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73 Magazine

1379 East 15th Street
Brooklyn 30, N. Y.

January, 1961
Vol. 1, No. 4

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COVER: W2MUM's Mosley beam as photographed by Joe Schimmel W2QDM.

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. . . de W2NSD

(Never Say Die)

WE'RE still completely embroiled in the mechanics of staying alive, worrying in turn about subscriptions, articles, advertisers, printing the next issue and (gulp) paying our bills. There are a few unavoidable diversions such as a chap who wanted us to help him get an FL8 license (he got it), a chap going to Zanzibar and wanted some gear (he got it), going to conventions (Miami on January 14th, Phoenix in May, etc.), talking to local clubs, fighting the flu (and losing), and trying to beat down a growing mountain of mail with my recalcitrant typewriter.

Helping Hands

A few fellows have really gone all out to let people know about 73 and to try to get everyone they knew or worked to subscribe. One of the most energetic is Ralph Morris, W1QUE of New Bedford, Massachusetts. Ralph sent in list after list of subscribers and put up his own money for the subscriptions, collecting it later from the other chaps.

Another bundle of energy is Don Smith, W3UZN, our Associate Editor down in Hagerstown, Maryland. There are many others that have helped tremendously too. Believe me we appreciate it and possibly might have not been able to get the magazine properly started without it.

If you are more interested in 73 and seeing it grow than perhaps just reading it over every month and then forgetting about it, then you can help. You can show it to your club members and talk them into subscribing. You can discuss our articles over the air and pass along our address to the interested. Maybe you'd like a sample copy sent to someone. . . just send us the name and address (we're printing a few extra these days for this). Perhaps you know one of the manufacturers who should be advertising in 73 and can pass a long some enthusiasm. You might be writing to a possible advertiser for some information and you could suggest that you'd like to see him supporting 73.

Most important of all are the advertisers who are presently supporting 73. They should be made rich and fat as a lesson to others. They will be very contented if you drop them a card asking for further information about their products. Before you shrug off the responsibility of this you should consider whether you like 73, whether you like the basic ideas which it represents, and if you think they are important enough you should take the time to help a bit. Please remember that though Brand X has five times our circulation the advertisers expect the same results . . . which means that the intrepid band of 73-ites has to be five times as active just to break even. Rally to the post cards, men.

Old Call Books

Few DX operators can afford to buy a Callbook. If you have one that is less than three years old that you would like to send to a DX ham then drop a card to Cliff Evans K6BX and he will send you a letter from a DX ham that would like to have your Callbook. K6BX, Box 385, Bonita, California. We think this is a wonderful service and extend our best regards to Cliff for his work.

Fearless Survey

Looking through the December issues of some of the more prominent ham magazines we find that the number of pages devoted to technical and construction articles runs about like this:

73 Magazine	33 pages
Brand X	28 pages
Brand Y	23 pages

Pacifists

Magazine reading is a pretty passive pastime and I suppose this has a lot to do with the tremendous inertia that I sense every time I suggest "doing" something. Like getting you to pepper the advertisers with encouragement or cast a monthly vote for the articles you like best.

How about taking an active interest? There are lots of things you can do. When you find a ham parts distributor that does not have any copies of 73 on the counter you could tell him about the magazine, suggest he order some counter copies, or drop me a card with his name and address so I can hound him about it. If you forget the address of the magazine just look up W2NSD in any Callbook.

Perhaps you know of some company that would do well to advertise in 73. If they have been advertising in other ham magazines you may be sure that I am after them . . . if not, then drop me a card with their name so I can send them information.

Now that home-brewing has dropped off to a shadow of its previous self we see few ads from component manufacturers. For that matter we see that many ham distributors have just about dropped their parts department. I hope that we can change the tide on this and revive a sweeping interest in home

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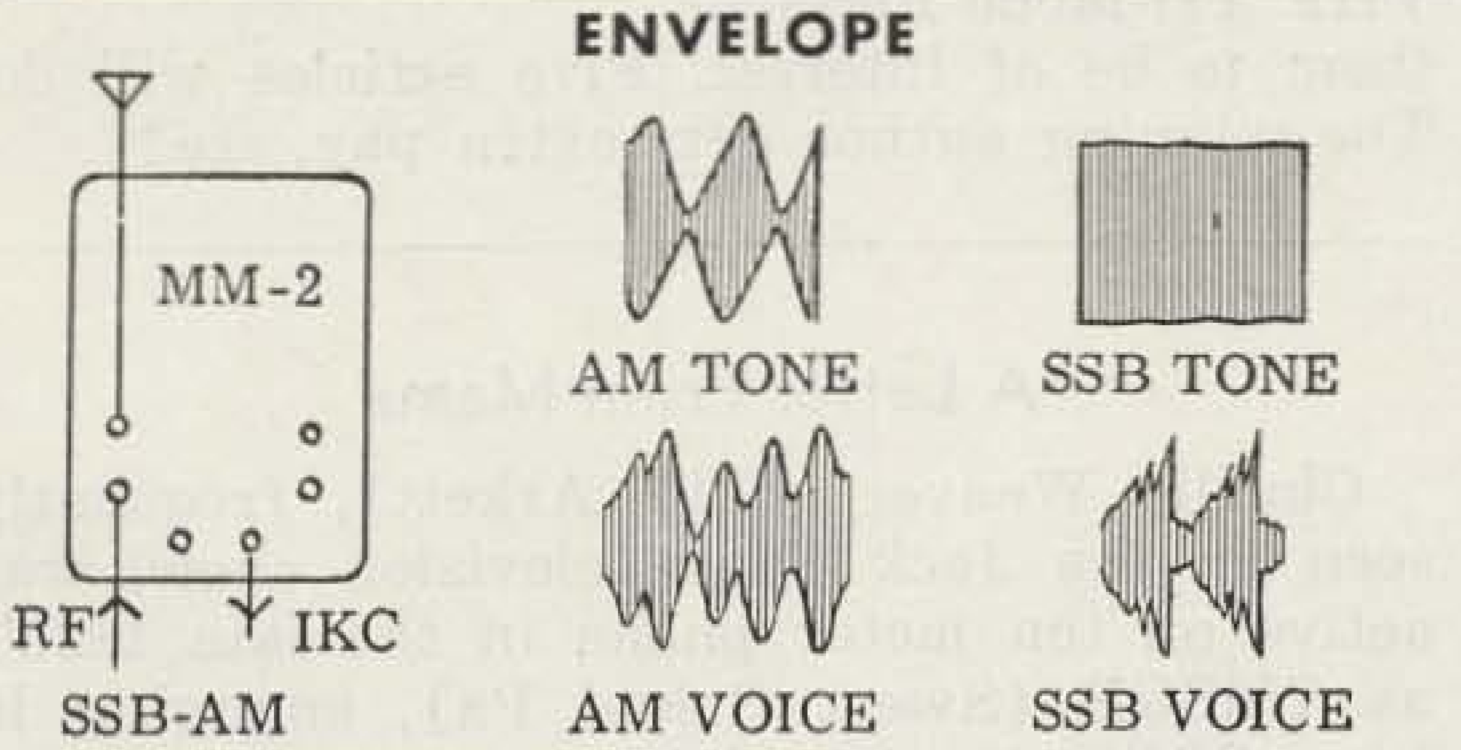
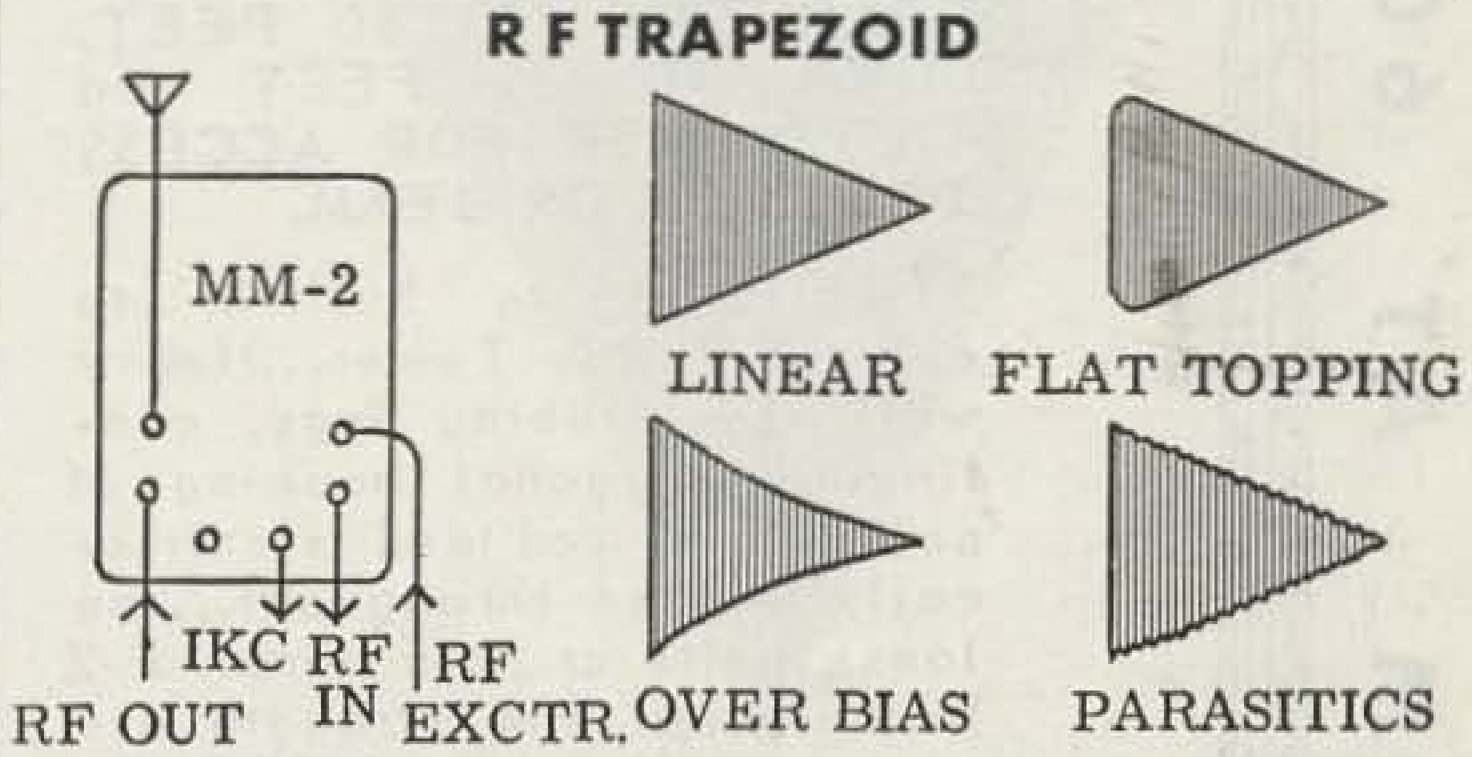


R F TRAPEZOID



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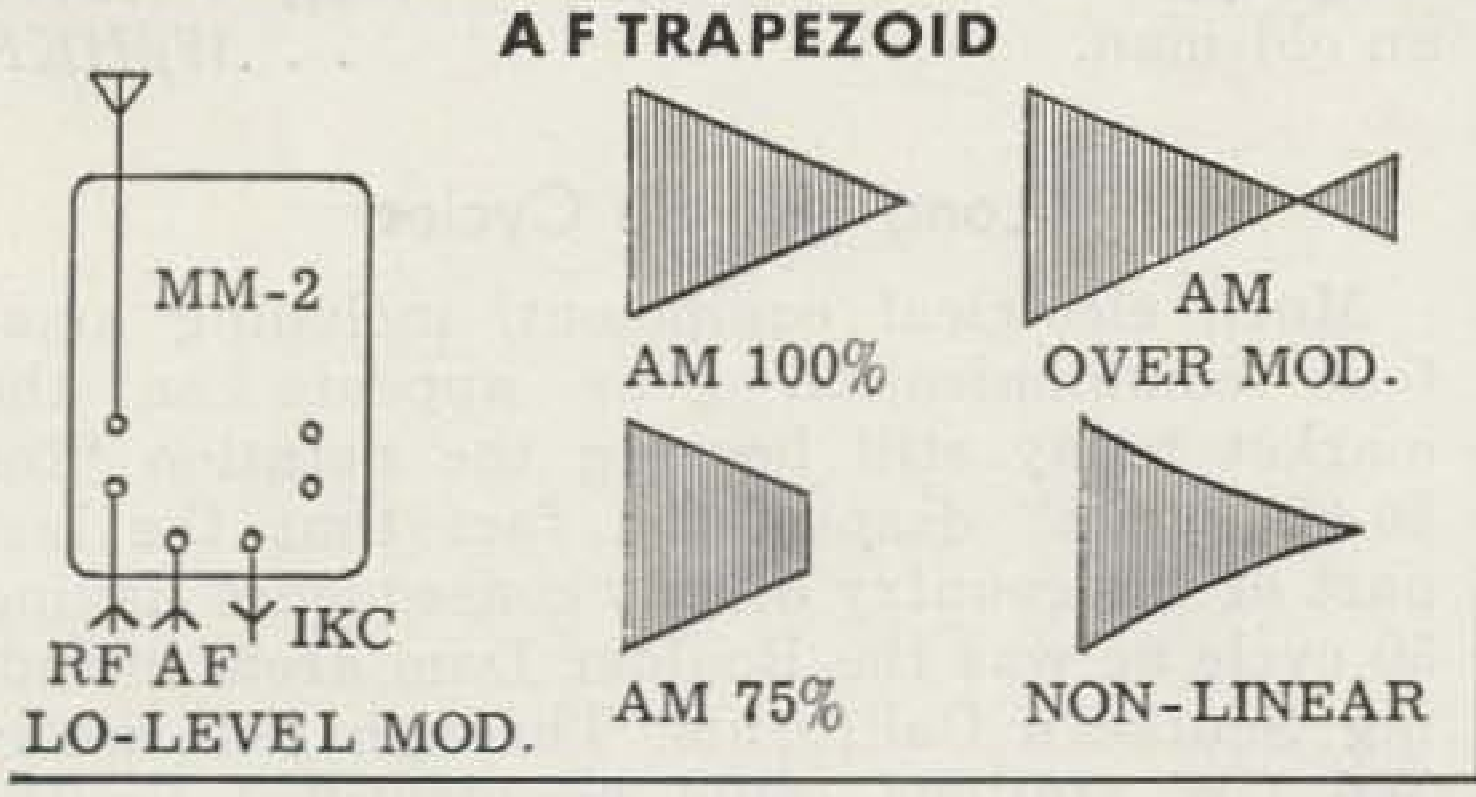

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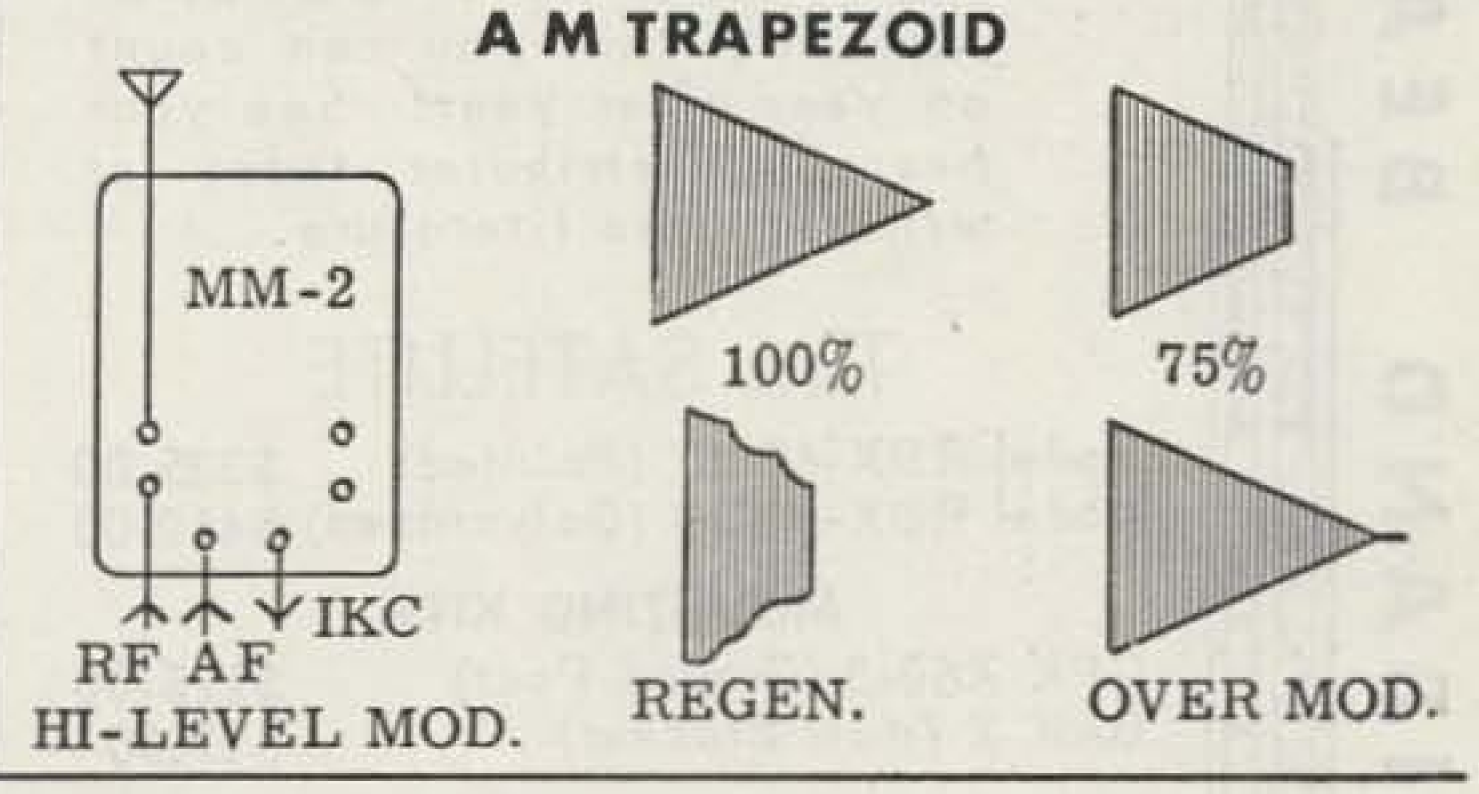

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construction. Whoops, there I go dreaming again. Why do I always try to make the world over the way I want it, including stiff battles with City Hall. If I had any brains I'd see that old handwriting on the wall and print what everybody wants: a magazine full of tests of commercial equipment which tell you how great each item is. Get away from me with that straight-jacket.

Which Do You Like Best?

The votes are in for the November issue and again we find that every article in the book received some first place votes (by other than their authors). The winner this month is Tom Sowers W3BUL and his Transistorized 10 Meter Converter. A check has been sent as the winning prize. In second place by only a couple of votes was Jim Kyle K5JKX/6 with his $5 Frequency Counter. Our technical article for the month on noise limiters placed third. Tied for fourth place were Bill Hamlin W1MCA's Improving the Performance of the Gonset III and John Wonsowicz W9DUT's VHF Tri-Mode Receiver.
them to be of interest. Five articles will do. The winning author gets extra pay, see?

A Letter From Mama

Charlie Weaver (Cliff Arkett), frequently seen on the Jack Paar television show, was active on ten meter phone in the late 1930's as W6SGP (Sweet Grand Pa), engaging in long QSO's in the high, quavering voice of an old man. . . .*WØHKF*

Long Live 50 Cycles

Much electrical equipment, including amateur communication gear appears on the market today still bearing the notation "for 50-60 cycles" despite the fact that the last part of the country of any consequence having 50 cycle ac was the Boulder Dam area, including Southern California. Through 1941 many W6 CW stations could be identified by the peculiar buzz on their notes resulting from the lower efficiency of their power supply filters at that frequency. The 50 cycle stuff did serve admirably as a standard reference for calibrating audio oscillators and frequency standards. . . .*WØHKF*

Lowering Crystals

If you're looking for different ways to *lower* the frequency of a crystal try sodium silicate, sometimes known as 'liquid glass.' Available in drugstores and hardware stores at very small cost, successive coats can be brushed on or washed off as the case demands.

