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MAY 1966

Four Bits

## 73's Worked The World DX Award

## and other Trivia . . .

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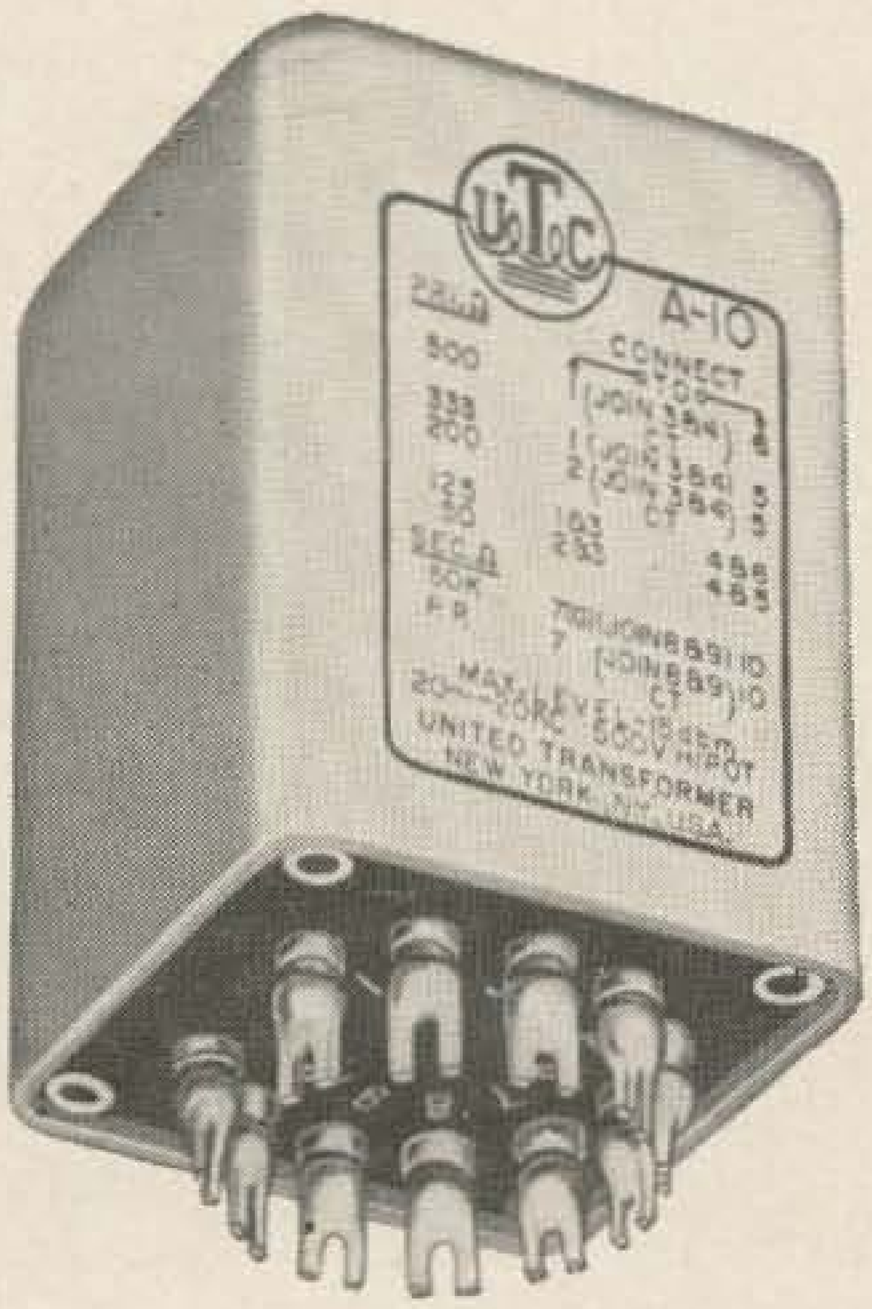
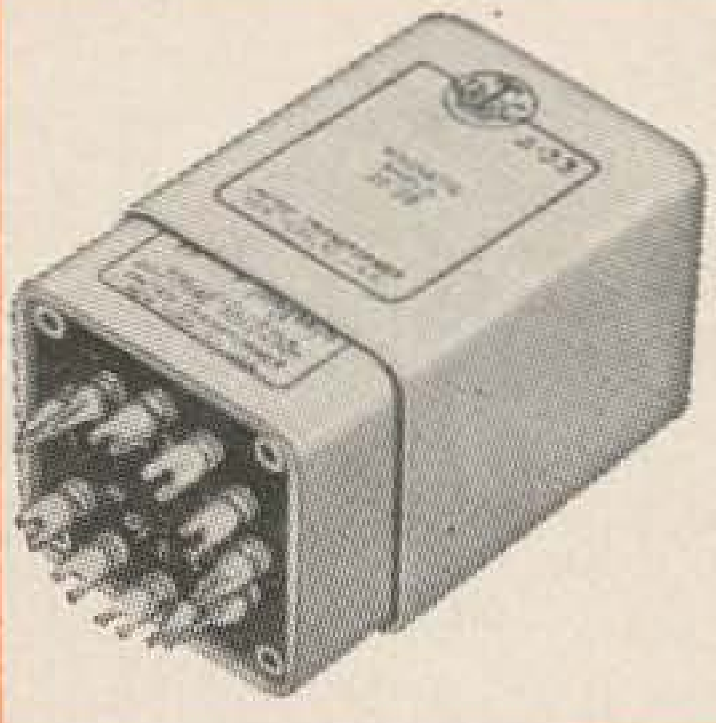



**TYPE A CASE**

| | |
|---|---|
| Length | 1½" |
| Width | 1½" |
| Height | 2" |
| Mounting | 1⁵⁄₃₂" sq. |
| Screws | 4-40 |
| Cutout | 1³⁄₈" dia. |
| Unit Weight | ½ lb. |



Hipermalloy Shield (A-33) shown slipping over "A"-line unit

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# 73 Magazine

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# de W2NSD/1

**never say die**

## Last call for Kenya

At this writing there are three of us going on an African Safari this August for three weeks. The total cost of the trip, including plane fare, guns, licenses, white hunters, the works, will run under $2000. There's room for one or two more. Let me know immediately if you want to go.

## Keeping up

The QST Board of Directors meeting this May should be fascinating. On top of all their other insurmountable problems they have to replace Herb Hoover as president. Many of us hope that the Directors will take some action this year toward helping ham radio survive by insisting that the IARU be given some funds for communications and promotion. A little help in our own country would not be wasted either . . . perhaps if the League could put on someone in Washington, even if he is a very part-time man, to speak up for amateur radio? And how about the information vacuum caused by the League refusing to do promotion work for ham radio? The Oscar series, though of international importance, were well-kept secrets . . . as is just about every other benefit provided by amateur radio.

Of course the Directors should take some action to stop the drop in membership. It has been dropping every year now for four years, you know. Perhaps if we could all have more confidence in their choice of employees, more amateurs would join the League. None of us like to support a dictatorship.

And if the QST Handbook continues to be the slip-shod book it has for the last few years, I give you warning that 73 will put one out that is done right. Fair warning? The Directors should do something about that inexcusable mess!

Perhaps, instead of interminable motions for congratulations, as seem to fill most of the few hours of the once yearly Board meetings, there should be some time devoted to Motions for Censure. Harry Dannals should get some mention for his part in the K2US disgrace. And Huntoon should get a commendation for his attempts to strike back at 73 by forcing the National Convention Committee to exclude 73 from the convention. This monument to small thinking should not go unrewarded.

While the commendations are being handed out, perhaps one should go to the Oscar group for continuing to exist in spite of the usurping of the limelight at every opportunity by Bill Orr.

## Mysteries

Scientific anomalies interest me. Sure, I know that most of them turn out to be fakes, but that doesn't spoil the fun at all. I try to get together with John Campbell W2ZGU, the editor of Analog magazine, whenever I can, because he is just full of these interesting stories.

I remember John telling me about a chap out in Colorado who had a power pack of some sort . . . black box type . . . and he would take it out for a demonstration anywhere you wanted him to, far away from commercial lines. He would then hook a tremendous load onto his power unit—it was about the size of a small suitcase—and turn out hundreds of kilowatts of power. You knew it wasn't batteries because it wasn't that big or heavy . . . what was it? I understand the chap was willing to sell the bag for around a million dollars.

In the March issue of Popular Electronics there is a story about a chap in Sarasota that can send signals through water with a little

*(Continued on page 112)*

# Editor's Ramblings

## Lids

The article "How to Be a First Class Lid on Phone without Really Trying" in the February issue apparently stepped on many toes. We apologize to all the lids we offended.

## Questions

People (mostly hams) write us all the time with questions. Most are fairly straightforward, and if we had a staff of five EE's with nothing else to do, we'd be happy to answer them. Unfortunately, we don't have those EE's. We don't have *anyone* here with the time to answer questions, whether they are reasonable or not. Please consult our indices each January or standard handbooks. You may not find your answer, but you'll certainly find something of interest. Please don't send us questions. And if you simply must, include a self addressed envelope so we can send back our form that states that we can't answer your question.

Incidentally, please enclose a self addressed stamped envelope when you write to 73 authors. Many get an awful lot of mail about articles and are perfectly justified in throwing away all questions unless you do this.

## Hz

For many years the English speaking world has used cycles per second (cycles, we usually say for simplicity) as the unit of frequency. Continental Europe has used hertz, obviously from the same source as amperes, volts, gilberts (gilberts?), etc. Hertz is simpler and shorter, but cycles per second has the advantage of reminding us of its meaning, though this advantage is obviously unimportant after you've spent a few days reading radio books and know what cps means. The big advantage of cycles is that we're used to it, so seeing 455 kHz instead of 455 kc tends to jar us.

*(Continued on page 115)*

# Take it from us...

## and who the hell hasn't?

**We began the manufacturing of ham gear not too many years ago on the simple premise that there was considerable room for improvement, particularly in the accessory field. It was our contention then as now, that up-dated equipment engineered right, built right and priced right would find a waiting market with the amateur. It did and it does!**

**From the very start we set our sights high, picking up where others had bogged down in the dogma of "it can't be done." Truthfully, improving on the products of some of the let-well-enough-alone makers was no considerable feat. They were sitting ducks for our kind of thinking. By ignoring trends and advanced theories they had continued year after year with the same antiquated items . . . never venturing, never daring, never doing.**

Waters developed the Auto-Match mobile antenna because there was need for it. Need for an antenna that was structurally strong enough to withstand the rigors of mobile use. Need for an antenna electrically capable of pushing out a stronger signal. An antenna capable of handling the thousand watts PEP of the new mobile rigs being introduced. We had something too good to go uncopied for long. Within six months, manufacturers who hadn't incorporated a change in their antennas since initial introductions, latched on to Waters improvements, heralding their "innovations" to the high heavens and lauding long-dormant engineering skill.

The erstwhile leading co-axial switch maker had been turning out the same outmoded product since proverbial Hector was a very young pup. Originally improvised around a standard wafer selector switch (misalignment and all) it was never changed, never improved. Never, that is, until Waters engineered a totally new approach in co-axial switches. It took the old timer about four months to get into the me-too act with a completely new line based on you know what! Recently we announced "Protax", the only automatic grounding co-axial antenna switch. Right now we're alone in the field, but we won't be lonely for long. Want to bet?

We perfected a couple of nifty speech-processing devices at Waters — the Compreamp and Clipreamp. We're proud of the compact circuitry and theory because it took considerable doing. Apparently one of the better kit manufacturers went along with our good opinions. You can now buy his version of Clipreamp in kit form. And, we're nasty enough to add, at a higher price than for our assembled job.

Most good CW ops are familiar with our now-famous Codax Automatic Keyer and its rhythm-smooth action. It seems another kit maker is familiar with it too, and offers a reasonable facsimile of same in kit form. You might do better by knocking down a Codax and ordering duplicate parts but we must warn you, assembly and adjustment can be very tricky.

There's more — but you get the idea! Some bright guy once ventured the thought that imitation was the sincerest form of flattery. If so, we've been flattered to a fare-thee-well and getting the least bit fed up. You can even get odds in our Engineering Department whenever we introduce a new piece of gear as to how long it will take the Brand X, Y and Z boys to incorporate Waters advanced thinking into their own products.

It all adds up to a pretty logical conclusion. Waters pace-setting ham equipment is engineered for tomorrow . . . and you can own it today. Or you can wait until tomorrow and take it from the guy who is taking it from us today.

Bob Waters **W1PRI**

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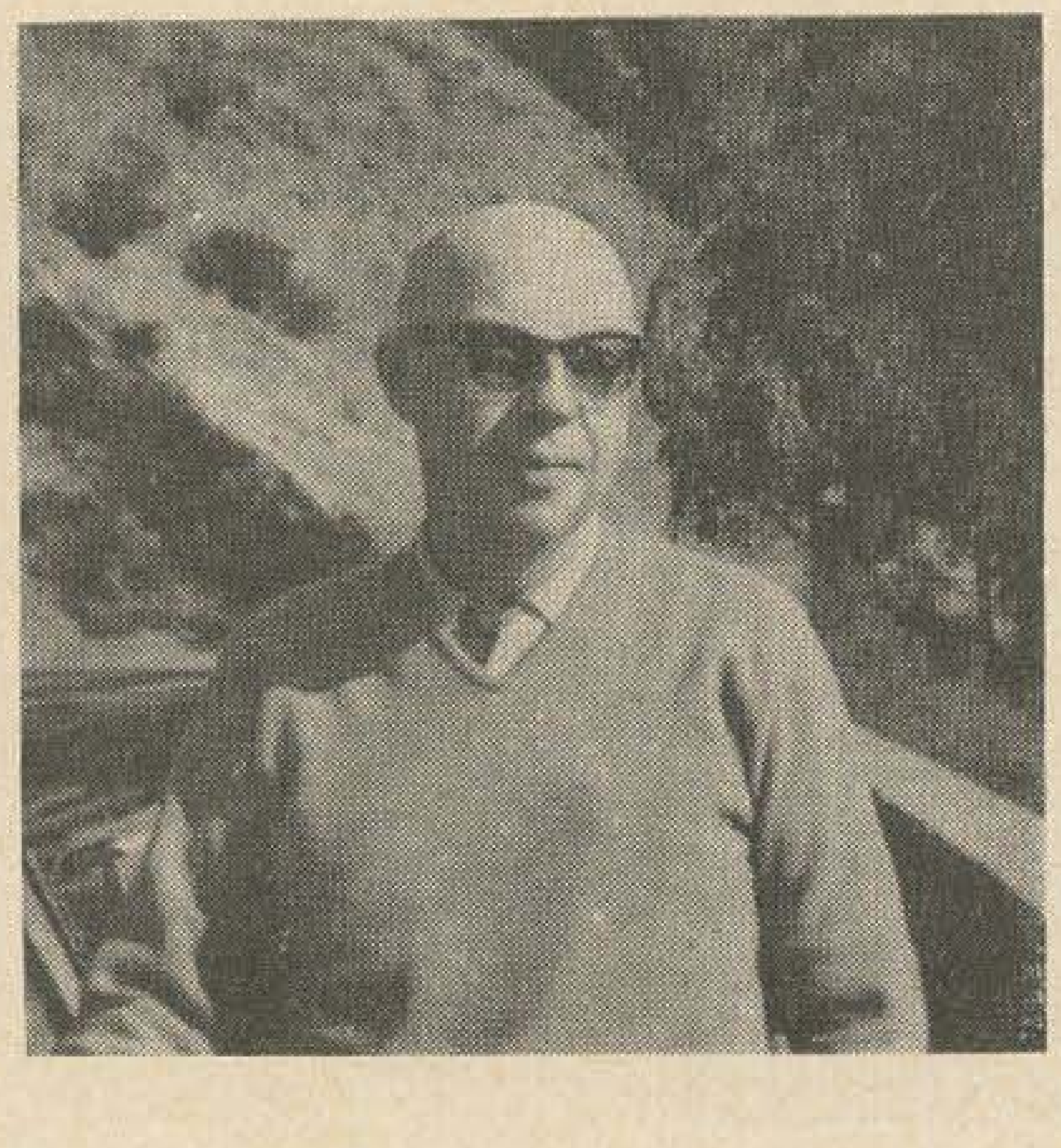
# New VHF Circuits for Transistors

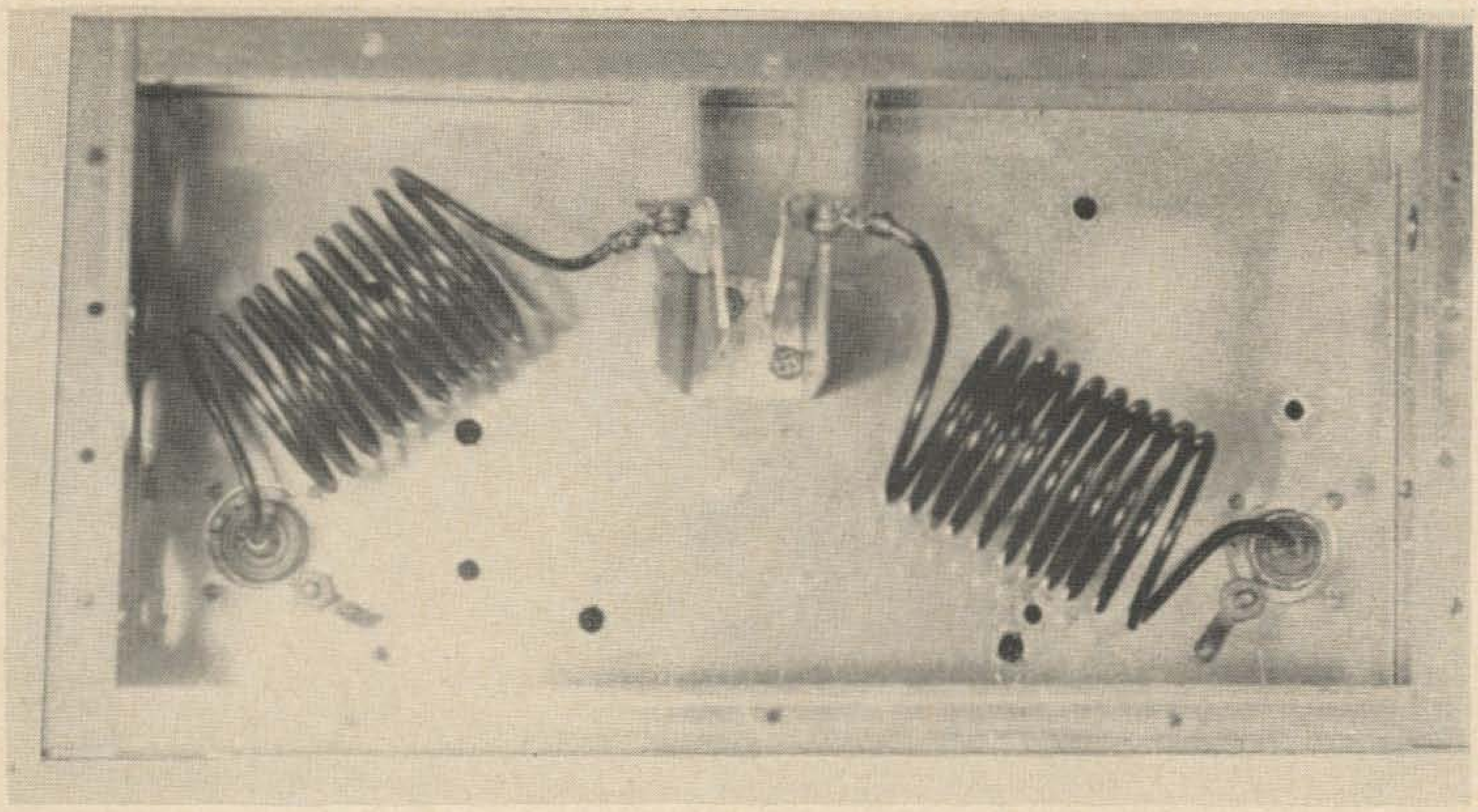
***This article, the first in a series, describes a simple but effective 50 mc antenna tuner and low noise 50 mc converter using three 52¢ transistors.***

Some sad experiences with transistor converters and receivers at my station have resulted in the use of several ideas for protection of transistors which now seem to be satisfactory for most overload conditions. These overloads in the past abruptly ended the useful life of the front end transistor or caused a gradual deterioration of receiver noise figure and loss of weak signals. Four general forms of overload were present at W6AJF. First, a high powered VHF transmitter connected to a beam antenna which was too close to another VHF band antenna and perhaps pointing across the other antenna at times. This would produce a damaging voltage across the input of the first transistor thru the antenna feeder, coax relay and input circuit (low Q) into the transistor even though that unit was not in operation, that is, with no battery connection. For a long time the only protection was to disconnect all antenna coax fittings except for the band in use. A good VHF contest with all antennas connected usually resulted in a frantic search for a new transistor or two.



The dual antenna couplers shown in this article cured this problem since two very high Q circuits added enough selectivity to the transistor converter front ends to knock out this problem. To get very high Q circuits these units have to be large physically, so a second benefit results from their use. Transmitter spurious frequencies are greatly attenuated and the rf energy reaching the particular antenna is confined to that particular band with a reduction of TVI problems in the neighborhood. These dual circuits were built into standard aluminum chassis and fastened on the wall for connection between the coax line of each beam antenna and its coaxial antenna relay. Very high Q is needed to not only reduce transmitting power loss but to

*Frank Jones is one of the best-known and most capable of VHF hams and authors. He has written over 400 articles and radio handbooks, including "VHF for the Radio Amateur," a staple on any VHF'er's book shelf. This is Frank's first article in 73; we hope that it will be followed by many more.*



Dual circuit antenna filter for 50 mc used in both transmitters and receiving.

keep from losing NF in the receiver. Any loss here reduces the weak signal capabilities so the losses should be kept well below one DB in the two circuits of each coupler.

If each circuit is coupled so as to have a working Q of perhaps 20 and the unloaded Q is perhaps 500, the total coupler circuit loss would be 8% or an efficiency of 92%. The loss in NF would then be less than ½ db. Small circuits cannot be built with high enough Q for low losses, and as much as 2 db is sometimes lost in NF if these selective circuits are built into the converter unit.

The second cause of transistor failures is fairly rare at this location, lightning storms in the area. These only occur once or twice a year here and the best protection is still to have all antennas disconnected from all receivers during these storms. Lightning protectors in the antenna feeders to a good outside ground may save the transmitters except in a direct hit, but transistors aren't tough enough and out they go even though the bolt of lightning may hit a few miles away. Low capacity fast diodes connected back to back across the first transistor circuit help a little.

The third cause of transistor failure has to do with improper antenna and power control relays. No matter how good an antenna relay is for isolation between transmit and receive positions, an arc at the points will sure put a lot of rf voltage across that first transistor. The answer to this problem is to manually control the relay switching or to use timed delay sequence by electrical means so the antenna relay will be in transmit position before the power relays are in transmit position—and most important, the power relays are "off" long enough for all transmitter rf energy to dissipate in the antenna before the antenna relay is restored to receive position. Some circuits which accomplish this properly have been or will soon be published. Antenna relay switching still seems to be the most effective way of getting those weak signals into the receiver in the VHF region.

A fourth cause of trouble is in the antenna relays because of lack of isolation between the transmit and receive coax connections. Nearly all VHF transistors will break down if the peak input voltage is much over a half volt. Some antenna relays only have about 20 db isolation at 144 mc, or a power isolation of 100 to 1. If you have 100 watts peak transmitter power output, this means 1 watt down

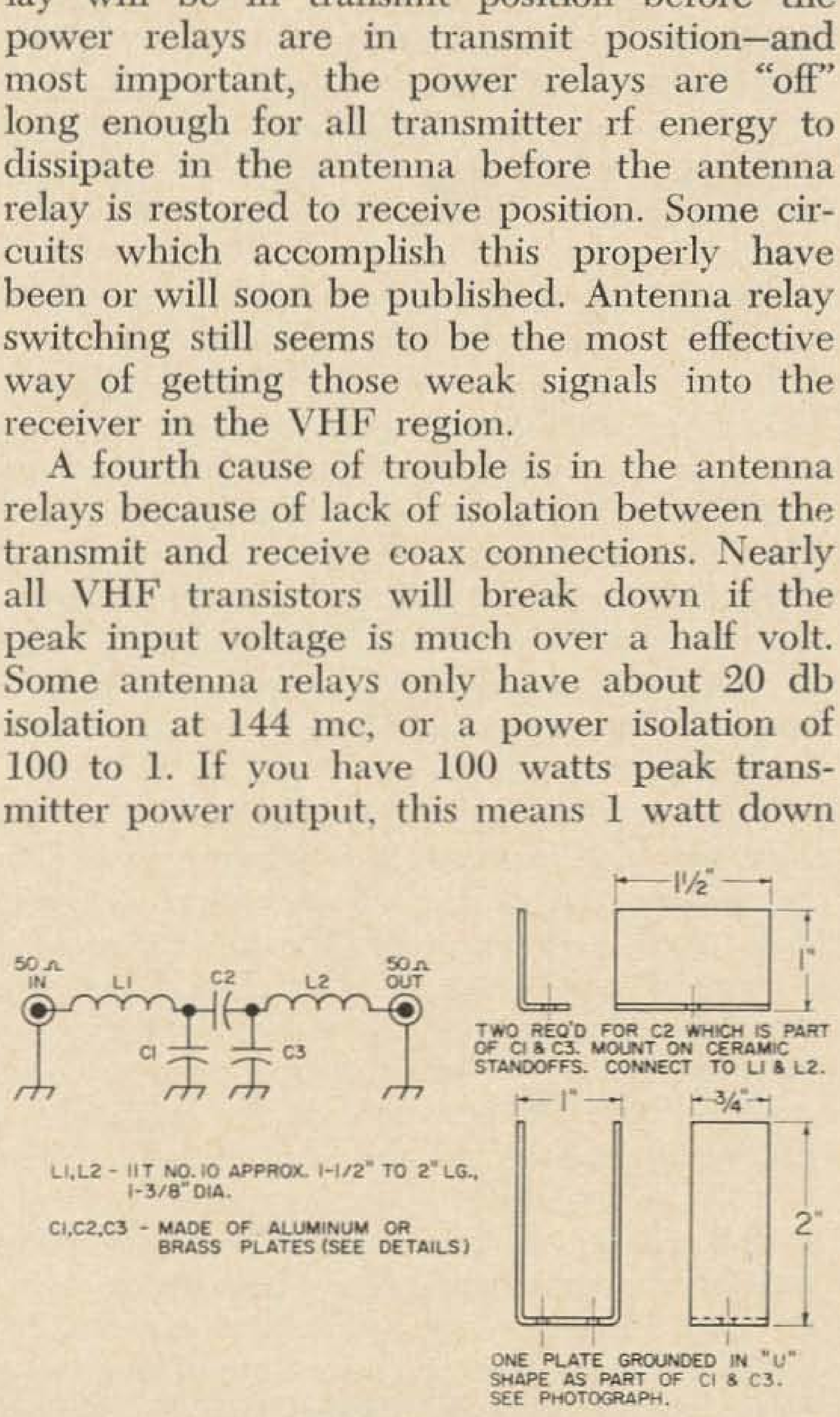



Fig. 1. 50 mc antenna coupler or filter.

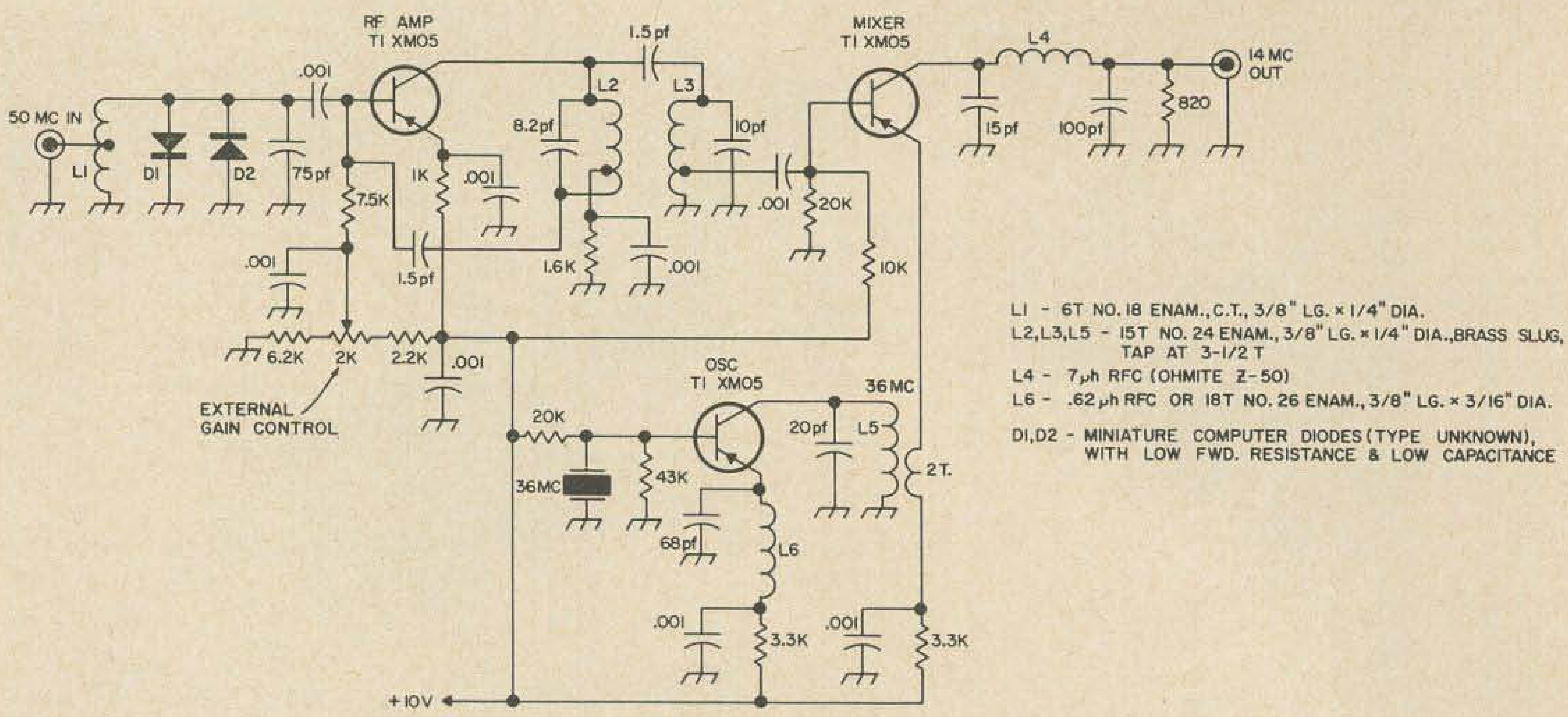



Fig. 2. Low noise 50 mc converter. The transistors are 52¢ TI-XMO5's.

into the receiver front end or about 7 volts peak across a 50 ohm circuit. Scratch one transistor! If your antenna relay has 50 db isolation in terms of power, then a KW of peak power would only put .7 volt into the receiver and the transistor might survive. Buy expensive coax relays that have good isolation especially if you operate with high power at 432 mc where antenna relays really lose db's of isolation.

About this time someone always asks why use transistors when tubes will cure this problem in the receiver front ends. The answer is that a recent transistor costing about 52 cents will have a better noise figure than tubes costing 10 to 100 times as much. A lower NF always means more readable signals except perhaps in areas of high man-made noise. Even in high noise level locations, a low NF receiver and noise blanker system will help as compared to the usual NF of a few db higher in the receiver front end.

Antenna relay lack of good receive-transmit isolation can be overcome to some extent by connecting two diodes of low forward resistance, back to back across the input circuit of a transistor. The two diodes should be of a fast type, preferably silicon rather than germanium, with low capacitance such as computor diodes. These two diodes will add a little capacitance to the circuit which can usually be tuned out. The signal loss at microvolt levels is usually quite small and their low resistance characteristics only become apparent at high levels when protection is needed against transmitters or distant thunder storms. Even good computor diodes can be burned out but only at levels many times greater than for a VHF transistor. Occasional checks are needed to ensure that these diodes in a circuit are still in operating condition. A soldering iron, long-nose pliers and an ohmmeter are the necessary test equipment for this purpose. Also be sure to isolate the transistor bias circuits from these two diodes with a small bypass coupling condenser. They should always be connected across a coil only, with one cathode and one anode to each end of the coil in order to short circuit high amplitude positive and negative rf pulses.

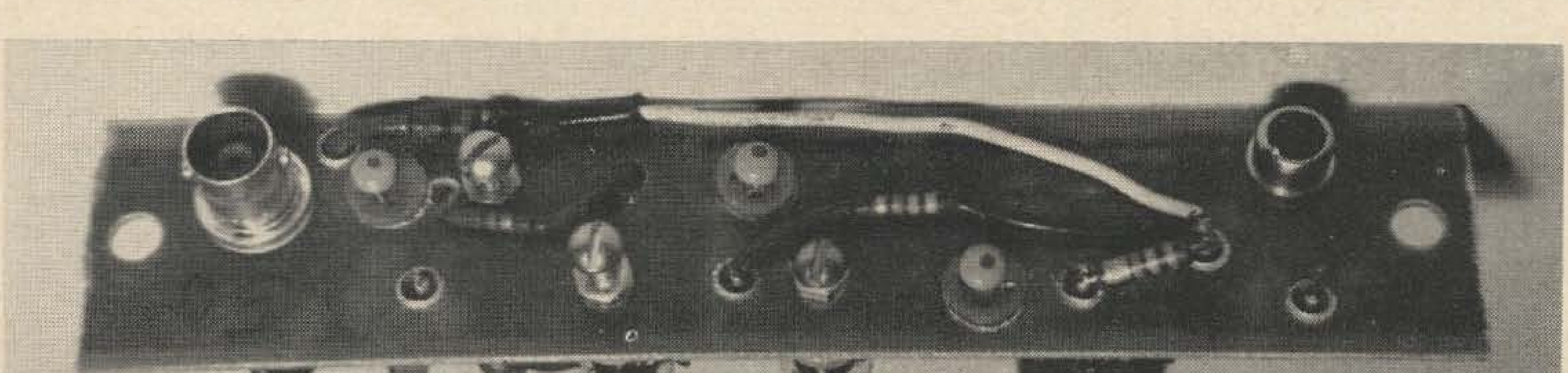
## 50 mc antenna coupler

The circuits and ideas described previously, were incorporated into four transistor converters and the dual circuit antenna couplers for 50, 144, 220 and 432 mc. The 50 mc units are shown in this article with a follow-up for the other band units. The antenna circuit was the result of a number of different dual circuit units at 50 mc. The system shown had the least heat loss for transmitting and the least loss for receiving of any of the more usual forms such as tapped coils with variable tuning condensers, etc. The input and output coax connectors are in series with each coil which is part of a low C resonant circuit. With the values of C and L chosen, the loaded Q of each circuit is between 15 and 20 which is ample for covering about 2 mc of the 50 mc band. More coil turns and less capacity at the high impedance ends will increase the Q for 50 ohm input and output connections, with a narrower band-width. The tuning condensers $C_1$ and $C_3$ of **Fig. 1** and the coupling capacitor $C_2$ are made of two small plates of aluminum or brass mounted on 1" x ½" or 1½" x ½" ceramic insulators. The grounded plate of $C_1$ and $C_3$ consists of a U shaped bracket of similar metal bolted to the chassis. The insulated plates were each 1½" square with ½" of one side bent at about right angles for mounting on the ceramic insulators. Bending these two plates towards each other increases $C_2$, the coupling capacity between the two tuned circuits. Bending the grounded U piece sides towards the insulated plates increases $C_1$ and $C_3$ and vice versa. Working the coil turns closer together increases $L_1$ or $L_2$. All these adjustments can be made when the mounting plate cover is in place since it was made of perforated Reynolds sheet aluminum. A 5 x 10 x 3 inch aluminum chassis (recovered from another project) was used to enclose the circuits. The circuits were tuned up before the whole unit was fastened to the chassis with numerous sheet metal screws.

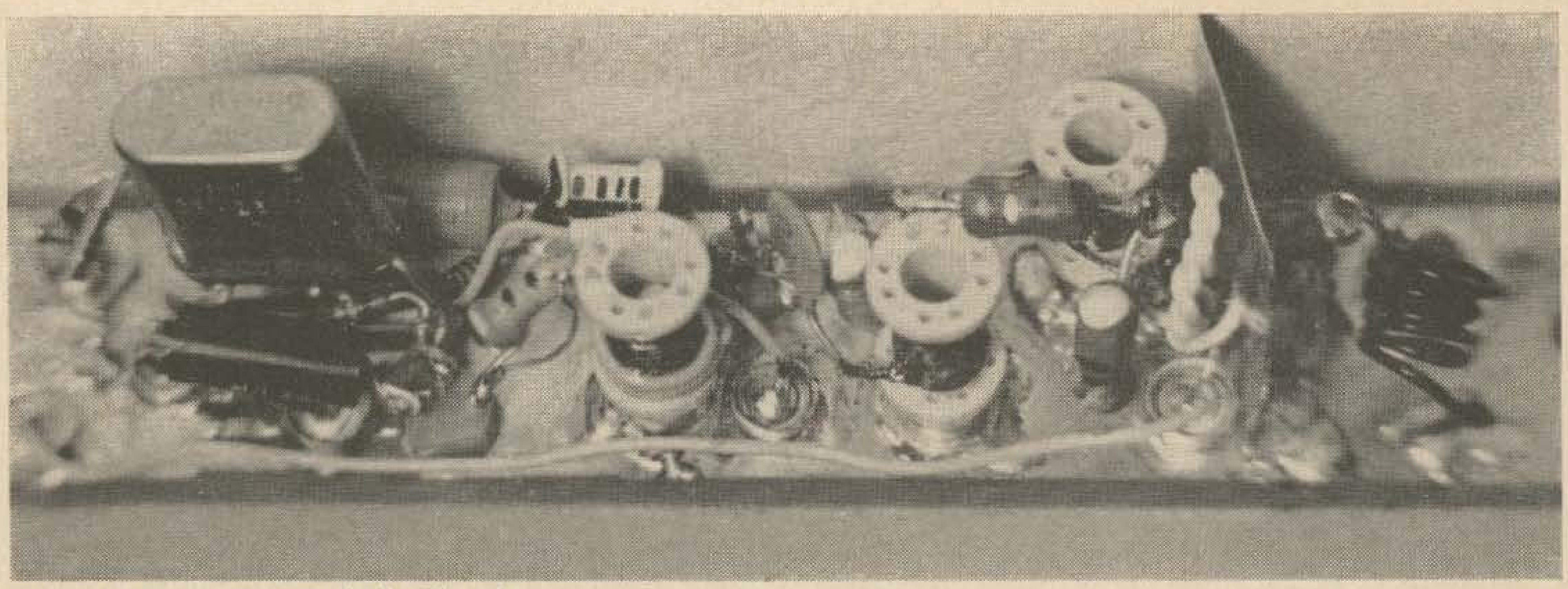
The tune-up can be done by shorting the coax fittings with a short piece of wire and grid dipping the coils to about 53 or 54 mc with the cover removed, shorting each coil not being adjusted. The next step consists of using a SWR power meter with a transmitter set for 50½ or 51 mc and with the chassis cover in plate. The transmitter is adjusted for maximum power output (plate circuit resonance, etc.) and the SWR reading noted for connection of the antenna feeder directly to the transmitter. The power reading should be noted also for a given value of plate current. Connect the dual circuit coupler between the antenna feeder and the antenna coax relay with the RG-8U coax. The coil lengths and $C_1$, $C_2$, $C_3$ plate spacings can then be adjusted in steps with a thin screw driver thru the perforated cover plate holes. The SWR meter on the antenna side of the coupler can be watched for maximum power reading with the same SWR reading as before. If you are lucky enough to have two SWR meters, put one on the transmitter side of the coupler and make sure it reads unity SWR by adjusting the final plate circuit condensers and the antenna coupler circuits. The final objective is to have unity SWR between the transmitter and coupler with nearly identical power readings into and out of the coupler. The output SWR will depend on the antenna matching at the antenna, not on coupler adjustments. An hour's work or less should result in, for example, 200 watts into the coupler and 185 watts output. For 90% or so of this time, use a large 50 ohm dummy antenna since the beam antenna should only be used for radiating intelligible signals, not as a general test instrument. Once the coupler or "filter" is properly adjusted, mount it in some out of the way place and forget it. It is intended for use on both transmitting and receiving and will add as much as 50 db of image suppression to the 50 mc converter and also reduce reception of unwanted signals outside of the amateur band.

## Six meter converter

The 50 mc converter shown in the photographs and in **Fig. 2** was recently built and has a lower NF than other 50 mc converters in use at W6AJF. The new TIXMO5 transistors presently available from Texas Instruments at about 52 cents apiece are very excellent for use at any frequency from 14 to 432 mc. The only disadvantage is that the "plastic" casing cracks easily so either solder them into the circuit carefully or use the new TO-18 type transistor sockets which will fit these tiny transistors. The writer broke several TIXMO5 transistors trying out several in the rf stages of the 50, 144, 220 and 432 converters. In all stages except the input rf stage, these transistors can be soldered into the circuit using a very small soldering iron and supporting each lead with long-nosed pliers as each is soldered to the other circuit components. A small transistor socket is advisable in the first rf stage of any converter since



Top view of 2 x 6 inch board with BNC coax input jack and phono jack output. Unit mounts in 6 x 17 inch chassis for shielding slong with numerous other converters and switching panel.



Bottom view; copper clad side of converter.

this unit determines the NF and may need changing in time, after a few thunder storms in the area, or transmitter overloads. The input circuit in **Fig. 2** should only be used when the matching antenna "filter" is to be used in order to have good front end selectivity. The loaded Q of the input circuit is about 5 resulting in optimum NF but very little selectivity.

The rf stage is neutralized partially and forward gain control on this transistor permits reduction of rf gain without strong signal overloading and loss of noise figure. Forward gain control actually increases the transistor collector current flow to produce a reduction of gain. The collector series resistor reduces the collector dc voltage at a rate fast enough to reduce the stage gain even though the collector current is increasing. Normal gain control reduces collector current to reduce gain with fixed dc supply voltage. This causes a fast increase of NF and increases the rf stage cross-modulation problems on strong signals many times as compared to forward gain control.

The 10 volt and gain control leads were brought out thru 1000 pf solder-in feedthru capacitors. These same capacitors were used for other by-pass condensers with some resistors mounted on the insulated side of the 2 x 6 inch copper clad board. The slug coil forms were tapped out for a 6-32 brass machine screw which became the "tuning slug." Normally coils of this type come with regular adjustable brass slugs or with coded ferrite slugs (white for above 30 mc.) If ferrite slugs are used, reduce the coil turns about 15% or to about 12 turns in the same winding space.

The mixer stage with base signal input and oscillator injection into the emitter, has large enough coupling and by-pass condensers to act as fairly low impedance to the *if* output frequencies of 14 to 16 mc. The pi network from collector to 75 ohm output jack tunes broadly to around 15 or 16 mc with a 7 μh Ohmite Z500 rf choke and a couple of fixed ceramic condensers of the values shown in **Fig. 2.** This mixer circuit has very high conversion gain with nearly any good VHF transistor.

The 36 mc overtone crystal oscillator has a semi-tuned emitter circuit which is resonant between the 36 mc desired frequency and the crystal fundamental of 12 mc. This gives regeneration to the oscillator so it will oscillate at the 36 mc. frequency only when the collector circuit is tuned near 36 mc.

A noise generator is useful in tuning the interstage slug coils and the input coil turn spacing. A reasonably good noise generator showed a NF of 2.0 db at 50 and 51 mc and 2.3 db at 52 mc. This should be fine for the really choice dx when the F-2 layer opens up again or at the present time for double hop sporadic E openings.

The 144, 220 and 432 mc converters and a different form of dual circuit low loss antenna coupler for each band will be described in the next article.

. . . W6AJF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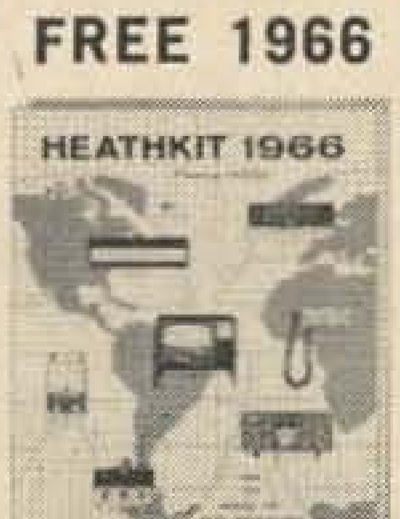


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# N-Channel FET's: RF Applications

***Another 73 scoop: low noise, low crossmodulation transistor VHF RF amplifiers.***

Occasional cryptic mention has been made recently in *73* of the Texas Instruments 2N3823, an N-channel field-effect transistor capable of excellent RF amplifier and mixer operation to 500 mc. This article will describe the advantages, disadvantages, and applications of this and similar devices for amateur use.

The operation of the FET has been described by WA6BSO (*73*, December 1965). Electrically it is similar to a vacuum-tube pentode, with high input and output impedances. The greatest advantage of the FET over tubes and transistors for RF use is its virtual immunity to cross-modulation—amplitude modulation of a desired signal by a strong interfering signal at an unrelated frequency, sometimes known as "riding in." Transistors are notoriously susceptible to this sort of interference. As long as the gate of the FET is neither driven sufficiently positive to conduct nor so far negative that the FET cuts off, the cross-modulation will be negligible. In practice the 2N3823 will handle interfering signals up to several tenths of a volt rms before cross-modulation of weak signals becomes even measurable.

The 2N3823 is also a low-noise device, with a noise figure typically 1.4 db below 100 mc. The typical noise figure of a 500 mc amplifier using the 2N3823 in grounded-gate, near the high-frequency limit of the device, is 4.5 db. However, there are transistors available that will do as well as this and which cost considerably less.

The FET will not be particularly resistant to intermodulation interference—the mixing of two strong signals to cause an interfering signal at the sum or difference frequency. This sort of interference is less of a problem because it occurs at specific frequencies, rather than everywhere in a band. In this respect the FET is neither much better nor much worse than tubes or transistors.

**Fig. 1, 2,** and **3** show the 2N3823 in the most common RF amplifier configurations: grounded source, cascode, and grounded gate. The grounded source amplifier will provide good gain and noise figure through 50 mc, but tends to be unstable with high load impedances; the feedback capacity is about 1.6 pf, compared to small fractions of a picofarad for pentodes. Output impedance is around 50K ohms below 300 mc, so high impedance loads can be used with no degradation of Q. Highest gain is obtained with high signal-source impedance, up to 10K ohms; best noise figure is obtained with a 1000 ohm source impedance; cross-modulation can be minimized with lower source impedance, (lower input voltage

*Jack is now a student at Stanford working on his MSEE; he formerly was with TI, where he worked on the development of the 2N3823.*

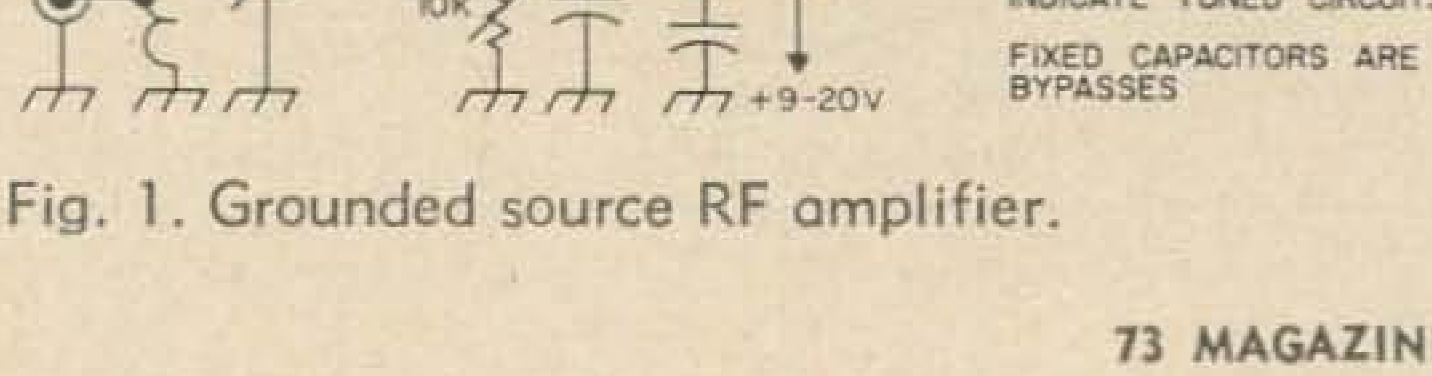



Fig. 1. Grounded source RF amplifier.

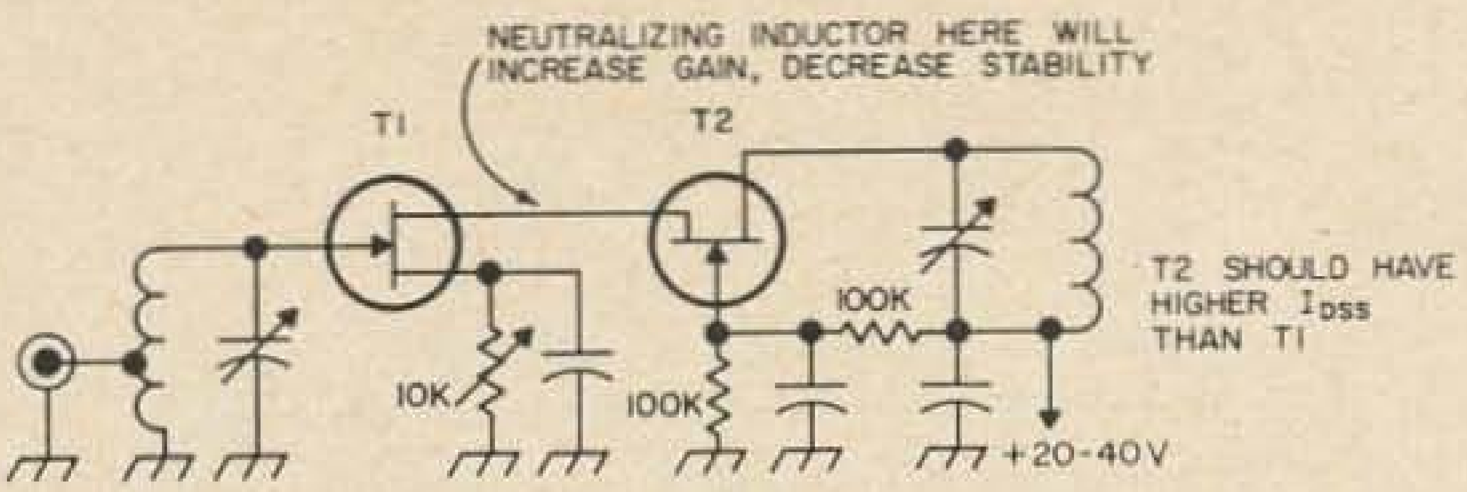



Fig. 2. FET cascode RF amplifier.

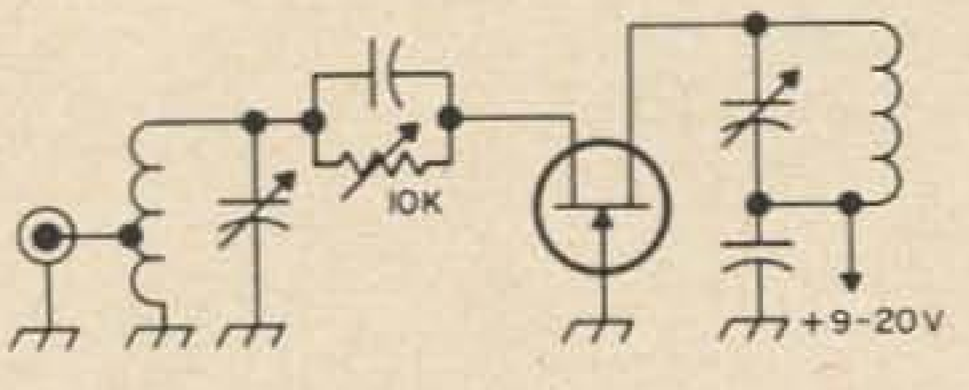



Fig. 3. Grounded gate RF amplifier.

step-up), limited of course by gain requirements. The cascode circuit is more stable, since the grounded source first stage is driving the low impedance grounded gate second stage. It has the obvious disadvantage of using two of these expensive devices.

Probably the best RF amplifier configuration for all frequencies is the grounded gate. The optimum source impedance for both highest gain and best noise figure is about 100 ohms. Since cross-modulation is caused by excessive gate-to-source voltage, the low impedance level gives better signal-handling capability. The 2N3823 in this circuit is stable and requires no neutralization through 500 mc. Power gain is between 15 and 20 db. Output impedance is above 50K ohms through 500 mc.

For each circuit, highest gain and best noise figure are obtained at zero gate source bias. Because of the P-N junction contact potential, the zero-biased FET will handle signals up to a few tenths of a volt before gate conduction becomes appreciable. For best resistance to cross-modulation, the FET should be biased so that the gate-source DC voltage is half the cutoff voltage.

To prevent cross-modulation in later stages in the receiver, interfering signals must be attenuated by tuned circuits before reaching stages capable of causing cross-modulation. If the FET RF amplifier is followed by a mixer susceptible to cross-modulation, and the intervening tuned circuits are not capable of lowering the interfering-signal amplitude sufficiently for the mixer to handle the signals, the advantage of the FET will be lost. Hence the desirability of an FET mixer. Any of the usual vacuum-tube circuits (other than those using screen-grid injection) can be used; **Fig. 4** shows a typical circuit. For maximum conversion gain, the local-oscillator voltage should be close to one-half the FET cutoff voltage (peak) with the mixer biased to half the cutoff voltage. However, for good resistance to cross-modulation, the instantaneous sum of oscillator voltage and signal voltage should neither drive the gate into conduction nor cut off the FET. Hence it is mandatory that the local-oscillator voltage be as low as is practical, at the expense of conversion gain and noise figure. High-selectivity tuned circuits can then cut down interfering signals to minimize cross-modulation in the IF stages.

While all FET's will provide the high resistance to cross-modulation of the 2N3823, there is no other FET capable of equalling the 2N3823's low-noise high-gain VHF performance. The greatest disadvantage of the 2N3823 is the price: $12.90. There is a less-expensive version, the TIS34, which is a 2N3823 in a plastic capsule and without guaranteed VHF specifications. A considerable part of the cost of the 2N3823 is in the testing of parameters. DC parameters can be tested very rapidly by machines; RF parameters have to be laboriously tested by human operators, an expensive process. The TIS34 sells for $7.80—still expensive, but a 40% savings. The 2N3823 guarantees a noise figure under 2.5 db at 100 mc, and transconductance minimum 3500 μmho at 100 mc. The probability that a TIS34 will provide RF characteristics equal to those of a 2N3823 is better than 90%.

Most of the competitive N-channel FET's have lower transconductance than the 2N3823, which will result in inferior noise figures. For applications below 50 mc some of these devices may do well enough to be below the atmospheric noise level. It has been stated that with respect to noise an FET is approximately equivalent to a pentode with 3½ times the transconductance of the FET. Devices fabricated at Texas Instruments with very high transconductance—15,000 μmhos and up—had inferior high-frequency performance. Apparently the 2N3823 has about the optimum geometry for RF applications.

Finally, if you intend to try out a TIS34, get a data sheet for the 2N3823 as well, since the latter has data and graphs not on the TIS34 data sheet.

. . . WA5KLY

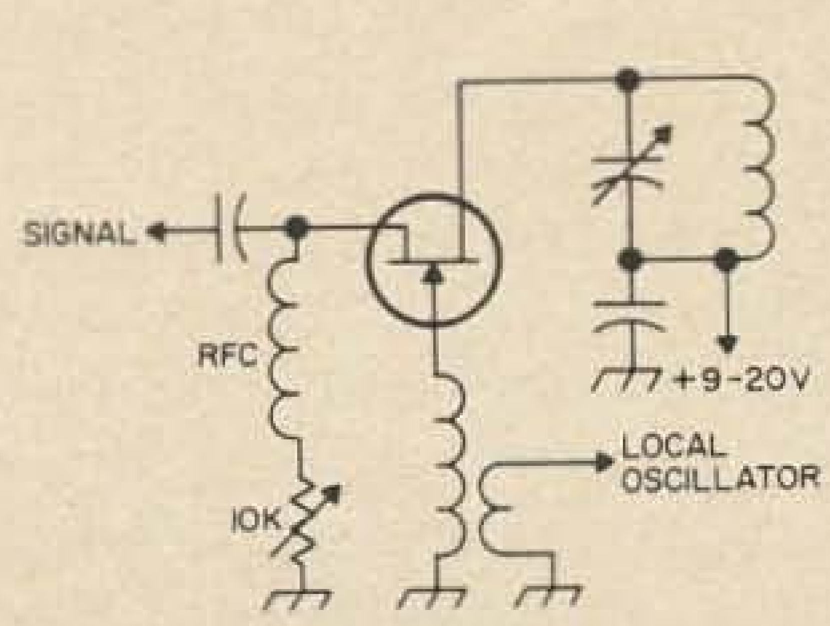
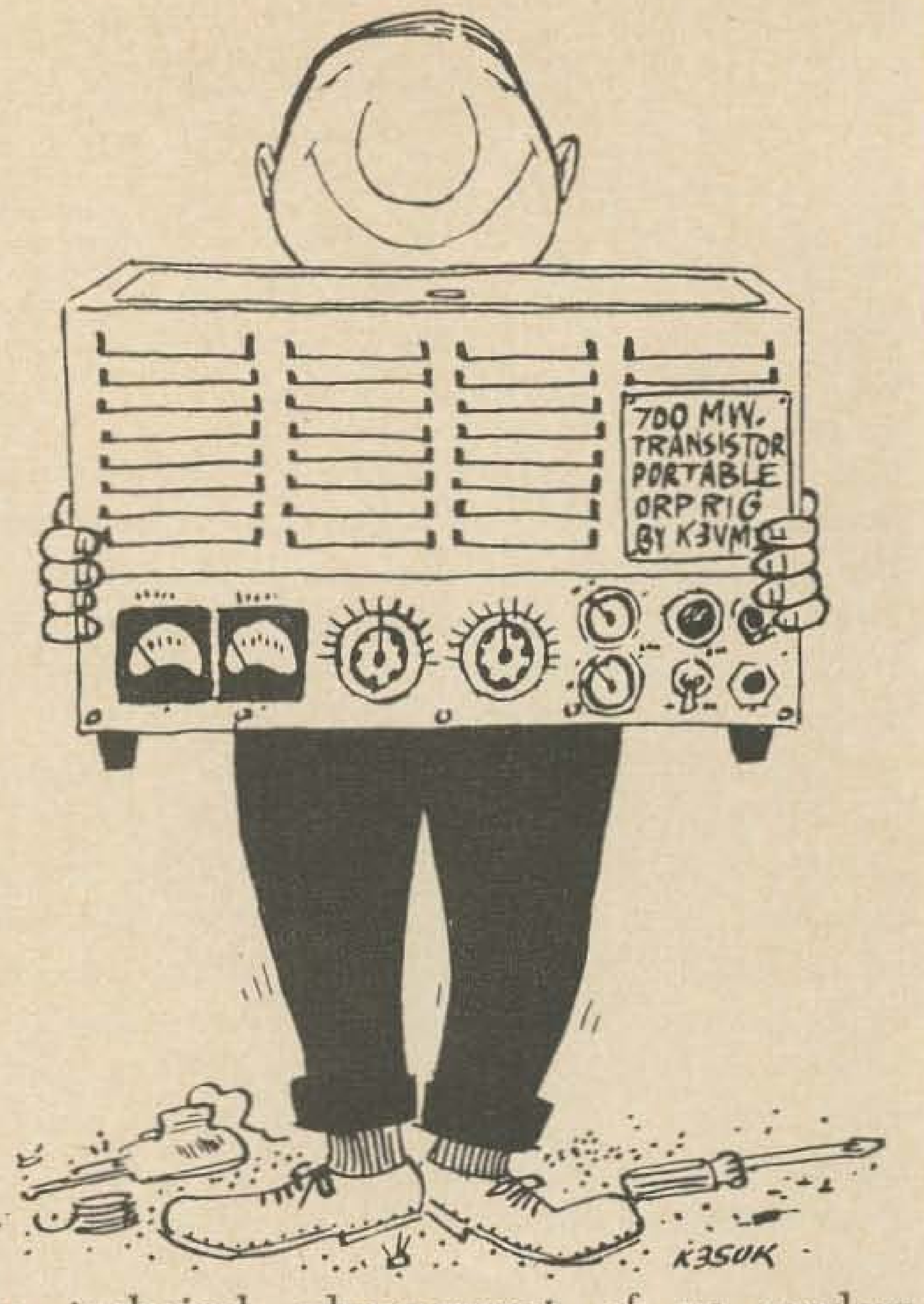



Fig. 4. FET mixer.

Dennis Ardinger K3VMZ
401 Maplewood Drive
McMurray, Pa. 15317

# Size is Impressive




Shakily I sat at the operating position and gleamed at my months of hard work of scrimping and scrounging. My first construction project was completed . . . a code practice oscillator.

With the help of a friend I pushed the cpo into the corner.

I told myself this was the end. I had proved to myself I could build something that I needed in the hamshack. But it was no use, the bug had bitten. I must now advance to harder and more classy projects.

Shuffling a 73 out of my precious box of moldy radio magazines, I leafed through it for something even I could build. I wanted something that was a challenge, but not impossible. Something that was impressive, but didn't have too many of those little carbon or paper things.

There it was. My hearts desire. A QRP transmitter for portable operation. A solid 700 milliwatts! And it had impressive milliamp meters with it too!

Carefully checking the parts list, I took note of what I had and what I needed. I was really going to do a neat job on this one I kept telling myself.

The rig required a 4x4x6 inch aluminum box. Ah—this old TV chassis would do the trick. "Build it breadboard fashion" I thought. Spread the parts around and give the 2N697 transistors plenty of space to dissipate all that choking heat they build up. "After all" I thought, "It has to be open to show friends the technical advancement of us modern hams."

In the weeks that followed my shack was turned into an anthill of filing, soldering, bolting, testing and retesting. By now I could even tell what all the symbols on the schematic meant without having to look in the *Handbook*. I could now identify the emitter, collector and the base on the transistors. I was in my days of glory!

I was careful to select very stylish venier dials for the variables. Then I decided to go highhat and completely enclose my pride and joy in a metal cabinet. The local radio store had just the one I needed—a 9x22x15 inch steel cover that cost me just under $15.

Several weeks later, after I had completed my "Emily" as I named her, and even made a contact, I got to wondering if high power would give me better results. After all, taking the transmitter with me everywhere I went was silly . . . I didn't have a portable receiver. Besides, the XYL complained about no leg room.

Once again I carefully consulted my technical library of literature and came up with a 10 watt rig for mobile use. Well that almost brings me up to date. With the car sold to provide money for the parts and the one wall of the garage turned into a giant chassis, I am almost ready to begin another tinkering job.

Now where did I put that article about advancements in miniaturization?

. . . K3VMZ

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Orlando, Florida

# FSK Principles

One of the simplest problems that faces the new RTTY'er is adapting his transmitter to FSK. Strangely enough, this job seems to be a stumbling block for many. This article will cover the principles of one of the simplest and most widely used methods for frequency shift keying. Also, methods for obtaining local copy while transmitting will be discussed.

## Basic principles

In order to transmit RTTY signals, the transmitter frequency is shifted between two different frequencies. The standard method for amateur use is to use the higher frequency for MARK and the lower frequency for SPACE. Remember; "LSMFT"—Low Space Means Fine Teletyping! The standard shift for amateur and MARS use is 850 cps. The FCC requires the shift to be less than 900 cps and many amateurs are experimenting with narrow shifts as low as 100 cps.

The basic idea in shifting a transmitter is to cause the keyboard to switch a reactance in and out of the oscillator circuit in such a manner as to change its frequency. While this reactance can be either an inductance or a capacitance, capacitors are usually used since they are cheaper and have lower loss. To obtain the space, or lower frequency, the capacity is switched across the tuned circuit in a VFO or the crystal in a crystal oscillator. For the mark signal, the capacitor is switched out of the circuit. It would be very difficult to do this switching mechanically so some type of electronic switching is generally used. A diode makes a very simple and effective electronic switch. By reverse biasing the diode, it looks like an open circuit and by applying a large forward bias, it looks like a short circuit. If the forward bias current is made small, the diode will look like a resistor instead of a short circuit. Thus, by varying the bias, we have an electronically controlled resistance! The switching from reverse to forward bias

*Don is a communications engineer at the Martin Co. with BSEE and MSEE from U. of Florida and Prof. Engineer degree from Stanford. He's a great RTTY fan and has written many articles.*

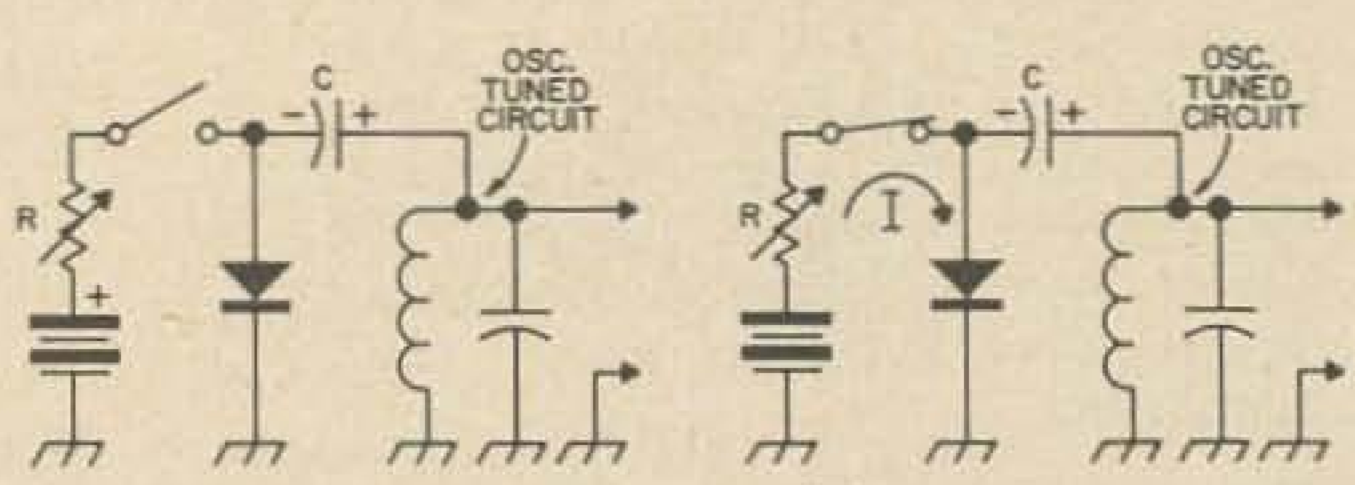


Fig. 1. Simplified diode FSK circuit.

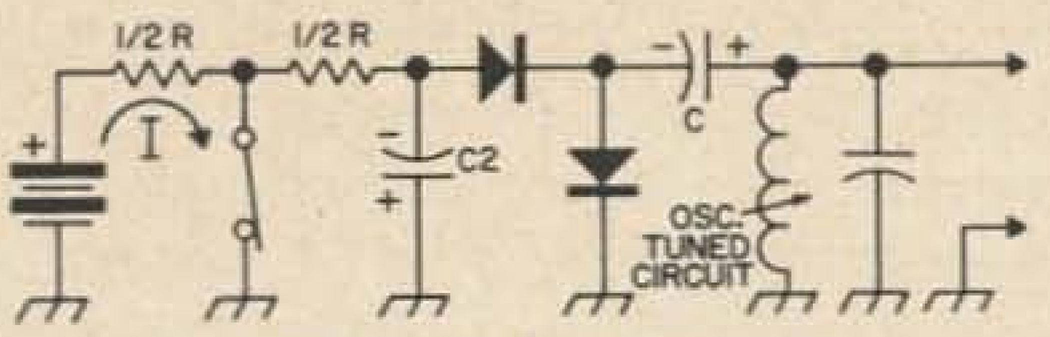


Fig. 2. Simplified diode FSK circuit for "space-low" condition.

can be done remotely by the teletypewriter keyboard.

**Fig. 1** shows a very simplified version of a diode FSK circuit which will illustrate how this can be done. **Fig. 1a** would be the high frequency condition and **Fig. 1b** would be the low frequency condition.

When the key is open, as in **Fig. 1a**, the RF voltage present at the oscillator tank circuit is rectified by the diode, causing the capacitor C to charge up to the polarity shown. This negative bias on the diode causes it to be reversed biased and to look like an open circuit. Thus, the capacitor C is effectively disconnected from the tank circuit and the frequency is determined by the oscillator tuning capacitor. In **Fig. 1b**, the key is closed and the diode coducts due to the external battery. The resistor R controls the current I through the diode and consequently controls the effective resistance of the diode. The diode is a non-linear device; that is, the current through the diode does not change in proportion to the voltage across it. Due to this characteristic, effective resistance of the diode (the ratio of the incremental voltage across the diode to the incremental current through the diode) will change as the dc current through the diode is varied. If this dc current is large, the diode resistance will be very small and the full capacity C is connected across the oscillator tank, lowering its frequency a maximum amount. If the dc current is reduced by increasing R, the diode resistance is increased and a smaller amount of capacitance is effectively across the tuned circuit and the frequency shift is less.

You may notice one difficulty with the circuit shown. If the key represents the keyboard, then the low frequency would be for the keyboard contacts closed (MARK condition). However, we want the SPACE to be the low frequency. Also, when the key is open, the leads from the diode to the keyboard are "floating" and might cause trouble with hum pickup. To solve these problems, a circuit shown in simplified form in **Fig. 2** is used. In this circuit, the key when closed cuts off the diode current by bypassing it to ground. A second diode in series will become reverse biased due to a charge built up on $C_2$ which completely isolates the external keying circuit from the oscillator. If shielded leads are used from the diodes to the external keyboard, etc., little trouble with hum or noise pickup should be encountered. When the key is open, forward dc current can flow through both diodes as before, producing the desired low space frequency.

## Practical FSK circuits

The FSK circuits shown above are quite simple but there are a few practical problems which need to be considered. The first problem involves the choice of diodes. Vacuum tube diodes are very well suited and are stable and reliable. The 6AL5 and 12AL5 miniature types are commonly used although the 6H6 and 12H6 are often used in surplus VFO's such as the ARC 5 series. Of course, heater power must be supplied to these diodes. Many of the point-contact germanium diodes work very well if simple precautions are taken. One of the best types is the 1N100 (or 1N99) which has a very high back resistance and is very small. However, the more common 1N69, 1N34A, and similar types will do a very good job. Junction diodes, such as silicon power rectifiers are not too satisfactory due to their high junction capacitance when reverse biased.

The second problem is that of eliminating "key clicks" which can produce excessive interference just as in CW. The problem is easily solved by using a simple RC network to soften or slow the transition from MARK to SPACE.

A simple circuit which fulfills these requirements and is easily built is shown in **Fig. 3**. It can be added to almost any VFO and provides smooth, stable frequency shift. In this circuit, the normally-closed keyboard removes the voltage from the diodes and the capacitance C is effectively disconnected from the oscillator. Note that this capacitor which produces the desired frequency shift is connected to the VFO cathode, since this is a relatively low impedance point. Most modern oscillator circuits have their cathodes above ground for RF. If

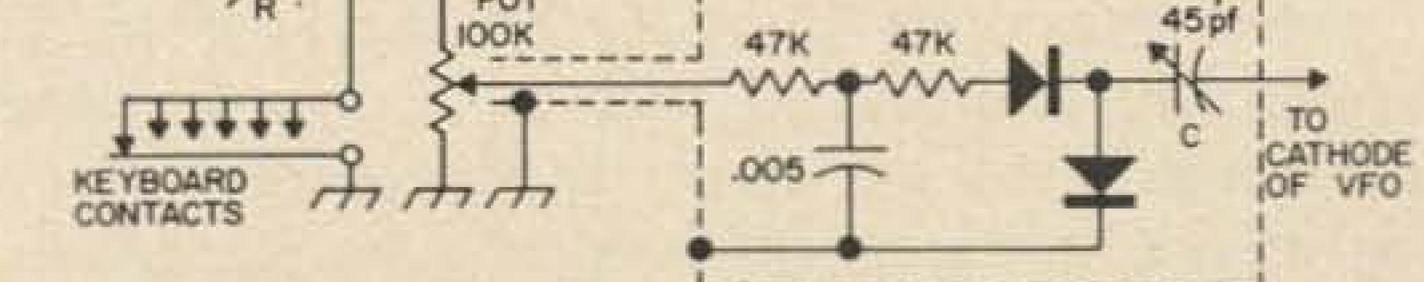


Fig. 3. Simple, practical FSK circuit.

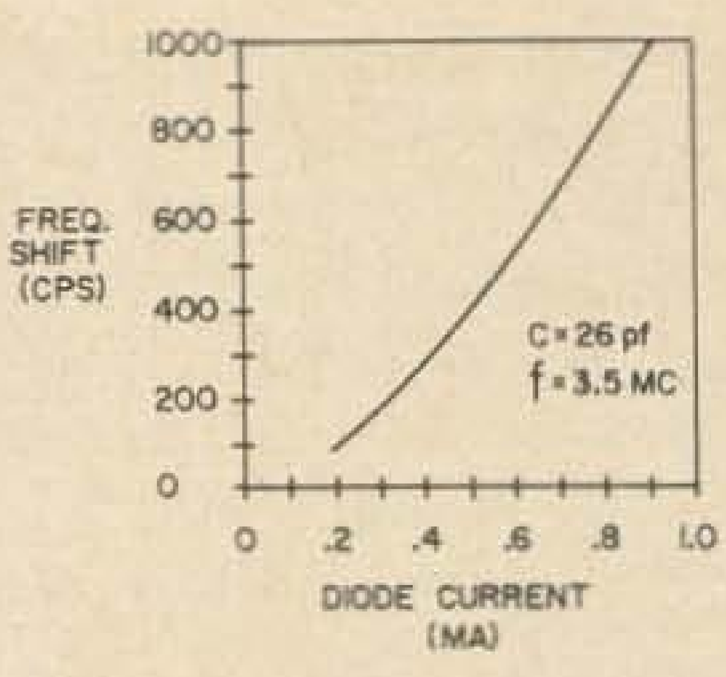


Fig. 4. Typical variation in shift with diode circuit.

this isn't the case in your VFO, you can tap the VFO coil a few turns from the ground end. When the keyboard is opened, the diodes conduct partially due to the forward diode current which flows. This causes a portion of the capacity C to appear in the VFO circuit, lowering the oscillator frequency for the space signal. The 47k resistor and .005 μf capacitor act as the key-click filter since the RC charge time causes a gradual frequency shift (about 1 ms) rather than an abrupt shift. Similarly, when the keyboard closes, the gradual discharge of the RC circuit softens the shift back to MARK.

The part of the circuit shown in dotted lines should be mounted as close to the VFO tube as possible. Many VFOs will have room to mount a tie-point strip with the components shown right in their shield cans. To avoid a permanent modification of a VFO, the circuit can be built in a small shield box mounted near the VFO and the connection to the tube cathode made by wrapping a small piece of solid hook-up wire around the cathode pin. The shift adjustment pot may be mounted externally from the transmitter if desired. It can be on the RTTY converter panel or near the keyboard. A shielded lead to the pot is recommended to prevent noise and hum pickup.

The value of the dropping resistor R will depend on the value of the regulated voltage you have available. This circuit draws only a milliampere or so from this voltage source so this can usually be obtained from a VR tube already in the transmitter or the RTTY converter, or one can be added to any convenient power supply. The following initial adjustment procedure is suggested. Choose R to provide about 50 volts at the top of the shift pot with the keyboard "open." Now with the pot wiper at the top, adjust trimmer (shift capacitance) C for slightly more than 850 cps shift on the lowest frequency band to be used. If insufficient shift is obtained with maximum C, either decrease R to get more diode conduction or parallel C with a small mica capacitor. When proper shift is obtained on the lowest frequency band, the shift can be reduced by use of the shift adjust pot for higher frequency bands where the oscillator frequency is multiplied. To illustrate the effect of varying the diode current with the pot, **Fig. 4** shows the frequency shift vs. diode current for a Heathkit VFO using this circuit with 1N69 diodes at 3600 kc.

## Shifting crystal oscillators

Many crystals can be successfully shifted 850 cps using diode shifters. However, some will quit oscillating before sufficient shift can be obtained. The circuit shown for VFO's can be used with slight changes. The shift capacitor C is connected to the oscillator grid and the shift pot is eliminated. Sufficient current is bled through the diodes to cause them to conduct completely instead of partially. Thus the diodes are acting as switches instead of variable resistors. The shift capacitor C is adjusted to obtain proper shift. Most existing crystal oscillators will be found to be unsatisfactory for shifting due to high fixed capacity across the crystal circuit. It is better to build a new oscillator taking great care to keep stray capacity down, such as using very short leads in grid circuit, etc. A high gm tube such as a 6AK5 is the best choice. The disadvantage of the crystal-FSK circuit is that usually there is no margin for zeroing-in on a net frequency since all possible "pulling" needs to be utilized for shifting. It is possible to adapt the VO circuit that is popular for mobile SSB rigs to provide a tunable crystal-FSK circuit.

