show, hunt breakfast, technical sessions, admission to leading manufacturers and sales exhibits. Advance registration closes one January. QSP QSL with ZIP and telephone number for details to Southern Nevada Amateur Radio Club, Box 73, Boulder City, Nevada 89005.

WANTED: Military, Commercial, Surplus—Airborne, Ground, Transmitters, Receivers, Test sets, Accessories. Especially Collins. We pay freight and cash. Ritco Electronics, Box 156, Annandale, Virginia, phone 703-560-5480 collect.

ALBERTA CENTENNIAL Amateur Radio Convention. Calgary, Alberta, Canada, July 8-9, 1967. Write to VE6NQ, Box 592, Calgary, Alberta, for full information.

ST. LOUIS COUNTY, MISSOURI: Second annual hamfest of the Suburban Radio Club, Sunday, July 30th, 1967, at Creve Coeur Lake Memorial Park, St. Louis County. For further information write Joe Owings, KØAHD, Suburban Radio Club, 10217 St. Daniel Lane, St. Ann, Mo. 63074.

SIX METER CLUB OF CHICAGO, Tenth annual picnic and mobile meet, Sunday, August 6th, at Picnic Grove, on Route 45 one mile north of Route 30, Frankfort, Illinois. For further information write Alfred Bagdon, K9YJQ, Chairman, 7804 W. 66th Place, Bedford Park (Argo P.O.), Illinois 60501.

INTERNATIONAL CHC/FHC CONVENTION: Third annual convention, at Stouffer's Inn, 120 W. Broadway, Louisville, Ky., August 3, 4 and 5, 1967. For further information write Fred Gleeson, WA4LMD, Box 20114, Louisville, Ky. 40220.

QSL CARDS???? "America's Finest" samples 25¢, Deluxe 35¢. (refunded) Sakkers, W8DED, Holand, Michigan.

EICO 753A transceiver, transistor VFO, excellent condition, with AC supply. $200 WB6RQR, Bruce Bennett, 938 Kintyre Way, Sunnyvale, Calif. 94087.

LAFAYETTE HE-45B 6M transceiver with matching HE-61 VFO, mobile bracket, AC-DC cords. Very good condition, $80 collect or $85 postpaid. Ron Retzler, WA8HXW, 11150 Telegraph, Carleton, Michigan.

SALE: Collins 351D-2 mobile mount & 350-12 Adcom 800 VDC PS, cables and manuals. $100.00. Will trade for 2-meter FM gear. WA5ODU, 4031 Brownstone Lane, Houston, Texas 77045.

NATIONAL NC-121W, nearly new, $85.00 Heath HG-10 VFO $35. Like new Harvey-Wells TBS50D with power supply, 80-2 meters $50. All in perfect condition. W. L. Johnson, W5FPI/6, 205 Mar Vista Dr., Monterey, Calif.

NEW: KNIGHT TR-106 6-meter xcvr and VFO $150; Ameco CN-50 60-meter conv in cabinet with reg pwr supply—handsome unit—RF gain control 14-18 MC IF $50; Workman Transverter 12 VDC to 117 VAC 125 watts $20; Like new: CX-110 with spkr $120; S-120 $45. Need money for school and must sell. Write or call: Louis B. Phillips K9SPD, 513 Holly Lane, Kokomo, Indiana 46901, 317-453-6132.

SBE-33, Band-Spanner Antenna, bumper mount, heavy duty 12v supply, 80-20 coils, mike, mounting plate, excellent. $200. FOB. Tolonen W7EIZ/4, 1637 N. 21st Road, Arlington, Va. 22209.

HIGH DENSISTY FIBERGLASS quad poles, 14 ft. long x 1⅝" O.D. weight 9.5 lbs. Will withstand heaviest ice and wind loading conditions. $8.50 per pole, F.O.B. Westminster, Calif. K6HZP, Box DE, Westminster, Calif. 92683.

VHF GEAR, Clegg Zeus xmtr perfect condition, $350.00. Interceptor "B" RX also perfect $250.00 Parks 432 mc converter $40.00. All $600.00. WA4-EVQ, 263 N.E. 8th St., Homestead, Fla. 33030.

Propagation Chart

JULY 1967

ISSUED MAY 15

J. H. Nelson

EASTERN UNITED STATES TO:

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

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	7A	7	7	7	14	14	14	14
ARGENTINA	21	21	14	14	7A	7	14	14	21	21	21A	21
AUSTRALIA	21	21	21A	21	14	14	14	7A	7A	7B	14	21
CANAL ZONE	21	14	14	14	14	7	14	14	14	14	21	21
ENGLAND	14	14	7A	7A	7	7	7	14	14	14	14	14
HAWAII	21	21	21A	21	14	14	14	14	14	14	14	21
INDIA	14	14	14	14	14	7B	7B	7A	14	14	14	14
JAPAN	14	14	14	14	14	14	7B	7A	14	14	14	14
MEXICO	14A	14A	14	14	14	7	7	14	14	14	14A	14A
PHILIPPINES	14	14	14	14	14	14	7B	7A	14	14	14	14
PUERTO RICO	14A	14A	14	14	7A	7	7A	14	14	14	14	14
SOUTH AFRICA	7B	7B	7B	7A	7B	7B	14	14	14	14	14	14
U. S. S. R.	14	14	14	14	7	7B	7B	14	14	14	14	14
EAST COAST	14A	14A	14	14	7	7	7A	14	14	14	14	14

A. Next higher frequency may be useful this hour.

B. Very difficult circuit this hour.

DONATE YOUR EYES SO THAT ANOTHER MAY SEE

Great advances have been made over the past 25 years in the repair of damaged corneas, the clear substance that covers the pupils of your eyes. The only material that can be used to make these repairs comes from other eyes—those WILLED by their owners for removal within 4 hours after death, and the degree of success in these operations is astonishingly high.