. . .*WØHKF*

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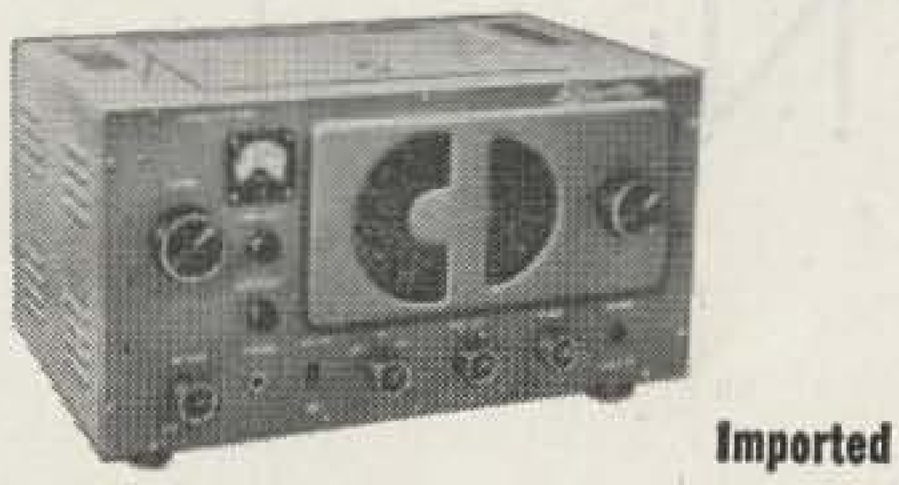

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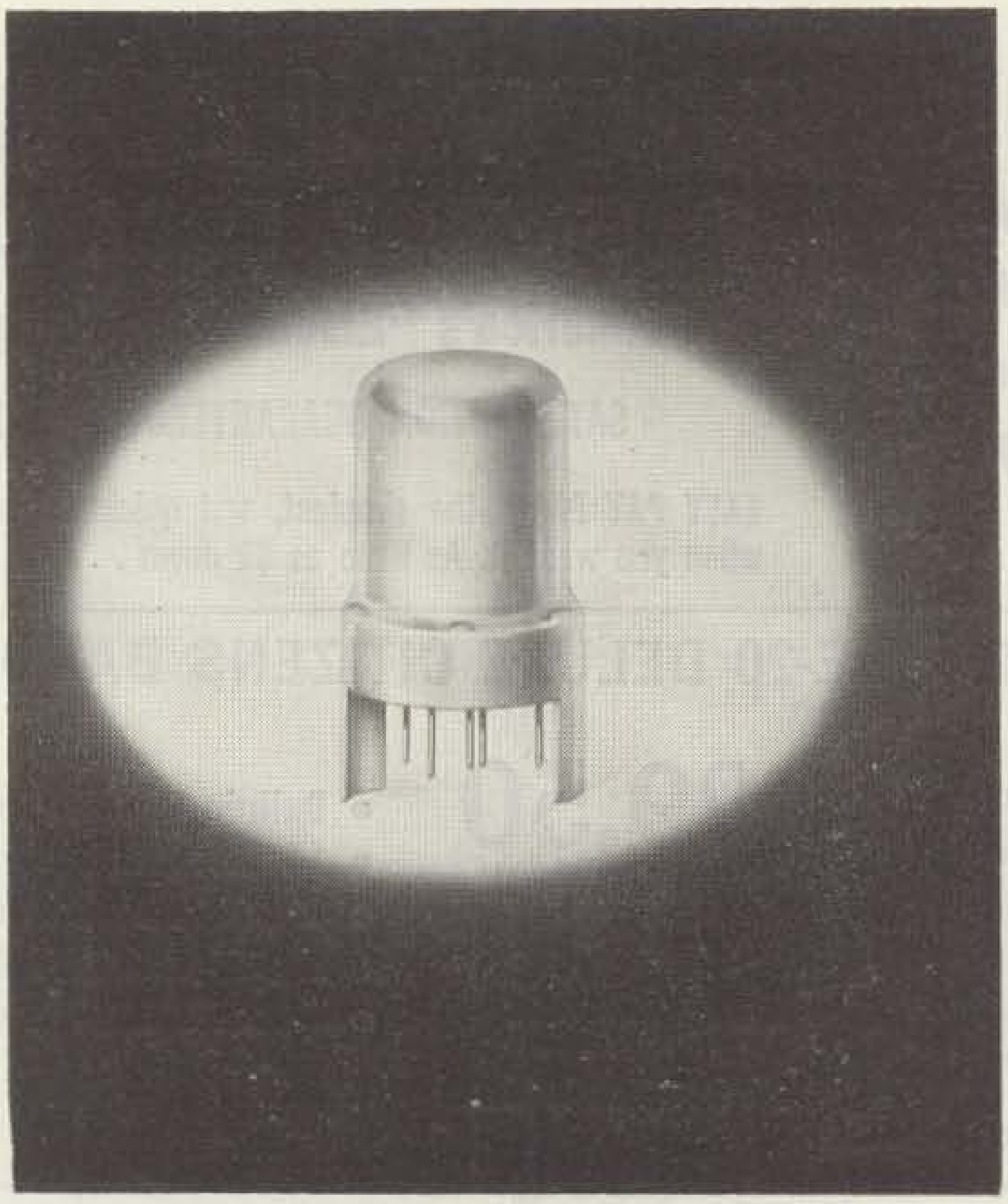
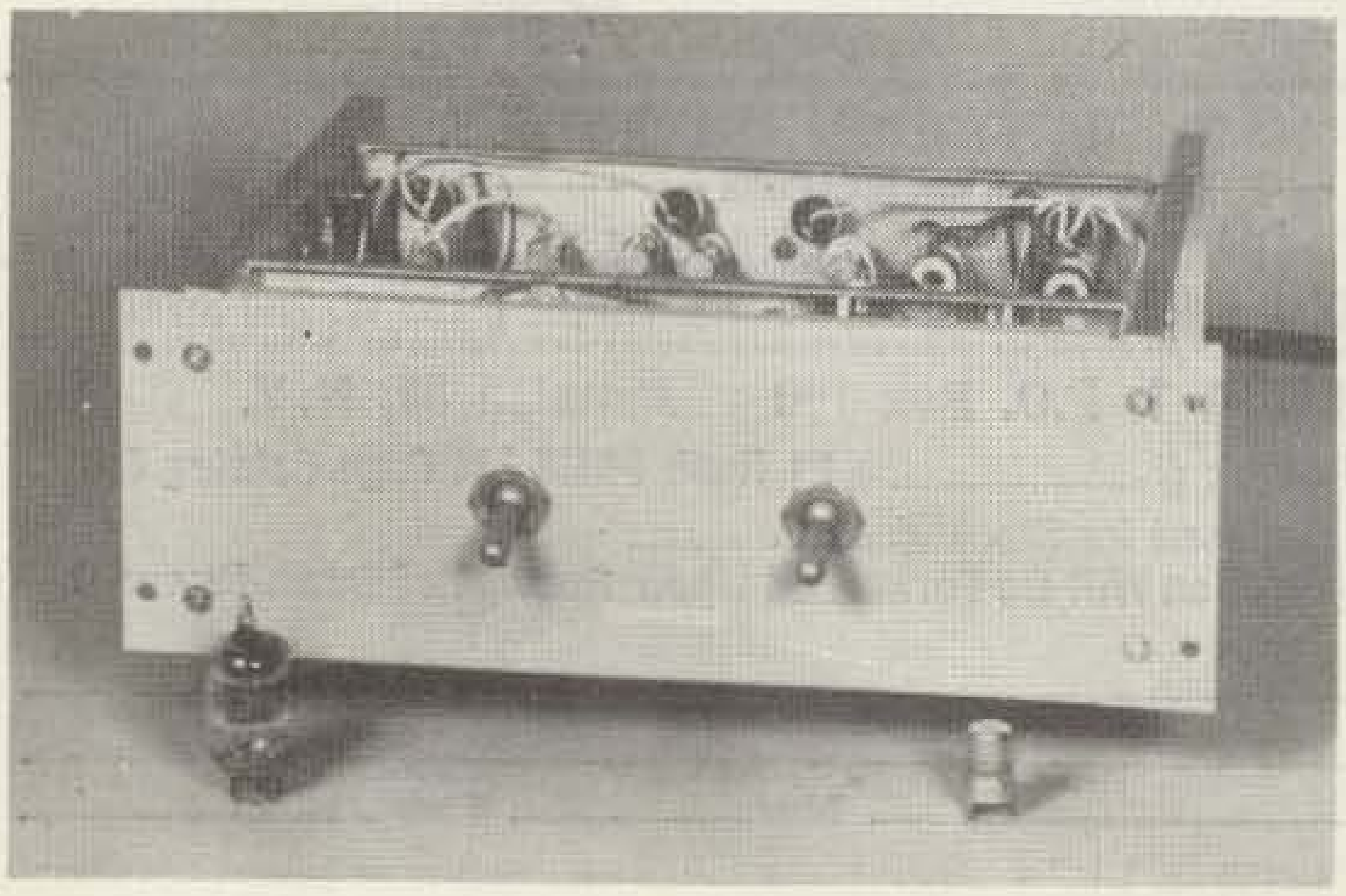


Nuvistor Converters for Six & Two

Tom Lamb K8ERV
1066 Larchwood Road
Mansfield, Ohio



THE recent article on Nuvistors by Tilton[1] has created a great deal of excitement on the two meter band. Within a month of publication there were at least five low-noise Nuvistor preamps on 2 in Ohio, with their owners giving glowing reports of performance.

A small group[2] of Ohio amateurs interested in low-noise conversion recently met to check the performance of the 6CW4 Nuvistor on 144 mc. This group used three noise generators and three receivers (HQ-110, 75A-4, 2A) to check several 6CW4, 417-A, and commercial converters. The result was that the 6CW4 is as good, or slightly better than, the very best 417-A's, and is a considerably easier tube to use.

1. Tilton, "The Nuvistor as an rf Amplifier at 144 mc," QST, September, 1960, p. 38.
2. Those attending: W8SFG, W8LCA, W8WNM, W8QVK, K8MFZ, K8ERV.

(Here are a pair of compact converters that will give Meteor Scatter performance without hanging a mortgage on the roof. The heart of the circuit is a new tube designed for VHF service.)

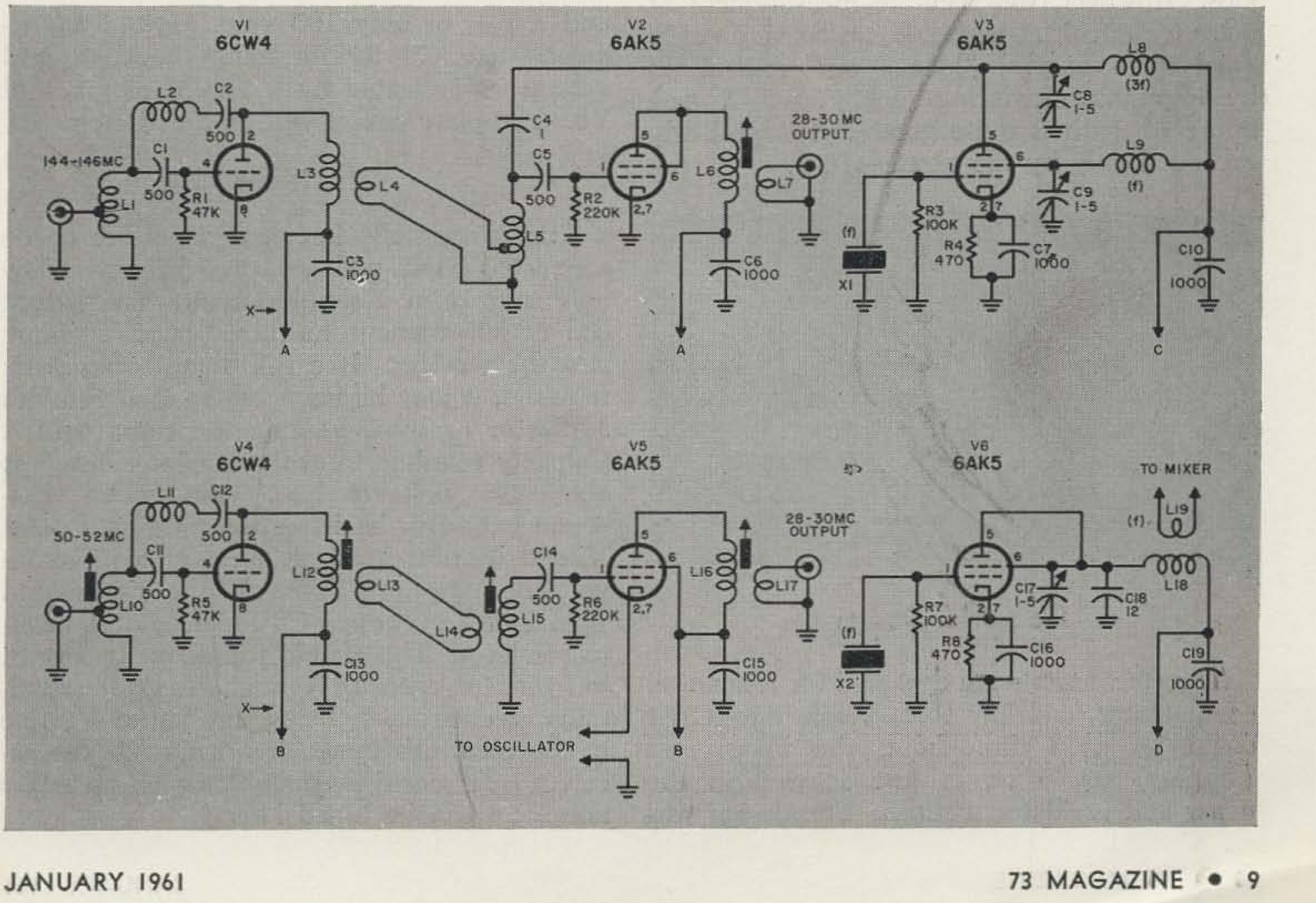
PARTS LIST

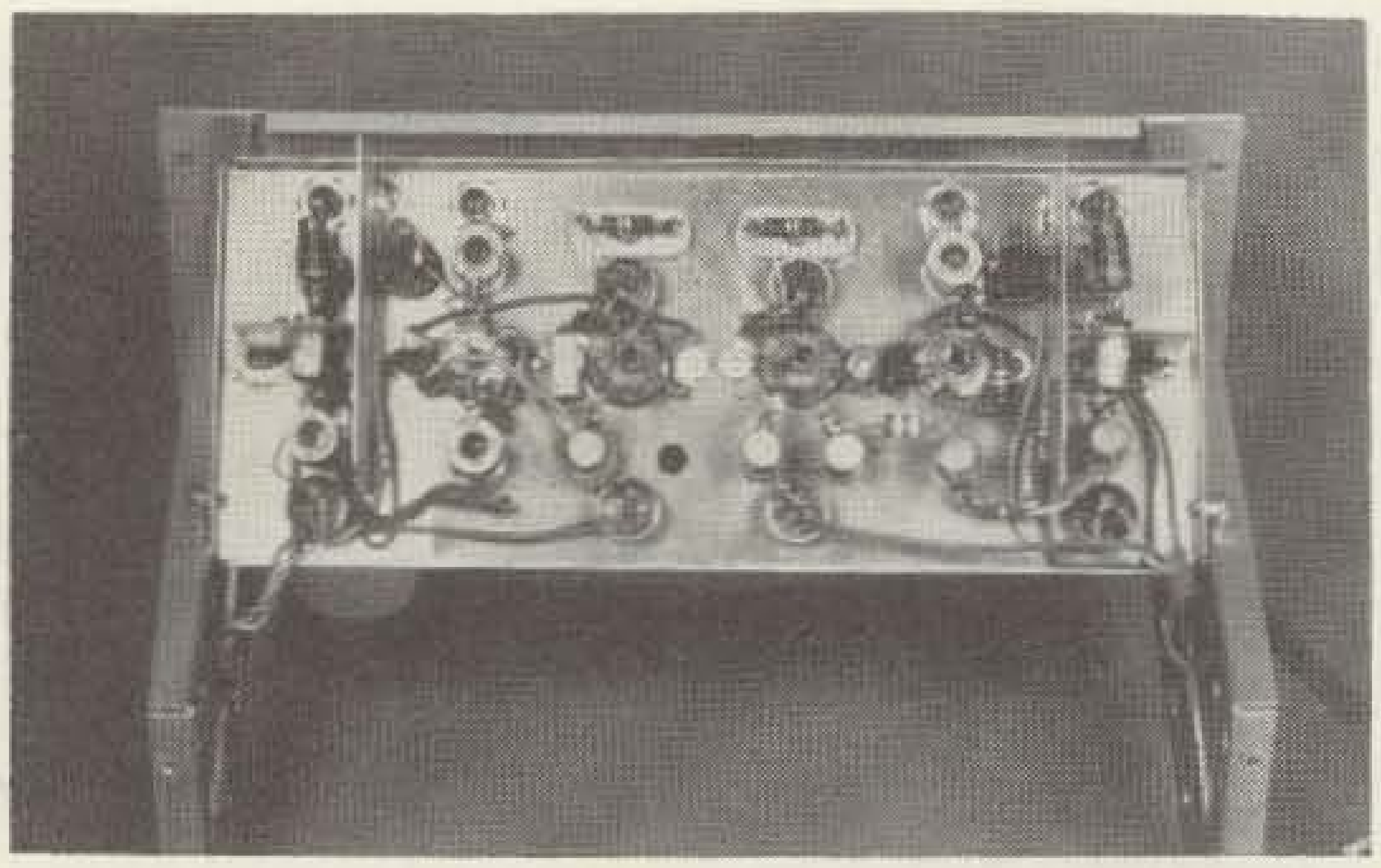
C1, C2, C5, C11, C12, C14—500mmfd ceramic (Erie GP-500)
C3, C6, C7, C10, C13, C15, C16, C19—1000mmfd silver-mica buttons (Erie FA-1000)
C4—1mmfd or twisted wire
C8, C9, C17—1-5mmfd tubular trimmer (Surplus-Barry #GC-35, 10¢)
C18—12mmfd NPO ceramic (Centralab TCZ-12)
C20, C21, C22, C23—1000mmfd disc ceramic
C24—40mfd 250 volt electrolytic
C25, C26—20mfd 250 volt electrolytic
R1, R5— 47k ½w
R2, R6—220k ½w
R3, R7—100k ½w
R4, R8—470 ½w
R 9—500 2w
R10—3k 10w (depends on T1)
R11—100 1w
R12, R13—10k 2w (depends on T1)
V1, V4—6CW4 RCA Nuvistor (Socket Cinch-Jones) 133-65-10-001)
V2, V3, V5, V6—6AK5
V7—0B2
S1, S2—DPST toggle switch
D1—Silicon Diode, 600 PIV (Texas Instrument 2071)
T1—See Text
X1—Third overtone crystal, 38.66666 mc
X2—Third overtone crystal, 22 mc

COIL TABLE

L 1—5t #26 enamel on ¼" polystyrene form, wind about ⅜" long. Tap 2t from ground end. Adjust by spreading turns.
L 2—Neutralizing coil. About 20t #30 on 5/32" dia. high value resistor. Close wound. Adjust by spreading turns.
L 3—Same as L1 but no tap.
L 4—1t link over L3.
L 5—6t tap at 2t, otherwise as L1.
L 6—26t #32 enamel on ¼" slug tuned form, close wound. (CTC PLS6 form with green slug)
L 7—2t link over L6.
L 8—5½t #24 enamel close wound on C8.
L 9—19t #32 enamel close wound on C9.
L10—16t #28 enamel tap 5½t from ground. Same form as L6.
L11—Neutralizing coil. About 50t #36 enamel wound as L2.
L12—19t #28 enamel on same form as L6.
L13—1t link over L12.
L14—1t link over L15.
L15—17t as L12.
L16—Same as L6.
L17—Same as L7.
L18—25t #32 on same form as L6.
L19—2t link over L18.