## Obtaining local copy

When transmitting FSK with the circuit of **Fig. 3**, the keyboard operates only the FSK circuit and does not print "local copy." To monitor what you are transmitting, it is necessary to tune your receiver exactly to your transmitter and to allow the RTTY converter to operate the printer. The receiver gain must

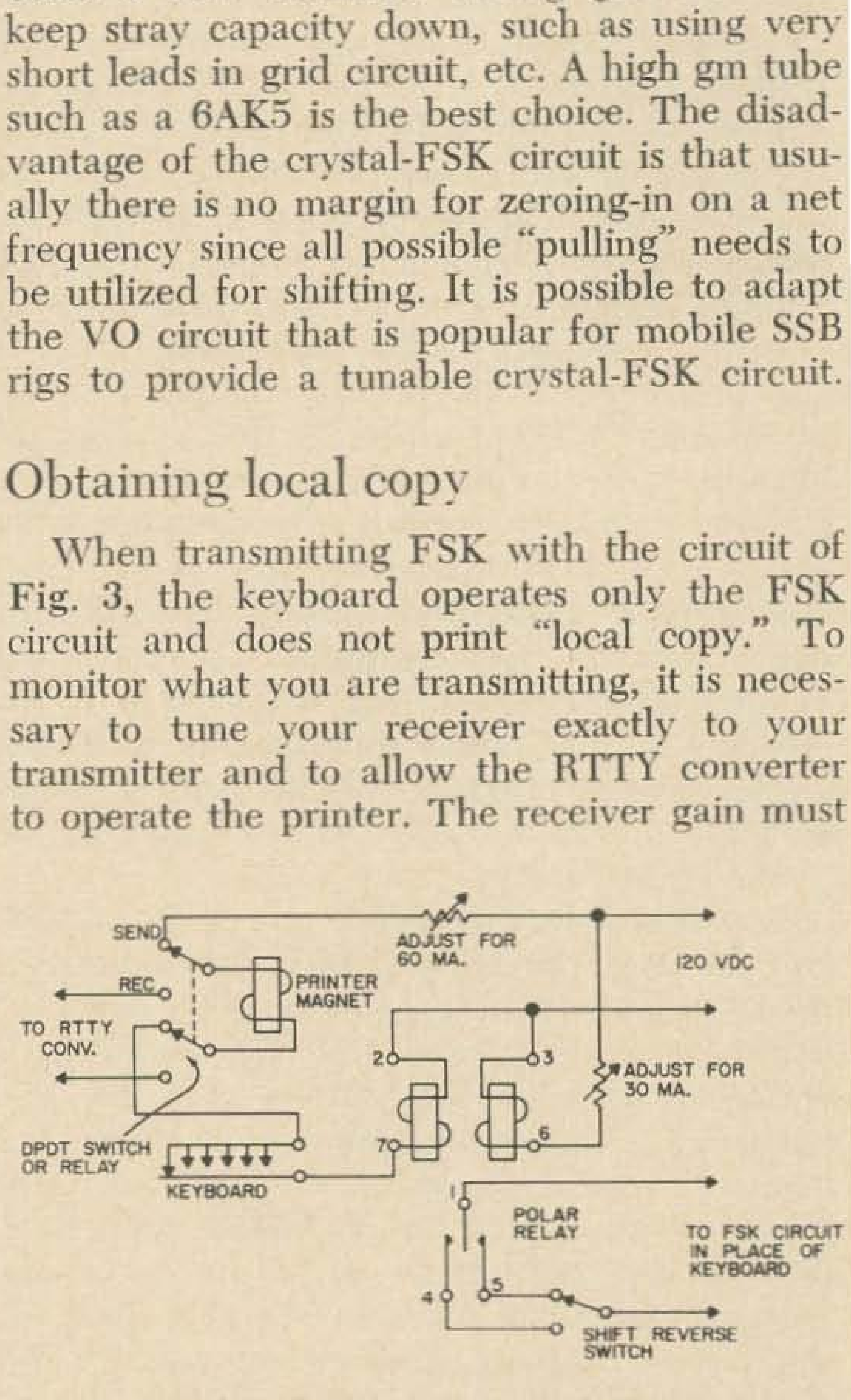


Fig. 5. Recommended keying circuit to obtain local loop copy.

be reduced to prevent overload. While this method allows continuous monitoring of the transmitted signals, there are some drawbacks. Beside the obvious difficulties in switching receiver gain and returning in case the other station is not right on your frequency, there is a problem in keeping the keyboard contacts clean. These contacts are subject to collection of an oil film along with dust and dirt. In the FSK circuit, they break only about 1 ma of current. This is not sufficient to keep this film "burnt off" as is the case when the 60 ma magnet current is being interrupted. Also, all spark-suppression filters must be removed from the keyboard circuit when driving the FSK direct or these will cause bias distortion. Then these filters are not available for local loop operation.

A method which gets rid of these problems is to operate the keyboard and printer in series in a local 60 ma loop along with a polar relay. The relay contacts then repeat the keyboard pulses to the FSK circuit and the printer provides direct local copy. A polar relay is used rather than an ordinary single-coil relay which would cause pulse distortion due to its different pull-in and release currents. The circuit shown in **Fig. 5** is a simple way of using this method.

A DPDT send-receive switch (or relay operated from transmitter S-R relay) changes the printer magnets from the converter for receiving to the local loop for transmitting. With some converters, the polar relay and keyboard can be permanently connected into the printer loop and the keyer tube circuit can supply local loop current for transmitting by means of a "hold" switch or relay. In mounting a polar relay, be certain to mount either vertically, or if horizontally, so that the relay armature moves in a horizontal plane.

The relay contacts are enclosed and free from dust and dirt. Clean frequency shift keying is easy to obtain. Another advantage of this method is that it allows the shift to be easily reversed by means of an SPDT switch. This feature is needed for some transmitters using heterodyne VFO's where the upper beat frequency is used on some bands and the lower beat on other bands.

## Summary

Adapting a transmitter to FSK is one of the simplest and easiest jobs in getting on the air with RTTY. If you see the principles involved, the construction and adjustment of the FSK circuit should prove very straightforward.

. . . W4EHU

E. R. Lamprecht W5NPD
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Victoria, Texas

***Build this simple adapter for low-cost panoramic display of the VHF and UHF bands.***

# Panoramic Reception for VHF-UHF

The serious VHF-UHF operator is interested in what's going on over a relatively large frequency spectrum. A panoramic receiver of some type can be a great help.

Usually the adapter scans the *if* of the receiver and displays what is present in the *if* passband on the face of a cathode ray tube. As the receiver is tuned in this case, the display moves, with the signal heard in the speaker being displayed in the center of the CRT. However, the range of frequencies seen on the screen at any one time is about 100 kc or less due to the selectivity of the receiver *if* system and/or the front end selectivity. If the receiver is left tuned to one spot on the VHF band, only 50 kc each side of that point is visible on the CRT. That's not much range compared to the limits of any VHF or UHF band.

There are other methods of obtaining panoramic displays and the following is a description of a usable unit. This simple gadget will allow a standard oscilloscope to be used as the screen. In addition it will allow a much larger portion of the band to be observed at one time, in fact *all* of the band in some cases. The amount of band viewed is variable and one "pip" or signal can be centered and "blown up" to check modulation and to be heard in the receiver speaker. In this case the spectrum viewed is just the band width of the receiver.

A dual triode is connected as a sawtooth or sweep generator just like the one in an oscilloscope. The output of this is fed thru a level control to the horizontal input of a regular oscilloscope. This control varies the width of the display and doesn't affect the frequency range. This same sawtooth waveform is also fed thru another level control to a voltage variable capacitor or varicap, diode. This diode is in the frequency determining circuit of a triode rf oscillator. This local oscillator is set up on the same frequency as the oscillator in the receiver or converter used. When the sawtooth voltage gets to the varicap, the oscillator changes frequency in step with the spot going across the scope tube face. Meanwhile the vertical circuit in the scope is looking at the receiver *if* output and when a signal appears it causes the spot to be deflected vertically. Thus, for each signal, a "pip" appears on the scope base line to indicate a signal, the frequency of this signal can be determined by its relative position from left to right. Since the sweep for the spot and the local oscillator are from the same source and "in step" the pips will remain stationary. The level control in the varicap circuit becomes the band width control.

*Ed is a self-employed communications equipment maintenance specialist and he also works on the family ranch. His main interest is VHF.*

The pip can be *if* voltage or this voltage can be detected by a diode. **Fig. 1** shows the two methods and their resultant displays. In the case of looking at the *if* directly, the vertical

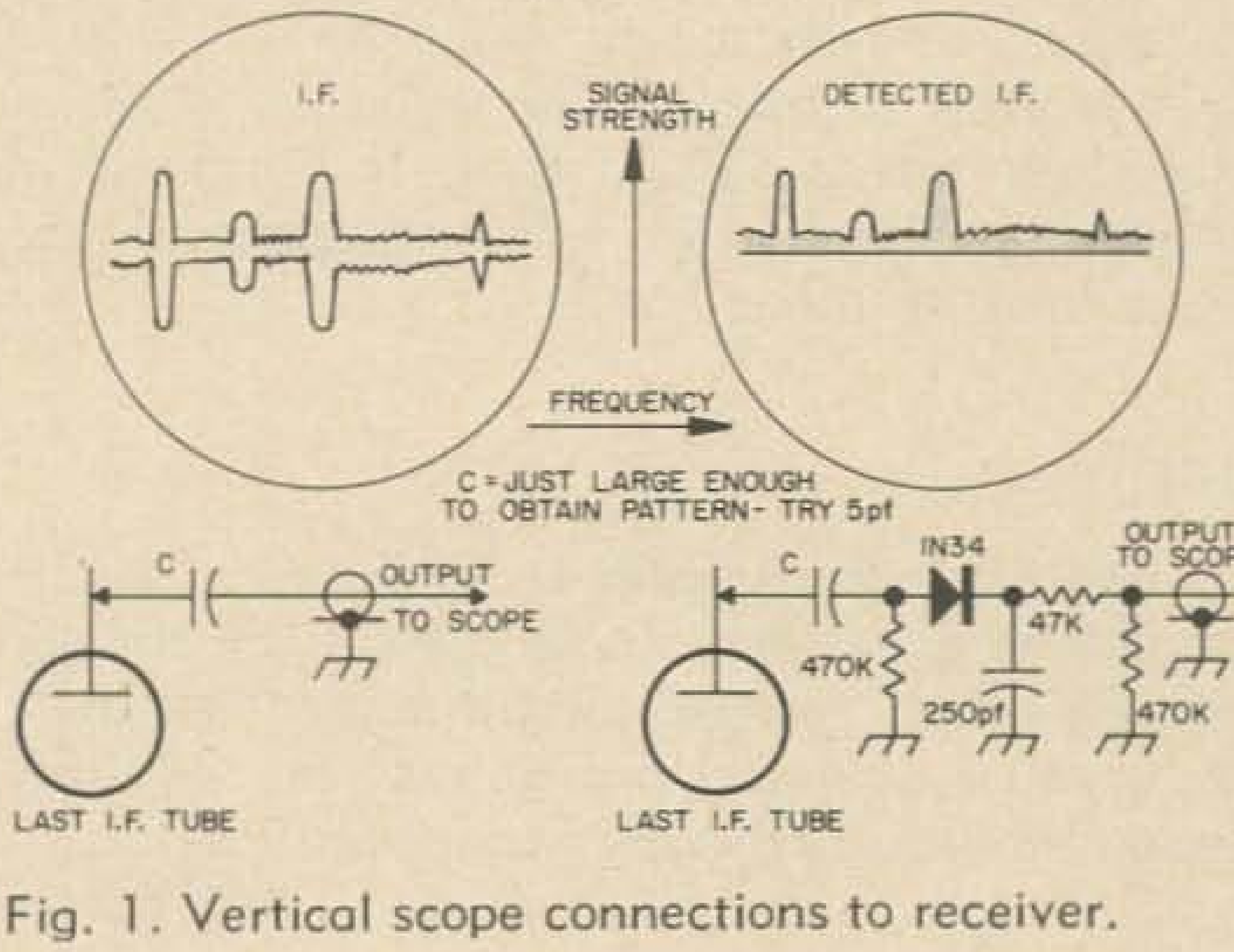


Fig. 1. Vertical scope connections to receiver.

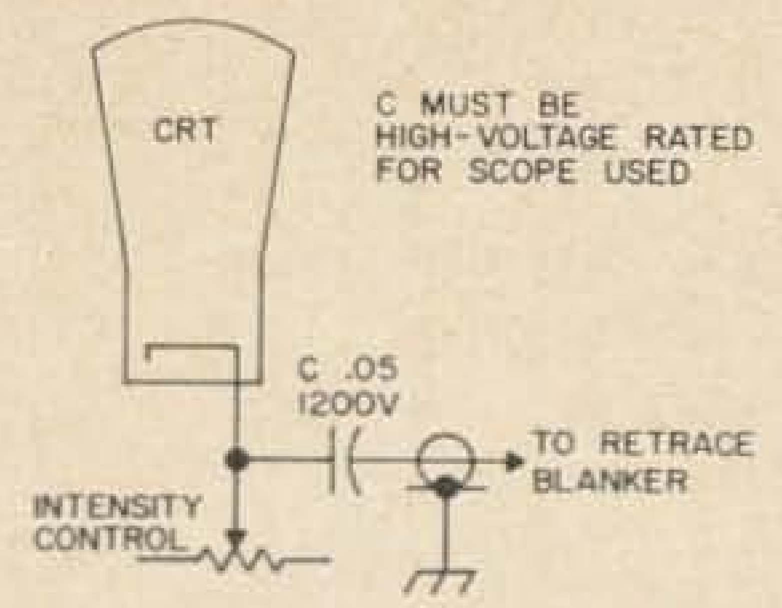

Fig. 2. Retrace blanking (optional).

amplifiers in the scope have to be capable of handling the *if* frequency. Many scopes will show up to 5 megacycles.

When the spot on the scope finishes its relatively slow trip from left to right across the screen, it has to come back to the starting place. Due to the rapid fall off of the sawtooth voltage from its peak value, this journey is made in much less time. The result is a dim line across the scope from right to left. Signals present in the vertical circuits at this time will be seen as dim "ghost" images, greatly widened because of the speed of the retrace. If the electron beam in the CRT can be cut off during this period, this retrace can be eliminated. If this is desired, a triode grounded grid circuit is included to feed a pulse from the cathode of the sawtooth oscillator to the CRT cathode in such a way as to bias it to cutoff at the right time. If the scope has a "Z" axis input connection this probably could be used. In the RCA WO33A used at this QTH a coupling capacitor was added in the scope from the cathode of the CRT to a phono socket on the front panel. The retrace blanking pulse is fed in here and puts a positive pulse on the CRT cathode at the right time to cut off the spot. This cathode has about 650 volts negative and the plate of the blanker a couple hundred positive, so better use a good pair of .1 µf at 600 volts in series or something better for the coupling capacitor.

The other half of the blanker is used as a buffer for the oscillator to isolate it from the receiver circuits. This also makes it possible to "swamp" the output of the adapter to keep from overdriving the receiver circuits.

Of course you will use small coax or shielded cable for all interconnections between scope, receiver and adapter. Parts layout is not critical, but keep lead lengths down and mount the RF parts solidly so calibration will hold.

The RF oscillator in the unit can be almost any type as long as it is capable of covering the desired frequency range. Extreme stability is not needed as a small frequency shift will not be noticeable if a large portion of the band is being scanned. With a given circuit, a high ratio of inductance to capacitance will

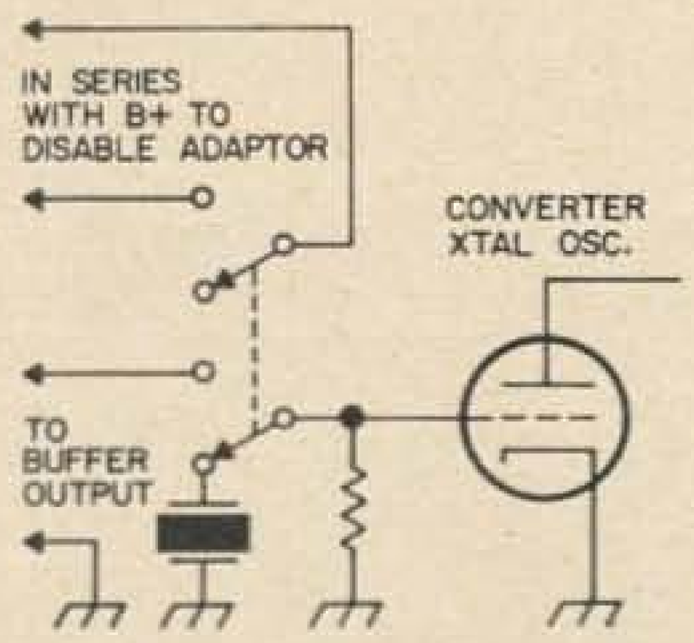

Fig. 3. Panadapter switching.

give the most frequency change with a given capacity change. A limit to this is reached when the "Q" of the circuit becomes too low to allow oscillation. Some types of diodes will have a lower "Q" and may be the limiting factor on the frequency range covered.

In the circuit shown, a regular power rectifier diode (silicon) is used as the varicap. One with a 400 to 750 volt peak inverse rating is adequate. Individual units will have somewhat different characteristics as to "Q", dc bias needed for a given capacity and capacity range available. Almost any will work but try a few if available and see if one of them might be better than the rest.

A regular varicap or varactor may be used but be careful not to exceed the piv rating. The circuit shown will exceed these ratings and should be modified at the "X" points in the high side of the diode bias control and the band width control. A suitable resistor may be inserted at these points to limit the voltage the controls may place across the diode. These resistors may run to several megohms. Leave out the diode until you have installed the resistors by trial and then run the controls all the way up and measure the dc bias with a VTVM and the sweep with your scope and be sure it isn't too much for the varactor you choose. This is not a problem with the power diodes used in the circuit as shown. More frequency range may be obtained with the varactors but other problems appear. The RF voltage at the grid can override the small bias used. A 100 pf at 4 volt diode tapped down on the coil between cathode and ground thru a 250 pf condensor with dc bias of about 4 volts (using 10 meg resistors in the "X" positions) will cover all of 2 meters

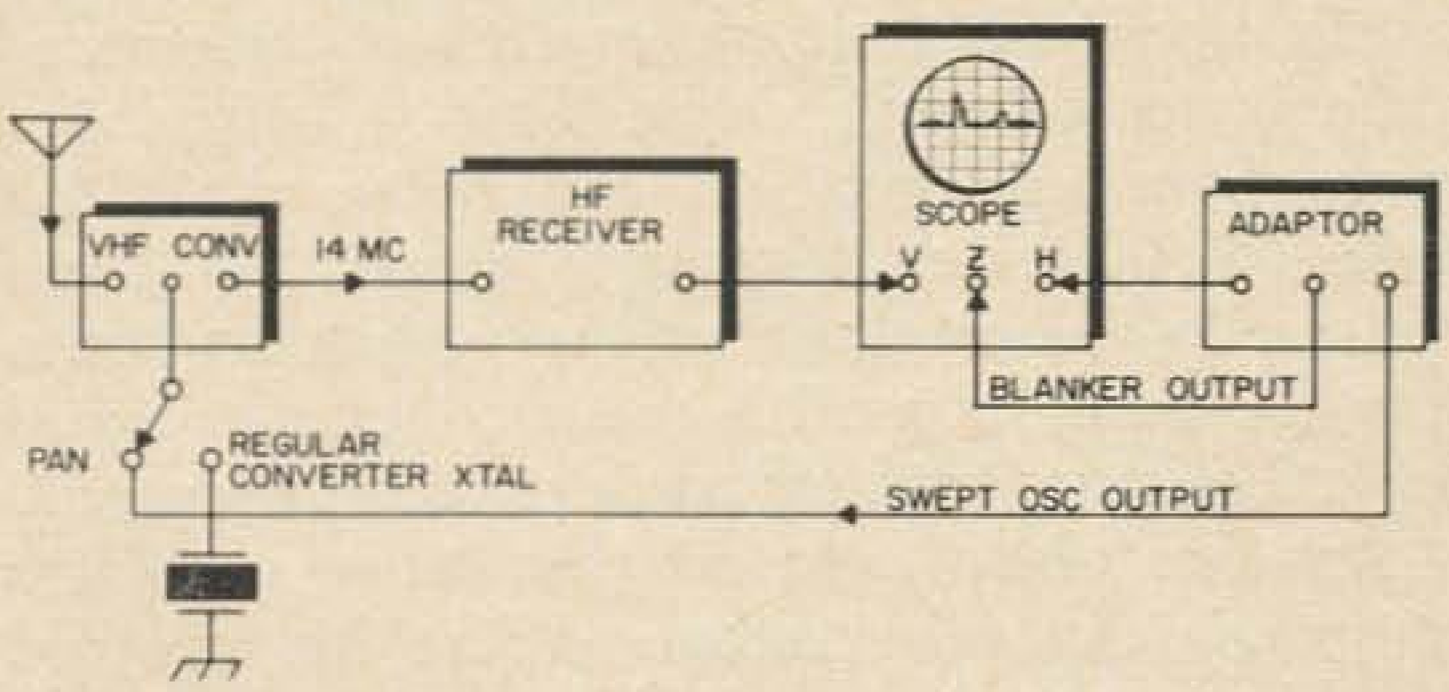

Fig. 4. Interconnection block diagram.

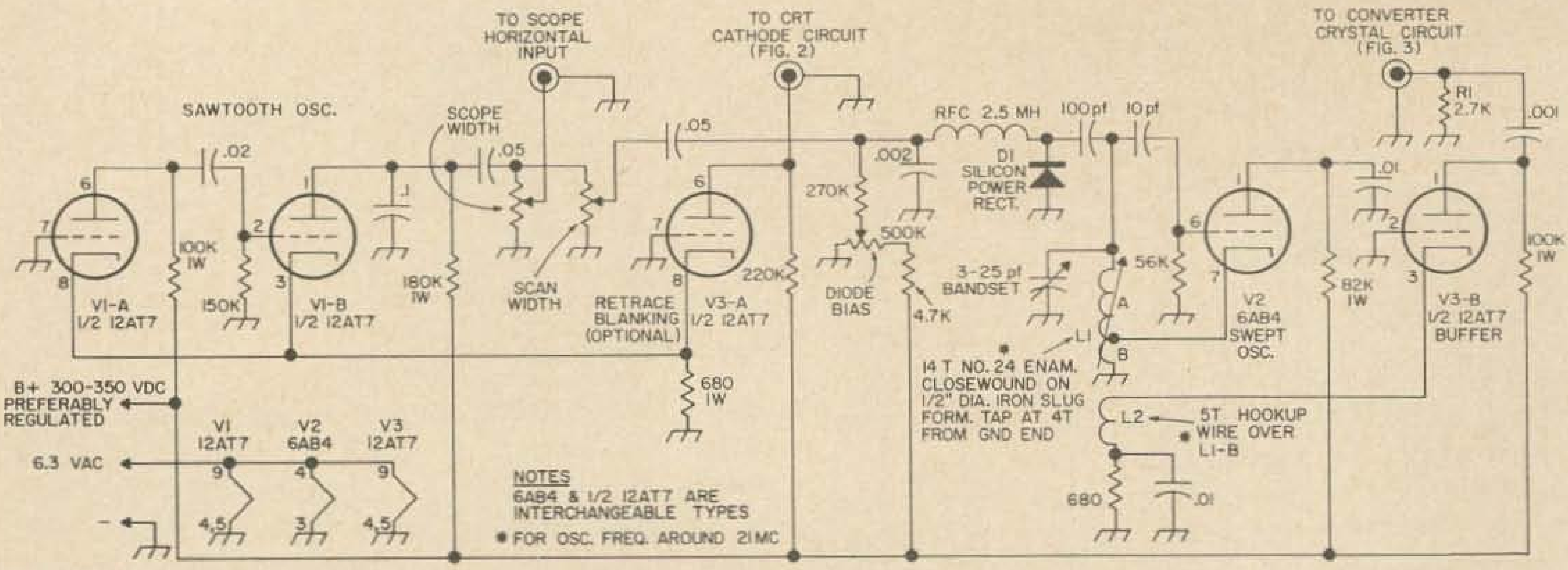


Fig. 5. Panadapter circuit.

easily when used as shown with a 2 meter convertor to a 14 mc receiver. As more band is covered it becomes more likely to get a spurious pip somewhere along the base line. Actually the power diodes are easier to work with in tube circuits and give plenty of frequency range. The low voltage high capacity diodes are ideal for use in transistor circuits. Those of you who believe the little rascals are here to stay could convert the circuit to a transistor operation.

The frequency range of the oscillator will depend on the receiver or convertor it is to be used with. The injection may be made into the crystal socket of most converters and in this case it may be one half of the crystal operating frequency. An example is the much used 2 meter converter working into a 14 to 18 mc receiver. The crystal in these converters is usually marked 43.33 mc. The output of the crystal oscillator is tripled to 130 mc and the result of mixing this with 144 to 148 mc is the 14 to 18 mc you feed into your receiver. So if a sweep frequency of 21.66 to 22.33 mc is put in where the crystal was the result is a 144 to 148 mc sweep which comes out on 14 mc. Tune your receiver to 14 mc, connect up the scope and adapter and you will be looking at 144 to 148 on the CRT screen. Of course in this case you are getting 6 times multiplication of the sweep range by the multiplier chain in the converter. Resistor R1 across the output of the buffer is to keep the crystal oscillator from generating spurious frequencies due to overdrive. This resistor looks pretty low but even less can be used. If too much oscillator voltage gets across the large resistor in the crystal oscillator grid circuit the tube becomes a good harmonic generator and lots of strong "birdies" appear on the screen.

Another place to insert the sweep oscillator output is the mixer stage in the hf receiver. In this case not so much range is available because of the front end selectivity of the receiver. However from 14 to 14.5 can be covered with most receivers. This would give you 500 kc of any VHF band depending on which converter you switched to. Also coverage of twenty meters which is rumored to be still in operation.

In any case the unit should be arranged so it can be switched in and the regular tuning oscillator or crystal out and vice versa, with just the flick of one switch. The oscillator should be disabled when normal tuning is used to keep down any odd birdies that might appear.

A few things to keep in mind when building the unit to use with a particular receiving setup: The more range you cover, the less distance between pips and the less you can tell of their nature. If you put a fairly good dial on the bandset variable condensor in the oscillator you can center a pip and keep it centered while you reduce the sweep to zero and look at that signal alone and hear it in the speaker. On a dead VHF or UHF band a signal coming on will cause a low frequency note in the receiver speaker. Vary avc, bfo and volume settings for best results. If different selectivities are available on the receiver see which works best. If noise pulses from a 60 cycle source stand still on the screen, change the .1 μf condenser or the 180 k resistor in the sawtooth oscillator slightly so it will not sync with the noise. This will make it easier to distinguish between signals and power line noise. Turn the rf gain down so that noise is just visible on the base line. You can spot check with your own transmitter or exciter to determine the frequency range covered. Be sure and compare your ability to detect weak signals with the scope to results you get by listening to the speaker and manual tuning with the bfo on.

. . . W5NPD

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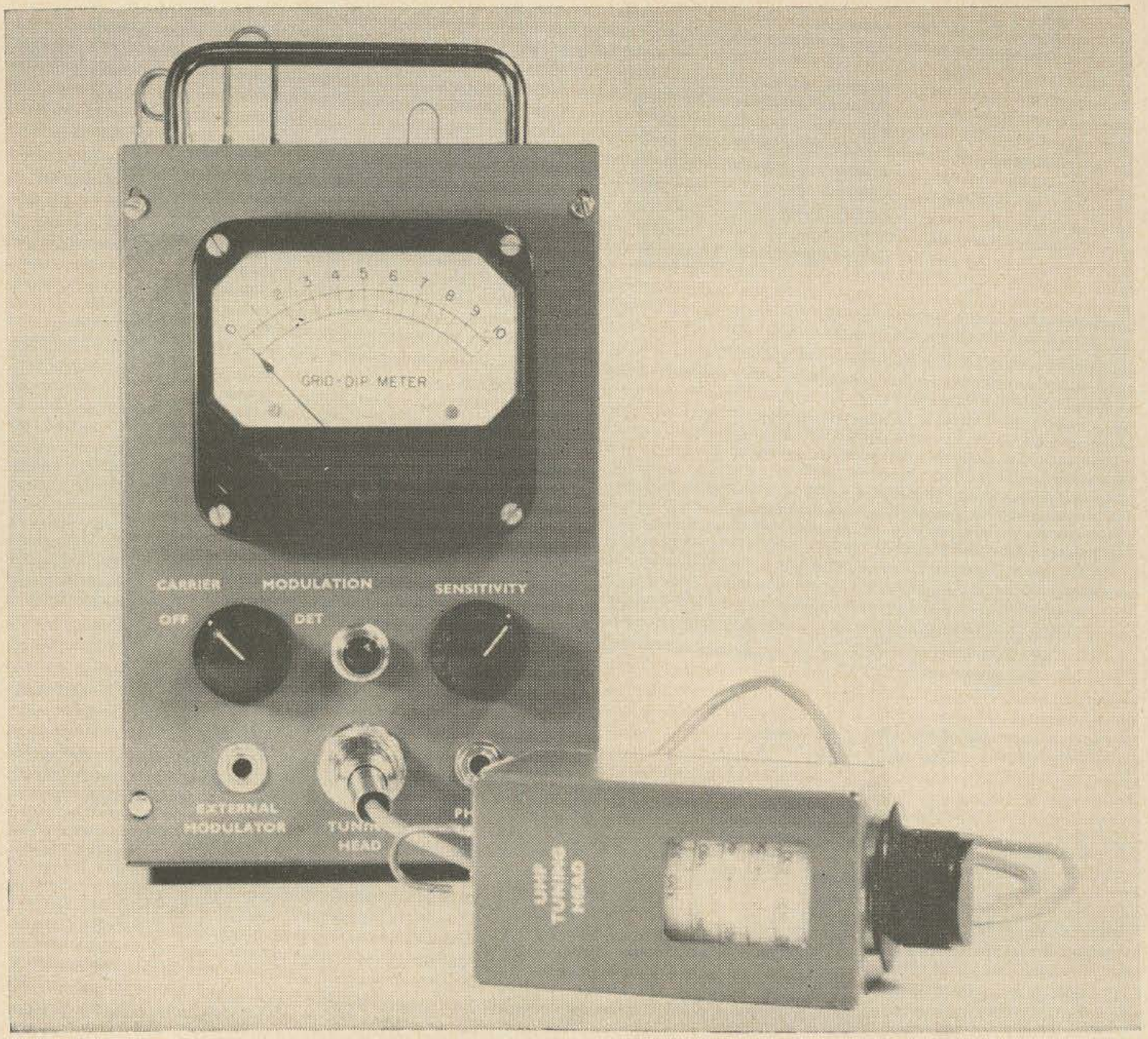



Jim Fisk WA6BSO
1560 Glencrest Court
San Jose, California
Photos by Jim Harvey WA6IAK

# UHF Grid Dipper

***In answer to your pleas for complete plans for a good UHF grid dipper, WA6BSO has written his up. It covers 300-680 mc and you can even use a precalibrated dial if you follow his instructions carefully.***

When building or testing equipment for the 420 mc band, amateurs invariably run into the problem of, "Where am I?". It becomes a little difficult to tell whether you are actually in the band or somewhere nearby. The uninitiated will counter that you should be able to figure close enough, after all the band is 30 mc wide; but even the experienced old timer will confirm that this just isn't so.

The 420-450 mc amateur band falls between the VHF and UHF television assignments and there is very little to use for a frequency reference point. It is nearly impossible to tell exactly where you are without resorting to expensive commercial gear or lecher wires. Nor is the problem confined to the ¾ meter band; when building crystal controlled converters for 432 or 1296, it's nice to know that the last tripler is really tripling and not doubling or quadrupling. Even with a 45 or 50 mc crystal, it's quite easy to tune up on the wrong harmonic. Remember that a 40 mc change at 400 mc is analogous to a 400 kc change on 75 meters.

There are several commercial instruments that fill this requirement nicely, but the cost of the least expensive of these would buy a pretty respectable all band receiver. Occasionally suitable test equipment appears on the surplus market, but again, the price is prohibitive. The simple UHF grid-dipper described in this article was designed specifically to economically fill this need. It covers the frequencies from 300 to 680 mc at a total cost that is comparable to a low-frequency kit-type grid-dipper. By using junk-box parts and smart horsetradesmanship this cost may be substantially reduced. I should hasten to point out that substitution of parts in the tuning head should be avoided if accurate dial calibration is desired.

This particular grid-dipper has been duplicated several times and in each case calibration has been within several percent of the original unit; at least as accurate as the familiar kit-type grid-dipper. This is helpful to the ham who does not have access to commercial equipment for calibration purposes. By using the layout and parts described in this article, the precalibrated dial illustrated in **Fig. 8** may be used with a minimum of error.

Although an accessory power supply, modulator and indicator are included in this design, an enterprising ham could use the power supply and meter presently available in any lower frequency tube type grid-dipper. Although us-

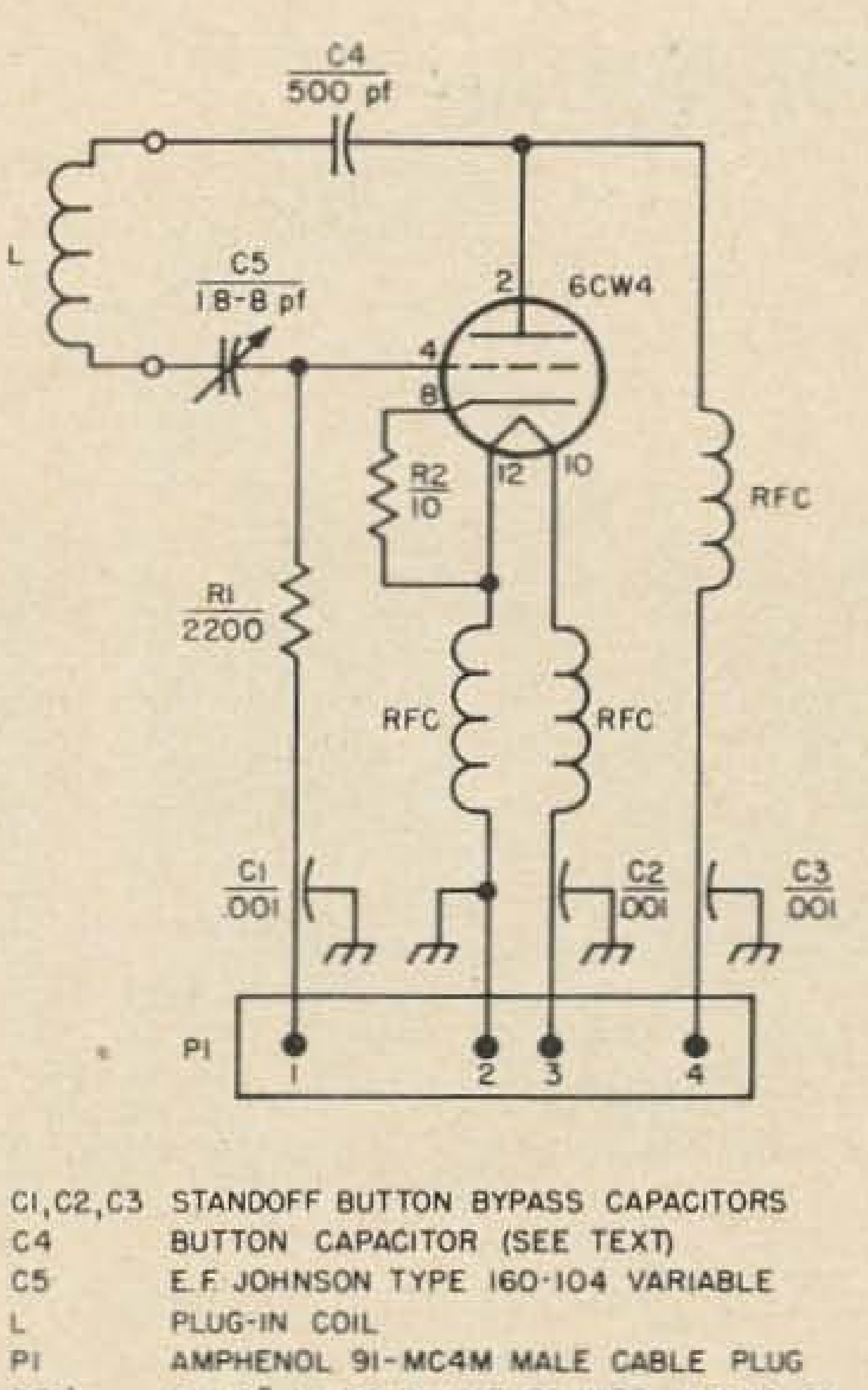



Fig. 1. Schematic of the rf head of the UHF grid dipper.

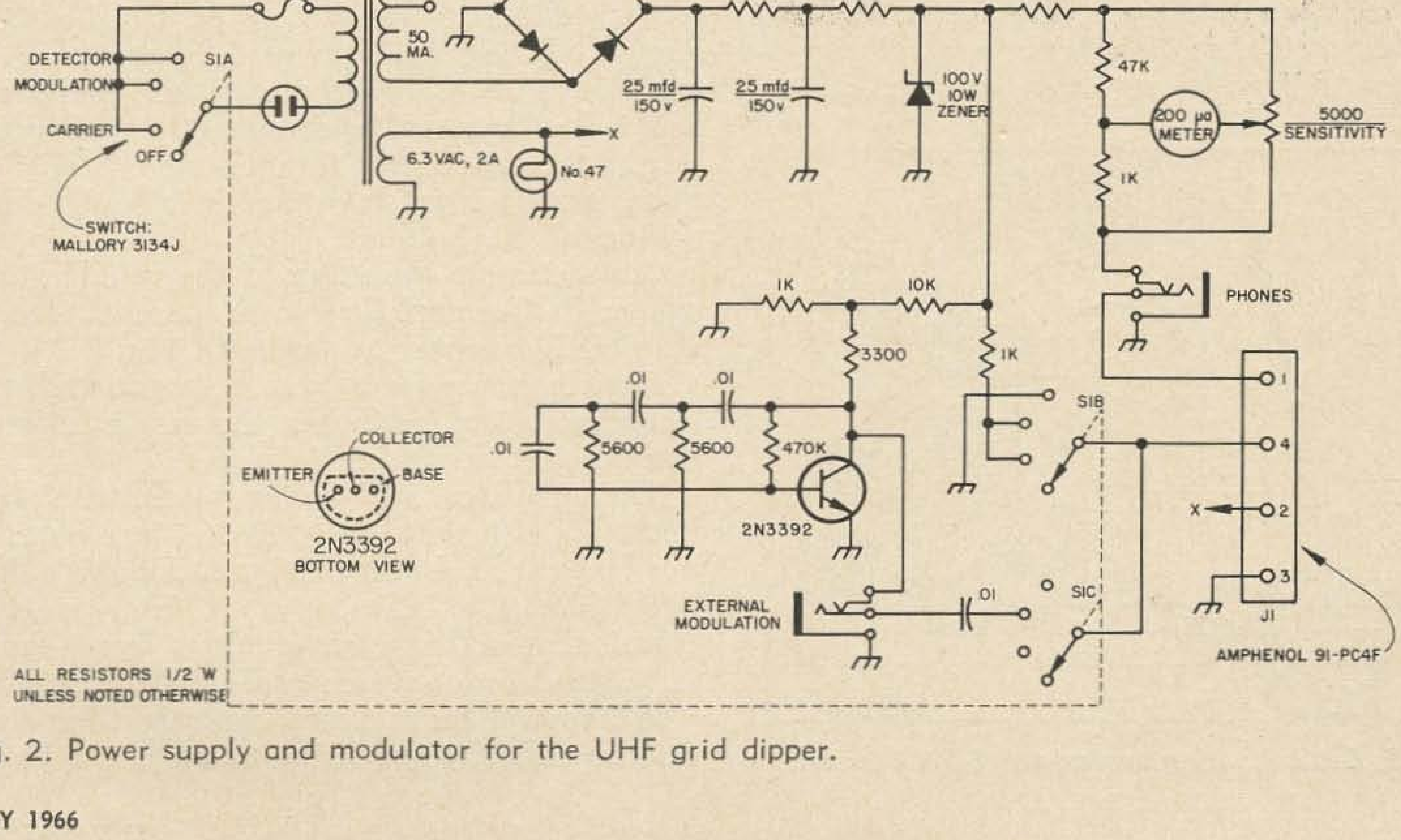
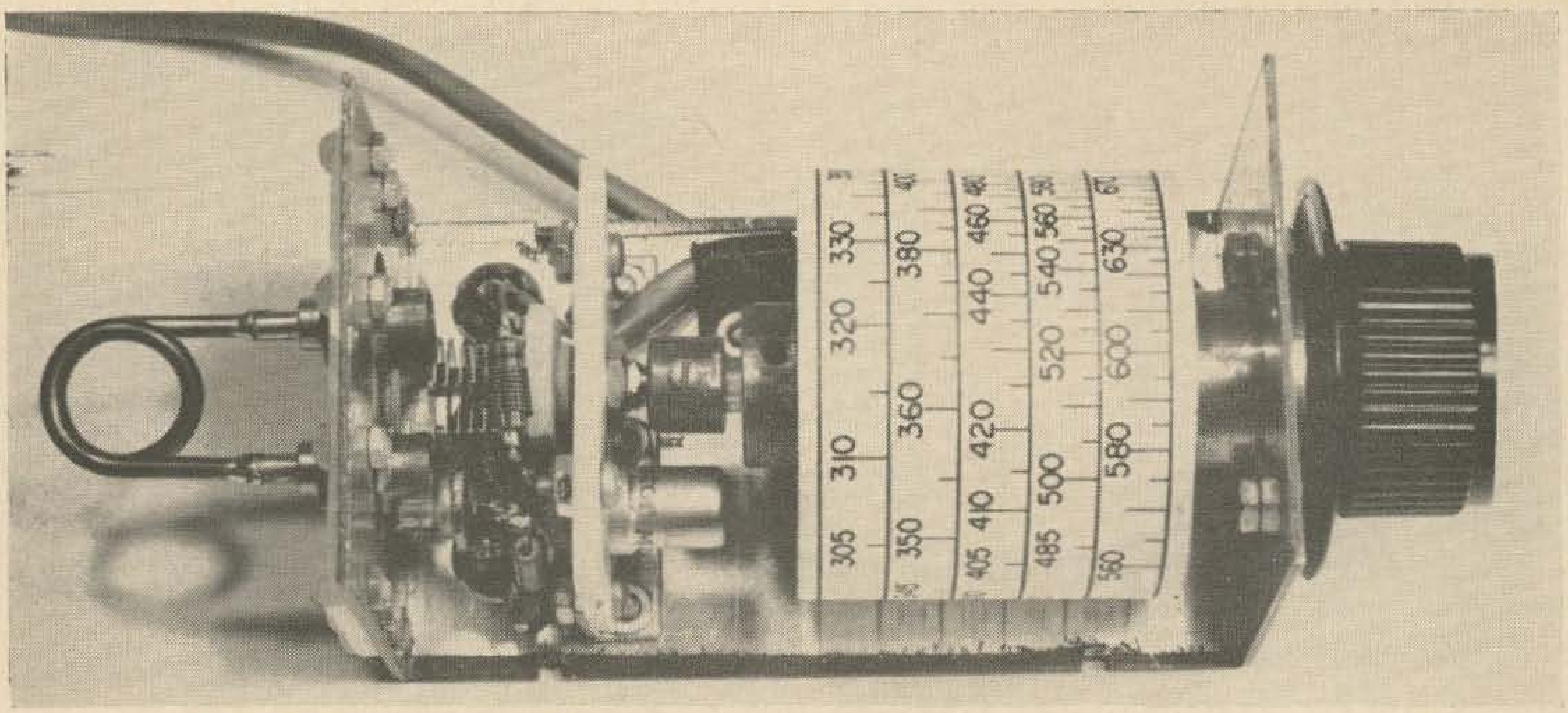



Fig. 2. Power supply and modulator for the UHF grid dipper.



ing a modified low-frequency dipper is simple and inexpensive, the power/indicator box specifically designed for the UHF tuning head has several features that are not available in inexpensive kit-type units. These include internal 1,000 cycle modulation, provision for external modulation, and voltage regulation which provides the necessary stability at the ultra high frequencies.

## The rf tuning head

The heart of this instrument lies in the tuning head itself. There is nothing particularly new or different about the circuit, but at these frequencies stray inductance and capacitance in circuit layout and construction will seriously affect the end result. All the lead lengths must be as short as humanly possible and physical circuit layout must follow standard UHF practice. One of the big problems in building tunable oscillators at UHF is to obtain an oscillator that will tune from one end of the range to the other with no "holes," frequency jumping or instability. The series tuned 6CW4 nuvistor oscillator shown in **Fig. 1** fills these requirements.

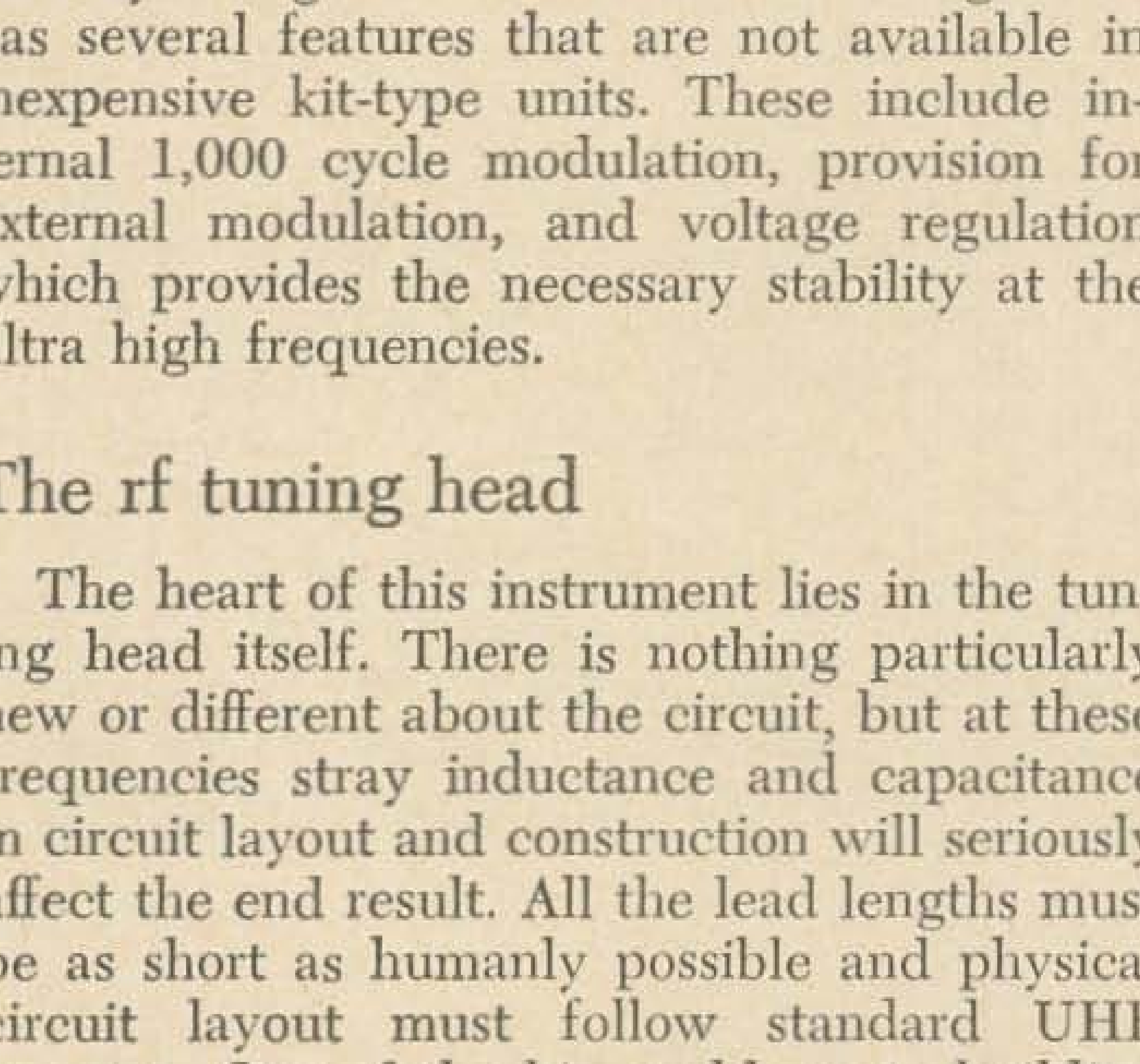



**Fig. 3. Critical wiring around the 6CW4 socket.**

Insofar as possible, all the tuning head wiring is done on a point-to-point basis with the components mounted directly to the 6CW4 tube socket or button capacitor lugs as illustrated in **Fig. 3**. To obtain the desired accuracy with the precalibrated dial, this diagram should be followed as closely as possible.

To keep stray circuit inductance to a minimum, all wiring between the coil and tube socket is done with one-quarter inch wide strips of thin copper sheet. In addition, the rotor of the variable capacitor is connected to the 6CW4 grid (pin 4) with a short strip of the same material. The only tricky part of this wiring is the installation of the series capacitor C4. This capacitor is a 500 picofarad button type mounted as shown in **Fig. 5**. The "S" shaped bracket ("A") is made from a one-quarter inch wide copper strip, one and one half inches long and soldered to the mounting stud of the capacitor. Connection to the 6CW4 plate (pin 2) is made with the soldering lug on top of the button.

Connection to the stator of the variable capacitor is accomplished with another short strip of thin copper as shown in **Fig. 5** ("B"). This piece of copper is bent so it touches both stator mounting pins when the unit is assembled; then it is soldered in place.

The oscillator and tuning mechanism are housed in a standard 2¼ × 2¼ × 4 inch chassis box laid out as shown in **Fig. 4**. Although the author's unit is based on an LMB type 107 chassis box, other manufacturers have similarly sized boxes which are equally suitable. The layout of the enclosure is straight-forward and no difficulty should be found in duplicat-

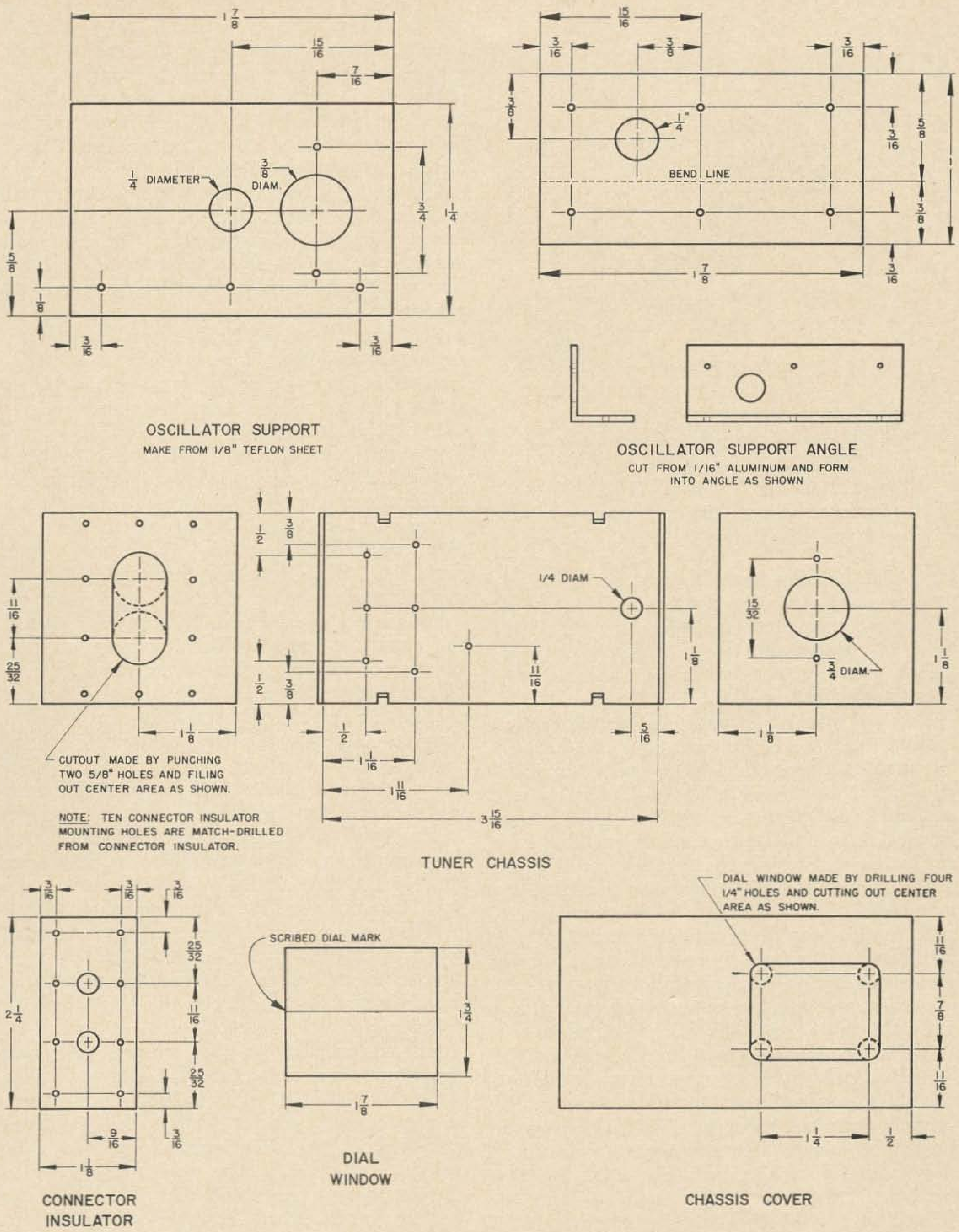
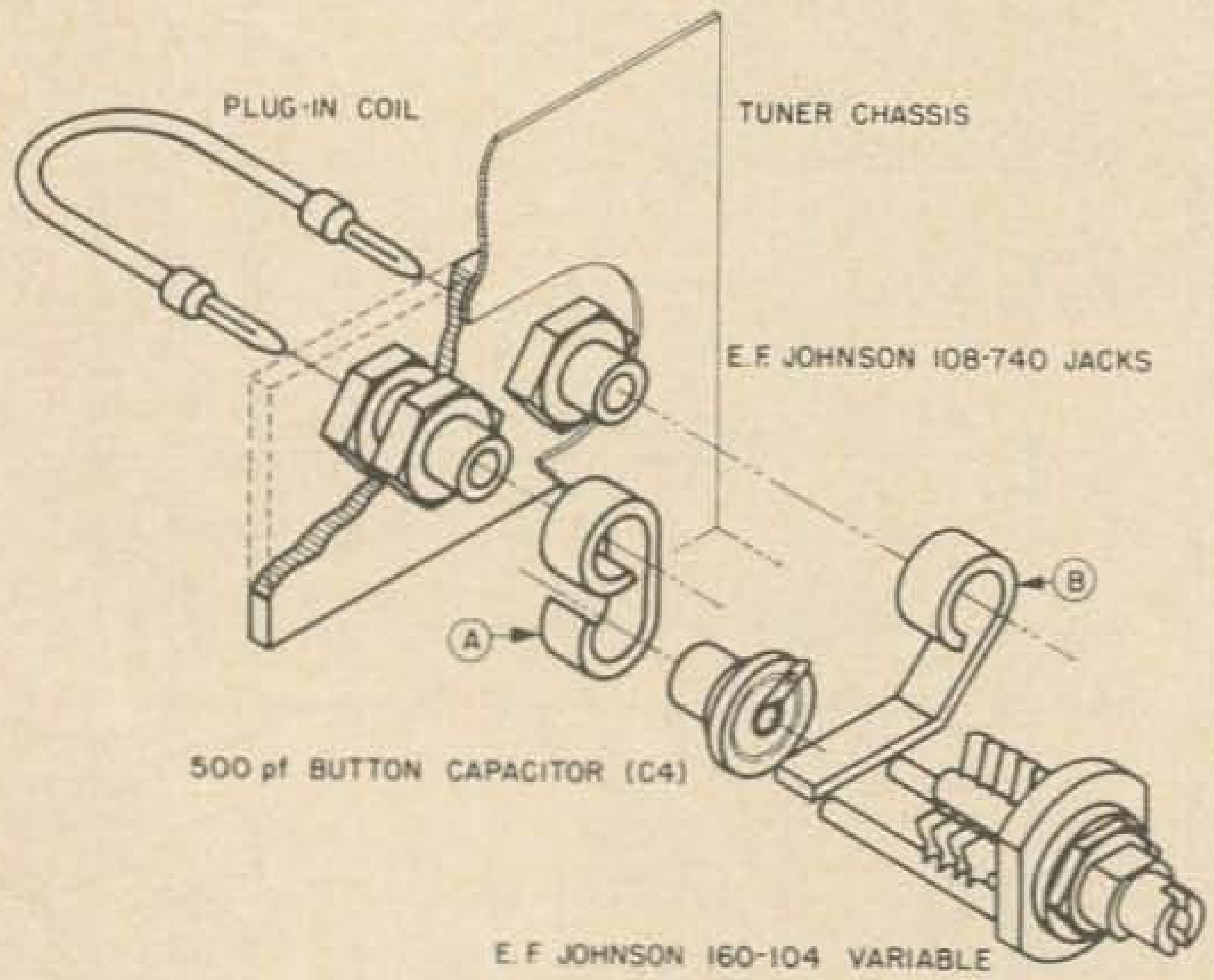



Fig. 4. Layout of the tuner chassis, chassis cover, dial, connector insulator, oscillator support and oscillator support angle.

ing it. The dial and coil socket cutouts are made by drilling or punching round holes and then cutting out the area between them as shown in the drawing. This is easily done with an Adel "nibbling" tool. All of the small screw holes are drilled with a standard ⅛ inch drill to pass 4-40 screws; 5/32 inch holes will be required if 6-32 screws are used.

The dial window is cut from a sheet of 1/16 inch clear plastic to the dimensions shown in




BOTH THE BUTTON CAPACITOR AND VARIABLE CAPACITOR CONNECTING STRAPS (A AND B RESPECTIVELY) ARE MADE FROM 3/16" WIDE THIN COPPER STRIPS AND FORMED INTO SHAPE AS SHOWN. NOTE THAT THE STATOR SUPPORTING PINS ON THE VARIABLE CAPACITOR HAVE LENGTHENED SOMEWHAT FOR PURPOSES OF THIS ILLUSTRATION.

Fig. 5. Exploded view of the connections between the 6CW4 and the coil socket.

**Fig. 4.** A hairline is scribed in the center of this window; if a more distinct line is desired, this scribe mark may be filled in with black india ink. After the tuner enclosure is completed, this dial window is epoxied in place over the dial cutout.

The coil socket is made by installing two banana jacks (E. F. Johnson type 108-740) on 11/16 inch centers in the Teflon connector insulator illustrated in **Fig. 4** (if Teflon is not available, Polystyrene may be used). This "socket" is installed over the large oblong hole cut in the end of the chassis. The screw holes used for mounting the connector insulator are match-drilled to the holes in the insulator itself. In this way it is properly mated to the enclosure. Although nylon attaching screws were used in the original model, they are not necessary and regular metallic screws will not alter any of the oscillator's characteristics.

To reduce stray capacity to a minimum, the oscillator circuitry is mounted on an insulating sheet. Teflon was used for this purpose in the original unit, but epoxy board with the copper peeled off would be perfectly suitable. Sheet polystyrene is not too desirable in this location because of its susceptibility to heat. The envelope of the 6CW4 gets very hot and the ambient temperature within the confines of the small chassis is quite high.

The general layout of the Teflon oscillator support and associated support angle are also shown in **Fig. 4**. The angle is cut out from a piece of 1/16 inch aluminum sheet and bent in a vise to form the angle. When these two pieces are mated together, the metal angle will probably interfere with the lower nuvistor socket mounting screw. It must be drilled out using the hole in the oscillator support as a guide. This additional hole is not shown because its exact location will vary from unit to unit and depends upon the accuracy with which the parts are laid out.

The dial mechanism is not complicated, but it is hard to ascertain from the photographs exactly how it is put together. The exploded drawing of **Fig. 6** should help in this respect. The vernier mechanism is an Eddystone 10:1 planetary drive that provides both smooth action and repeatability in a small package. Although this unit is manufactured in England, it is available from many of the larger electronics parts houses in this country.[1]

Substitution of similar drives should be perfectly satisfactory as long as they don't extend more than one inch beyond the front panel of the tuner chasssis.

The vernier drive is connected to the variable capacitor through a ¼ inch polystyrene shaft 1-¼ inches long and the usual "¼ to ¼" shaft couplers. Polystyrene or some other insulator must be used here because the rotor of the capacitor must be isolated from ground. Because of the space limitations inside the enclosure, the coupler at the variable capacitor end of this shaft is only one-half of a standard coupler. A standard "¼ to ¼" coupler is sawed in two and one-half is epoxied to the end of the polystyrene shaft. Save the other half; it will be used for the dial drum hub.

The 8 pf variable capacitor was designed for screwdriver adjustment and its 3/16 inch shaft must be made compatible with the standard coupler. This is accomplished with a bushing made from sheet copper. A short piece of ¼ inch wide, 1/32 inch thick copper strap is formed around the capacitor shaft and takes up the slack between the shaft and the coupler.

The drum dial in the original unit was made from the metal top of a Johnson's Shoe Shine Kit (49¢ at the local grocer's), but any similar closed cylinder 1-15/16 inches in diameter and about 1-11/16 inches long should be suitable; other diameters will void the accuracy of the precalibrated dial. The "skirt" or bottom rim is cut off the metal can at the circumferential notch and a ¼ inch hole is drilled in the center of the top. The remaining half of the ¼ inch shaft coupler that was left over from the polystyrene shaft is then epoxied in place over the hole to provide a dial drum hub. Another hole is drilled in the side of the

[1]Arrow Electronics, 900 Rt. 110, Farmingdale, N.Y. $1.50.

can 1¹¹⁄₁₆ inches from the top; this provides access to the shaft coupler on the rear end of the vernier drive.

The precalibrated paper dial may now be cemented in place. It's a good idea to cement a piece of white paper the same size as the dial between the dial and the drum, otherwise the label on the can will show through the paper dial. Rubber cement is recommended at this point to prevent excessive wrinkling and distortion of the dial.

When all of the dial parts are completed, they are put together as shown in **Fig. 6**. It's a little crowded in the small box, but all of the parts *will* fit. However, in order to get all of the dial machinery into the box in the right order, a correct assembly sequence must be followed. First the polystyrene shaft and coupler are inserted into the dial drum from the rear. Next insert the Eddystone drive assembly through the hole in the front panel and mate it with the end of the polystyrene shaft. Place the bushing over the capacitor shaft, attach the polystyrene shaft and tighten the coupler; also tighten the coupler at the back end of the Eddystone drive thru the access hole provided in the dial drum. Install the vernier drive mounting screws. Now completely mesh the capacitor plates, center the low edge of the dial in the window and tighten up the dial drum hub. Disassembly must be accomplished in reverse order.

The tuning head is attached to the indicator/power unit through a four-conductor cable three feet long. This cable is attached to the box with a plastic cable clamp mounted in a hole provided immediately adjacent to the oscillator support angle and exits through a rubber grommeted hole at the front end of the enclosure. There is not enough room at the rubber grommet to use a cable clamp, so the cable is epoxied to the box at this point. Before installing the cable, however, check for sufficient clearance between it and the dial drum. It will probably be necessary to route the cable along the corner of the chassis to gain enough clearance.

## Power indicator modulator

The power/indicator unit is housed in a standard 9 x 6 x 5 inch utility box (Bud type AU-1040 or equivalent). The layout of this circuitry is not at all critical, and just about anything that suits the builder may be used. The only particular caution that must be observed is with the transistorized 1 kc phase shift oscillator. This unit is built on a piece of perforated epoxy board (Vector 32AA18) 1-³⁄₁₆ inches wide and 1-¹¹⁄₁₆ inches long. To preclude any 60 cycle pickup, this board is situated on the opposite side of the chassis from the power transformer.

In the author's case all the power/indicator components were mounted on a 4 x 5 x 1 inch aluminum chassis. This chassis was then mounted to the front panel of the utility box with the phone jack and power plug mounting nuts. Two large diameter holes (1-⅛ inch) are punched in the rear panel to provide access to

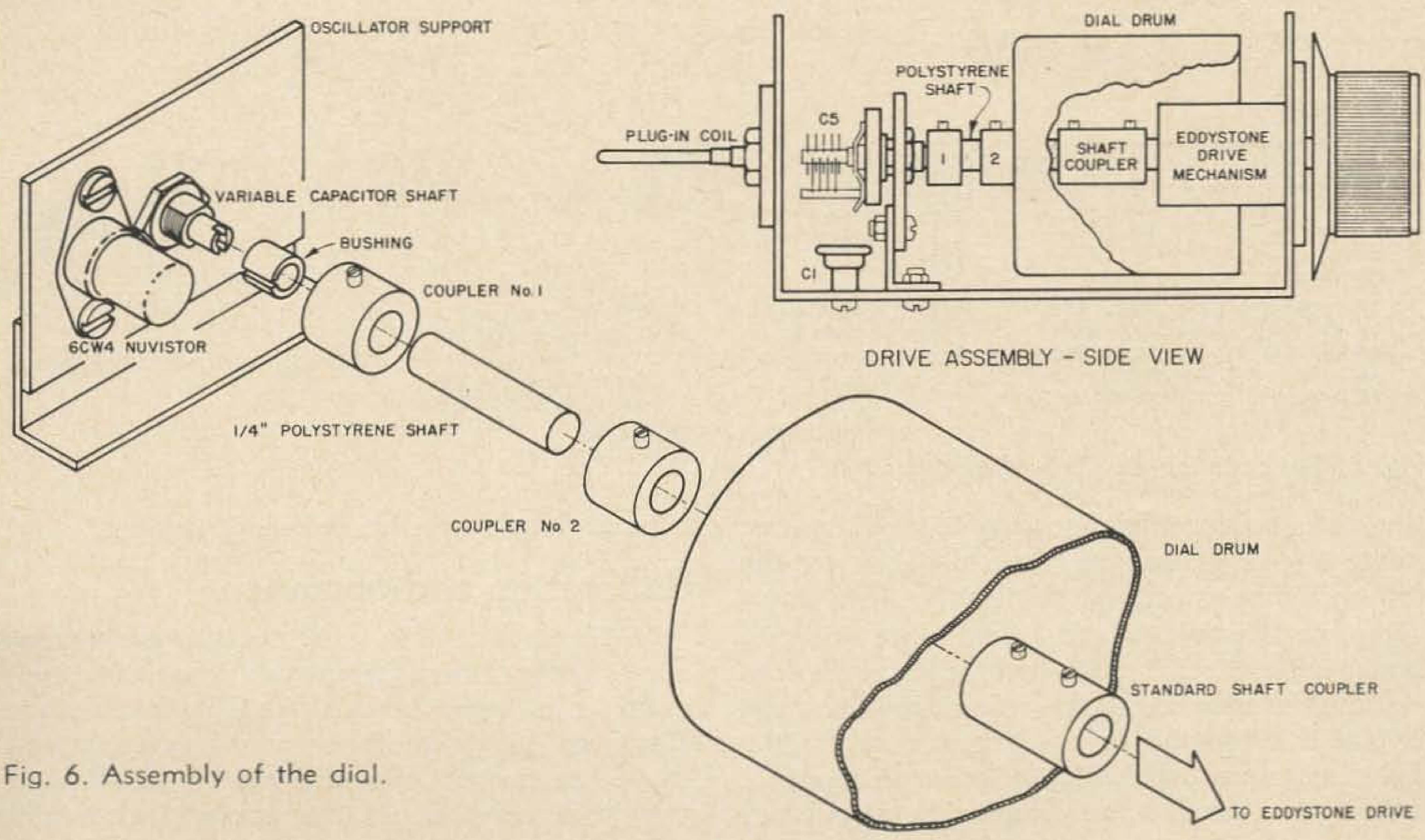



Fig. 6. Assembly of the dial.

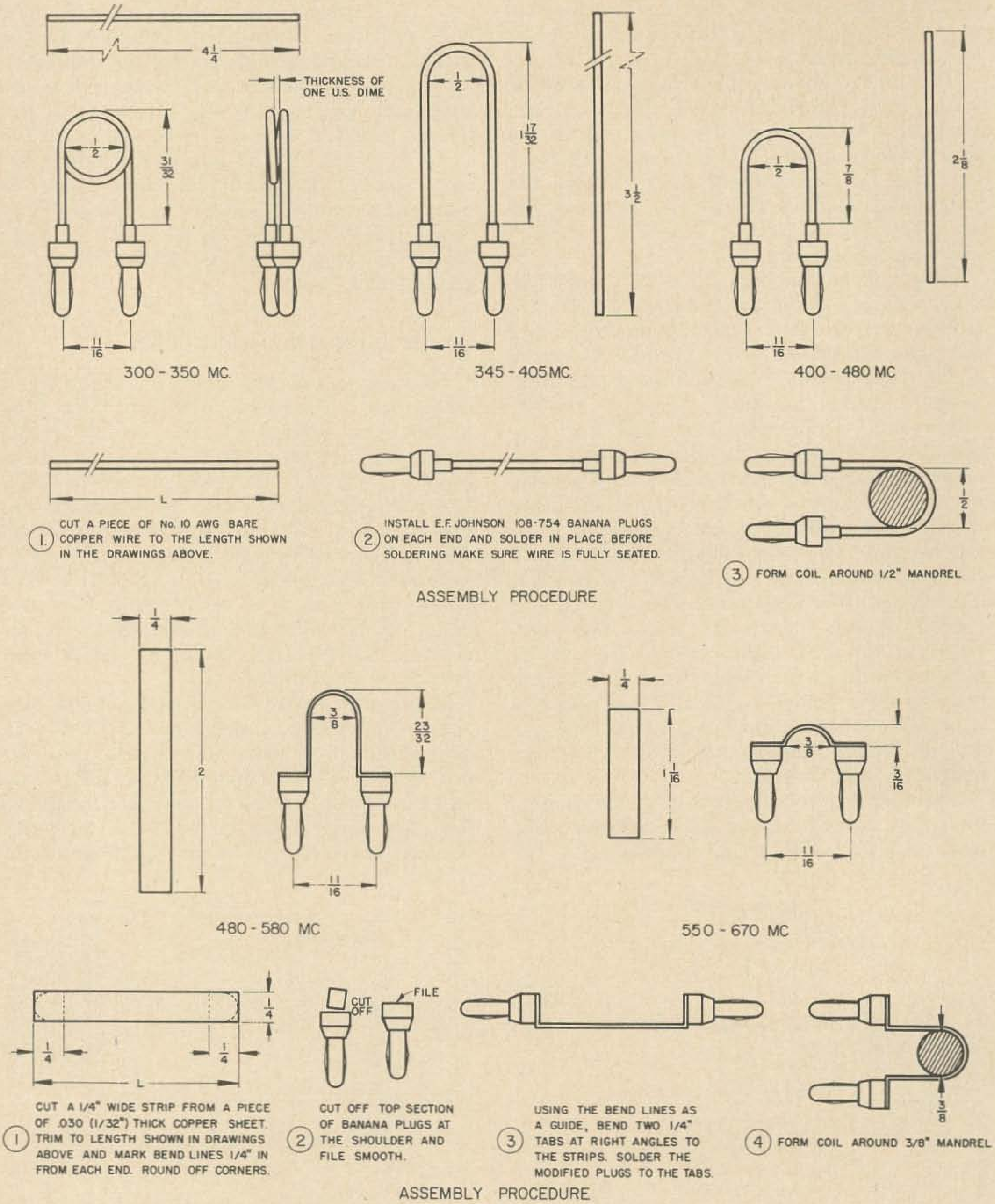



Fig. 7. The coils for the UHF grid dipper.

the fuse holder and to pass the AC power plug. A chassis handle (Bud H-9168) on the top and rubber feet on the bottom just about complete the unit. There is one other addition however; five pairs of 5/32 inch holes, drilled on 11/16 inch centers along the rear edge of the top of the box provide convenient storage for the five frequency determining coils. A coat of spray paint and some Datak "Letraset" dry transfer labels are the finishing touches.

## Calibration and operation

Without access to existing 420 mc equipment with known frequency characteristics, exact calibration in this band is impossible. However, this grid-dipper may be checked on the other ranges with the aid of an all-band television receiver. If the circuit layout and

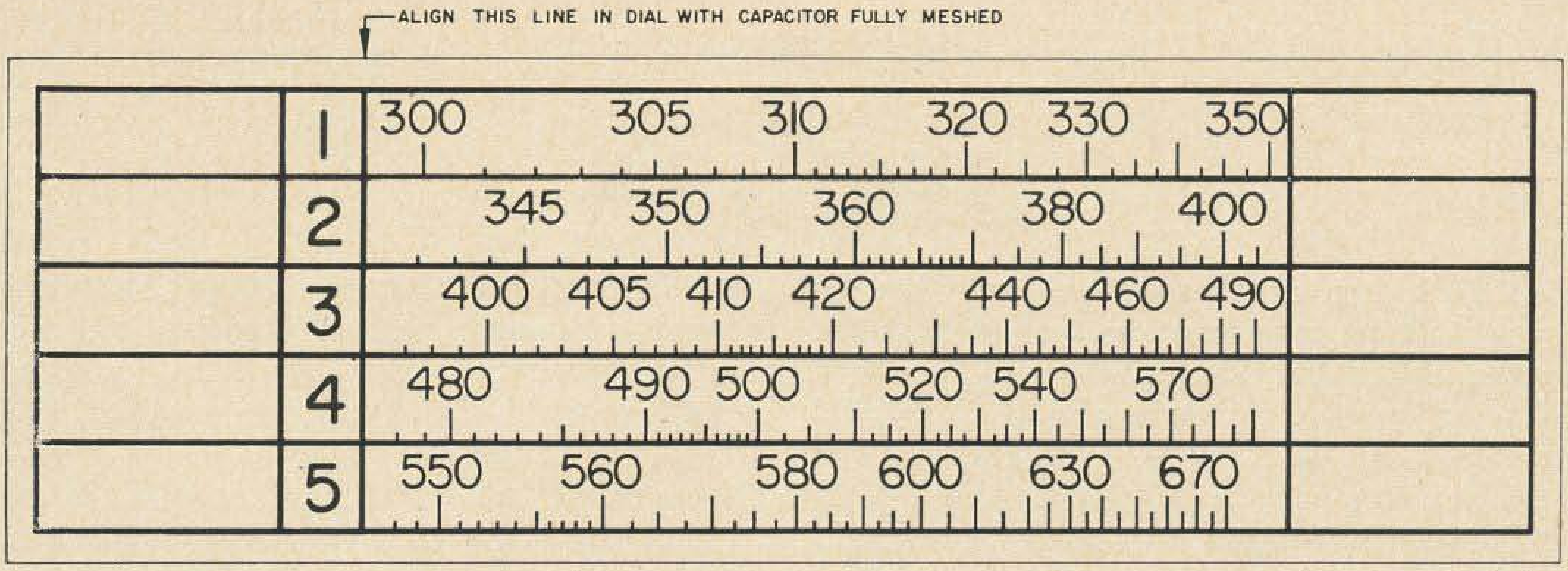



Fig. 8. Full size dial scale.

construction techniques described are closely followed, good correlation can be obtained and reasonable accuracy insured. The bands that are likely to be the furthest off are the lowest and the highest. In the lowest the coil spacing is quite critical and in the highest a slight change in length will move the frequency several megacycles. An accuracy of 2% at 600 mc is plus or minus 12 mc; close attention to the specified dimensions should provide accuracy better than this.

Operation of this grid-dipper is exactly the same as any lower frequency unit. It may be used in determining circuit resonance, detecting parasitic oscillations or as a signal generator. Because of its extended range, it has been found to be very useful in determining the series resonance point of rf chokes and ceramic bypass capacitors.

In the detect mode, this unit will indicate rf voltages as low as 50,000 microvolts. More sensitive operation may be obtained if it is used as an oscillating detector. In this case headphones are used and an audio beat note will be heard when the grid-dipper is tuned to the oscillator being checked. In the upper frequency ranges, it is usually difficult to obtain an actual beat note, and only a "tick" will be discernible when you tune by the frequency of the unknown energy.

When the oscillator is tuned between 605 and 650 mc, there is sufficient second harmonic energy to provide a strong reference signal in the 1215 mc amateur band. This is particularly useful in the initial tune-up of converters for this band. Use of the internal 1000 cycle modulation aids in distinguishing the grid-dipper signal from other rf sources that are present throughout the spectrum. There are many other applications for which this instrument is suited, but entire books have been written on the subject and they won't be recounted here.[2]

Since this unit has been built, it has proven to be extremely useful in tuning up gear for 432. It has been borrowed a number of times and in every case a desire has been expressed for "one just like it". Hopefully this article and the pre-calibrated dial will fill that need.

. . . WA6BSO

[2] "How to Use Grid-Dip Oscillators," Rufus P. Turner, Copyright 1960, John F. Rider, Indianapolis, Indiana "Servicing With Dip Meters," John D. Lenk, Copyright 1965, Howard W. Sams, New York, N. Y.

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São Paulo is only forty-five miles from the beautiful bathing beaches of the seaport of Santos—and yet we are 2,100 feet above sea level! In fifteen minutes by car you climb all that and you are away from the warmth of a tropical seaside port. Still you have a comfortable temperature that seldom reaches freezing point in July or August, evenings are cool even in midsummer, hurricanes are things unknown to us—and all *paulistas* apologize to foreign visitors for our reasonable downpours in January or in March.