Hundreds of people every year are able to see again because of these donations, but even so the availability of eye material is so limited that the majority of the over 75,000 who should have this surgery will not live long enough.

The need now is for hundreds of thousands of additional pledges to produce an ever increasing availability. A thousand pledges today may produce no material for many years, so the greater the pledge group, especially among the upper age levels, the greater the chance that many of those who need this transplantation will indeed live to see again.

Obtaining these pledges has been a project of Lions Clubs in many cities, and their members, or Doctors and Hospital Administrators, can direct you to a source of pledge cards which you and your family must complete to make an eye donation valid. Here is a project for entire families. What greater gift could you give to a fellow man!

Amateur Radio's participation in this work can be heard every day of the year on 3970 kHz, currently at 7 A.M. and 8 P.M. EST, as the Eyebank Network locates the availability of and/or the need for corneal transplant material among the nations 57 Eye-Banks.

INDEX TO ADVERTISERS

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80-40 Meter SSB Transceiver

Ham Net $159^{95}

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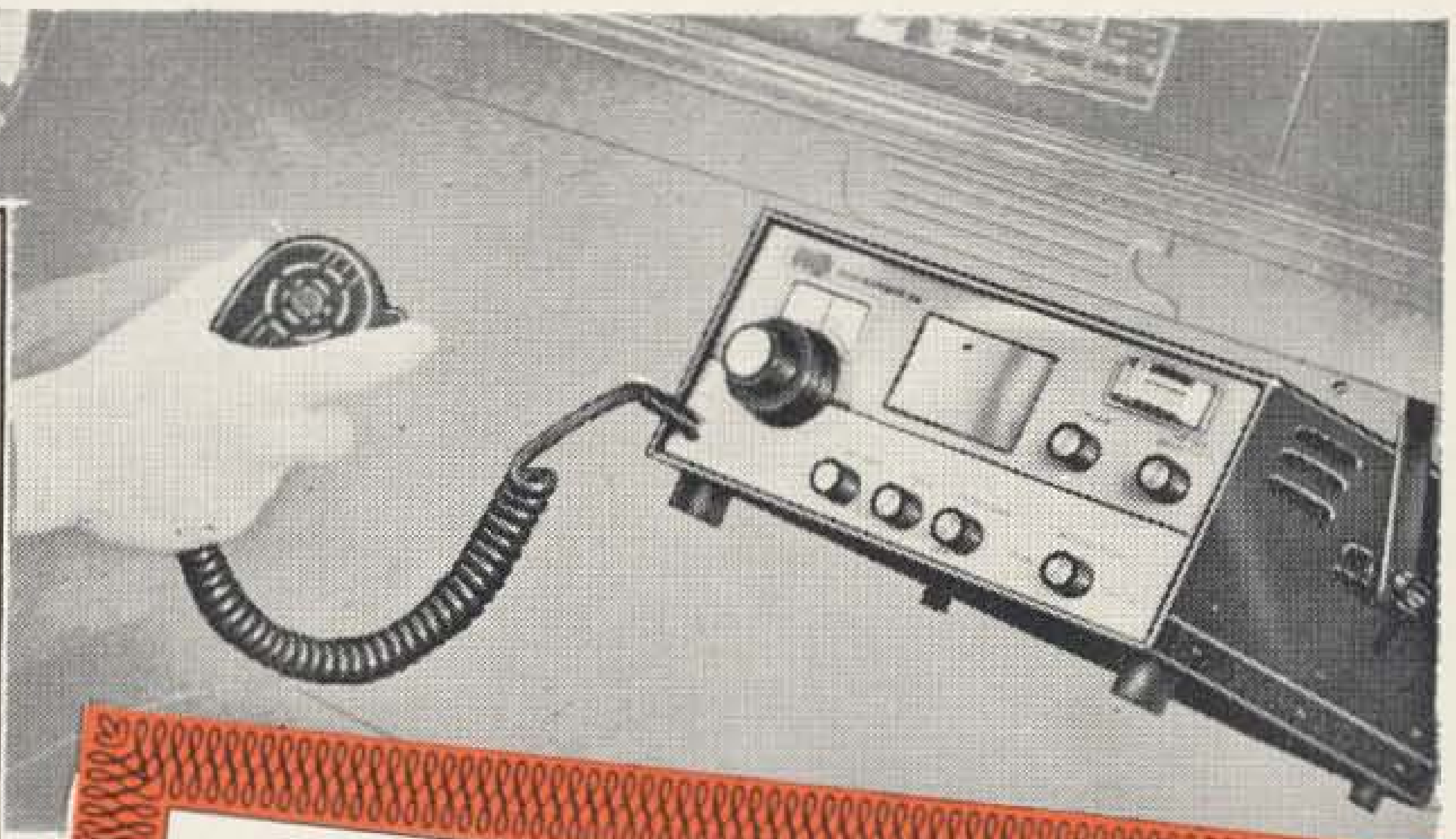
NOW —GO MOBILE 300 WATTS

AT AN AMAZING SAVINGS!



A Complete 80-40 Meter MOBILE PACKAGE!

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☐ I am enclosing one BONUS COUPON as I have no trades. Deduct $20.00 from the regular package price above.
☐ My check or Money Order for $________ is attached.
☐ Charge it to my WRL charge Acct #________

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