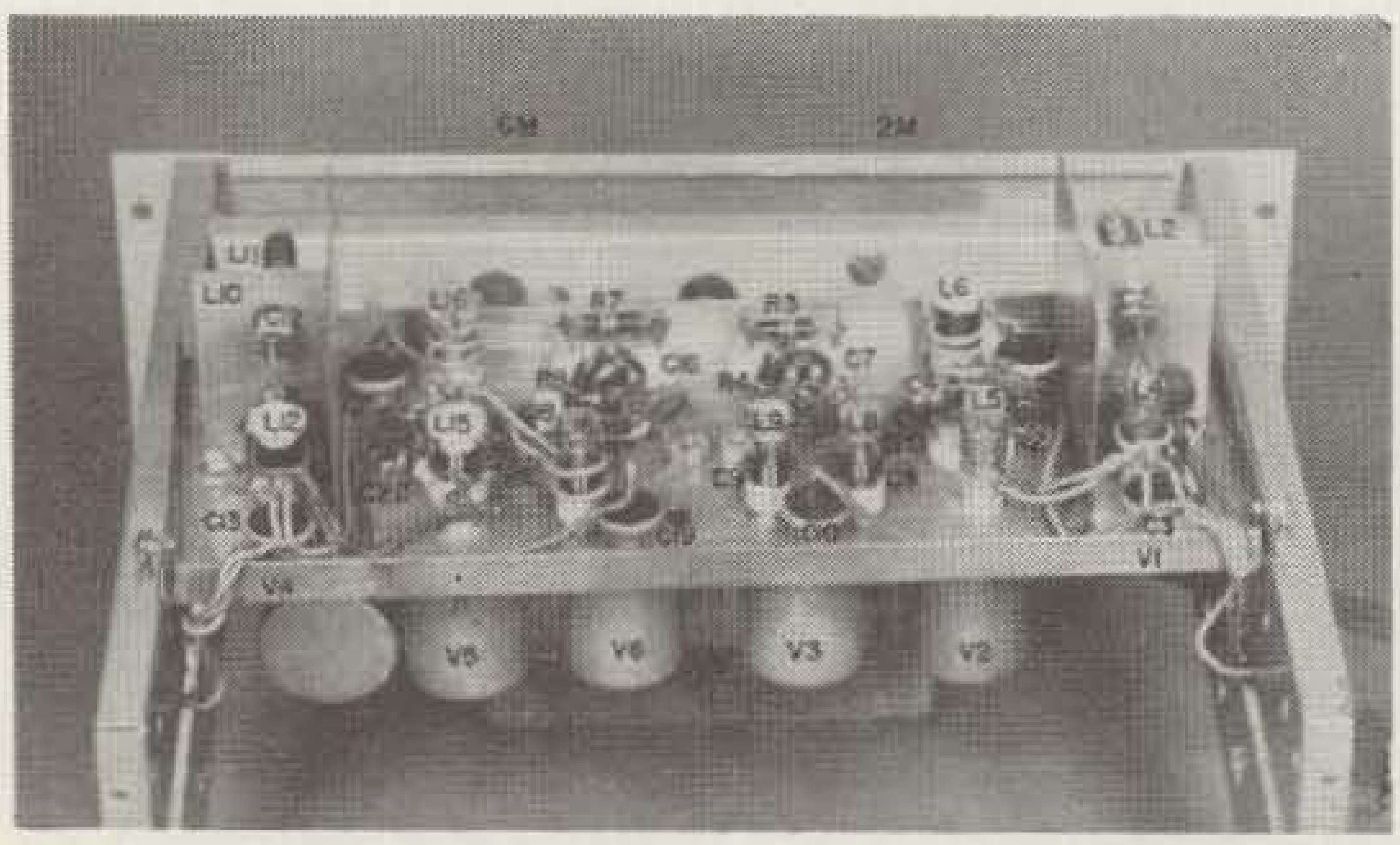
Note: In place of Silver-Mica button condensers, which are rather expensive, .001 discs mounted with short leads on a stand-off lug can be used will work just as well.





The lower transconductance of the 6CW4 (12500 umhos vs 25000 umhos for the 417-A) makes it more stable, with a small sacrifice in gain. While a high transconductance is usually thought to be essential in a low noise tube, actually it is the ratio of transconductance to plate current (among other things) that determines the noise figure of a tube. The very low plate current of the Nuvistor gives it a slight edge on the 417-A in the Gm/Ip ratio. The 6CW4 is probably the best tube presently available for stable, low noise amplification in a grounded cathode circuit. It is a thimble-sized, budget-priced paragon.

The group's very careful measurements gave the 6CW4 converters a noise figure of 3.2 ± .4 db. This is not a startling value when compared with the claims of some of the 417-A jobs. However, the accurate measurement of noise is difficult at best and can be very easily (and unknowingly) "helped out" several db by improper measuring techniques. A true figure of 3 db is quite good and is probably exceeded only by the exotic 416-B.



Converter Design

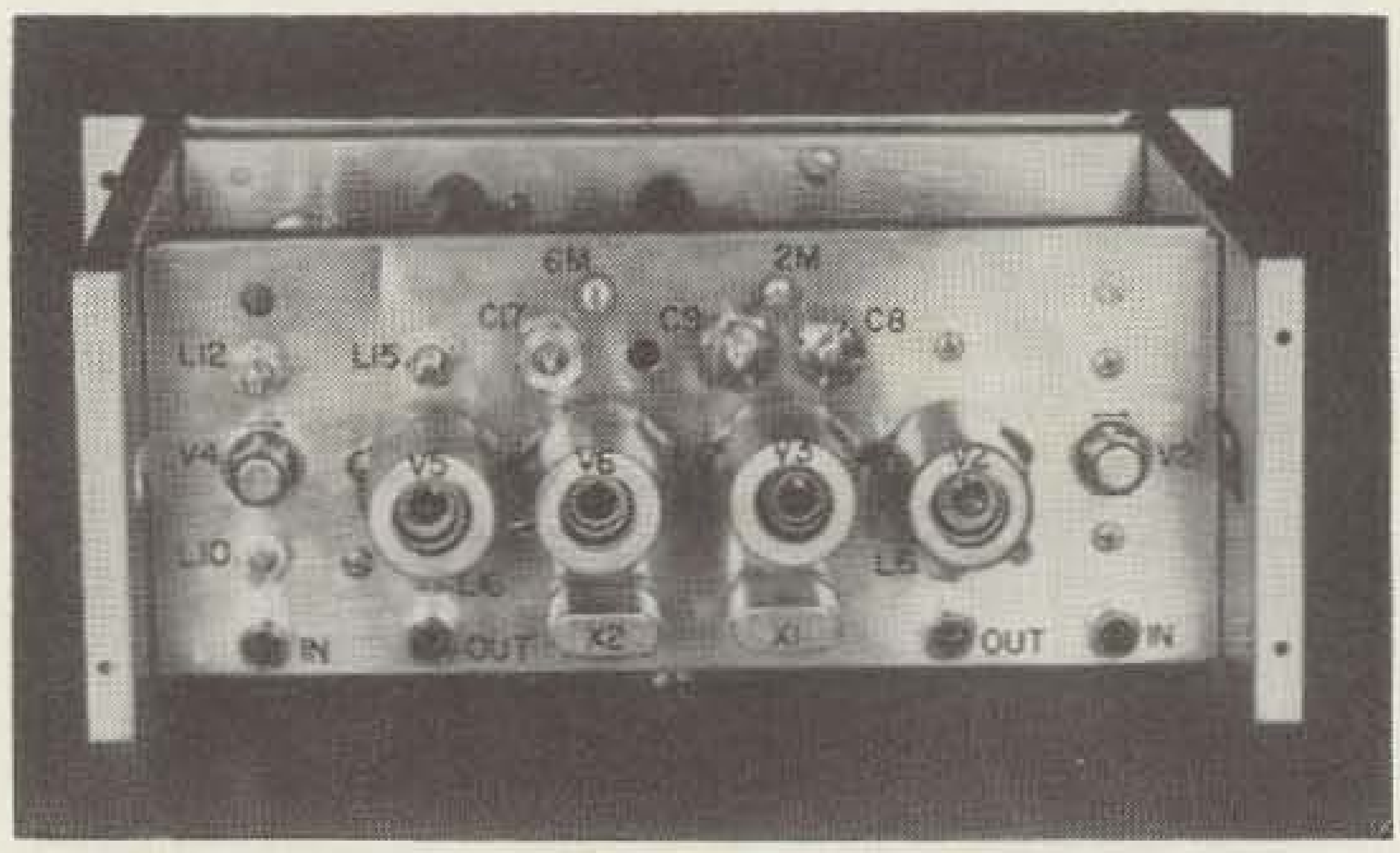
The converters were designed for low noise, compactness, and low cost. While the 6CW4 could be used throughout, the lower cost (surplus) 6AK5 serves just as well in the mixer and oscillator sections. The design was started backwards, with the oscillator-multiplier first.

The if

A 28-30 mc *if* was chosen for the two mc coverage found on most 10-meter receivers. The high intermediate frequency eliminates all image problems, and allows a simple broadband output coil to replace the usual cathode follower matching stage.

The Oscillator

A 38⅔ mc third overtone crystal oscillates in a conventional turned plate circuit, using the 6AK5 screen as a triode plate. The plate circuit triples to 116 mc. This very simple circuit generates a stable signal and sufficient mixer injection with a low tube dissipation



and a B+ of only 105 volts. *Initial adjustment:* tune C9 for maximum negative grid voltage as indicated by a VTVM at pin 1 of V3. The plate circuit will be tuned later.

The Mixer

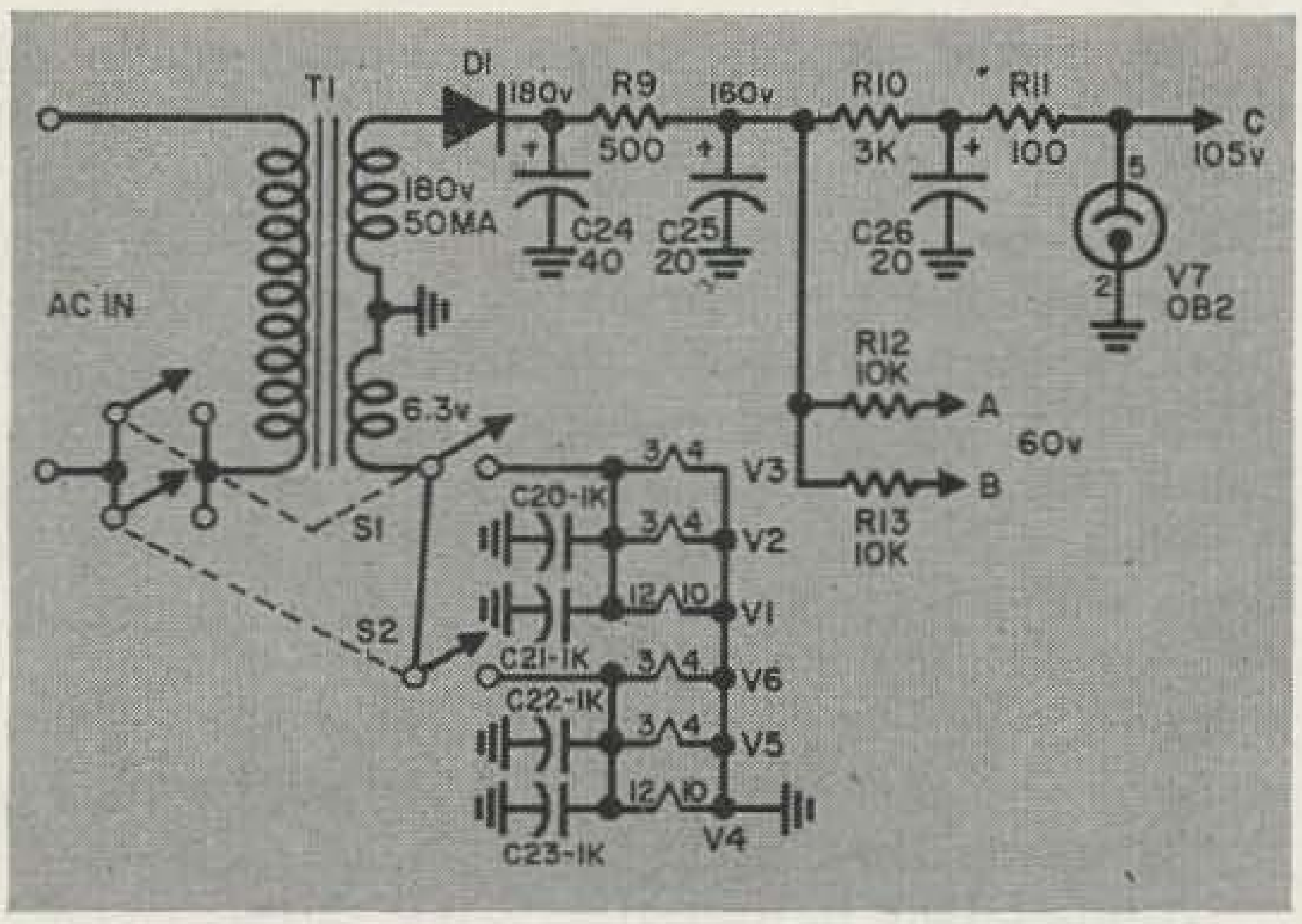
The mixer stage is conventional. A triode connected 6AK5 with grid leak bias gives low noise mixing in a simple circuit. The output coil is self-resonant for broad-band coupling into the receiver. If a full 4 mc bandpass is required, it may be necessary to load L6 with a resistor or by increasing the turns on L7. Capacity coupling from the oscillator develops about two volts of bias. *Adjustment:* Disconnect the B+ lead from the 6CW4 at point X, and connect a 28 mc receiver to the converter. With a VTVM on the mixer grid (pin 1 of V2), adjust C8 for maximum negative voltage. This should run about two volts, but isn't too critical. Now adjust L6 for maximum receiver noise, being sure you don't tune to the receiver's image frequency. If the receiver isn't sensitive enough to pick up mixer noise, L6 can be tuned later.

The rf stage is a "steal" from the K1IJB design. For all Ye Doubters, it can be shown both mathematically and by experiment that a *single* rf stage with a gain of 20 db or better is sufficient to swamp out the noise of even a moderately good mixer stage. Additional rf stages may increase the converter gain and bandwidth, but will not noticeably improve the noise figure, and may lead to overload problems. Any needed gain should be placed ahead of the receiver, not the converter. With anything less than a 2-meter kw in your block, the single rf stage should not produce cross-modulation *in the converter.*

The rf stage from L1 through L4 may be built as a separate preamp for an existing converter. Several have been built with close duplication of coils and performance.

Adjustment

With all previous adjustments roughed in, the rf stage is ready for alignment. With the 6CW4 B+ still off, connect an antenna and receiver to the converter and tune in a strong local signal. (A GDO may not work due to direct pick up in L3 or L5.) Roughly peak L3, L5, and L6. Now carefully spread L2 for a minimum received signal. The neutralization point will be a sharp and almost complete null. A few turns may have to be changed, but in all cases neutralization has been reached very quickly and easily.



Now reconnect the B+ lead and tune in a weak signal near the center of the desired tuning range. Peak L3, L5 and L6. L1 will tune so broadly that it may not seem to be effected by adjustment. Recheck the neutralization and secure L2 with Q dope. As a final stability test, insert an 0-10 ma meter at X. The 6CW4 current should run close to 8 ma and should not drop when the antenna is disconnected at the converter jack. Any drop indicates oscillation of the rf stage.

If a noise generator is available, the input tap and L1 tuning can be further improved, but a 4 db noise figure was obtained with the above procedure.

The 6-Meter Section

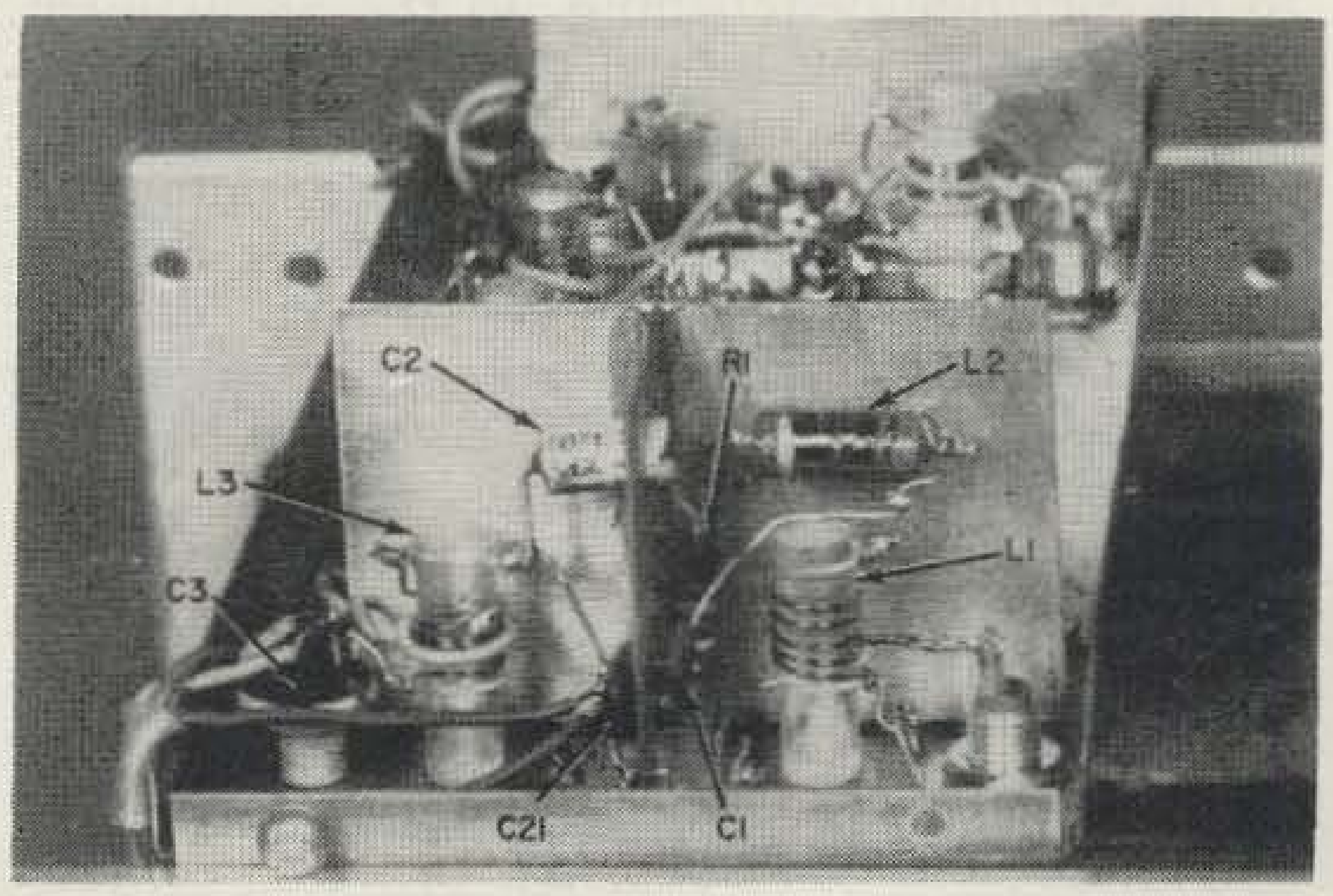
The six-meter converter started out with the circuit of the first two stages identical to the two-meter unit. The triode mixer immediately developed a few bugs. First, it was difficult to obtain enough injection coupling a 22 mc signal into a 50 mc tuned circuit. Cathode injection was tried with excellent results. Next, the mixer oscillated when L16 was tuned to 29 mc. Apparently the broadly tuned grid and plate coils caused some feedback at a common frequency. Changing to a pentode mixer solved this problem. The overall noise figure on six is 3 db, so the pentode connection does not contribute too much noise at this frequency.

The adjustments and operation of the six and two meter converters are identical. One caution—be sure to use iron slugs in the six-meter coils that are intended for use at high frequencies. The Cambridge Thermionic green and white slugs are rated for use in the 50 mc range.