Take a walk down-town in this incredible city and look around. Nisei children show an amazing prettiness in their oriental features and distinctive European origin; Portuguese, German, Spanish, Italian blood of third-generation Brazilians seems to make a happy combination with the Japanese product! Towheads, redheads, slant-eyed *caboclos* of Indian descent are all Brazilians named Johnson, Whitaker, Pignatari, Giovanni or Takasaki. . . .


Read the trolley-car sign of destination: Brooklyn! Yes, it will take you to Brooklyn, a residential section of São Paulo, near another section called Indianapolis. On the way to Brooklyn you may drop off and walk down streets sounding so familiar to you Americans: Rua Nebraska, Rua Nova York, Rua California . . . . If your teenagers ask for it, just look around and you will find it: Snack-Bar, cokes, hamburgers, ice-cream sodas. . . . Sears-Roebuck is just five minutes away with counters displaying perfect copies made in Brazil of all those things to be found back home. The newsstands display New York papers just a few days old—and that certain TIMEly magazine which is distributed in Brazil on the issue's date! Brazilians are familiar with Little Joe of Bonanza—and with Flintstone adventures brought to us in TV tapes.

This is the town where PY2USA had to be created through imagination and originality. It is a radio club of the outstanding educational entity promoting closer relations with the U.S. since 1938—the well-known União Cultural Brasil-Estados Unidos, where 5100 pupils of all ages learn English and the American way of life by useful, practical and up-to-date methods. The organization occupies a modern building in an area almost the size of a city block. It is unusual in every detail because—well, it is in São Paulo!

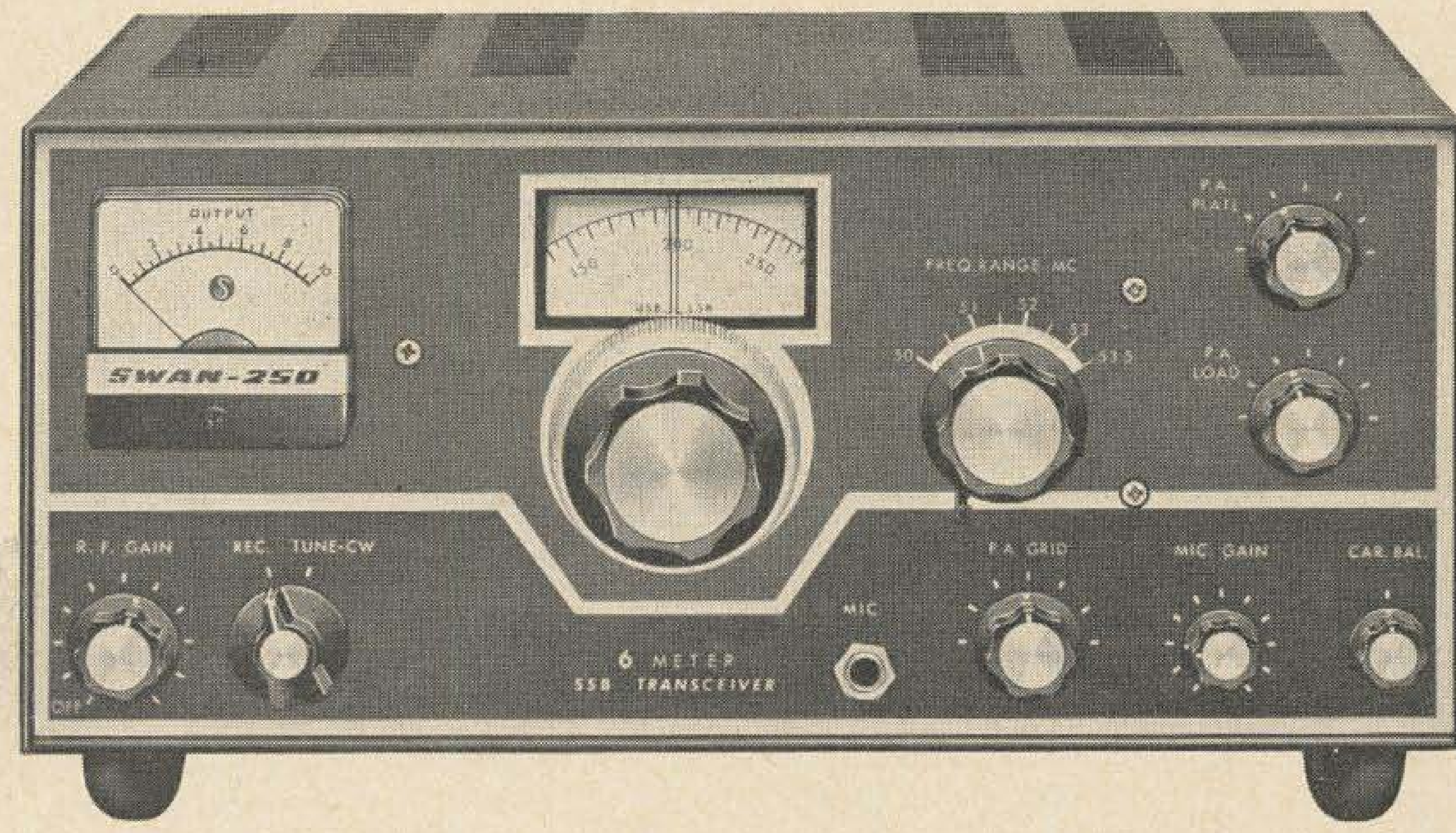
PY2USA was officially opened on November 26th last. Its rig had been sponsored by the Glencoe Rotary Club, of Illinois, through the efforts of W9JKC, lawyer Byron C. Sharpe. He was present for the ceremony, when a Brazilian flag draping a plate on the wall was taken down by his own hands to reveal our humble tribute: PY2USA, Sala Byron C. Sharpe.

But this was just the initial step in our program of activities to foster better relations between Americans and Brazilians, the leading brotherhoods in this vast continent.

. . . PY2CUB

# INTRODUCING

# THE

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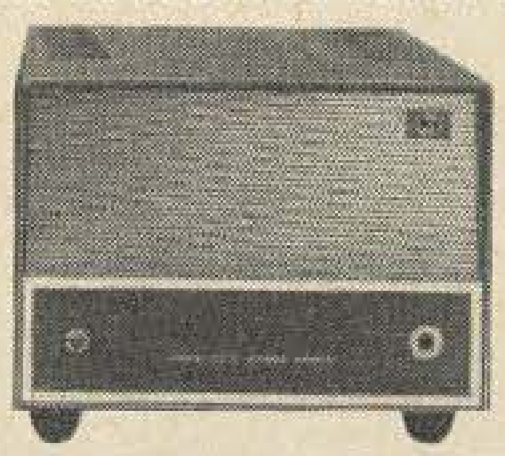

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Art Lynch W4DKJ
2827 Valencia Way
Fort Myers, Fla.

# W2USA/TV

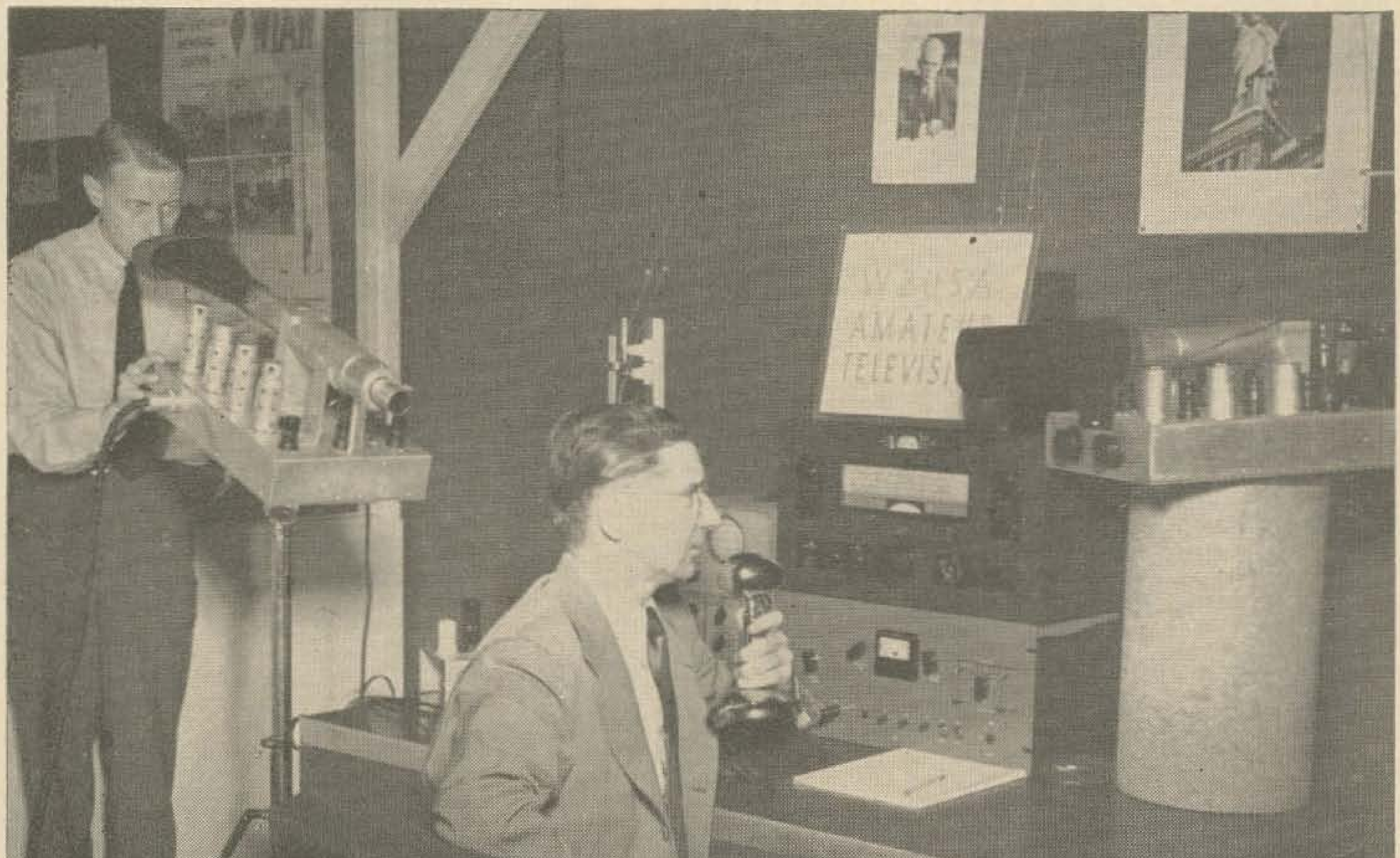
## *New York Worlds Fair 1940*

Two-way television, with voice, was accomplished at the New York World's Fair in 1940, for the first time in history. It is very interesting to note that this remarkable achievement was the work of radio amateurs.

While the story of W2USA—the six-station amateur set-up at the World's Fair, 1939—is "Old Hat" to many old timers, there are now thousands who never heard of it, and a brief review is indicated.

One of the most active amateur radio groups in the metropolitan New York area was the Garden City Radio Club, of Garden City, L.I. One of the outstanding features of that club was the fact that it had no charter, no by-laws, no officers and no regular meeting times. By general choice, Stanley P. McMinn, W2WD, was "Honorary Secretary."

When several of the "gang" got their heads together and thought we should have a meet-



Before the opening gun was fired, for the public showing, a trial run was conducted. Here, Bill Meissner W2HYJ, host at W2USA/TV has the camera trained on Arthur H. Lynch W2DKJ, Managing Director of the W2USA Radio Club, who is shown chatting with Fred Cusick W2HID, operating similar equipment, on the roof of the New York Daily News Building, eight miles away. Some idea of the speed with which this circuit was tossed into operation, may be had from the location of the TV receiver, on top of a waste basket.

ing, Mac would be notified and it was his job to pass the word to all the members. Most of the meetings were sumptuous affairs, including complete bar service, the meeting, and then roast turkey and roast ham, with beer, wine or ale. As a rule, some prominent person, who happened to be in the New York area, would be the Guest of Honor. These meetings generally took place in the elaborate basement play rooms, in the home of former ARRL Hudson Division Director, Dr. Lawrence J. Dunn, then W2CLA and now, W2LP.

When Dr. John S. Young, the famous announcer, was asked by Grover Whalen, President of the N.Y. World's Fair, 1939, to become head of the Communications Department, it was Dr. Young's idea that amateur radio should have a prominent place in the Fair's activities. He communicated with ARRL and was told that Dr. Dunn could, no doubt, be of great assistance to him. He most certainly was. At his suggestion, the W2USA Radio Club, Inc., was organized. There were five Directors: L. M. Cockaday W2JCY; C. B. Cooper, Fiscal Director; Arthur H. Lynch W2DKJ, Managing Director; Dr. A. L. Walsh W2BW, and John S. Young, Liaison Director. There was a very impressive list of "Honorary Members", including: Dr. Lee de Forest, Pres. Lee de Forest Laboratories; Paul F. Godley, Pres. Radio Club of America; Raymond A. Heising, Pres., Institute of Radio Engineers; Lenox R. Lohr, Pres., National Broadcasting Company; Alfred J. McCosker, Pres., Station WOR; William S. McGonigal, Pres., Veteran Wireless Operators Assoc.; William S. Paley, Pres., Columbia Broadcasting Company, and Eugene C. Woodruff, President of American Radio Relay League. In anyone's book that would seem to be an impressive group!

Actually, the work done at the World's Fair began long before the fair opened. For instance, the famous "Round the World Round the Clock" Relay Message, to stations throughout the world, from Grover Whalen, was sent every hour, on the hour, for twenty-four hours, on New Year's Day, 1939, from the Fair Grounds, through W2DKJ2, to many

*Art Lynch W4DKJ, former W2DKJ and W2USA (for the World's Fair), first went on the air as a ham when no licenses were needed. He served on a number of yachts, including the famous Wakiva and Wakiva II, was the first public relations director of RCA, editor of Radio Broadcast Magazine, a radio manufacturer, etc. He retired a few years ago from his own company in Florida.*

Lola Lane, star of "Girls on the Road" photographed with an ordinary camera from the front of the picture tube, gives an idea of the definition which was possible. Stills were used for setting up, but live subjects seemed much clearer. It was generally agreed that definition was considerably better than this photo would indicate.
McMinn, W2WD photo.

relay stations, in the New York area and relayed by them, on most of the amateur bands, giving us world coverage. Within an unbelievably short time, just four hours, we received a reply, from a Llama Priest, in Tibet.

Unfortunately, the impression was created in some quarters that all work from the Fair was to be carried on on 5 meters, which was the frequency (wave length, if you wish) to be used at W2USA, when we received our license. Incidentally, the license was not received until the day the Fair opened. All communications prior to that were handled by W2DKJ/2, located at the Fair Grounds. Actually, when we were completely set up, we had complete receiving, transmitting and antenna facilities operating on every amateur band then available—and all from a single room, in the Hall of Communications.

Some of the finest operators in the country helped us, both at our temporary "Shack" and through their home stations, handling "relays". Ultimately, when we did get our W2USA license, most of our problems were washed out. Because I was able to put in the necessary time to conduct affairs at W2USA, I was chosen Managing Director. Looking back on the job done at that time, I take a great deal of pride in the number of "Firsts" born there. And that brings us to the story of W2USA/TV.

While controlling the operation of W2USA, I was operating a radio manufacturing business, among other things, such as being the New York Representative of the National Company. As a member of the Radio Manu-

Lee Waller W2BRO, looks at the picture tube of the home-built receiver, as the first picture was received from W2DKJ/2, on the roof of the N.Y. Daily News Building, eight miles away, where Fred Cusick W2HID, a CBS engineer, worked for W2USA, on his spare time.

McMinn, W2WD photo.

facturers' Association, I was attending the annual "Trade Show", of RMA, in Chicago. Ed Braddock W3BAY, of the Amateur Division of the Radio Corporation of America and an old friend of mine, invited me to the RCA room, to witness the demonstration of the first showing of a special tube, which RCA was introducing for amateur TV use. The show was remarkable! From their room, in the old Stevens Hotel, they were able to produce rather good pictures of boats, out in the lake, a couple of miles away. Right then the idea of W2USA/TV was born. Months of hard work followed. As briefly as I can tell it, without leaving out any of those who helped to make it a success, here we go!

First, we secured the assistance of Lee Waller W2BRO, who had put on the show in Chicago. Using some of the techniques described in a series of articles by J. B. Sherman and himself, which had appeared in the May, June and July 1939 issues of QST, and with the co-operation of my good friend, Cliff Denton, then in charge of the Radio Department of the N.Y. Daily News, we set up a transmitter on the roof of the Daily News Building, in New York, and a receiving rig in our "Ham Shack" in the Communications Building, at the Fair Grounds. Fred Cusick, W2HID, an engineer with CBS, was selected to run that show. Boy, what a job he did! Fred, by the way, is still very active and has done much traveling with the Arthur Godfrey show.

So, with this introduction, much longer than I thought it would be, I believe the photos, with their captions, can give you a fair idea of the job, done entirely by amateurs, more than a quarter of a century ago, of which they have every reason to be very proud.

. . . W4DKJ

Crowd around W2USA TV booth on the night the first two way circuit between the World's Fair and the Daily News Building, was opened.

A Bert Uthe W2JZO photo.

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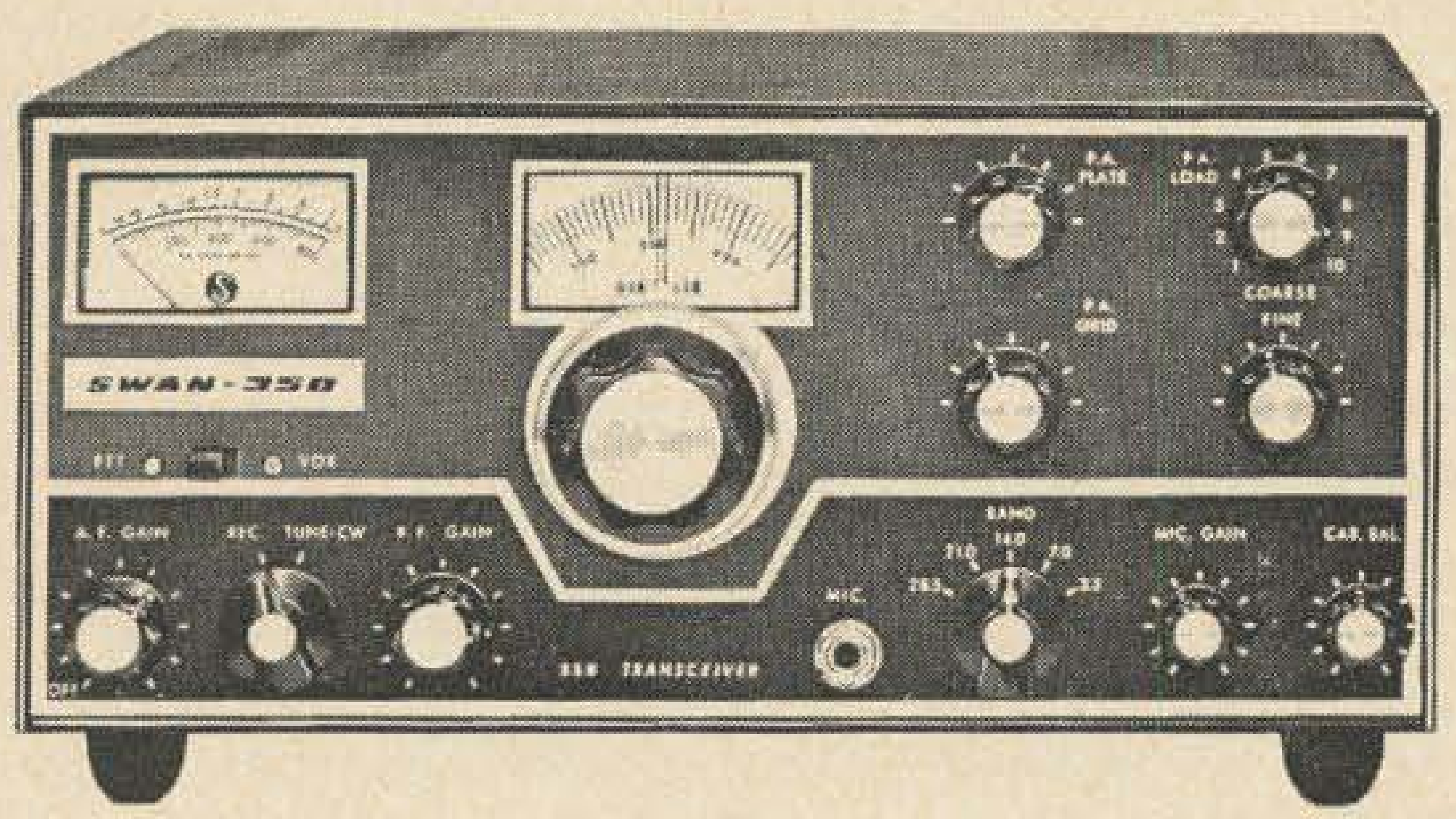


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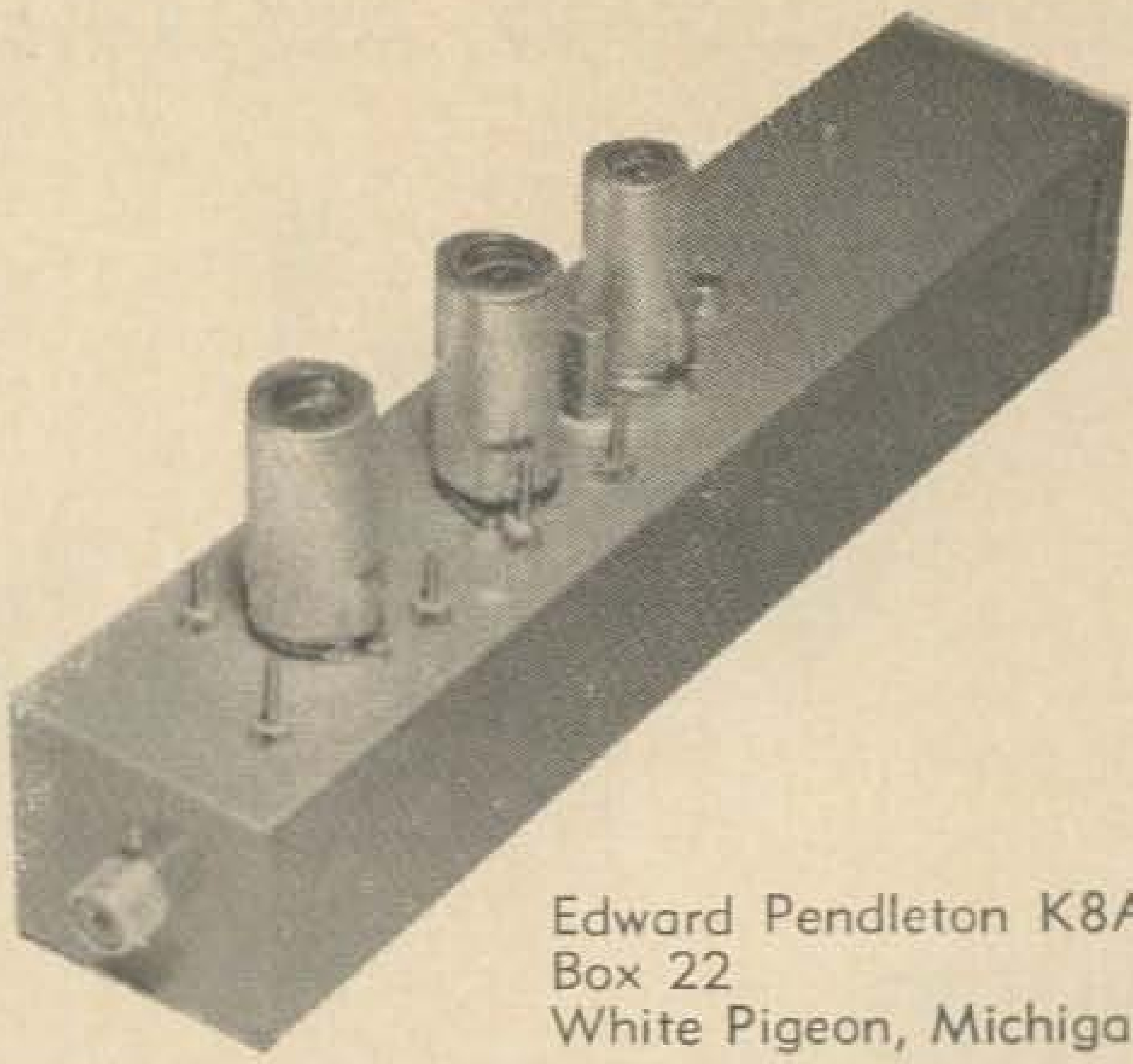
# 12 volts on Six Meters



Edward Pendleton K8ADG
Box 22
White Pigeon, Michigan

Here's a six meter crystal controlled converter designed especially for the radio amateur who has tasted the misfortune of using transistor VHF converters, and the poor compatibility of these units with high power VHF transmitters.

Several years ago the tube manufacturers went to a great deal of trouble to design a line of 12 volt tubes for radio receiving applications, yet few of these tubes have appeared in published ham radio circuits. I feel as though I'm resorting to antiquity to design a converter using them, however, the results proved excellent, and the compatibility with a 100 watt input transmitter proved well worth the effort.

After a thorough search of the tube manual I found the one tube that would merit operation in the VHF bands for RF and converter service. The 12EC8 is listed as a VHF triode-pentode which contains a medium mu triode and sharp cut off pentode. It is intended for use as a combined VHF oscillator and mixer where the heater, screen grid, and plate voltages are supplied directly from a 12 volt automotive battery.

The internal arrangement of the 12EC8 suggested a grounded grid first RF amplifier followed by a pentode second RF amplifier. This established the excellent noise figure to work with the pentode mixer and triode oscillator combination.

Four tuned circuits preceed the mixer in a stagger tuned broad band configuration with link coupling between the first and second RF and link coupling to the mixer input: affording the maximum rejection of adjacent signals and those on the intermediate freq.

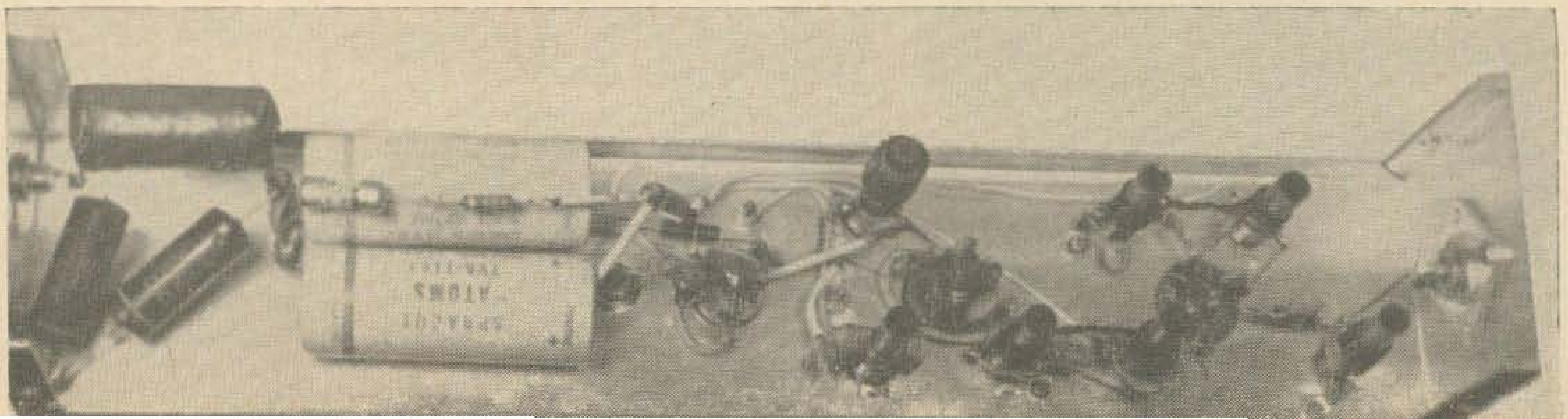
The overall performance of the triode-pentode combination RF amplifier already described is such that the mixer following it has substantially no effect on the noise figure of the system. I felt that the pentode mixer would be less susceptable to oscillation trouble and afford a better isolation between RF and IF and contribute to the ability of the converter to reject signals on other than the desired frequency range. The pentode has a higher conversion gain and due to inherent power sensitivity would require less oscillator injection voltage, allowing maximum sensitivity to S-1 signals.

One stage of *if* amplication follows the pentode mixer, before the output is passed on to the receiver.

The tubes in the converter are cathode type tubes and may be operated from AC. A built in ignition and AC ripple filter with a 1N60 diode provide everything necessary to operate either from 12 volts AC or DC.

## Mechanical details

A 2½ x 2½ x 12-inch Minibox (Bud CU-2114) comfortably houses all components without crowding, although VHF circuit lead lengths were kept very short through careful parts layout. Holes are drilled in the box section having the 2½ x 2½-inch ends according to the photos. After drilling, larger parts are mounted on this chassis in the locations marked on this illustration. Tube socket pins are positioned in the direction indicated on each socket hole circle and fastened with a 4-40 x



¼ inch machine screws through holes drilled to match those on the socket. The lugs for the pins 1, 4 and 8 on the first and second RF amp socket are soldered to the center pin on the socket. The center pin is then grounded to a lug under the socket mounting screw near pin lug 4.

The lugs for the pins 3, 4 and 8 on the 12EC8 mixer tube socket are soldered to the center pin on the socket. The center pin is then grounded to a lug under the socket mounting screw near pin lug 4.

The lugs for pins 2, 3 and 7 on the *if* tube socket are soldered to the center pin on the socket. The center pin is then grounded to a lug under the socket mounting screw near pin lug 3.

Next, the heater and plate voltage leads are run to the tube sockets, RF coils, and the three insulated terminal posts, as pictured in the bottom view.

Resistors and by-pass capacitors which run between the tube sockets and ground lugs are then assembled. All coils and RF chokes, which previously have been wound according to the data in the parts data, are mounted between their associated components with shortest possible leads.

Link coupling between the first and second RF amplifiers is constructed of #20 enamelled wire with two turns at the cold end of each coil. The second RF to mixer grid coil link is #20 enamelled wire with one turn at the cold end of each coil.

Power connection is made through an RCA phono jack mounted in the end of the converter.

## Adjustment procedure

All wiring should be re-checked after completing assembly, then power may be applied and measured at each tube socket before inserting the tubes. The input jack J1 is connected to the antenna. Output jack J2, is connected through a coaxial cable to the antenna terminals of a communications receiver covering the proper range. Install all tubes and a suitable crystal and a 0-3 ma meter is temporarily connected in the plate voltage lead to L6. Output may be obtained from the oscillator over a wide range of L6, but a sharp dip in plate current should occur when oscillation at the crystal frequency takes place. Check the frequency of operation with the grid dip oscillator or a receiver tuned to the crystal frequency.

Conversion grid current at the mixer should be checked using a VTVM at the junction of R3 and R4. Negative .4V dc should be present with the crystal operating, falling to −.25V dc with the crystal removed. Approximately 10 to 12 microamps of grid current should be present for proper operation of the mixer.

Using the grid dip oscillator align the RF and mixer grid coils to the 6 meter band. For a final alignment some local long winded operator can provide a convenient signal source, and L1-L5 adjusted for maximum signal without oscillation.

. . . K8ADG

**Parts Data**

6 Meters:
L1, L2, L3, L4, L5-8T #20 CW ¼" form.
L6- 7 T #24 CW ¼" form.
L6A- 3T #24, cold end L6.

10 Meters:
L1, L3, L3, L4, L5, L6-16T #24 CW, ¼" form.
L2- 14T #24 CW ¼" form.
L6A- 4T #24 CW at cold end L6.

L7-Grayburne Loopstick.

L8-2.5 mh RF choke.

X1- Third overtone: 49.5 mc for 6 meter mobile; 43 mc for 7-11 mc **if**; 27.45 mc for 10 meters mobile; 26.3 mc for 11 meters mobile.

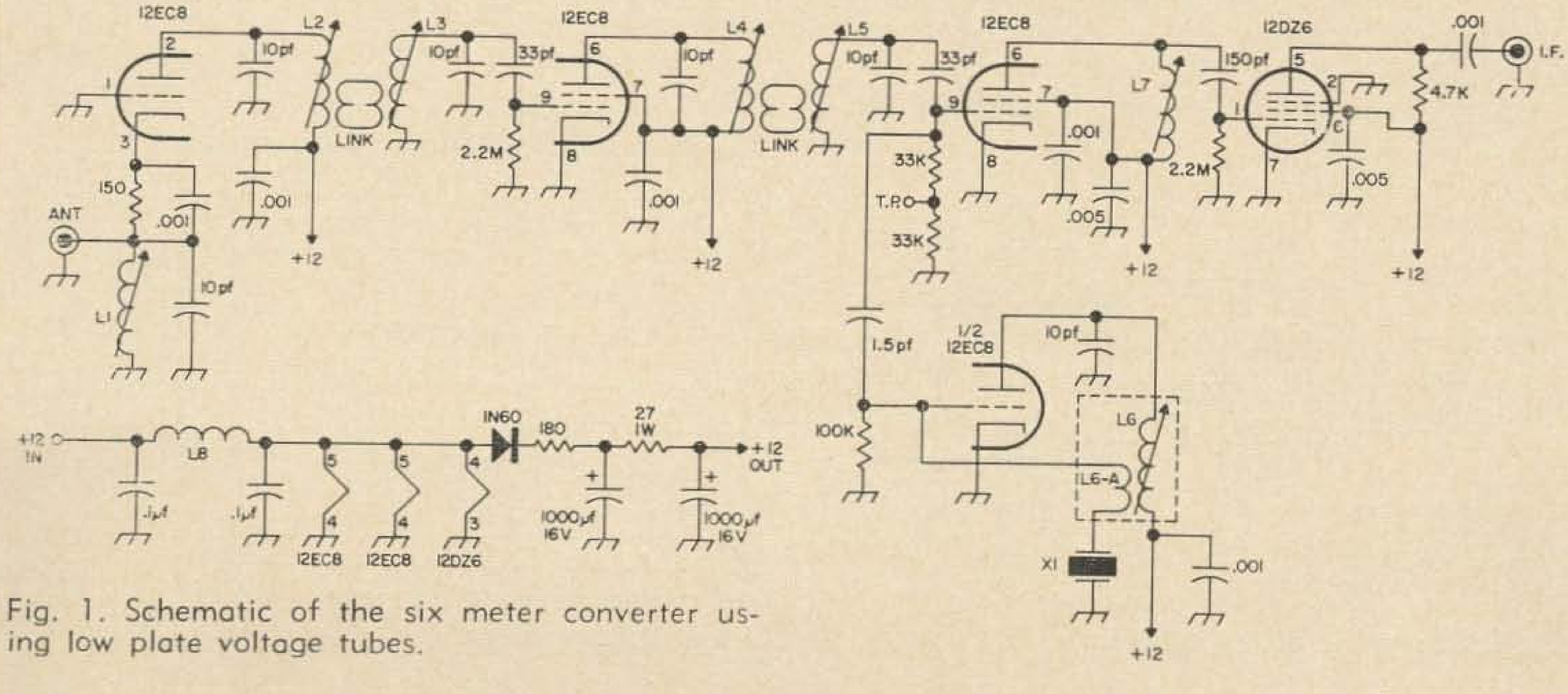



Fig. 1. Schematic of the six meter converter using low plate voltage tubes.

Ray Vath WB2FYB
1334 Teaneck Rd.
Teaneck, N.J. 07666

# Getting on 432 the Easy Way

After reading about all the activity on the first UHF band allocated to amateurs, I decided it would be quite a bit of fun to try and get a signal on the air. After reading plenty of articles about the construction of all kinds of transmitters, I decided to experiment with one of my own; using a type of antenna coupling I had discovered while playing around on 220 mc. It may not look as though it would work, but this tripler works well and there are quite a few fellows who will testify to it. A few are WA2JVO, WB2COZ and W2NTY as they have all heard the signal to prove it.

## Construction

This tripler is built on a 4x8 inch piece of aluminum which in turn is mounted on top of a 4x8 aluminum box. Construction should be exactly as the template indicates.

Starting at the grid end L1 and L2 should be resonant at the frequency of 144 mc. It is a good idea to check it with a grid dip oscillator if you have one available.

L3A and L3B are four and a half inches long, bent down at the tube end one half inch so they are on the same plain as the part of the butterfly variable to which you will solder. L4 is a 1½ inch loop which is standard for this frequency except it is grounded at one end.

L5 is a four and a half inch piece of wire coupled to the plate tank closest to the ground end of L4 and adjusted for maximum output using a number 47 pilot bulb or whatever you may have.

B plus is applied 3 inches from the center of the 7 pf per section butterfly. On one of the few built so far, maximum output was acquired with the B plus 3¼ inches from the center of the condenser. So don't be afraid to play with this adjustment.

## Tune-Up procedure

Apply 5 watts of drive to the input and turn C1 until the pilot light lights. Adjust L5 for maximum output. Connect an Antenna to the output. (I built the beam described by Hoisington in 73, December 1964. Note: If you want to get all elements on it, get a 14 foot boom; then call CQ and fight your way through all the QRM.)

Using the audio from the driver, you will be able to work the boys; but they will all tell you it is mushy. What I did was take an old record player audio amplifier and convert it to a modulator. This may be a good idea in case there are any official observers in your neighborhood.

By the way, the output of this gem is 4½ watts measured on a Bird watt meter.

. . . WB2FYB

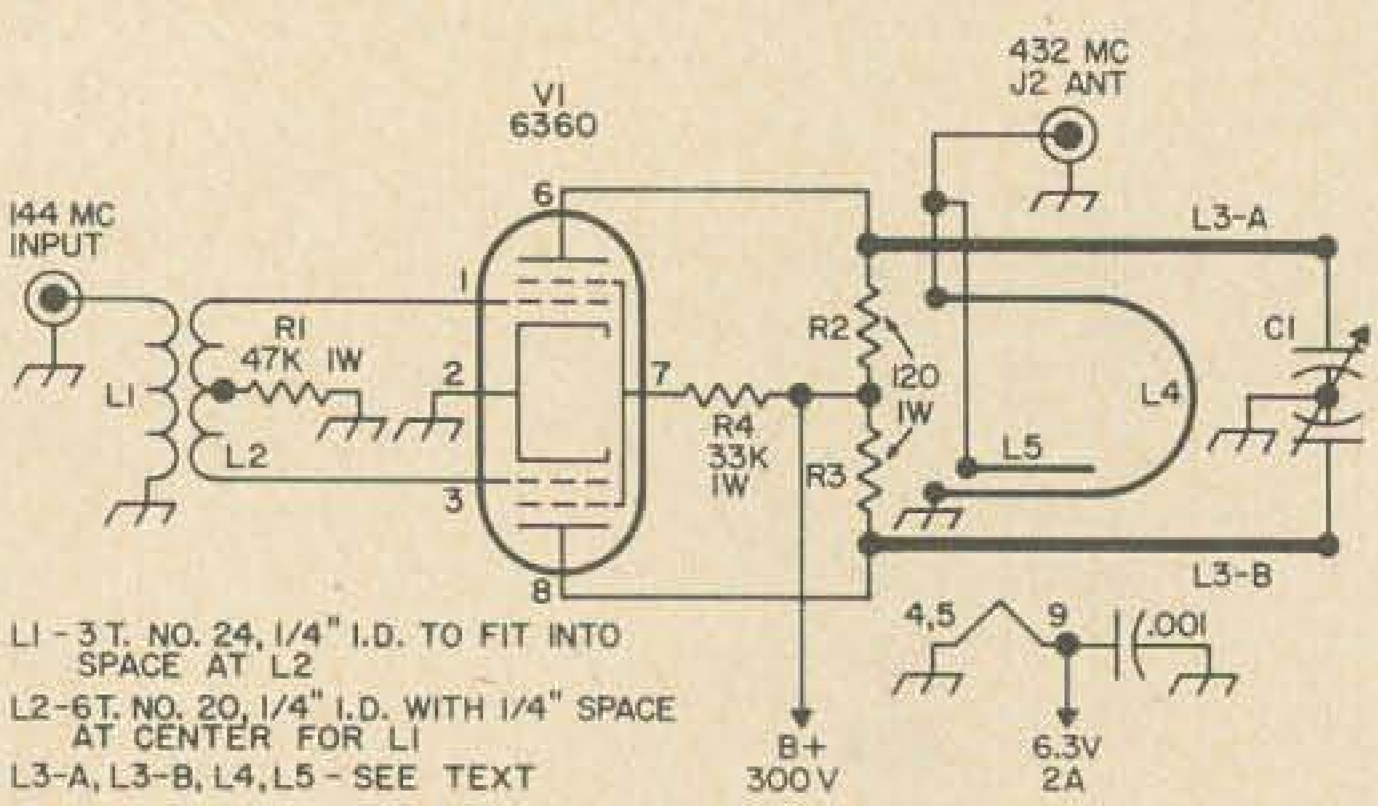
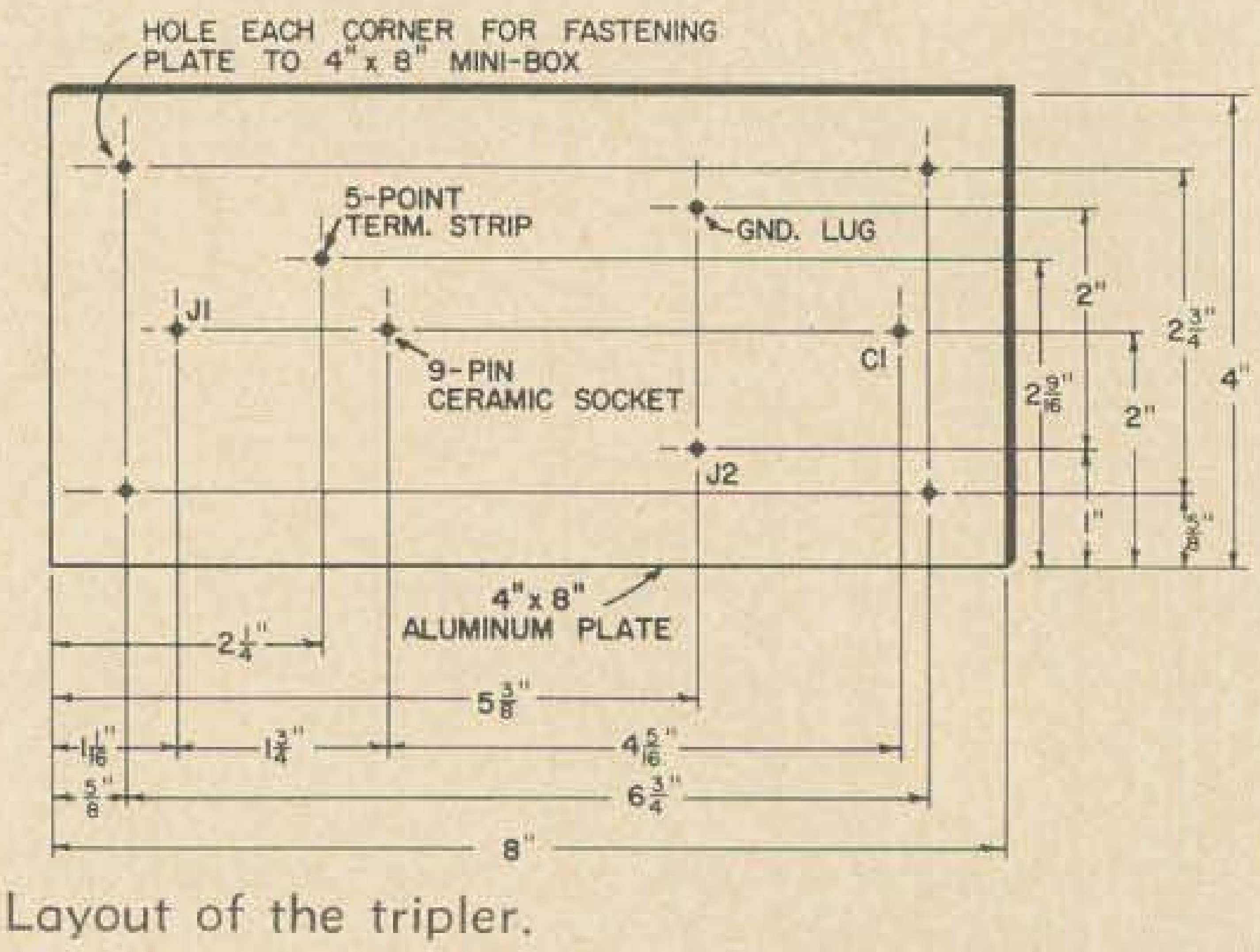



Fig. 1. Schematic of the tripler.




Layout of the tripler.

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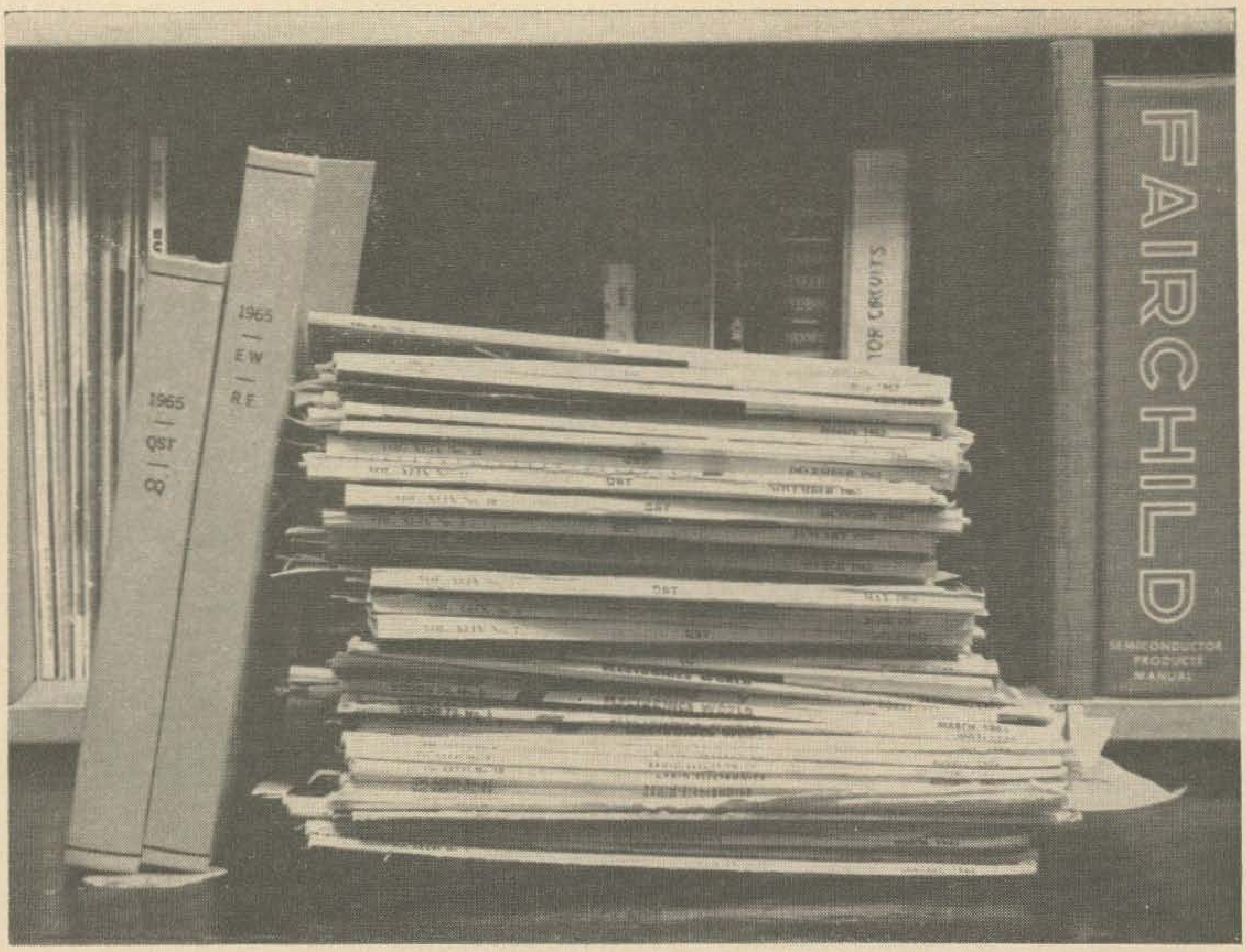



A year's run of four magazines in two handy volumes. The pile of leftover scraps is nearly nine inches high!

# Dealing with the Information Explosion

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

Researchers the world over are trying to do something about the information explosion. Too many unnecessary facts cover up the essential ones. But the researchers aren't the only ones facing this problem. There are anywhere from one to eight or more magazines in the amateur electronics market, depending on what your interests are. A few years' accumulation of these can use up a lot of space. And there is the further problem of finding, in a mass of advertising and often additional irrelevant material, a particular bit of needed information.

One solution is simply to throw out everything over ten years old. The rapid development of all engineering fields at present makes this a reasonable solution. However, there are two counts against it. The first is a growing tendency to print material of fundamental significance, which like mathematics, ages only very slowly. Much of Jim Kyle's work, for instance, can be expected to outlast by a good wide margin most of the construction material now being printed. Also, if only four magazines are retained, that will still be a standing file of about 480 copies from a ten-year period. Too much for browsing! A better solution is to save the useful and valuable material and discard the rest.

## Gruesome details

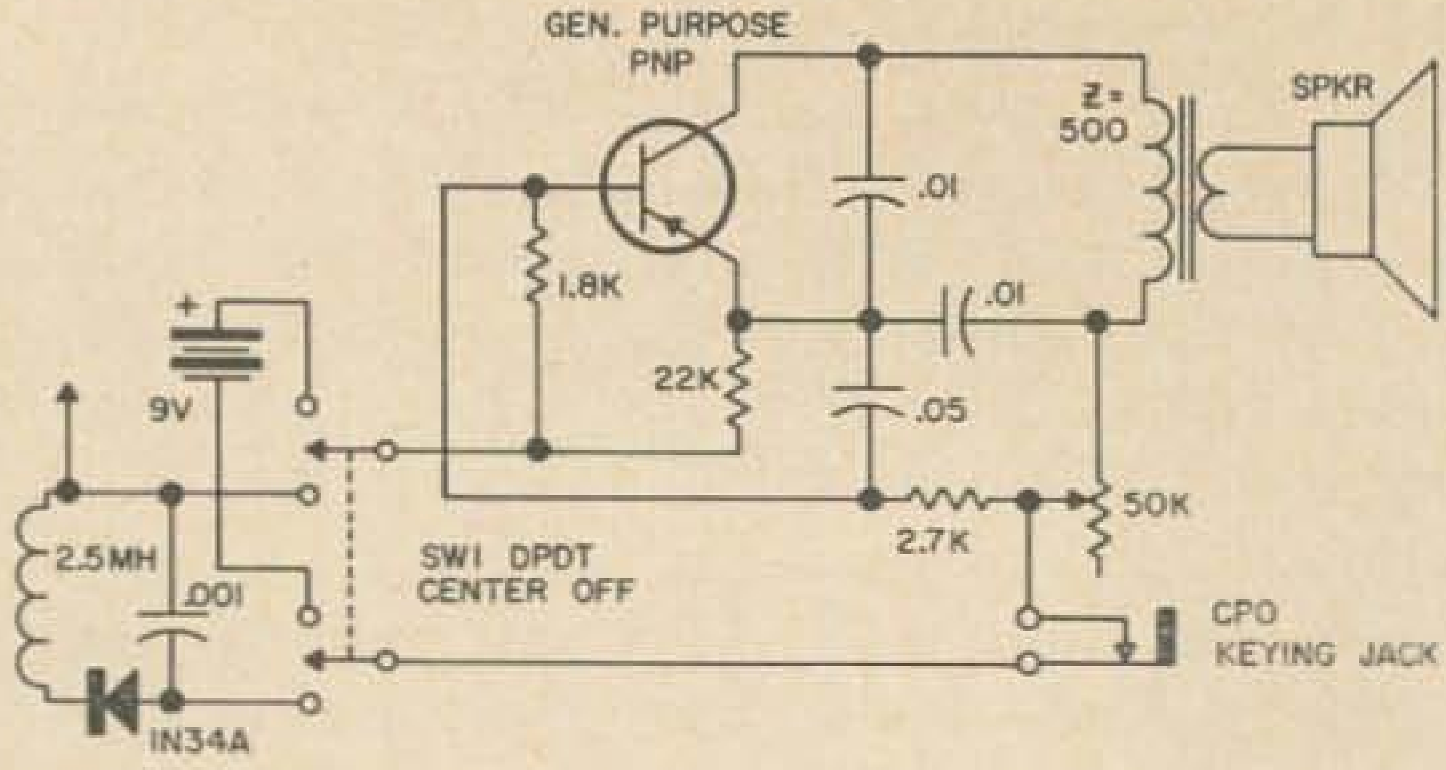
Most modern magazines consist of several sections glued and stapled together. With some care, they may be dismantled into usable pieces without too much interference from the glue and cover. A certain amount of care is required because they are assembled for the ages, though you may doubt this from some of the content and the properties of the paper. The greatest difficulty arises where the glue has worked its way far in between two sections.

The first step is to find and remove the staples. A knife blade and pliers are appropriate; fingernails definitely are not. When the staples are out, the magazine is opened to page one and the process commences. One page at a time, decide if you have any future use for it. Check each page even if it's in a pure advertising or operating news section. Editors sometimes have funny ideas. Wanted material is removed by sharpening the crease at the back of the magazine and then tearing it out. If glue interferes, take the whole thing apart and cut off the usable page. Practice on other magazines of similar construction before getting into the good ones; it's quite important for future application not to spoil the inner edges of the pages. If you do, make a note of the month and page so the damage can be repaired later.

A year's supply of magazines will reduce to a remarkably small pile. Leaf through it and you will find that the general readability has been greatly improved. But all is not done yet! Paperback magazines are rather flexible and the pile of essentials will be much more so. One solution is stapling and storage in folders, each holding a year's material from a single magazine. But a better one is to have them all bound up in nice volumes. This is not very expensive, the local price being $4.50 for a volume up to three inches thick. Choice of colors, good library binding, and lettering included. Look around. If you have this done, a good arrangement is to place several blank pages for notes at the front and the back, and don't forget to bind in the yearly indexes! And you can economize by binding more than one magazine into a given volume. Same price.

The resulting volumes stand better, handle easier, take up less space, and are more readable than the original piles of magazines. Getting out all the trivial, dated and irrelevant material makes a phenomenal difference. There is just one magazine for which this does not work. Of course it is 73 (I dare not submit this to any other editor!) which has such a terrific ratio of content to volume that you must bind it whole. And it's become too thick for binding more than one year into a volume so there's no economy there. Oh well . . .

. . . W2DXH




## CPO and CW Monitor

Here's a simple CPO/CWM monitor that I have been using at my station. It works very well. The antenna lead is a short length of insulated wire. Leave the switch in the center when not in use for code practice or CW monitoring, or it may annoy you!

. . . Gene Gillespie W2EAF

---

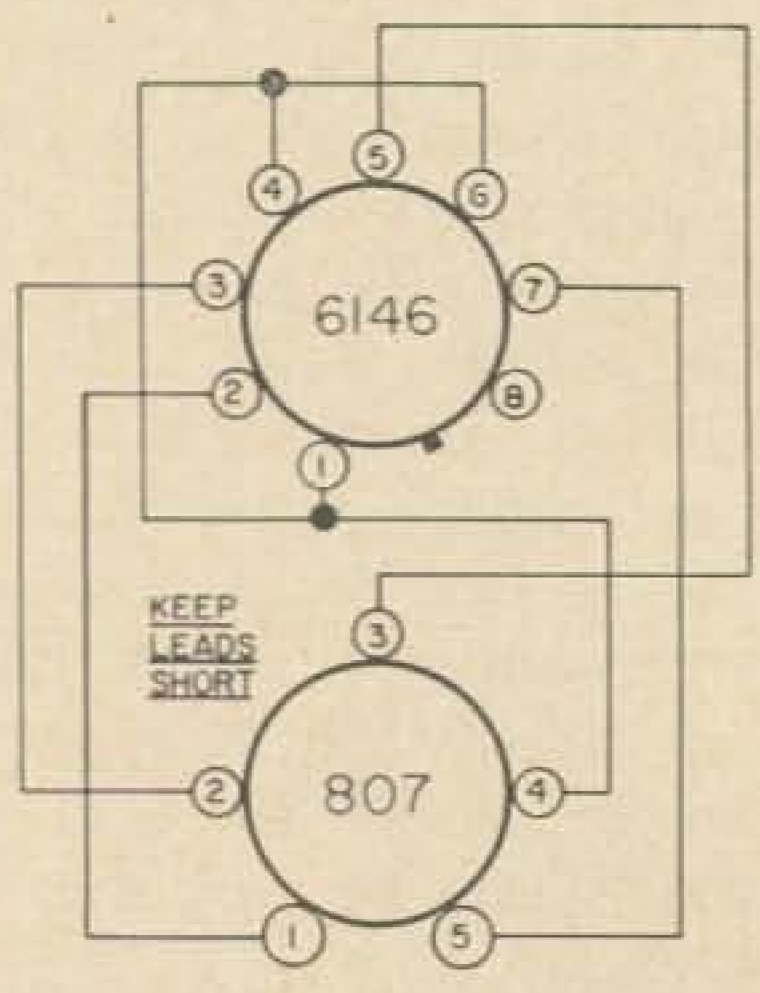
George Oberto K4GRY

## 807 to 6146

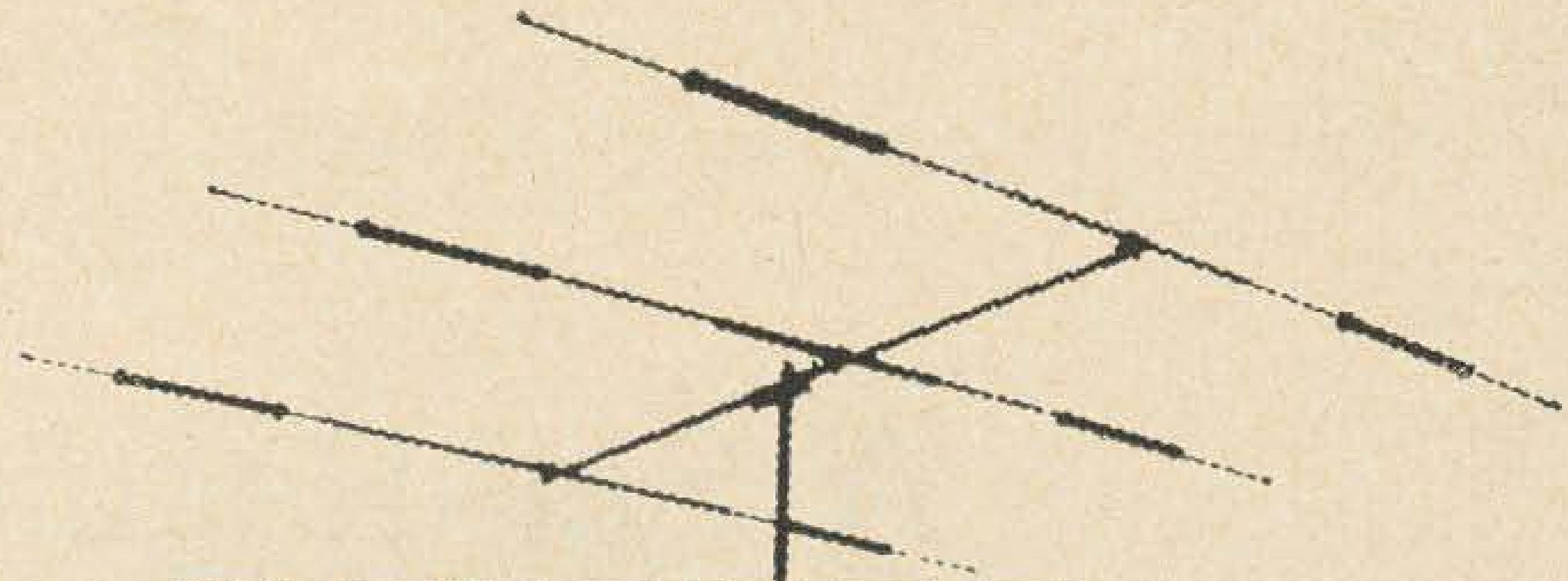
The new 6146B with its higher power and screen voltage rating is a natural to soup up an old 807 rig. Break the glass of an old 807, clean out the base and take an octal socket and wire it as in the diagram. Plug the adapter into the 807 socket, put a 6146B in the adapter, and with a slight returning of the grid and plate circuits you are ready to go without making any changes in your equipment.

I tried this out on Motorola 30 and 50D six meter FM equipment. The grid drive came up with the power output really climbing. A TBS-50 Harvey Wells, a GE rig, an Eldico and several homebuilt rigs were tried with similar success.

. . . K4GRY




An adapter for converting 807 rigs to 6146B's.



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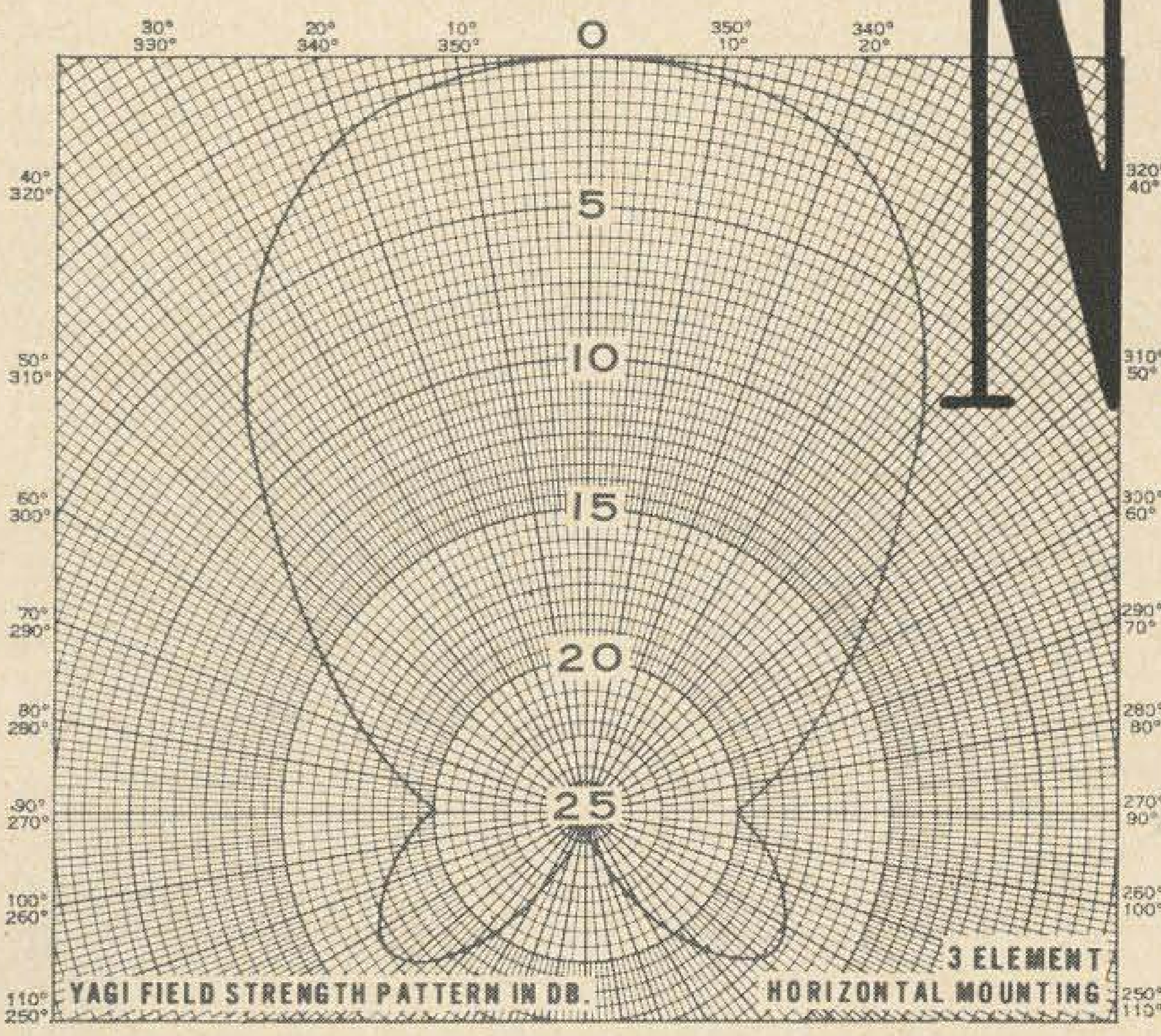


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Hank Olson W6GXN
3780 Starr King Circle
Palo Alto, Calif.

# A Self-Regulating DC to DC Converter

*Apply 6 to 24 volts DC and get out 12!*

Often in the use of electronic circuits, the available primary power is extremely variable in voltage, causing many undesirable effects in the circuit performance. One of the most aggravating effects of this type is that of the variation of frequency of oscillators as input voltage is varied. The aircraft or automobile radio receiver is perhaps the most common device plagued by this difficulty.

The standard method of handling the mobile problem is to use a transistor magnetically-coupled multivibrator type converter to provide isolation and voltage conversion, then use a series regulator.[1]

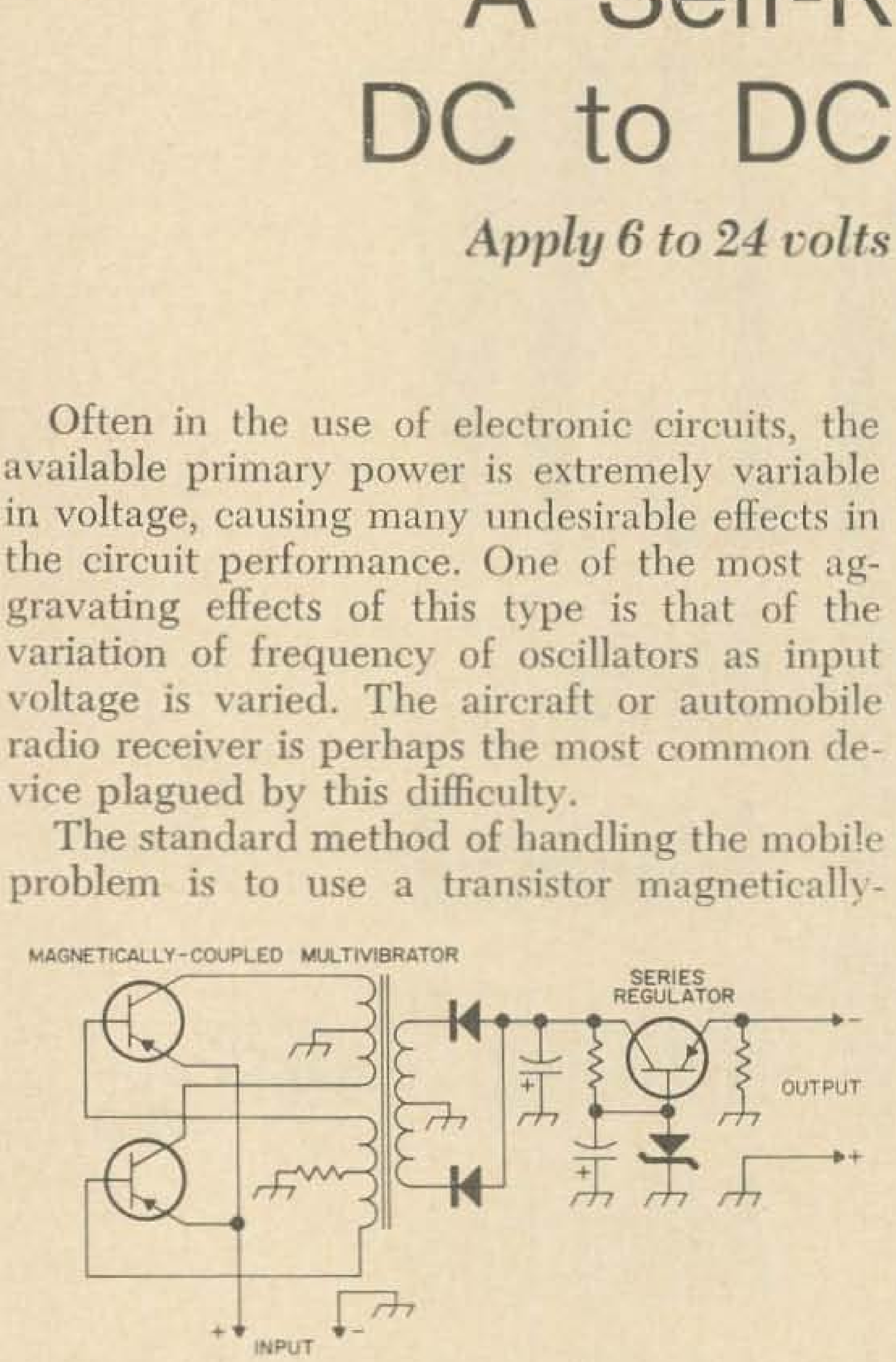


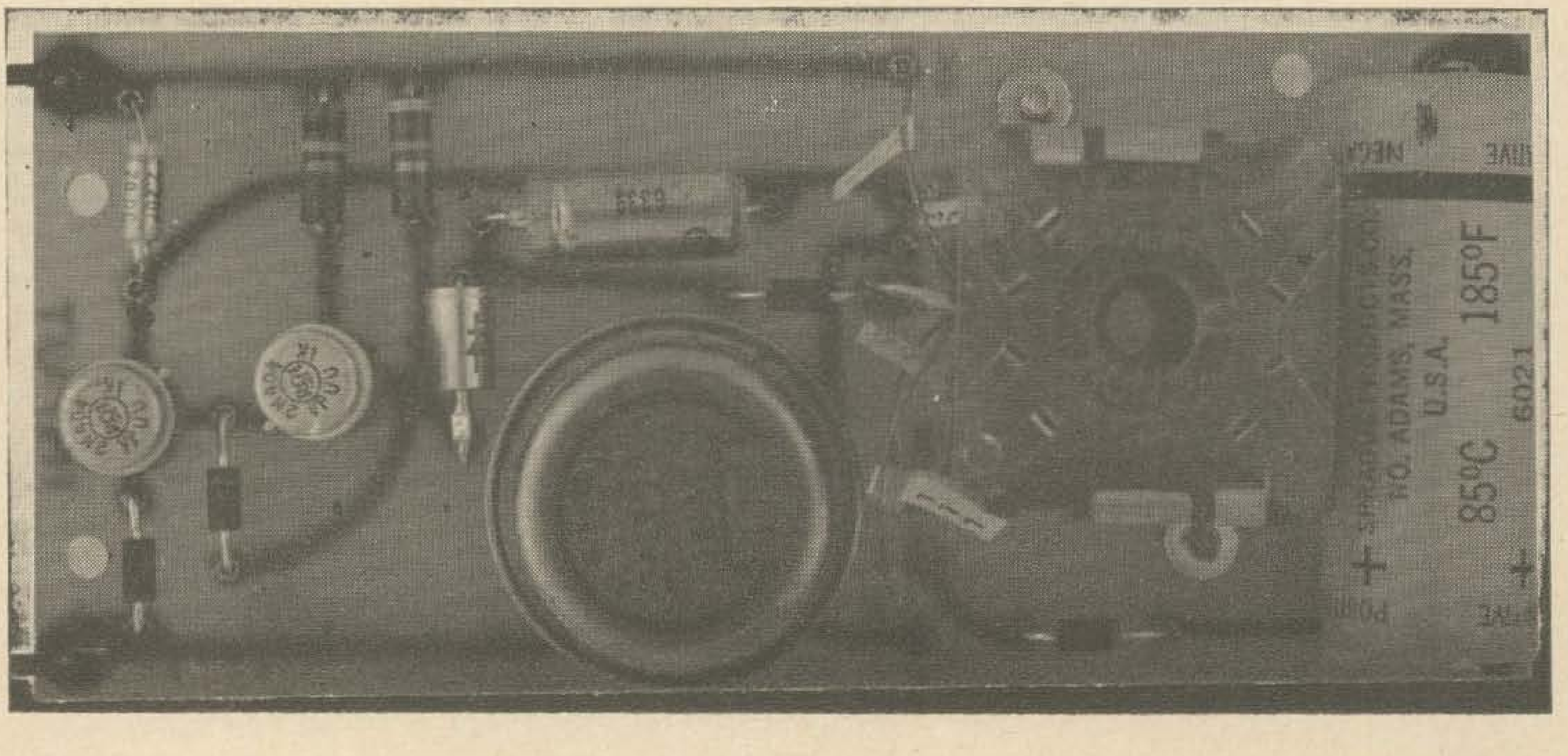

Fig. 1. DC to DC converter with a series regulator in the secondary DC circuit. This is not too efficient.

This means of regulating the output voltage of the converter is very fine, but rather inefficient because we must dissipate power in the collector-base junction of the series regulator. Such a system is simply shown in **Fig. 1.**

Improved efficiency could be obtained by using a switching-type regulator following the DC-DC converter. Such a regulator also uses a series transistor, but it is either saturated "on" or turned "off" completely. The output is then a pulse train, the average DC value of which (after filtering) is the output voltage. Either the pulse width or the frequency (of a constant width pulse) is made output-voltage-sensitive to effect regulation.[2] Such a system is shown in **Fig. 2.**

The device to be described here combines

Top view of the self-regulating DC to DC converter. Note that this is the opposite side from that shown in Fig. 5.



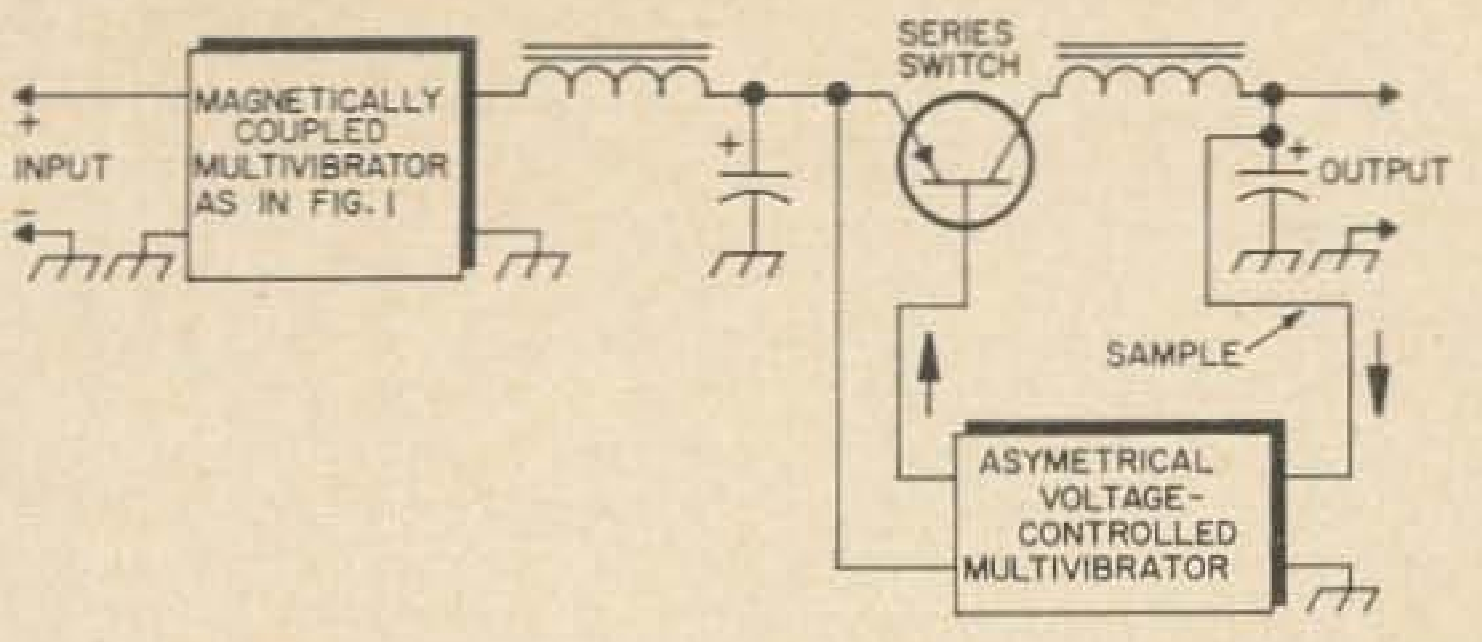



Fig. 2. DC converter with asymetrical voltage-controlled multivibrator regulation.

conversion and regulation in one simple circuit. It affords input-output isolation, high efficiency, and phenomenal input voltage tolerance. In fact, the unit will work on any input voltage from 6V to 24V with a constant output voltage of 12V. This would make it possible, for instance, to operate a transistor radio receiver on almost any type of vehicle having any battery voltage from 6V to 24V with either polarity grounded.[3]

The circuit is shown in **Fig. 3**, and it will be noted that it uses readily available and inexpensive parts. The total semiconductor cost is about ten dollars, and the transformer core will only cost about two dollars. The Siemens B65-701 in 2000N28 material with a 0.41 mm gap works nicely.

The regulation and efficiency are described in **Fig. 4.** It is rather a strange feeling to one to pick the device up as a "black box" and subject it to varying input voltage, with a 12V, 100 ma lamp on the output as a load. The bulb doesn't visibly change brilliance as the input is varied, and the input current *drops off* as we increase input voltage. This is all as it has to be, if efficiency is to be preserved, but to the "black box" viewer it at first appears to be black magic!

The circuit uses a rather large transistor for the power level in the series switch position. The 2N174 used is not even heat sink mounted, because it is not the 40 watt dissipation feature of this unit that is in use here. The 2N174

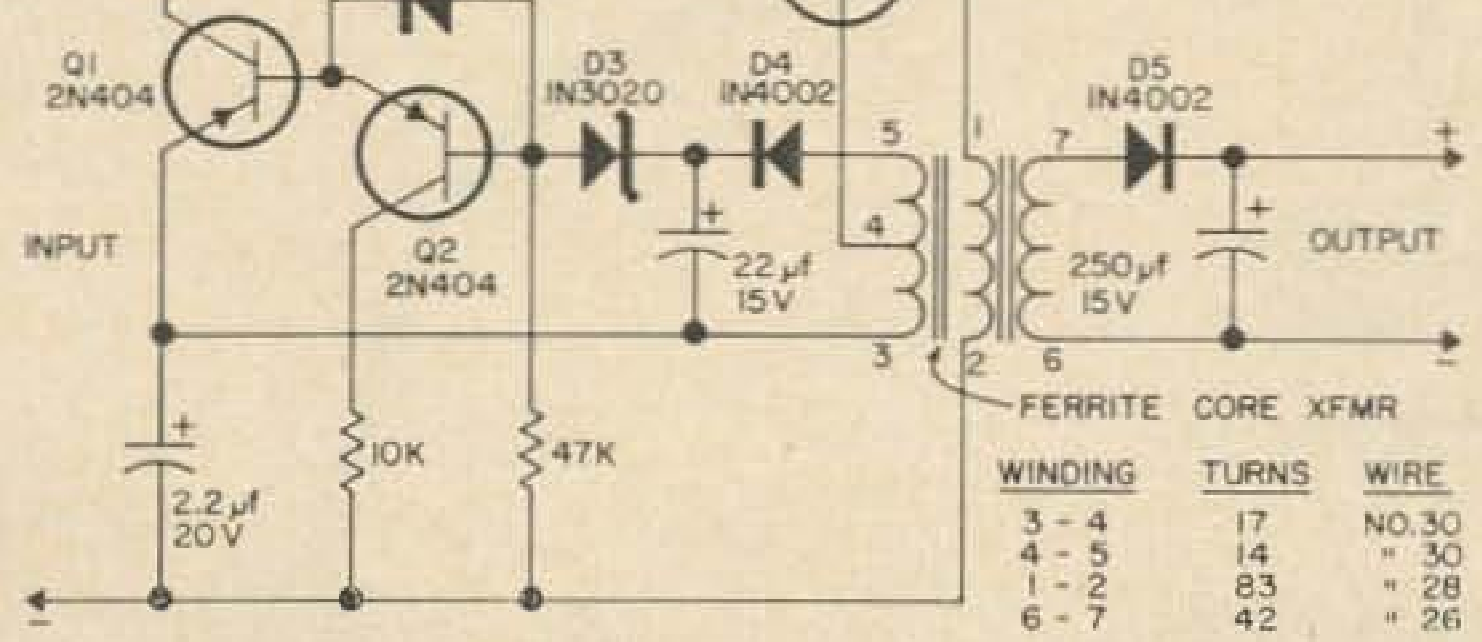



Fig. 3. Practical combined converter-regulator circuit. An input of 6 to 24 volts gives terminals 3, 1 and 6 are the beginnings of their respective windings. 12 volts output.

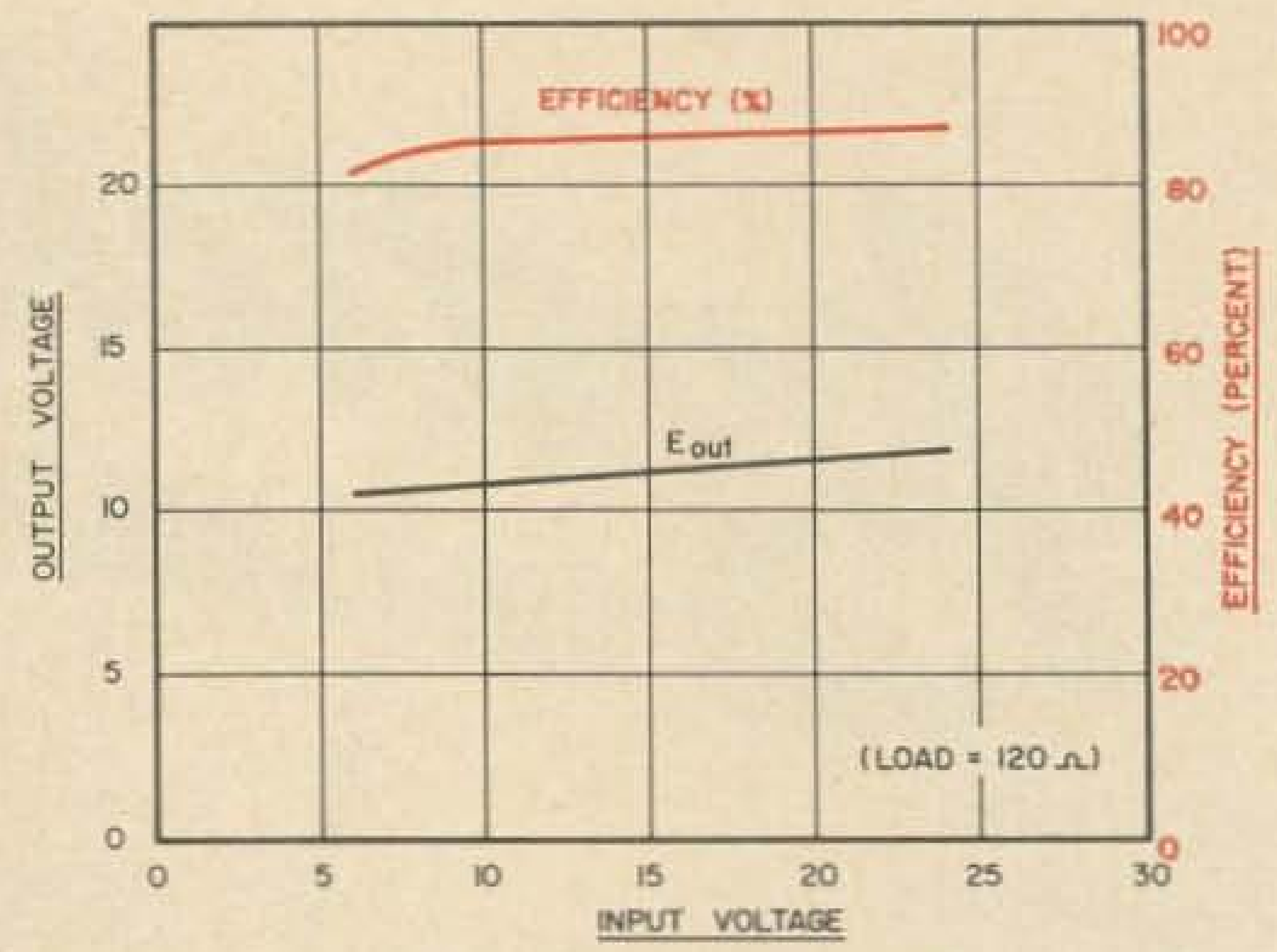



Fig. 4. Regulation and efficiency of the self-regulating DC to DC converter shown in Fig. 3.

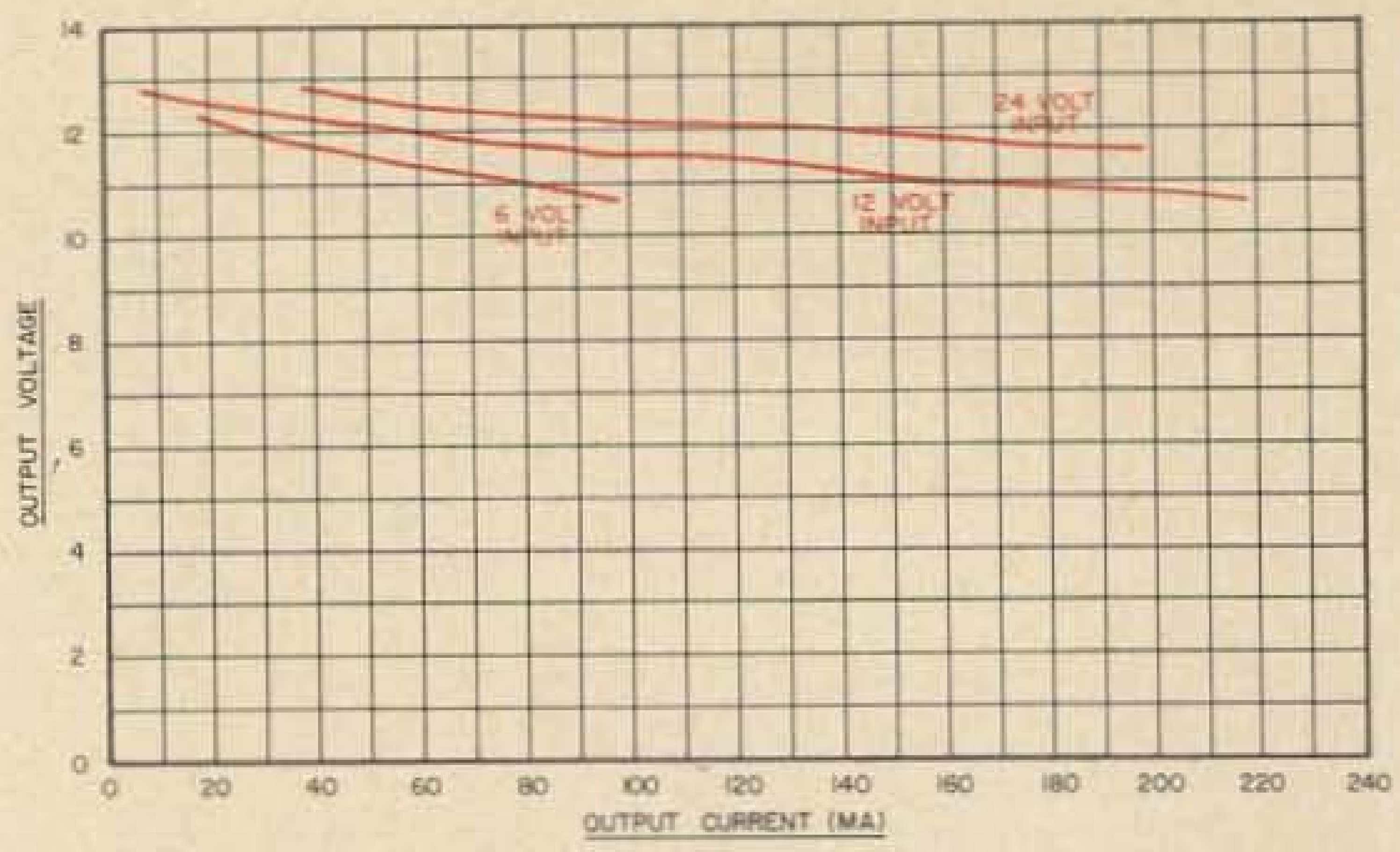



Fig. 5. Output current and voltage regulation with 6, 12 and 24 volts input.

was used simply as a low-priced compromise to give: (1) Low saturation voltage, (2) fairly high frequency cutoff, (3) high current capability, and (4) high breakdown voltage. (1) is understandable since the 2N174 is to act as a switch. (2) is to insure fast switching so that there is no large fraction of our duty cycle where there is appreciable voltage across the switch while current is being drawn through it. (3) is necessary because the maximum current drawn through the switch may be as great as five times the average input current. (4) because when the switch opens, there is a rather large inductive spike at the switch collector, and attempts to suppress this by means of capacitors increase the rise time of switching.

Surely there are other transistors which will work as well, and some perhaps better, but the 2N174 is the best this author has found. Since the features of low saturation voltage and high frequency cut-off are mutually incompatible, one has to pick his switch transistor to be a compromise. Either a high saturation or a low frequency cutoff will have the effects of lowering efficiency *and* raising the lower limit of regulated operation.

The converter is built on a circuit board which is etched to fit any of several series switch transistors; so one can try others if one wants to do so. The board fits into an L.M.B. 108 box chassis, for packaging.

This particular unit is used to power an FM receiver made up of Görler transistorized sections. The unit is used part time in a Volkswagon on 6V with a positive grounded system and used part time in a Chevy II on 12v with a negative grounded system. The versatility of the converter makes this type of operation completely successful.

. . . W6GXN

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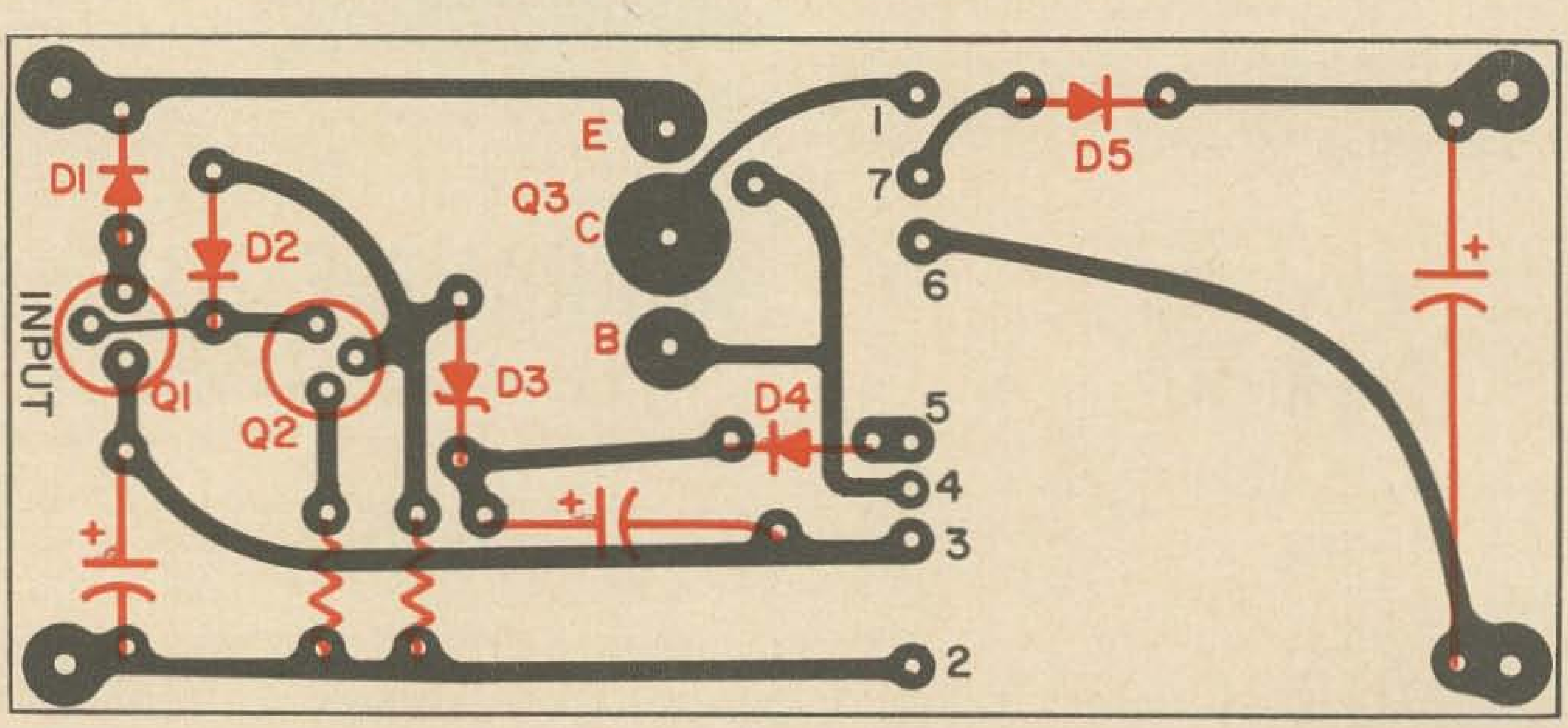


Fig. 6. Full-size printed circuit layout. This view is from the copper side, showing where the components lie on the opposite side.

Jim Kortge K8IQY
Jerry Kortge K8JAC
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# A Simple End of Line Indicator

This is an article to present a simple counter that works well as an end of the line indicator for the Model 14 typing reperforator. It will work equally well on any other type of reperforator, providing it has a punch bail used to operate a cam which in turn is used to close two contacts of a leaf switch each time the bail moves back. The cam-switch arrangement can be added to any reperforator by using one's imagination.

As can be seen from the schematic, the circuit is very simple. The power transformer was taken from an old television booster but anything that will supply the necessary 180 volts for the high voltage and 6 volts for the filament of the 6C4 will work fine. The rectifier is a 1N2071 silicon rectifier in a simple half wave circuit. The filter capacitor can be anything from 40 µf on up. The voltage regulator was included after the authors found that, without it, the counter was not accurate, due to changes in the line voltage. After the VR150 was added, the counter was accurate to plus or minus one pulse. The dc voltage is keyed by the cam-switch arrangement mentioned earlier. The rest of the circuit is composed of an integrator network and a dc amplifier. Each time the switch is closed by the cam, it sends a pulse of voltage through the variable resistor into the capacitor. The capacitor stores the pulses of voltage until the level is high enough to fire the NE-2 neon bulb. When the NE-2 fires, it drives the 6C4 grid positive making the tube draw a larger amount of current. This increase in plate current pulls in the plate relay which is in the plate circuit of the 6C4. When the relay pulls in, one set of contacts rings a bell indicating a full line has been punched, while the other set of contacts shorts out the capacitor, discharging its stored voltage, and the counter starts counting at zero again. The 10 µf capacitor across the winding of the relay gives a "hold in" time of about one second. This makes the bell ring for a short period instead of just striking once. It also provides a longer time to discharge the stored voltage in the capacitor. The purpose of the reset switch is to set the counter to zero at any time. Because we are typing blind when we use the 14, we sometimes forget where we are in our train of thought. When we start a transmission to any station we send his call, de K8JAC or K8IQY in Midland, Michigan returning, then reset the counter and proceed.

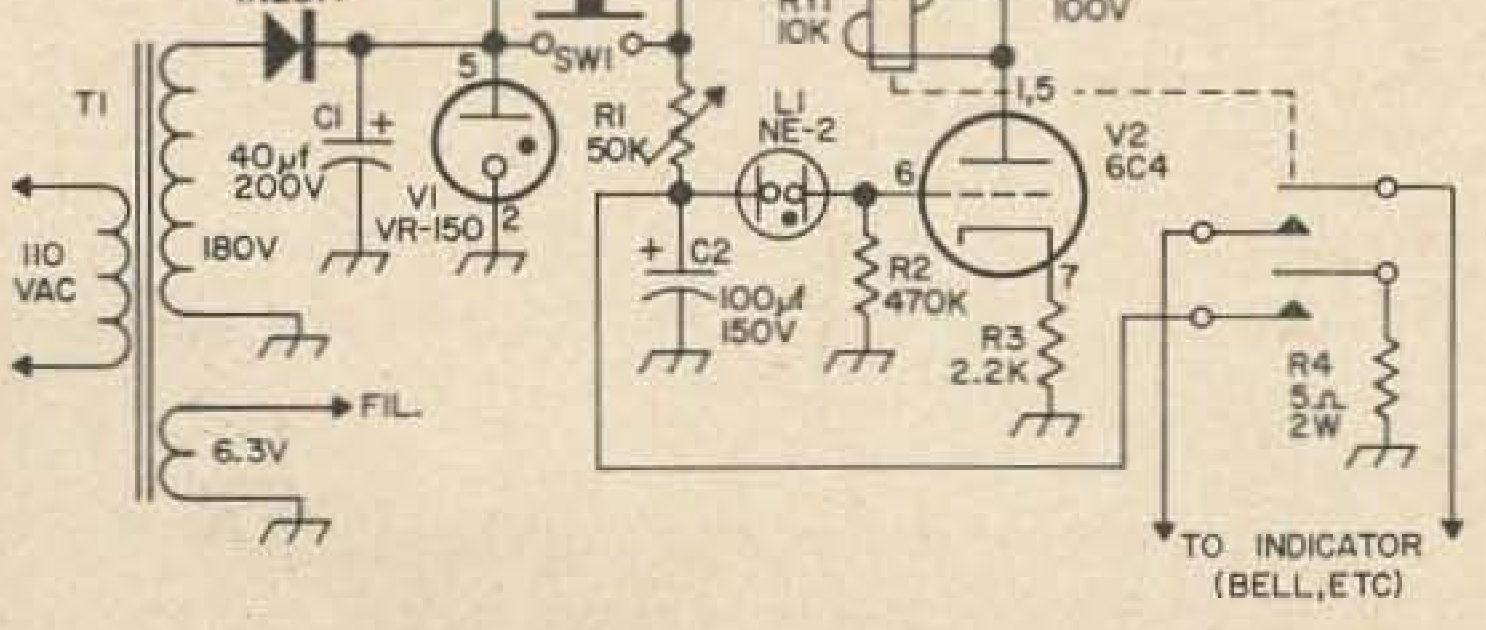


Fig. 1. A simple end of line indicator.

We hope this article will be helpful to those amateurs who have reperforating equipment in the shack but have not gotten it on the air because they lacked the necessary end of the line indicator. Although the one we constructed is not accurate to the pulse, it is accurate enough so we never over print another station's machine because we have punched too long of a line. At the present time we are using a 65 character line. As most machines will print a 72 character line before they over print, this gives a wide margin of safety with the plus or minus pulse accuracy of the counter. The number of characters to a line can be set to any number by the individual operator. This adjustment is made with the potentiometer in the integrator circuit. On our model we can vary the number of characters to a line from 40 to 80 with the 50 K potentiometer that we used.

. . . K8JAC, K8IQY

Lew Fitch W4VRV/8
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Columbus, Ohio 43212

# How Much Capacitance for the SSB Rig?

## *Or: Beat the high cost of microfarads*

Once upon a time I decided to build a big linear. (Didn't we all.) I had the big bottles, a power transformer, choke, sockets, chassis, variable capacitors, and even a circuit diagram for the final. No sweat so far. Let's draw the diagram for the power supply, haul out the surplus catalogs for the miscellaneous components and away we go. ## !! Look at the prices on those capacitors! They cost many dollars per microfarad. The higher the working voltage, the higher the price. Maybe we don't need 80µf at 3 kv after all. Let's see what the Handbook says. "The output capacitor should present a low reactance at the lowest frequency of interest." Thanks a lot, Buddy. What's low?

After going through the above line of reasoning, I got to wondering, "How much is enough? The following half-baked hypotheses are presented in the hopes that we'll all save money. The approximations are my own, and the entire process is presented so that it can be fudged at any point where you think I've guessed too conservatively, or conversely, come too close to the ragged edge.

A summary of the energy transfers involved would present a clearer picture of the quantities involved than a consideration of the impedance of an amplifier whose plate current varies. That output capacitor can be regarded as a storage device. There are times when the terminal voltage of the capacitor is well above the voltage supplied to it, since the input is pulsating. If there's an inductor (choke) ahead of the capacitor the voltage developed across the inductance when current is drawn through it opposes the change in current. This drops the supply voltage to the capacitor again. Consequently, in either case, the capacitor is standing alone for a while as a supplier of power for the final. The capacitor has $CV^2/2$ Joules stored in it, where C is in farads and V in volts. (We'll take care of the units later.)

Now comes the first of the assumptions. If the power supply is a half wave job, there is 1/60 second, or something less, between the intervals when the power supply is putting power into the capacitor. As a sort of worst possible case, assume that this capacitor must supply the entire amplifier input power for the full 1/60 second. This power is VI, where V is the power supply voltage and I is the peak dc current that the final stage draws.

While the capacitor is supplying the energy the voltage across the capacitor is going to fall off some. The amount of decrease is

$$\frac{C(V_1^2 - V_2^2)}{2} = VI \times \frac{1}{60}$$

In the above equation I assumed that the drop in voltage is small enough that $V_1$, the maximum voltage across the capacitor doesn't change much and is approximately V. (Purists may substitute $\frac{V_1 + V_2}{2}$ for V and go on from there.)

The question is: how much can this voltage be allowed to fall off without giving some distortion or noticeable decrease in power at the antenna? The second assumption is that we can stand a 1 db drop in power. If the current doesn't change much,

$$20 \log \frac{V_1}{V_2} = 1 \text{ db, or } \log \frac{V_1}{V_2} = 0.05$$

The number whose log is 0.05 is 1.122, so:

$$V_1 = 1.122\ V_2, \text{ or } V_1^2 = 1.26\ V_2^2 \text{ so}$$
$$V_1^2 - V_2^2 = .32\ V_1^2$$

going back to the expression with the capacitance in it;

$$\frac{C \times .32 \times V_1^2}{2} = \frac{V.I}{60} \text{ or, finally, } C = \frac{I}{V \times 9.6}$$

To use this as a formula giving C in microfarads, use I, the peak current to the final, in milliamperes and V, the final plate voltage, in kilovolts.

Note an economically fascinating fact about this equation. For a given input power, as the plate voltage goes up, current goes down, and, effectively, the amount of capacitance goes down as the square of the voltage. Since, as you remember, the price of capacitors seems to go up about the same way, the money comes out about even. But using this equation we're not misled into thinking that because a low voltage SSB rig uses 80µf filters we have to use 80µf at 3000 volts.

For example: a 1 KW PEP rig with 500 volts on the plates would draw 2 amperes on peaks and require from the formula an output capacitance of 410µf for a 1 db drop, running full bore. A 1 KW PEP rig with a 2 KV plate supply and 500 ma peaks would require about 26µf for the same 1 db drop:

$$C = \frac{500}{2 \times 9.6} = 26$$

Notes on the assumptions: The assumption that the capacitor supplies full power to the final is only going to apply for an almost square envelope output, a case you would only get with either CW or clipping of the sort used by the Clegg VHF gear. For unclipped SSB, a sine wave assumption might be better, in which case only half as much capacitance would be necessary. For full wave rectification only half of that will be required.

The assumption of an allowable 1 db drop in power was taken because 1 db is the minimum detectable change to the ear. One KW falls off to 800 watts at 1 db down, though, so 1 db might be a bit much.

Don't blame me if somebody's commercial gear uses less capacitance than the equation calls for—they may have settled for a drop of more than that 1 db that I assumed. Just say "aaah" into the mike and see if the output power meter drops as the syllable goes on.

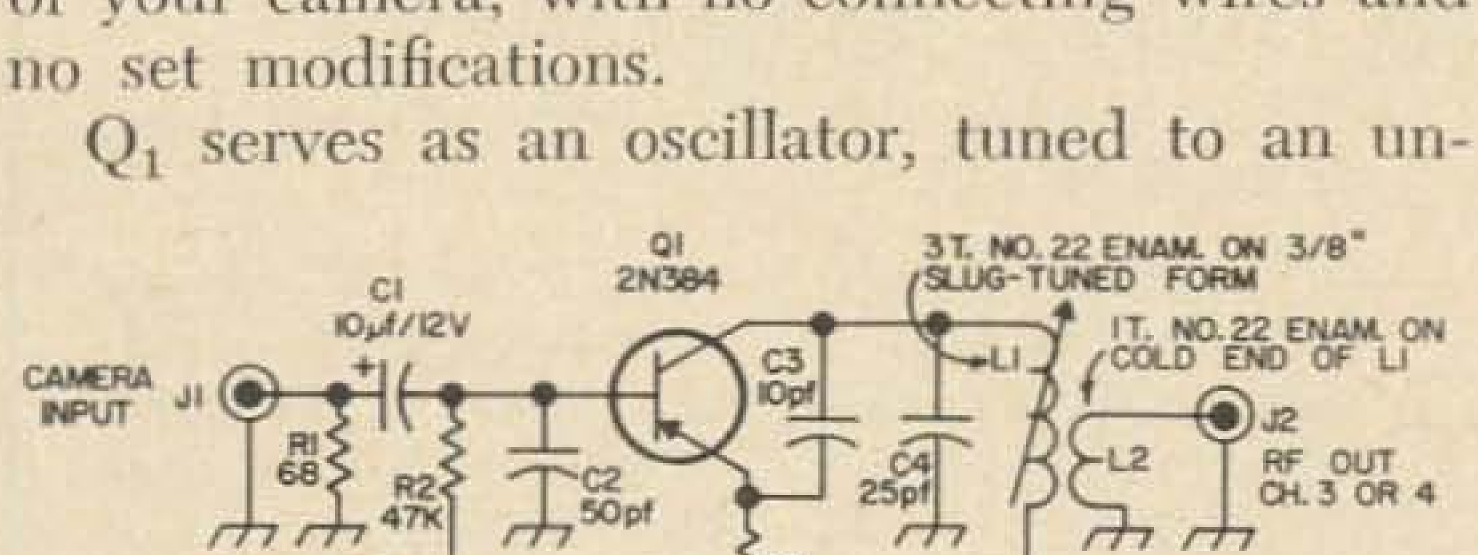
. . . W4VRV

## A Simple Oscillator for Monitoring ATV

Ralph Taggart WA2EMC

Monitoring the output of an ATV camera, whether it's a flying spot scanner or a vidicon, can present a few problems. If the TV set you would like to use as a monitor is a fairly new one, there is often a little reluctance about cutting into it to make the necessary modifications. A second problem arises if you want to give a closed circuit demonstration at a hamfest, club meeting, or at someone else's shack. The usual procedure is to pack both the camera and TV set into the car and take off, but in my case anyway, this produces an inconvenience factor which is directly proportional to the size of the set and inversely proportional to the size of the car. This unit, which will fit into a small Minibox, will solve both these problems. Basically, it is a low powered TV transmitter which, when parked next to any TV set, will allow you to view the output of your camera, with no connecting wires and no set modifications.

$Q_1$ serves as an oscillator, tuned to an unused TV channel between 2 and 6. The oscillator is base modulated by the camera, with a 68 ohm resistor serving as a termination for the coaxial cable carrying the camera output. $C_4$ and $L_1$ are the principle frequency determining elements, and with the values shown, it will hit channel 3 or 4, depending on the setting of $L_1$. If output on another channel is desired, one or two additional turns on $L_1$ should get the oscillator on channel 2, while reducing $C_4$ to about 10 pf and juggling the number of turns on $L_1$ will give output on channels 5 and 6.




The ATV monitor oscillator. The author recommends replacing the 2N384 with a more modern transistor such as the 2N1746 if there is trouble maintaining oscillation when the input is loaded.

The output jack can be a coax connector, a phono jack, or even a binding post. Only about one or two inches of wire connected to the output jack will be sufficient for a good picture when the unit is placed next to the TV set. Keep in mind that a TV channel is not a ham band, and more output than you need won't improve the picture, but in many cases, it might get you in hot water!

My unit was constructed on a 2x3" piece of Vector board and packaged in a 2¼ x 2¼ x 4" Minibox. Mounting the input connector at one end, with the output at the other makes a compact arrangement. A SPST switch and a 9 v transistor battery complete the unit. The battery may be taped to the bottom cover of the Minibox, and if you don't forget to turn it off for a week or two running, you should get just about the normal shelf life. The modulation level can be controlled with the camera gain control.

This little gadget literally uses only a handful of parts, but you'll wonder what you did without it.

. . . WA2EMC

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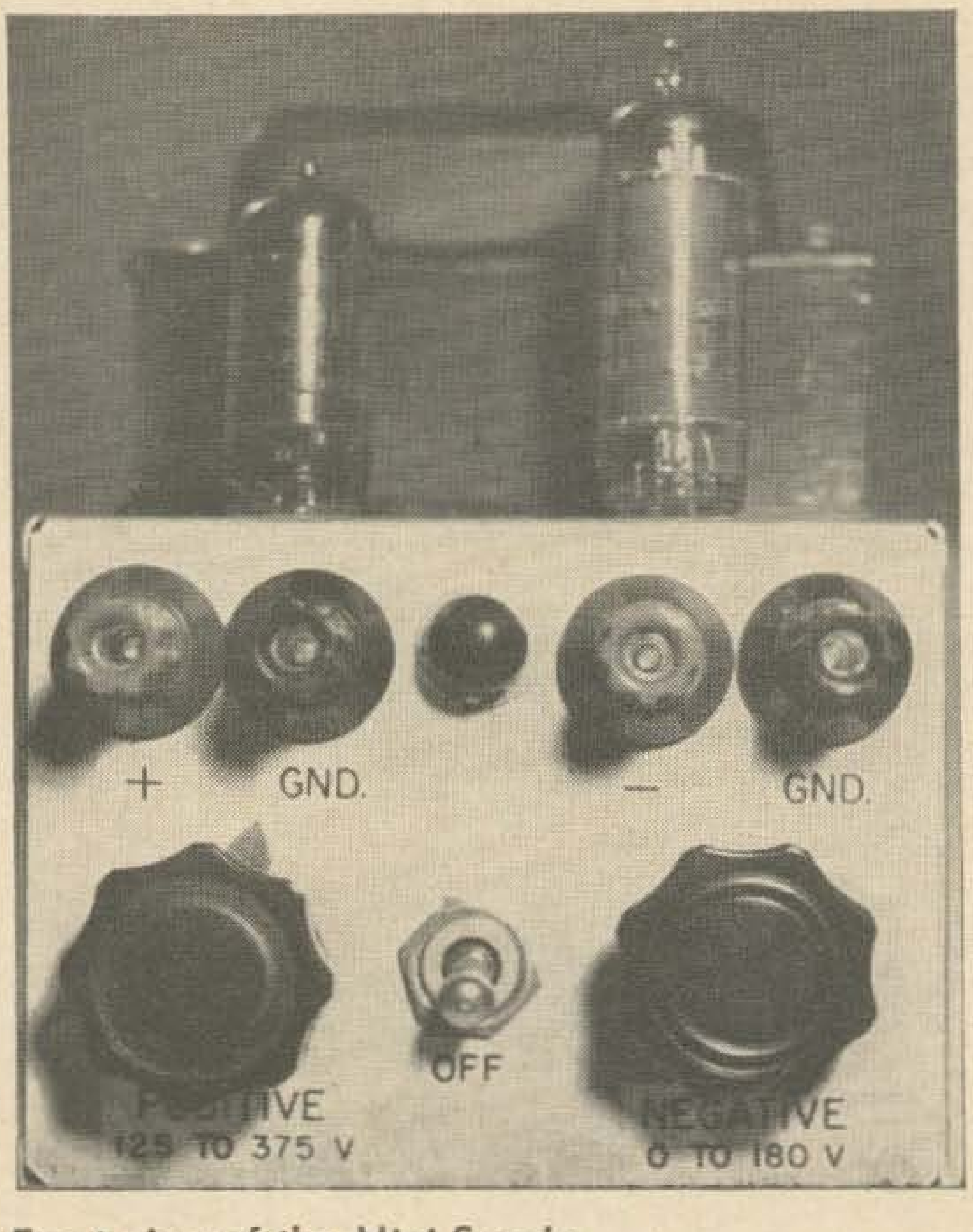
# The Mini Supply

How many times have you wished that you had one more source of high voltage? Invariably when breadboarding circuits, one of the problems that arises is the need for an additional source of regulated voltage. This is particularly true in VHF and microwave work when setting up *if* strips, mixers and other peripheral equipment. Furthermore, this type of work usually requires a certain amount of portability. Unfortunately, most bench type regulated supplies are rather bulky affairs which don't lend themselves too well to moving around. In addition to being simple, inexpensive and lightweight, the truly versatile supply should provide both variable positive and negative voltages. With these requirements in mind, the "mini-supply" was constructed.



Front view of the Mini-Supply.

This unit is compact, inexpensive, and provides an adjustable positive voltage from 125 to 375 volts and an adjustable negative supply from zero to −180 volts.

Until recently, the realization of a really lightweight, high-voltage regulated power supply was next to impossible; with the advent of inexpensive semiconductor diodes this is no longer true. There is no doubt whatsoever that transistors are here to stay; but for many high voltage applications vacuum tubes are still a better choice at the present state of the art. However, the use of silicon rectifiers and regulator diodes cuts size, weight, and cost. In fact, with a little shopping around, semiconductors may be obtained at a lower cost than equivalent vacuum tubes. For example, the total cost of the diodes in this unit was $3.57. The vacuum tube equivalents (assuming a 5U4G full-wave rectifier, a 6X4 half-wave rectifier and three OB2's) would run about $3.75, even on the surplus market. The hybrid design of **Fig. 1** evolved by using the best characteristics of both silicon diodes and vacuum tubes to the most advantage.

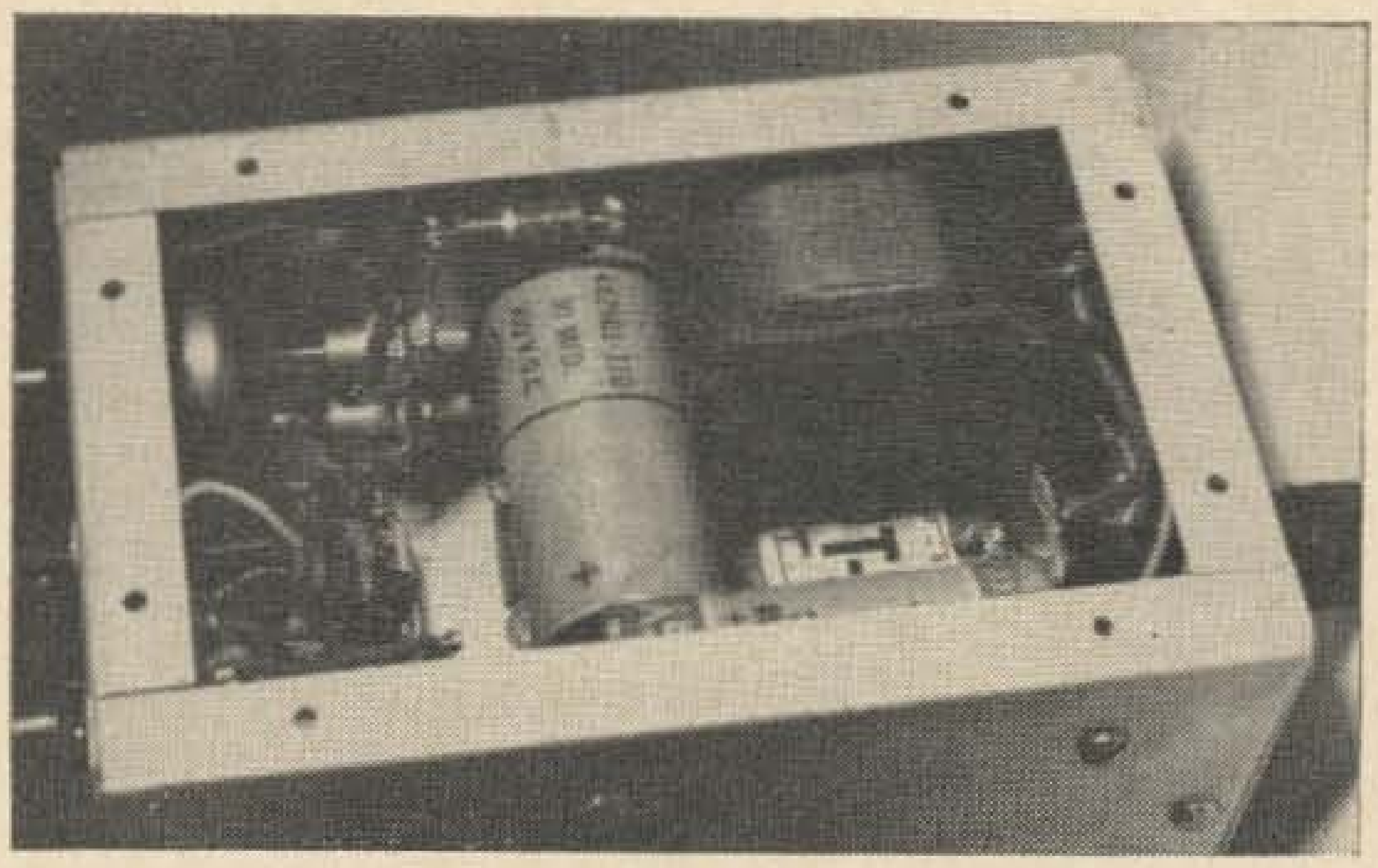
In essence, the positive voltage section of this power supply consists of a simple series regulator in series with the B+ line. A small portion of the output voltage is picked off at the 25K pot and fed to the grid of the 6AU6 voltage amplifier. The cathode of this tube is maintained at 90 volts above ground by the 90 volt, 450 milliwatt zener diode in the cathode lead. The voltage fed into the grid is compared to this 90 volt reference signal and the plate voltage varies accordingly. This voltage controls the grid of the 6AQ5A series regulator and determines the voltage drop across it. In other words, the 6AQ5A series regulator acts like a voltage-controlled resistor in series with the high-voltage line.

To show how the regulation process works, consider the case where the load increases and tends to lower the regulated output voltage.

As the output voltage goes down, so does the voltage on the grid of the 6AU6. As the grid voltage decreases, the plate current flow decreases and the plate voltage goes up because there is a smaller voltage drop across the 220K ohm plate load resistor. Of course, this increasing plate voltage is reflected on the grid of the 6AQ5A regulator tube; the cathode current increases and the cathode voltage goes up. Actually, all this happens instantaneously and any time the output voltage tends to increase or decrease, the voltage amplifier and series regulator immediately compensate just enough so that the output stays at the same level.

When you want to change the output voltage, rotation of the potentiometer changes the voltage at the grid of the voltage amplifier. This voltage change sets the electronics in motion and the circuit immediately tries to compensate; this results in the desired change at the output.

Any compact high-voltage power transformer with about 350 volts each side of center tap at about 100 mils is suitable for this supply. The exact voltage is not too important because there are inherent differences between regulator diodes and slight component adjustments will be required anyway. However, don't let this frighten you; the only component that will change is the 6800 ohm resistor between the 25K pot and ground and the proper value is easily determined. Simply attach the lower end of the 25K pot to ground and measure the voltage at the cathode of the 6AU6 as the potentiometer is varied from one



Bottom view of the Mini-Supply. Note the mounting of the zener diodes (right center) and the way the components are stacked up around the edge of the chassis.

end to the other. You will note that the cathode voltage remains constant at about 90 volts over a rather wide range of potentiometer resistance, but abruptly falls off as the arm of the pot passes a certain point approaching ground. Below this "break-off" point, the cathode current of the 6AU6 is insufficient to maintain proper zener regulation; therefore, a resistor must be placed in series with the pot to limit the resistance between the 6AU6 grid and ground to the required level.

To determine the required series resistance, set the pot slightly above this breakoff point, turn off the power and measure the resistance between the arm of the pot and ground. Assuming that the measured resistance is 5600 ohms, the simplest approach at this point would be to remove the 25K pot from the

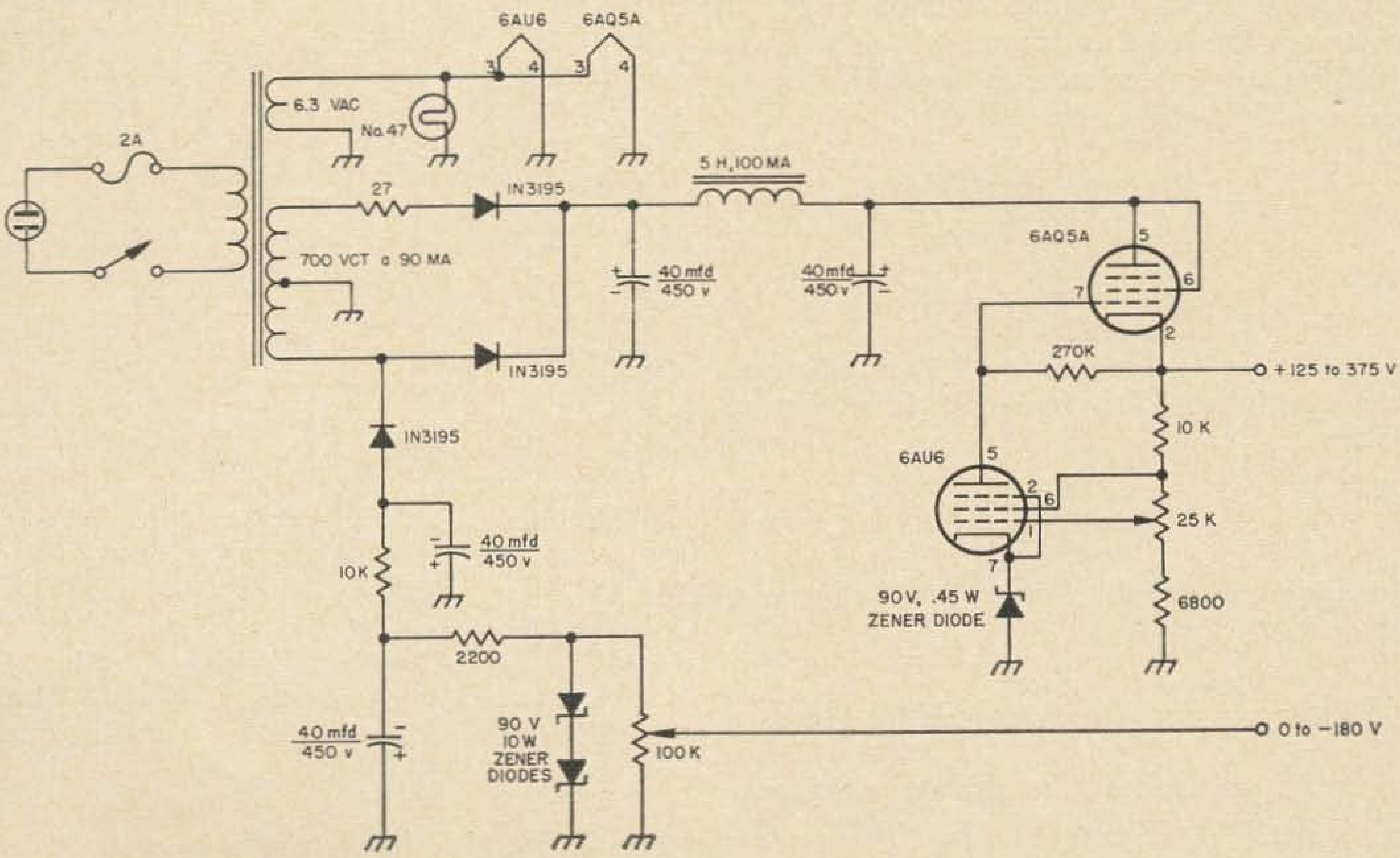



Fig. 1. The Mini-Supply.

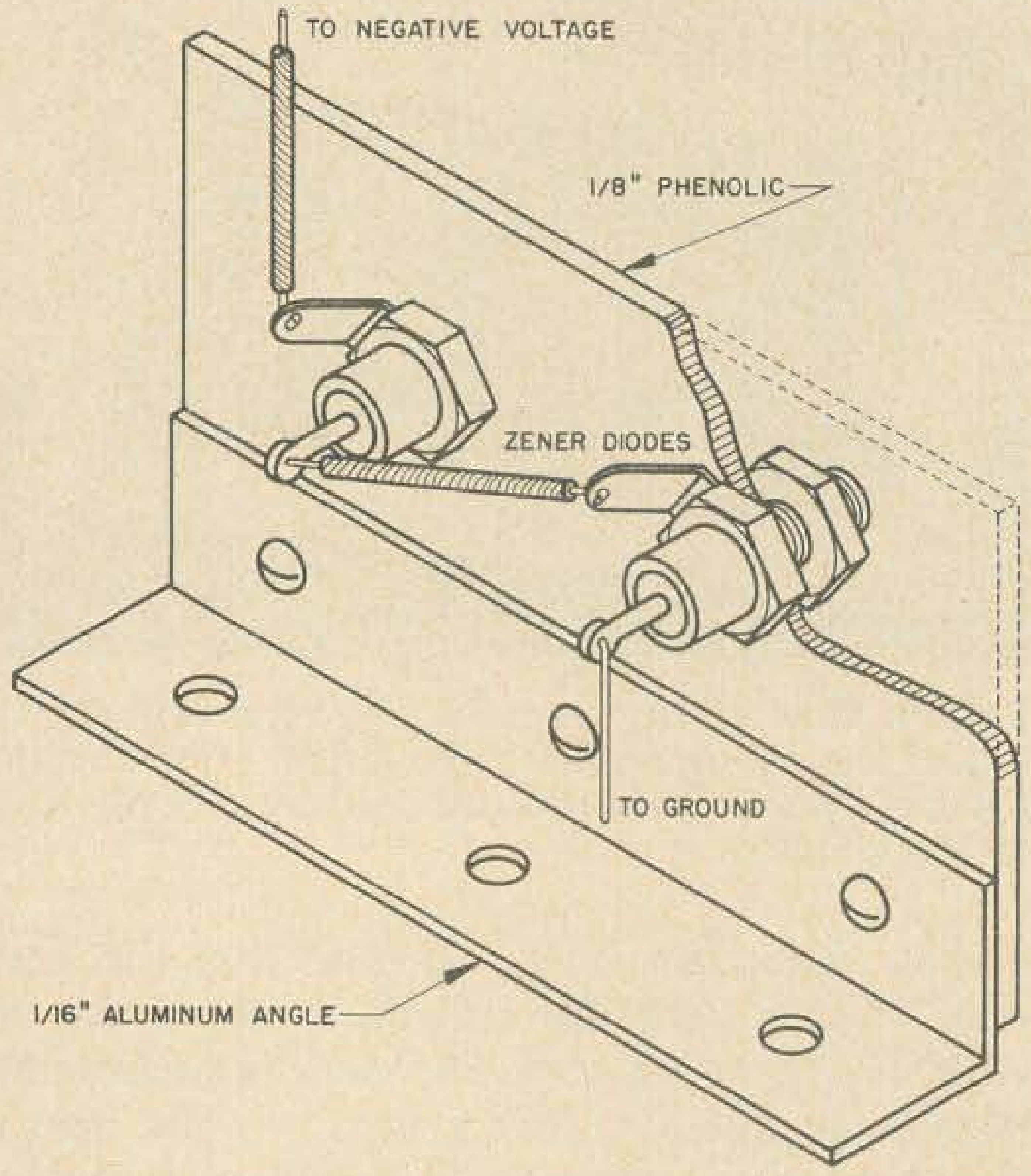



Fig. 2. Mounting the ten watt zener diodes.

circuit and replace it with a 20K pot in series with a 5600 ohm resistor. This combination would pretty nearly meet the requirements, but being economical at heart, why not use the 25K pot in series with a value of resistance which provides the same voltage ratio? Using the measured value of resistance (5600 ohms), the correct value of series resistance may be calculated by the following procedure:

1. Calculate the ratio (designated K) of the measured resistance ($R_m$) to the total resistance in the voltage divider ($R_T$). In this case the total resistance consists of the 10K resistor in series with the 25K pot or, $R_T = 35000$ ohms. Therefore

$$K = \frac{\text{Measured Resistance}}{\text{Total Resistance}}$$

$$= \frac{R_m}{R_T} = \frac{5600}{35000} = 0.16$$

2. Calculate the value of the added series resistance ($R_s$) from the following relation:

$$R_s = \frac{R_m}{1 - K}$$

In this example where $R_m = 5600$ ohms and $K = 0.16$,

$$R_s = \frac{5600}{1 - 0.16} = \frac{5600}{0.84} = 6667 \text{ ohms}$$

3. Select the next largest standard value of resistance for the series resistor (6800 ohms in this case).

With a properly adjusted output resistance combination, the positive voltage is continuously variable from about 125 volts to 375 volts. The current capacity of the positive supply is limited by the current rating of the transformer at the higher voltages and by the maximum permissable plate dissipation of the 6AQ5A at the lower voltages. For a unit with 100 milliamp power transformer, operation should be maintained within the "safe operating range" diagrammed in **Fig. 3.** Regulation is not as good above 325 volts as it is on lower voltages, but it is still stiff enough for the majority of breadboard circuitry and bias applications.

Thus far very little has been said about the variable negative voltage. This circuit is a straightforward shunt regulator using zener diodes in place of the familiar gas regulator tube. With the diodes shown in the schematic, this voltage is available from zero to about −180 volts. The current capacity of the negative supply is determined by the power rating of the regulatory diodes; for 10 watt devices, 30 milliamperes is available on a continuous basis. With the addition of a suitable heat sink, this could be just about tripled, but a much larger chassis would be required.

Most of the commercially available stud-mounted regulator diodes are designed for regulating positive voltages and as such, the chassis mounting stud is located at the cath-

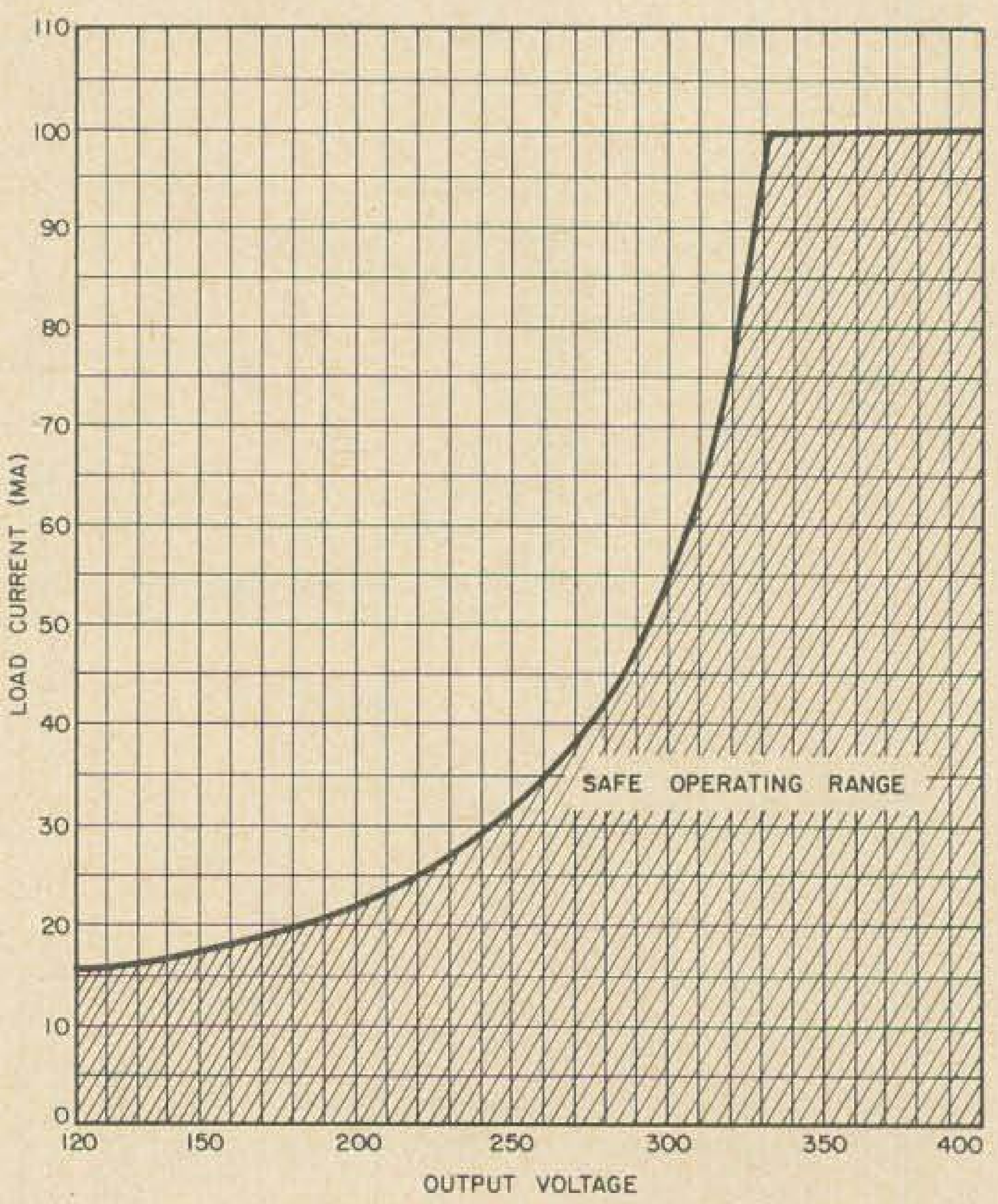



Fig. 3. The Mini-Supply should be operated within the safe operating range above.

ode stud must be isolated from ground. A simple way of accomplishing this is illustrated in **Fig. 2.** Although this mechanical arrangement seriously limits the total dissipation of the diodes because of the poor heat conducting qualities of the phenolic board, the current required from a negative supply such as this is usually at a minimum and this type of construction is more than adequate.

The entire mini-supply is housed in a standard 6 x 46 x 3 inch aluminum chassis. It is evident from the photographs that it's a little crowded, but there is more than eough room for all the components. The easiest way to put the supply together is to install the power transformer, choke, diodes and front panel controls first; then the filter capacitors are wired into the circuit. In this way the circuitry is built up in tiers and there is sufficient room to work. The available space may be more fully utilized by mounting the 90 volt reference diode and resistors associated with the 6AU6 voltage amplifier on a 7 pin turret socket (Vector type 8-M-9T).

In the several months that this supply has been in use, it has proven to be an invaluable adjunct to the workbench. In fact, like so many new tools, I often wonder how I got along without it!

. . . WA6BSO

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# Origin of the Wireless Code

***International Morse Code: the lifeblood of CW men but a parasite to phones. Where did it come from? When did it start? Who invented it? Why? How does it differ from American Morse? What is "Continental"?***

Confusion reigned on the high seas during the early days of wireless. A wireless operator who sailed in the American merchant marine from 1904 to 1907, states he used American Morse. An *American Morse* operator who left the sea in 1907 to work at the Telefunken station in New York City, will never forget the struggle to copy the first message: *"Continental" code in the German language*. The combination practically swamped him. Another operator, sailing out of Philadelphia in 1910, distinctly recalls using International Morse. In the Gulf, a former chief engineer at WNU, (Tropical Fruit's key station in New Orleans) tells about the "fun" the night American law required the Great White Fleet to switch over to *International Morse*. And David Sarnoff of the Radio Corporation of America says he used "Continental" during the Titanic disaster of 1912 when he handled messages between the rescue ship Carpathia and Wanamaker's New York City store where he worked. *All speak the truth.*

Foreign ships used International Morse. Nevertheless, problems hounded them too. It took an International Wireless Telegraph Conference held at Berlin in 1903 to get nations to agree to exchange messages between ship and shore stations using rival equipment, *to agree to give preference to calls for help*, and to set a fixed scale of charges for messages. At a second Berlin conference held in 1906, twenty-seven nations met and agreed to use the International Morse code and adopted SOS for the distress signal. (English ships used CQD and the Germans SOE). The United States sat in at the 1906 conference too, but the Senate never ratified the treaty. America's ships continued with both codes.

Operators who learned the code at American Marconi schools, transmitted in International Morse. Telegraph operators who switched to the sea, sent American Morse. Naturally, many American ships couldn't communicate with each other let alone with the foreign fleet. At the London Convention of 1912, nations created the "Q" signals and again tried to establish International Morse as the sole code. Once more the United States attended and the Senate procrastinated. Not until the Titanic, England's "unsinkable" luxury liner, struck an iceberg on her maiden voyage and sank, did the United States act. On July 1, 1913, International Morse became the universal wireless code.

## The early codes

If you don't like the code, don't blame wireless; blame the telegraph. Wireles didn't create International Morse, it only adopted it. International Morse code existed fifty years before Marconi spanned the Atlantic with the letter "S" on December 19, 1901. It grew out of American Morse.

Dot-and-dash codes originated with the electromagnetic telegraph. The first dates back to 1838. It occurred as a result of the Morse/Vail experiments that lifted electricity out of the

|  | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
|---|---|---|---|---|---|---|---|---|---|
|  | Bacon. | Rees. | Swaim. | Schilling. | Gauss & Weber. | Steinheil. | Original Morse. | Later Morse. | European Morse. |
|  | 1605. | 1809. | 1829. | ---- | 1833. | 1836. | 1838. | 1844. | 1951. |
| A | aaaaa | 11111 | t | rl | r | lrl | sss | sl | sl |
| B | aaaab | 11112 | tt | rrr | ll | lrrl | ss ss | lsss | lsss |
| C | aaaba | 11121 | ttt | rll | rrr | llr | s ss | ss s | lsls |
| D | aaabb | 11122 | tttt | rrl | rrl | rl | sss s | lss | lss |
| E | aabaa | 11211 | s | r | l | l | s | s | s |
| F | aabab | 11212 | ss | rrrr | rlr | lrr | s sss | sls | ssls |
| G | aabba | 11221 | sss | llll | lrr | rrl | ss s | lls | lls |
| H | aabbb | 11222 | ssss | rlll | lll | rrrr | ssss | ssss | ssss |
| I | abaaa | 12111 | ts | rr | rr | r | sl | ss | ss |
| J | ---- | 12112 | t tts | rrll | ---- | r | ss s | lsls | slll |
| K | abaab | 12122 | t t | rrrl | rrr | llr | lsl | lsl | lsl |
| L | ababa | 12211 | t tt | lrrr | llr | rll | l' | l' | slss |
| M | ababb | 12212 | t ttt | lrl | lrl | rrr | lss | ll | ll |
| N | abbaa | 12221 | t tttt | lr | rll | rr | ls | ls | ls |
| O | abbab | 12222 | t s | rlr | rl | lll | ss | s s | lll |
| P | abbba | 21111 | t ss | llrr | rrrr | rllr | sssss | sssss | slls |
| Q | abbbb | 21112 | t sss | lllr | ---- | ---- | ssls | ssls | llsl |
| R | baaaa | 21121 | t ssss | lrr | rrrl | ll | s s | s ss | sls |
| S | baaab | 21122 | t ts | ll | rrlr | llrr | sls | sss | sss |
| T | baaba | 21211 | tt tts | l | rlrr | lr | lls | l | l |
| U | ---- | 21212 | tt t | llr | lr | rlr | sll | ssl | ssl |
| V | baabb | 21221 | tt tt | lll | rlr | rlr | l | sssl | sssl |
| W | babaa | 12121 | tt ttt | rlrl | lrrr | rlrl | ssl | sll | sll |
| X | babab | 22212 | tt tttt | lrlr | ---- | ---- | ll | slss | lssl |
| Y | babba | 22221 | tt s | rllr | ---- | ---- | sl | ss ss | lsll |
| Z | babbb | 22122 | tt ss | rlrr | rrll | rrll | sls | sss s | llss |

Fig. 1. Comparison of the early alphabetic codes with the final International Morse code created by the Germans.

laboratory and put it to work. At last the world possessed the means for rapid distant communication; communication dependable day or night regardless of the weather. A triumph of simplicity itself, American Morse survived well over a hundred years in telegraph systems of the United States and Canada. It provided careers for thousands, a hobby for thousands more, and set the foundation for amateur radio.

Construction of the American Morse code undoubtedly benefited from the alphabetic codes available at the time. A number existed. One goes back to the ancients 150 years before the Christian era. The Greek historian, Polybius, in the tenth book of his General history, describes a bi-signal method of signaling over a distance by torches. He credits Cleoxenus and Democlitus with the invention and himself with its perfection. The scheme divided the Greek alphabet of 24 letters into five series or tablets with each (except the last) containing five letters. One to five torches exposed on the left side indicated the group or tablet; similar torches raised on the right side indicated the place of the letter on the tablet. Slow and useable only at night, distance depended upon weather conditions and the resolving power of the receiver's eye.

Non-alphabetic systems got messages across much faster. Roman armies used the heliograph; the African, the tom-tom; the American Indian, smoke signals. Reflected sunlight flashing off polished shields, conveyed battle instructions to Roman legions and spread deeper fear among defending armies. Tom-tom rhythms, haunting as the drums in Ravel's musical classic "The Bolero," aroused the jungle and sent cold chills up and down the spines of white traders in slaves. Puffs of smoke floating lazily above surrounding peaks, forecast a kind of trouble that raised hair on end as pioneers in Conestoga-wagon caravans trespassed Indian lands to settle the American West. Again, weather affected each. Subject to sunlight, daylight, or wind conditions, these systems could convey only limited intelligence.

Galileo's telescope gave birth to a much faster system—the semaphore. Using it, Claude Chappe, a French engineer produced a practical system that sent messages all over France. Above simple towers holding a vertical wooden post, a horizontal beam pivoted controlled by ropes. At the end of the beam, two vertical

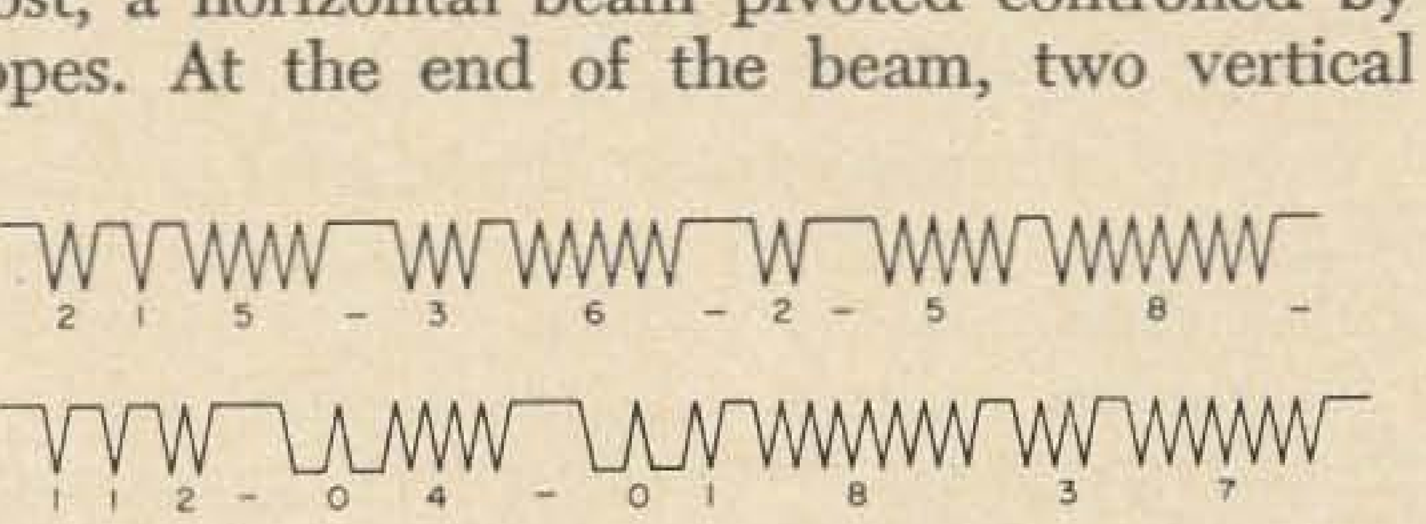


Fig. 2. Example of constant-line message produced by Morse's first telegraph machine. The receiving operator numbered the "V's" between spaces. By comparing the groups of numbers with a numbered dictionary, he deciphered the message. An inverted "V" represented a zero. When the zero came before a number or group of numbers, the operator read the number as an actual number not a word.

**LETTERS**

| | | |
|---|---|---|
| A - — | J — - — - | S - - - |
| B — - - - | K — - — | T — |
| C - - - | L — — | U - - — |
| D — - - | M — — | V - - - — |
| E - | N — - | W - — — |
| F - — - | O - - | X - — - - |
| G — — - | P - - - - - | Y - - - - |
| H - - - - | Q - - — - | Z - - - - |
| I - - | R - - - | & - - - - |

**NUMERALS.**

| | | |
|---|---|---|
| 1 - — — - | 4 - - - - — | 8 — - - - - |
| 2 - - — - - | 5 — — — | 9 — - - — |
| 3 - - - — - | 6 - - - - - - | 0 ———— |
| | 7 — — - - | |

**PUNCTUATION.**

| | |
|---|---|
| Period - - — — - - | Exclamation — — — - |
| Comma - — - — | Parenthesis - — - - — |
| Semicolon - — - — - | Italics — - - - — |
| Interrogation — - - — - | Paragraph — — — — |

Fig. 3. The alphabet of Revised Morse; the code used in telegraphy throughout America and Canada.

arms moved. Movement of the three members produced a large number of configurations which a viewer at the next tower read through a telescope. When in 1852 the electric telegraph replaced the semaphore system, a network of 556 semaphore stations covered France stretching over a total distance of 3000 miles.

England used a different scheme. The visual system installed by the British Admiralty between London and its naval bases consisted of 15 towers each supporting a horizontal board that contained six circular holes opened and closed by shutters. A round-trip test run over the London to Plymouth circuit covered the 500-mile route in three minutes—170 miles a minute. A tremendous speed at that time, but a speed dependent upon daylight and clear weather. In the United States, the first semaphore system connected Martha's Vineyard with Boston in 1800.

For speed and maximum intelligence, inventors turned to alphabetic codes. **Fig. 1** shows a comparison of nine. Probably the first five-unit, even-letter code of record appears in Francis Bacon's monumental work, "Advancement in Learning" published in 1605. It antedates Morse by over 200 years. Bacon's code used two letters; "a" and "b". By juggling them around through five positions, he obtained thirty-two differences—far more than the twenty-four required for the alphabet then used. (J and U didn't appear in the alphabet at that time)

In volume eight of Dr. Abraham Rees' Cyclopedia published in 1809, a signaling alphabet similar to Bacon's appeared using numbers instead of letters. This code included symbols for letters "J" and "U". The first nine letters of the alphabet followed exactly the notation of Bacon. After injection of the letter "J" which takes the same symbol as Bacon's "K", the remainder of the alphabet from "K" to "V" inclusive follows regularly the arrangement of Bacon's but shifted two letters downward. Only the symbols for "X", and "Y", and "Z" differ. See columns I and II of **Fig. 1.**

James Swain of Philadelphia in 1829 published "The Mural Diagraph, or the Art of Conversing through a Wall." Sometimes designated the *prison code,* the symbol "t" signifies an audible tap or knock, and the "s" an audible scratch. Swain failed to use the simplest combinations of taps and scratches possible. He gave five signals to "N", "R", "T", and "W" and six to "X" when combinations of only four could suffice to make characters. Also, byt adopting the "numeral system," Swain could not escape using awkward, spaced letters in two-thirds of the alphabet. Column III shows this code.

Baron Schilling of Cronstadt, a Russian counselor of state, used the low potential cell of Alessandro Volta and the galvanometer of Luigi Galvani to develop a telegraph system moving an upright pointer to the left or right of a fixed position. His code consisted of combinations of the letters "R" (right) and "L" (left) as shown in column IV. Five letters of Schilling's code appear in the International Morse code.

Gauss and Weber of Germany introduced a telegraph system in 1833 that used an "r" and "l" code of unequal length. A simple plus or minus dot made up the binary combinations. Steinheil expanded upon their system. He also used the "r" and "l" method but his equipment made dots upon a ribbon of paper from small becks holding ink. Two rows of dots appeared, one to the left and one to the right, looking very similar to a modern cable signal record. Like Schilling and Gauss, Steinheil gave short symbols to the letters appearing most often in German. In a paper published in Sturgeons "Annals of Electricity" in 1839, he anticipated reading telegraphy by ear.

## American Morse

Professor Samuel Finley Breeze Morse solved the telegraph problem by not expecting too much out of a primary circuit. His first apparatus, however, bore little resemblance to the final system put into operation between Washington and Baltimore May 24, 1844. Neither did the code.

Morse's patent disclosure dated October 3, 1837, showed a pendulum holding a pencil in contact with a moving strip of paper. *A continuous line appeared on the paper.* Pieces of cast type containing 1 to 9 raised points, (equal to the numbers they represented) fit into a hodler when composed to form a mes-

**LETTERS.**

| | | |
|---|---|---|
| A - — | L - — - - | W - — — |
| B — - - - | M — — | X — - - — |
| C — - — - | N — - | Y — - — — |
| D — - - | O — — — | Z — — - - |
| E - | P - — — - | |
| F - - — - | Q — — - — | Ch — — — — |
| G — — - | R - — - | ä - — - — |
| H - - - - | S - - - | ö — — — - |
| I - - | T — | ü - - — — |
| J - — — — | U - - — | é - - — - - |
| K — - — | V - - - — | ñ — — - — — |

**NUMERALS.**

| | | |
|---|---|---|
| 1 - — — — — | 4 - - - - — | 8 — — — - - |
| 2 - - — — — | 5 - - - - - | 9 — — — — - |
| 3 - - - — — | 6 — - - - - | 0 — — — — — |
| | 7 — — - - - | |

**PUNCTUATION, ETC.**

Parenthesis — - — — - —
Understand - - - — -
I don't understand - - — — - - - - — — - -
Wait - — - - -
Erase - - - - - - - - -
Call signal — - — - — - —
End of message - — - — - — - — -
Cleared out all right - — - - - — - - - — -
Period(.) - - - - - -
Comma(,) - — - — - —
Query (?) - - — — - -
Exclamation (!) — — - - — —
Apostrophe (') - — — — — -
Hyphen (-) — - - - - —
Fresh paragraph - — - - — - -
Inverted commas - — - - — -

Fig. 4. The International Morse code used universally in wireless since July 1, 1913, and throughout the World in telegraphy except for America and Canada.

sage. As the holder moved forward, the points on the type worked a lever up and down which regulated the times and intervals electricity flowed to an electromagnet mounted on the pendulum. When energized, the electromagnet moved the pendulum sideways and a spring pulled it back. Each action zig-zagged the line making a series of spaced "V"s on the paper. *As the machine could not break the continuous line, it could not produce dots and dashes.*

The code Morse devised to work with this machine required a dictionary suitably prepared with numbered words. By counting the "V"s and observing the space arrangements, the receiver obtained groups of numbers which he deciphered by means of the numbered dictionary. See **Fig. 2.** An inverted "V" represented a zero; if it appeared before a figure or group of figures, one read the group as an actual number instead of a word. Numbered codes existed long before this one. Both optical and semaphore telegraphs as well as naval signals used them. But Morse's system produced a permanent record. Speed averaged about five words a minute.

After a laboratory demonstration in September 1837, Morse hired Alfred Vail of the Speedwell Iron Works at Morristown, N.J., under contract. Then came big changes. At an exhibition of the telegraph at the New York City University on January 24, 1838, the electro magnet no longer operated a pendulum; *it moved a horizontal bar.* Each time it moved *a dot or dash appeared on the moving strip of paper.* And the operators, working directly in the language, reached a speed of 10 words a minute. The demonstration marked the first use of a dot-and-dash code and communication by means of an alphabet.

The original dot-and-dash code named after the Morse telegraph instrument, appears in column VII of **Fig. 1.** Morse's patent application of April 7, 1838 and the patent issued June 20, 1840 contain it. This alphabet transmitted language in words and sentences for the first time. The general plan used the simplest and shortest combinations of symbols to represent the most frequently recurring letters of the English alphabet. In this code, "G" and "j" took the same symbol as did "i" and "y" and "s" and "z". Also, the code included seven broken letters.

Morse and Vail didn't use this code when they opened the Washington to Baltimore telegraph line in 1844. They used revised Morse: the code that opened careers to thousands over the next 100 years. This code incorporated the folowing basis:

The dot ...................... 1 unit
The dash ..................... 3 units
The space between the elements of each letter .................. 1 unit
The space between two letters .... 3 units
The space between two words .... 6 units

**Fig. 3** shows the complete alphabet of the revised Morse code used in telegraphy throughout the United States and the Dominion of Canada. Revised Morse contains six spaced characters: C, O, R, Y, Z, and &. This arrangement secured economy of space and consequently of time. No letter, except "j", exceeds 5 dots or 9 units, and frequently used letters in the English language contain the fewest and shortest elements. Numerals kept within a six dot or eleven unit restriction to distinguish them more easily from the letters.

Revised Morse became a high-speed code in the hands of professionals. Glamorous careers sprang up everywhere. Speedy operators transmitted blow-by-blow descriptions direct from ringside. Others watched big-league baseball games and fed the play-by-play action into newspaper lines. Some traveled West with the railroads. Some died in the middle of a message manning dangerous frontier outposts deep in the Indian lands. How fitting the first message sent by Morse—a message composed by the daughter of the U.S. Commissioner of Patents: "What hath God Wrought!" Morse's harnessing of electricity soon brought the telephone, a cable linking Europe with America, electric light, an amplifier tube, and *wireless*.

## International Morse

When you transmit in International Morse, you use four letters from Original Morse and eleven from Revised. The remainder come from the best of various European codes. Developed on the European continent where it got the nickname "Continental," International Morse became the universal code for wireless but never for the telegraph.

Austria and Germany share responsibility for the "Continental" code. Austria adopted the Morse apparatus after the Emperor saw a demonstration in 1845. Three years later two Americans built a 90-mile line conecting Hamburg with Cuxhaven. Earlier, the Bavarian Government adopted Steinheils's slow system and installed a short line between Munich and Augsburg. Several of the North German railroads used Wheatstone's equipment.

When the Austrian Government appointed Steinheil to organize the telegraph systems of that empire, he met in Vienna with representatives of the German states of Prussia, Bavaria, Wurtemburg and Saxony in October 1851. After scrutinizing all systems and all codes, the delegates unanimously adopted the superior Morse apparatus but not the code. They never wanted any part of spaced letters.

From the code of Dr. Clemens Gerke, a telegraph engineer of Hamburg, the Vienna telegraph convention selected letters C, F, L, and R. Steinheil's code furnished O and P. Letter X and numerals 1, 2, 3, 4, and 5 came from M. Lefferts' code introduced on the American Bain lines in 1849 as did also 6, 7, 8 and 9 though arranged in reverse order. By this arrangement the first half of the five-digit number act as a check on the second half. Other sources supplied letters J, Q, Y, and Z leaving 15 to come from revised Morse.