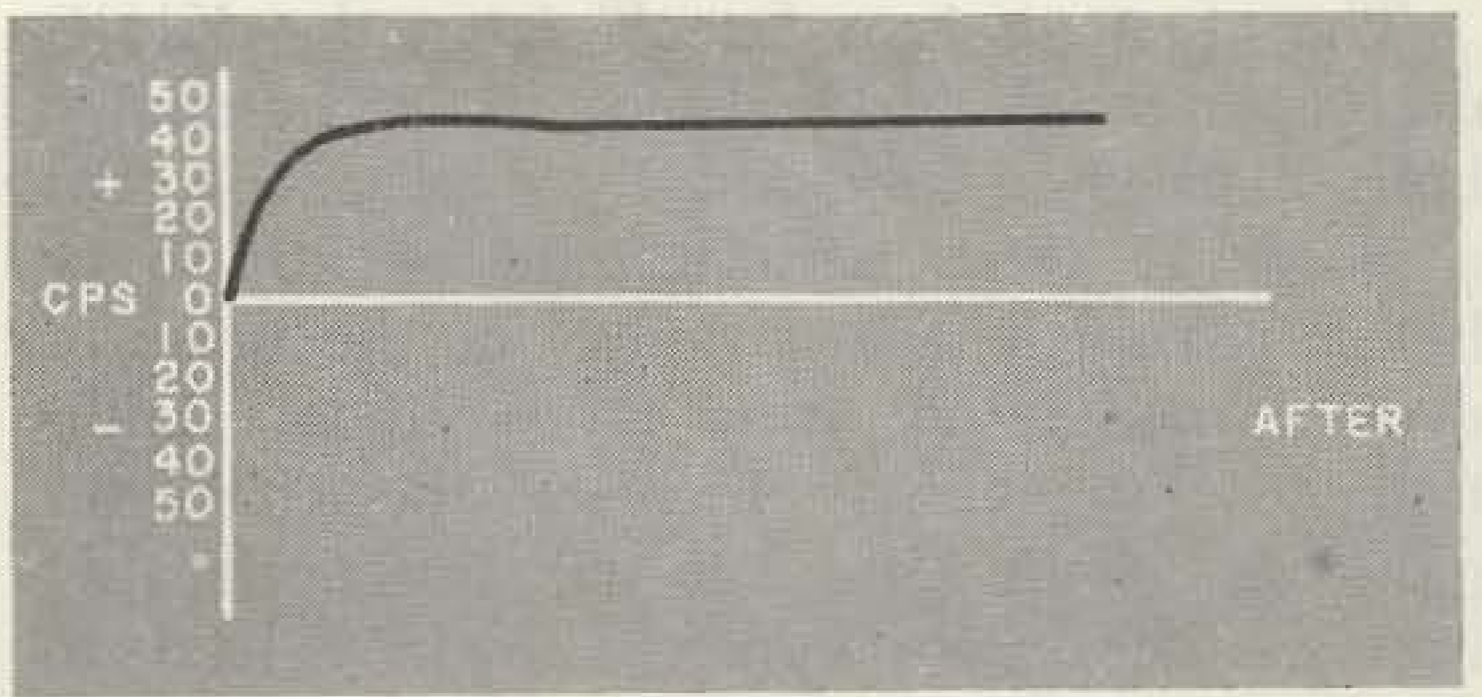
The Common Power Supply

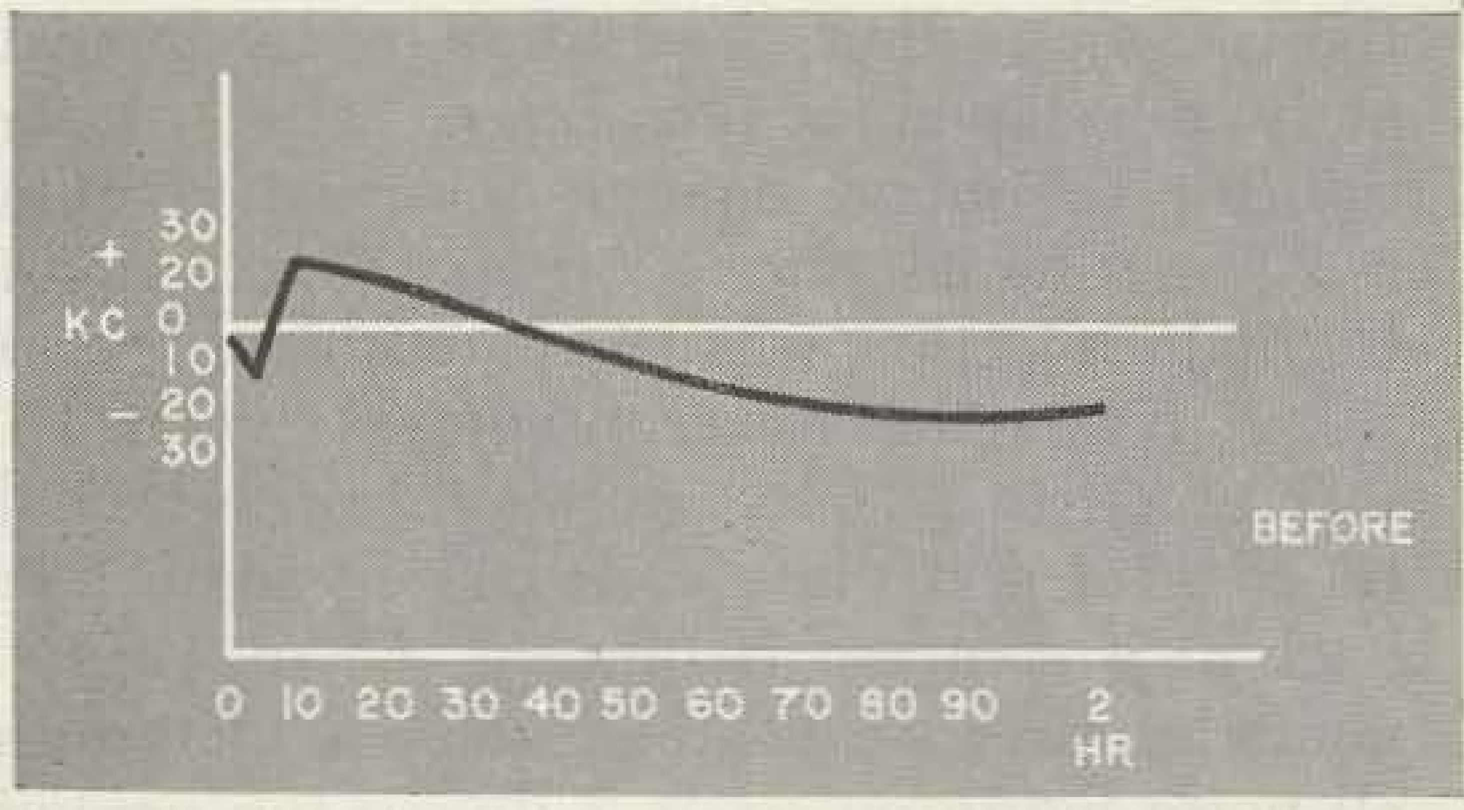
The power supply is conventional and will be described only briefly. The requirements of each converter are 60-70 volts at 10 ma for the rf and mixer stages, and 105 volts at 5 ma for the oscillator. The VR tube should be set to draw an additional 15 ma, for a total of 30 ma. A TV booster type of supply will power one converter, especially if the VR tube is omitted. For operating both converters at the same time a larger transformer is needed.

(Continued on page 50)



Down With Drift!





Jim Kyle K5JKX/6

These graphs show before-and-after performance of a BC-779 (Vintage Super-Pro) which was modified as explained in the text. Note that prior to modification, drift was measured in kilocycles, while after, overall drift was less than 50 cycles.

How's the stability of your receiver? Does it stay rock-like and steady where you tune it, or does it have a tendency to wobble and drift, thus necessitating retuning every few minutes for the first hour or so that you're on the air?

Chances are, unless you have a recent model of receiver—and one of the top-price models at that—that the rig could use some improvement in the stability department.

And if you should chance to ask, "Why bother? I can retune until it warms up," here are three good reasons for making that improvement:

In the first place, it's much more convenient to be able to tune once and stay there than it is to be continually touching up the adjustment.

Secondly, if you intend to utilize ultra-selective receiving techniques such as crystal filters, Q-multipliers, low-frequency *if* adapters, or audio filters, frequency stability is a must. The super-selective gadgets are a distinct hindrance if the received signal is wandering over the dial, even though they are a great help when the signal stays put.

Finally, in case you're interested in sideband, you will find that signals must stay put to be readable. Just 50 cycles drift when listening to a sideband station will make the voice sound unnatural, and very much more than this will make it unreadable.

Convinced? Ready to go out and trade off the old rig for a new super-stable receiver at a cost of half a kilobuck? Relax—you don't have to. Here are seven gimmicks to improve the stability of any existing receiver. Any of them can be used alone, or all can be combined. Naturally, the more you use the more improvement you'll get—but don't jump off the deep end too soon. Just three of them managed to tame a drifting Super-Pro down to an overall 40 cycles in the first hour!

The first two tricks involve no circuit changes in the receiver, so you might like to try them at the start.

Number One is an oldie. Since most frequency drift is caused by heat trapped in the receiver circuits, added ventilation will reduce the heat and therefore will also reduce the drift. The simplest method of getting more ventilation is simply to open the lid of the receiver cabinet!

Purists may not like the appearance of a receiver sitting in the shack, its cabinet lid open. They can place a small blower on the side or rear of the cabinet to achieve the same result at a much greater cost.

Trick Number Two isn't so basic or so elementary, but it can be a great help in taming an older Driftmaster.

In most of the better-class receivers, there is a centering-adjustment screw on the tuning capacitor rotor shaft. This screw adjusts pressure at the shaft's rear bearing.

Proper adjustment of this screw will result in decidedly-lower drift. The object of the adjustment is to get the capacitor rotor plates in the exact center of their area between the stator plates. Expansion of the plates (caused by heat) will then have a much smaller effect on frequency of the local oscillator, since the distance from rotor to stator plate will be at its greatest.

To make the adjustment, tune the receiver to a steady carrier of known stable frequency (such as a broadcast station or WWV). Turn on the BFO and adjust for comfortable pitch. Now, without touching the tuning knob or BFO adjustment, adjust the screw for the lowest beat note. That's all there is to it.

The other five gimmicks all require some circuit modifications in the set; finish reading the article, then heat up the old soldering iron and prepare to dig beneath the chassis.

Number Three is also based on the heat-drift relationship and applies only to older sets which use metal or glass-octal tubes.

These large tubes have large elements, and are themselves a heat source. The large tube elements expand and change position as the cathode heats. This expansion results in frequency drift when the tube involved happens to be the oscillator.

The remedy is this: replace that big bottle with a miniature tube. The 6C4 is recommended as a replacement for any triode, triode-connected pentode, or strapped-grid converter tube such as the 6SA7 when used in the oscillator stage of a receiver. Except for changing the socket, no circuit modifications are necessary since all receivers operate this tube at ratings satisfactory for the 6C4.

The small elements of the 6C4 still change position with heat, but the amount of change is smaller and so is the resulting signal drift.

Trick Number Four is really a switch on Number Three, but is highly recommended for both old and new sets since it combines all the small-tube advantages with the additional bonus of a buffer stage.

Number Four is the twin-triode cathode-coupled oscillator. First described some two years ago by Leonard Geisler (who used a type 6SL7 and thus missed some advantages), this circuit may be substituted for the oscillator stage of almost any communications receiver.

Wiring of the stage is shown in Fig. 1. None of the parts values is particularly critical, but make sure that all leads are as short as possible and that all bypass capacitors are securely grounded.

If you don't happen to have a 12AT7 around, use a 12AX7, a 12AU7, or with modification of the heater connections, any of the cascode-type TV twin triodes. They all work nicely.

Number Five differs from all its forerunners. So far, we've been approaching the stay-put problem by trying to eliminate or minimize the effects of heat. Now, we're making a turnabout. We're going to use them.

Of course, it's not quite a complete turnabout, since we're going to be using them to counteract other heat effects.

What we're going to do it this: Install temperature-compensating capacitors at strategic points in the oscillator circuit to make heat effects cancel out as much as possible.

Since every receiver reacts to heat differently, no hard-and-fast formula can be given to help you find those strategic spots. A good place to start is right at the tuning capacitor frame. Use type N750 capacitors, and don't add more than 5 micromicrofarads if you can keep from it. In other words, if 5 mmfd doesn't do the trick, look for another place to put the capacitor.

Naturally, the capacitor's electrical connection will always be the same—in parallel with the oscillator section of the main tuning gang. Only its physical location may differ.

Closely allied to Number Five is Number Six. However, it uses no special component such as the temp-compensating capacitor. It is this:

Disconnect the leads from the cathode terminal of the oscillator tube. Then, between the cathode and any or all leads which were at the socket terminal, connect a 1,800-ohm composition resistor.

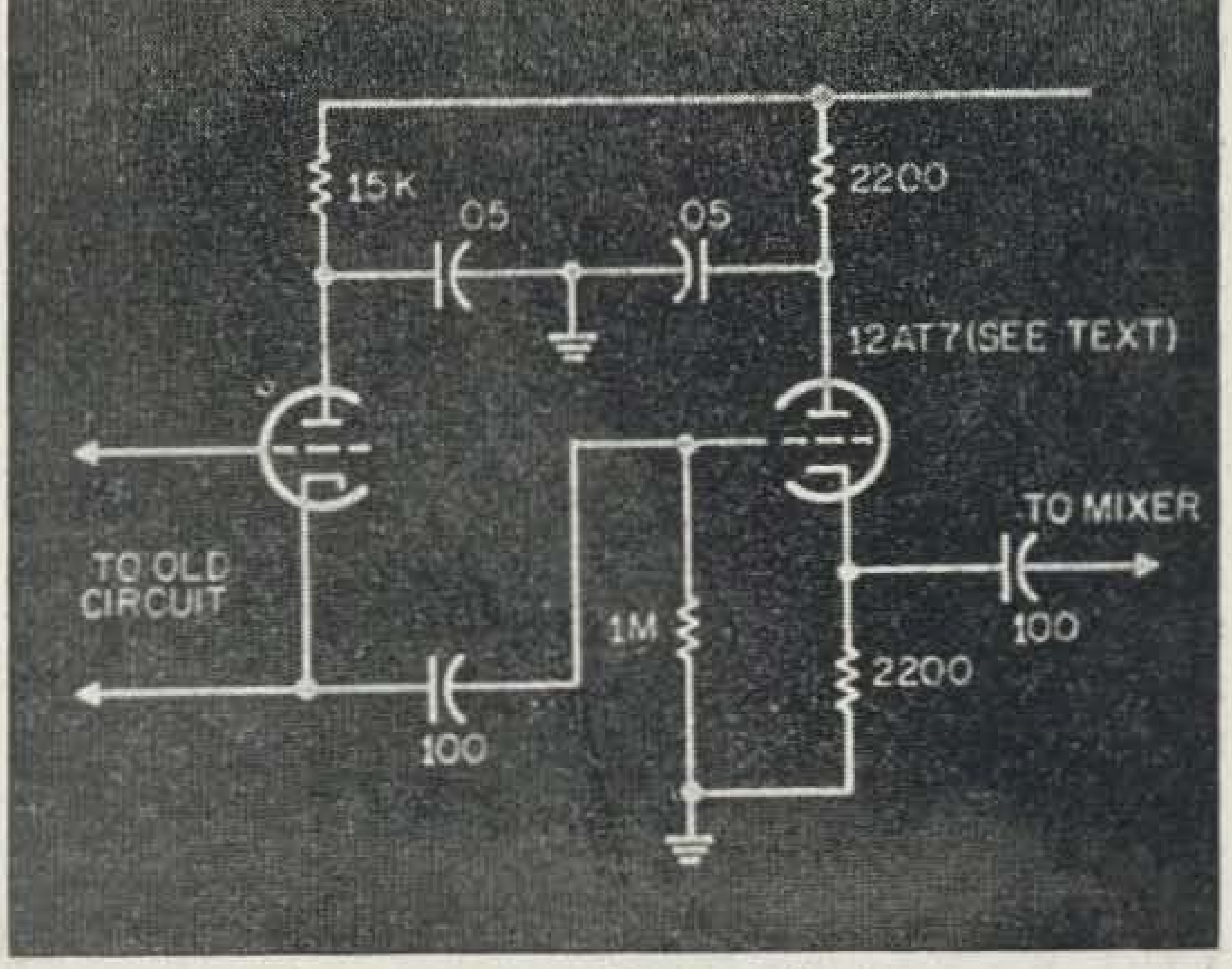
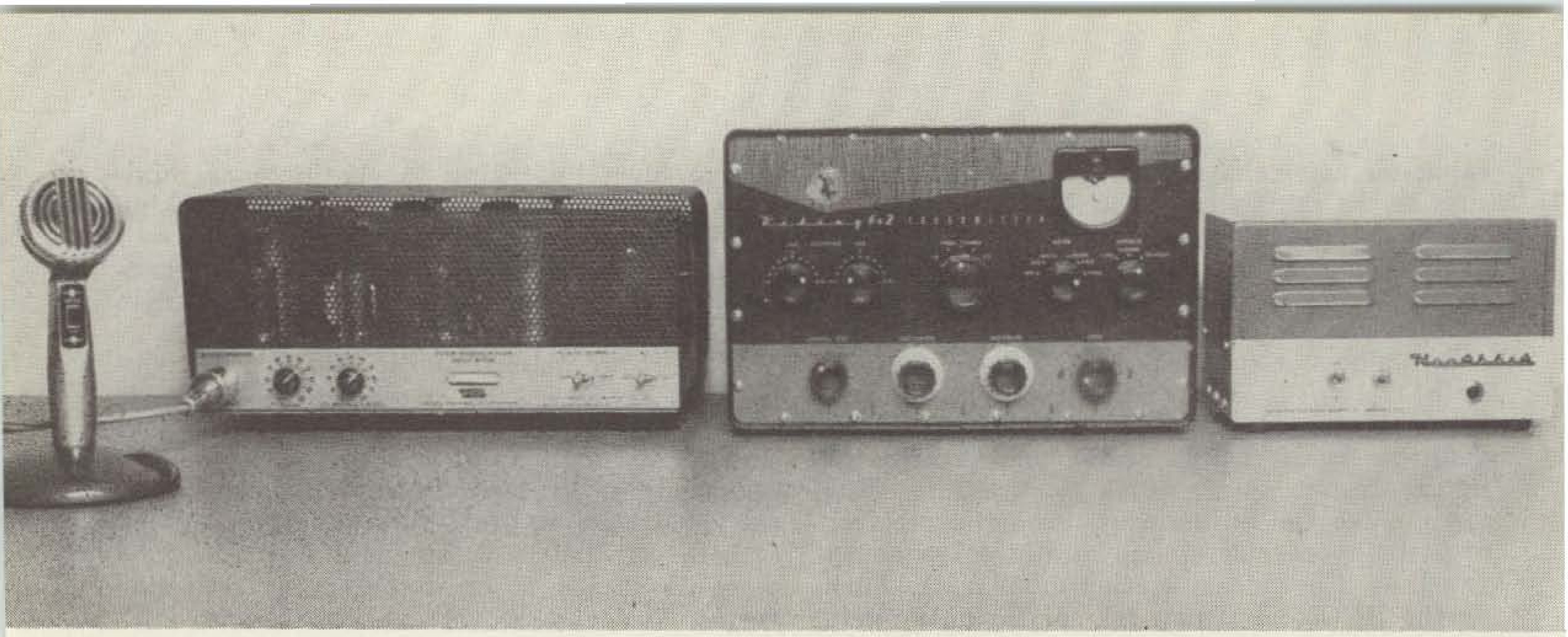


Fig. 1—This circuit, substituted for your receiver's present oscillator stage, will substantially reduce frequency drift. Parts values are non-critical, but lead dress must be direct and short. Use of a Vector 6-N-6T socket or an Amphenol type 59-369 socket will simplify wiring and installation of the stage.