Besides the regular 26 letters of the alphabet, International Morse contains 32 other characters. An accented "e" and the apostrophe satisfy the French language, the ä, ö and ü the German, and the ñ the Spanish. The period consisted of six dots sent in three groups of two. This stood until September 1, 1939. At the Cairo International Radio Convention in 1938, the delegates agreed to change the period to the symbol used for the comma. This satisfied telegraph companies whose printers produced it as three "i"s. The symbol for the exclamation mark then became the comma. (Telegraph operators never used the exclamation mark except to abuse each other within the law. A half dozen !!!!!! expressed ironical admiration of another operator's stupidity). See **Fig. 4.**

England switched to the Continental code when cables laid in 1854 and 1855 connected the British Isles to Holland, Germany and other European countries. Like the Americans and Canadians, English operators didn't want to change; however, they soon succumbed to pressure. Each operator received a copy of the new alphabet with two months grace to learn it. When the day for the change arrived, the company found many not ready. Granting of another month produced the same result. Not until the company *gently* promised a reduction in pay for those not ready by the end of a third period did the new code go into operation.

Adventure trailed Morse's telegraph as it moved eastward from the business countries of Europe. At army outposts in India, dangerous excitement awaited British operators and sometimes a saber in the back. The British call the code "Morse." Others think of it still as "Continental." But the gain in international scope as the Morse telegraph spread, caused the "Continental" moniker to diminish in favor of "International Morse."

. . . W2AAA

# THE HUSTLER® NEWS

FROM "The home of the originals" *Number 2 of a series*

# Showtime...U.S.A.

The amateur radio convention season is just about here. This is really a special time for manufacturers of amateur products and for hams, too. Often you may wonder why there are so many conventions and why manufacturers become a part of this mass migration from one major city to another. Be assured, it's not just for fun. The manufacturer is simply trying to show amateurs all the new products to aid or enhance amateur operations.

Originally, conventions were just social events with a lot of friendly greetings, beer and hot dogs. Today, to add to the showing of new products, live-wire panel discussions are programmed along with gala entertainment. The latter often includes awarding of valuable prizes to lucky convention-goers. The prime purpose is to get you, the amateur enthusiast, to attend the convention.

Amateur radio conventions today are full-fledged industry shows. The promoters depend on manufacturing firms to help pay the way and they must have high attendance to attract the manufacturers. Hence, each show must have enough interesting exhibits, seminars and entertainment to attract you, the amateur, for ultimate success.

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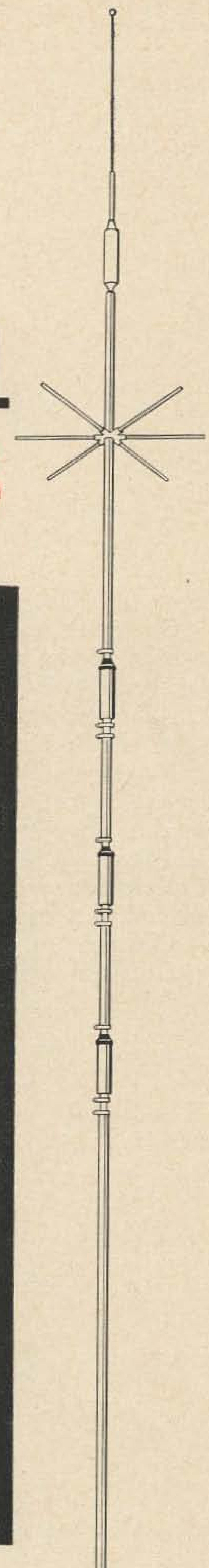

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# Understanding AVC

On most every communications receiver worthy of the name, you'll find a small knob labelled "AVC-MVC" or something of the sort. On the newer ones, the label is more likely to read "AVC: Fast-Slow-Off."

Experienced operators use this control more or less by instinct. The newer hams more often tend to leave it set in one position permanently and ignore it. But chances are very few of us, experienced or not, really understand what's behind that knob—and why.

Contrary to widespread belief, the AVC* circuitry in a receiver isn't necessarily just a "lazy man's gadget." While the original intent was to eliminate need for adjusting the receiver's gain controls when tuning from a weak to a strong signal, modern AVC does much more than that.

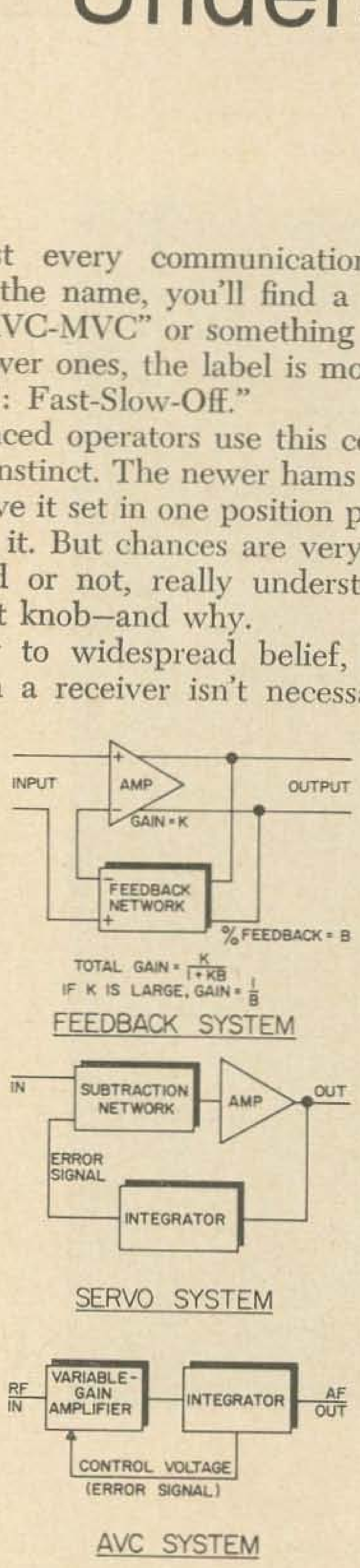


Fig. 1. AVC as a servomechanism.

For instance, in a SSB round-table a properly performing AVC system will make the fellow a continent away who's running a barefoot 10B sound almost exactly the same strength as the guy across town who's pouring the coal to a kilowatt. Neither will blast your eardrums, and more important, neither will overload the receiver to cause distortion products.

In CW net operation, a good AVC circuit will allow you to run full break-in, monitoring your own outgoing KW if you like while dragging in the 20-watt station in Podunk between your dits.

Don't misunderstand us. Not every AVC system will meet these standards. All too many, even in completely factory-built (and never modified) gear, fold up at one end or the other of the signal-strength range. But performance of this nature is not impossible to achieve, nor is it even particularly difficult once you understand just what the AVC circuitry does and how it works.

## Feedback and servomechanisms

Let's look at the "how it works" first, before we get into the more complex matter of "what it does."

And to see how it works, we forget all about AVC and receivers and such for a spell and go

* Or AGC, automatic gain control, perhaps a better name.

back to some basic (although not too widely published) theory. This concerns "feedback."

Now in the ham vocabulary "feedback" is usually considered as something not too desirable, as when rf gets into the audio lines and a wild whistle goes out over the air. However, none of us could do a thing without it. Here's why:

Feedback, broadly defined, consists of taking a part of the output of a system and feeding it back to the input. (The name is almost obvious from its inclusion in the definition.) This part of the output can be fed back in such a way as to *add to* the input, or to *subtract from* it. If it adds, the feedback is called "positive," while if it subtracts, the feedback is called "negative."

*Positive* feedback is what causes the howls, unwanted oscillations, etc., which have made "feedback" a not-good term to so many of us. A very small input signal can be applied to an amplifier, and a similar but bigger signal comes out. If we now put some of this bigger signal into the input, adding to the original, we have an even larger original signal, and the output is still larger. The process keeps repeating until we have the maximum possible output signal, and the input signal no longer has any control. Even if the input signal is then removed, the amplifier will supply its own input from the fed-back portion of the output, and all you have is an oscillator.

If, however, the part of the output fed back is arranged to subtract from the input signal, then the original small signal is reduced still more, and all that the amplifier gets as input is the difference between input and feedback. While this may appear to be only a senseless waste of gain, consider what happens if we have some distortion in the amplifier.

In this case, the input may be pure but the output is distorted. The difference between input and output will contain all the distortion of the output, but in such a polarity that it will tend to cancel out the distortion introduced by the amplifier on its second trip through. The result is a significant reduction in distortion, due to the feedback.

All of which is basic to the idea of feedback, but doesn't tell much about how it helps us do things.Let's forget electronics for a moment and consider the application of feedback to a physical problem.

Assume that a pencil is lying on the table and you want to pick it up. You start your hand moving in the direction of the pencil. As your eye registers the distance from hand to pencil, it feeds back to the brain to inform the arm muscles that the distance is becoming less and less, and when the distance is zero

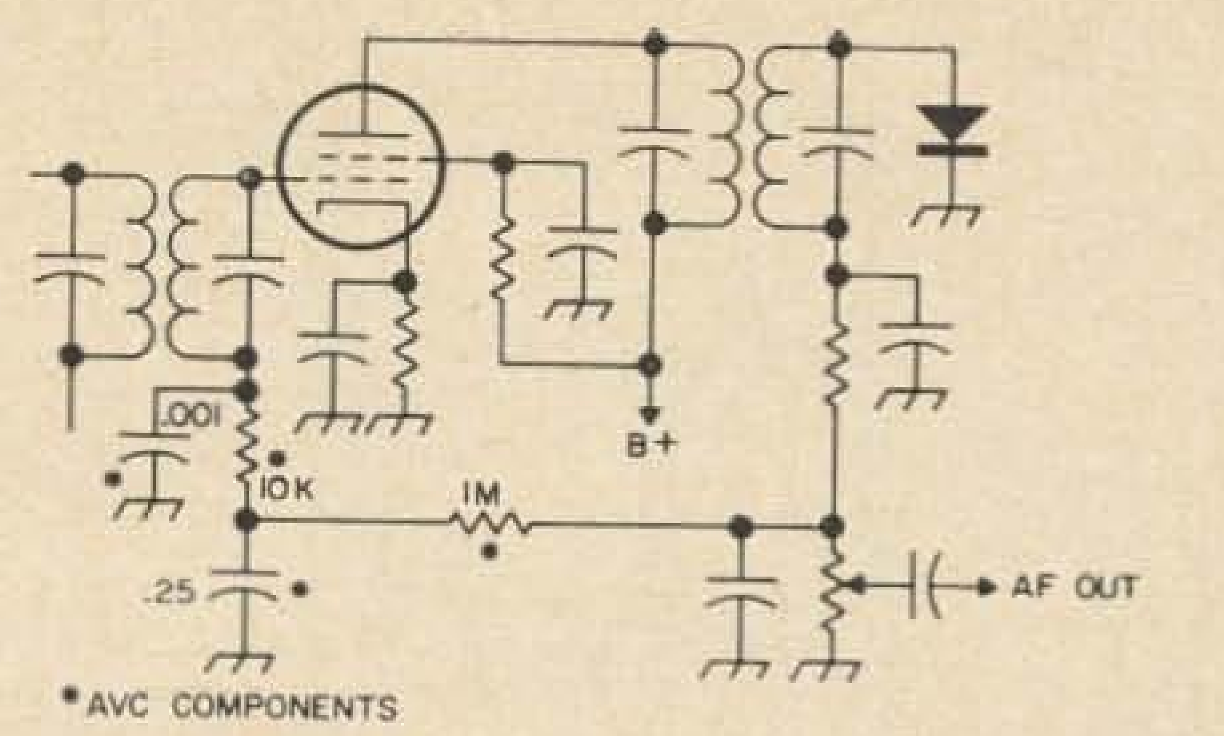


Fig. 2. Simplest AVC.

(hand on pencil) the feedback tells your arm to stop moving.

To test it, try to pick up the pencil blindfolded. Chances are very great you'll knock it to the floor the first 100 times.

Of course, all this feedback takes place on an unconscious level, and we never really realize it's going on. However that doesn't change the fact that feedback is necessary to human activity.

The basic negative-feedback principle can be applied in many ways, as has just been demonstrated. One way of applying it—which was actually the way your brain applied it to the hand-and-pencil problem—is to use the feedback to develop an "error" signal, and the "amplifier" of the system to adjust conditions so that the error signal has the smallest possible value.

Naturally, the error signal can never be reduced to zero. Should this happen, then the feedback would also be zero and the system would cease to function. However, the error signal can be made to get about as close *to* zero as you like—say about 1/1,000,000 volt in

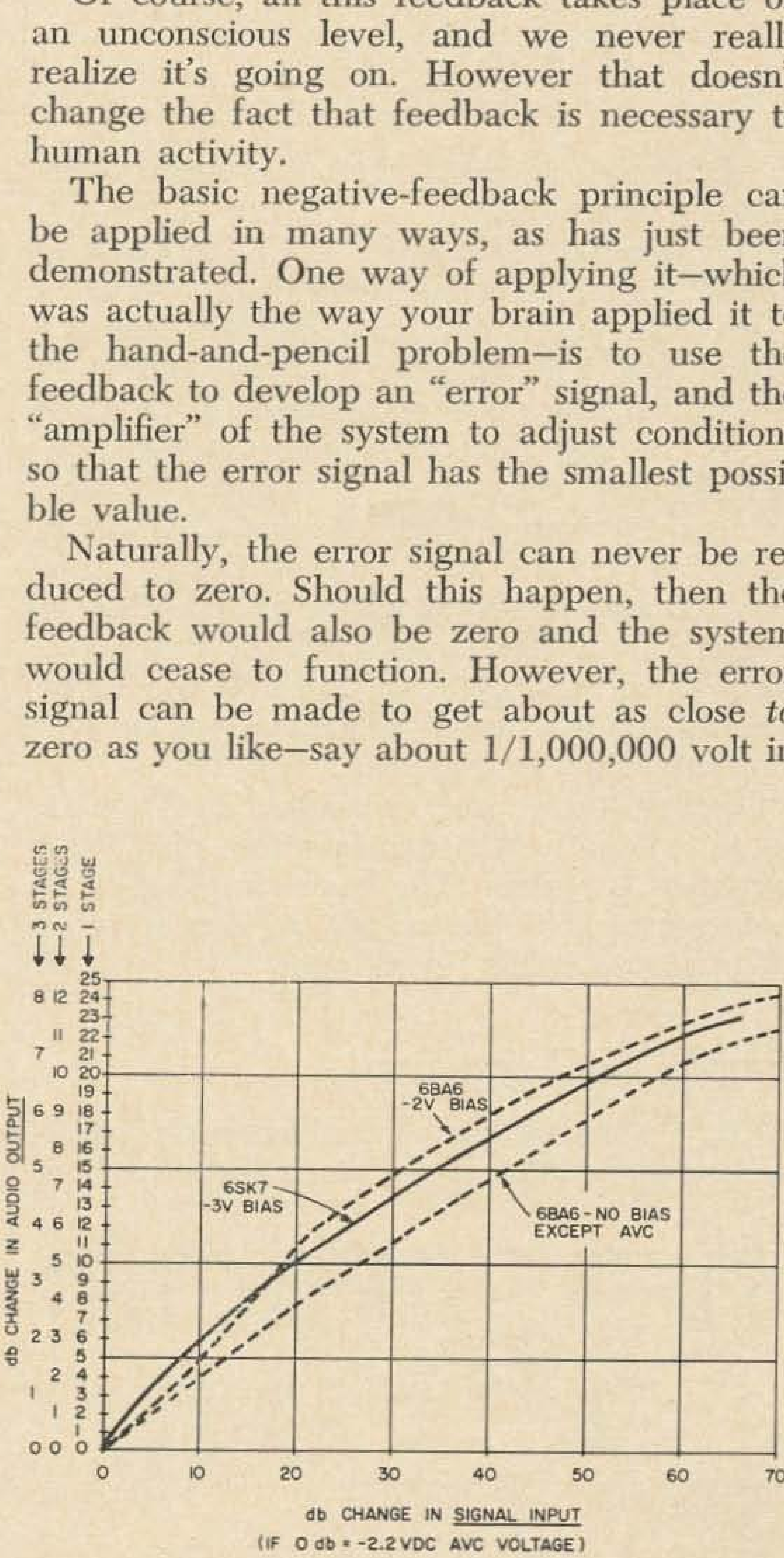


Fig. 3. Control curves for 6SK7 and 6BA6; typical for all remote-cutoff pentodes.

CQ, CQ, CQ, CQ, CQ, . . .

an electrical-feedback system. But we're a bit ahead of ourselves.

This error-signal approach to feedback is usually known as a "servomechanism" and is in itself an entire branch of applied science. Within that science, three different classes of servo-mechanisms are recognized. Type O is defined as that class of servomechanisms designed to hold the *output* of a system constant with varying input; Type I is that class which varies the output as a control signal varies (such as aircraft servos which develop tons of pressure from the mere touch of the pilot's hand on a control); and Type II is a class which holds the rate of change of output con-constant with varying input.

Of these, we're only interested in Type O, since it's identical to the definition of a basic simple AVC system. The basic simple AVC is designed to hold the output volume constant with changes in RF signal input.

## Simple AVC systems

**Fig. 1** shows some block diagrams illustrating these points. As signal input to the receiver

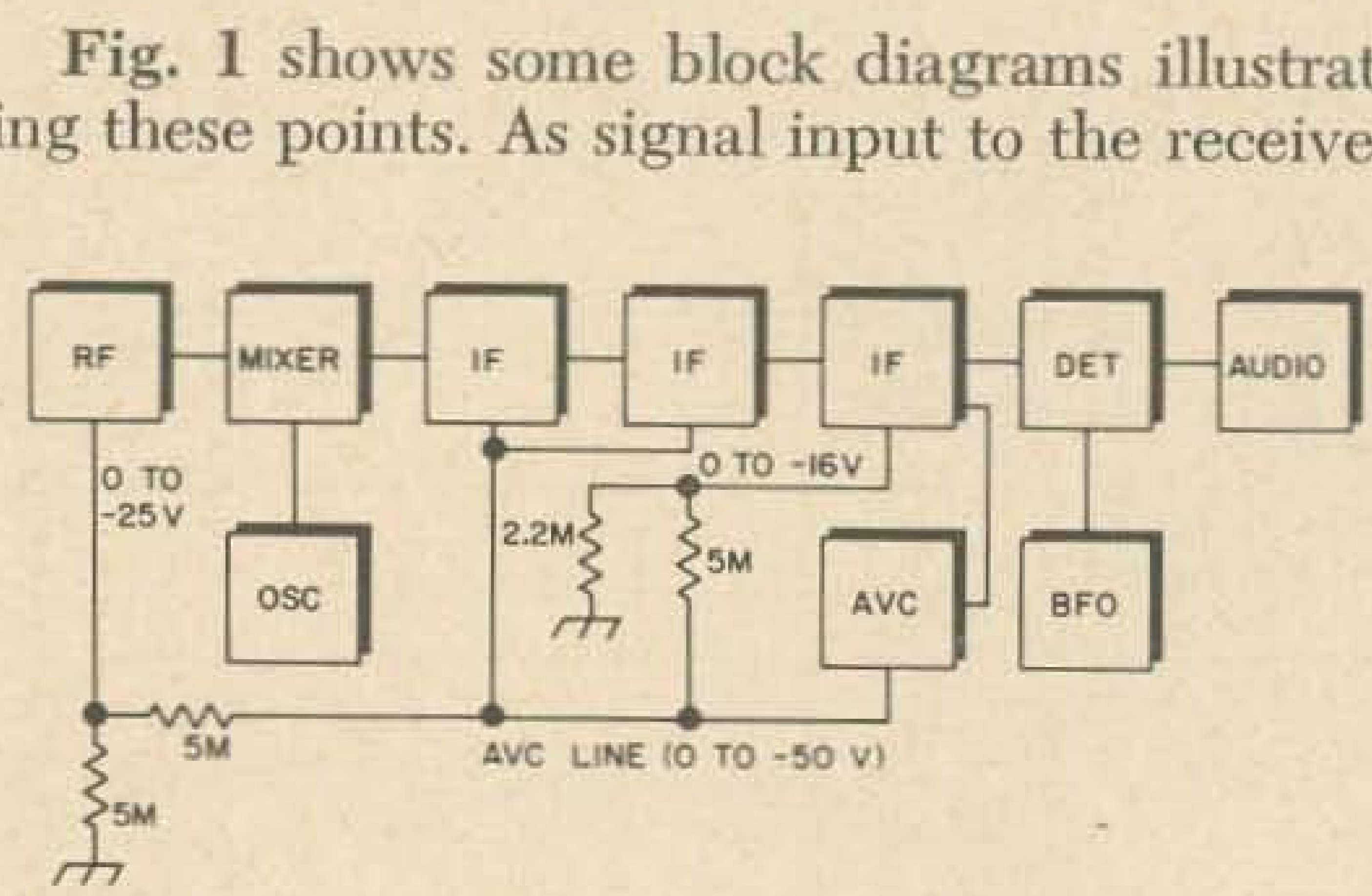


Fig. 4. Application of partial AVC.

increases, the "error signal" developed by the AVC circuit also increases. This "error signal" is then applied to the receiver in such a manner as to reduce its gain, and with the gain reduced the output signal tends to be reduced also, thus offsetting the increase in input signal.

Since increasing "error signal" reduces receiver output, while increasing input signal increases output (in the absence of AVC) it's easy to see that the feedback is negative. And since the net effect of all this is to attempt to hold the output constant with varying input, it's also easy to see that this is a Type O servo-mechanism.

Note, though, that we can't use the audio output of the receiver "as is" for an error signal, for this would tend to wipe all the modulation off the input signal. We must process the error signal so that it reacts only to changes in input over a period of time which is long compared to individual audiofrequency cycles.

**Fig. 2** shows one way of doing this, which was the original AVC circuit. The carrier is rectified at the output of the *if* amplifier to obtain a negative dc voltage, which is then filtered and fed back to the grids of the *if* stages to reduce their gain. This is convenient, since the same diode which rectifies the carrier for AVC can also detect the signal for audio, but it falls far short of perfection.

To find out why, we must examine in more detail the purposes of AVC circuitry.

## Purposes of AVC

First, of course, is the obvious one of letting the operator's volume-control hand rest as much as possible.

Of equal importance, though, is the avoidance of overload in all stages of the receiver. Surprisingly, it's not always the final stage which overloads first. Many modern receivers suffer from *mixer* overload long before the *if* chain is in any danger of getting too much signal.

Speed of reaction is another purpose for AVC as opposed to manual control. No operator living can twist a knob fast enough and accurately enough to have full receiver gain in the spaces between dits at 40 wpm, while reducing gain sufficiently to keep from overloading with the local transmitter's signal when the dits and dahs are going out. For electronic circuitry, capable of operating in billionths of a second, it's a lead-pipe cinch.

Now for any AVC system to approach perfection it must score high on all three counts.

That is, it must hold output-level variations to a minimum through a wide range of input signal levels, it must prevent all stages of the receiver from being overloaded, and it must be capable of reducing and restoring gain as rapidly as the operator desires.

In addition to this, though, there are a few more points a top-notch AVC system must meet as well. It should *not* impair the receiver's sensitivity to weak signals, which means that the AVC should *not* work on very weak signals, but instead should turn itself on when the input signal passes a certain level. While reacting rapidly, it must not react so rapidly that it wipes the modulation off an incoming signal. And finally, it must not create distortion on its own, by biassing amplifier tubes into non-linear portions of their operating curves.

Satisfying all of these requirements, of course, takes quite a bit of design, and frankly we're not going to try to put it all down here. The idea at this point is to make it understandable, not incomprehensible!

## AVC for constant output

So let's start with the requirements one at a time, in order. Let's see how we can keep the output variations to a minimum.

Assume that our input signal is expected to vary from 1 microvolt to 1 volt. That's a million-to-one range, which when we put it into db of voltage variation comes out to be 120 db.

If we set out to hold the output completely constant, this means that we must vary the gain through the receiver by 120 db also. For instance, with 120 db of gain and a 1-microvolt input signal assume we get a 1-volt output to the final audio amplifier. With a 1-volt signal, and the receiver gain reduced to 0 db by a 120-db-controlling AVC, we still have a 1-volt signal driving the audio output. The audio volume would be the same.

However, the gain of a single-stage *if* amplifier is rarely in excess of some 46 db, which means we would have to have 3 stages of *if* merely to be able to vary the gain at least 120 db.

And for completely constant output, the error signal would have to reduce to zero at both ends of the line—which won't do. So let's see what happens if we allow 6 db of output variation.

The control range required now is 120 (input signal) minus 6 db (output variation allowed) which equals 114 db. We still need those 3 *if* stages.

So with 114 db of control required, and 3

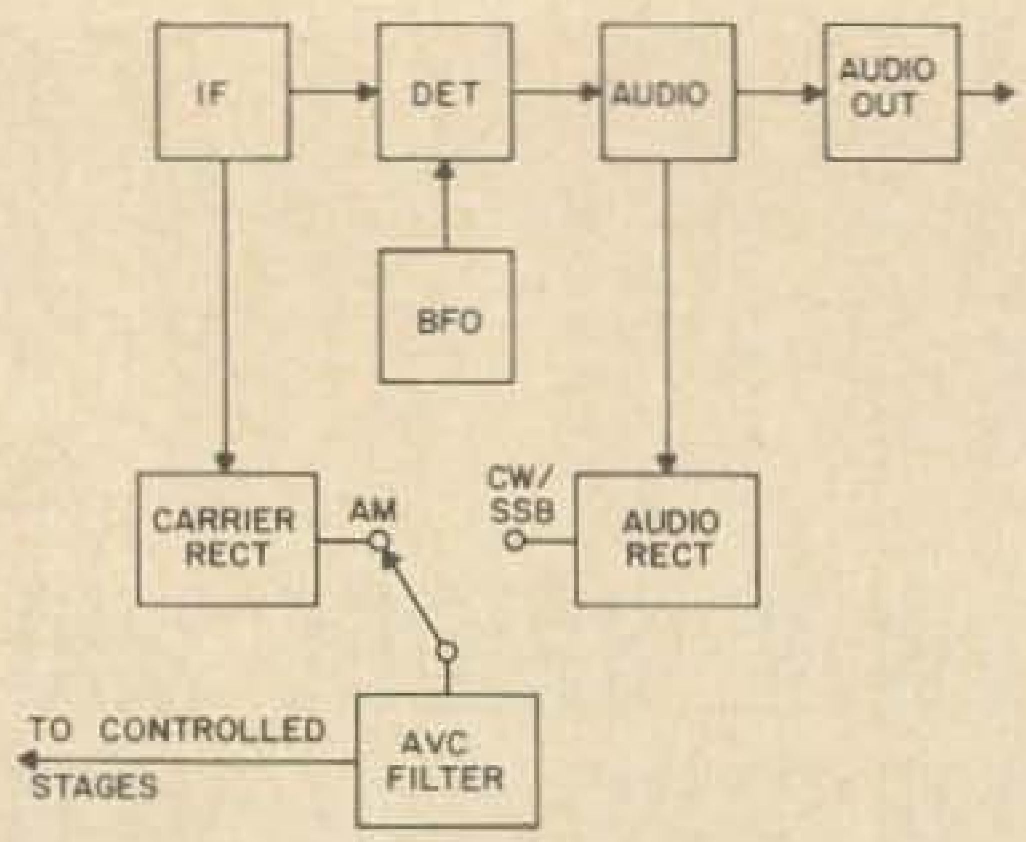

Fig. 5. Audio/carrier AVC hookup.

stages to get it in, we find that we must vary the gain of each stage by 114/3 or 38 db. Let's assume that the gain with no control voltage applied is 42 db; this gives us a total *if* gain of 126 db or approximately 2 million times.

This means our 1-microvolt input signal will come out as approximately 2 volts.

If we increase our input signal to 11.22 microvolts (21 db greater) and leave the gain unchanged it would give us an 11¼-volt output signal to the detector. However, we don't want the signal at the detector to exceed 4 volts (6 db greater than the no-AVC condition) which means the gain must be reduced somewhat. If it is reduced to 35 db per stage, a reduction of 7 db, we will get an output of 2¼ volts.

Now let's hit the amplifier with a full volt input. To have 4 volts output, the total gain must be reduced to 12 db, which is 4 db per stage.

At this point, let's look at some figures developed along the way. With 2 volts at the detector, our control voltage was zero. With 2¼ volts out, we had a control voltage reducing gain by 7 db per stage. And with 4 volts out, the control voltage reduced gain by 38 db per stage. Thus in the first ¼ volt of control, we were reducing gain by 28 db per volt, while at the other end of the control range we were reducing gain only 19 db per volt.

And tubes (or transistors either) just don't like it that way. They tend to change gain at a relatively constant rate. The 6SK7, which used to be standard for *IF*-amplifier service, had an average gain-change rate of about 1½ db per volt. At −3 volts, it had maximum gain, while to reduce this gain by 41 db required 29½ more volts of bias.

Since our original specifications allowed us only a 2-volt range from no control to full control, and practical tubes work with a 30-volt (approximately) range, something was obviously wrong with our original specification. The trouble was that we wanted performance too close to perfection.

In practice, we can expect the working range of an AVC system to be about 1/2 to 1/3, per controlled stage. That is, with a single controlled stage the variation in ouptut will range from 1/2 to 1/3 of the input variation (60 db input change results in approximately 20 db change of output; 20 db input change results in about 10 db output change).

If we have two amplifier stages on control, the output variation will be cut in half. With 60 db input change, the output level will change only about 10 db.

With three stages controlled, the variation drops to 1/3. 60 db variation of input gives only about 7 db output change. By increasing the number of stages under control, we can keep reducing the output variation, but a practical limit is reached eventually. Nobody wants to put 100 amplifier stages into a receiver simply to get output constant within 2 db for a 60-db variation in input!

And it probably wouldn't work right anyway.

In case you're interested, **Fig. 3** includes the single-stage control graph for the 6SK7 and also for the 6BA6, more representative of the newer tube types now in use.

## AVC for overload protection

Which fairly well disposes of point 1. How about point 2—over-load protection?

As mentioned a bit back, to get wide control range the control voltage must be made fairly large, and not all tubes can take it. This isn't of importance particularly with a factory-built receiver because we assume the manufacturer's engineers took this into consideration, but it does stand to warn us not to substitute *IF* tubes unless we know exactly what we're doing.

In particular, a sharp-cutoff tube should *never* be used to replace a remote-cutoff type. The S-meter may read higher on noise, and it may even read a bit higher on some signals, but the chances are rather great that the substitution will play havoc with the AVC action of the set. You may find that the S-meter just

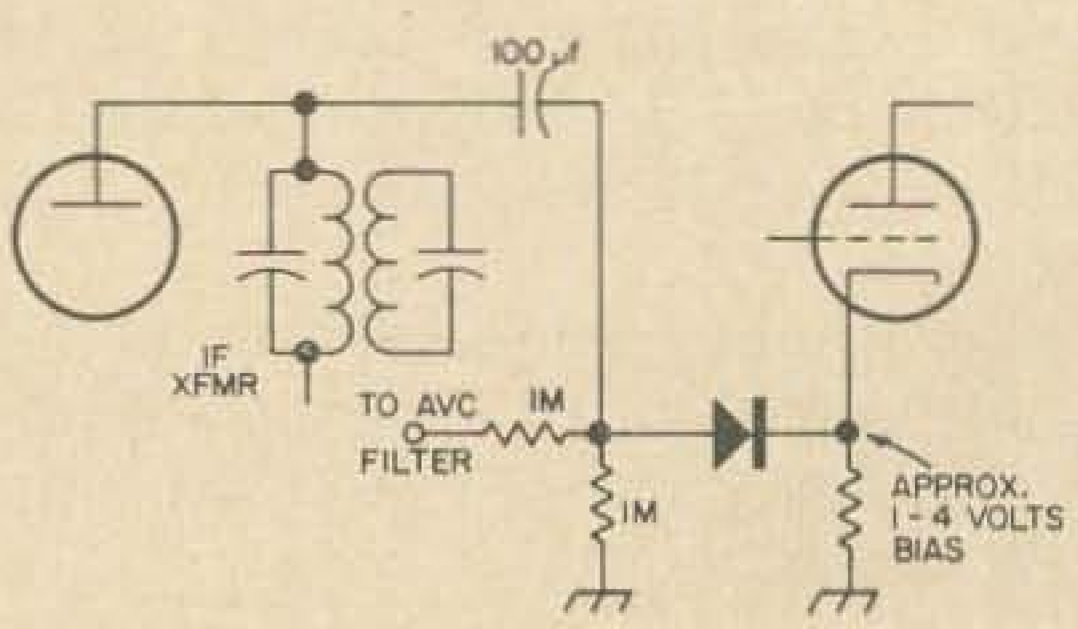

Fig. 6. Simple delayed AVC.

sits there hovering around 9, with almost no change between a weak signal or a strong one. You may not even hear the weak signals. What happens is that the sharp-cutoff tube amplifies set noise up to the point where the AVC takes hold, then cuts off at that amount of AVC voltage, so that stronger signals don't get by and weaker ones are highly distorted.

Even substituting another remote-cutoff tube should be done only with care, because the transfer characteristics (linearity to you sidebanders) of the different types at similar bias voltages is quite likely to differ. That 6SK7 may be there for a reason; possibly no other tube can handle the particular level of input signal at high values of AVC voltage.

Normal design procedure to prevent overload is to first select tube types which can handle large values of voltage while having high grid bias applied; for instance, a typical communications receiver may be called upon to furnish a 66-volt swing at the output of the final *if* stage, wrile the stage is biassed to some 20 volts negative. This is a rough requirement. It it can't be met, about the only thing to do is to leave the final stage *off* the control line, which then restricts the range of control you have available. Already we're compromising.

Next is to estimate the control voltage produced by various input signal levels, and check to see that each stage can handle it's voltage requirement at that level of control voltage. If things are arranged so that the *first* controlled stage overloads before any of the others, you'll satisfy the overload-protection requirement—but this is seldom practical to do.

Incidentally, while AVC is usually omitted from rf stages to keep from hurting the signal-to-noise ratio, it's about the only way to prevent mixer overload. A point usually overlooked is that the AVC, if properly designed, won't affect the rf stage gain until the signal is already strong enough that there's no worry about S/N ratio!

In applying the control voltage to the complete amplifier chain, it's frequently helpful to use only part of the control voltage on some stages. For instance, the rf stage may get only 1/3 of the control voltage. If control voltage ranges from 0 to 30 volts, that on the rf stage may range only from 0 to 10 volts. This frequently gives protection for the mixer, while helping make sure S/N ratio isn't reduced until a signal is particularly strong.

**Fig. 4** illustrates one way to get partial control, and shows also application of similar partial control to the last *if* stage to protect it against overload. This can be carried on to the point of applying full control to only the first

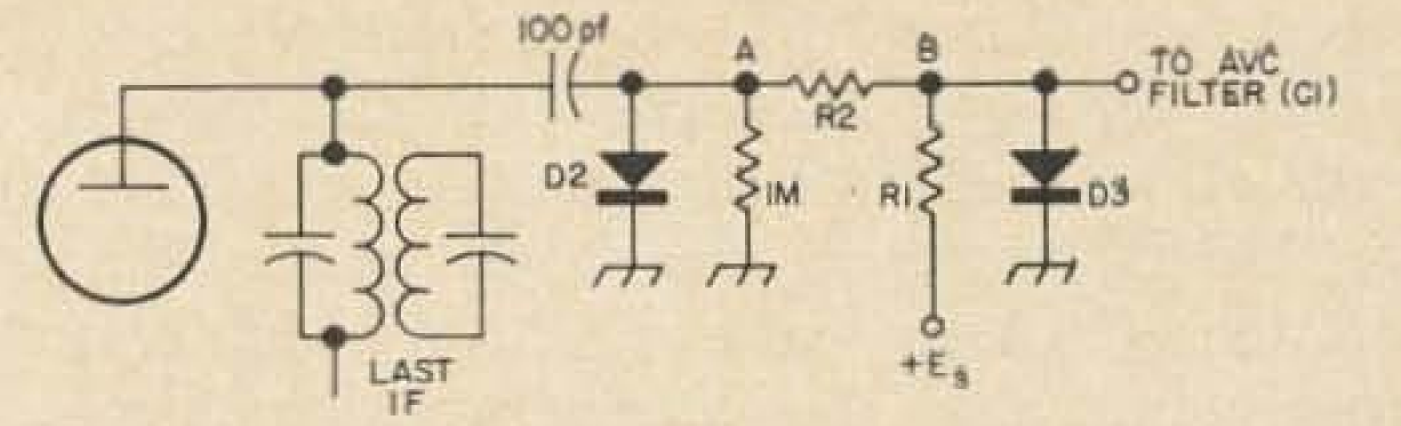

Fig. 7. Sinking diode AVC circuit.

*if* stage, a little less to the second, etc. However, doing it this way will reduce the control range below that indicated by Fig. 3, so the compromise should be made on the basis of what *you* want more.

## Reaction time

And now we're down to point 3, reaction time. This is more frequently referred to as "time constant". Like control range, it involves many factors.

On one hand, we never want reaction so fast as to wipe any audio off an incoming signal. At the other extreme, we don't want reaction so slow that the receiver takes hours to adjust itself. Our desired reaction time is somewhere in between.

To find out what its *practical* limits are, let's look first at the area of wiping-out-audio. If we want to preserve all audio frequencies above 100 cps, the fastest our system can be allowed to react is 1/100 second (1/f), or 10 milliseconds. If we don't care about anything below 300 cps, we can reduce reaction time to 3.3 milliseconds. For "broadcast quality" response to 30 cps, however, reaction time minimum is 33 milliseconds.

What this means is that if our AVC system can reach the desired control voltage in 33 milliseconds when signal increases, or drop back in the same time if signal drops, it will just cancel out a 30-cps tone on the incoming signal. For actual broadcast-receiver use, a time constant of ¼ to ½ second is more commonly used.

But we're not so much interested in BC as in communication. Let's see how fast the reaction time must be for CW. If we intend to operate at speeds up to 50 wpm, this means the spaces between dits will be only about 40 milliseconds wide. If we intend for the receiver to have usable response during this time, the AVC system must react in less than 1/10 of this time, which gives us a reaction time of 4 milliseconds for high-speed CW.

Since this will also suffice for 300-cps response to audio, it might appear that a 4-ms reaction time for both initial response to increased signal and for drop-off with reduced signal would be good.

But how about SSB? In this mode, we want to hold average gain constant throughout a word at least—and 4-ms reaction wouldn't do this. To fill this need, circuits known as "hang" AVC circuits have been devised, which charge rapidly but hold the control voltage in place for a while after the signal drops again.

Which brings us to the "Slow-Fast-Off" knob on the modern receiver. Ideally, the complete system for today's use should have a uniformly fast (4-ms or so) charge time, with a choice of either equally rapid release time (fast) or a much slower release, on the order of ½ to 1 second.

In practice, many receivers consider 100 milliseconds fast. These can usually be improved by changing resistors or capacitors as necessary to reduce the charging time constant by a factor of 25, but in doing so care must be taken that nothing else is changed. For instance, reducing a series resistor by 25 times might drop voltages throughout the system so much as to make it stop working, and reducing the filter capacitor by 25 times will usually shorten the "slow" time constant as much as it will the "fast."

However, if the "fast" and "slow" positions use two different capacitors, the "fast" capacitor can be made smaller as desired. We'll get into this a bit more down the road a spell, with schematics, but first we have some more points in design to dispose of.

## Delayed AVC

Next on the list is that AVC should *not* reduce sensitivity. In a simple AVC system such as that of **Fig. 2**, any input signal at all (no matter how weak) would result in some control voltage, which would in turn reduce receiver gain. This is not good.

To overcome it, the AVC system is so arranged that no voltage is developed until the input signal exceeds a specified value. This is called "delayed AVC" but contrary to the implications there is no *time* delay. The delay is a matter of *voltage*. A wide variety of circuits has been developed to introduce the "offset" action; we'll look at some a bit farther on.

## Distorition from AVC

The final point to be considered in designing the perfect AVC system is that the AVC should introduce no distortion of its own.

The point was partially considered when examining control range, but there's more to it still. When the AVC runs the amplifiers down near cutoff, a phenomenon known as "modulation rise" takes place which introduces second-harmonic audio distortion if a modulated signal is being received. While the signal is still quite audible, it sounds quite "mushy." If your receiver sounds perfect on weak signals but all signals above S9 are a bit distorted, modulation rise is quite possibly present.

When voltage delay is introduced to satisfy point 4, then a type of distortion known as "differential distortion" may come along with it. This type of distortion results from the AVC coming into action part way up the waveform on a weak AM signal, but in practice has not been found to be appreciable unless modulation at the 100-percent level is being received. If 100-percent modulation is being detected, similar distortion will also be generated in the detector, so differentail distortion can be considered merely a fine point of AVC engineering.

## Sources of AVC voltage

You may note that so far, except for **Fig. 2**, we haven't mentioned just *where* in the receiver the control voltage is derived. This is because the control can be developed from either of two sources, and when all factors are taken into consideration either works equally well (or equally poorly if you prefer the negative connotation).

Most conventional, of course, is the practice of using rectified carrier voltage as in **Fig. 2** for the control. This approach lends itself well to AM use but is a bit sticky for SSB and CW since the incoming "carrier" is intermittent at best and may not necessarily bear any relation to the actual signal strength. For example, the sentence "his sis is 5" consists entirely of dits and spaces. If a steady carrier would be coming in at 10 microvolts, the *average* voltage for the duration of this sentence would be less than 5 microvolts, and the AVC would treat it as a 5-microvolt carrier. On the other hand, the sentence "Tom to Ø" is all dahs and spaces, so would be closer to 7½ microvolts average.

To overcome these problems, many designs have taken AVC control voltage from the *audio*, after detection but before the gain control. With SSB and CW, this gives equally good results, and in many cases proves superior, since there's no worry about bfo energy getting into the AVC line and hurting receiver sensitivity.

However, with AM it's again sticky. If all signals were modulated 90 percent or so, an

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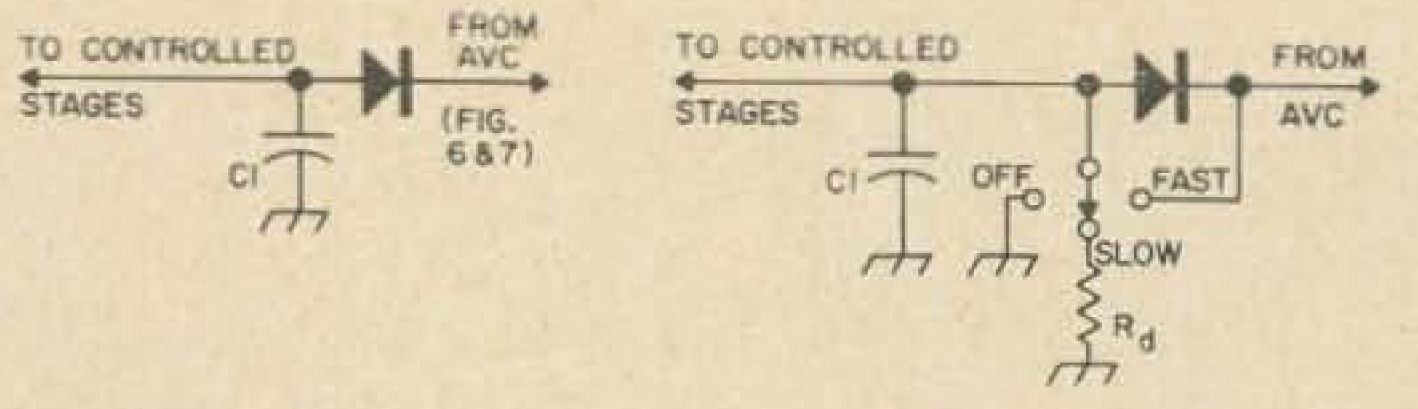



Right, Fig. 8. Hang diode hookup. Left, Fig. 9. Switching release time with the hang diode.

audio-AVC system for AM could be made reliable, but the audio recovered from a 100-microvolt carrier with only 10 percent modulation and from a 10-microvolt carrier modulated 100 percent are about the same. The system can't tell which is which. If amplifier gain is set to be right for 10 microvolts, then the 100 microvolts will overload it. And if it's set for 100 microvolts, the gain may be too little for the 10 to get through.

One of the most satisfactory answers is to provide *two* sources of control voltage, one taken from the carrier for AM and the other from the audio for other modes, and to choose between them with the receiver's function switch. How this is done is shown in **Fig. 5**, in block-diagram form.

## Practical AVC application

By now, you may be wondering "How can I put some of this data to use on my own receiver?" Here are a few circuits which will serve as starting points for your modifications. It must be emphasized that they are starting points only. Before plugging in a soldering iron, warm your receiver up and make some measurements. You'll need to know the grid voltage is on each controlled stage with antenna disconnected, what the voltage is when a "S9 + 100 db" signal is coming through, and what the dc output of the detector or AVC diode now in the set is under each of these conditions. Write 'em all down, for you'll need them along the way.

The circuit of **Fig. 6** provides delayed AVC, using only the cathode bias across any convenient audio tube to obtain the delay voltage. As shown, the first af tube is included in the same envelope as the two diodes, but this isn't necesary. In fact, semiconductor diodes of either the germanium or silicon varieties may be used.

Delay voltage will be determined by the bias on the tube, and until the incoming signal produces more control voltage than this the control line will remain at ground potential. If bias is set at 2 volts, AVC voltage will be zero until the control voltage exceeds 2 volts, and then will be equal to control voltage minus the 2-volt delay.

Returning 1-megohm resistor R2 to a source of negative bias voltage will establish the AVC voltage at the level of this bias, but will also reduce the delay voltage by the same amount. You can use this to set a minimum 1-volt level on the AVC line, with 2-volt delay, or whatever you want, and get rid of cathode-resistor problems in the *if* chain; such an approach was used in the BC-779.

A more complex delayed-AVC circuit known as the "sinking diode" hookup is shown in **Fig. 7**. This one eliminates all differential distortion and allows the AVC action to be tailored to almost any circuit requirements, but is more complicated than most. Here's how it works:

To start with, let's assume that D3 isn't in the circuit. Let's also assign some values for Es, Ed, and consequently Rl. Es might well be 150 volts from a regulated supply, which Ed (the delay voltage) could easily be 5 volts. Then if R2 is set to be 470K, Rl will be 14 megohms.

Now, with no signal input, point A will be at ground potential, while the voltage at point B will be that developed by the voltage divider R1 and R2 in series from the 150-volt source, or about 4.89 volts positive.

When the voltage at point A drops to −5 because of incoming signal, the voltage across the divider becomes 155 (from +150 to −5) and the voltage at point B becomes 5.02 positive, in comparison with that at point A. Since point A is −5, the resulting voltage at point B with respect to ground is 5.02 − 5, or 0.02 volt.

As signal increases and the voltage at point A becomes say −25 volts, the voltage across the divider becomes 175 and the voltage at point B becomes 5.79 volts positive to that at point A, or −19.21 volts to ground.

When the voltage at A goes to −50 volts, that at B will be −43.5. As the voltage at A becomes more negative, the percentage difference between B and A becomes less.

In this circuit, the delay voltage may be set to any desired value as shown in the illustration. The larger Es is made, the less percentage reduction of control voltage will be introduced by the R1-R2 voltage divider. However, if the ratio is made too high you may have difficulty locating suitable resistors for R1 as few distributors stock anything larger than about 22 megohms.

So far, we have been ignoring the action of D3 and of C1. D3 prevents the AVC line from ever going positive, by conducting and clamping the line to ground whenever its plate is more positive than its cathode. If you would prefer to have the line clamped at some value of standing bias such as −1 or −2 volts, simply returning the cathode of D3 to such a voltage instead of directly to ground will accomplish this.

C1 is the filtering capacitor, and its value will determine at least the charging time constant of the system. The other component of this time-constant network is R2. The value of C1 should be chosen after R2 is selected, so that the product of C1 in microfarads and R2 in megohms is equal to the desired charing time constant (0.004 if the 4-millisecond recommendation is to be followed). To get a 4-ms charging time with our previous example, C1 should be 0.0087 µf. This is not a standard value; you could use an 0.0082 in parallel with a 500 pf, or probably just a 0.0082 or an 0.01 alone with little real error.

As shown, the discharge time will be longer than the charge time, since the discharge path includes 1 megohm in series with R2 (the high resistance of R1 prevents it from having much effect in rapid discharging of C1). If a 0.01 µf unit were used, the discharge time constant would be 0.0147 second, or 14.7 ms, too slow for CW and too fast for speech.

Discharge time can readily be lengthened by adding a diode in series with the capacitor as shown in **Fig. 8**, so that no discharge path is provided except by the leakage across the capacitor (this can't be done if divider resistors are used to give partial AVC to some stages as discussed earlier since they will allow more rapid discharge). However, the only practical way to shorten discharge time in this circuit is to modify component values in a multi-way compromise. The simplest way to make the compromise is to make C1 small enough that discharge time falls to the desired value; in our example this would be 0.004 seconds/1.47 megohms, or 0.0027 µf. Charge time would now be only 0.0027 × 0.47 or 1.28 milliseconds. This, however, is no particular disadvantage.

At this stage, the circuit can be converted to fast-slow switching as shown in **Fig. 9** by adding a diode and paralleling it with a switch. With the small value used for C1, a 0.5-second discharge time constant can be obtained by using a 185-megohm resistor at Rd in **Fig. 9**—and this amount of resistance is undoubtedly present in switch and circuit leakage. In fact, you may have trouble getting that long a discharge time with no physical resistor at all for Rd. This, incidentally, is the basic "hang" AVC approach.

Before getting into how to modify only the though, let's look at one more AVC circuit. This one employs dc amplification of the control voltage after detection, for a wider range of control than would be possible otherwise. The circuit appears in **Fig. 10.**

In this one, the delay voltage is set by choice of resistor RL in the cathode circuit of V1. So long as the voltage developed across the 1-megohm resistor in V1's grid circuit is more positive than cutoff voltage for V1, the cathode voltage of V1 will be positive. With this voltage positive, diode D1 will be reverse-biassed and cannot conduct, so the AVC voltage will remain at zero.

When signal is applied and D3 rectifies it, a negative voltage is developed across the 1-megohm resistor. When this negative voltage approaches the cutoff value for V1, the cathode voltage of the tube will move toward the negative-supply level, and when V1 cuts off the cathode will assume the negative level of the negative supply.

This forward-biases D2, which conducts and allows the negative voltage to appear on the AVC line.

If signal level is only enough to supply say a 10-volt negative value across D3, the AVC voltage can be made much greater by proper choice of tube type for V1, of negative supply voltage, and of $R_L$. With a 150-volt negative supply and a tube which will cut off at −10 volts between grid and cathode, the AVC line can be made to go to virtually the full −150 of the supply.

Note that D2, D3, and V1 can all be a single duo-diode/triode tube such as the 6AT6 or 6AV6, while detector diode D1 can be any semiconductor type. This means that, though the circuit appears more complex than most, it actually requires only a few more components than does the simplest of AVC arrangements. The negative voltage supply can be obtained from the regular power supply through a capacitor and shunt diode as shown in **Fig. 11.**

Now let's look at the time-constant or reaction time situation with an eye to possible modification of your own receiver. **Fig. 12** shows a typical AVC setup, with the actual time constants of your own AVC system,

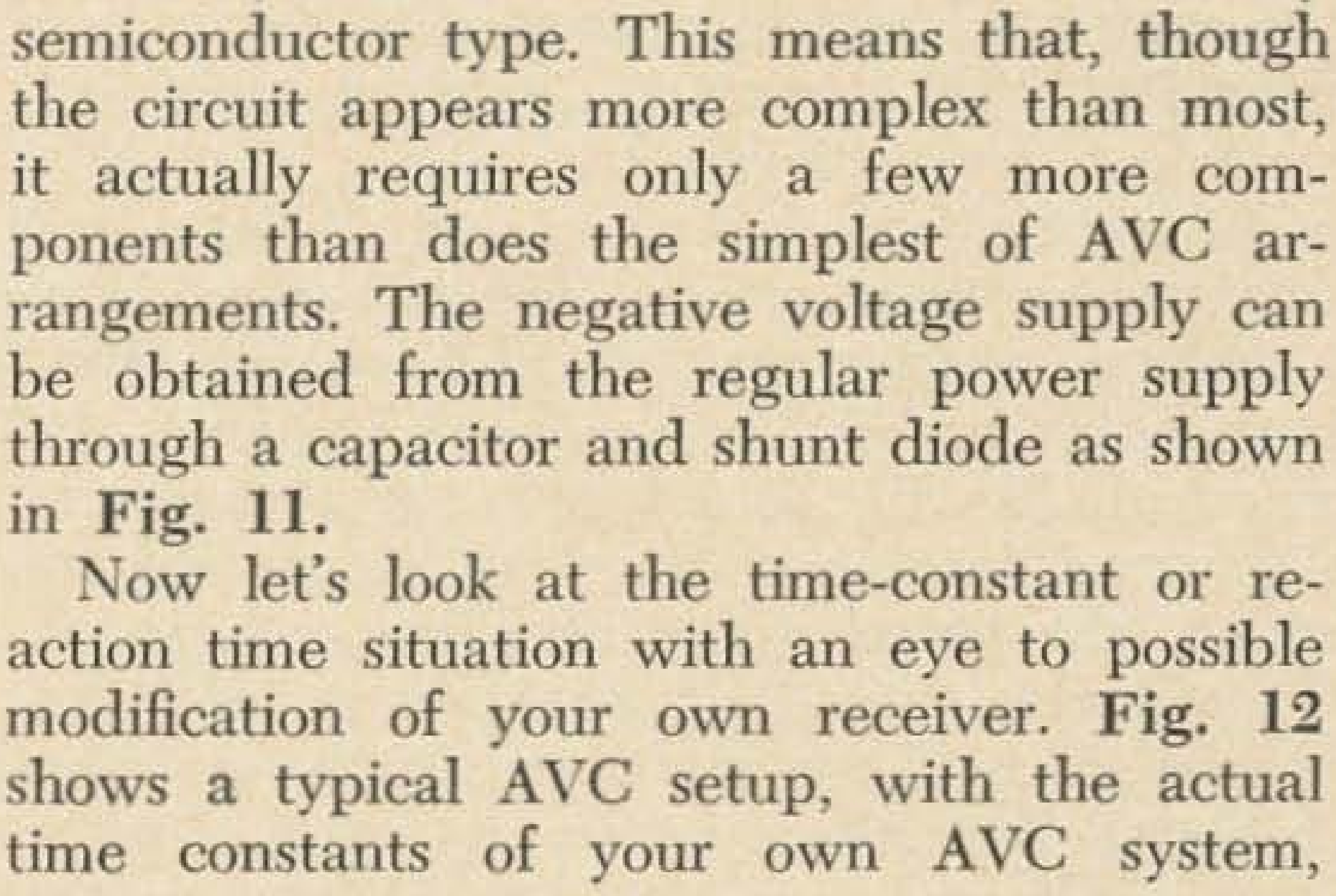



Fig. 10. DC-amplified delayed AVC.

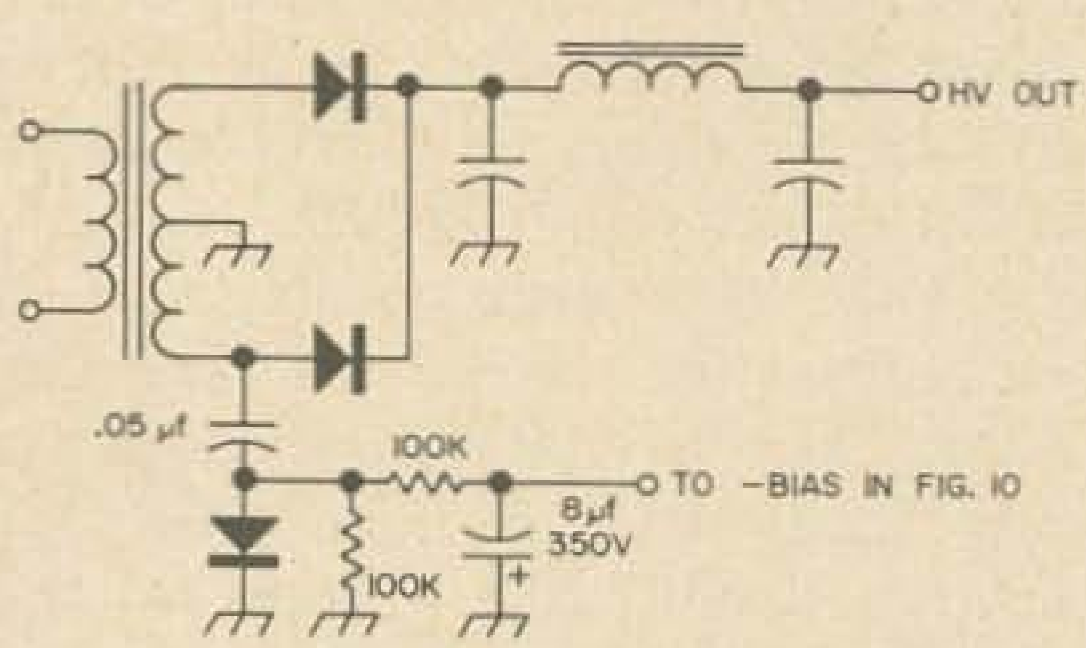



Fig. 11. Bias supply for circuit of Fig. 10.

control-voltage takeoff and rectifiers indicated merely by a block. You can compare this to the schematic of your own receiver to determine which components correspond on your own schematic.

You can see that our earlier discussions assumed that reaction time was determined *entirely* by R4 and C4; this isn't quite true. The formulas shown in the figure include the effects of all resistances and capacitances in the circuit. If more stages are under control than the three shown here, their decoupling networks can be included by adding R7,C7 in the same way that the underlined R6, C6 are included here (for two-stage control, omit all underlined components in the formulas).

While R4 and C4 still predominate in the control of reaction time, with the typical values indicated on the schematic the R4-C4 time constant was lengthened by some 2.4 milliseconds on charge and by 42.65 milliseconds on discharge.

To reduce these other effects, you can replace all decoupling resistors (R5, R6, and filter resistor R1) with RF chokes, and reduce the associated bypass capacitors to somewhere near 100 pfd. A shorter discharge time constant can be achieved by adding a parallel resistor (Rp) as shown in dotted lines, but this resistor together with R4 will then form a voltage divider which will keep full AVC from being applied to the line. Reducing the value of C4 will shorten both the charge and discharge times; you may find it possible to reduce the value of C4, add Rp, and modify the value to R4 to equalize charge and discharge times. Then adding a diode as shown in dotted lines gives you an option of short or long discharge time; with the diode in the circuit, discharge time will be long.

In making these modifications, refer to the chart of "normal" AVC voltage levels you prepared before starting, and be certain that you end up with the same voltage on the AVC line for the same signal input that you had in the beginning. (Of course, if you had overload problems too you might want to use a little less or a little more, but if the control was satisfactory and all you want to change is the reaction time then you must be certain that you get the same control voltages out after making circuit changes.) These measurements should be made only with steady signal applied, because even the 11-megohm input resistance of a VTVM will drag off any charge on C4 if it is made small.

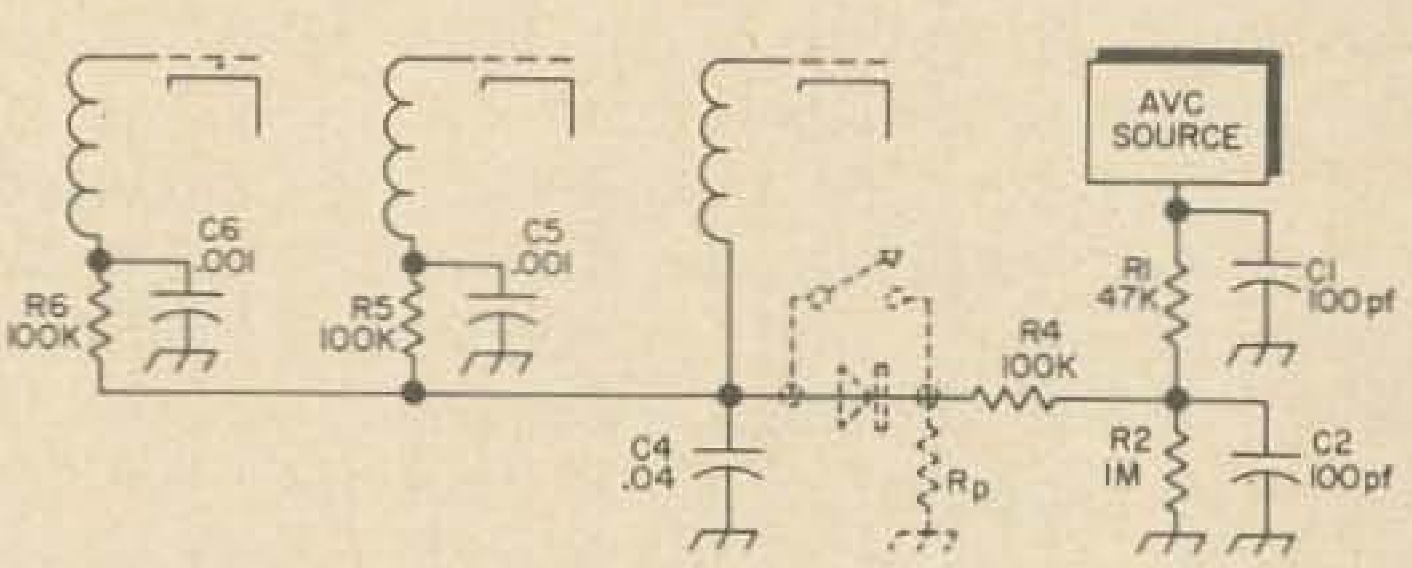
The same considerations, of course, also apply to the substitution of any of these AVC circuits for that existing in your receiver. The final voltages applied to the AVC line of the receiver must be a fairly close match to the original voltages if undistorted, completely controlled output is to be achieved.

Not yet mentioned has been the use of the AVC voltage to control other functions such as anl bias-setting or squelch circuits. If the AVC is to be so used, it's a good idea to include some form of dc amplification such as the circuit of **Fig. 10**, with an additional diode connected in the same manner as D2 for each of the additional functions. This will prevent undesirable interaction between the functions, and will prevent them from having any effect upon the AVC circuit itself. For economy reasons, such isolation is not usually provided in factory-built gear.

From this point on, AVC design becomes more of a detailed engineering study than a general survey subject. If you care to pursue it further, a good starting point is the "Radiotron Designer's Handbook" available from Radio Bookshop. Look in Chapter 27. An additional reference is K. R. Sturley's book "Radio Receiver Design," Part 2, Chapter 12, if you can locate a copy—it was published in London in 1943.

But for a general understanding of the subject, additional reading shouldn't be required. And now, at least, you should know what that little knob on the panel does when you turn it!

. . . K5JKX




**Formulae:**

Charge time constant (seconds) =
R1(C2 + C4 + C5 + **C6**) + R4 (C4 + C5 + **C6**) + R5C5 + **R6C6**

Discharge time constant =
**C6(R6 + R4 + R2)** + C5(R5 + R4 + R2) + C4 (R4 + R2) + C1(R1 + R2) + C2R2

Resistances in megohms, capacitances in microfarads. With typical values shown for components, charge time is 6.38 milliseconds and discharge time is 46.647 ms.

Fig. 12. Time-constant considerations of AVC circuit.

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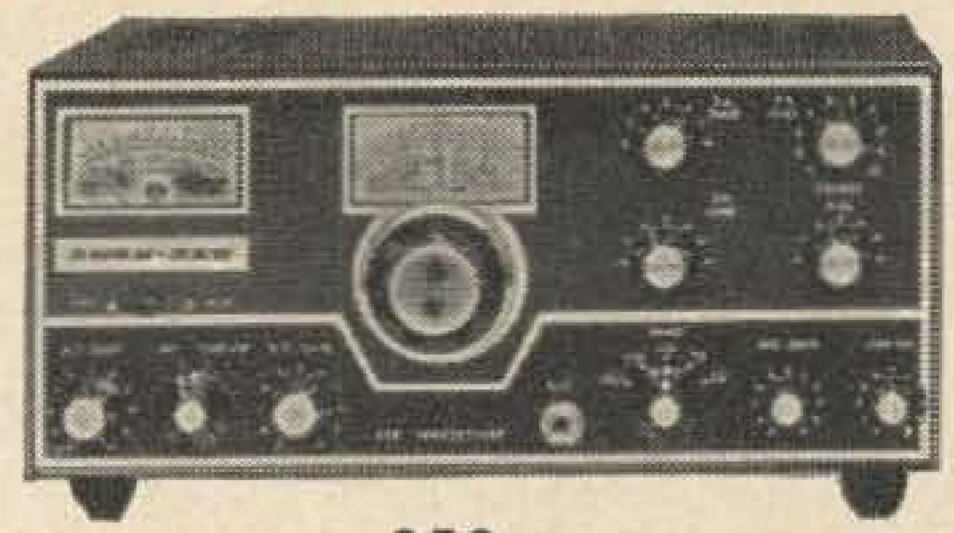

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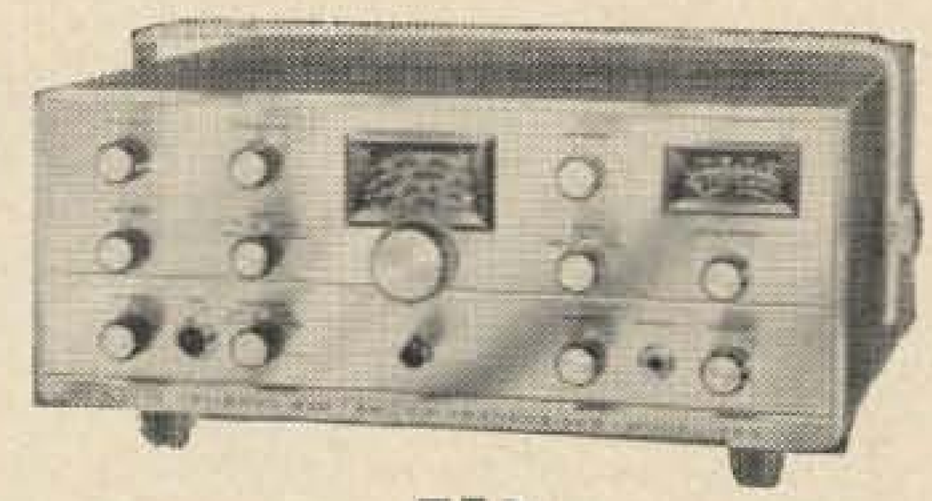

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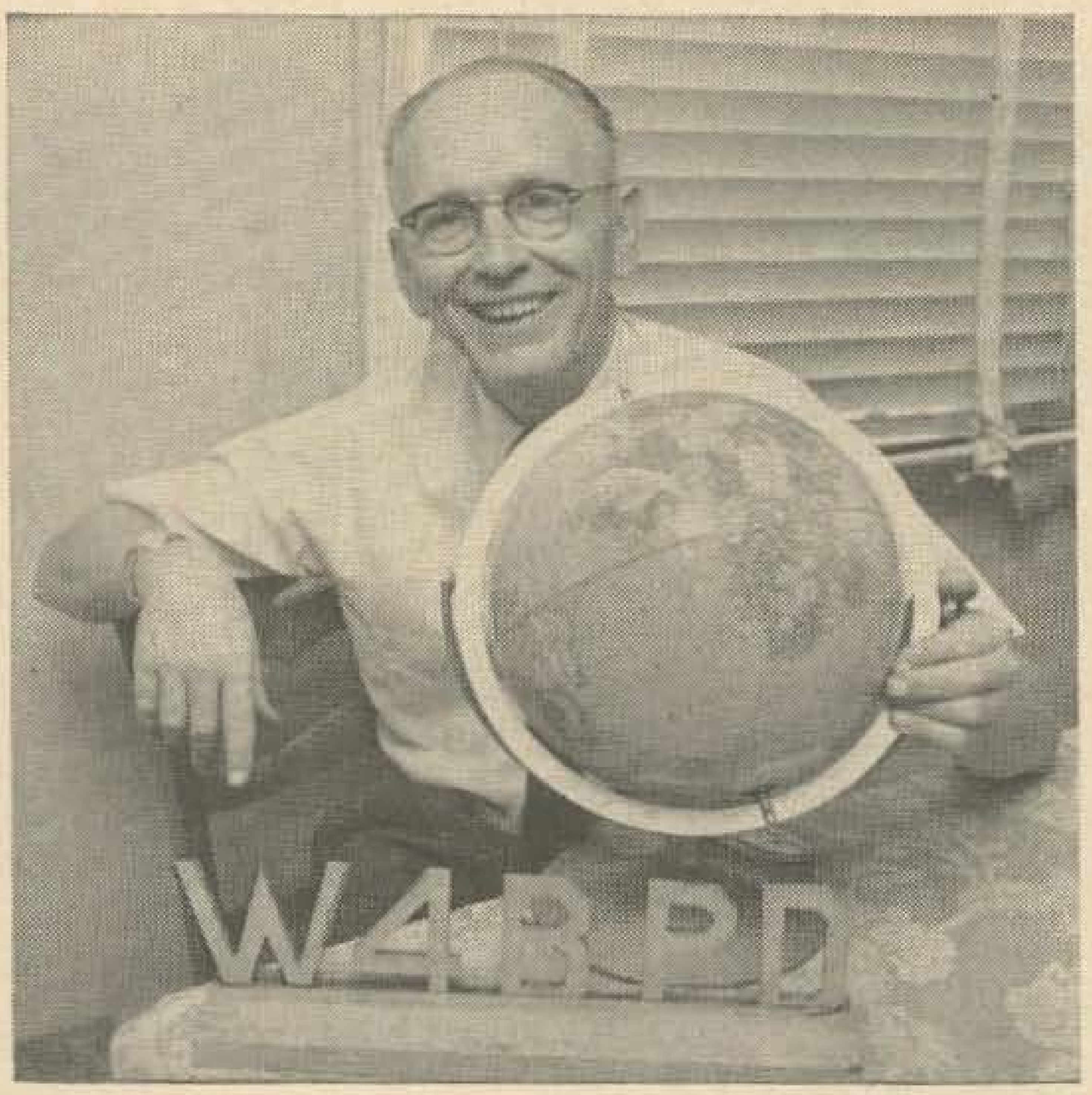



Gus Browning W4BPD
c/o 73 Magazine
Peterborough, N.H. 03458

# Why WTW Now?

## *Details on 73's NEW Work the World Certificate for DX'ers*

I suppose some of you are wondering why another DX award at this time. The answer to this is very simple. This is not **another** DX award, this is **the** DX award. Don't call it just another DX award. DX awards come and go but this is the one that will stay with us, because it's the one award (the only one I know of) that will make you keep on your toes to stay on top.

Basically the WTW award is an award that either phone or cw stations can qualify for. They are both completely separated, there will be no mixing of the two together. If you want a phone award you will have to be in there on phone and work phone stations. The same goes for CW. Each band will stand on its own feet. There will be awards for 10 meters, 15 meters, 20 meters, 40 meters, 80 meters and even 160 meters. Each QSL card will have to indicate the band, mode, time, date, QTH, and signal report. For statistics we would even like to have the signal report sent and received indicated on each QSL card. This is not necessary but would be preferred. We will try to have a certification point in as many countries as possible under the jurisdiction of a National Club. How about some volunteers from you clubs overseas?

The first WTW certificate requires 100 verifications to be submitted. The second certificate for 200 countries verified, then 300 for the top and the real WTW certificate for 350. What's beyond the 350 country certificate is not known at this time. Maybe even a Moonbounce certificate or one for Satellite relay later on if anyone ever works the required 100. This will be an award that intends to stay up to date. We are in the process now of getting "country lists" from the various clubs overseas. We will begin by using the ARRL country list and others will be added on as the suggestions are received from the overseas groups. I don't think the list will ever get up to 400 countries, but it surely will be over 350. 73 Magazine will keep you informed, so watch 73 magazine very closely for all announcements from now on. Of course the certificate will be one of the nicest and you will be proud to hang it on your wall. To cover our handling and mailing costs please enclose a one dollar bill. Overseas stations will be allowed to enclose seven IRC's to cover costs.

This DX award commences at 0001 GMT, May 1st, 1966. All cards must have this date or a later date to certify for WTW. Until we announce the various certification places send your cards to: Gus, 73 magazine, Peterborough, New Hampshire. South American stations can send theirs to the Venezuela Radio Club, P.O. Box 2285, Caracas, Venezuela, South America. Later on there may be other clubs for other portions of South America. We will keep you well informed in 73 Magazine about the verification points.

At the end of the first 5 years (from May 1 to 31st. Dec. 1966 will be considered the first year) your total will go down each year if you don't QSO the countries you worked 5 years before. WTW will be an award for *active* DXers. The top country totals will be listed in 73 Magazine. News about the WTW will of course be written about in 73 magazine.

Watch for W4BPD on these frequencies at these times for latest info about WTW:—14065—1400 GMT, and again at 2100 GMT (this is CW) 14275 + or − 1500 GMT and again at 2200 GMT (SSB). Starting about July 5th. Of course if I am out of my QTH at these times I will not be on. I would like to gather DX information and be able to give it out also during these periods of operation. I have even been thinking (but not seriously) about a weekly DX bulletin later on. How about a post card from *everyone* who would subscribe to such a thing?

New comers have mentioned to me many times that they have no chance to ever get caught up with the old timers. The WTW will be run by DXers for DXers—not 75 meter rag chewers, 80 meter traffic handlers, or phone patchers. We know what DX is and what the DXers want. I think we will give them what they want with WTW. The overseas groups have always looked upon the DXCC as an American award and some of their opinions vary considerably from ours as to what they think is or is not a country. We think they will like the WTW and will look upon it as something they have a little sayso in since they will at least have a chance to help select the countries to be included in the WTW country list.

I have had many complaints about QSL cards that were mailed to the USA for verification apparently becoming lost or even stolen. When we have our overseas certification points selected we think this type of a complaint will practically cease, or at least will be considerably lessened. I think we all will admit that we need as much activity as possible on every band right now, because of the next frequency allocation conference that will be coming up soon. You can bet that all of our frequencies are being eyed by the various services as possible good hunting grounds. Oh yes, we are being surveyed very carefully and all the wide open frequencies that we don't use will certainly be mentioned when this frequency allocation conference takes place.

To help keep the commercials out of our bands *please* pick out one of them when tuning up, checking your keying, checking your SWR, testing, etc. And then there is no law that says you can't call CQ on their frequency. Sign your call every ten minutes to satisfy our FCC. Of course run *full* power during these times, I mean *full* power. We must fight fire with fire and many of them can be discouraged if enough fellows share their frequencies. Wayne has the right idea about this. Maybe a planned operation of this sort might some day come about—who knows. I myself would like to keep our frequencies clear and this is one way to at least start clearing them up. More *power* to you all on this suggestion. Remember some of that RTTY around 14090 to 14100 is Ham, so don't do your monkey business on top of them. It would be real nice to have a RTTY receiver to be sure of fellows around these frequencies.

Future DXpeditions by me—oh yes things are moving nicely along these lines. Another thing, I want to sort of wait a while to see what the WTW boys will be needing and also what will be included in some of the overseas suggested country lists. By July I'll know better what you fellows will be needing.

WTW is not in competition with any other award. I think that DXCC has had their day, WAZ has had theirs, the WPX has sort of slowed down (with some fellows it never even got started) and from now on the WTW will take their places—and keep it for a long time.

We at 73 Magazine want everyone of you to know this is your award. We are always open to suggestions from the gang, and if it's a good one it will most certainly be considered. As for myself, I am for anything that will make you fellows happy. By this I mean the DXers. Of course DXing is not the only thing in Ham Radio. You fellows who like Rag Chewing, Contest operating, phone patching, testing out new antennas or equipment—you keep right on doing what you like. I am for you 100 percent. Can you picture the bedlam in our bands if everyone was a DXer? I myself think the DXer is *tops*—he has to have good equipment, good antennas, be a good operator, know geography, and be on his toes all the time to keep up with the other DXers. Good luck to you all on the WTW. I wonder who will get certificate Number ONE for each band and each mode?—LET'S GO FELLOWS AT 0001 GMT MAY 1st, 1966.