The reasoning behind this gimmick is somewhat involved technically. Researchers at RCA Laboratories discovered it while investigating stability of TV oscillators in the UHF region. They report that changes in "cathode interface resistance" occur when supply vol-

(Continued on page 61)



Combining Kits for 100 Watts on 6 & 2

Donald A. Smith W3UZN
Associate Editor

How does a 100 watt 6 and 2 meter, crystal controlled transmitter complete with power supply and plate modulator for $200.00 sound to you? Good, eh? Using kit equipment manufactured by E. F. Johnson, Heath Company and Eico, you can build such a rig. These three pieces of equipment go together as if they were made for one another.

The transmitter section of the complete rig is the Johnson Viking 6N2. It uses the pentode half of a 6U8 tube as oscillator-doubler, the triode half as a tripler to 48-54 mc. A 6360 is used as a driver on 6 meters and a tripler on 2, driving the final amplifier which is a 5834 tube. The 5834 is an excellent choice for these two bands, running 100 watts input AM on both 6 and 2. A 6AQ5 is used as a clamper to protect the final. Efficiency is very good on two meters (where losses are generally very high), due to the use of silver plated tuned lines in the final The rig uses the common 8-9 mc crystals for both bands and has provisions for the addition of an external VFO. An 8 prong female socket is mounted on the rear panel for this purpose and has filament and proper B- available from it. (This voltage comes from the supply furnishing voltages to the rig.) The 8-9 mc output from the VFO is also connected to this socket. The Viking does not contain its own power supply or modulator and requires 600 volts at 200 mils., 300 volts at 70 mils., plus 6.3 vac at 3.5 amperes. 50 watts of audio is necessary to plate modulate the rig at 100 watts input.

As mentioned above, the rig has provisions for an external VFO. Johnson makes a unit especially for this purpose. It does not have a built-in power supply and requires the supply voltages brought out to the VFO plug. It covers 6 & 2 meters and sells for $34.95 in kit form and 54.95 wired. The National Company also makes a VFO for both bands which they call model VFO-62. It is available only in wired form and sells for $49.95. (This is a reduction of $20.00 as the unit originally sold for $69.95.) Another VFO is the Globe model 6-2, selling for 49.95 in kit form and 59.95 wired. I have used the Johnson and National VFO's with the 6N2, both with excellent results.

Your "Catalog Searcher" found the perfect answer to the power supply problem in Heath's UT-1 Utility Power Supply kit. The supply is rated at 600 volts at 250 mils. *or* 600 volts at 200 mils. *and* 300 volts at 100 mils., which is just what the rig requires! The supply also furnishes 6.3 volts at 8 amperes for filaments. The circuit used in the supply is the well known voltage doubler with large value input *and* output filter capacitors. Extensive filtering is used in the primary of the power transformer to reduce TVI. This filtering includes two line chokes and four bypass capacitors! A neon lamp is mounted on the front panel to indicate when the supply is on and both sides of the ac line are fused with 3 ampere fuses.

Catalog searching also turned up a 50 watt plate modulator kit manufactured by Eico (model 730.) The modulator is conservatively rated and contains the following tube line up. An ECC83 (12AX7) is used as a two stage speech amplifier, a 6AL5 as a speech clipper, a 6AN8 as amplifier-driver feeding two EL34 power amplifiers in push-pull. An EM84 tube is used as an overmodulation indicator and a slow warm up, heavy duty GZ34 is used for full wave rectification, eliminating the need for an external power supply for the modulator.

The modulator has several desirable features. One is the clipper circuit (6AL5). This is a series type clipping circuit with adjustable clipping level. A filter is included in this circuit to suppress high order harmonics generated by the peak clipping. It is possible with this circuit to raise the speech level of the signal 8-12 db. Another feature is the output transformer which is multi-tapped, providing a number of output impedances, one of which is 3000 ohms, perfect for feeding the final of the 6N2. The over modulation indicator indicates over modulation when the modulator output signal exceeds the plate voltage of the rf amplifier. In this condtion, a negative voltage will appear at the grid of the indicator tube causing the indicator bars to overlap. The front panel of the modulator contains both gain and clipping level controls.

The Heath power supply must be modified, as it has only an off-on switch for ac power. A 6.3 vac, DPDT Potter & Brumfield relay is installed on the chassis of the supply in front of the large wire-wound resistor, as can be seen in the photo. A SPST toggle switch is also installed on the front panel, next to the ac off-on switch. This switch will connect 6.3 vac to the field of the relay when on, thus acting as the transmitting switch. The negative (B—), lead of the power supply is connected to one of the movable contacts on the relay. Both lower contacts are grounded. The B— from the modulator will also be connected to the relay (the other movable contact), so that when the relay is energized both the power supply and modulator will be on.

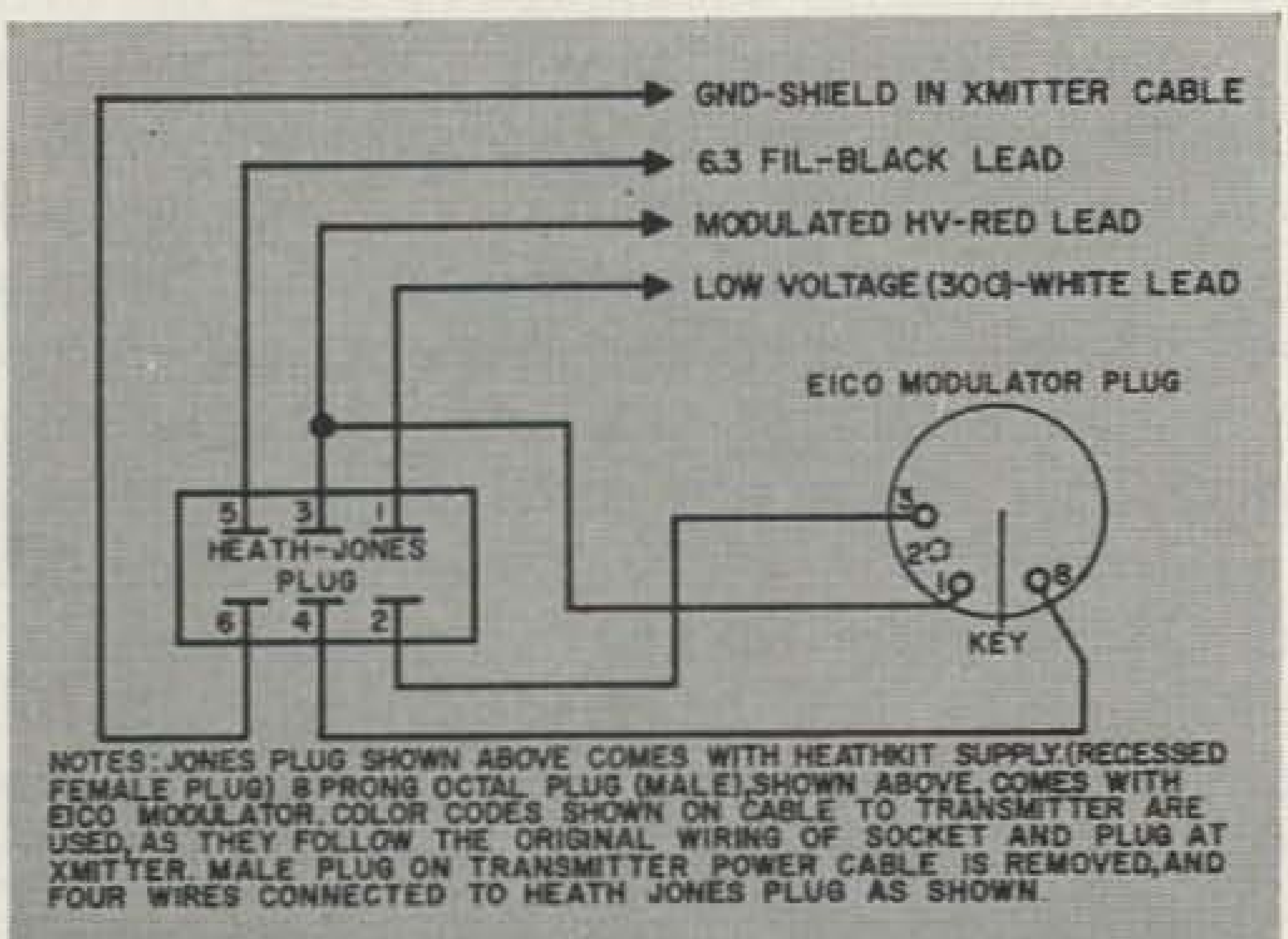


Fig. 1

The modulator has an off-on switch for the plate supply, located on the front panel of the unit. One side of this switch is ground so that the switch will ground the B— of the supply when closed. For safety this lead is removed from ground and the wire from the center tap of the plate transformer connected to pin 8 of the modulator output jack is also disconnected. A lead is then run from this side of the switch to pin 8 of the output jack. A wire in the cable run from the modulator to the Heath supply permits the relay to control the plate supply of the modulator. The old plate switch of the modulator is now in series and must be left to the on position. If cw is desired, simply turn this switch to off and the relay on the Heath supply will only apply plate voltage to the rig and the modulator will be inactive. (See drawings.)

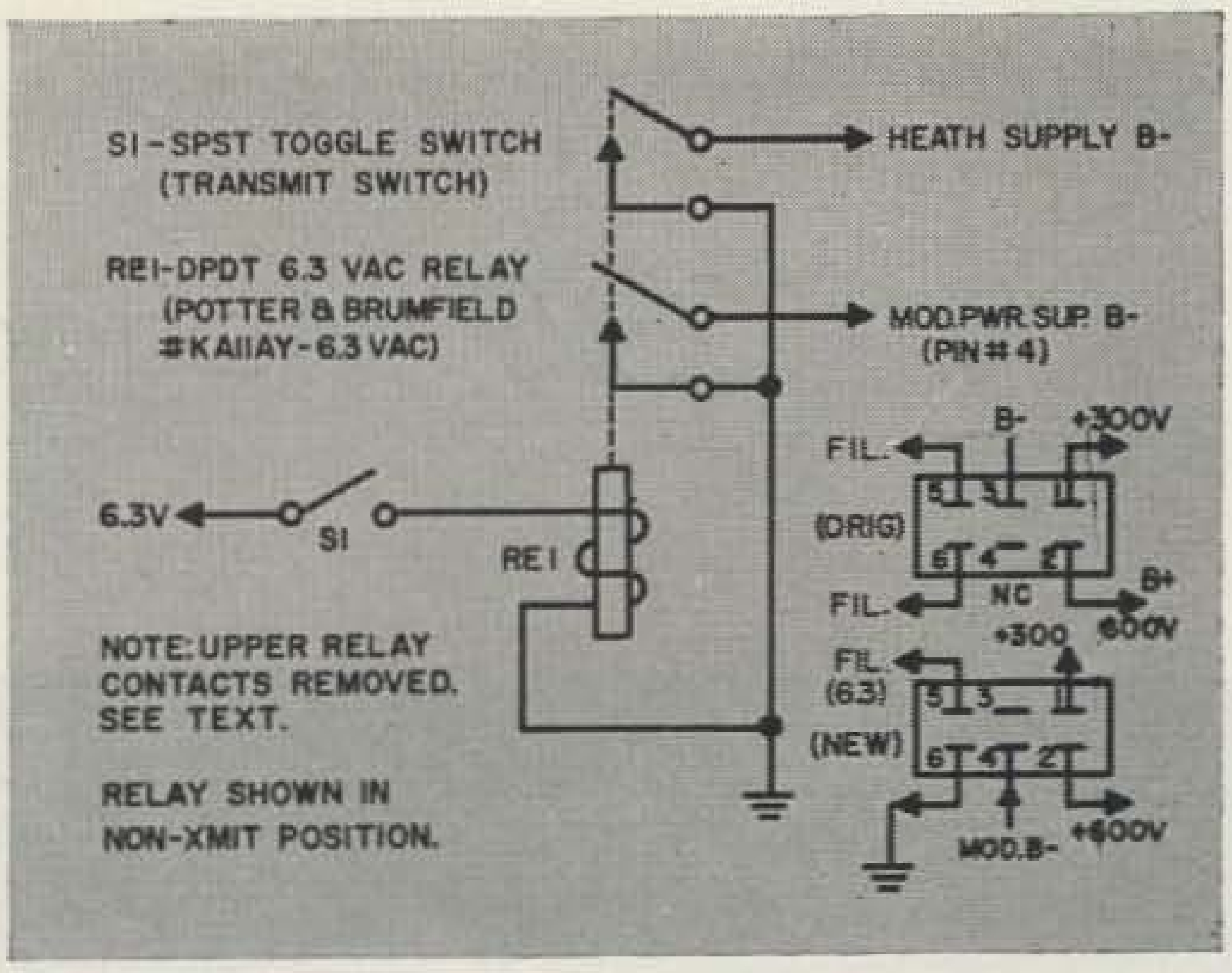


Fig. 2

Power supply showing relay installed and extra (transmit) switch.

Note that a heavy ground strap (¼ to ½ inch), should be run from unit to unit and then to a good ground. This will prevent any of the units from being "Hot" and will provide a common ground return for all of the units.

Operating the complete rig is a real pleasure. The 6N2 is provided with a "tune" switch, permitting tune up without the final being in operation. This of course protects the final amplifier tube until there is drive available. After tune up, the proper modulation can be obtained by reducing the clipping level to zero and increasing the gain control until the indicator shows the two bars overlapping slightly when talking into the mike in a normal tone.

(Continued on page 59)

1296 Megacycles

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WORK on equipment for 1296 mc started here four years ago. It was immediately apparent that years of experience on 432 mc were not going to help much. Those circuits and techniques that had been found to work well on 432 mc would operate, but the efficiency on 1296 mc was terrible. There is as much difference between 432 mc and 1296 mc as between the BC band and two meters!

For Instance

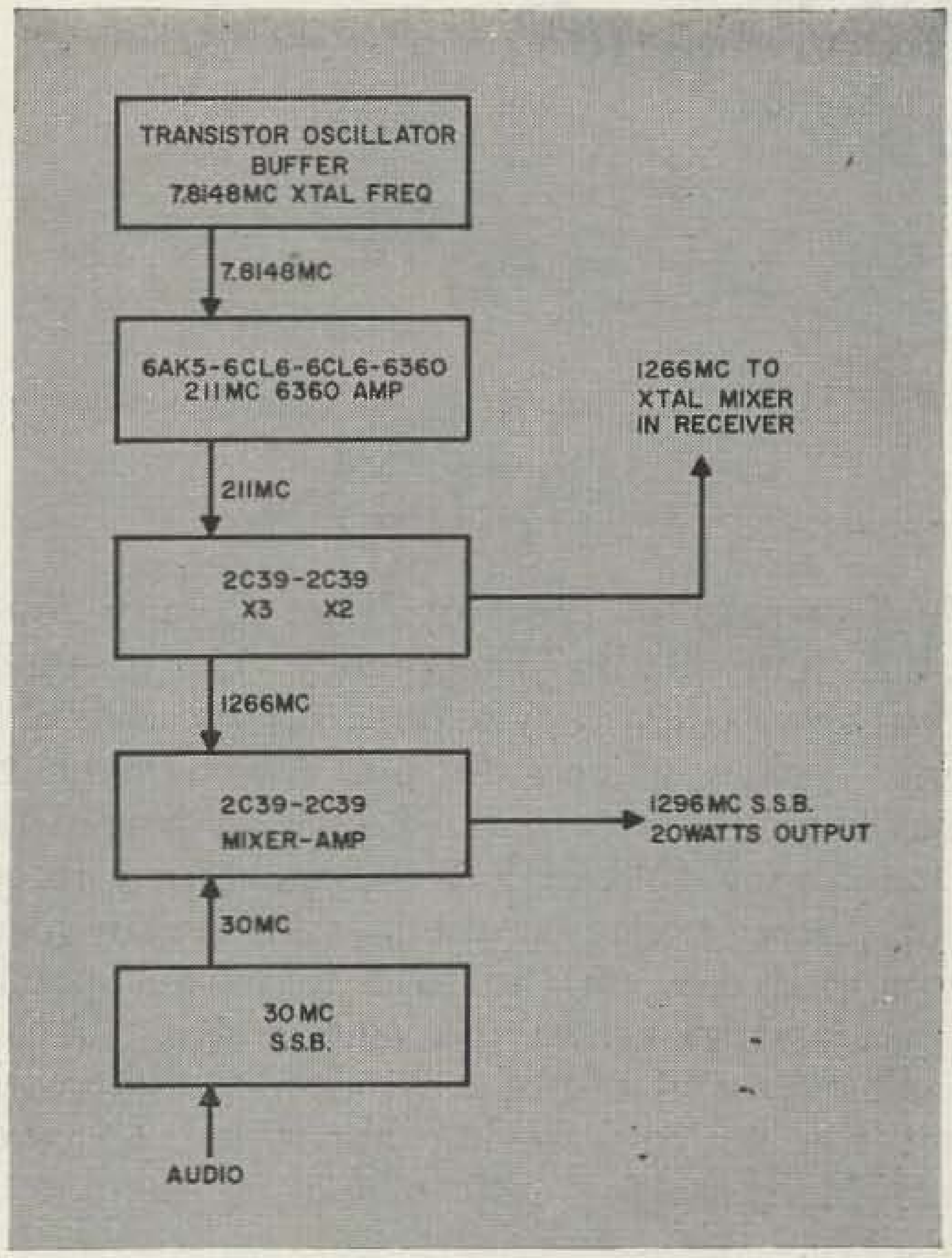
Link coupling from one resonate circuit to another will result in at least 3 db loss.

Solid dielectric co-ax of any type, size, or cost is useless. Eliminate all plans to use any amount, even a few inches for a flexible, twister section to the antenna or receiver. The losses at 1296 mc are horrible, and even a few watts will melt the line. Many have thought that with RG-17 or 19 and a short run, that they could keep their losses to about 2db—actual practice shows that true loss is about 3 times published figures, plus 3db of coupling loss. They end up with well over 6db loss in transmission—less than ¼ of the very hard to get watts from the Xmtr get into the antenna—and 6db of loss in receiving is a disaster. "G" line makes sense, but the lowest loss method is to mount all 1296 mc equipment at the feed-point of the antenna. Use of 3″ x 6″ copper clad down-spouting is a wave-guide possibility.

UHF television transmitting tubes look interesting, but don't plan on results til you have seen the amount of rf output compared to the input! It is apparant that the 1200 to 1300 mc region is the dumping ground for odd resonances, sneak circuits, and resonant grid structures. 2.15 inches of metal or less from a low impedance point is infinity—and you cannot get rf from one point to the other. I have RCA-6161's and RCA 6181's operating on 1296 mc, but not at full power, or in circuits that an amateur would care to build. Both have good possibilities and can be obtained by trading your grandmother, for they are used in UHF television transmitters. The 2C39A is excellent, so are other planar triodes that have the grid structure straight across the grid ring. Grounded grid operation is a necessity, and stage gain is very low. Figure on at least four stages of triodes to get from the 10 watts output from a 3C39A doubler to the 300 watts of rf necessary to drive a KW input final! 2C39's need air, plenty of it, not only on the plate, but the glass to metal seals must be cooled, if reasonable life is to be expected. I have four 2C39A's in parallel in a barrel structure that will take 500 watts input and better than 30% efficiency. The blowers and cooling system are four times the size of the rf section.

The tremendous advantage of 1296 mc over any other frequency known is the possibility of hearing weak signals. The noise output of a good amateur-built receiver on 1296 mc will drop more than 15db when switched from a good 52 ohm resistor load at room temperature to an antenna looking at a cold portion of outer space. This means you can hear a signal that is more than 20db weaker than you can on 432 mc. Cosmic noise is low here, and amateur-built paramps can be made to work. After many hundreds of hours, acres of flashing copper, and weak eyes from re-reading every available article written on paramps, I am certain I know less now than ever about these machines of Mephistopheles. Don't even bother trying a 2K25 etc., Klystron for 3 cm pumping at 1296. At least 300 milliwatts of available power is needed from a 3 cm pump. 30 milliwatt klystrons work in well designed paramps using a 3X freq. pump, but the extremely important problem of keeping the pump signal out of the mixer circuit is increased. A stable, controlled amplitude, pulsed test signal on 1296 mc is an absolute necessity for test and tuning a paramp! Dis-regard your pet circuits—build a transistor crystal oscillator—buffer on 7.8148 mc and bury it at least 3 feet in the ground; build a multiplier string that gives 162X the osc. frequency (3x3x3x3x2), and the resultant 1266 mc signal is the LO for your pet mixer circuit. Couple the crystal mixer thru a bi-filar coil tuned to 30 mc directly across the cathode of a 6AN4 grounded grid 1st *if,* and a reasonably stable, low noise 30 mc signal is available from the plate circuit of the 6AN4. Use of Varactors for the last two multipliers in the LO allows use of transistors thruout the oscillator—multiplier string, with plenty of injection signal at 1266 mc.

Antennas—be my guest! As a result of 4 months of hard labor by K2YUD, master welder; K2RIA, welder - owner; W2MHK, scrounger - deluxe; K2TKN, contributor of materials, elbow grease and design info; a 20 ft. steel parabola, of welded conduit tubing and covered with solid #24 gauge sheet iron takes up most of my back yard. It is still on the temporary mount, but by means of a 30 foot tower and a winch it can be pointed at any interesting portion of the sky and with much labor can be tracked on the moon as long as the beer holds out! When the weather is bad and given about 2 feet of snow, work may begin on the polar, motorized mounting. With Kraus handbook on antennas, 300 square

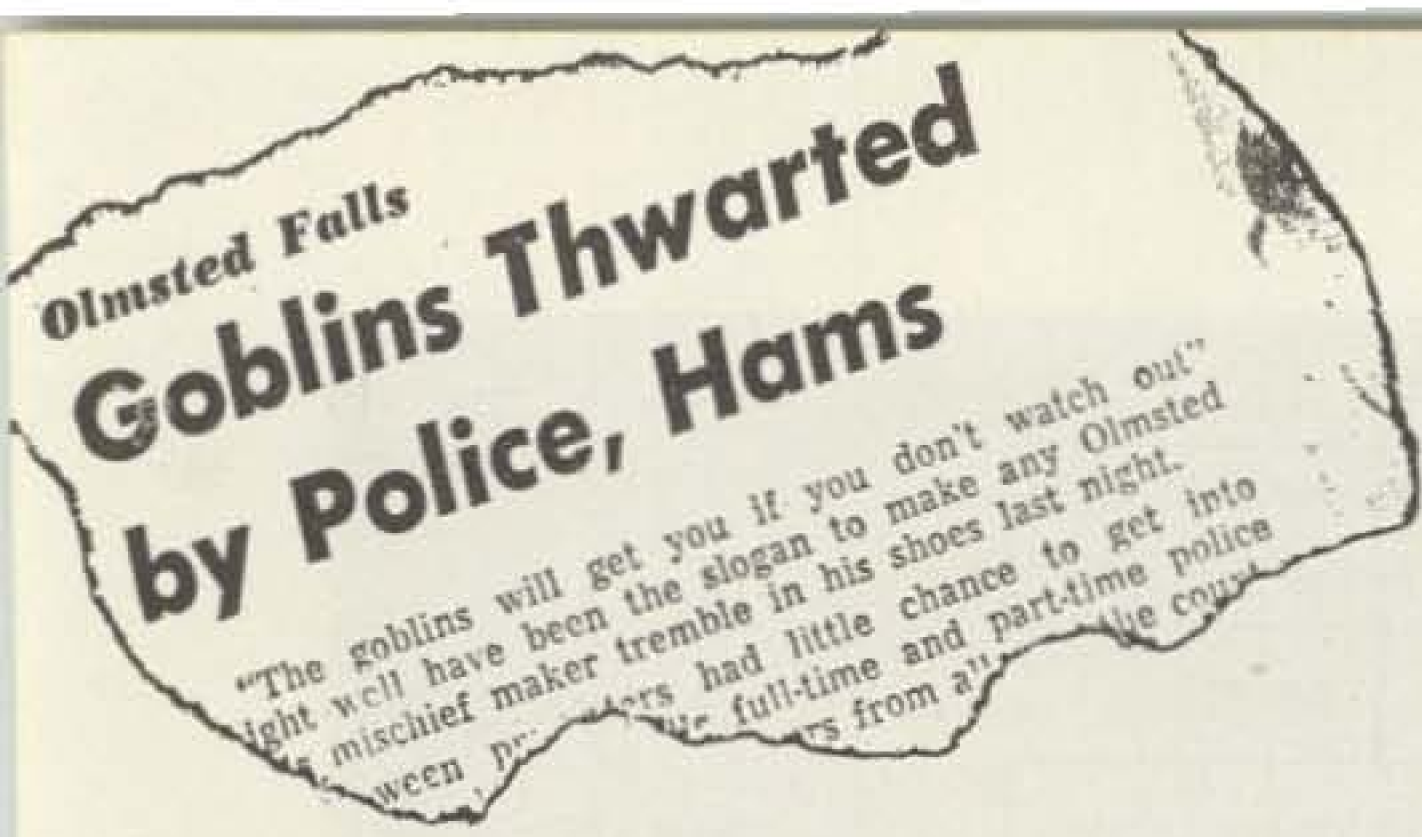


feet of chicken wire, and a wooden frame, you will be in business. Yagis are impossible—bed-spring and square corner arrays work, and a slotted sheet holds possibilities.

When are you ready to start holding aurora and moon schedules? When pointing your antenna array at the Sun gives at least 6db raise in noise output from the tail-end of your receiver and you can burn large brown spots on your fingers with rf off of the antenna feed during Xmit.

(Continued on page 55)

Framework for 20-foot dish at K2TKN.



Operation Gobiln Patrol

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South Euclid 18, Ohio

Members of the Cuyahoga County Amateur Radio Emergency Corps made local news when they teamed up with Olmsted Falls police officers to put the damper on malicious Halloweeners. Led by Police Chief Don Shirer (W8QBF), the combined forces put three police cruisers and seven ham-equipped cars on the road to patrol specific areas and to cruise the community. "A kid can't even spit out of a window tonight without the police knowing about it," observed one high ranking city official, a twinkle in his eye.

Hams served for the fifth year to augment the police normally serving that and two neighboring communities with a total population of 15,000. In the Olmsted Falls police station, the amateur master control station was located in the same room as the police master control. This arrangement allowed the desk officer to hear amateur communications and to relay the information immediately to one of the police cars on tour duty.

A police officer rode in each amateur's car, ready to serve as legal authority if required. Special emphasis was placed on points regarded as vulnerable; schools, a housing development with 400 homes under construction, shopping center, lumber company, and farmer's exchange. Not regarded as vulnerable and in need of no special attention on Halloween or the several days preceding was the graveyard. "It's never been bothered," said the Chief.

Last year a group of teen-agers set fire to kerosene-soaked corn shocks. Afterwards someone armed with a fire wrench opened a fire hydrant, and by the time the police arrived to close one hydrant, had opened three more elsewhere in town. An estimated 100,000 gallons of water were lost to the community that night.

Ready to roll are (from left) Walt Ermer, W8AEU, Al Dolgosh, K8EUR, Ed. Schweikert, K8BUT, Ed Posey, K8KKO; (second row) Ahti Wahter, W8LHX, Art Cavar, K8JHZ, Bob MacLaren, SWL, Al Hollar, K8DPA; (third row) Chuch Jirsa, W8NZI, Glenn Bodeker, K8SBZ, and Prentis Drew, K8SPL.

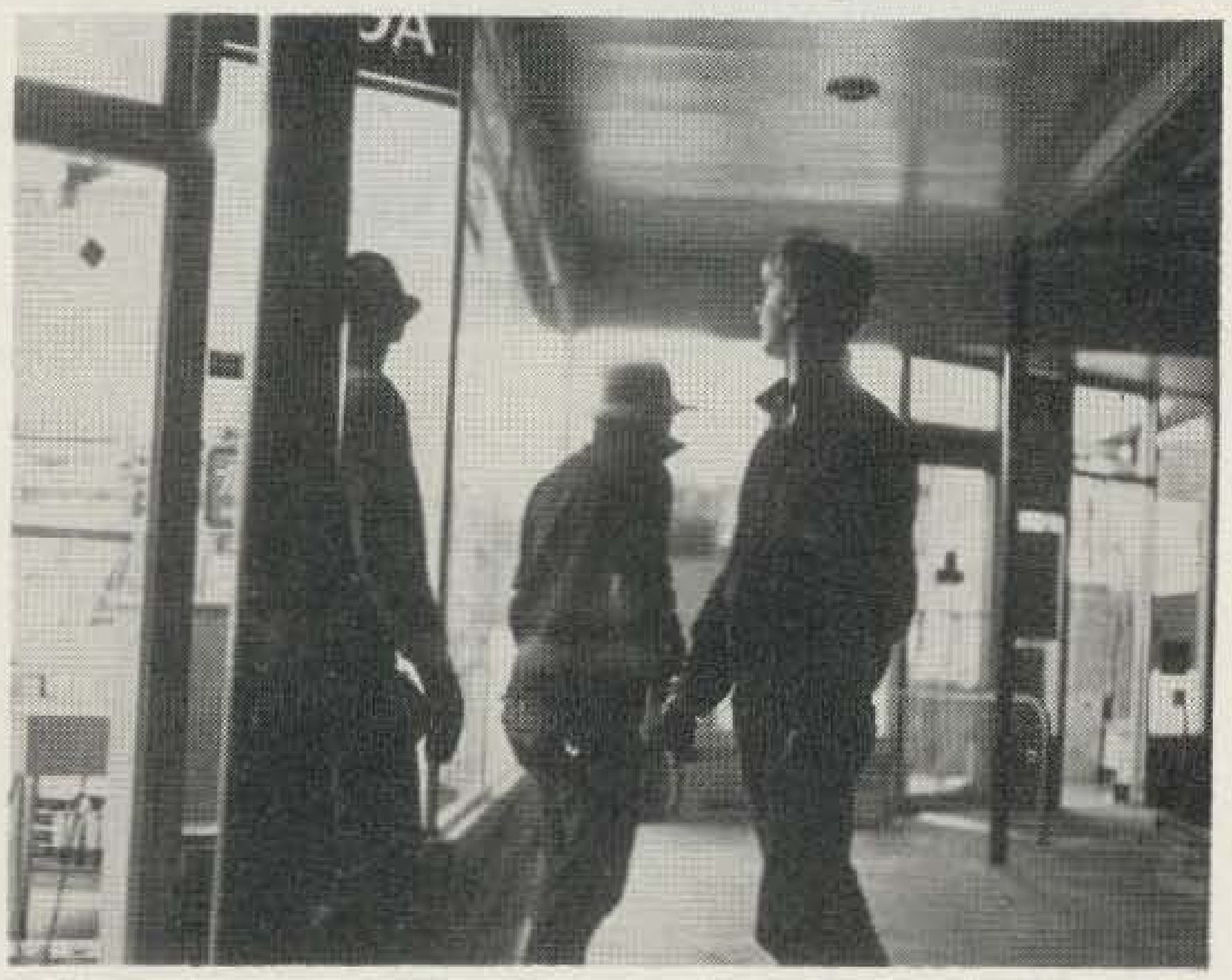
Briefing the force is Olmsted Falls Police Chief Don Shirer (W8QBF). Front row, from left, are the chief, Sergeant Harry Powers, Policewoman Mary Powers, and Captain Ferb Bowen. In second row are Patrolman Lee Wurstner, Bob Fenderbosch, Francis Anderer, and Lester Sellers.

A chilly day and early rain seemed to dampen the normally rambunctious spirits on Halloween this year, although police had reason to suspect trouble. Several sources reported that teen-agers were planning to start a fire, drawing the fire department and several police cars to the scene.

Then they expected to have free reign through the center of town. The report indicated the youngsters intended to break windows of people they didn't like, destroy signs, and possibly damage the city hall, which houses both the fire and police departments.

Scouting around, a police sergeant found what appeared to be a pile of brush and debris, ready to be saturated with kerosene and set afire. According to the report, the fire was scheduled to be started between 10 and 11 P.M. Fortunately, and for some unknown reason, the rumored fire and later events never did materialize.

At a bridge repair site, youngsters stole 34 lanterns and more than 40 oil pots.



Three teen-agers, observed from patrol car, lounge casually in front of drugstore, apparently without a care in the world. A few minutes earlier, police came upon barricaded roadway to trailer park less than half a block away, saw youngsters running in direction of drug store.

Three 18-year old girls from a nearby community were apprehended with a carful of pumpkins taken from outdoor displays.

The roadway to a large-scale trailer park was blocked off by pyramids of cinder blocks, topped by signs reading, "Speed Limit—10 MPH," and "Peddlers and Agents—Keep Out."

Included in the patrol was Walter Ermer, W8AEU, Edison Award winner in 1959 for his organization and leadership of the AREC in Cuyahoga County. Said Walt, "We all enjoy it and the amateur acquires a much better knowledge of what our law enforcement officers contend with and vice versa. I think that only when the ham group is around on Halloween, do the officers have a really good time. We all have fun, and this type of activity helps train the amateur for the real emergencies when they arise."

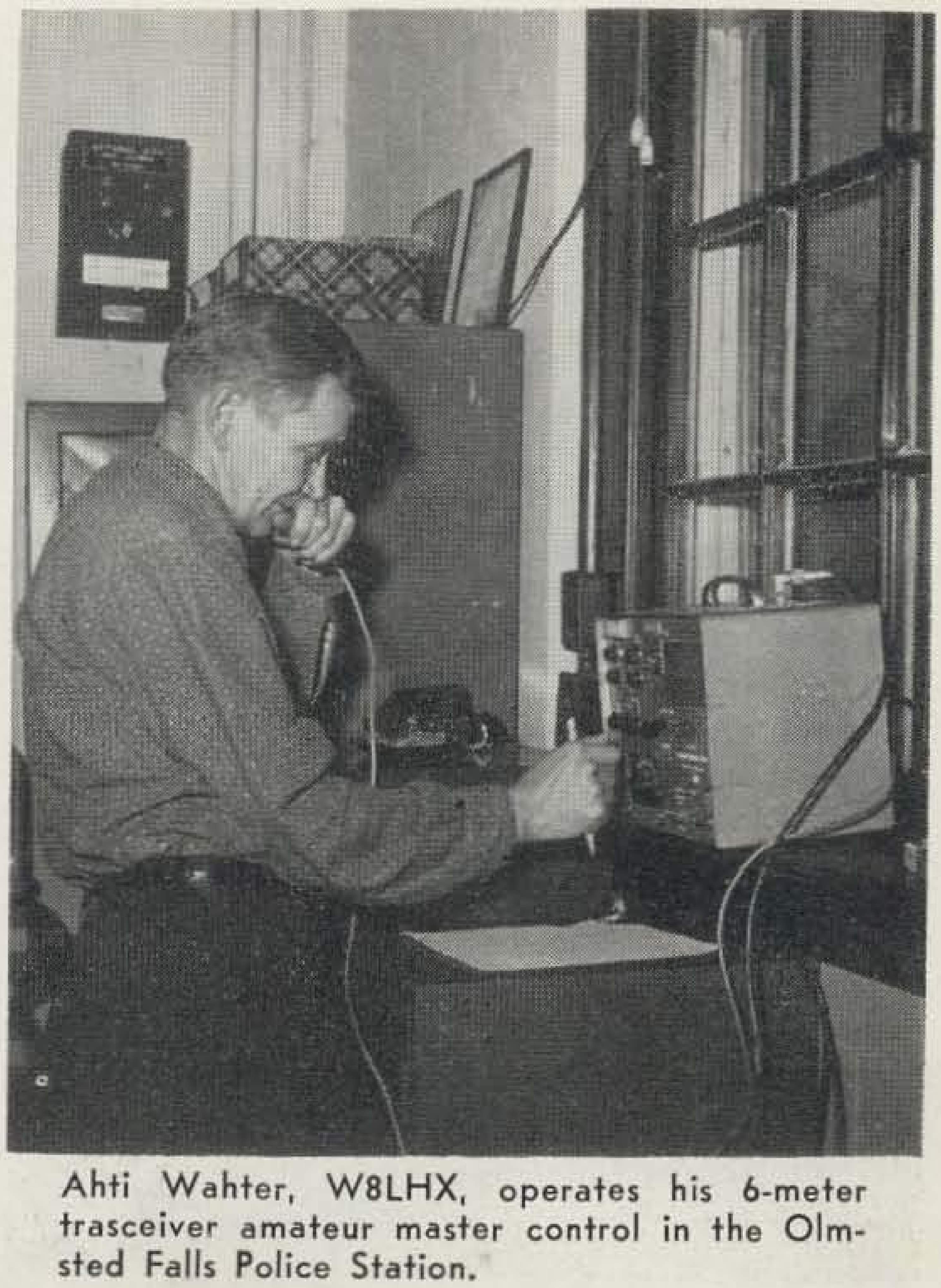
Ahti ("Ottie") Wahter, W8LHX, operated the 6-meter master control on Halloween. On preceding evenings, the patrol operated on 10 meters. Ahti is one of two amateurs who reports to the U. S. Weather Bureau for the thunderhead net in time of threatened severe thunderstorms of tornados.

Another outstanding ham in the patrol was Ed Posey, K8KKO, renowned for his rescue of 16 Valley View, Ohio, families in January of 1959. Ed volunteered and piloted his boat equipped with a 30-hp outboard motor to buck the current of the raging Cuyahoga River.

The amateurs on "Goblin Patrol" found much in the police group to appreciate and admire. Mrs. Dorothy Wurstner, wife of Patrolman Lee Wurstner, supplied and prepared an urn of coffee and three frosted cakes each of the four nights of patrol for the coffee break. Each of the police officers seemed more genial than the next, the geniality changing to firm tone and manner when it came to conducting police work.

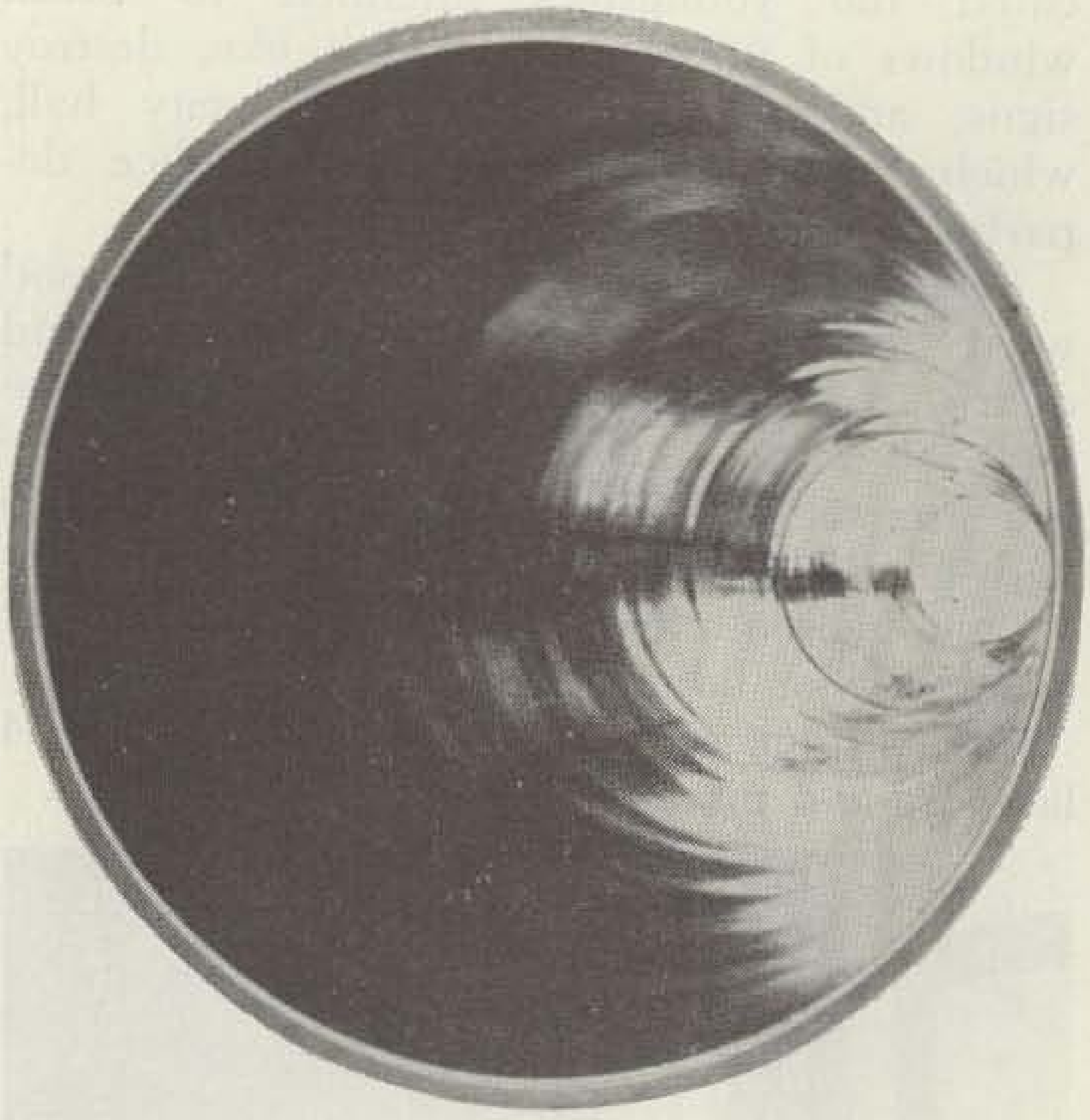
During the coffee break on Halloween, when the cars had returned to the station, someone managed to place a kitchen stove in the middle of Olmsted Falls' main street. Could he have had a receiver?