. . . W4BPD

A. J. Bivens K5BEC

# Private Listening Speaker

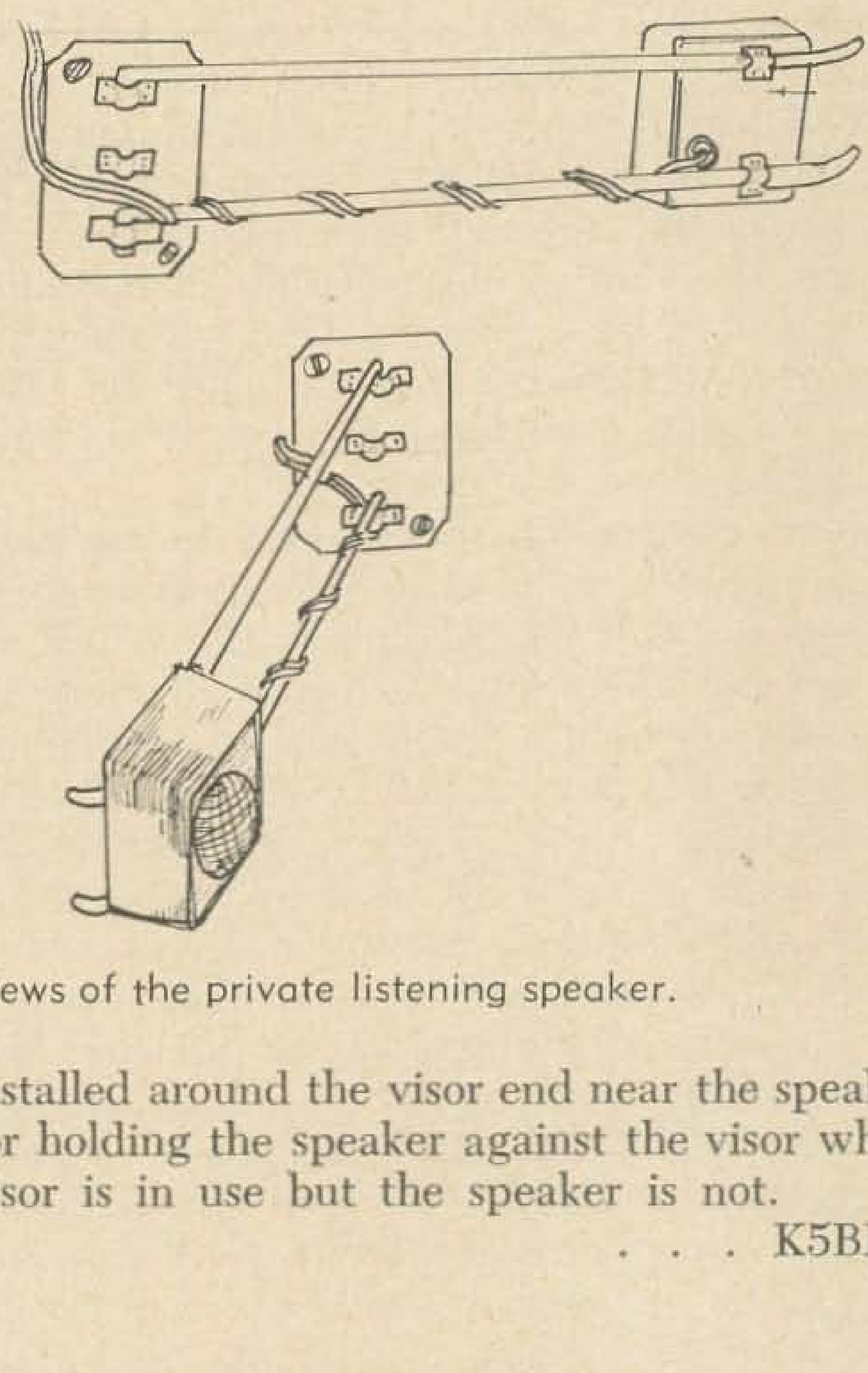
Ever wanted to keep the noise level down in your mobile station while other members of the family are trying to sleep, talk, or listen to the car radio? Have you ever wanted to hang a small speaker close to your ear so you wouldn't have to wear an ear phone and keep tangling in the cord?

Well, here is a device that has worked very well for the writer. It consists of a miniature back seat speaker (Lafayette order No. 99G6122) which may be ordered or purchased from most electronic stores, and a 59 cent cup towel rack purchased from a dime store.

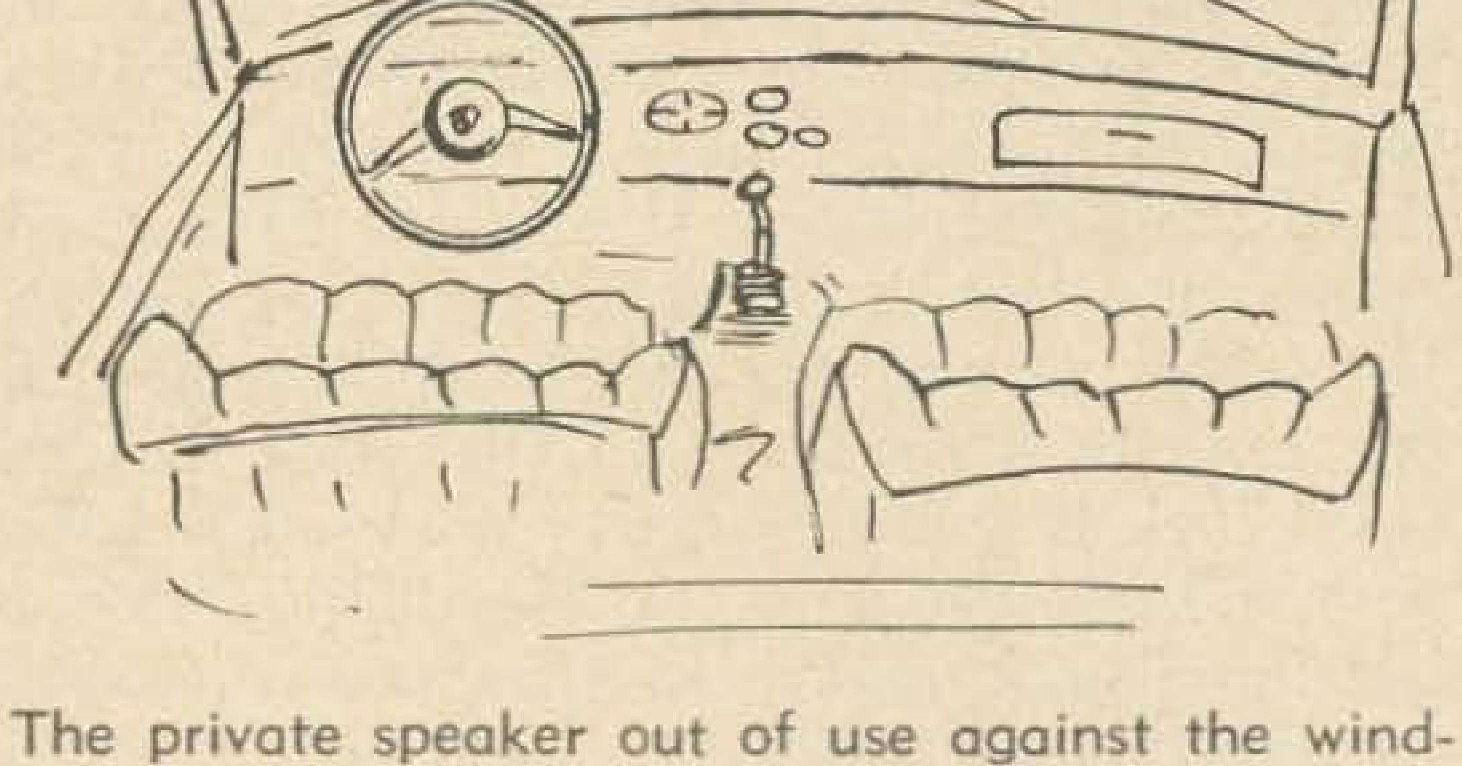
If the rack has more than two bars they should be removed for better side vision. Mount the assembly as diagramed making sure to mount it on the side of the visor facing driver when visor is down. The speaker may then be swung out when needed or folded back and then lifted up with the visor when not in use. Lateral adjustment is done by swinging the rack and vertical adjustment by pushing or pulling the visor slightly at the bottom.

A heavy rubberband may be permanently installed around the visor end near the speaker for holding the speaker against the visor when visor is in use but the speaker is not.

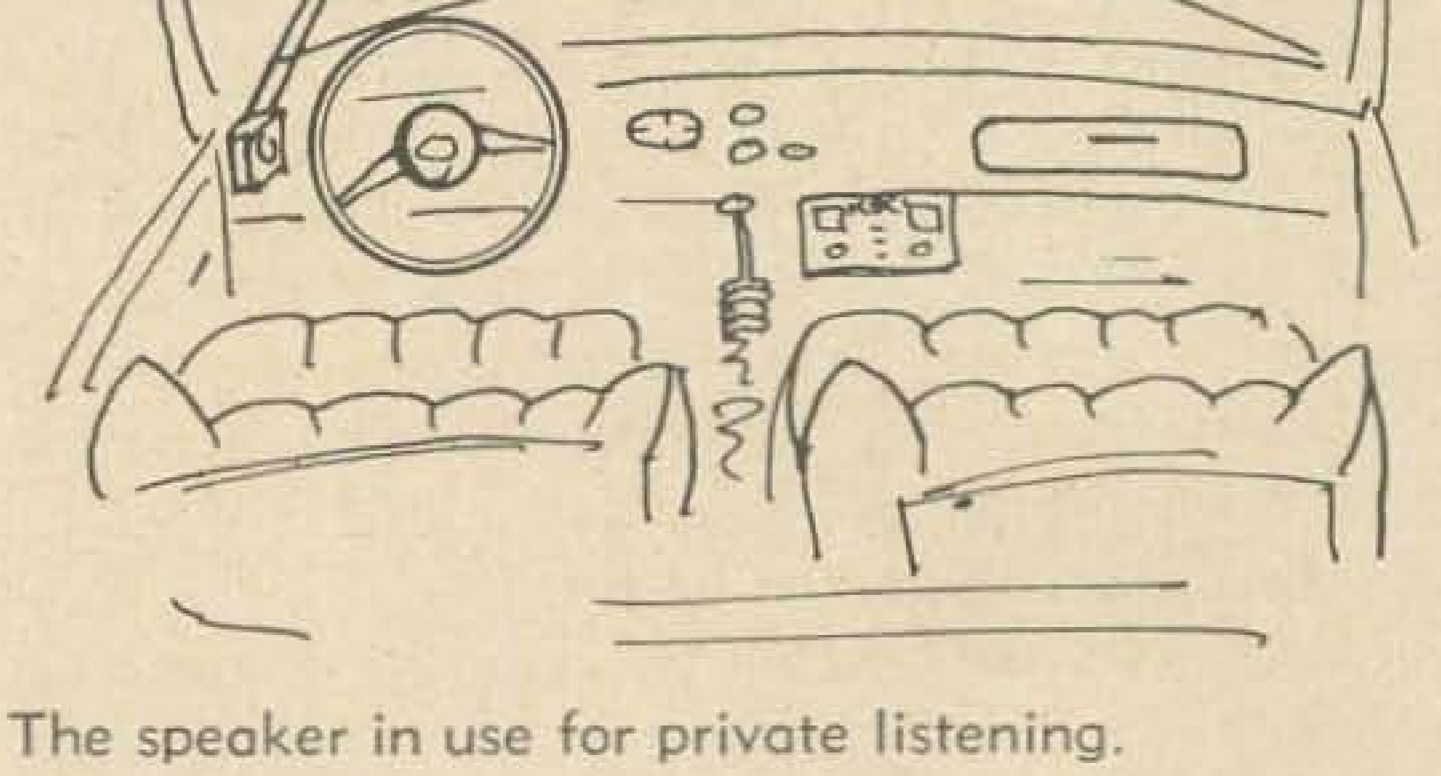
. . . K5BEC



Views of the private listening speaker.



The private speaker out of use against the windshield.



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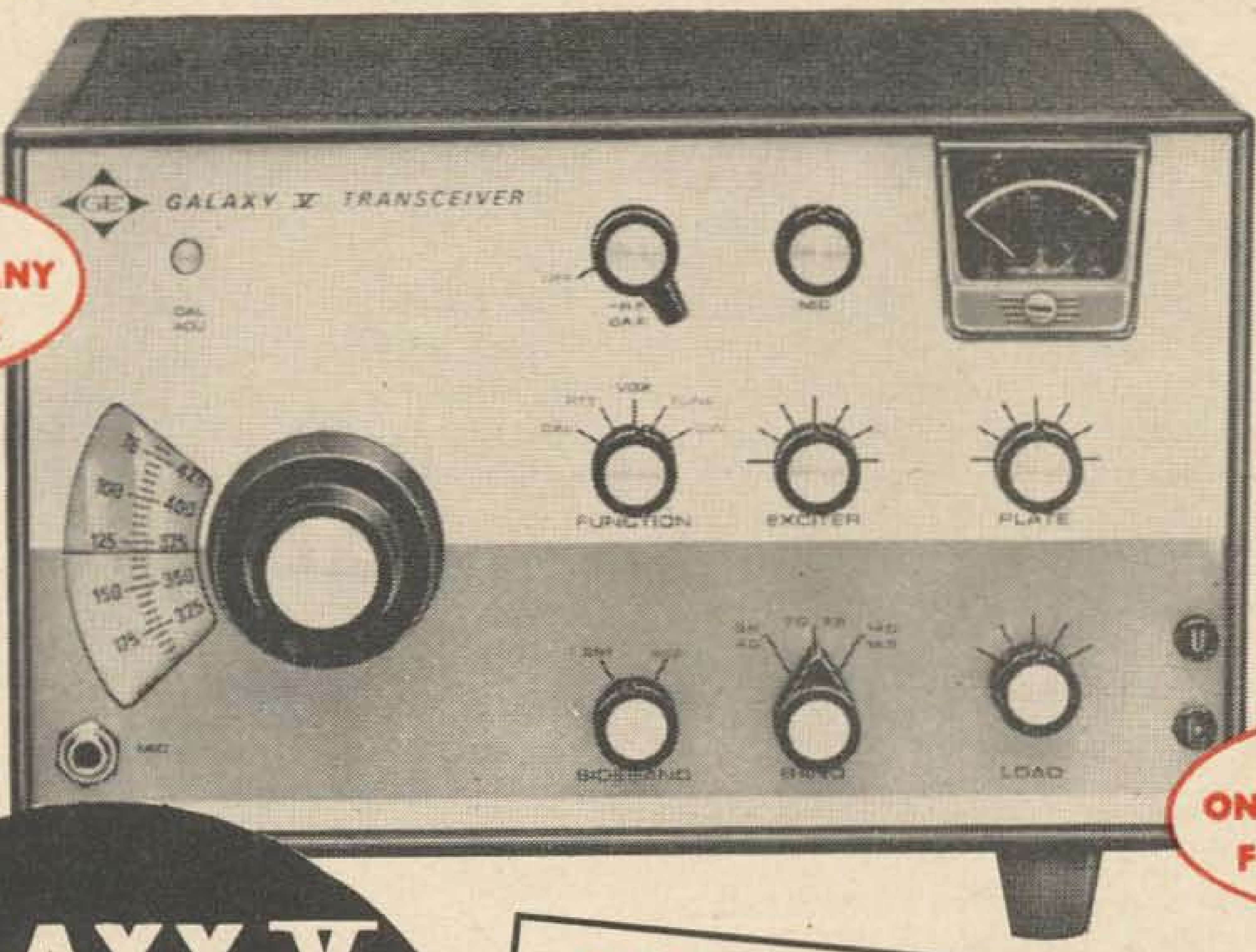


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# NEWS FROM THE INSTITUTE OF AMATEUR RADIO

## Compiled by A. David Middelton W7ZC, Secretary

### IoAR constitution approved by Members

A Report was mailed to all Members of record in early February. Due to a delay in production of the Report at 73, the deadline of February 10th for the return of ballots on the Constitution and By Laws came shortly after mailing from Peterborough. A post card extension notice to all Members the first week in February established the new date of March 10th for receipt of ballots at IoAR HQ.

Here are the results of the voting on the ratification of the IoAR Constitution and By Laws.

| | |
|---|---|
| Total votes received | 233 |
| Votes of approval | 228 |
| Votes of disapproval | 5 |

The Constitution and By Laws as presented in the Members Report of January 1966 is thereby ratified by a majority of the votes cast, and the approved C and BL are now in *effect*, as of *March 12, 1966*.

Several Members sent in suggested amendments or changes. There being no mechanism for such changes *at this time* it is suggested that Members reconsider their desired changes and re-submit them later, prior to the first Board meeting. A call to Members will be issued at that time for such amendments to be considered as provided for under Article 12 of the IoAR C and BL.

### QST young IoAR members

You may win prizes in a construction-article contest specifically designed for IoAR Members under 20 years of age! See March or April IoAR columns for complete details. Deadline for receipt of written entries is July 15, 1966.

### More on tower suit

March 73, page 72, informed you that a Pennsylvania Amateur had been forced, at the order of the State Supreme Court to dismantle his tower and antenna. This unfortunate Amateur, W3HJ, recently wrote IoAR HQ. Here is the pertinent part of his note.

"Thanks for the offer of help but don't know just what you could have done. I think I got just about all of the legal and financial support that I could have expected. In fact a good deal more. ARRL gave me wonderful assistance in both the local court and the Supreme Court of Pennsylvania.

"Since this suit was filed against me on the basis of deed restrictions and not zoning laws the chance of my winning it was not too good. There were some aspects involved though which made it seem advisable to try.

"I followed it through to the end more in consideration of Ham Radio as a whole than from winning it for myself as I would have been moving to another location in the future even if I had won the case.

"*I was just too trusting a soul from a verbal approval stand point.* As you say, read the fine print and with a fine tooth comb."

### International hamfest July 16-17

IoAR Member Withey, WAØHUD informed HQ that an international hamfest is planned for a location on the border of Manitoba and North Dakota. Watch this column for further details.

### Educational Amateur Radio

Project EAR, a person-to-person exchange of information and ideas via Amateur Radio has been cooperatively developed by Mr. Edgar Klugman, Principal of the Harrison (N.Y.) Avenue School, and Mr. C. Robert Fine WB2LUM.

Since 1964 Project EAR has successfully brought together school groups in distant points for direct child-to-child discussions of their respective locations, climate, and customs.

Also, panels of educators in New York have held joint meetings with similar panels in Australia utilizing the techniques of Project EAR, over cooperating Amateur Stations.

Mr. Klugman asked IoAR for assistance in obtaining volunteers in the Amateur ranks who are seriously interested in helping him enlarge Project EAR into a world-wide operation.

IoAR applauds this vital concept in the use of Amateur Radio. Project EAR has tremendous significance both in the field of international relationships (with resultant benefit to all Amateur Radio) and in is rewards to cooperative Amateurs in bringing this project to its potential worth!

If you are desirous of assisting, write Mr. Edgar Klugman, Principal, Harrison Avenue School, Harrison, New York, or to WB2LUM for complete information.

IoAR commends Mr. Klugman and WB2LUM for the originality of Project EAR and for their devotion to the cause of international friendship by extending the horizons of school children and educators through the organized use of Amateur Radio!

### Technical examination questions needed

IoAR HQ is experiencing difficulty in securing assistance in the preparation of questions for its Certificate of Merit examination as described in the March column. If you are *qualified*, and wish to aid in this worthwhile project, please write IoAR HQ.

**IoAR—Totally Dedicated to the Betterment and Preservation of Amateur Radio.**

## Get it in writing and read the fine print

An amateur (who gave his call but it is being withheld) in a large eastern city wrote IoAR recently—"When I moved into this apartment a few months ago, I was told that I could put up an antenna. But when I attempted to put one up, my landlord said NO. He soon changed his mind, however, but demanded $500,000 (WOW) insurance. I am allowed a TV antenna (in the lease—which does not state the size) so I will use the stacked TV antennas as my ham antenna!"

Moral—get it in writing—and watchout for the fine print. $500K—that's probably more than the building cost!

## FCC continues study of Docket 15928

IoAR HQ recently inquired of FCC regarding the status of Docket No. 15928, and asked for the name and call of the new Chief of the Amateur Division. Here is FCC's reply, dated Feb. 15, 1966.

"At the present time, the Commission is carefully studying the comments that were submitted in response to the Notice of Proposed Rule-Making in Docket No. 15928. Further action in this Docket is anticipated sometime this year.

"Mr. Everett Henry (W3BG), presently Chief of the Marine Radio Division, has been reassigned to serve as Chief of the Amateur and Citizens Radio Division.

"Signed—Ben F. Waple
Secretary"

## Changes in Members QTH

All IoAR Members are urged to keep Membership Department, Peterborough, N. Hampshire fully informed as to their *correct, up-dated* mail address, complete with Zip code. Do *not* send this information to IoAR HQ, but *do* send it to Peterborough!

## IoAR member heads important emergency net

The West Coast Amateur Radio Service has been in daily operation for almost three years. A group of dedicated and highly skilled operators maintain a continuous watch on 7225 kHz, ready to handle any type emergency, priority, routine message or information to be passed among the seven Western states.

A daily practice (and traffic) drill is held at noon, PST, with formal net proceedure.

Direct contact is maintained by WCARS with highway police and similar public safety and welfare services.

IoAR Member David Atkins, W6VX, is President of WCARS and often NCS for the drill or during the daily monitoring. IoAR Secretary W7ZC is a Director of WCARS and a frequent participant in network operations.

Amateurs in the Western part of the US are invited to call in on 7225 at any time the WCARS can be of any help.

IoAR commends these and other amateurs who devote much of their operating time to highly valuable public service.

**Important IoAR Addresses**

For all correspondence except that regarding membership and supplies:
**Institute of Amateur Radio**
**Springdale, Utah 84767**

For membership correspondence and IoAR supplies:
**Institute of Amateur Radio**
**Peterborough, N.H. 03458**

## Ham-CB cooperation effective in Texas

This column carried an inquiry (in March) concerning possible Ham-CB joint efforts. IoAR HQ received the following information from Gene Nowlin WA5JPW;

"Here in Marshall, Texas, this has been in effect for about two years, under Civil Defense, Marshall Amateur Radio Club, Inc.—(WA5MRP) and the Caddo District CB Radio Club under a CD50 unit call of KKV2461.

CD Communication Director—Bert Wood K5MVJ; Co-ordinator, Cliff Crabtree W5NYW-10Q1495 who is also President of Marshall ARC; President Caddo District CBRC—Vernard Grimes—WA5MNF-KKV6996.

The amateurs handle some traffic locally on 10 meters and most all long distant traffic. The CB'ers handle all county as well as city traffic in the event telephones are out. We think it works out very well here in Harrison County, Marshall, Texas."

## QTH? Lost members! Where are you!

IoAR HQ needs the updated, correct address of the following;

Davis, R.W. KB6CS
Livingstone, A.W. K6VYJ
MacArthur, Roger K9UYA
Miller, Chase. W. Jr. W4AXV
Nelson, Robt. L. K6ZGQ

## Keep the news clips coming!

The response to HQ's appeal for news clippings concerning amateur radio has been excellent! Here is a project in which everyone can help! Watch your newspapers and magazines for any references to amateur radio, cut out the clips and send them to HQ. Please help fill HQ's Scrapbook!

## Copies of constitution

With the ratification of the C and BL contained in the January 1966 Members Report this became an official document of IoAR. Members are urged to keep the January Report on file. The C and BL contain many pertinent facts about IoAR structure.

The Membership Department has been requested to include copies with all membership processing since Feb. 5, 1966.

Members who have not yet received their copy, please advise IoAR HQ.

. . .W7ZC

Hank Olson W6GXN
3780 Star King Circle
Palo Alto, California

# The Solid-State Product Detector

Increasingly, the use of solid-state circuitry is taking over in the field of electronics.

In amateur radio equipment, too, the "little three-legged gadgets" (transistors) are making in-roads. That solid-state ham gear has "arrived," is evidenced by several of the new SSB transceivers on the market, which use tubes only in the transmitter output stages.

There remain, however, a number of areas in commonly-used amateur circuitry, where transistors are awkward to use. For this reason, I suppose we shall continue to see *new* "all-tube" designs for some time to come. If a manufacturer decides on a tube-transistor "hybrid" circuit, he must face having two power-supplies: a high-voltage, low-current supply for tubes and a low-voltage, high-current supply for transistors. The expense of having two supplies for a "hybrid" design makes the two-faction system a near-reality—a company usually decides to either manufacture "all-tube" or "all-solid state." This means that *every* circuit block must be made solid-state (at least in the low power stages) before a manufacturer can seriously decide to join the "solid-state camp."

One of these "hard-to transistorize" blocks in our circuitry is the product detector, as needed for SSB reception. One obvious solid-state solution is the diode-ring demodulator, as used by Bell Telephone Laboratories, when SSB was first put into commercial service. The ring-demodulator is shown in **Fig. 1**. Of course, nowadays one would use a matched-quad of modern silicon-diodes instead of the original copper-oxide quad. The trouble with the ring-demodulator is that it requires diode-matching and a special balanced input system to be used. Also, a relatively large power level from the BFO is required to drive the ring, as the BFO current must drive the diodes of the ring well into forward conduction.

There are several double-diode product-detectors in amateur use, which are simpler to use than the full-blown four-diode ring-demodulator, but these are basically of the same family.[1,2,3]

Another amateur solid-state product detector is similar to the popular triode-tube

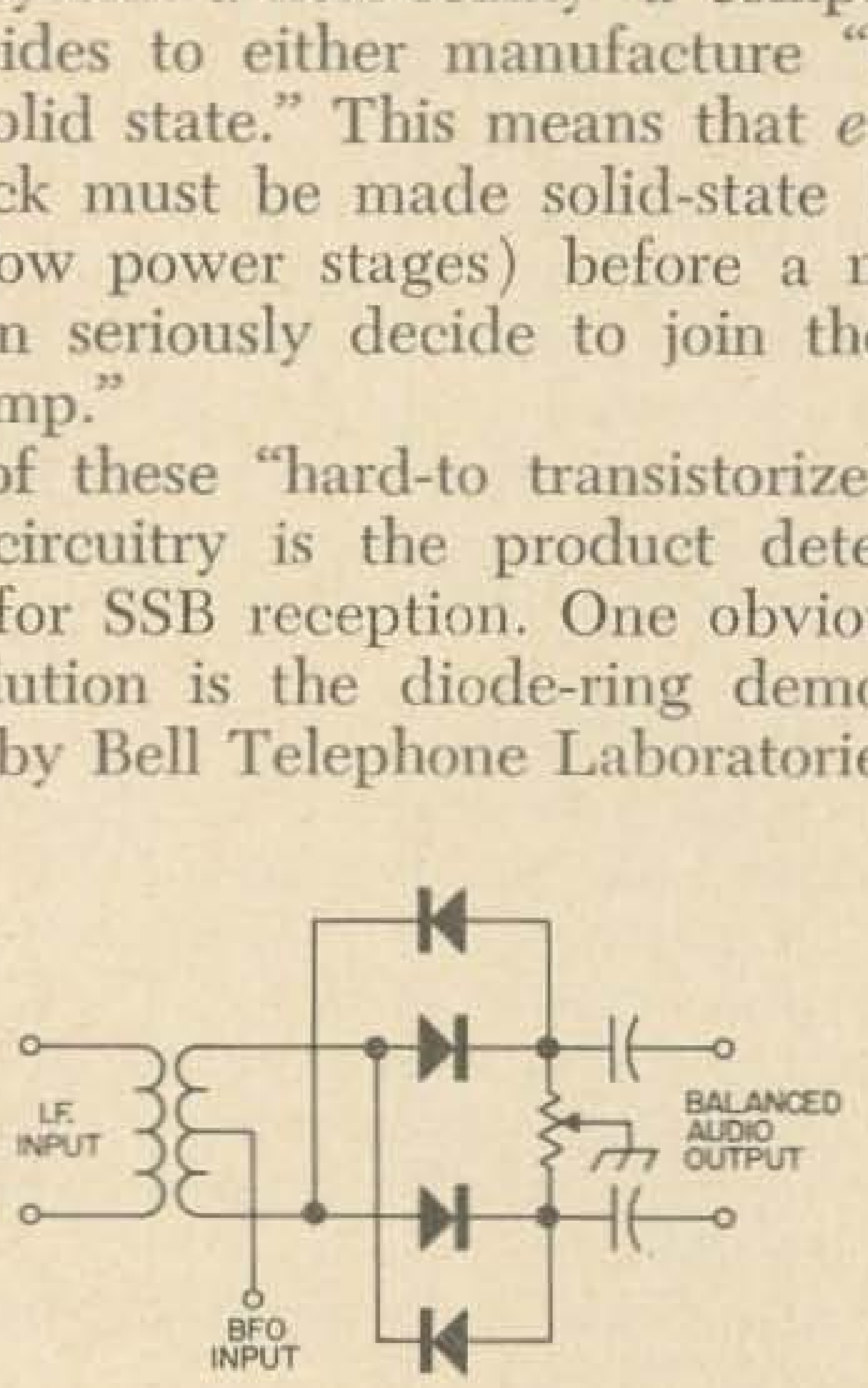


Fig. 1. The ring demodulator.

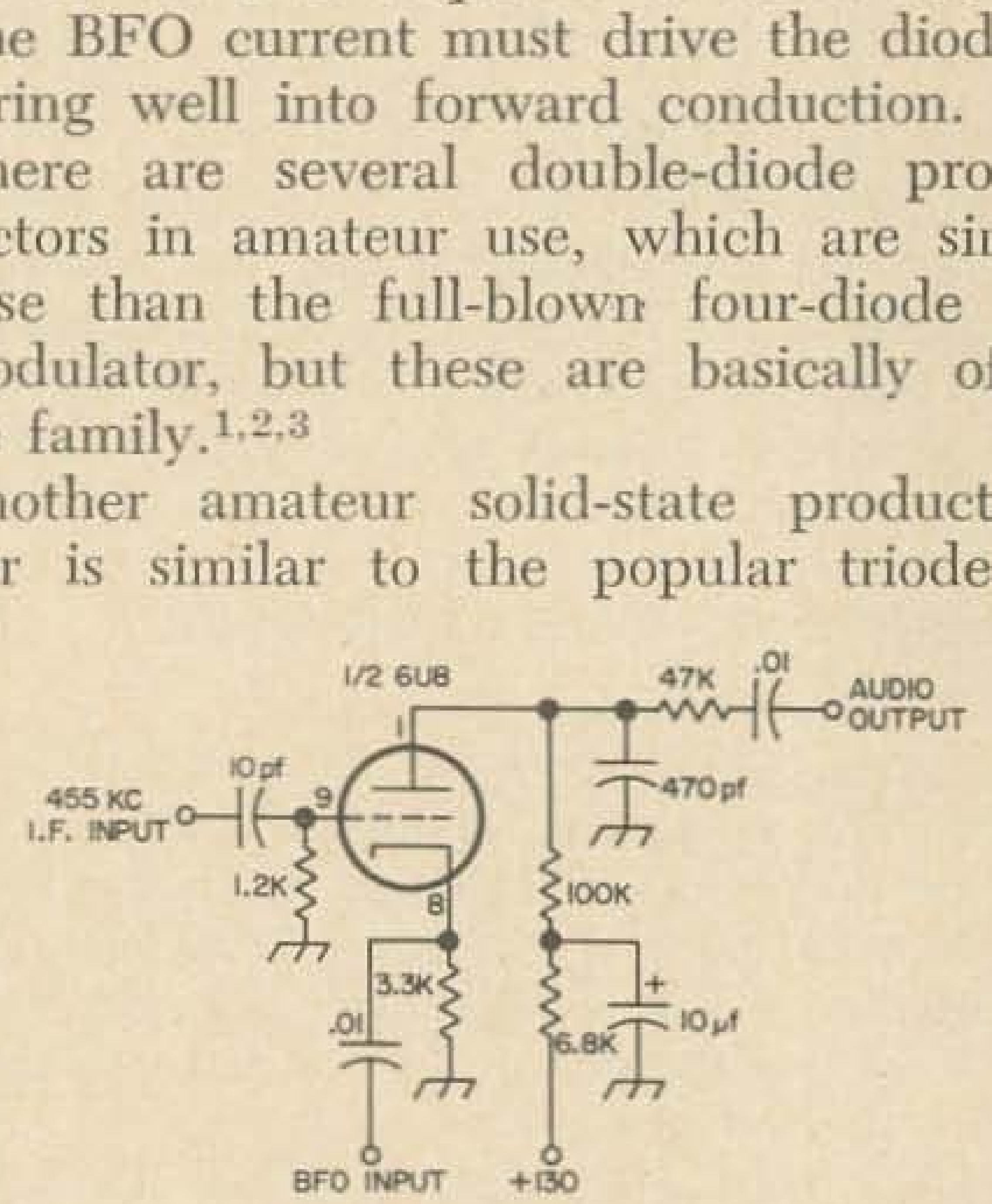


Fig. 2A. Triode tube product detector.

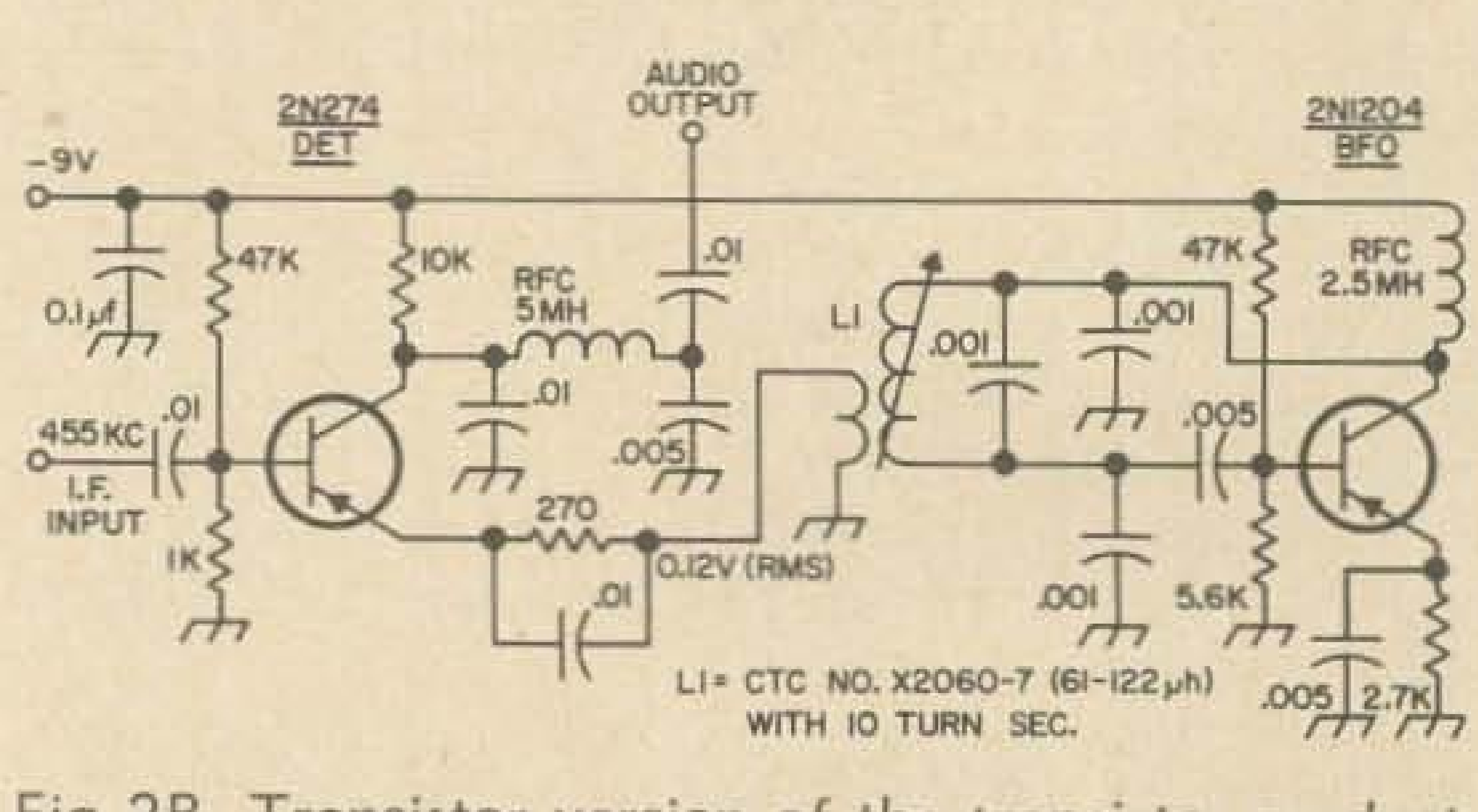


Fig 2B. Transistor version of the transistor product detector in Fig. 2A.

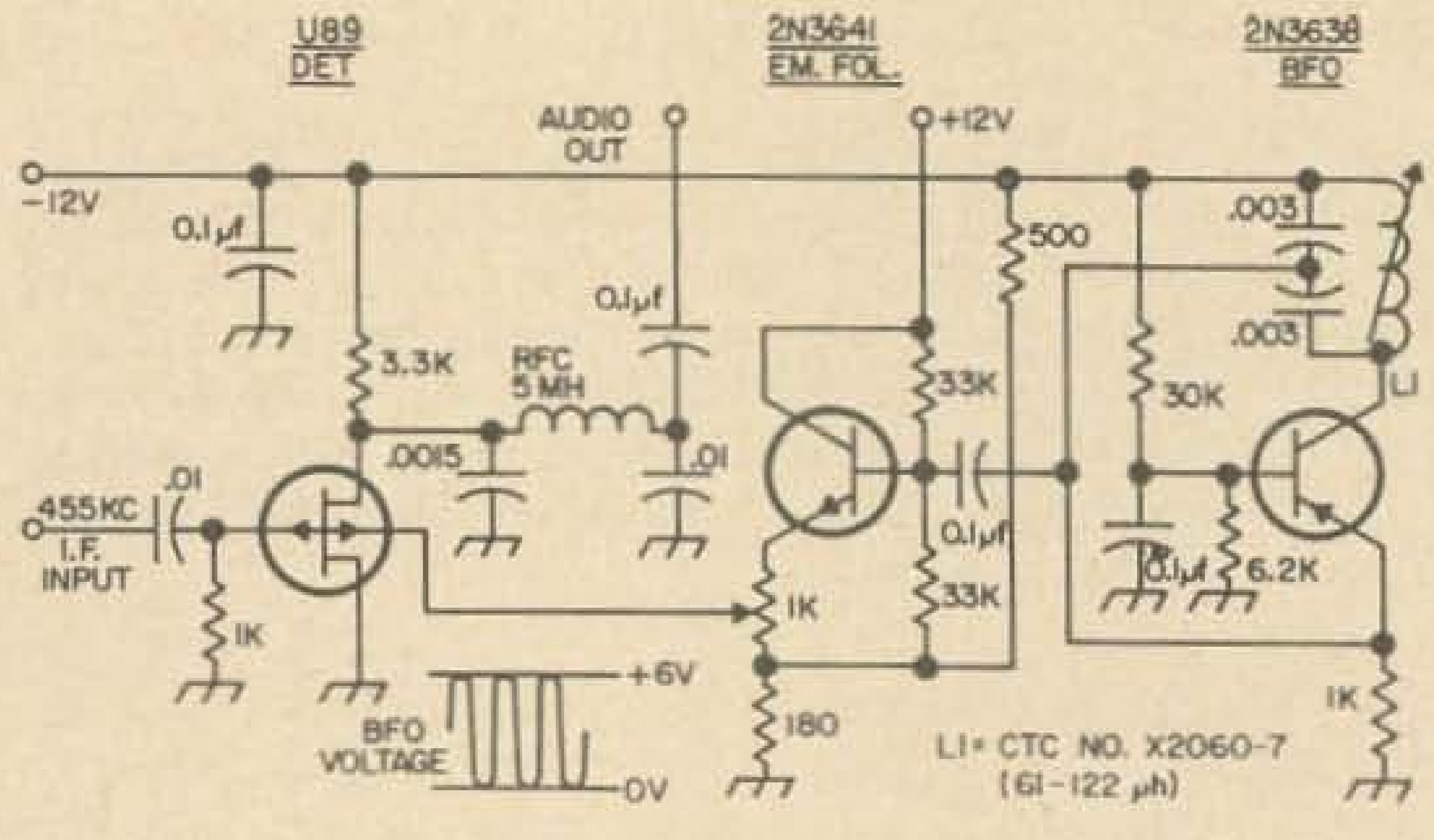


Fig. 3. Field effect tetrode product detector.

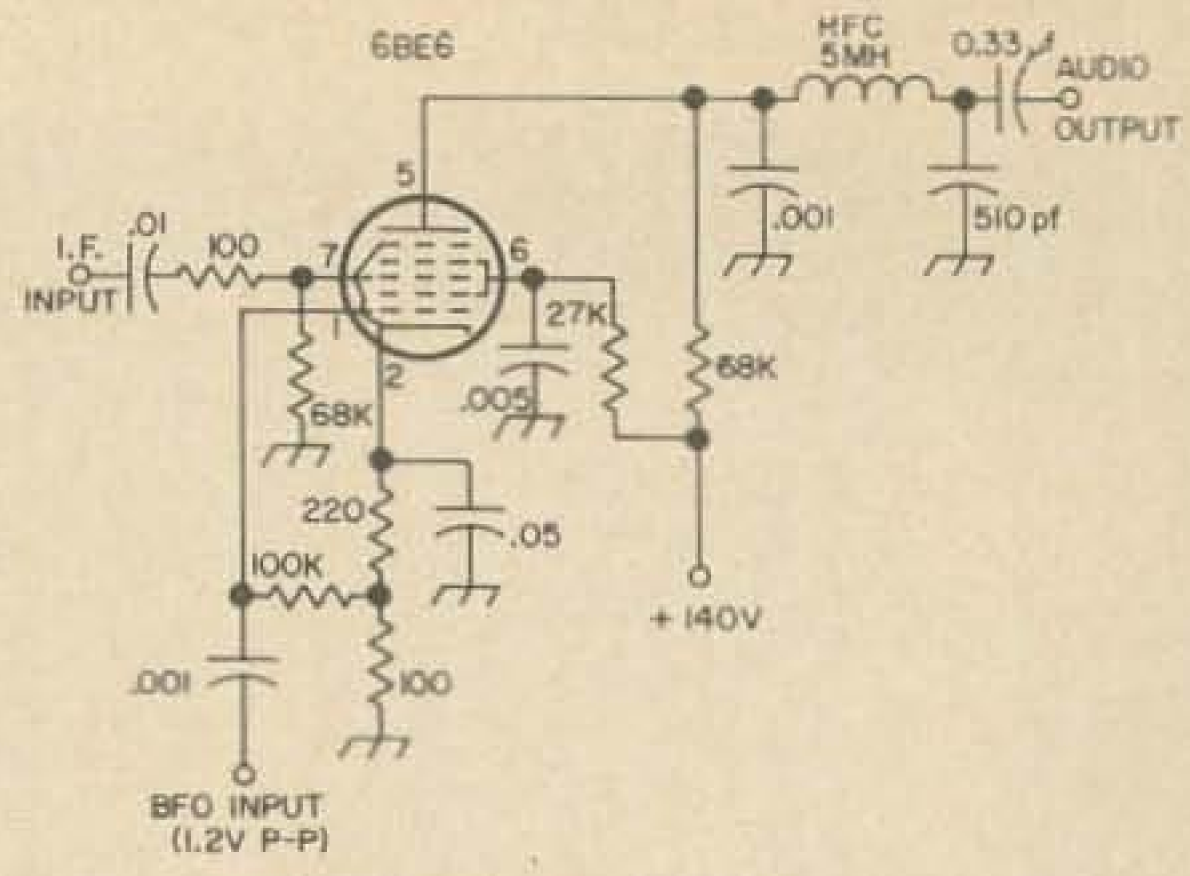


Fig. 4. Pentagrid product detector

type. **Fig. 2A** shows the essential part of the triode-tube detector and **Fig. 2B** shows its transistor counterpart.[4] Since the BFO drives the emitter, we again must deliver rather a large power level from the BFO (into a low impedance) to make the detector work. In fact, it is the rectified BFO voltage that biases this product-detector. When the BFO is turned off, the operating point changes considerably, and it is then possible to use the detector for AM. This product detector (the transistor version) is identical to most transistor mixers, and like them it cannot take large input signals.

The input-output characteristic of the circuit in **Fig. 2B** is shown in **Fig. 5**. If we define maximum useful output as the point on the input-output curve where the output departs from a linear relationship by 1 db, this circuit is only useful to 0.077 volts (rms) input. The curves were taken with the carrier-BFO difference frequency set at 2 kc. The input signal level was not increased above 0.12 v rms, because at about 0.13 v rms the BFO is "pulled" (injection locked) to the signal frequency. The use of an emitter-follower between BFO and product detector here would have allowed more complete measurements.

There remain, in the collection of tube-type product-detector circuits we may use, two which would seem to have no obvious solid-state counterparts. They are the product-detector using a pentagrid mixer, and that using a beam-switching tube. Each of these circuits has the advantage of having a pair of independent, high-impedance input ports, either of which will control the detector output current. This means that we get, at once, signal—BFO isolation, *and* small BFO input power requirement. But, unfortunately, the solid-state equivalent of the 6AS6, 6BE6, or 7360 hasn't been readily available; so no product-detectors along this line have been used in amateur circles to this author's knowledge.

Now, finally, at a price any ham can afford, a device is available to provide a solid-state product-detector with similar advantages to those of the pentagrid or beam-deflection tube types. The Siliconix U89, an industrial version of the 3N89 field-effect tetrode, is available for about $5.75, less than the cost of two 7360 Tubes. It is the fact that this FET has *two* gates, that are mutually independent, that makes it so useful.

In **Fig. 3** is shown the product detector using a U89. The second gate ($G_2$) is driven by the BFO and its emitter-follower. The emitter-follower gives BFO isolation and also, provides the proper bias level to the second gate. In **Fig. 5** is also shown the input-output curve of this detector. One will note that the output only deviates by 1 db from a linear relation, over an operating range of more than 65 db. About 0.5 v rms is the maximum signal input level, before linearity is lost.

In order for one to be able to make comparisons of the solid-state product-detectors shown above, a conventional 6BE6 product detector was constructed and measured. The

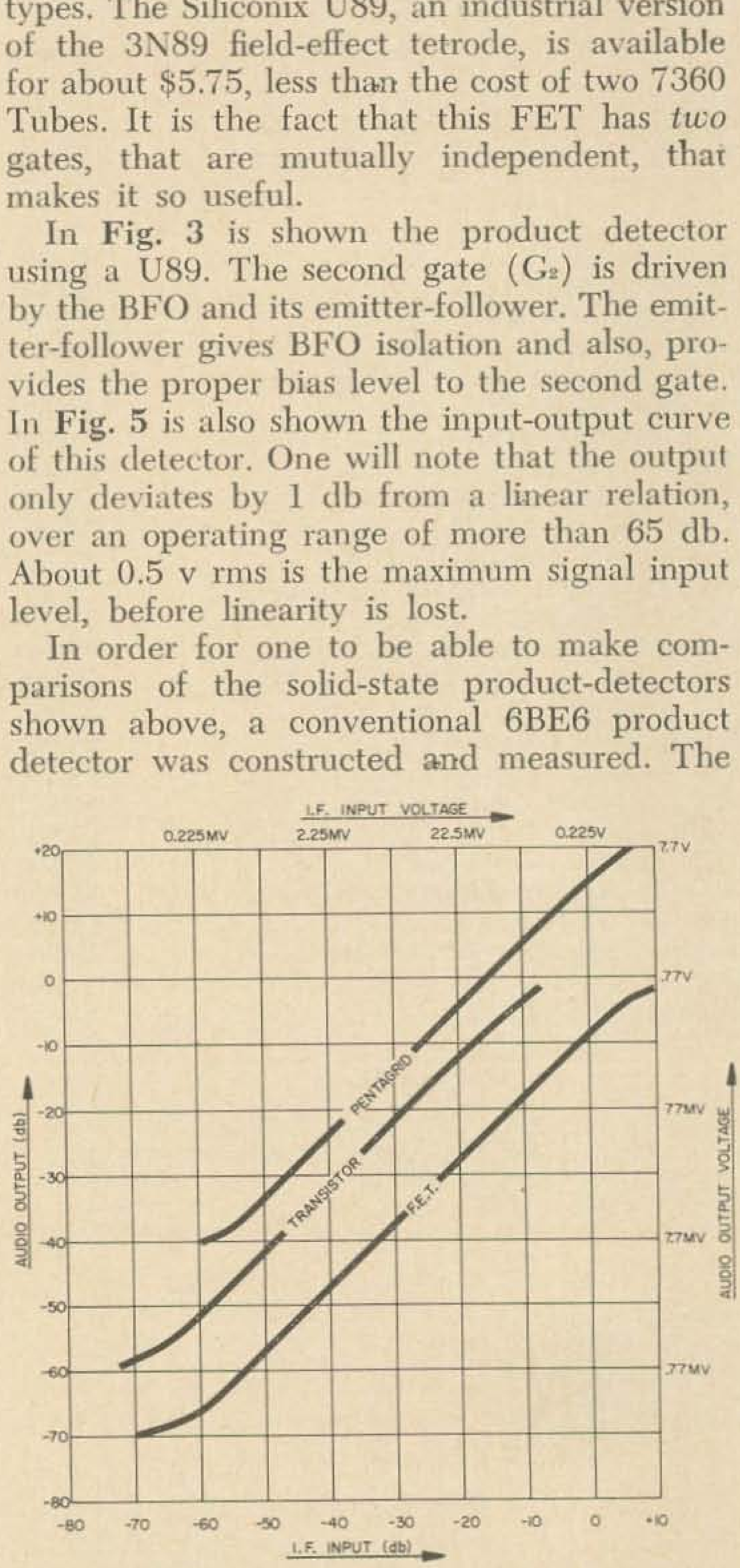


Fig. 5. Comparison of three product detectors.

circuit is similar to one used in one of the newer "amateur-band-only" HF receivers, but an additional L-C filter (5 mh and 510 pf) was added to cut down 455 kc in the output, and dc was used for the heater. These additions were to prevent the audio output VTVM from reading 455 kc or 60 cps, to either of which frequency it was sensitive. The 6BE6 product-detector circuit is shown in **Fig. 4** and the response curve is also shown in **Fig. 5**.

As can be seen, the useful ranges of the transistor, FET, and tube product detectors are respectively: 55 db, 67 db, and 58 db. The FET detector is clearly the best of the three circuits tried.

One note of caution is in order, however, since the FET product detector operates at an output level about 23 db below that of tube circuit. If this detector is to be used to replace the 6BE6 circuit in a receiver, an extra audio amplifier stage must be added.

. . . W6GXN

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2. Goodman, B. "The Misers Dream" *QST* May 1965, p. 13
3. R.S.G.B., *The Amateur Radio Handbook* 3rd. Ed. p. 93
4. Stoner, D. and Earnshaw, L, *The Transistor Radio Handbook* 1963 p. 92-94

Gary Elliot W7UXP/1
Box 45
Prospect Harbor, Maine

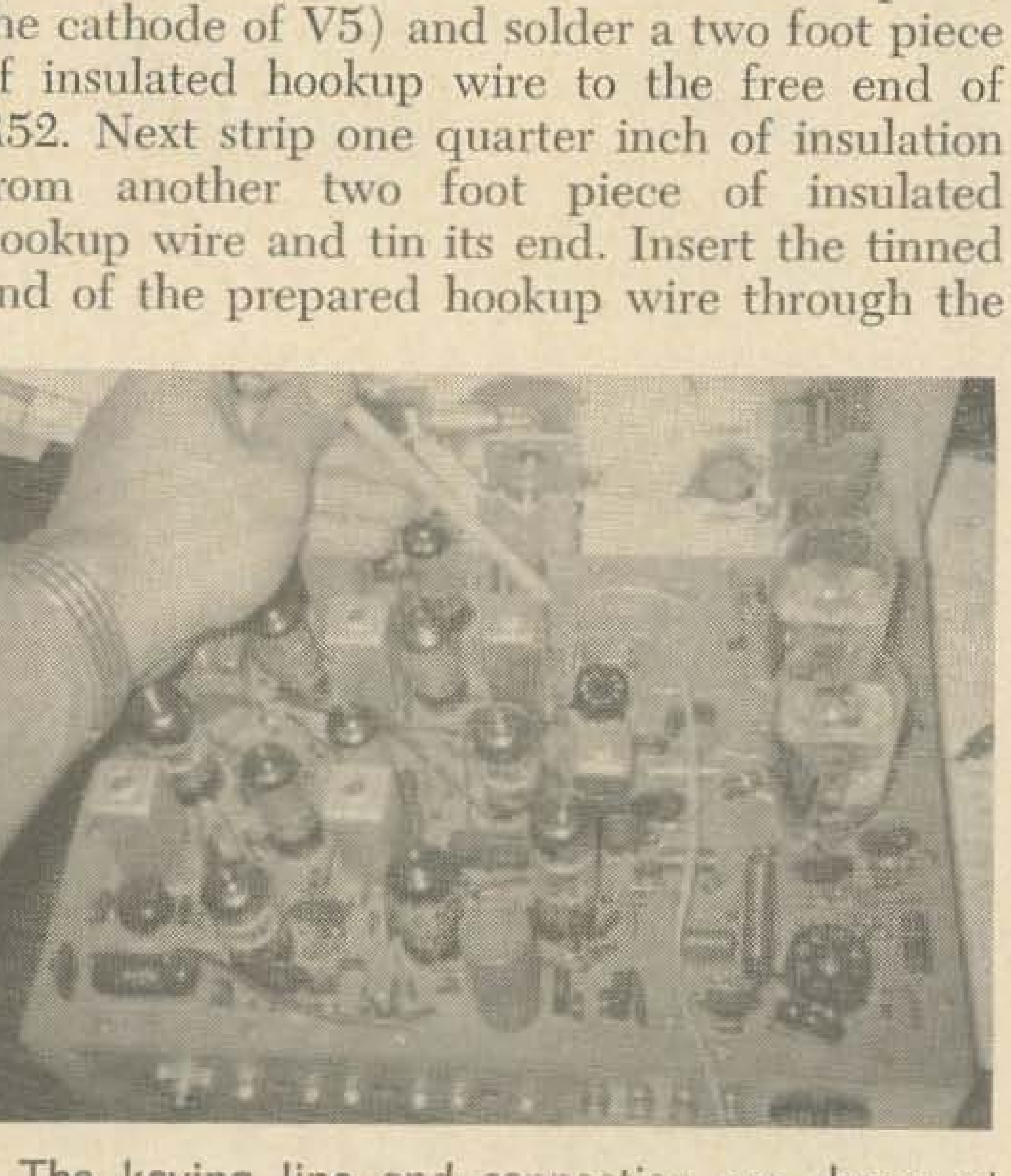
# Put Your HW-22 on CW

***It only takes a few minutes to modify this Heath SSB transceiver for CW.***

I admire the Heathkit monoband SSB transceivers and feel that for the price, they are one of the best buys on the amateur market. Their only weak point is that they have no provisions for CW. However, the HW-22 can be put on CW very easily (and no changes in its appearance) by cathode keying the 12BY7 driver, V5 and by lowerlng the VFO frequency to the CW segment of the 40 meter band.

## Modification

After pulling the chassis and turning the unit on its side, locate the driver tube V5 (12BY7). Carefully remove the grounded side of R52 (a 150 ohm resistor connected to pin 1, the cathode of V5) and solder a two foot piece of insulated hookup wire to the free end of R52. Next strip one quarter inch of insulation from another two foot piece of insulated hookup wire and tin its end. Insert the tinned end of the prepared hookup wire through the hole in the printed circuit board vacated by R52 and solder.



The keying line and connection are shown at the end of the pencil point. The 12BY7 driver has been removed for this picture.

Now locate the VFO coil L6. Moving the slug out will lower the frequency. It is easier to turn the slug from the bottom side rather than the top. Be sure C131, the main tuning capacitor, is fully meshed before turning the VFO slug. In my case turning the slug all the way out to the stop brought the frequency down to 7012 kc. After the adjustment of L6, the transceiver will now tune 100 kc or so of the bottom of the 40 meter band. Replace the cabinet and put the twisted two foot length of hookup wire through one of the holes in the cabinet. Connect the free ends of this hookup wire to a bug or key.

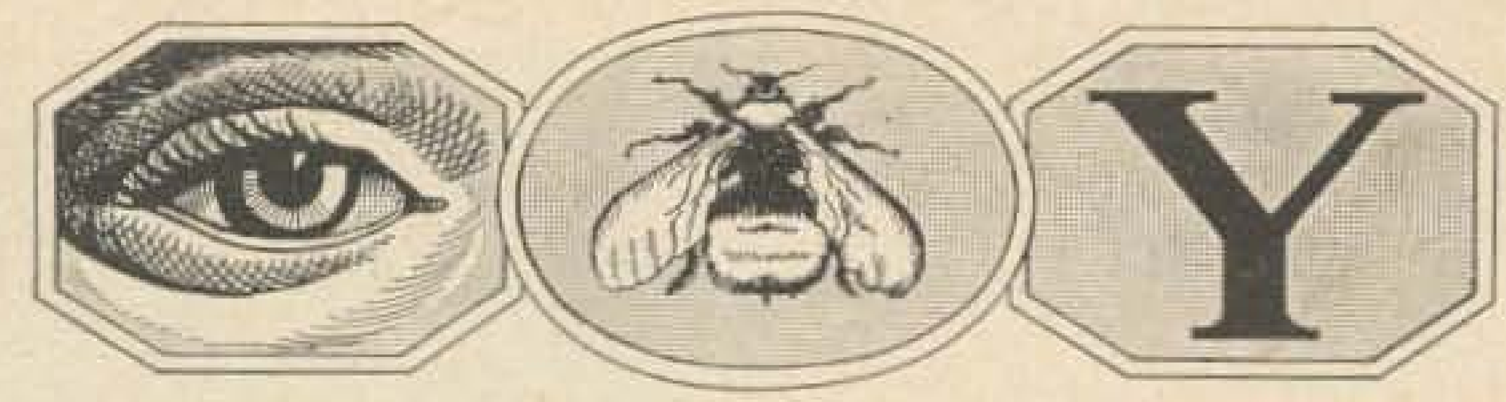
## Operation

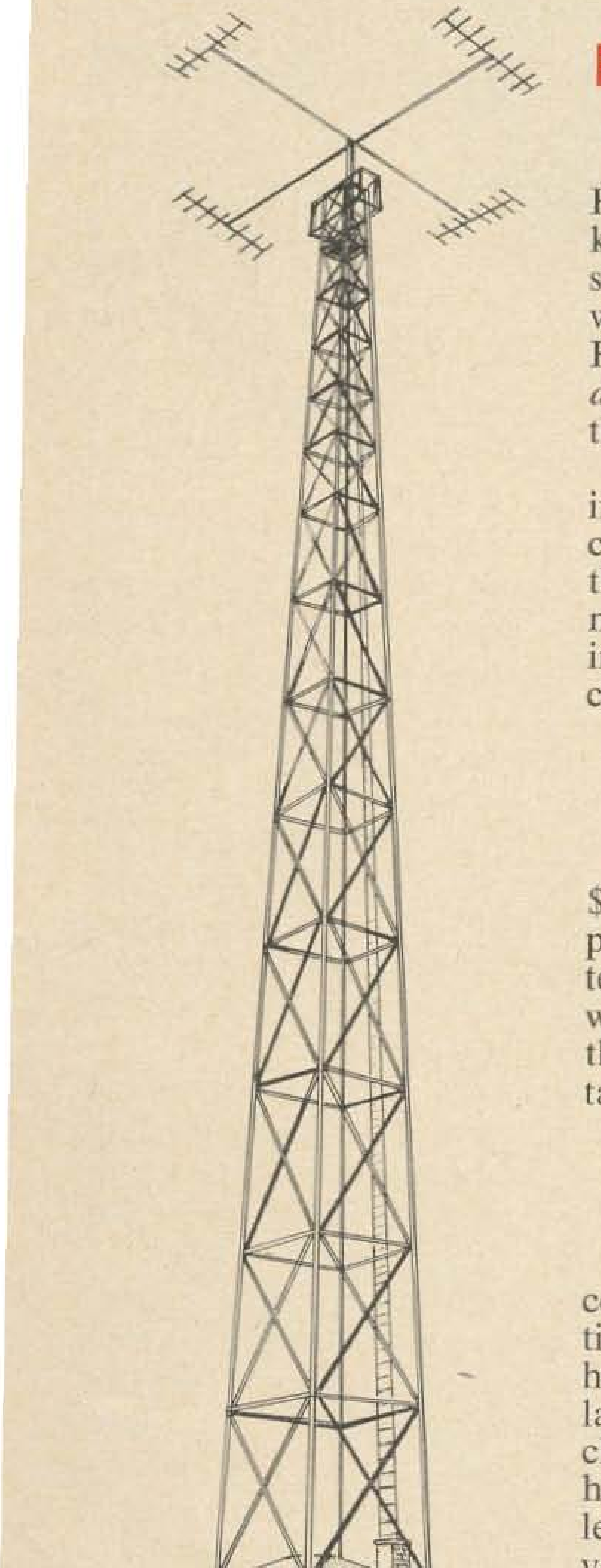
With the function switch in tune position, a DC voltage is applied to the balanced modulator to provide a steady output signal for transmitter tuning purposes, but since we have lifted the cathode of the driver V5 from DC ground, we are now able to key this output signal. To operate the HW-22 on CW just put the function switch in the tune position, close the key, load in the normal manner and start sending CW. To receive, just put the function switch back in the VOX position.

I have made many CW contacts with the HW-22 and all reports have been excellent with no signs or reports of clicks, drift or chirp. This modification can also be made to the HW-32 and HW-12.

To put the HW-22 back on SSB, just raise the VFO frequency back to 7200 kc and close the key. The modification for CW takes less time than reading this article.

. . . W7UXP



## HEATHKIT, HAM RADIO AND HERB GORDON

Contrary to the general belief among radio jobbers, I feel that Heathkit products have very high resale value. In fact, I build Heathkits too and very much enjoy doing so. Their design, layout, and instructions are superb, and if you follow the instructions precisely you will have an equivalent to a factory-wired product. *NO,* I don't sell Heathkits—can't do it directly for there is nothing in it for us, but I *do* take Heathkits in trade, and I encourage all of my friends when they are disposed to trading to remember this fact.

Because Heath has been so consistently good over the years in making a fine product available to neophytes and veterans alike, they have contributed to the over-all strength of ham radio and made all of us the better for it, and anything which helps ham radio is going to get my vote. To that end I will gladly accept any Heathkit ham product in trade provided only that the original design has not been altered or changed and that a reasonably good job of wiring has been done.

## HAMMARLUND, TOO

I still have a few brand new Hammarlund HQ-105 receivers left at $169.95. For those who missed my December ad, this is a general purpose set with excellent ham band characteristics, BC thru 10 meters, RF gain, BFO, Q multiplier, S meter, tuned RF stage—really the works, a darn good value at $219.50 regularly, but until the last of these go my price is $169.95 delivered to your door in continental USA.

## MOSLEY, ROHN AND CDR

With the snow all gone and the ground firming up, isn't it time you considered overhauling the most important part of your whole station? We have the TA33s in stock at $109.95. Rated a KW input, I have never known one to fail for any ham. They are our most popular HF beam and justly so. They should be mounted as high and clear as you can get them—and here is where the Rohn comes in. I have Rohn #6 and #25 in stock at $15.95 and $18.60 per 10-foot lengths respectively—and all the CDR line too. The minimum rotor you should use for the TA33 is the TR44 at $64.95—or if you have a larger array the Ham-M at $119.95.

Let me quote your antenna needs including the foam coax, the rotor cable, connectors, and tower beams. Catalogs of all standard brands cheerfully sent—prompt service—and free advice.

**de W1IBY**

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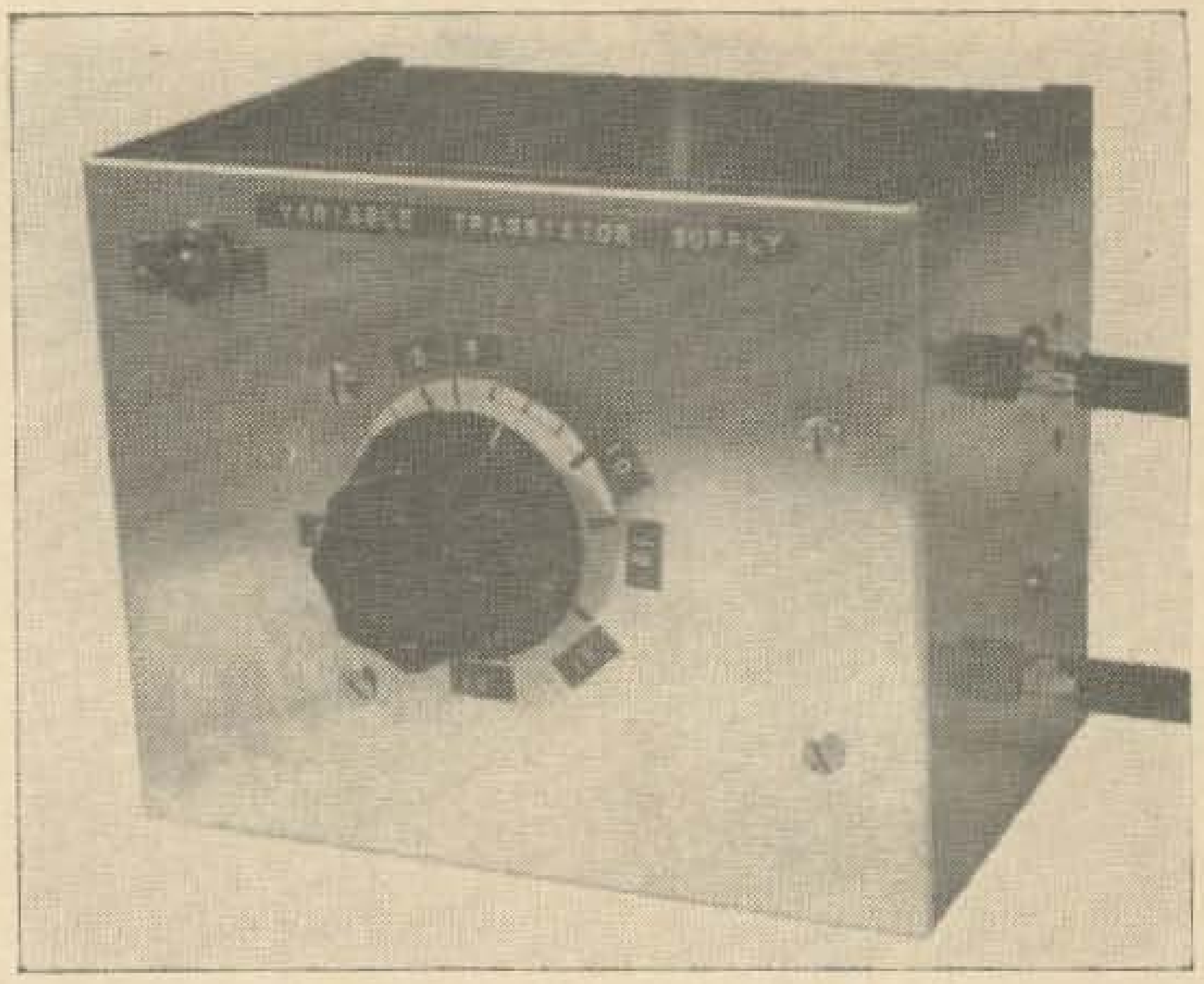
Lew Clark WA2TOV
1800 S. Park Ave.
Haddon Heights, N.J. 08035

# Variable Voltage Transistor Power Supply



I don't imagine I am alone when it comes to a spur of the moment decision to try out some new fangled transistor project (or something you have copied from Bill Hoisington using transistors) only to find you either have no batteries around or those that you do have should be buried with honors, having already served a very useful life. Rather discouraging.

Here is a transistor power supply for your bench or shack that is ready to go on short notice and simply needs an available AC outlet (**Fig. 1**).

This supply has operated in the author's shack for some time without any hitches and is rarin' to go on a minute's notice. All components are readily available from off-the-shelf stock of most any radio parts distributor, mail order houses (Allied, Lafayette and Newark) and in many cases out of your well stocked junk box. The transistor used in the supply is not an exotic and high priced type.

As noted in the schematic, this is a low voltage dc supply. Output is adjustable up to 18 volts. The maximum current at 18 volts is about 30 ma. On some lower voltages the current may run as high as ½ amp.

Some experimentation was required for R1, but after a few additions and subtractions it was found that 2000 ohms 2 watts did the best job for all around performance and smooth operation.

This was built in a 6 x 5 x 4" Mini-box (**Fig. 2**), but can be constructed in something smaller if desired. Originally it was contemplated using a meter with the supply, installed in the box, but not having a suitable meter handy at the moment, the project was completed without it. The calibration under the dial was made by hooking up a volt meter on a suitable scale and marking off the voltage readings convenient for work on my bench.

*WA2TOV is an avid homebrewer interested in UHF and SHF. He works at the inspection and testing department of Weathers Electronics and Development.*

The circuit wiring is all between two eight point tie strips, one each side of the box. The rectifiers can be seen above the two 1000 µf capacitors. The 500 µf filter capacitor, between transistor base and potentiometer, is to the right in the photo. Using this supply on light loads, as presented by most transistor circuits, there is a slight drop of about 4 to 5%, but this is hardly noticable.

Since this supply is definitely not intended as a continuous replacement for batteries, but just as a handy bench supply for trying out various experimental circuits and during repair work on gear, its few faults are miniscule.

I feel the components have ample ratings and will suffice as compared with what would be taken from regular cells. A note at this point is worth mentioning. There is no heat sink used with the 2N301 as this would increase the total size by a considerable amount. Also note that the transistor is mounted on a small bracket (**Fig. 2**) made by bending a small piece of aluminum. Shoulder washers are used on the two bolts suspending the bracket to insulate it from the Mini-box, and a small piece of insulating material (bakelite in the author's case) is used between the bracket and case. The binding posts are also insulated from the case by using shoulder washers. Remember

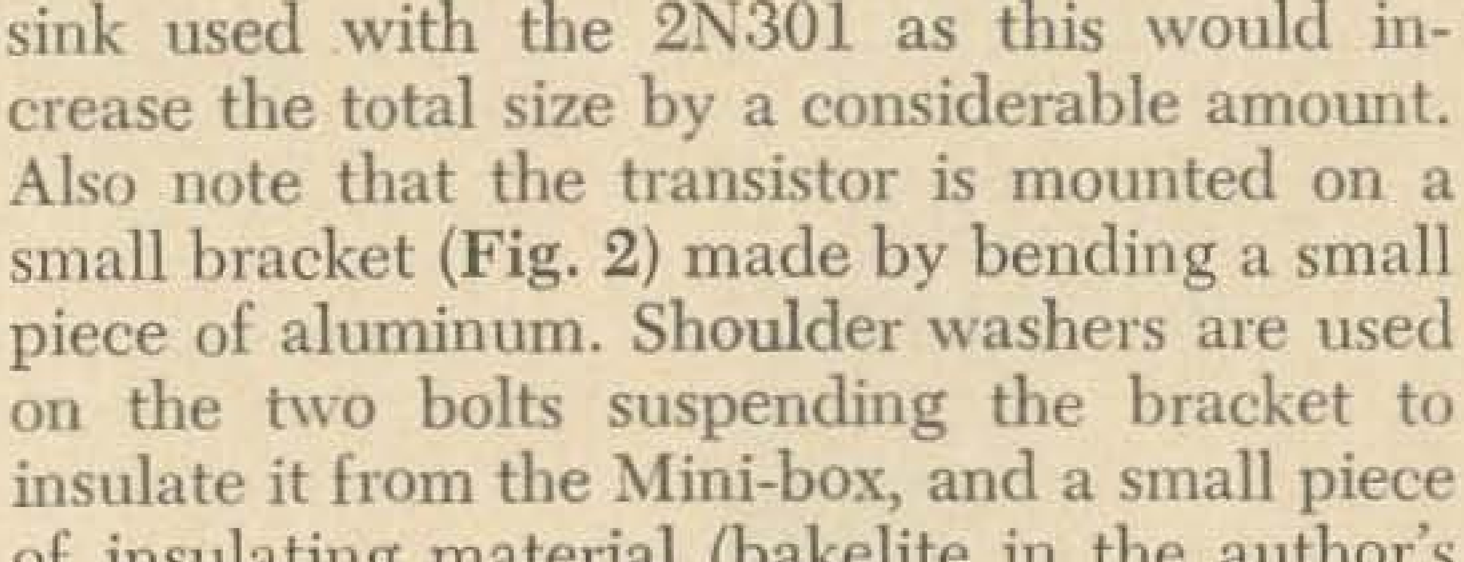



Fig. 1. Schematic of the transistor power supply.

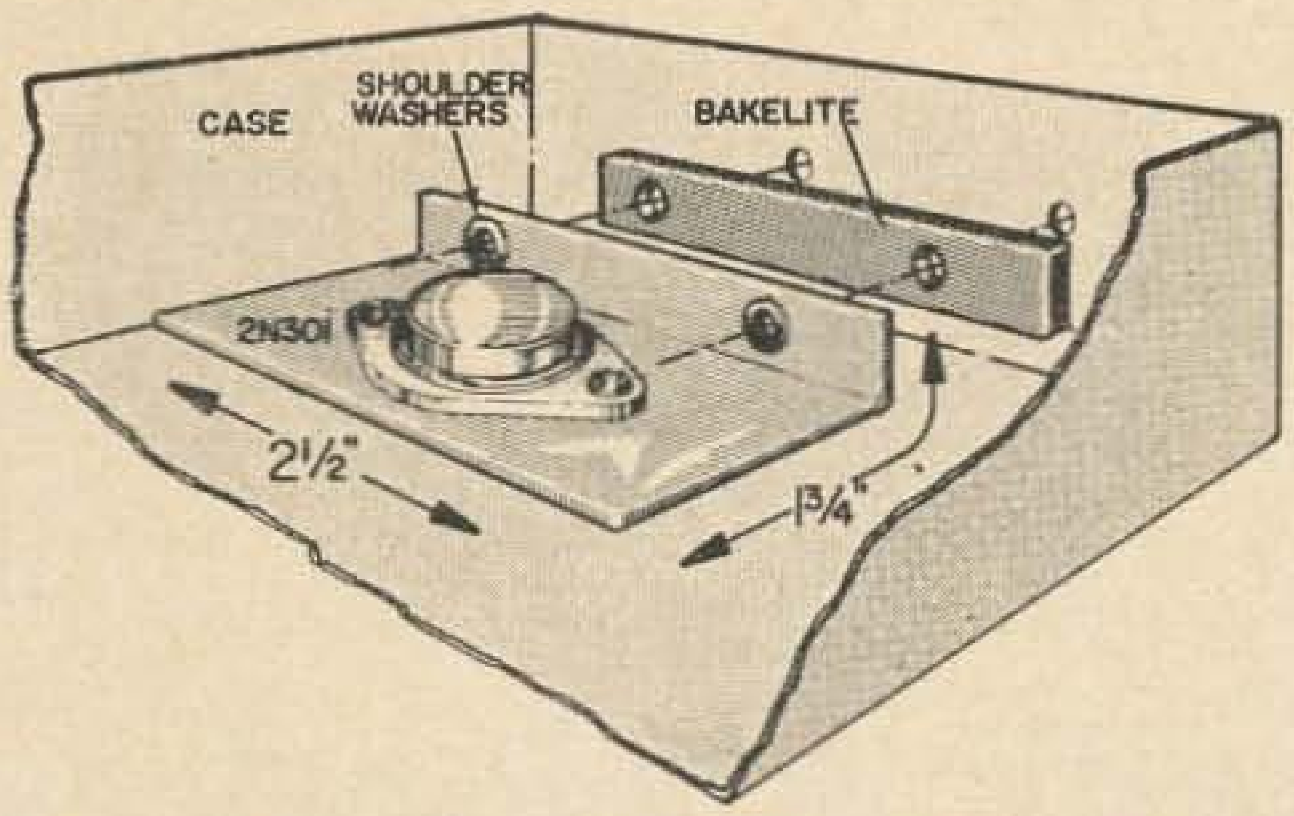
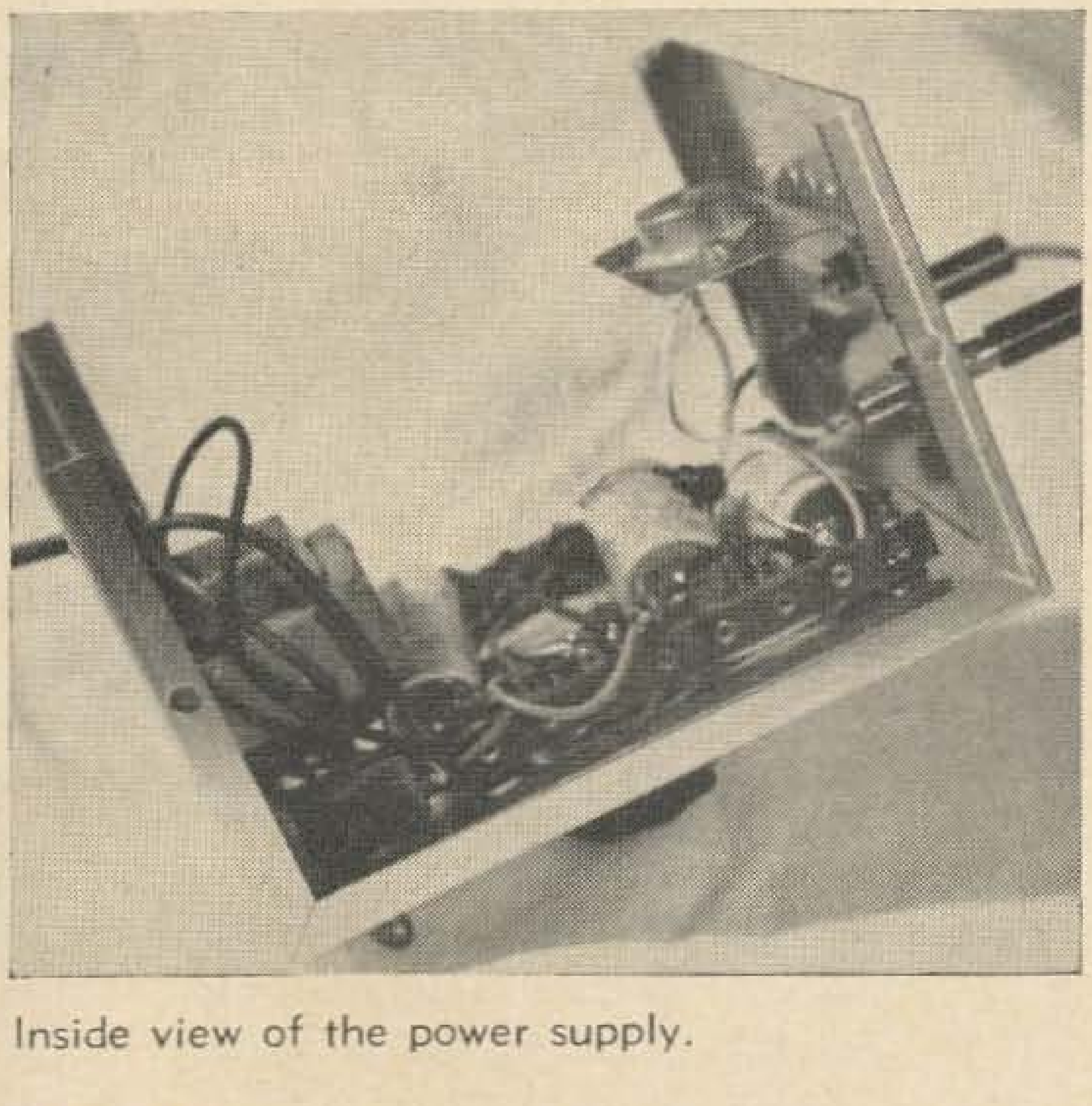



Fig. 2. Mounting the series regulator transistor.

that transistor heating is a factor at low output voltages and without a heat sink incorporated in this supply it is not advisable to run on high current for lengthy periods of time without cooling the 2N301 off. However, as stated before, this can be overcome by adding a heat sink for the 2N301 and additional bulk to the supply. In most transistor circuits the current requirements are quite low and this supply has more output than is normally required or needed.