The 1960 Goblin Patrol ended at 12:30 A.M. It had been a quiet and relatively uneventful Halloween. Parting remark of one amateur as he turned to Chief Shirer: "Thanks, Chief. Invite me to your party again next year. **73**



Ahti Wahter, W8LHX, operates his 6-meter trasceiver amateur master control in the Olmsted Falls Police Station.

Lost In A Tunnel



Jim Kyle K5JKX/6
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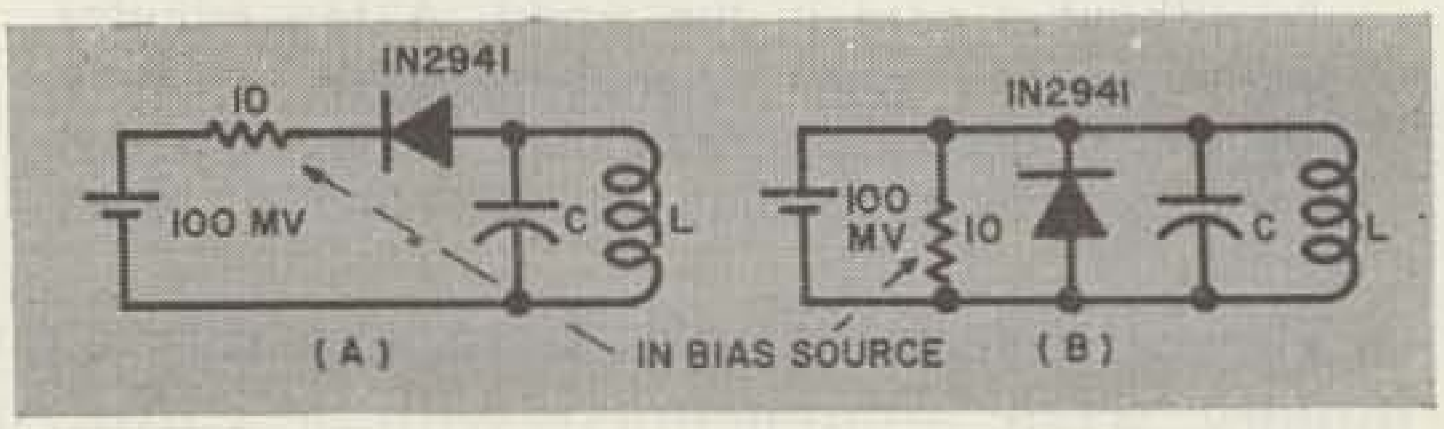
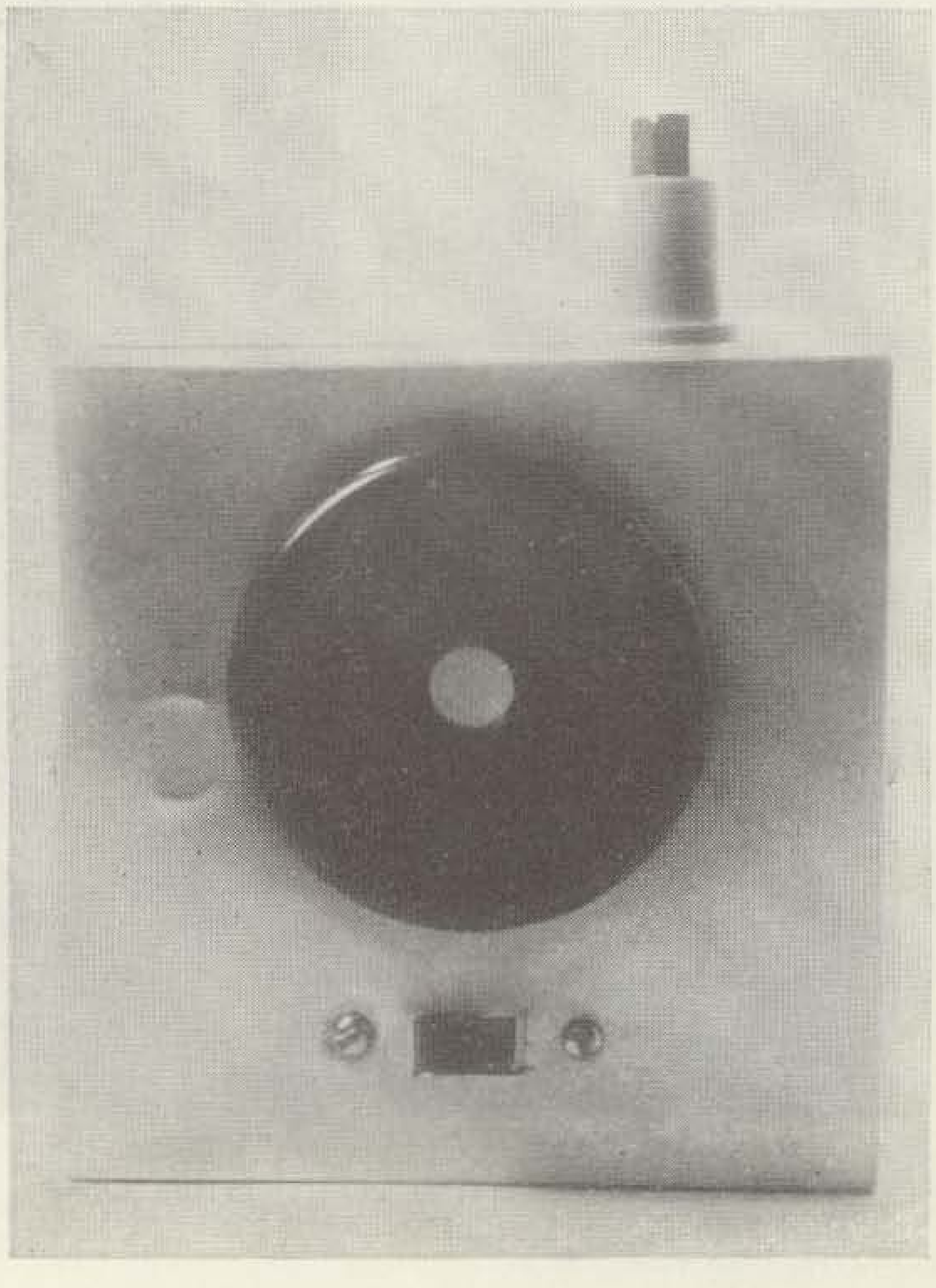


Fig. 1

Of the many new devices introduced into the electronics world within the past few years, none has captured the fancy of engineers, experimenters, and of course hams like the tunnel diode—that interesting little chunk of theoretically-impossible negative resistance which has nearly rewritten the book on semiconductor physics.

Shortly after the idea for "73" was born, this writer (half-humorously) suggested to Wayne that an article on "How To Build a

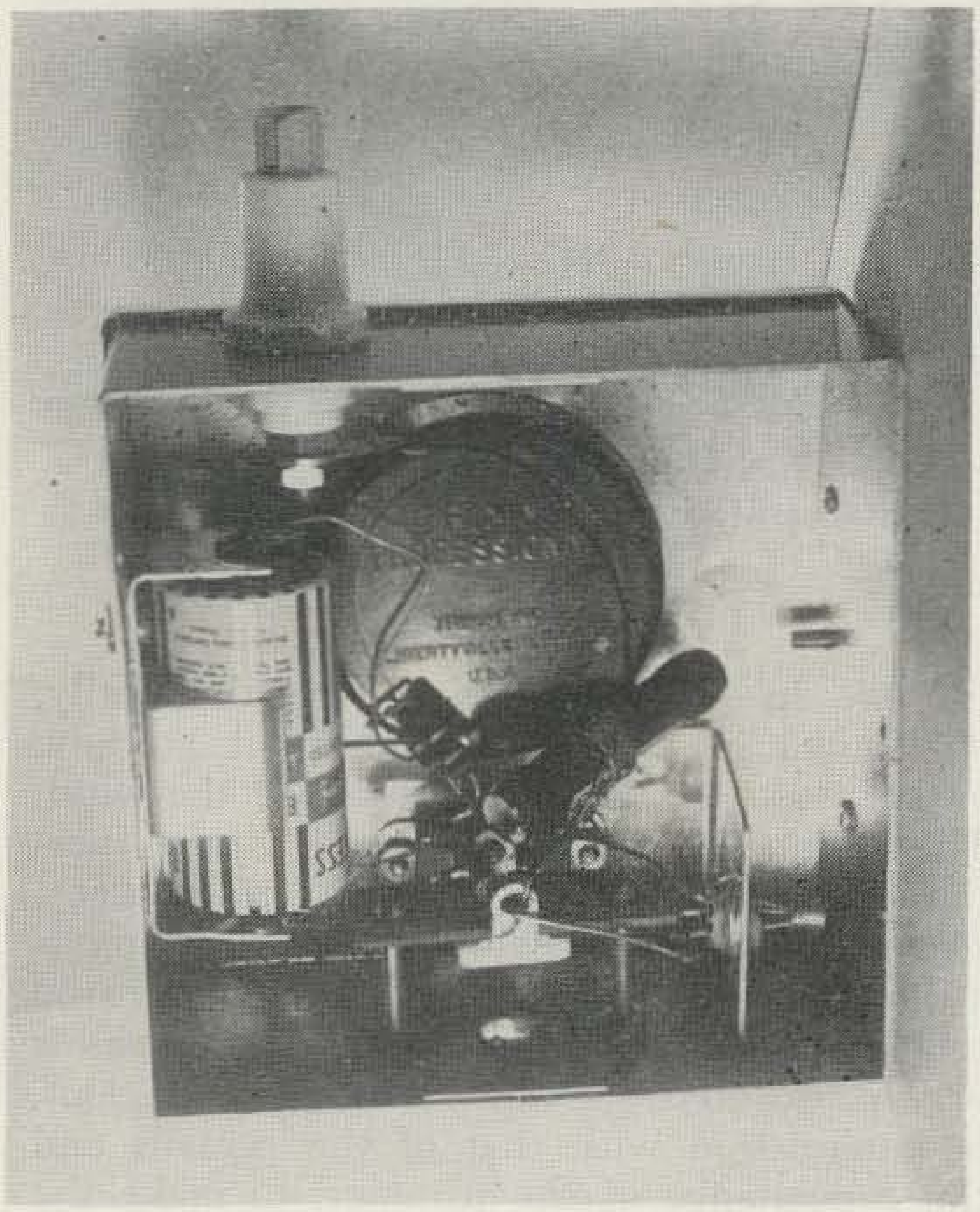


Head on view of front of rig. Box is 4 x 4 x 2.

Tunnel-Diode Transmitter" might be in line with the magazine's policy of bringing into focus the frontiers of amateur radio.

"Great!" was the answer from W2NSD. "Hop to it!"

The writer hopped. The only thing wrong was that this particular frontier seems determined to remain a soft-focus image. Whatever laws of classical physics fail to hold with the tunnel diode, at least one is proved truer than ever before: Murphy's Law No. 1—If in any project, any conceivable factor can cause the wrong result, it will!



Interior shambles. Messy look is due to short leads necessary for functioning of gadget.

Before going into the long story of how we got lost in the tunnel, let's say right here that this *is* a construction article. Before it's through, it will tell you how to build a tunnel diode transmitter that works. However, that's only a small part of the story, and if you want to stay out of trouble with the FCC, you'd better read it all.

As in the famed recipe for rabbit stew which begins, "First, you catch a rabbit," this instruction must begin with "First, get a tunnel diode." This isn't so hard as you might believe. Most major electronics parts houses catering to the industrial trade stock a few, and almost every manufacturer of semiconductors has at least one tunnel diode in the line.

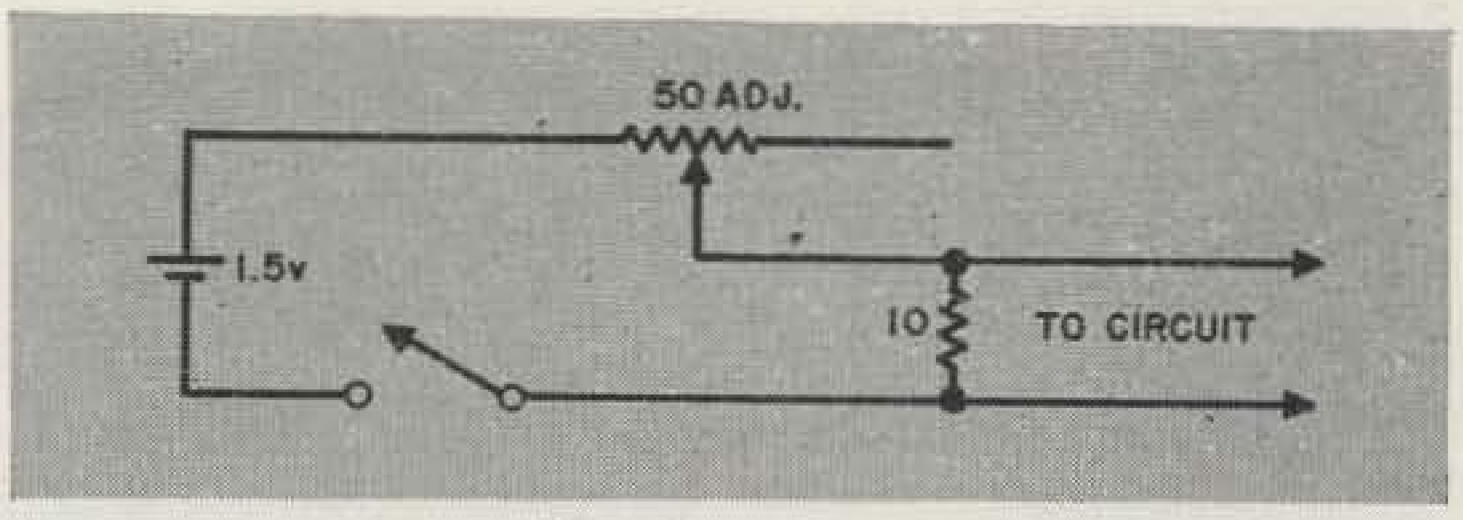


Fig. 2

One of the least expensive is the General Electric 1N2941, a 50-milliwatt, 5-milliamp unit which sells for $6.50 each in unit lots. You can buy 100 of them for $450, if you want your troubles in large doses. Others available for less than $15 include the Texas Instruments 1N653 and the Sony Esaki Diode (no type number) which sells for $10. The GE unit was used in this effort.

For a bit of background on the use of the gadget, see the July, 1960, issue of Radio-Electronics in which two GE researchers show how the negative resistance is achieved. A more scholarly treatment of the action appeared in the July, 1959, issue of the Proceedings of the I.R.E.

If you happen to read both these articles, you will discover that there are at least two ways to go about building a tunnel-diode oscillator, in theory at least. For convenience, we called these "Type A" and "Type B" circuits. They're shown in Figure 1.

Looking at the circuits, you see that the source of bias voltage—necessary for operation of the device—is specified as a 100-millivolt battery with zero internal resistance. Naturally, such a varmint doesn't exist. Obtaining such a power source (or at least, something which would look just like it to the diode) proved to be somewhat of a problem.

Fortunately, following the lead of the GE researchers, a circuit was developed which provides from 10 millivolts to 1.5 volts, with an effective 10-ohm internal impedance. It's shown in Figure 2. This bias-source circuit, without change, was used in both Type A and Type B oscillators and produced perfect results. However, there's a disadvantage—due to the heavy drain of the two resistors, the battery only lasts about a week. Be sure to disconnect it when the rig isn't in use to keep the battery alive longer.

Now to the long story. The first circuit tried was the Type A, following the lead of the GE people. With various inductance values inserted in the tank circuit—and omitting all lumped capacitance—fine oscillations were produced at several points between 12 and 20 megacycles. Modulation was accom-

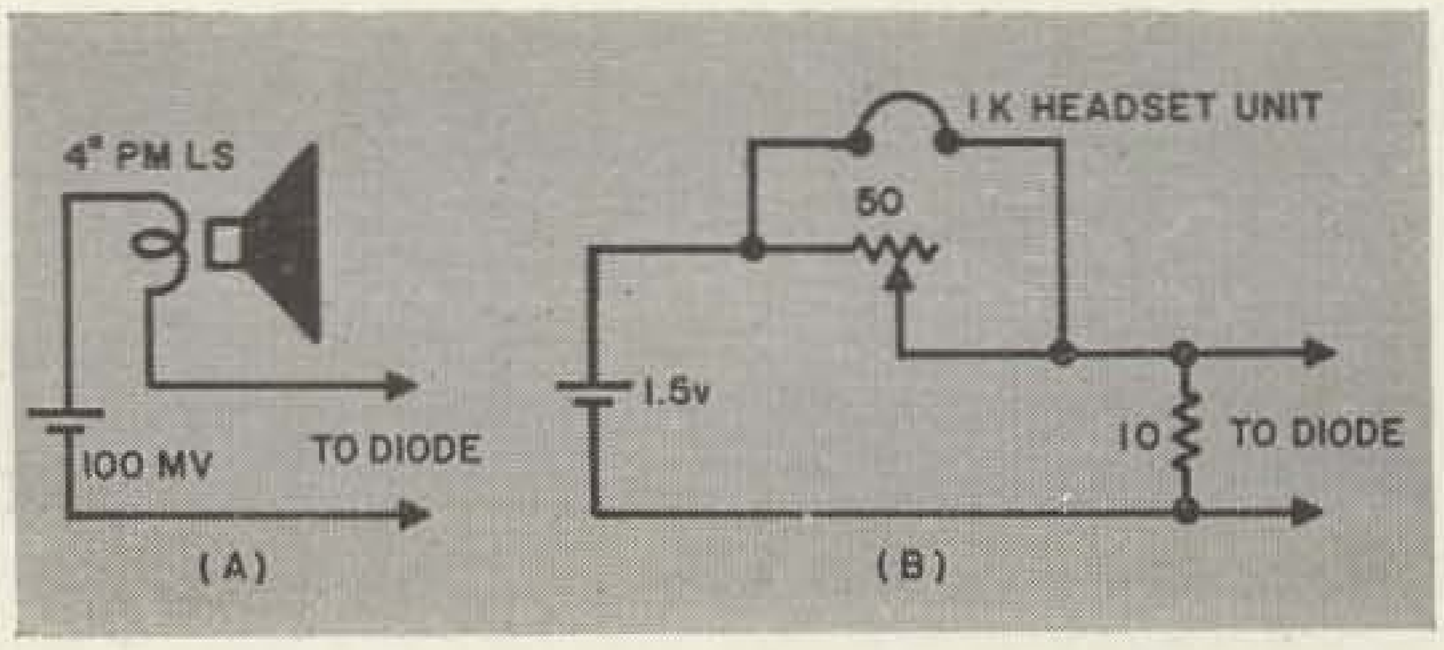


Fig. 3

plished as shown in Figure 3A, and the resulting FM-AM combination was copiable on a Super-Pro in the 25-kc bandwidth position although quality was definitely poor.