The hookup of the circuit follows with most power supplies in that it is quite simple and the main factor is the insulation of the 2N301 shelf and plugs from the case. Placement of the components is not critical and can be made to your own pet methods. The adjustable feature is quite useful in that you can determine the voltage limits at which a piece of transistorized equipment will operate properly. I have come up with many other uses for this piece of equipment and I am sure you will too.

Those of you getting your "feet wet" on transistors will appreciate the usefulness of this supply.



Inside view of the power supply.

Martin Krey K7NZA
3608 West Minnezona Ave.
Phoenix 19, Arizona

# Here's a Ham with a Heart

Charles B. Grout is a ham with a heart—and a peck of trouble. In fact, it's the trouble that has given him the time to be Mercury for other multiple sclerosis victims. Yep, that's right, K7SML is an MS patient himself, and since he knows first hand what an MS victim has to contend with in the line of handicaps, he goes out of his way to make his Phoenix ham station something of a message center for MS patients and their relatives and friends.

Ten years ago, Charles was a Denver area banker on his way up. At forty-two he was president of the Littleton National Bank of Littleton, Colorado. Life was bright and challenging. Then he got MS, and his world of business was shattered. He continued as bank president as long as doing so was wise; and then, realizing that MS is a progressively worsening illness, he gave up his high office and moved to Phoenix for its healing warmth.

That was six years ago. The mild weather didn't make Charles's illness any better, but it kept him feeling good enough to want to do something worthwhile with his time. In 1962 he decided that since he had been trained in Morse code in the Navy during World War II, he would make a stab at getting into ham radio.

Chuck Grout K7SML, answers a CQ in his shack in Phoenix while his XYL, Ida, stands by to help out on the land line. Rig is an SBE 33, which Chuck runs barefoot.

Considerably restricted in movement by then, Charles nevertheless pushed himself into his quest in his characteristic, determined way, and he soon got his Novice license. He operated code for a year, and then he passed his test for a General license and was in fine business shape to go on phone. Phoenix area hams had erected an inverted-V all-band trap antenna and installed his gear for him when he had gotten his Novice license, so all he had to do was swing over to a phone band and go to work on the mike.

Hamming quickly became a big thing in the life of Charles B. Grout, and he began spending most of his waking hours in front of his barefoot SBE 33. It wasn't long until K7SML was a common call on 15 and 20 meters, and the handle, Chuck, had replaced the name of Charles B. Grout. Chuck found the precision of hamming not unlike the exactness of banking; and he was glad, too, to find that radio could give him an opportunity to help other people.

In the year since he got his General ticket, K7SML has worked virtually every state, including Hawaii and Alaska, and he's gotten into New Zealand, Argentina, Puerto Rico, and Australia. During the year, he's also gotten acquainted with many of the 500 MS victims in the Phoenix area, and he's gotten a number of them in touch with relatives and friends both near and far—no mean accomplishment for a man who cannot walk or read a book any longer.

Typical of Chuck's service to fellow MS-ers is the phone patch he recently ran for a friend in Phoenix. The friend, Barclay Harris, whom Chuck had met through the MS Association, had fallen and broken his hip. His elderly mother in Minneapolis, and his own son, who lives with her while attending the University of Minnesota, had become much distressed after hearing about the accident. Mr. Harris wanted to put their minds at ease, and he was able to do so with the help of K7SML. Chuck made a 20-meter contact in the Twin Cities area who patched him in to the mother in Minneapolis, and Chuck patched in Mr. Harris in Phoenix. Hearing her son's voice and his calm assurances erased the mother's anxiety, and she happily put her grandson on the phone to let him share in the family chat. Everybody felt better after that contact—including Chuck.

Chuck Grout says that without the help of his jovial XYL, Ida, he just wouldn't have a ham station at all. In fact, when the traffic gets heavy at station K7SML, Ida often mans the telephone and rigs up the phone patches while Chuck handles the microphone. Both Chuck and Ida like to recall the lighter experiences they've had on ham radio.

Chuck says the funniest phone-patching experience of all comes on 40 meters when a Colorado ham called CQ Phoenix with important traffic for his wife, who was visiting in the Valley of the Sun. Chuck took the call, and Ida got the wife on the land line. When Chuck patched husband and wife together, the wife promptly informed her mate that she had just started eating a big bowl of soup and that she could think of nothing more important than getting back to it. Then she hung up, leaving Chuck the job of saying 73 to the bewildered husband.

And so it goes for Chuck Grout, day after wonderful, challenging day. Whether the traffic is humorous or deeply serious, he will be in the shack passing more than his share of it. He says he figures there are a lot of people in the world who are worse off than he is, and he's going to help them if he gets the chance.

While Chuck enjoys helping others—and especially MS victims—to get messages passed, he has never gotten too busy to shoot a CQ up Denver way and get a contact there to patch him in with his eighty-year-old mother.

"Moms have feelings, too," he says, "and, anyway, I get a big kick out of talking to mine."

Chuck Grout and his dedicated operation of K7SML must be an inspiration to many, for as one Phoenix ham was recently heard to say about him, "There's a ham with a real heart—in more ways than one."

. . . K7NZA

Don Hansen W9ZZH
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# Fuses

Protect your expensive equipment from overloads and burnouts. The simplest way to protect your equipment is with fuses. A fuse is a circuit protecting device that disconnects the equipment from the power source when a potentially damaging fault occurs in the unit. A fault is a moderate overload or short circuit that could cause a fire hazard or damage the equipment.

A fuse operates on a time element principle. The fuse will blow almost instantaneously for a short circuit, but blows after a definite time lag for a moderate overload. The time to blow varies inversely with the overload current.

When a short circuit or overload occurs, the fuse link vaporizes and becomes ionized, forming an arc. To interrupt the circuit, the arc must be extinguished. To extinguish the arc, a current zero must be obtained.

There is no current zero for direct current; therefore, the current must be forced to zero to extinguish the arc. There are two major ways to force the current to zero. The first method is to increase the arc resistance until the voltage drop across the arc equals the circuit voltage. The second method is to decrease the arc temperature and ionization. Arc resistance is increased by lengthening the path of the arc and by constricting the diameter of the arc. The length of the arc path is increased by the continued melting of the fuse link due to the high temperature of the arc. Arc diameter is constricted by use of fillers in the bodies of certain types of fuses. Arc temperature and ionization reduction is accomplished by enclosing the fuseable element in a protective tubing and filling the tubing with silica filler. When the element melts, the heat from the resulting arc melts the filler. The filler conducts heat away from the arc, reducing ionization and causing the arc to extinguish.

Alternating current periodically passes through zero. When the current passes through zero, the arc is extinguished. It is only necessary to see that the arc is not re-established when the ac voltage attempts to cause the current to flow again. When the ac current is near zero, it is very important to deionize the arc gap so the arc cannot be re-established. The arc will remain extinguished when the dielectric strength of the gap permanantly exceeds the voltage that tends to re-establish the current in the circuit.

*W9ZZH is an electronics engineer (Wisconsin) at Industrial Controls Division of Square D. He likes to design and construct ham gear and has written a number of articles for 73.*

## Fuse types

There are two major styles of fuses: the plug and cartridge. The plug fuse will not be discussed in this article. Cartridge fuses are of two types. One type has knife blades and the other has ferrules. The ferrule fuses are normally used to interupt circuits up to 60 amps and the knife blade fuses are used to interupt circuits carrying 60 to 600 amps. Ferrule fuses are generally used in electronic equipment.

The three common types of fuses are the high speed, medium lag, and slow blow. High speed fuses are used where any time lag would be damaging to the equipment being protected. Ammeters and milliammeters are examples of this type of equipment. Medium lag fuses are the most widely used fuses. They are used when there are no special requirements, such as protecting equipment that requires high speed fusing or draws current surges. Time delay fuses are used to protect equipment that draws a high initial current that later drops off to a normal operating value. Motor starting current or power supply filter capacitor charging current are common examples of surges.

Quick acting and medium lag fuses have a single link that blows when overloaded. Slow blow fuses have a compound element consisting of a fusible link and a thermal cutout. The link acts on high currents due to shorts or very high overloads. The thermal cutout functions on low or moderate overloads, preventing the fuse from blowing.

Fuses also have voltage ratings. The voltage rating is the maximum voltage at which the less than the maximum voltage rating of the fuse can clear the circuit. The fuse will operate satisfactorily in circuits with voltages less than the maximum voltage rating of the fuse. Underwriters' Laboratories require that fuses rated at 250 volts must be capable of interrupting 250 volt circuits that can deliver 10,000 amperes to a short circuit. This gives a great safety factor to the average application of a fuse.

## Using fuses

Fuses are generally used to protect wiring or equipment. Wiring is fused to eliminate fire hazard due to heating effects of the overload current. Equipment is fused to prevent expensive damage due to shorts or overloads. **Fig. 1** lists fuse sizes to protect various insulated copper wire sizes.

The most common use of fuses in electronic equipment is to fuse the 115-volt or 230-volt power inputs to the equipment. To find the size of fuse to protect the power supply, determine the input volt-amperes (VA) to the power supply. Refer to **Fig. 2** to determine the size of fuse to use once the volt-amperes have been determined. The VA input to the power supply can be determined by measurement with a voltmeter and an ammeter and multiplying their indications to obtain volt-amperes.

The VA input can also be calculated from known circuit constants. If a transformer is used in the power supply, determine the VA input by multiplying each current being drawn from the supply in amperes by the voltage at which the current is being drawn. Include current through bleeder and voltage dividing resistors. Also include filament winding volt-amperes if the transformer is supplying filaments. After multiplying the various voltages and currents, add the products together to obtain the total volt-amperes delivered by the power supply. Neglecting transformer core losses and copper losses (assume transformer is 100% efficient), the input volt-amperes are equal to the output volt-amperes. Use this value to determine the size of fuse to be used from **Fig. 2**.

Medium lag fuses are normally used for fuses selected by **Fig. 2**. However, if large

| B&S Wire Size | Fuse Rating (Amperes) |
|---|---|
| 8 | 50 |
| 10 | 40 |
| 12 | 20 to 30 |
| 14 | 15 |
| 16 | 10 |

Fig. 1. Fuse size to protect wire gauges.

| Power Supply Rating in Volt-Amperes | Fuse Rating For 115 Volt Operation | Fuse Rating For 230 Volt Operation |
|---|---|---|
| 40-65 | 1 | ½ |
| 65-100 | 1-½ | ¾ |
| 100-150 | 2 | 1 |
| 150-250 | 3 | 1-½ |
| 250-350 | 5 | 2 |
| 350-450 | 6 | 3 |

Fig. 2. Fuse rating for various powers.

surges are encountered or cyclic fatigue is present, slow blow fuses should be used. Surges would normally be of the inductive or capactive type. Cyclic fatigue is caused by the weakening of the fuse link due to heating and cooling caused by pulses of current from vibrators or choppers. As the link heats, it expands; as it cools, it contracts. This weakens the fuse link in a fashion similar to bending a paper clip until it breaks. The thermal cutout of the slow blow fuse is a spring that takes up expansion and contraction due to heating and cooling, thereby reducing cyclic fatigue of the fuse link.

When fusing instruments, quick blow fuses should be used. The resistance of the fuse must be taken into account. To determine the size and resistance of fuses to be used in instruments, manufacturers catalogs should be consulted.

A common error made in the selection of a fuse is to select a fuse with a rating almost equal to the normal current in the circuit to be protected. Since a fuse is a heat operated device, its characteristics are similar to those of a light bulb. The more current passed through a given light bulb, the faster it will burn out. A lamp operated at three percent higher than its rated load will have its life reduced by about 30 percent. Fuse life is also governed in a similar fashion. Therefore, a fuse should always be operated at currents below its rated current to increase its life. The fuse rating should be selected to be somewhere between the normal current in the circuit to be protected and the lowest overload current that could cause damage. This gives the fuse longer life, but allows it to protect the circuit in case of overload.

Now that you understand fuses, check your equipment and see if it is fused. If it is, check that you have the proper size. If your equipment is not fused, fuse it. Better to burn up an inexpensive fuse than your expensive equipment.

. . . W9ZZH

Eugene Fleming WØHMK
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# Confession

Sure, I know it shouldn't have been done, but sometimes a fellow has no choice. The judge hasn't decided what the punishment will be yet. Obviously, it's a new crime. No one seems to doubt that it is a crime, even though there is no law against it. The lawyer made a point of that at the trial, but then he really wasn't on my side. Maybe they will think up some new punishment to fit the crime like exile from Earth or something.

It all started one afternoon when the 15 meter cw band was just beginning to open up. There were a couple of QSO's going, but they were not the kind you want to break into. So I gave a good long CQ myself to open up the band a little. When the receiver came on, there was already a zero beat S9 signal calling.

". . . ØHMK WØHMK de MR2LK/m MR2LK/m AR"

"MR2LK MR2LK de WØHMK R Tnx fr call Ur RST 599 QTH is 328 Gunnison Ave, Grand Junction, Colorado Hndl is Gene" With my left hand I flipped the log open to the countries list. "Rig hr is SC 100 rcvr es xmtr is DX 100" No MR2 land listed. Maybe he is in one of those new African nations. "Pse QSL QTH? MR2LK de WØHMK K"

"WØHMK de MR2LK R Ur RST 579 Present QTH is approx 2300 miles above western


U S in synchronous orbit of Earth Home QTH is Saklar in what u call northern hemisphere of Mars Hndl is Sobem Rig here is special built using a computer for translation, so will not describe We would like to ask a favor of U Would U consider WØHMK de MR2LK K"

"MR2LK de WØHMK R U r pulling my leg OM Better cut this false signal b4 FCC tunes u in" It had to be a local running low power to be lobbing in the kind of signal this guy had. "Have to admit it is real original gag tho QTH? MR2LK de WØHMK K"

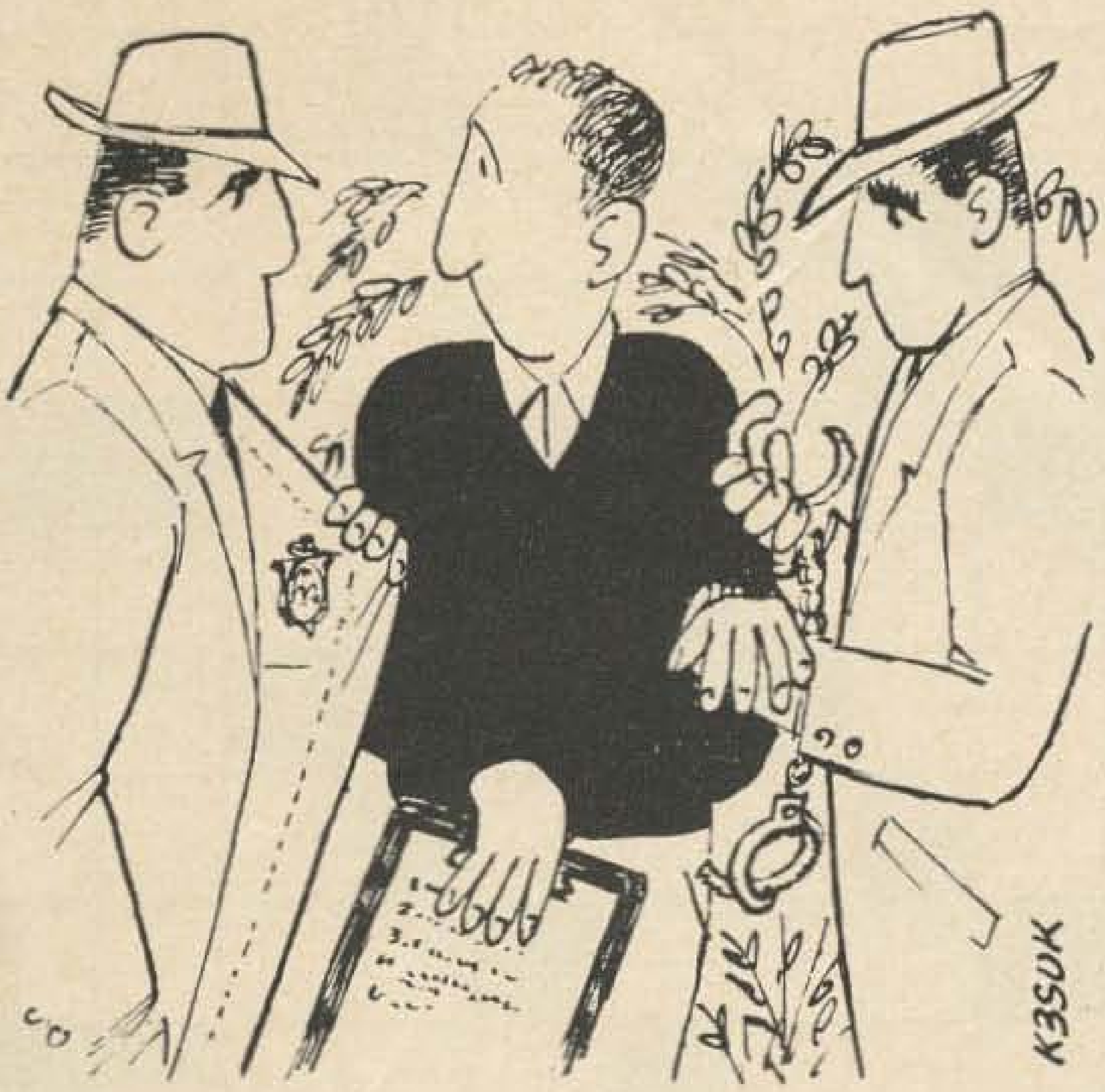
"WØHMK de MR2LK R Earthman U R insolent Close ur eyes immediately" I did it involuntarily. Before I could think what it was all about there was a flash like that of a flashbulb and the faint smell of ozone in the air. The cw resumed. "in case u think that was a coincidence, keep them closed" I needed no urging. There was another flash and more ozone. "Can Earth technology match that, Gene Will U co-operate with us now WØHMK de MR2LK K"

If they could make a noiseless flash like those two, no telling what else they could do. I dreaded to think of making them angry. I had no ambition to end up as a puff of white smoke, or for that matter black smoke either. There was only one logical thing to do.

"MR2LK de WØHMK R OK U R convincing But what if I tell our government U R up there" This time there was no warning before the flash. Luckily, it was behind me, but it took a full minute for my eyes to recover. No one would have believed such a story anyway, but I was stalling. The foreigners waited patiently. "State your request MR2LK de WØHMK K" They'd get no satisfaction from thinking me willing.

"WØHMK de MR2LK R U will make a list of the forsythia trees in your city and report the location of each to us Do U understand WØHMK de MR2LK K"

"MR2LK de WØHMK R What is forsythia Is that ur name for that kind of tree or earth's If earth's, what language" The initial surprise and fright was beginning to wear off now and was blooming into curiosity and fantasy. "How long have you been up there Am I the only one to be counting What kind of power did




you use to get here Are ur electronics all solid state Will you be coming down soon How many are in ur crew Have you developed useful telepathy R ur intents friendly MR2LK de WØHMK K"

"WØHMK de MR2LK R Keep ur questions to yourself We do not need a lesson in linguistics, Earthman Forsythia is Anglisized form of the Latin name for an ornamental shrub of the same family as the olive tree It produces yellow bell shaped flowers in the spring before it leafs Do U understand our request WØHMK de MR2LK K"

"MR2LK de WØHMK R Yes I know the plant K"

"WØHMK de MR2LK R Count them in your city and listen for us to contact you on this freq 5 days from now U will report location of each plant K"

"MR2LK de WØHMK R It is not possible to make contact on the fifth day It will have to be the seventh K" I closed my eyes tight and waited.

"WØHMK de MR2LK R That is acceptable SK WØHMK de MR2LK/m CL"

Well, the rest of the story has been in the papers, so there is no need to tell how the transmissions were taped by an SWL down the street, how the FCC monitored the report a week later, and then turned their tapes over to the FBI, or about the hearings.

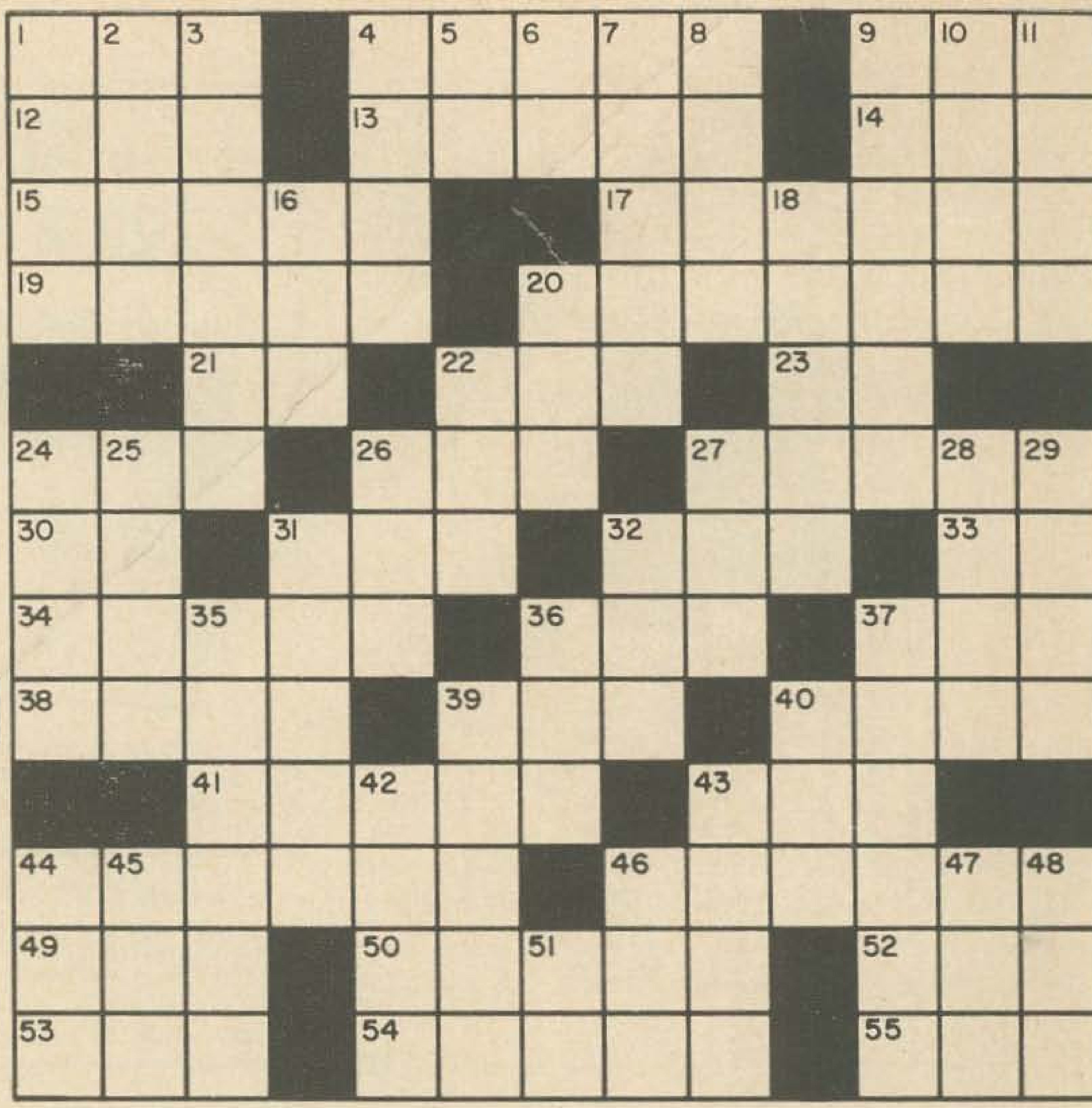
You would think they would give you an award or something for being the first to make contact with extra-terrestrials, but instead I get locked up for counting bushes. But how could a guy like myself know the Army had used those bushes as a hiding place for their Martian detectors?

. . . WØHMK



Max Winter K2PIJ
2444 Barker Avenue
New York 67, New York

# Crossword




Solution on page 114.

**Across**

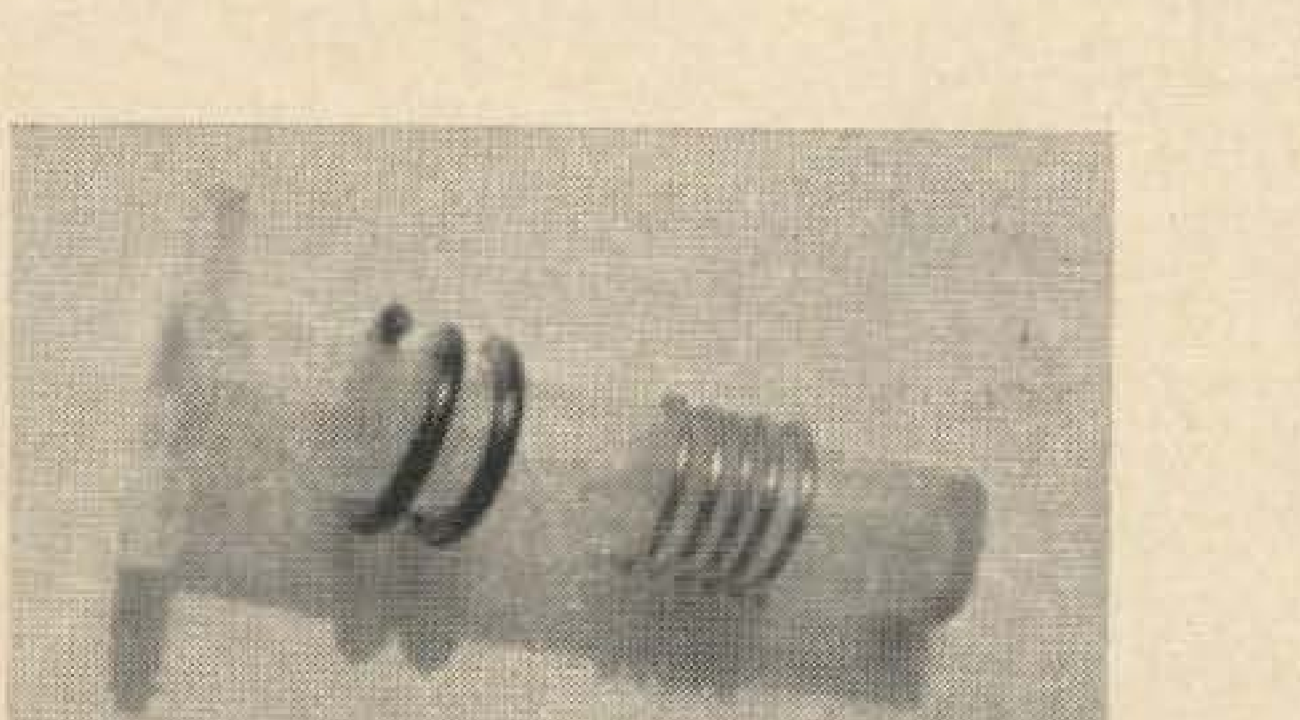
1. Amateur radio operator
2. Vents used in bass reflex speaker enclosures
9. Adjustment of a transmitter's rf amplifier stage to resonance
12. Consumed
13. Type of quartz crystal
14. Fruit drink
15. Movable plates of a variable capacitor
17. Bandwidth of a crystal
19. Type of gas sometimes used in voltage regulator tubes
20. Old-fashioned word for antennas
21. Type of circuit coupling
22. Continent (abbr.)
23. Band from 30 to 300 kc (abbr.)
24. Substance in tube indicated by a dot in diagrams
26. Type of blocking coil (abbr.)
27. Trials for a piece of equipment
30. Prefix letters for certain types of connectors
31. Type of wire insulation (abbr.)
32. Vehicle for a mobile rig
33. New England State (abbr.)
34. Antenna supports
36. Cover
37. Radial disc attached to dissipate heat
38. Girl's name
39. Vase
40. Common material used for a mast or a beam
41. Nimble
43. Unit of relative power used to express amplitude
44. Mechanism used on indexed rotary switches
46. Small octal based tube used in portable sets
49. Transformer winding (abbr.)
50. Term used to indicate that current is being taken from a source
52. Present name of RETMA
53. Transformer winding (abbr.)
54. Rescued
55. Transportation systems

**Down**

1. Mata - - - -
2. Weight of BC-610
3. Electrical measuring instruments
4. Component
5. Old Timer
6. Type of circuit coupling (abbr.)
7. RF section of a receiver
8. Celestial body
9. Opposite of farads
10. Matinee - - - -
11. Church seats
16. Grampus
18. Teaser
20. Stabilizer circuit in an FM tuner
22. Stabilizer circuit in an FM tuner
24. Diversion for children
25. Study of the body (abbr.)
26. Type of circuit coupling (abbr., plural)
27. Partial output point of a transformer winding
28. Open a circuit breaker
29. Trigonometric function
31. Components in a circuit having one or more vacuum tubes with a single input and output
32. Against (prefix)
35. Noise heard on a radio receiver
36. Three (Italian)
37. Device used to block certain frequencies
39. Shorter in wavelength than VHF
40. Writing implement
42. Race of people (abbr., plural)
43. Radio frequencies within definite limits
44. Displaced persons (abbr.)
45. Before
46. Near (German)
47. Dielectric for some types of variable capacitors
48. Mothers (colloq)
51. Mean (abbr.)

## Hypo Coil Form

In constructing ham gear over the past few years I've often run into the problem of procuring good quality coil forms for small pieces of equipment. Here is an easy way to convert something that is readily available and easy to work with. We are all familiar with the disposable syringes used extensively today for innoculations. Well they make dandy coil forms with relatively little modification. Simply remove the plunger and the needle and trim down to an appropriate size for your need. Then wind your coil. For mounting, simply drill a small hole in each tab on the sides of the barrel and you can mount the unit on any surface. The syringe barrels can probably be prosured from any family doctor or clinic that you are familiar with. If worse comes to worse you can buy them at any local drugstore. They come in a variety of sizes and lengths. If used carefully they can be a real "shot in the arm" for any piece of gear.



. . . Stanley Scalize W4WZZ

*Use your old converter on 12 volts.*
*S meter, TNS, and BFO, too.*

Denys Fredrickson WØBMW
3923 E. Funston
Wichita, Kansas 67218

# Low Voltage Gonset Super Six

This article describes my conversion of a Gonset Super Six mobile converter and other mobile accessories to use with a modern transistorized auto receiver that doesn't furnish the high B+ old receivers did.

## Gonset Super Six modifications

The first task I undertook was to modify the converter for low voltage operation. The completed schematic is shown in **Fig. 1.** Many of the existing components were used; the tuning and oscillator circuits were left intact except for the tubes. A 500 pf capacitor was paralleled with the existing 100 pf rf input coupling capacitor; this really increased the signals. The AVC switch was disabled, but you may use it if desired. The wiring of the "Broadcast-High Frequency" switch on the front of the converter was modified so the whip antenna could also be used for the broadcast antenna. The 200 pf capacitor added between the switch and the whip antenna connection may be required if the auto radio trimmer will not peak up the signal. This will reduce the effect of the shunt capacitance added due to the long coax cable connected to the whip antenna. This value may not be correct for your particular installation and car radio input. The optimum value may be found by the cut and try method. A filter was added to the converter 12 volt input line by making a choke out of #16 insulted line with 20 closewound turns on a ⅜" form.

The existing oscillator tube socket in the Super Six may not have all the socket inserts to accommodate the 12EK6 tube. This can be rectified by simply removing an insert from another socket and pressing it into place. This eliminates the need for replacing the socket.

*Denys is an electronics engineer for Boeing Aircraft. He's also a semi-professional magician and makes his own tricks—watch out for him at hamfests.*

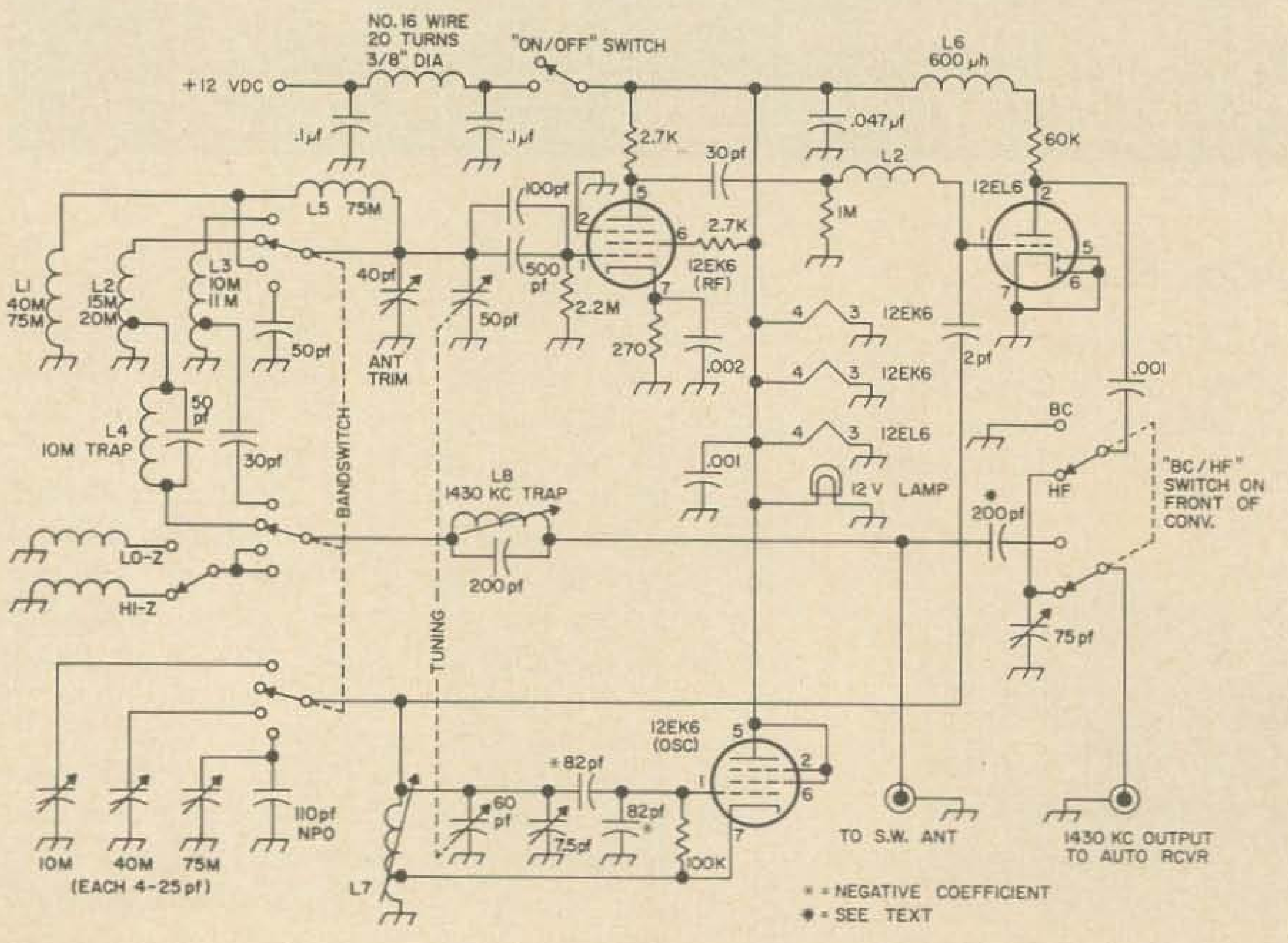



Fig. 1. Gonset Super Six modified for low voltage operation.

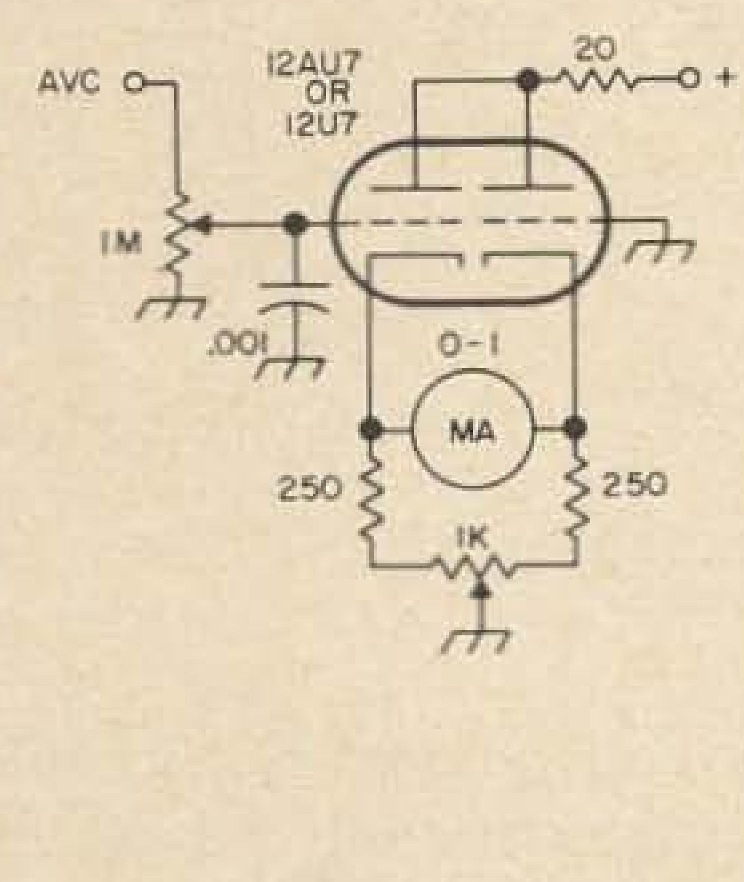



Fig. 2. S meter circuit using dual triode 12U7.

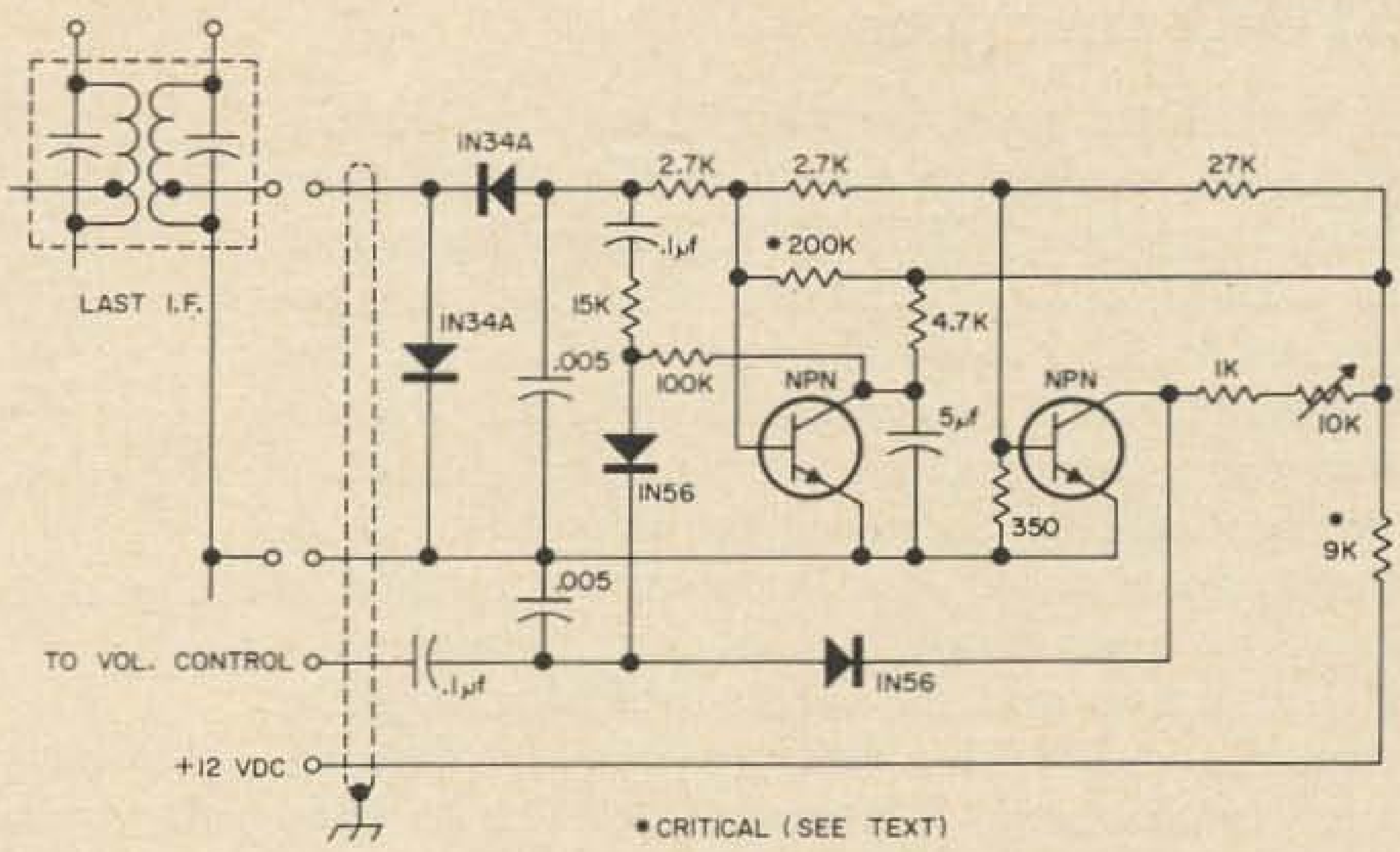



Fig. 5. Transistor TNS for transistorized receivers.

The 20 meter band must be aligned prior to aligning any other band. This is accomplished by adjusting the variable capacitor on the rear apron of the converter. The oscillator coil may have to be adjusted slightly if the capacitor doesn't quite make it. After the 20 meter band has been aligned these two must not be readjusted during the remainder of the alignment. Be sure the chassis is in the cabinet when alignment is being accomplished. When aligning the 10 meter band, the frequency changes considerably when the cabinet is removed to obtain access to the 10 meter padder capacitor. It will be necessary to note the frequency change when removing the cabinet and then align the 10 meter band accordingly. The 40 and 75 meter bands can be aligned and the 1430 kc output peaking capacitor can be adjusted with the converter completely assembled.

## S meters

The S meter circuit shown in **Fig. 2** was used by many mobile hams. It can easily be used with low voltage tubes by replacing the 12AU7 with a 12U7 and connecting the plate leads to 12 volts through a small resistor.

Many of the new transistorized car radios don't seem to work well with the circuit in **Fig. 2**, so I tried a couple of small transistorized meter amplifiers. They are shown in **Figs. 3** and **4**. When no signal is received, the meter should read zero unless there is some current leakage. This can be minimized with silicon transistors.

## Transistorized TNS

The transistorized squelch shown in **Fig. 5** is taken from the May 1961 CQ. It works very well, but to make it work properly with some transistor auto radios, the TNS ground circuit must be isolated above chassis ground due to the circuitry of some auto radios and connected to the low side of the last if transformer as shown in **Fig. 5.** The detector circuit of the auto-radio must be disconnected from the if transformer. It may be necessary to disconnect the audio input lead from the volume control also, depending upon the radio circuit. These leads must be left disconnected for proper TNS operation. For optimum operation, it may be necessary to temporarily install a 30K pot in series with the plus 12V DC lead. Adjust this 30K pot and the squelch control until full squelch control is obtained. Remove the 30K pot and measure the resistance and install a fixed resistor of the same value. You may have to file a V-notch in a resistor of lower value to bring it up to the exact resistance required. This resistor served another purpose by providing isolation between the 12-volt supply and the TNS. Prior to the insertion of this resistor, the noise was uncontrollable and unbearable. The 200K resistor may have to be varied for optimum results but is not too critical.

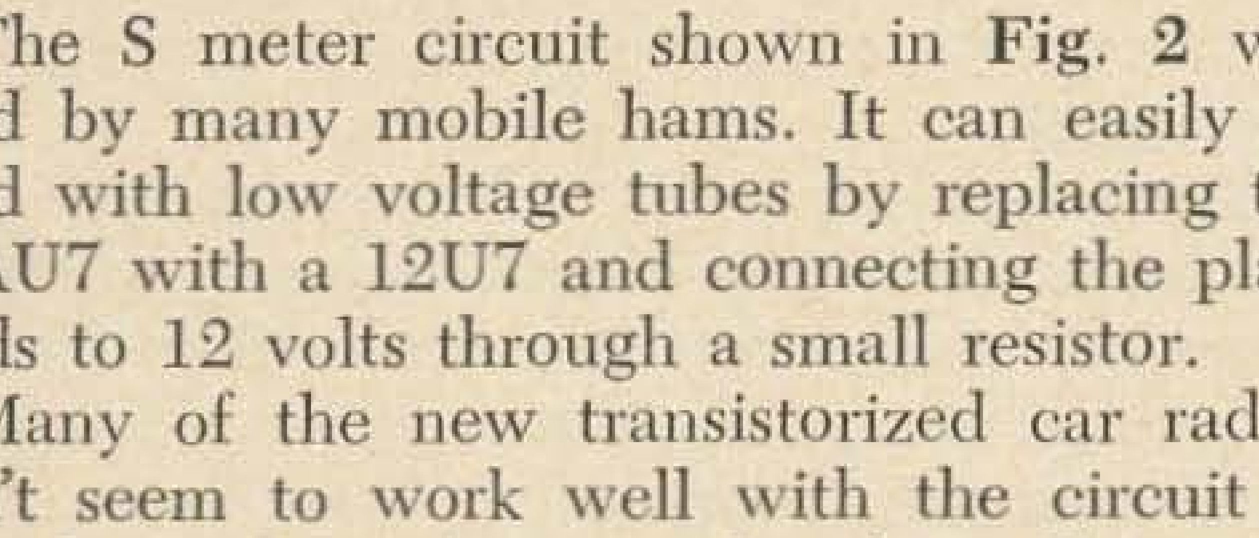



Fig. 3. Simple S meter using 1.5 volt battery.

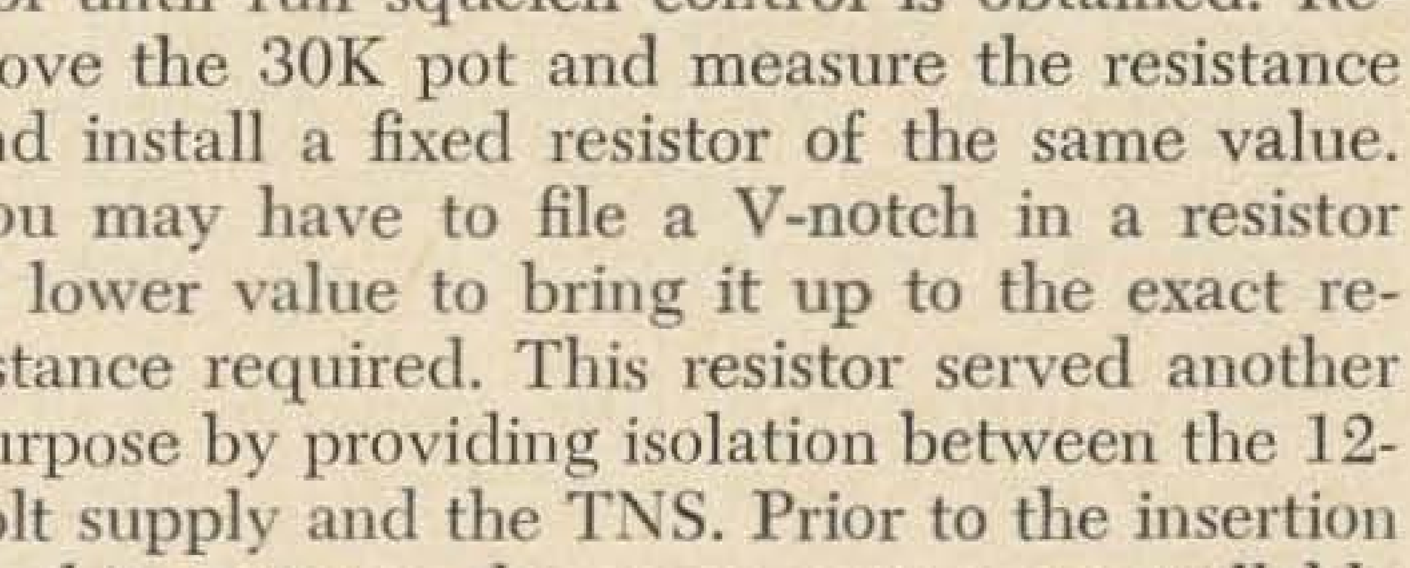



Fig. 4. S meter amplifier using auto voltage supply.

## BFO-Q multiplier

Very little need be said about the transistorized Q multiplier shown in **Fig. 6.** It comes from the January 1958 QST. To use the circuit as a BFO it was found that the feedback capacitor $C_1$ had to be changed until oscillations were obtained. Several different PNP transistors were used and all were made to oscillate satisfactorily by changing the amount of feedback capacitance. Another word of caution is to use a 3 pf coupling capacitor between the RG-58 cable and the mixer-oscillator stage in the auto radio. This will prevent any disturbance to the radio alignment. Be sure to keep the leads as short as possible.

These modifications make the Gonset Super

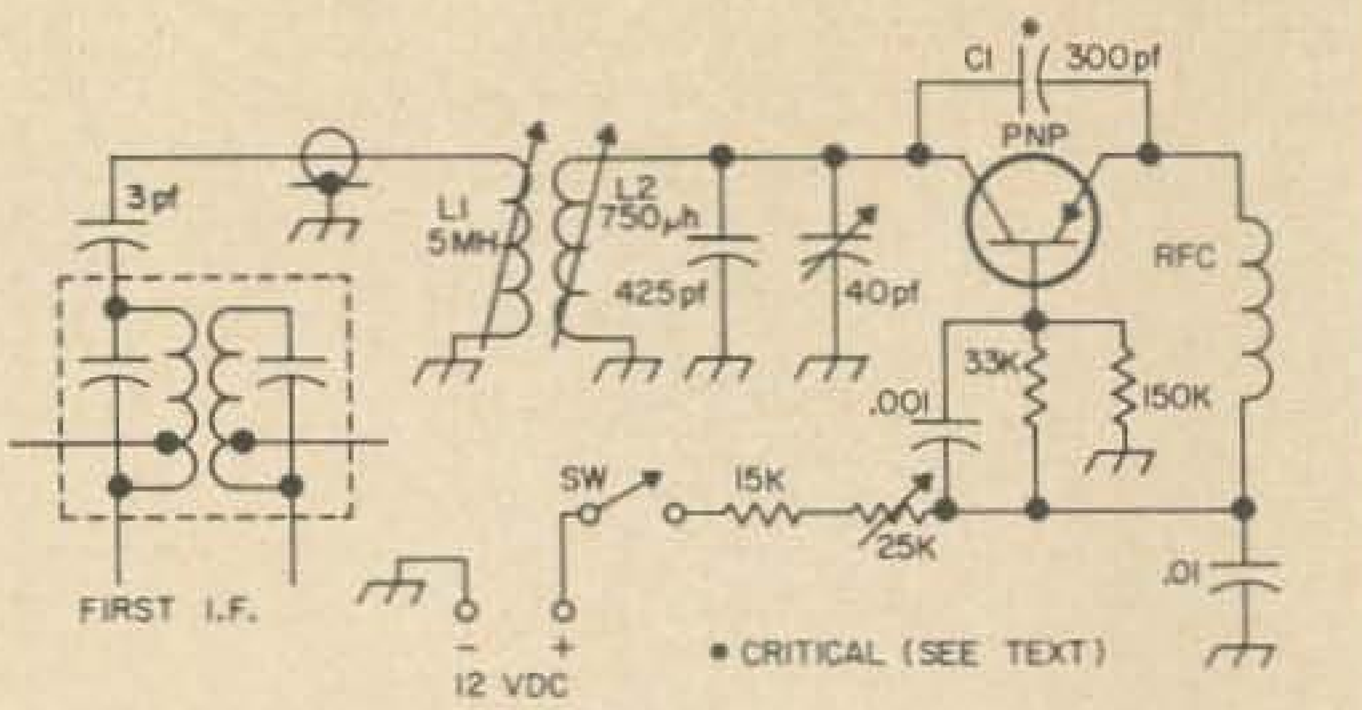



Fig. 6. 262 kc Q multiplier-BFO.

Six-car radio very satisfactory for mobile use. If you have any queries for me, please include a self addressed stamped envelope.

. . . WØBMW


Larry Levy WA2INM/1
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# Cut-out Capacitors

I have often found when building equipment for VHF and UHF that the biggest problem encountered was the availability of adequate bypass capacitors. Often, space considerations and lead dress make it very hard to fit something in that will do a good job. At the higher VHF frequencies, ceramic disc capacitors often have too much lead inductance to properly bypass. At the UHF frequencies, it is hard to find anything that does not have too much lead inductance to properly bypass. It seemed that the answer to my problems was to construct my own capacitors, which could fit into the spaces required and still have low enough lead inductance to be an adequate bypass.

The simplest type of capacitor is two sheets of metal with some type of dielectric between them. If the capacitor is to serve a bypassing function, one of the sheets of metal could be the chassis. This will reduce lead inductance by eliminating the lead. The other sheet of metal wound up being a piece of copper foil. Dielectric was a problem, as well as mechanical mounting. I had some Teflon film, which makes an excellent dielectric, as well as having the advantage of being relatively insensitive to heat, which means that soldering will not destroy it. Mounting was solved by glueing the copper foil to the Teflon, and then glueing the Teflon to the chassis. The result of this is a copper-Teflon-chassis sandwich,* functioning as a bypass capacitor with very low inductance.

The details are simple. A sheet of copper foil is glued to a sheet of Teflon film. This combination can be cut out to shape and glued to the chassis.

I have found that contact cement will work to glue the two materials together. I am not sure how good a dielectric it is, and I am sure that better adhesives are available, but this does work and it is easily available. You coat both surfaces that are to be glued with the cement, let them dry 10 or 15 minutes, and just press together. Use caution in pressing the two surfaces together, especially with the copper foil, or the foil will not be flat, causing more inductance and less effective capacitance for a given area. It is just about impossible to separate the materials after they touch. The contact cement can take the heat of soldering for a while without unbonding, so it is easy to mount the capacitor and then solder the leads to it.

There are many possible uses for this. It can be made up in sheets and cut out to fit around a tube socket, as a B plus feed bypass, for example. It will withstand several hundred volts using thin Teflon film. About one square inch is an effective bypass at 220 mc, possibly requiring somewhat more at lower frequencies. A square can be glued to the chassis at almost any point a bypass is needed, and if part leads are kept short, there will be negligible inductance.

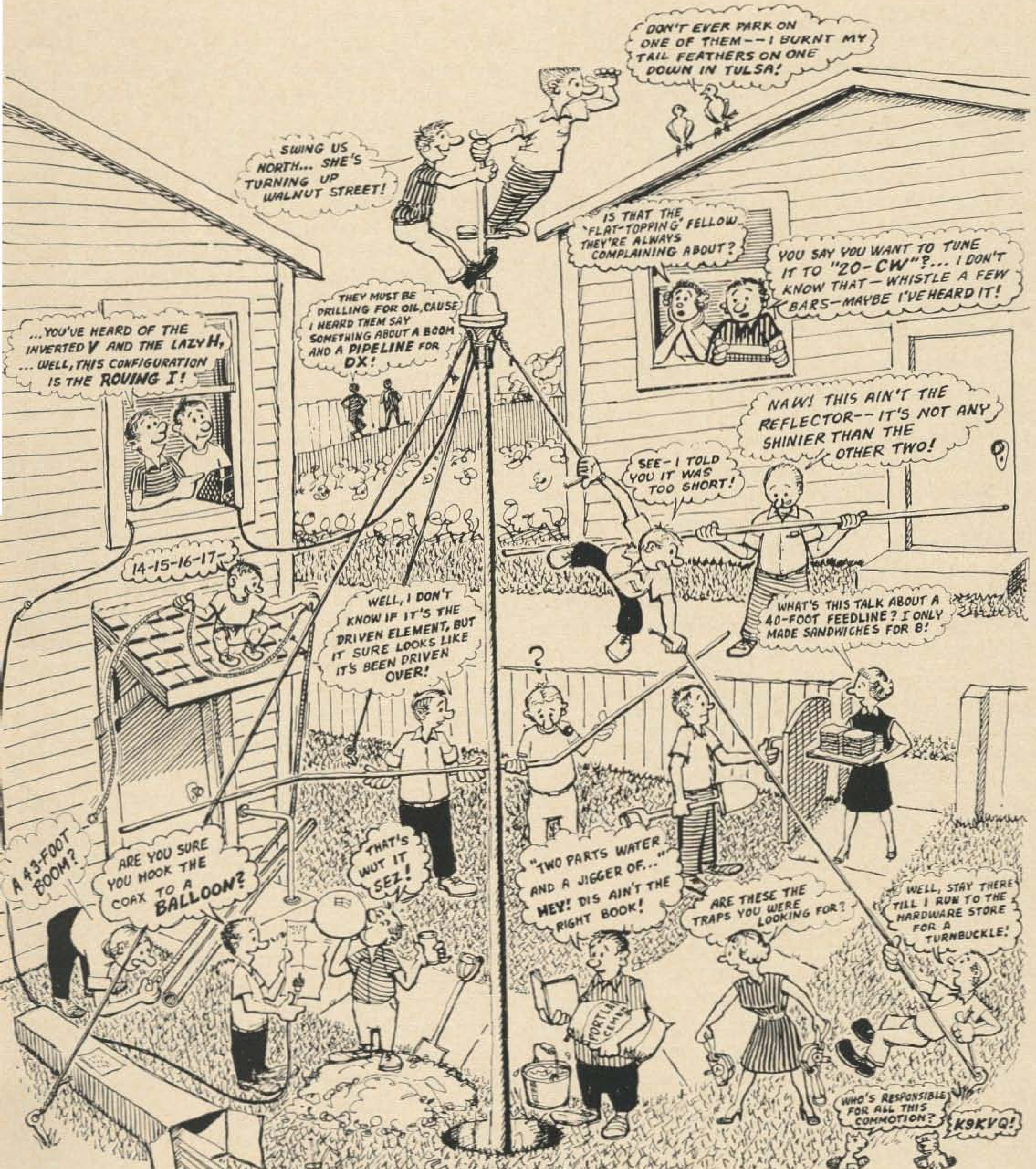
It will be worthwhile to give it a try the next time you are building VHF or UHF equipment.

. . . WA2INM/1

*An even simpler high frequency capacitor is a piece of double clad Fiberglas laminate. It's a bit harder to mount on the chassis, though. WA1CCH.

# The Antenna Bee

*As seen by Rodger Nordlung K9KVQ*



Del Brown K9CZI
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# Put your HX-50 on MARS

The HX-50 transmitter incorporates many features that make it a very worthwhile unit for use on the ham bands. However, like many ham band transmitters, the average owner will feel that he cannot get this unit on the MARS frequencies. In the case of the HX-50, this is not necessarily the case.

In Area 3, we had a wintertime After Dark Net that met on 3315 . . . normally upper sideband . . . and 3299 as an alternate or supplementary frequency. I had been on the VHF circuits, and decided to look over the HF as a possible additional outlet.

Checking the HX-50, and its passband filter information, I found the following to be the possible coverage: 3.2 to 4.2 mc; 6.9 to 7.9 mc; 13.8 to 14.8 mc; 20.8 to 21.8 mc; and 27.0 to 31.0 mc. As this included the 3315 channel, I calculated the required crystal frequency and ordered one for upper sideband. The internal vfo is switched in frequency when changing sideband on the normal hambands, and, of course, this would mean a need for two crystals to cover other frequencies with both upper and lower sideband.

The crystal was close, but the actual frequency was reached only by readjustment of the heterodyne oscillator trimer C-158. In view of this problem, I decided that another crystal for the other sideband would be more of a problem than I wanted. This was brought to the fore when they switched from upper to lower sideband on two occasions to avoid QRM.

I dug out an old BC-458 which had been around for years and lashed it up to feed into the external vfo input. I removed one of the 1625's and lowered the plate, screen, and oscillator voltages to just one . . . . about 150 volts. Then, removed the antenna coil, and adjusted the link for the 3 volts into the HX-50 . . . . using the RF probe on the VTVM. Tried it on 3315, and it worked. A 3 plus kc adjustment put it on lower sideband. Now they could switch sidebands and I could follow!!

About this time, we were having a Technical Net on 4580 kc. Hammerlund had written that the HX-50 wouldn't go up there. This was while I was thinking in terms of crystals. One Sunday morning, I decided to try to load up on that frequency . . . and it worked. Since then, I've had the HX-50 on 4450, 4580, 3315, 3299, 7305, and all without trouble. The output seems to vary, but the signals have been Q5 with wonderfully satisfying results.

No modifications were made to the HX-50. I merely added the external vfo, and using a Johnson Matchbox with a "Drooping Doublet" antenna, no antenna changes have been necessary either.

In view of the obvious variation in the crystal frequency of the first heterodyne oscillator in the HX-50, I would suggest the use of an external vfo rather than the crystals. Besides, the VFO can keep pace with the eternal changes of the MARS (at least the Air Force Mars) program in the matter of frequency.

I normally use this little rig barefoot, and have gotten excellent reports on all these frequencies. It would seem this is the easiest way to get an existing transmitter on the MARS circuits.

The BC-458 is ideal for the external vfo also. The internal vfo has a range of 5.975 to 6.525 mc. and with the 458 range of 5.3 to 7.0 mc, you can see that the range of coverage will be adequate for most excursions. Also, the range of the vfo is constant with the HX-50 . . . . no doubling or sideband reversals are a part of its operation, when going from band to band. This means that FSK when built into the vfo requires no reversing switch.

Hammarlund has a modification for FSK using the internal vfo that is a wonderfully simple and cheap conversion using the existing Varicap that moves the vfo when switching sidebands. A schematic for this is available from Hammarlund.

If your use of the HX-50 is as successful as mine, I am sure you will agree that the flexibility of this rig is a wonderful feature.

. . . K9CZI

## Armed Forces Day Tests

Saturday, May 21, is this year's Armed Forces Day, and an opportunity for hams to work military stations for special QSL's, or copy CW or RTTY messages for certificates from the Secretary of Defense. The first part of the tests will be military to ham communication from 2114GMT to 2202GMT. Military stations WAR, AIR, and NSS in Washington and NPG in San Francisco will be on frequencies near the ham bands to contact hams in the adjacent bands: **CW**: 4001.5, 4020, 6992.5, 7325, 14405 (WAR); 3269, 4015, 6970, 7301, 13992 (NSS); 3397.5, 6997.5, 13995, 49.98, 143.95 (AIR); 4005, 4016.5, 7375, 13975.5, 14385 (NPG).
**Phone**: 4040, 14385, 143.82 (NSS); 4025, 7305, 14397, 49.98, 143.95 (AIR); 4013.5, 7301.5, 13975.5, 49.692, 143.7, 148.41 (NPG). **RTTY**: 4012.5, 7380, 14480, 143.82 (NSS); 3347, 7315 (AIR); 4001.5, 7332, 143.7. VHF is AFSK, of course.

The NSS frequency of 143.82 will be for RTTY and AM from a plane flying from Washington to Hartford. Call is NSSAM.

The CW receiving contest at 25 wpm will be broadcast at 2203 GMT from Washington on 3269, 3347, 3397.5, 4015, 6992.5, 7301, 7315, 13992 and 14405, and from San Francisco on 4001.5, 4016.5, 6997.5 and 7301.5.

The RTTY receiving contest at 60 wpm will be at 220335 GMT from Washington on 3347, 4012.5, 6992.5, 7315, 7380, 14405, 14480; San Francisco on 4001.5, 4580, 6997.5, and 7332; Texas on 4025, and Illinois on 4590 and 7540.

All transcriptions should be submitted as received with time, frequency, call sign and address of individual submitting the entry on the page containing the text, to Armed Forces Day Contest, Room 5B960, Pentagon, Washington, D.C. by May 31.

## Checking Frequencies

Quite often it becomes necessary to determine the resonant frequency of a well shielded coil or one that is in a place not readily accessible. In order to grid dip a coil of this sort, some means must be found to get the coil coupled to the grid dipper.

By wrapping a wire around one pin of the grid dipper and inserting the other end of the wire close to the coil to be measured, a dip can be observed. It may be rather small, so care must be used.

A short wire connected to the coil in question and the other end inserted in the coil of the grid dipper will give the same result.

. . . L. A. Stapp WØPHY

*Editor's Note: The very popular "Kleiner Keyer" was described in 73 issue of September, 1965. Many hams who have built it will appreciate these improvements which our author has developed since moving to the sunny south.*

E. L. Klein W4BRS
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Huntsville, Alabama

# Improving der Kleiner Keyer

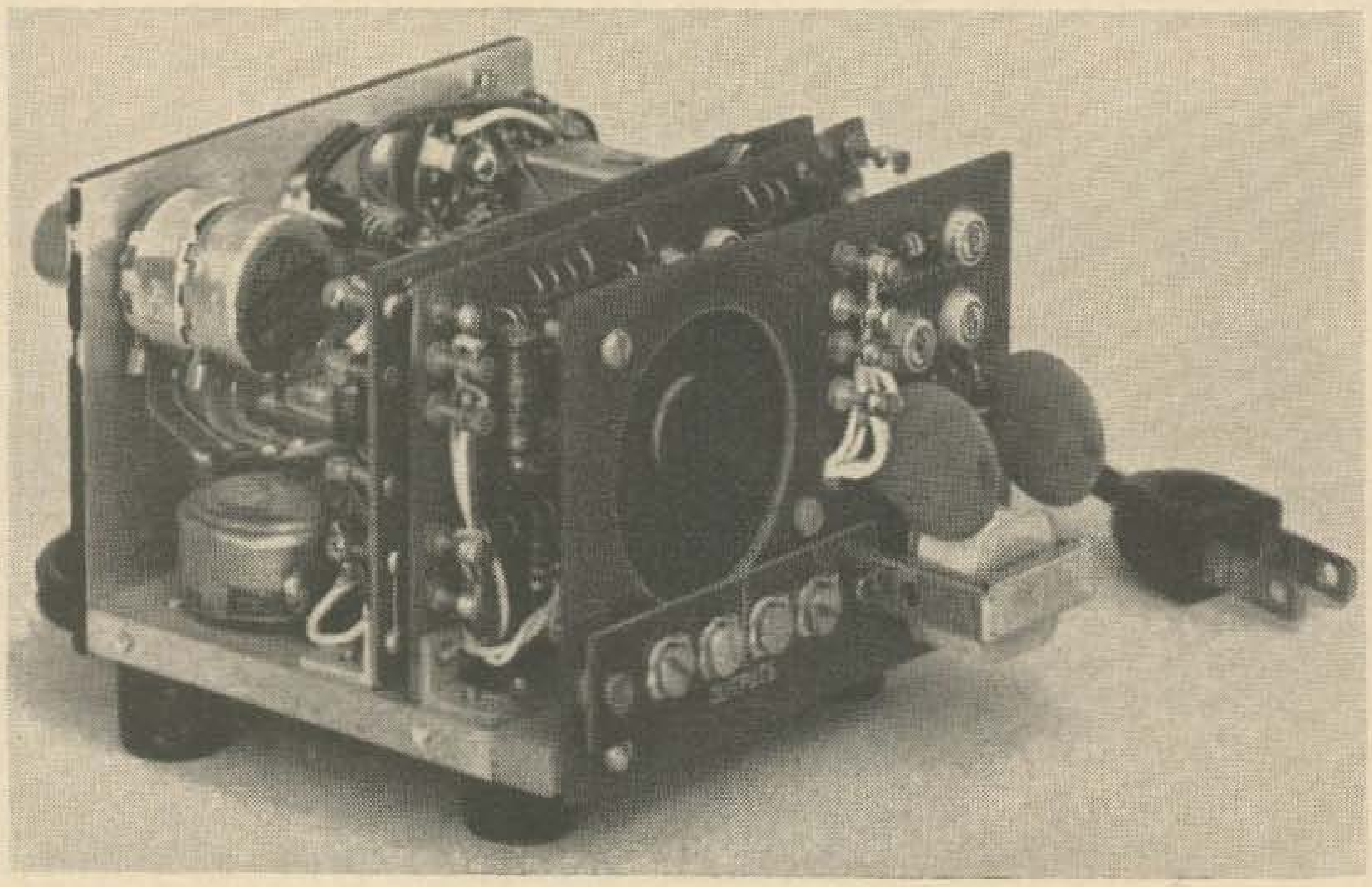
Normally judging from the correspondence received on der Kleiner Keyer, a great number of hams have found it to be a worthwhile home construction project. In the meantime, a number of improvements have been made on the original model and are described in this article. Most noteworthy of these improvements is the keying monitor which is shown in the photograph and accompanying schematic diagram.

## Keying monitor

An astable multivibrator was used as the audio oscillator because it draws less current than many other oscillator circuits and is relatively free of tone changes when voltage changes occur in the power supply. As in the rest of the keyer, PNP transistors are used. Their characteristics are not critical and surplus transistors such as those advertised in the back of this magazine will work very well for Q 8, 9 and 10.

The reader will observe that an isolating circuit comprised of Q 8 and its bias resistors is used. This circuit "switches" the audio oscillator off and on as well as provides further isolation of the oscillator from the grid-block keying transistor, Q 7. Several other minor circuit changes were also made to provide hand-keying capabilities and improved semiautomatic operation. The builder will find it desirable to experiment with various values for the 2.7K resistor (*) to obtain equal dot and dash tones when operating in the semiautomatic mode.

*Gene has held a number of calls: W7HNT, W3MCM, W4UHN, J2BAC, JA2AP, WA2Q-YD, and WB2PKE. He's an engineer (U. of Washington), a private pilot, likes to build and has written many articles.*



Rear view of the keyer with the cover removed. The new component board is shown mounted from the keyer base. Audio oscillator, speaker and terminal board are accommodated by this third phenolic component board.

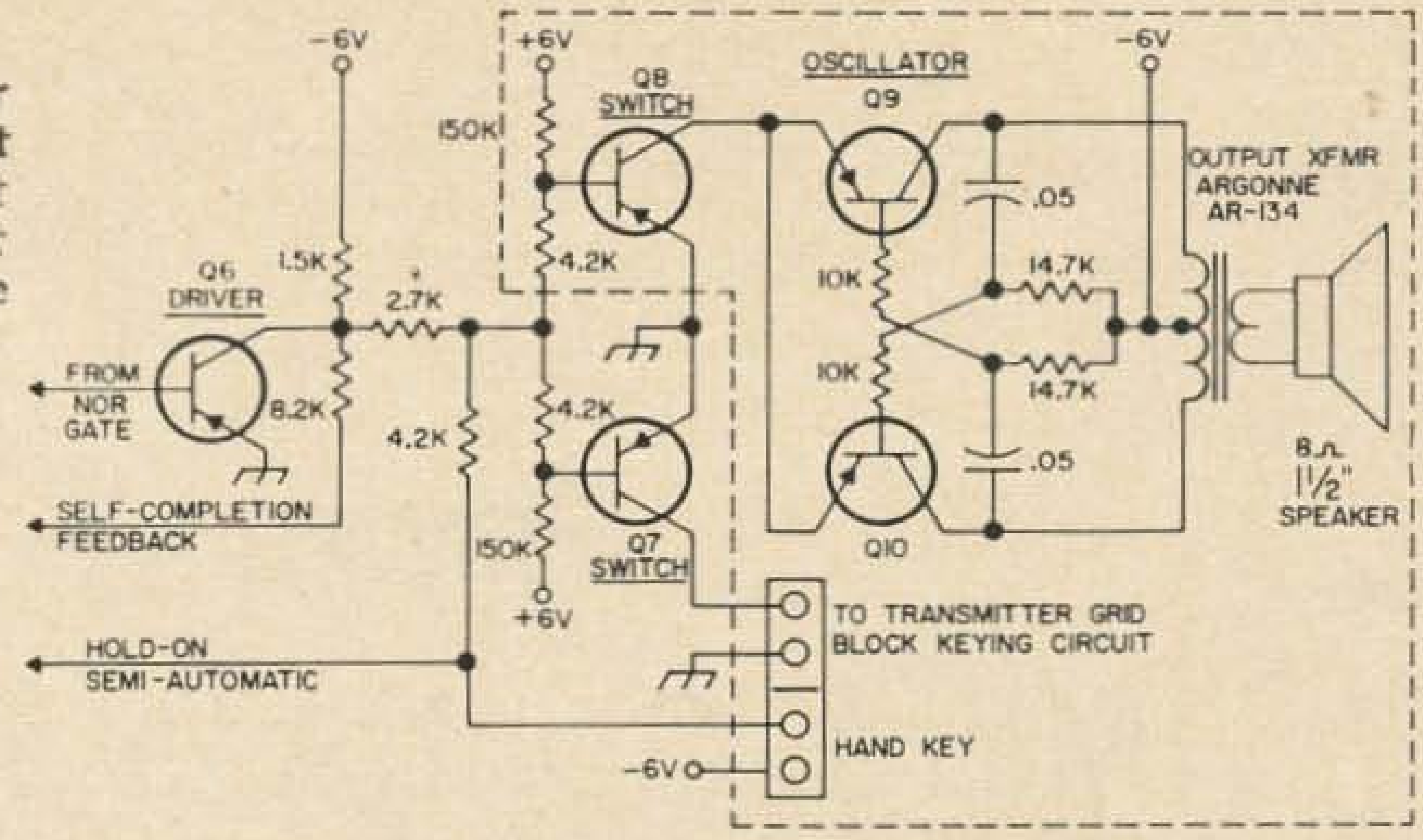



Fig. 1. Schematic of the monitor oscillator The portion of the Kleiner Keyer circuit within dotted line is mounted on new circuit board. Notice component changes in circuit for Q6 and Q7. Resistor (*) value to be selected at assembly; see text.

## Construction

A third 2½ x 4 inch phenolic board is added to accommodate the monitor oscillator and loudspeaker. This 1/16 inch board is secured to the rear of the original base with two #4-40 screws. A ¼ x ⅜ x 4 inch spacer holds the new board out so that the 1½ inch loudspeaker will not interfere with components on the original rear board. A new cover which is 1⅛ inches longer in the front-to-back dimension completes the mechanical construction of the newly added keying monitor.

## Those elusive 5.8K resistors

As many readers concluded, the dual 15K potentiometer is non-standard and, therefore, must be replaced with another value for the speed control in the free-running multivibrator. One solution which provides a two-fold advantage is to use a dual 10K potentiometer. First, a standard control is provided. Secondly, the small amount of fixed resistance which is placed in series with each potentiometer prevents the maximum speed from exceeding 50 WPM. Hence, the elusive 5.8K, ½ watt resistors which appeared in the photographs, now have a logical place in the schematic diagram.

## Power supply corrections

The two 150K filter resistors in the power supply alas were wrongly labeled as 150K which is about 1,000 times their proper value. Two 150 ohm, ½ watt resistors should be used in this application.

Due to the very small load on the 6 volt supply, we find that the +6 is more nearly +9, especially when generous filter capacitors are used (peak voltage = 1.4 times RMS). A 750 ohm, ½ watt bleeder resistor across the plus supply will tame this voltage and provide more realistic biasing of the PNP transistors as well.

## Mechanism contacts

One of the better insulators known to electro-chemists is aluminum oxide. And that's just what we have on the paddle contacts in a very short period of operation. Although brass screws may be used for the adjustable contacts, it is still desirable to install some form of better contact material on or in the paddles themselves.

One very successful method is to use a small piece of silver solder as a rivet and "peen" it into 1/32 inch holes which have been drilled in line with the adjustable paddle contacts. After the silver has been hammered snugly into position so that it tightly fills the drilled hole, it should be smoothed off with a very fine file or emery cloth.

## Improvement of the hinge joints

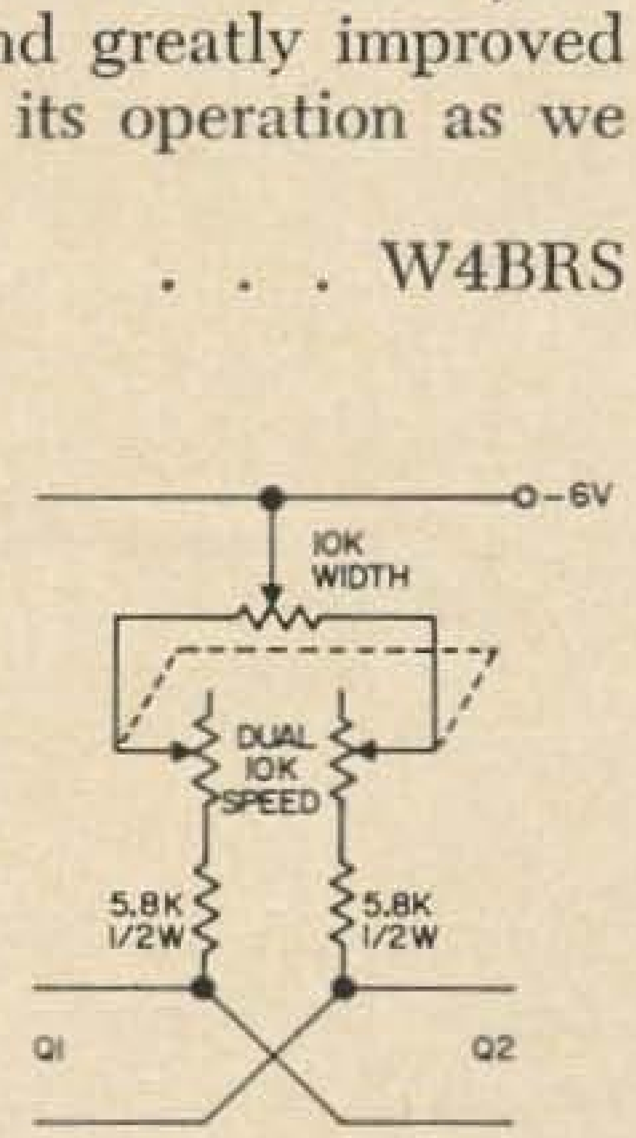
In order to provide better electrical connections through the hinge joints, a spring was added to contact the ends of the hinge rods. The spring was made of spring brass and held in place by the last two screws of the keyer mechanism.

The contacts were cut from a piece of 1⅛ x ¼ inch spring brass. Two #27 holes were drilled and 1/32 inch slits were sawed in a "T" pattern, as shown. Try not to distort the spring while fabricating it, in order to keep the contact snug on the hinge rod ends.

Once these modifications are made to your Kleiner Keyer, you will find greatly improved reliability and pleasure in its operation as we have here at W4BRS.

. . . W4BRS

Fig. 2. Wiring changes in the free-running multivibrator. Two 5.8 K resistors are added and 10 K replaces 15 K for dual potentiometer speed control.



Anthony Curtis K3RXK
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# Fewer Tears, More Contacts from Within

***Make your own Joystick.***

There are thousands of fellows across this country in the same predicament as I, living in a home of maximum inner space and minimum outer space. Ever pound your head against the walls because your Super-Tri-Blex transceiver just doesn't cut through the soup to be heard by the stations you hear? A lot of experts on the subject of getting out will tell you to look to your antenna system first in such cases.

You say you have looked? You know that's where your difficulties lie? Well, maybe I can wipe away a few frowns. Over the last dozen years I have lived in four different locations, none of which permitted even a mediocre, outdoor antenna. Through those years, I have refined some systems for apartment-type, limited space antennas.

Most of my operating difficulties have been associated with the lower ham frequencies where antenna lengths are longest. Compacting the radiating system can be nothing but detrimental to a projected signal, yet this is the only answer for many hams such as myself who want very much to operate, even at lousy efficiencies.

Many magazine articles have described the hidden wire tricks, the attic beams, the floorboard rhombics, and the like. I would like to suggest an idea brought on by a product relatively new on the home decorating market. It doesn't appear to damage the male self-image too heavily these days for the ham-husband to allow the XYL the indoor antenna prerequisite of making it 1) as unnoticable as possible and 2) the noticeable parts as decor-matching as possible.

*Tony also holds W8TIZ. He's a full time student at the Pennsylvania State University Journalism School and works as a DJ at WMAJ.*

Pole lamps have sprung into vast popularity across the land and many specialty stores carry complete, un-lamped poles and/or all the various pieces which go together to make up whole poles. These poles can vary in length from 6 to 10 feet under usual conditions and possibly shorter, or longer, if you find a store selling shorter and longer extension tubing. The poles are long pieces of tubing which have spring-loaded stakes in each end. These are wedged against ceiling and floor, in a vertical configuration. Or, they may be wedged between wall and wall in a horizontal line. Of course, the tips of the stakes are rubber covered to prevent damage to wall, ceiling, or rug.

Poles come in many finishes of plated metal, paint, and sometimes wood. They can be put together as spartanly as you like, or as luxuriously as the eye of the XYL requires. If the indoor antenna would be entirely hidden, the poles could be of simple chrome plated metal. If the wife will see parts of the antenna, and if the antenna will serve a dual purpose as discussed later, then make it up to match the decor of the home area in which it will be located.

The average pole, bought whole, will be about 7 ft long which matches the height of ceiling in many apartments today. Sections can be purchased and inserted which are shorter or longer to make your vertical antenna meet your requirements. If you are going horizontal, you may wish to add long sections to lengthen

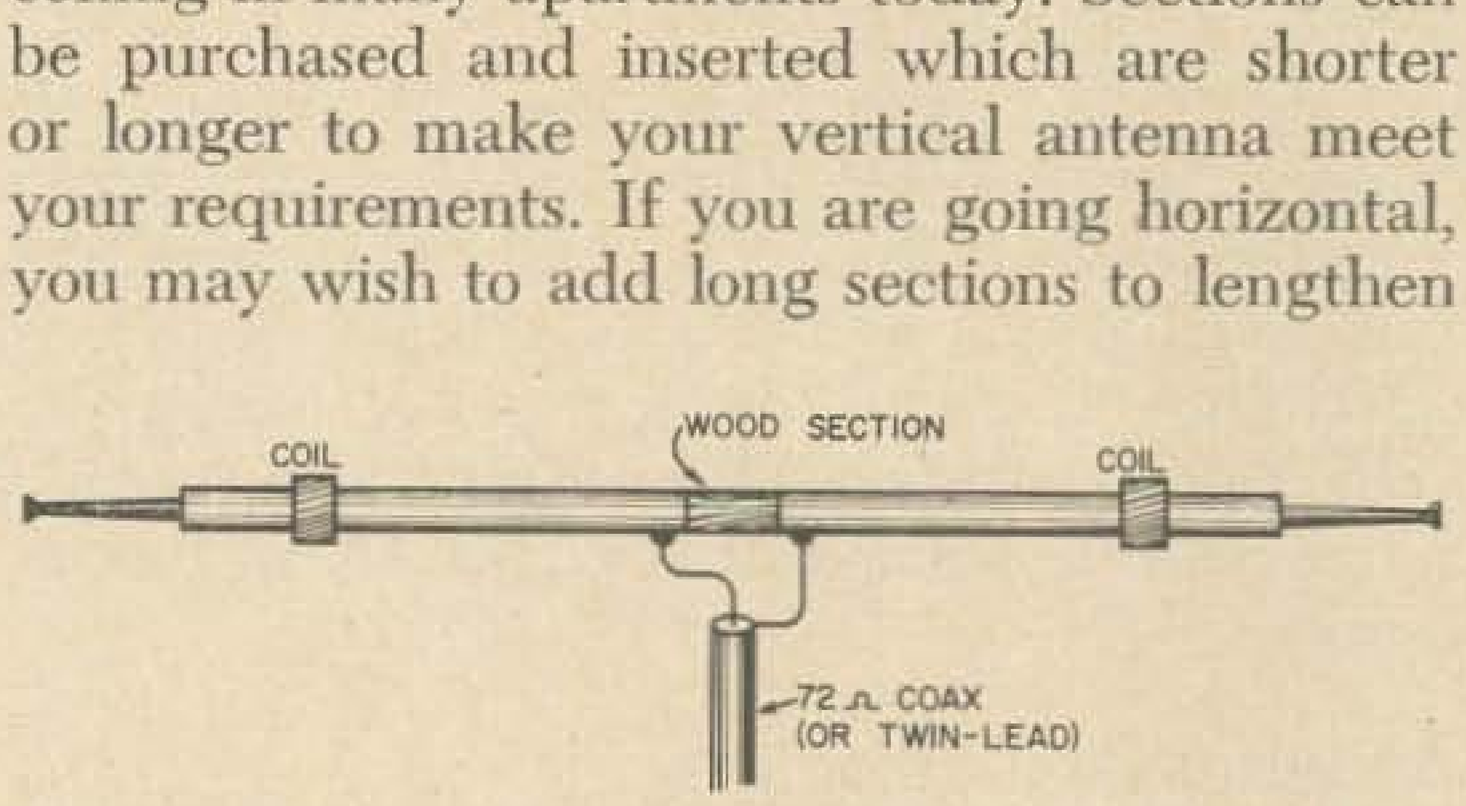
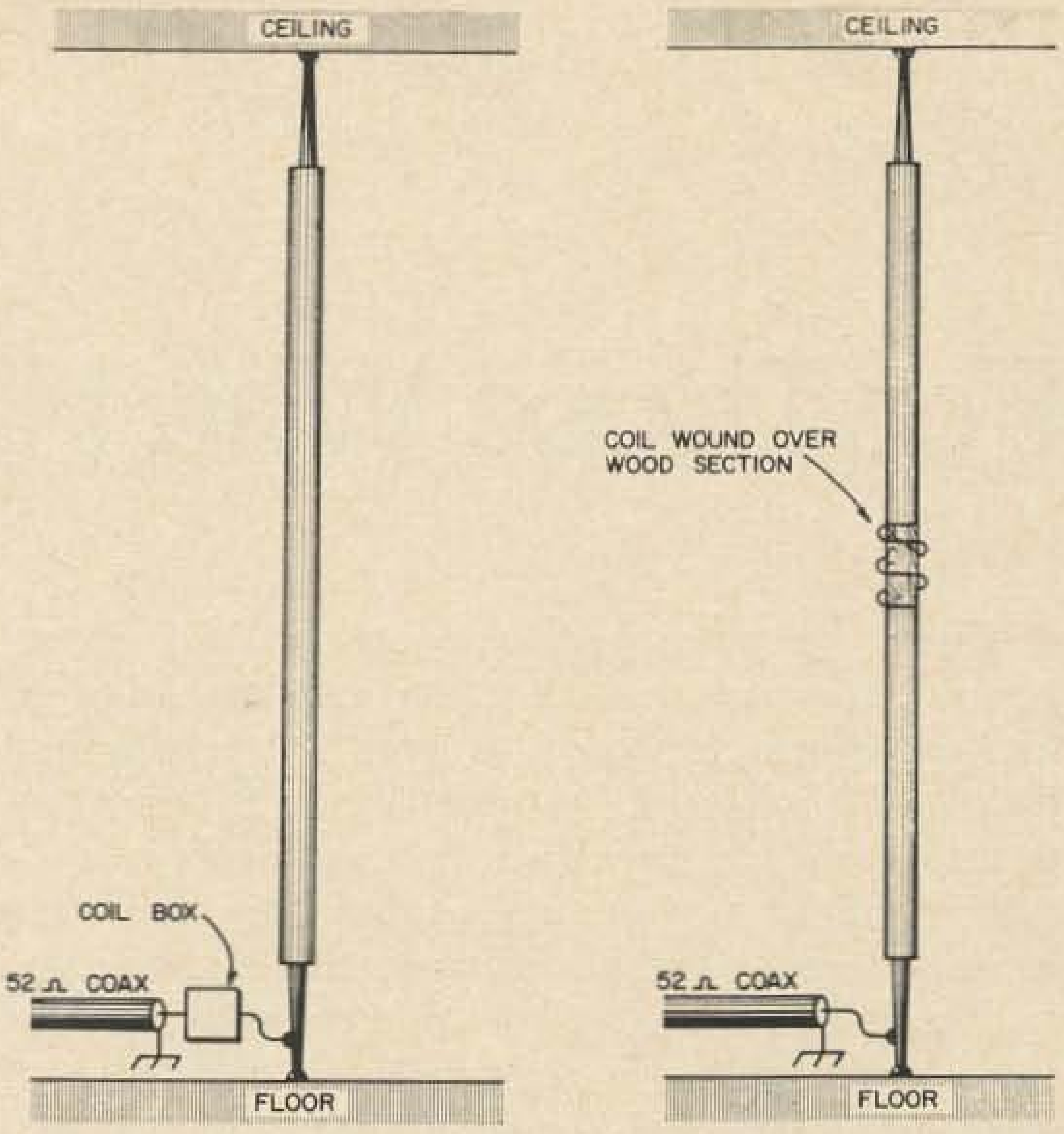



Fig. 1. Coil loaded dipole antenna.

the antenna out to 12 or 15 ft or more. In such case, check for the possible need of center support as the pole weight increases.

I have used the system in three different configurations shown in **Figs. 1, 2** and **3. Fig. 1** is quite effective when you have a long pole pushing against two walls. It is also the more complicated to build with the three "breaks" in the continuity of the pole: the center dipole insulator, the two loading coils out along each arm of the dipole.

The center insulator is usually a wooden section made by the pole manufacturers, for beauty, to replace one metal section of the pole. This will work out fine as a center, dipole insulator. The two coil inserts must be wound individually to match the specific band requirements with the size of your pole. I have used standard practices for making coils for loaded dipoles.




Right, Fig. 2. Base loaded vertical pole antenna. Left, Fig. 3. Center loaded vertical pole antenna.

**Fig. 2** is a common quarter wave vertical with base loading. I have found it convenient to build the loading coil (s) in a small, nice looking, *wooden* cigar box placed on the floor at the foot of the vertical. In my set-up, I feed the coils and antenna with 52 ohm coax, grounding the shielded side of the cable to a water pipe some ten inches away. This pipe happens to be part of a room-circling, hot water system.

These antennas will work on all bands for which they are cut; I use mine regularly on 3.5 mc, 7.2 mc, and 14 mc. Remember that these are highly compressed radiators and the higher the frequencies the better the efficiencies involved as the pole lengths reach closer to actual quarter wave and half wave figures. For this reason, I have always had better luck in getting out on 20 than 75 meters. I use, and mention, these frequencies as these are the bands covered by my NCX-3. Of course, those persons operating on 15 and 10 with this type of antenna would be better off as these frequencies approach even closer to pole length in terms of quarter and half waves.

**Fig. 3** is a variation of the idea presented in **Fig. 2.** Familiar to mobile operators, this is the center loaded vertical. The 52 ohm coax feeds the base of the vertical with the cable grounded to the nearest ground point.

In this antenna, I have used again a wooden, manufactured piece made to replace a metal section of the pole. In this case an appropriate coil may be wound right on this wooden form, and connected properly to both halves of the vertical pole antenna.

**Fig. 2** is the easiest to construct and is, therefore, my favorite. In a wooden-sided house where I previously held residence, I placed a 7 ft pole in a closet near the front door. This small area was built at an outside corner of the building and the walls appeared to be completely invisible to my outgoing waves. I managed to pick up WAS along with contacts in Europe, South America, and New Zealand with this system. No reason for me to worry over the system after that!

Here are some of the decor ideas I mentioned earlier:

The pole may be used horizontally, between two walls, and the XYL can hang drapes of non-conducting material on it for one of the full-wall drape effects which are so popular today. The drapes, while faking a picture window area or whatever these feminine tricks are meant to do, will also cover your coax as it runs to the center feed point of the dipole.

Poles or their sections can be purchased with small holes drilled in for large, round, towel-hanging rings. One might locate a corner of one's bath for a pole and hand non-conducting towels from the rings. High fashion! The coax could be concealed from the pole base into the next room for your operating area.

A neighbor suggested an even more "far out" idea. In a vertical set-up, place a horizontal arm out from the pole at the five foot level. From this arm, suspend the wife's canary in its gilded cage. This would look great, hiding the pole's real purpose. Sorry, no tests have been run to determine the physio-psychological ramifications of single-side-band operation on the canary.

. . . K3RXK

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# For Those Who Have Given Up Code

Since the advent of Amateur Radio, many people have at one time or another tried to become Amateurs only to balk when the first requisite could not be met. Even those Amateurs who have successfully passed their code test suffered a time when they decided that it was impossible to absorb this "nonsense" and approached a point that would prevent them from going further without the help of pure tenaciousness, or some gimmick. I discovered such a gimmick that helped me, and if there was ever anyone who needed help it was me.

I was convinced for a long time that the code requirement should be abolished, and any person in his right mind that operated in this mode was a nut. Why drive a horse and buggy when cars were so cheap? You can say more verbally and much more effectively using the mode that we are all better suited for. However in the end I became an addict to CW and it is hard to break away.

After struggling along for months, and long after my Novice license had expired, it was easy to see that my code speed was never going to exceed ten words a minute. So I decided that something was going to be done. I read some books on the subject and made a list of the things that I had done wrong. My first glaring error was in memorizing the code as dots and dashes. For those who have made this mistake, all is not lost. You can still do it. It was only after many headaches and frustrating repetitions with paper and pencil that I realized what I was doing wrong. The second mistake was scribbling, or trying to get the character on paper before it was received. This is a common mistake and its only natural to want to record the letter as fast as possible in order to be ready for the next. Both mistakes are unnecessary and most important to overcome before any progress can be made.

The third mistake was trying to copy the myriad of fists and bad signals on the air. Fast and slow, good and bad, clean and dirty, it made no difference. I tried to wade through these and make some sense of them, only to become more confused and disgusted. This was easily rectified by turning off the receiver.

I obtained a tape recorder and a good tape with code signals and went to work. It immediately became apparent that I was getting nowhere. The first plateau to get over was to be able to recognize the characters instantly and without error. I played the tape as slow as it would go and wrote the text on a sheet of paper. After several runs I finally had it all down. After setting the tape at its normal speed and replaying what I had all ready copied, I traced over the letters while listening to the tape at 13 words per minute. I was stupified at the phenomenal results! There was no need to hurry. There was time for me to make large block letters with plenty of time in between to rest and look around the room. It was tried at 15, 18, 20 words a minute with no strain on the pencil. I used this technique for a number of days, and soon discovered that dahdahdidah was no longer two dashes a dot and a dash. My mind did not have to mentally associate dots and dashes with what I was hearing. I was actually receiving code, and what's more I was putting it on paper. My speed increased in a short two weeks from a slow ten words to well over the required thirteen. In listening to on the air code practice from W1AW I was able to get the 13 and 15 words per minute almost perfect. Subsequent practice increased my speed to 20 words a minute for which I received the Proficiency Award for both 15 and 20. After my General ticket was received I managed to go on to speeds well over 30 WPM.

Please bear in mind that my experience with the code was a common one. How it was overcome was not, but the method is unique and worth a try by those who have had bad advice, and other stumbling blocks. Listen to W1AW code practice sessions and other Amateur stations giving this service. One such station that I can heartily recommend is W4RUR who conducts code practice twice a week on 40 meters. I listened to both and was able to pass my General code test letter perfect with their help.

For those who finally get to the point where they are ready for the examination, here is a tip or two that helped get me over the hump. The evening before the test or the same day if possible, listen to a machine tape or record at exactly 13 words per minute. No other speed will do. Put it on paper. You should get it perfect. But don't be too disappointed if you don't. I'm convinced that someone very carefully chose 13 words a minute for the FCC test. It's neither slow nor fast. For me it's still difficult to copy. After listening to and copying high speed and then dropping back to slow speed, you will find yourself anticipating what is coming and have it on paper before you know what happened. This can mess you up on a test and it is hard to overcome. For this reason listen to the test speed, regardless of how fast you are able to copy, just before the test so you can gear yourself mentally for what is to come. Ten or fifteen minutes should be enough. Send yourself code mentally on the way to the examining room—at 13 words. Get this rhythm in your mind. In taking the test don't make the mistake of trying to count the characters mentally for a minute or two and trying to correct any errors and skipping the rest of the test. It simply won't work. If you make an error forget it and continue, and I mean forget it. The time spent in worrying about it, and trying to correct it will distract you and you will continue to make errors right to the end of your failed test.

If you are a Novice or Technician, let me caution you about the delusion that on the air practice will get you anywhere. It will only take the time that could be used for studying the theory. On the air practice will only slow you down and add to the QRM all ready there. Believe me I should know. As a Technician I tried for weeks to stir up some activity on six meters for practice. True, some would accommodate me and with one or two exceptions all comers set me back considerably.

When you have become an addict to the code and the CW mode of operation you will find Amateur Radio has a new meaning. As an Engineer for a large Aircraft Company my job is very demanding and is not without a great deal of pressure from time to time. Occasionally I have seated myself at the operating table, my mind wandering and thinking everything but relaxing. And then hearing a nice cheery CQ at a comfortable 18 to 20 words a minute, and with a fine fist at the other end, usually lends itself to an hour of rag chewing that absolutely cannot be beat for letting your tensions slowly drain out your system. CW is beautiful when sent right, and whenever I hear an operator with a FB fist who is aching for a rag chew I experience a thrill that makes any effort, any expense or inconvenience well worth while.

One final word. If you have prepared yourself properly for the FCC examination, you will know immediately if you passed without anyone telling you. If you passed the code, you are on your way to completing a good day, and you will have that good feeling that thousands of other Amateurs have had and know that you finally "belong."

. . . WA8BJX

*(Continued from page 2)*
black box. PE wonders if something new has been discovered or whether there is a hoax involved somehow. Interesting. The story reminded me of a little experiment I pulled off 22 years ago. Good heavens, how time flies! This was back during the war and QST was marking time for us with little communication projects using light, ground, etc. The ground bit interested me particularly and I decided to give it a try.

For those of you who might not have read all the stuff from those olden years, it seems that if you poke a couple stakes in the ground and feed audio into them, the signal will be detectable for some distance to an audio amplifier hooked onto two other electrodes.

Since I didn't have any ground around me anywhere I decided to use what I did have: water. We were cruising off the coast of Okinawa at the time, surfacing at night to recharge our batteries and looking for an unwary Jap ship to sink. Unfortunately most of the Jap ships we sighted were sub chasers and we had to be pretty careful.

There was about 2/10 of an ohm resistance between the APR-1 forward and aft dipoles, so I hooked the low impedance tap of a small audio amplifier to them, turned up the gain and said, "Hello." About ten seconds later came the call . . . "Green to the conning tower." I rushed up to find the underwater sound man all excited. It seems that someone had just spoken very clearly through his sound gear and said hello. Hmmm . . . wonder who that could have been. About this time the fellow arrived from the forward torpedo room . . . he had heard the same thing on his JT sound gear. By George! They both reported it was very loud . . . very, very loud.

I listened to the reports from the two sound men and thought for a moment . . . yes, I could fix that right up . . . nothing to worry about, sir. And I did fix it . . . they never had any more problem with strange voices on the sound gear.

I understand that the Icefish, some miles away, heard the same strange voice. How about that?

Every now and then I've wondered why this system wasn't used for underwater communications, but I supposed that there probably were reasons. Obviously it was something that many people had researched thoroughly years ago . . . or was it?

## Mensa

Every now and then I get a letter from an amateur who is also a member of Mensa. Fine. I'd like to see more of you join Mensa. I think it would be very good if every amateur who can make it would join. If you've got smart brains, prove it. Write to Box 86, Gravesend Station, Brooklyn 23, New York for details. Mensa, a club for people in the top 2% IQ, is quite active in the larger cities . . . and only a small percentage are in it to show off how smart they are.

## The New President

At the Flatbush Radio Club the other evening I was asked what changes I would make if I were made president of the League. Interesting thought.

Number one would be a long facts-of-life session for the Directors to acquaint them with the real situation that amateur radio is in these days. From there we would take the steps necessary to set up a public relations department of the League which would gather information of all of the valuable things that are being done by amateurs and see to it that these stories are released to the newspapers, presented in feature magazine articles and given world wide distribution. This could have a profound effect in getting more people interested in our hobby and give it a tremendous boost in official circles all over the world.

Next I would open that controversial Washington office and arrange it so that the League could for the first time have some influence in Congress what happens to our hobby. I would make it so that the League could honestly say that they represented amateur radio rather than just exploiting it.

Then, as president of the League, I would go to Washington and try my damndest to get an amateur radio section of the Peace Corps established to send small teams of amateurs to the newer countries to set up amateur club stations and train locals in the basics of radio and communications. If we can get amateur radio really started in these countries we will have given them a tremendous boost for they will then have experienced men to draw upon for commercial and government communications and electronics work. Without amateur radio there just is no one to even start with in these fields.

Then I would visit the member societies of the IARU and find out what can be done to get amateur radio ready for the next ITU conference. I'd get the ARRL Directors to authorize the funds to set up a small office in Geneva with one full time amateur in charge to provide communications for the Region I IARU, including a monthly bulletin to all concerned.

All this would cost money, no doubt about it. And even though The League has over a half million dollars sitting around in cash and securities which it is not using in any way for our advantage, I believe that the additional expenses can easily come out of increased income.

All the above, and more, could easily be done for under $80,000 per year. This amounts to just $1 per ARRL member more than is now being collected. A small increase in the advertising rates of QST would achieve the same result and their rates would still be about one third to one fourth those of any comparable publication in any other similar field. No, there are many ways to easily finance the job that must be done. All we lack at present is the will to do it. This is why it is so extremely important that all of you support the Institute.

## Suggestion

It might be worth while if the ARRL Directors devoted a little of the time of their short yearly meeting to a discussion of ways for the League to re-establish confidence in amateur radio among the amateurs.

The repercussions of the Incentive Licensing hassle should be apparent to everyone by now. I told you that they looked like they would be serious and they certainly have proven to be that.

The immediate response was turmoil in the amateur ranks. This was followed by an intense depression in our field. Sales of new gear fell off and the prices of used gear dropped badly. This had the effect of driving dozens of ham distributors to more rewarding lines of business such as CB. It seriously hurt many of our ham manufacturers and seems to have caused many of them to lose faith in the ham market. We now see several of our largest and oldest ham manufacturers wavering on the edge of dropping out of the ham business completely.

It is possible that confidence can be regained in ham radio if the League acts immediately to remove the Sword of Damocles that is hanging over us all by putting all of their pressure to work on getting the FCC to forget Docket 15928 and Incentive Licensing.

Ham radio and the large firms that have done so much to support and encourage the hobby have been the victim of the ill considered actions of a couple of people at headquarters. It is just possible that this tide can be turned if the Board acts immediately.

. . . Wayne

Henry Cross W1OOP

## Permanent Cure for the NC-300 Filament Regulator

The oscillator heater in the NC-300 is fed from a 12 volt tap on the power transformer through an Amperite current regulator. These work very well but seem prone to quit at critical times. A 6V6 will be found in most 300's instead, as it will make the beast run, even if it won't regulate. The circuit shown was installed in a 300 belonging to W2NSD. C1 is at least 1000 µf, at least 12 working volts. D1 was a shorted 2N301—or a good one . . . power transistors are fine low voltage diodes. D2 is a 1N1602 (International) or other 6.2 volt ten watt zener diode. If the stud goes to the anode in what you can get, turn the other diode and electrolytic around—mica washers are too fussy. For a 6AH6 R1 came out about 8 ohms 10 watts (10 in parallel with 40). The action would be better with about 2500 µf and 8 ohms.

. . . W1OOP

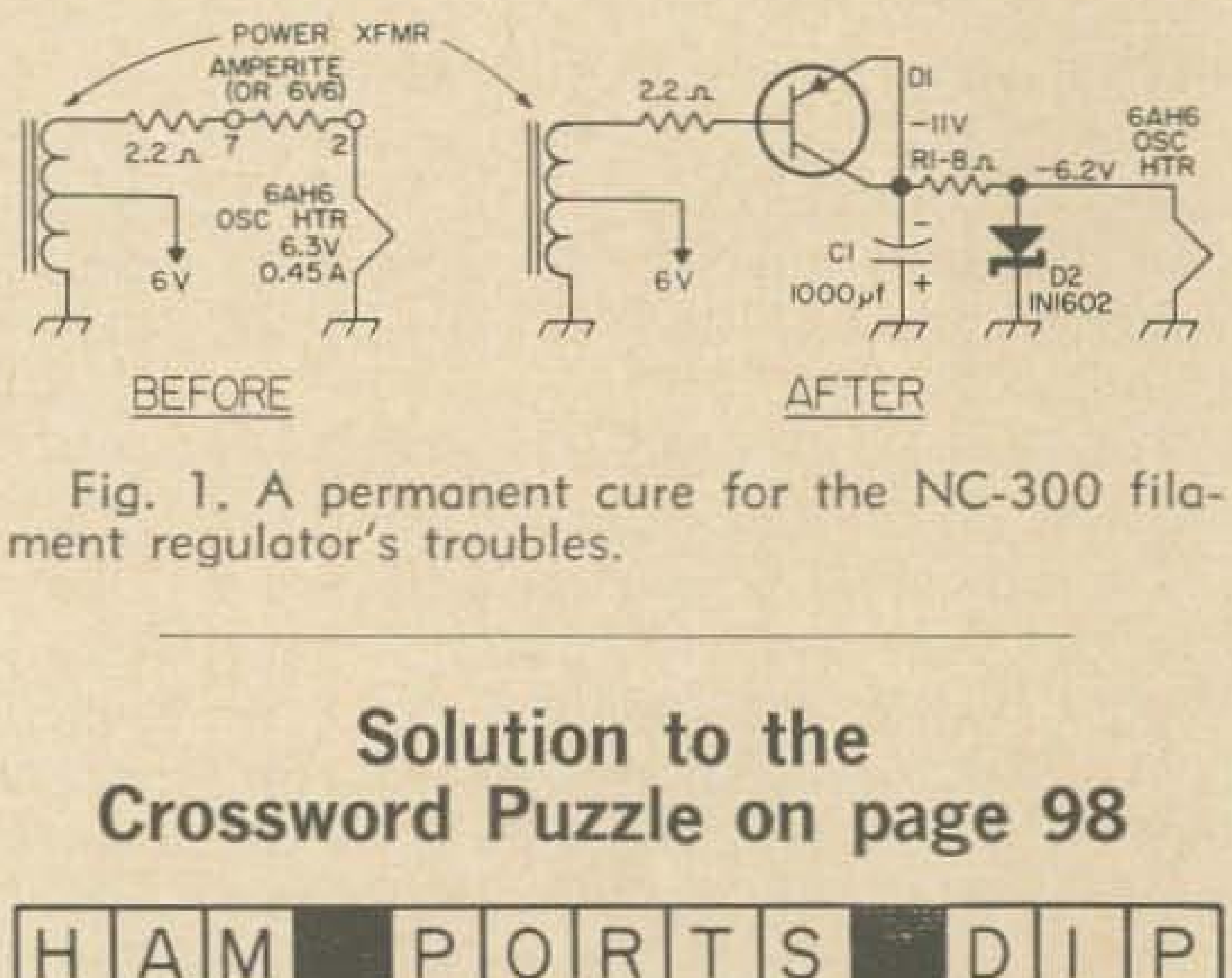



Fig. 1. A permanent cure for the NC-300 filament regulator's troubles.

## Solution to the Crossword Puzzle on page 98

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H | A | M | | P | O | R | T | S | | D | I | P |
| A | T | E | | A | T | C | U | T | | A | D | E |
| R | O | T | O | R | | | N | A | R | R | O | W |
| I | N | E | R | T | | A | E | R | I | A | L | S |
| | | R | C | | A | F | R | | L | F | | |
| G | A | S | | R | F | C | | T | E | S | T | S |
| A | N | | S | C | C | | C | A | R | | R | I |
| M | A | S | T | S | | T | O | P | | F | I | N |
| E | T | T | A | | U | R | N | | P | I | P | E |
| | | A | G | I | L | E | | B | E | L | | |
| D | E | T | E | N | T | | B | A | N | T | A | M |
| P | R | I | | D | R | A | I | N | | E | I | A |
| S | E | C | | S | A | V | E | D | | R | R | S |

*(Continued from page 4)*

Well, we're all being jarred more and more these days. Two names for frequency units have been causing more and more problems (though I can't believe they're that serious) in international science and engineering as these fields tend to be less and less nationalistic and more international. An international conference a few years ago decided that it would be better to use hertz, and the USA National Bureau of Standards and Institute of Electrical and Electronics Engineers have accepted this ruling, as have most of the engineering level publications in this country. Now the hobby and technician magazines are starting to, too. Massive resistance to apparently inevitable social changes seems to have had little worthwhile effect recently, and I suppose that the same can be said for resistance to hertz.

Hz, kHz and MHz for cps, kc and mc will undoubtedly offend your eyes as much as ours at first, so we're going to switch to them slowly to get you accustomed to them. If Hz annoys you, think of how I'm going to enjoy changing all of those cycles, kc, and mc to Hz, kHz, and MHz in all of the manuscripts we publish.

. . . Paul

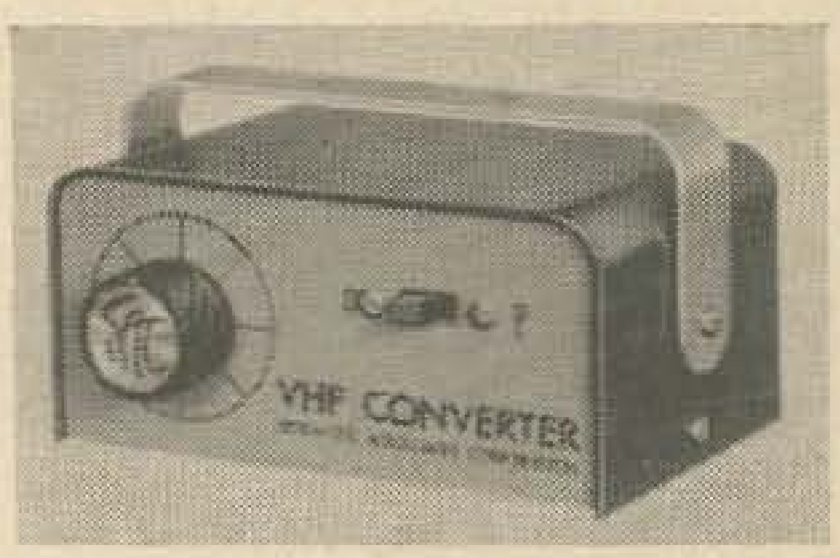
# NEW PRODUCTS

## Denson's 20th Anniversary

Al Denson has just brought out a fat, 96 page twentieth anniversary catalog full of TV, ATV, test equipment, ham gear, surplus, TV camera kits, etc., etc. You'll spend hours looking at this catalog, drooling over the contents every minute. It's also got lots of schematics, conversions, information about equipment and other interesting data. If you're a builder, you've got to get this one. Write to Al Denson, Rockville, Conn., and ask for catalog 965-S1.

## Lafayette Spring Catalog

If you haven't gotten Lafayette's new Spring catalog, number 663, be sure to write them and ask for a copy. Address is 111 Jericho Turnpike, Syosset, L. I., N. Y. 11791.




## Scientific Associates VHF Converters

The new Scientific Associates solid-state converters come in tunable and fixed frequency models for HF and VHF reception. An interesting feature is built-in squelch that can easily be connected to the receiver the converters are used with. They come in many models at prices from $24 to $35 and you can get details from S.A., P.O. Box 276, S. Glastonbury, Conn.

## Mosley Lancer

Mosley's new Lancer 1000 2 kw mobile five band antenna offers a lot of features to the ham. It's made of stainless steel, and uses interchangeable coils for all bands but ten, which is fed direct. If all coils are bought together, they come in an attractive coil caddy for easy, safe storing. For more information, write Mosley at 4610 Lindbergh Blvd., Bridgeton, Missouri 63042.

### GE Compactron Catalog

GE Compactrons have made quite a mark in the TV industry. As usual, this has brought many dividends to hams. The small, reliable, multi-purpose Compactrons have many ham uses—and are being used by many ham manufacturers and ham builders. An interesting catalog of Compactrons and their advantages over other tubes is the new GE publication ETG-3983, which you can get by writing GE, Schenectady, N. Y.

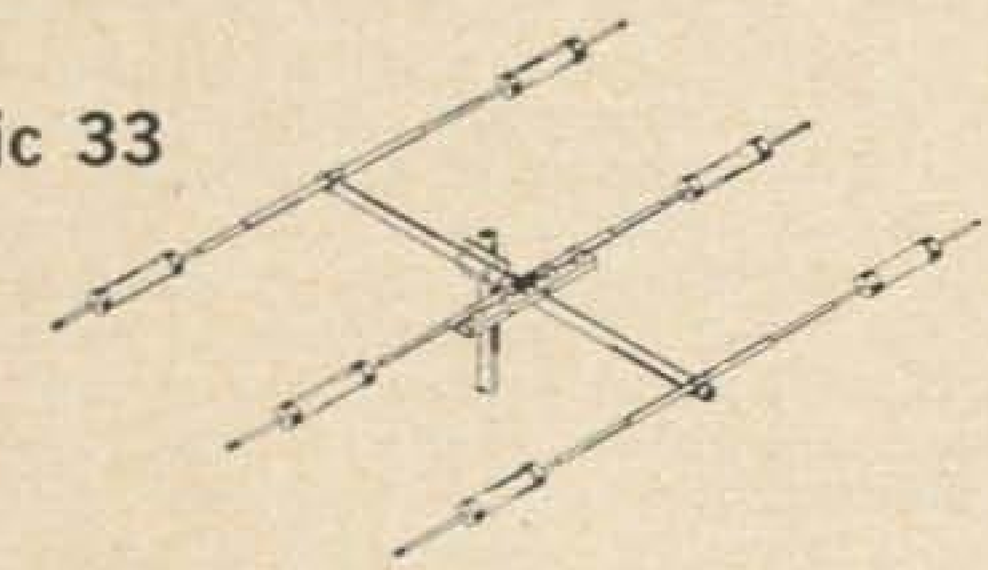
### National Reduction Drives

National Radio has recently announced a new line of 10:1 and 5:1 ball reduction drives that require only one inch-ounce input at no load, but can transmit outputs of 35-40 in-oz. They're smooth and virtually back-lash free. For more information on these drives, please contact National Radio, 37 Washington St., Melrose, Mass. 02176.

### GE Semiconductor Guide

The new General Electric Semiconductor Almanac is a must for servicemen and experimenters alike. Under the slogan, "A few will do," GE has devised a cross index to all sorts of transistors, diodes and other components, that tells you which of the readily available GE Universal Replacement Transistors will replace which other transistors, etc. Like the RCA SK-line, these transistors (GE-1, GE-2, etc.) are a little more expensive than some others you can use for similar applications, but unlike other transistors, are available at most distributors. Get your copy of the almanac at your local distributor.

### Mosley Classic 33



Mosley's new Classic 33 triband beam is their newest addition to the Trap-Master family. The Classic will handle 1 kw AM/CW or 2 kw PEP SSB and features a new type of matching developed by Mosley, "Broad Band Capacitive Matching." The beam features a long boom for excellent gain and assembled weight is only 60 lbs. For more information, write Mosley, 4610 North Lindbergh, Bridgeton, Missouri 63042.

advised by my lawyers that
don't you ever proofread y
are a bunch of crooks and
this is the last straw for
have no other recourse but
should be tarred and feath

# Letters

Dear 73:

I am not a V.H.F. man, but I do know my math! Your illustrator shows the curvature of the parabolic reflector ("Design of Parabolic Reflectors", February, 1966) as being greatest at the ends.

The curvature actually decreases as the distance from the axis is increased, since the curvature is proportional to $1/(z^2)$, which also decreases.

It makes no difference in the actual construction, of course, so long as one sticks to the equations given, but some of your readers may be worried if their dishes don't look like the illustrations!

Please excuse the criticism, but as a teacher of Engineering Graphics, I guess I'm a bit fussy about accurate drawings!

**Mike Guérard WA5JMY**
**Bryan, Texas 77801**

Dear 73:

Lately I've seen the concept of "noise figure" and "noise factor" treated loosely; however, I have had no objections because, in general, most readers gain additional insight to the general concept of noise (whether it is generated externally or internally to a receiving system) and how it effects receiving sensitivity. But I must object to the February 1966 article "Noise Considerations in a Preamplifier". Author Nelson has fallen into the trap many do in interpreting the equation for determining overall noise figure when adding a low noise preamplifier to a receiver.

The expression $NF\ overall = NF_2 + \frac{NF_1 - 1}{G_2}$ is correct. However, NF overall, $NF_2$, $NF_1$, and $G_2$ cannot be used in decibel form in this equation! These terms must be in factor form. Subtracting the factor 1 from $NF_1$ expressed in decibels is like trying to subtract apples from oranges.

The expression $NF\ overall = NF_2 + \frac{NF_1 - 1}{G_2}$ the terms should be redefined as follows:

NF overall = overall noise *factor*
(overall noise *figure* = $10\log_{10}$ NF overall)
$NF_1$ = noise *factor* of the original system
(noise *figure* of original system = $10\log_{10} NF_1$)
$NF_2$ = noise *factor* of the preamplifier
(noise *figure* of preamplifier = $10\log_{10} NF_2$)
$G_2$ = absolute power gain of preamplifier
(decibel power gain of preamplifier = $10\log_{10} G_2$)

In the example problem as given in the article, if noise *figure* of original system = 11db then noise *factor* of original system = 12.6. Also if noise *figure* of preamplifier = 5db then noise *factor* of preamplifier = 3.16 and, if power gain of preamplifier = 10db then absolute power gain of preamplifier = 10.0. Therefore,

overall noise *factor* (NF overall) $= 3.16 + \frac{12.6-1}{10} =$

$3.16 + 1.16 = 4.32$ And, overall noise *figure* $= 10\log_{10} 4.32 = 6.35$db

Just because the author obtained 6db by using the equation incorrectly, the reader must not be misled in believing that the difference between the correct method and the incorrect method of calculating overall noise figure is always small. A few sample problems will soon convince the reader of this.

**Robert L. Eison**
**Ventura, Calif.**

Dear 73:

Jim Kyle's "Full Story on Low Pass Audio Filters" in the March issue of 73 was doing fine until he wandered off on the problems of impedance matching (the right hand column of page 94). In the first place he started out to design a filter with a 470 ohm characteristic impedance and then decided to feed it from a 500 ohm source. This is not too bad a mis-match but the idea of isolating the source from the filter is really wild. The idea is to match the source to the filter. This may be done in this case most easily with a minimum loss matching pad. In this case going from a 500 ohm source to a 641 ohm load he should have placed a shunt resistor of 1067 ohms across the 500 ohm source and a 301 ohm resistor in series with tthe 641 500 ohms and the load will be driven from an effective 641 ohm source. The loss of this arrangement will be only 4.346 db rather than the 44 db mentioned in the article. The 44 db loss mentioned in the article is about 9,500 times as much power loss as is obtainable with the above mentioned minimum loss matching pad.

Keep on coming with the good technical and construction articles as 73 is about the only source left among the ham journals for such a profuse supply. The table of contents for one issue of 73 will beat the annual index of the other brands.

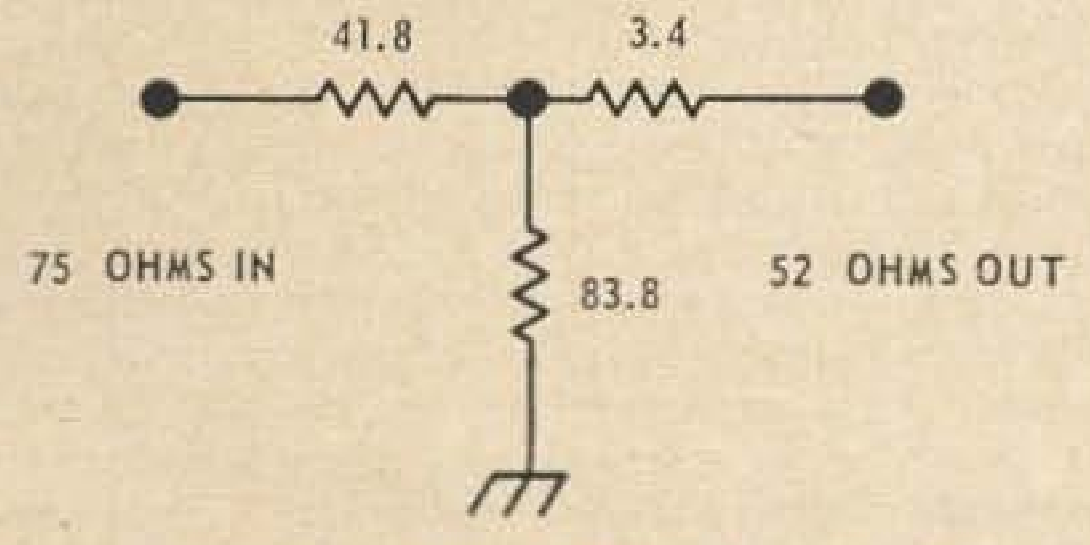
**John I. Sheetz K2AGI**

Dear 73:

Just a word of appreciation for your magazine. It gives a fresh atmosphere of imagination and originality (and controversy!) in what had become a rather stilted and dull field of technical journalism.

Your articles are always interesting, but occasionally an author gets a bit careless with his slide rule. For instance, "Seeing your SWR" in the February issue offers a new and interesting approach to a perennial amateur problem. However, on page 68, Fig. 6, the values given for the 6 db pad appear to be in error.

For matching a 75 ohm generator to a 52 ohm load with 6 db of insertion loss the values shown below appear to satisfy the conditions:




This error doesn't detract from the usefulness of the article but if someone tried to use the pad he might be disappointed in its performance for anything like precise tests.

**Jim Sprong K1YZP/1**
**Roselle, N.J.**

Dear 73:

I would like to thank you for publishing the tongue-in-cheek article "Historical Note" by Ray Thrower WA6PZR, in the March issue of 73.

It takes me back to the days of my youth when my two ambitions in life were to be a Ham, and to be the male vocalist in an all-girl band.

Even in those days I was interested in Broad Bands.

**W. H. Rocholl W5ZXZ**

## Corrections

**In VU2NR's transistor receiver in the February issue, each coil L4, L5, L6 should have a grounded center tap.**

**In the February issue, page 102, "Semimodernizing Vibrator Power Supplies," the center tap of the transformer should not be grounded or poof!**

## INSTITUTE OF AMATEUR RADIO MEMBERSHIP APPLICATION

(Use separate sheet if desired)

Name . . . . . . . . . . . . . . . . Call . . . . . . . . . . .

City . . . . . . . . . . . . State . . . . . . . Zip . . . .

. . . . $5 for 1 yr. IoAR Membership.

. . . . $2.50 for 1 yr. IoAR Student Member.

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. . . . I am a new Member of IoAR. Age . . . . .

. . . . I am a Charter IoAR Member and desire to have my membership continuous.

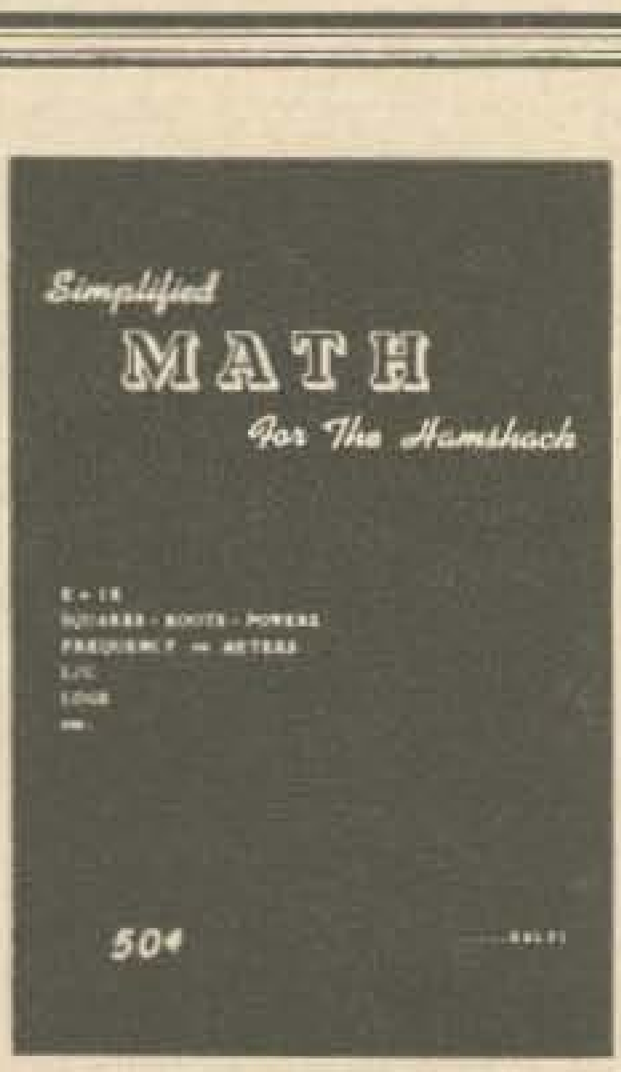
. . . . This is a renewal of 73 but a NEW IoAR Membership.

Please send check or money order (cash sent at sender's risk) to:

**Institute of Amateur Radio, Inc.**
**Membership Department**
**Peterborough, New Hamp. 03458**










Dear Wayne,

In your January issue you mentioned the UFO enigma. That's been a pet interest of mine for years. In November of '53, the first year the 15 meter band was opened up for phone operation, I conducted the first known UFO seminar on the ham bands on this subject. We met every day at noon California time. There were several regulars who called in daily, some of whom are now among silent keys. These included W6ZZ (deceased) W6BD (deceased) W6IJU, W6OZC (deceased) several other W6's, and many persons from Texas, the east coast, the midwest, Canada, Hawaii, South Africa, Mexico, and occasionally Chile. Many persons told of personal sightings of these strange objects. There was sufficient interest in this topic that the discussion would run for hours daily. I had a tape recorder and whenever a person who was not being copied by other interested parties told a personal sighting story, I would tape record his offering and play it back for the benefit of those who missed it. This discussion group ended late in December when 15 meters became so useless as to become simply a ground wave band. Some interest was revived when the band started opening up again late in February and in March, but by that time many persons in the discussion group had read some of the personal contact stories that were then beginning to appear in book form for the first time and so the subject of personal sightings seemed too tame to hold their interest to a degree necessary to perpetuate the old discussion.

I went further. Being located in California where eccentric stories were more easily told from the platform than in other sections of the U.S., I went to hear some of these contactees such as Truman Bethrum, Orphio Angelucci, George Adamski, Dan Fry, and others, tell their stories in person. I have heard some of them speak twice and three times just to see if they would change their stories. They did not. Naturally, their stories lead the interested to investigate other fields touched upon such as telepathy, reincarnation, and other strange or rather not understood phenomena and I did this too. It seems that after a while one finds himself so bogged down in a metaphysical quagmire of speculation and half truth that he realizes the full truth that one can only accept that which is his own personal experience. The rest of man's knowledge with which he copes during his lifetime is borrowed only to stimulate these experiences. It is said by those who have claimed contact with these beings that telepathy is the means of communication which they employ between their craft and their home planets and that they can indeed, converse across the entire universe. "Time and distance are no barrier" says Remu in George Adamski's book INSIDE A SPACE SHIP. But I cannot confirm this from my own experience and therefore cannot answer your question posed in the January issue.

**Donald R. Farnsworth WØJYC**
**Florence, Colorado 81226**

Dear Wayne:

The "gravity-detector" that I have been using for a test of some 40 hours during the past few days would respond to dots and dashes of the morse code if gravity could be controlled in like manner.

In other words if the gravity force was broken up into dots and dashes my "detector" would respond at perhaps 15 or 20 wpm.

Gravity is believed to have a very-very high frequency, way beyond what any detector that we know of would respond to.

The gravity particle (graviton) is supposed to have a wavelength of $6.75 \times 10^{-14}$ cm. and a frequency of $4.54 \times 10^{23}$ cycles per second, a mass of $3.351 \times 10^{-24}$ grams and a volume of $6.3 \times 10^{-12}$ cm$^3$. So figure it out, what kind of a circuit and equipment you would use.

We do not know as yet how to vary the gravity field. The earth does it, but we want something much smaller than that.

**Thomas Appleby W3AX**

**Dear 73:**

How did that CB'er get on the cover of the March issue of 73? He really gets out—I've heard him around here several times—at least somebody who sounds as he looks.

Maybe he's about to get converted—at least he reads a good magazine.

**Jim Hornaday**

**Dear 73:**

In the March 1966 issue of 73 on page 112, Mr. Irwin wrote that he was not a licensed ham (maybe he's an unlicensed one, hi) just because of his attitude toward CW. Also, he wrote he didn't even like the frequency allocations for such. Sounds like sour grapes is written between the lines. And I'd like to see the figures on which he based his statement that "the majority of hams can't and don't use CW." Maybe Mr. Irwin would be happy as a CB'er.

But what really bothers me was that Mr. Irwin had the nerve to ask for "more articles for the SWL and less articles on Xmiters and amplifiers." I don't think he ever noticed the two words that appear regularly on the covers of 73 (to the right of the numeral) that clearly spell out the type of material to be found between covers and specifically for whom. If he wants to read about SWLing, he can read Popular Electronics.

The best thing about 73 is that there is plenty to it. With all the ads in QST, you'd think the ARRL could run a better magazine. 73 to 73.

**T. Victor Mukai WB2STR**

P.S. Was there some special reason for printing Mr. Irwin's letter?

*No.*

**Dear Wayne,**

The story by KØJXO in February intrigued me. The day after my copy arrived, I received one dozen surplus crystals, all marked "400 kc." Ten turned out to be good oscillators. These were checked with a standard oscillator (32 pf input capacity) and a frequency counter. The same variations mentioned were experienced here.

One crystal was within 2 cycles. The rest were off by at least 50 cycles, and in some cases as much as 200 cycles. Average reading was 400,102.4 cycles. This variation might not sound like very much, but when we tried to check the crystal harmonics with WWV, 90% of the crystals were way "out."

For testing, we used only first-class, fixed components, plus an electronically regulated plate supply. Raising the plate voltage from 130 to 195 volts (50%) changed the frequency by only 4 cycles—or 1 part in 100,000. We were able to effect a 30 cycle change in frequency by shunting an additional 50 pf capacitor across part of the grid circuit.

Two conclusions stand out from these tests. One, you can't trust what the label says, as previously stated. Two, you can get a very high order of frequency stability from a properly tuned crystal oscillator, even without the need for a regulated supply voltage. All the crystals were type FT241-A, but it would seem these random frequency characteristics would apply to any given lot of crystals.

**Neil Johnson W2OLU**
**Tuppan, N.Y.**

## A Simple Damp Chaser

Is dampness in your rig causing drift and component damage? Try connecting a 6 watt bulb across the on-off switch. Put the bulb near the most critical components to keep them warm and dry. If you don't like the light, paint the lamp with aluminum or other heat resistant paint.

. . . K4GRY

## FOREIGN DEALERS AND RATES

A year of 73 costs $4 worldwide. Foreign hams can pay in their local currencies direct or order through the national dealers listed below:

**Australia**
McGill's News Agency
183 Elizabeth Street
Melbourne, Victoria

**Finland**
Akateeminen Kirjauppa
Keskuskatu 2
Helsinki

V. J. Velamo OH2YU
Isokaari 4-B-30
Lauttasaari
Helsinki

**Germany**
Richard Beeck
Am Schiffgraben 57
Hanover

**Great Britain**
Jim Coote
56, Dinsdale Avenue
Kings Estate
Wallsend, Northumberland

RSGB
28/30 Little Russell Street
London, WC1

Short Wave Magazine
55 Victoria Street
London, SW1

**Netherlands**
VRZA
P. O. Box 190
Groningen

**New Zealand**
NZART
P. O. Box 5545
Auckland

**South Africa**
SARL
CTM Building
112, Loop Street
P. O. Box 3911
Capetown

**Sweden**
Per Bergstrom SM7CKJ
Box 608
Lund,

**Price for one year of 73 in foreign currencies**

| | |
|---|---|
| Austria: 104 OS | Japan: 1440 yen |
| Australia: $A 3.50 | Mexico: 50 Pesos |
| France: 20 NF | Netherlands: 17.50 |
| Finland: 14.2 FM | New Zealand: £1/6 |
| Germany: 16 DM | Norway: 28.50 NKr |
| Great Britain: 28/6 | South Africa: R 2.85 |
| Italy: 2500 lira | Sweden: 20.80 SKr |

**73 Magazine**
**Peterborough, N.H. 03458, USA**

# Caveat Emptor?

★ Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

★ Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

★ We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

★ For $1 extra we can maintain a reply box for you.

★ We cannot check into each advertiser, so Caveat Emptor . . .

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**BC** 348—Double conversion—miniature tubes with power supply, new panel. Diagram included—$15.00. Two new 4CX250K tubes with home brew socket—$10.00. J. E. Richardson, Box 54, Pottstown, Pa. 19464.

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**WANTED:** Hammarlund HQ-180 buy or trade coins of equal value. Send for list. Walter Jandro, 473 Success Avenue, Bridgeport, Connecticut 06610.

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**WANTED!**—Cash or 6 meter transceiver for HQ-100, Globe Chief, R.M.E. S.S.B. receiving converter, Tapetone 2M. conv, Signal Sentry, Walkie Talkies etc. K1PIC S. Feldman, 31 Goodale Rd., Boston, Mass.,

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**RTTY GEAR** for sale. List issued monthly. 88 or 44 Mhy toroids five for $1.75 postpaid. Elliott Buchanan, W-6-VPC, 1067 Mandana Blvd., Oakland, Calif. 94610.

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**HEATH HW-22** 40M SSB transceiver in excellent condition, professional wiring, will ship, $100. A. Duddles, WB2NJX, 505 Rockland Ave., Mamaroneck, N.Y. 10543.

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**SPRING AUCTION** of the Rockaway Amateur Radio Club will be held Friday evening, May 13th. at 8:00 P.M. at the American Irish Hall, Beach Channel Drive (at Beach 81st. Street), Rockaway Beach. Come to the best Auction in the New York area. For detailed directions write to: P.O. Box 205, Rockaway Park, N.Y. 11694.

---

**DIODE STACKS.** 4000 volt PIV, 1 amp 3¼ x 1¾ x 1. Beautiful insulated plastic blocks with terminals and mounting holes. Physical rejects, TESTED. Four required for full wave 1500 VDC supply. $3.20 each postpaid. Send for list of many other diode and transistor bargains. WA3ACL, 120 Chapel Knoll, Pittsburgh, Pa. 15238.

---

**PLATE XMFR**—120v, 60 cy. pri. Sec. 850v C.T. @ 200 ma. 3000v test. Sealed. Mtg studs. Stand-off terms. Wt. 8 lb. Free list of more good xmfrs. A.R.C. Sales, P.O. Box 12, Worthington, Ohio.

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**75S-3, 32S-3, 516F-2, 312B-4, SM-1 Mike, SB-200** Amplifier, HO-10 Monitor scope, TA-33 Sr., CDR TR44, Low pass filters, etc. Will sked on any band. Prefer package deal. Only serious offers will be acknowledged. K1VCB Fern Belanger, 61 Lafayette Street, Fall River, Massachusetts 02723.

**QRZ:** RME 4350-A, w/spk. $110.00. Knight T150-A $65.00. Both very clean. Twoer, one year old $45.00. WB6PME, Chuck Evans, 2014 Enslen Ave., Modesto, California.

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**RCA VIDICON 7735A.** 15.00, Heath test equipment, 432 KW, Telrex 2 Meter system, 2 meter transmitter, 6 meter converter, 432 grid dip meter, Radar sentry, UHF converter, 2 meter linear, 432 converter and preamp, 2 meter halo; Andrew's HO 7/8" Heliax-Coax, CDR rotor, Tube tester, HO-13 plus more, write for list; Wanted: HP-24, HP-23, IM-30, HO-10. Stan Nazimek WB2GKF, 506 Mt. Prospect Ave., Clifton, New Jersey 07012.

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**COLLINS** KW-1 Deluxe 1000 watt phone/cw transmitter $1200.00. Cost $3850.00. Want Collins 312B-4 or 312B-5 station control. George Norton, W4EEE, Georgia University Station, Athens, Georgia. 30601.

---

**TRANSISTORS:** U-Test-Em—100 assorted for $2.50. Postage paid in U.S.A. No C.O.D. Star Sales Company, 404 West 38th Street, Wilmington, Delaware 19802.

---

**$200 TAKES:** Collins 32v-1 transmitter; homebrew kilowatt; National NC-88, Heath Q-multiplier; Gonset G66B receiver, G77A transmitter, modulator, mobile/fixed P/S. WBRS, Brandeis University, Waltham, Massachusetts.

---

**MAKE** your own bifilar filament choke. New use for our famous Toroid Balun Kit. $5.00 plus 40¢ postage. Ami-Tron Associates 12033 Otsego Street, North Hollywood, California 91607.

---

**SB-300** bought 2/2/66. Perfect condition and accurate calibration with no scratches. $255 or best offer. Driggs WA8OMP, 1807 Riverhill, Columbus, Ohio

---

**COMPLETE HAM STATION.** HT 40xmtr. SX 140 rcvr. Both factory wired. Many extras. All in excellent condition. Best offer. WB2RBK, 30 Sunset Blvd., Massapequa, N.Y. (516) Py 8-4313.

---

**HEATH SHAWNEE** six meter transceiver. Mobile mount, all cables. $150 or best offer. K2RFO Bruce Ryan, 106 Lynhurst Avenue, North Syracuse, N.Y. 13212.

---

**DRAKE T4X** $280, R4 Receiver $280, MS4 Speaker, power supply $45. Bought new 11/65. Ray Conway, 2012 No. 6th St., Burbank, California VI-93720.

---

**HEATHKIT HA14 KILOWATT** mobile amplifier $90, HP14 DC supply $80. Professionally assembled 10 hours use. Vietnam orders. M/Sgt R. H. Odom, 1410 Converse Ave., Fayetteville, N. C.

---

**HEATHKIT MOHAWK RECEIVER.** Like new. Used less than 100 hours. Excellent for SSB, CW, and 'phone. $175. Sanford E. Lery, 478 Jeannette Drive, Richmond Heights, Ohio. 44121.

---

**CLEGG ZEUS.** Excellent condition. Low Price. WBZCUD. 201-756-8340. Collin Deokin, 1424 Clinton Ave. South Plainfield, New Jersey. 07080.

---

**HALLICRAFTERS S76 RECEIVER.** In good condition. $50. Contact WB2KDH OL5-7812 Bx. N. Y.

---

**HRO-60, GLOBE HIBANDER** with VFO Gem 6 Meter Conv. All for $300. W. Carroll, 15 Whittier Lane, Oakland, N. J.

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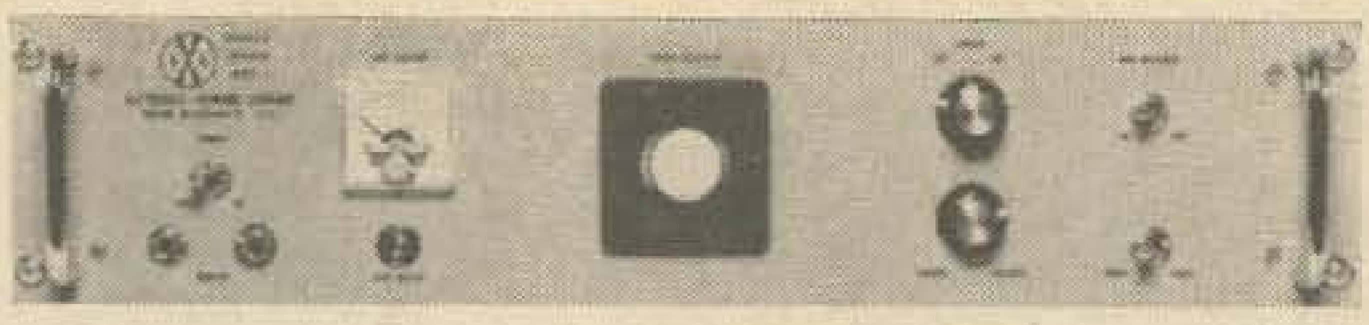
**NORTH DAKOTA STATE UNIVERSITY** Amateur Radio Society. Annual Hamfest on the NDSU in Fargo, North Dakota, on May 8, 1966. Write WØHSC for more information.



## ALLTRONICS-HOWARD MODEL L RTTY CONVERTER

Telewriter Model "L" frequency shift converter designed for two-tone AM or FM with limiter operation available by switch. Solid state ratio corrector compensates for fading signals. Permits copying on Mark or Space only. Selector magnet dc loop supply built-in with bias supply and octal socket for optional polar relay to key transmitter. 6W6 keyer tube. Plug-in discriminator for 850 cycle or other shifts. Cathode ray or dual eye indicator. Auto-start control system optional. Prices for 19" rack mounting: Model "L" with dual eye $199. Model "L" with C. R. tube indicator $279. Cabinet $19.50

**ALLTRONICS—HOWARD CO.**

**Box 19, Boston, Mass. 02101. Tel. 617-742-0048**

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40-20-15-10 meter. 54-ft. (best for swl's) Complete .. $16.95

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60 cy pwr sply: $30. SSB product detector: ....... $20.

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**P.U.R.** for tuners 975-2200 and 2175-4000 mc.
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**Phone: Area 213, office 272-5707, messages 275-5347**

**WANTED** Goldkit thriller transceiver. Cheap. Box 110 Charleston, S. C.

**WANTED:** British EL37 DX Transmitter. Box 49, Charleston, S. C.

**WANTED:** El 37 British DX Transmitter. Box 47, Charleston, S. C.

**QSLS?** Samples 25¢. Sakkers, W8DED, Holland, Michigan.

**HIBANDER** 682. Very good. $75. Sixer/12v P.S. $45 PPD. F1-1 Clipper $8. Ameco CCS/144 2M Converter and P.S. $25 WA8XF, 715 Harvery St., Petuskey, Mich.

**AUCTION IN BROOKLYN, PRIZES,** Sunday, May 15th, Noon-6PM at the Sgt. Meyer Levin Hall, 1628 East 14th Street. For more information call 771-5852.

**PRE-STARVED ROCK HAMFEST** Dinner Dance. Streator Ill. June 4, 7:00 P. M., Tickets $3.50 Each. Must have reservations by May 21. Contact—WN90MG, Myles Van Duzer, Route 1, Streator, Ill. 61364.

**LANCASTER OHIO HAMFEST.** Swap and Shop. Sunday, June 19. Fairfield County Fairgrounds. Bring your gear to sell or trade. Food, Prizes, Meet your friends.

**WESTERN ILLINOIS RADIO CLUB HAMFEST** June 19, 1966. Door prizes and entertainment. Tickets $2, advance, $2.50 at gate at Eagles Alps, Quincy, Illinois. Obtain tickets from Pat Hardin, 2040 Payson St. Quincy, Illinois. 62301. Phone 223-8177 code 217.

**HEATHKIT SB-300E,** brand new, with assembly manual. Expertly assembled and precision aligned, with CW crystal filter installed, $285. R. Goodwin, W50JX, RFD 2, Box 70, Carriere, Miss. 39426.

**APACHE:** Good condition, $110. Graduating senior and must sell. Ed Guida, 556 VMI, Lexington, Va. 703-463-3343.

**KWM2A** s/n12706 516F 2 real clean $775. ADCOM 350-12 mobile supply new $75. Loudenboomer Linear w/pwrsply New $270. First check gets one or all. W5HBE Box 30241 Dallas, Texas.

**SAMCO QSL PRESENTS** "Proto-Call" for '66. Samples 10¢. Stamp-Ett 2x3 inch multi-purpose cards $1, hundred ppd. Samco, Box 203-C Wynantskill, N.Y. 12198.

**AUDIO FILTERS.** Low pass will remove everything above 3300 cycles before it reaches speaker. See the full story in 73 for March 66. These are 500 ohm units, unused top grade military surplus at $2 ea plus about 35¢ postage. Lock City Electronics Box O Freeland, Michigan 48623.

**WRL** blue book prices save money. Take 10% off these prices without trades. Apollo 700—$199.00; Zeus —$329.95; 75A4—$409.00; GSB100—$179.95; Communicator III-6m—$159.00; SX101A—$209.00; SR150—$389.00; Apache—$139.95; HW32—$119.00; DX100—$99.00; HQ100—$99.00; NCX3—$219.00. Hundreds more. Free List. LEO, WØGFQ, Box 919, Council Bluffs, Iowa.

**WANTED: MILITARY, COMMERCIAL, SURPLUS.** Airborne, Ground, Transmitters, Receivers, Testsets, Accessories. Especially COLLINS. We Pay Freight and Cash. RITCO POB 156, Annandale, Virginia Are 703-560-5480 Collect.

**FOR SALE:** R23/ARC5 190-550 KC Receiver, Good operating, $15.50. Also R445/ARN30 Tunable VHF late type Command Receiver 108-138 MC, Same Setup as Command sets, Good operating, with Schematic, $26.50. Also Aircraft Radio Corp T-13A VHF Transmitter 125-148 MCS, NEW with schematic $13.95. Also SRT14 synthesizer units 6, 8, 9, 10, 11A, 11B, 11C, new, with schematic $8.00 each, any three $6.50 each.—RITCO POB 156, Annandale, Virginia.

**TOP CASH PAID** for electronic test equipment as Hewlett-Packard, Tektronix, General Radio, Dumont, Boonton, all types of tubes, special purpose and receiving, transistors, Allen-Bradley resistors. Bring your gear. Plenty of free parking. Open 6 days weekly 9—5:30. Rex Industrial Electronics, 759 10th Avenue (nr. 51st St.) New York, N.Y. 10019. Telephone 757-1361.

**BC-221-T,** original Xtal, Cal. book, Modulated, AC Power Supply, extra set of tubes. $80.00 Money Order. Ted Dell W4BEX 1828 Highland Ave., Eau Gallie, Fla.

**SWL NEWS** is a magazine for ShortWave Listeners. Monthly, printed, photos, illustrations, articles etc. Sample copy 60 cents. SWL Publications, P. O. Box 9768, Kansas City, Mo. 64134.

**SIX METER SIDEBAND,** Heath SB110, new, perfect $290. Also NC303 immaculate, $260, with speaker, calibrator and converter. Contact WA8DQY/WB4CEV 2113 West Riverdale, Germantown, Tennessee.

**ART'S QSL'S** Samples 10¢. Art Bliss, 1829 N. Catalina St., Burbank, California.

**CONVERTERS** $10 and up. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them all now in our full page ad in this issue. Vanguard Labs, 196-23 Jamaica Ave., Hollis, N.Y. 11423.

**WE WILL PAY CASH:** Wanted, popular, late model unmodified amateur equipment. Highest prices paid for clean, good operating gear. Write Graham Radio, Dept. 10, Reading, Massachusetts.

**TECHNICAL MANUALS.** Signal Corp. Some of the available manuals R-390,A, SP-600, BC-610, I-177, TV-7, teletype manuals, test equipment. World's largest list 10¢. Quaker Electronics, Hunlock Creek, Pa.

**ARE YOU SINCERE?** Are you *really* looking for the best deal on a new or fully guaranteed used unit? Let us convince you with a specific quote that will *really* save you money. Graham Radio, Dept. 10, Reading, Massachusetts.

**FT-243 CRYSTALS:** 0.1% setting $2.00 each, ±2 kc setting $1.00 each. 3000-8700 ks. Denver Crystals, 776 South Corona, Denver, Colorado 80209.

**DAYTON HAMVENTION** April 16, 1966—Everyone welcome at the Dayton Amateur Radio Association's 15th annual Hamvention, Wampler's Ballarena, Dayton, Ohio. Come and participate in the technical sessions, forums and banquet. See new equipment exhibits. Take part in "Home Brew" contest and hidden transmitter hunt. New this year Giant "Flea Market." Activities for the XYL. FCC general class examination at 09:00 Saturday. Exhibits open Friday evening. For information write Dayton Hamvention, Department F, Box 44, Dayton, Ohio 45401.

**NOW!** A publication devoted entirely to government surplus electronic equipment. Many schematics and other data each issue. Sample copy 25¢ or $3.00 per 1-year subscription. National Surplus Digest, P.O. Box 36, Sweet Valley, Pa.

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# Propagation Chart

## MAY 1966

J. H. Nelson

### EASTERN UNITED STATES TO:

| GMT: | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 14 | 14 | 7* | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| ARGENTINA | 21 | 14 | 14 | 14 | 7 | 7 | 14 | 14 | 21 | 21 | 21* | 21* |
| AUSTRALIA | 14 | 14 | 14 | 7# | 7# | ·7 | 7* | 7 | 7# | 7# | 14 | 14 |
| CANAL ZONE | 21 | 14 | 14 | 14 | 7 | 7 | 14 | 14 | 14 | 21 | 21 | 21 |
| ENGLAND | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| HAWAII | 14 | 14 | 14 | 7 | 7 | 7 | 7# | 14# | 14 | 14 | 14 | 14 |
| INDIA | 14 | 7# | 7# | 7# | 7# | 7# | 14 | 14 | 14 | 14 | 14 | 14 |
| JAPAN | 14 | 14 | 7 | 7 | 7# | 7# | 14 | 14 | 14# | 14 | 141 | 14 |
| MEXICO | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 |
| PHILIPPINES | 14 | 14 | 7* | 7# | 7# | 7# | 14 | 14 | 14 | 14 | 14# | 14 |
| PUERTO RICO | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 |
| SOUTH AFRICA | 14 | 7# | 7 | 7# | 7# | 14 | 14 | 14 | 14 | 14* | 14 | 14 |
| U. S. S. R. | 14 | 7 | 7 | 7 | 7 | 7# | 14 | 14 | 14 | 14 | 14 | 14 |
| WEST COAST | 14 | 14 | 14 | 7 | 7 | 7 | 7* | 14 | 14 | 14 | 14 | 14 |

### CENTRAL UNITED STATES TO:

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

### WESTERN UNITED STATES TO:

| GMT: | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 14 | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 7* | 14 | 14 | 14 |
| ARGENTINA | 21 | 21 | 14 | 14 | 14 | 7 | 7* | 14 | 14 | 21 | 21 | 28 |
| AUSTRALIA | 21 | 21 | 21 | 14 | 14 | 14 | 14 | 7 | 7# | 7# | 14 | 21 |
| CANAL ZONE | 21 | 21 | 14 | 14 | 14 | 7 | 14 | 14 | 14 | 21 | 21* | 21* |
| ENGLAND | 14 | 7# | 7 | 7 | 7 | 7 | 7# | 14 | 14 | 14 | 14 | 14 |
| HAWAII | 21* | 21* | 21 | 14 | 14 | 14 | 14 | 7 | 14 | 14 | 14 | 21 |
| INDIA | 14 | 14 | 14 | 14 | 7# | 7# | 7# | 7# | 14# | 14 | 14 | 14 |
| JAPAN | 14 | 14 | 14 | 14 | 14 | 7# | 7# | 7 | 14 | 14 | 14 | 14 |
| MEXICO | 14 | 14 | 7* | 7 | 7 | 7 | 7 | 7* | 14 | 14 | 14 | 14 |
| PHILIPPINES | 14 | 14 | 14 | 14 | 14 | 7# | 7# | 7# | 14 | 14 | 14 | 14 |
| PUERTO RICO | 21 | 14* | 14 | 14 | 7 | 7 | 14 | 14 | 14 | 14 | 14* | 14* |
| SOUTH AFRICA | 14 | 7# | 7 | 7# | 7# | 7# | 7# | 14 | 14 | 14 | 14 | 14 |
| U. S. S. R. | 14 | 14 | 14 | 14 | 7# | 7# | 7# | 7# | 14 | 14 | 14 | 14 |
| EAST COAST | 14 | 14 | 14 | 7 | 7 | 7 | 7* | 14 | 14 | 14 | 14 | 14 |

# Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

**Good: 1-3, 6-12, 14-16, 18-20, 25, 26**
**Fair: 22, 27-30**
**Poor: 4, 5, 13, 17, 21, 23, 24, 31**
**VHF DX: 2, 6, 7, 13-16, 24, 30**

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73 MAGAZINE DECEMBER 1965 for uses 'n' hookups.

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|---|---|---|---|---|
| 3 | ☐ 5¢ | ☐ 7¢ | ☐ 12¢ | ☐ 19¢ |
| 15 | ☐ 15¢ | ☐ 22¢ | ☐ 40¢ | ☐ 65¢ |
| 35 | ☐ 39¢ | ☐ 50¢ | ☐ 75¢ | ☐ 1.19 |
| **AMPS** | **400 PIV** | **600 PIV** | **800 PIV** | **1000 PIV** |
| 3 | ☐ 25¢ | ☐ 35¢ | ☐ 45¢ | ☐ 69¢ |
| 15 | ☐ 90¢ | ☐ 1.35 | ☐ 1.59 | ☐ 1.79 |
| 35 | ☐ 1.90 | ☐ 2.50 | ☐ 2.95 | ☐ 3.50 |

## 750 MIL TOP HAT AND EPOXIES

| PIV | Sale | PIV | Sale | PIV | Sale |
|---|---|---|---|---|---|
| 50 | ☐ 5¢ | 600 | ☐ 19¢ | 1400 | ☐ 95¢ |
| 100 | ☐ 7¢ | 800 | ☐ 29¢ | 1600 | ☐ 1.10 |
| 200 | ☐ 9¢ | 1000 | ☐ 51¢ | 1800 | ☐ 1.35 |
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FACTORY TESTED

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- ☐ 10 PNP SWITCHING TRANSISTORS, no test ,TO5 $1
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- ☐ 2—500MC, 2N708 NPN Silicon planar TO18 ..$1
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| | | |
|---|---|---|
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| ☐ 6V | ☐ 30V | ☐ 90V |
| ☐ 8V | ☐ 45V | ☐ 110V |
| ☐ 12V | ☐ 60V | ☐ 100V |
| ☐ 20V | ☐ 70V | ☐ 124V |
| ☐ 24V | ☐ 80V | ☐ 150V |

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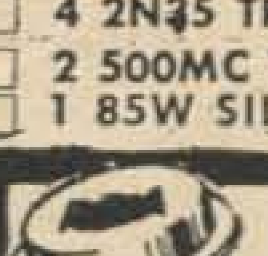

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## 750 MIL TOP HAT AND EPOXIES

☐ ☐ 1000 PRV **3 for $1.29**

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