This original attempt might have resulted in the article in itself, except for one item: Murphy's Law. The inanimate objects proved their perversity, for the blame thing absolutely refused to oscillate within the borders of any amateur band. At 13.7 mc, yes. At 14.7 mc, yes. But between 14.2 and 14.35 mc, no indeedy! After a week's effort, project A-1 was abandoned and the Type B circuit was tried.

The Type B circuit evolves from experiments carried out in RCA's David Sarnoff Research Center. While the Type A arrangement places the tank in series with the diode, the Type B circuit places the tank and the diode in parallel. This makes them more tractable at SHF, although it has little effect at lower frequencies.

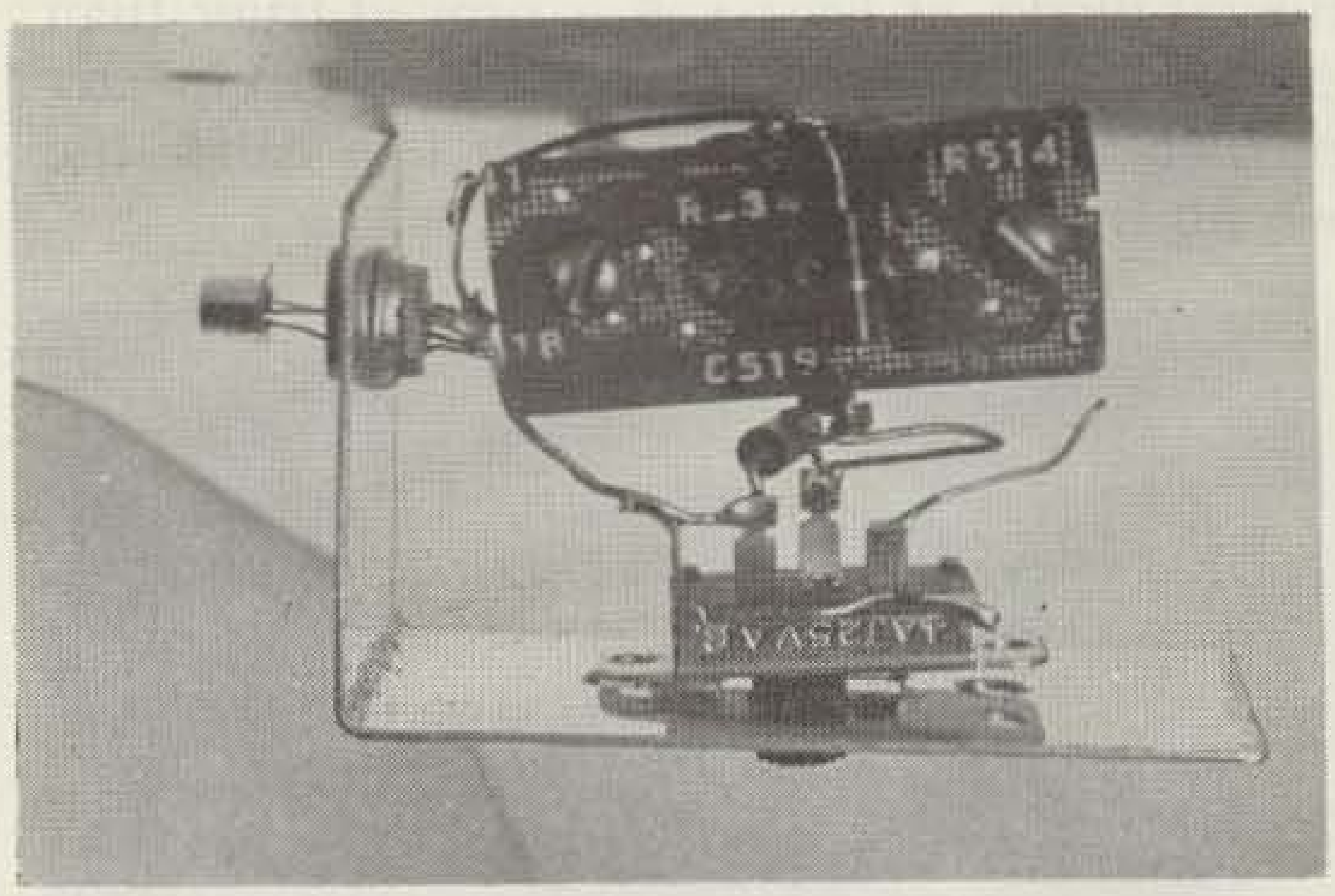
The target this trip was a 432-mc converter consisting only of a tank, a diode, and the bias circuit. An 8-inch strip of twin-lead was used for the tank, and the 10-ohm resistor of the bias supply was used to provide the short at the shorted end of the line. The diode was located an inch out from the resistor, and bias leads were run from the resistor through 1-uh rf chokes.

Like the preceding circuit, this one oscillated nicely with approximately 100 millivolts applied. When the Super-Pro's antenna lead was connected to the loading resistor (a zero-voltage point for the rf within the oscillator) any number of TV carriers could be obtained. Varying bias voltage between 70 and 150 millivolts tuned the oscillator across many, many megacycles. However, the signal from the grid-dipper which was simulating an incoming 432-mc signal eluded capture. After nearly 40 hours of searching with the receiver set in 3-kc bandwidth position, the signal was spotted—but promptly faded out when the dipper was moved more than six inches from the tuned line.

Sensitivity? Hardly!

Project B-1 went down the drain and the writer went to see the engineers.

After several weeks' study, during which a number of other versions were constructed, tested, adjusted, retested, and torn down, Project A-9 was put together. It was different from all its predecessors. It worked.



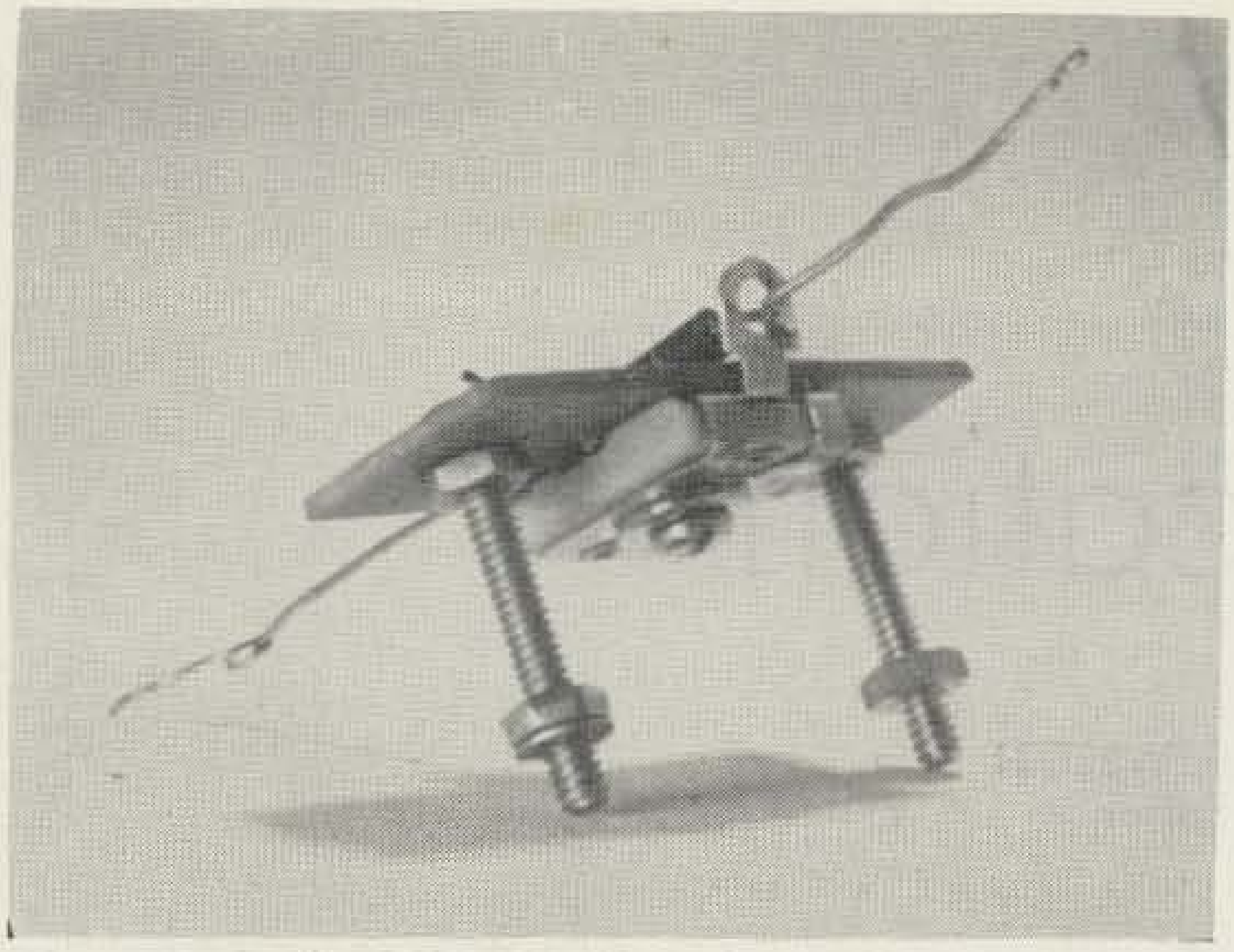
Main subassembly shown separately. Diode and those resistors not part of power supply are shown.

Since its circuitry also differs, drastically, it's shown in Figure 4. Note that no tank circuit exists, in the normal sense of the word. The engineers deduced that irregular performance of earlier models was due to excessive inductance which forced them to operate in the switching mode rather than as true oscillators, so the 20-ohm composition resistor was substituted. Its inductance is sufficient, in conjunction with that of the pigtails and the capacitance of the trimmer, to make the device operate in the range from 50 to 150 mc.

Modulation in this one is somewhat different, also, as shown in Figure 3B and 4. DC resistance of the headphone unit is high enough not to upset the biasing arrangement, and ac output is great enough to give a swing of nearly a megacycle in the 50-mc region—far too great to be used below 525.5 mc.

If you want to build one of these, duplication of the Figure 4 circuit is recommended as a starting point. It's far from perfect, but it *can* be used to amaze your friends, at least. With a few months more work, it can probably be developed into a reliable hand-carried portable good for up to a mile or so, suitable for CD and transmitter-hunt usage.

A standard 4x4x2 Minibox makes a good chassis, with a subchassis of light aluminum inside to hold the tunnel-diode socket and the



The tank circuit (also shown in No. 4). Capacitor is visible, resistor is partially hidden behind phenolic board. Incidentally, phenolic board was scrounged from old RCA printed circuit; this is reason for stencilled numbers on it which may draw questions.

switch. Wiring is straightforward, with one exception: DON'T CUT RESISTOR LEADS SHORT! While component leads should usually be short in VHF work, this rig uses their inductance for a tank circuit, and if you dress them in proper approved fashion, it probably won't work at all.

The big problem with this gadget is coupling of the antenna. If you have a perfectly-matched line which is actually a true resistance, it can probably be shunted across the 20-ohm resistor without effect. However, any reactance reflected into the circuit will be ruinous to its performance. Whip antenna and the like are out—every movement within 15 feet shifts the operating frequency a megacycle or more.

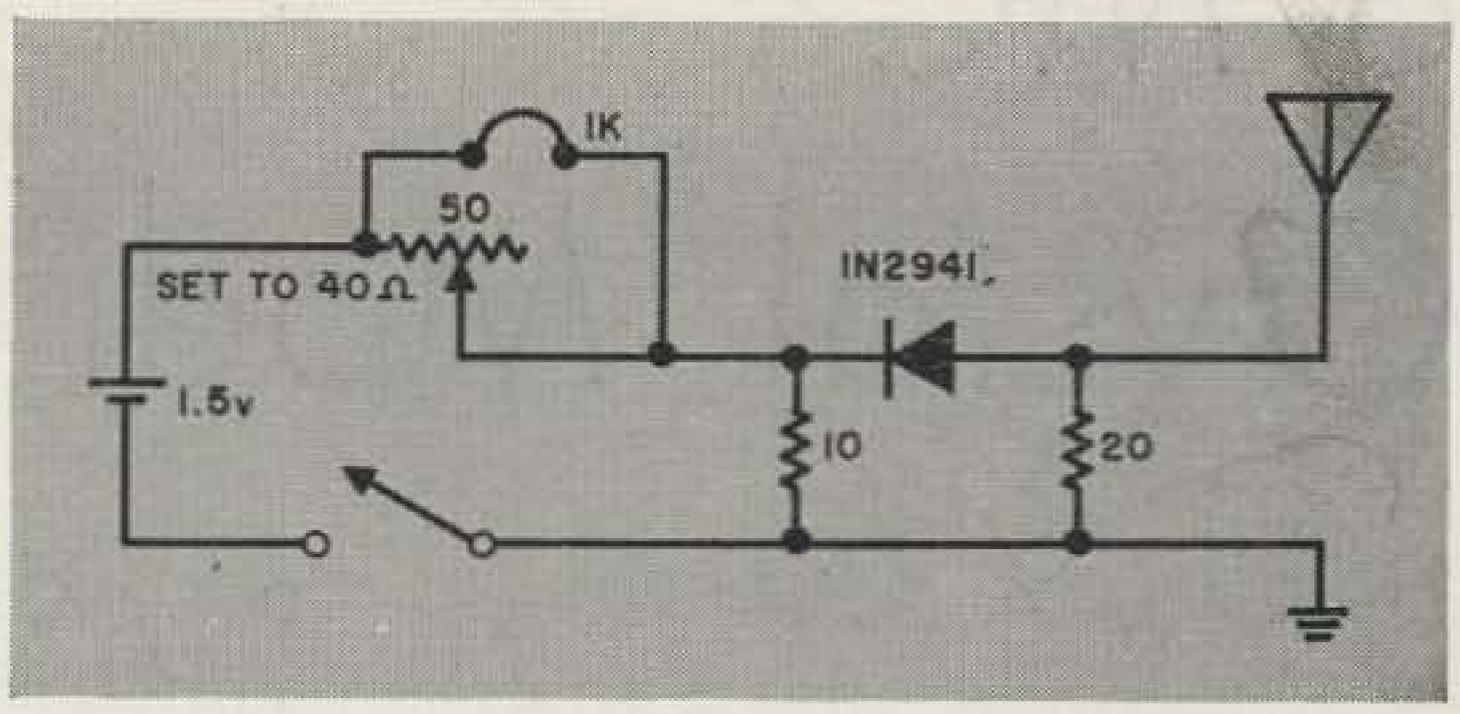


Fig. 4

This may sound as if the gadget is still far from perfected. You're right—it is. The only claim made for this gadget at the present time is that it produces modulated rf—about 1 volt of it peak-to-peak into a 1-megohm load. Location of this rf in the frequency spectrum is *not* guaranteed. If it falls within the bounds of any ham band, you're not just lucky, you must be the seventh son of a seventh son of a sev . . . The gadget, as hinted earlier, is notoriously unstable so long as any reactance whatsoever is in the vicinity —and this includes the variation in capacitance caused by the breathing of the operator. However, it does show promise, and that's why it's here.

Meanwhile, back at the madhouse, experimentation continues. Someday soon, model C-293 may produce more useable results. If not, you can still say you read about the battle first in . . . 73

"Mechanized Hole Cutting"

Roy E. Pafenberg

The problem of cutting large round holes in heavy steel rack panels has long plagued the amateur who uses this method of construction. Hole saws and Greenlee knockout punches have been used with varying degrees of success. Of course the hard way of drilling a circle of small holes and chewing out the remaining metal is used by many but this is extremely laborious and the results leave much to be desired.

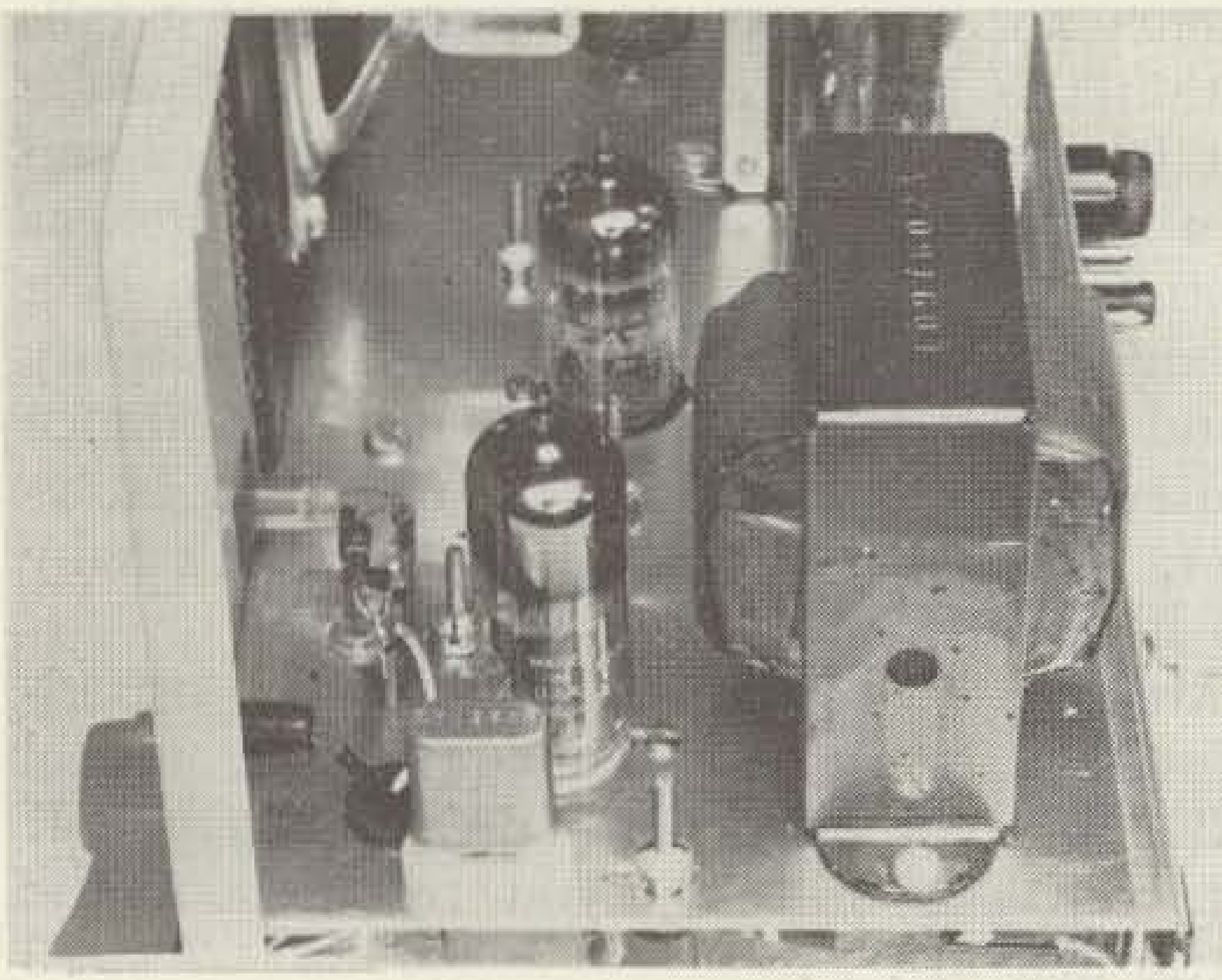
Electric impact tools, or wrenches as they are commonly known, are becoming more and more popular and are available with a wide range of attachments. The Greenlee hole punch becomes a formidable tool when powered by one of these labor saving devices. The comparatively light, rapid impacts of the tool drives the punch through the thickest metal with great rapidity. The wear and tear on the punch and drive screw is much less and the familiar problem of twisting off the drive screw is virtually eliminated.

These handy tools have many other uses and any number of drilling, tapping and threading operations may be accomplished in addition to that of nut driving. Use one and you will not be happy until you own one. ■

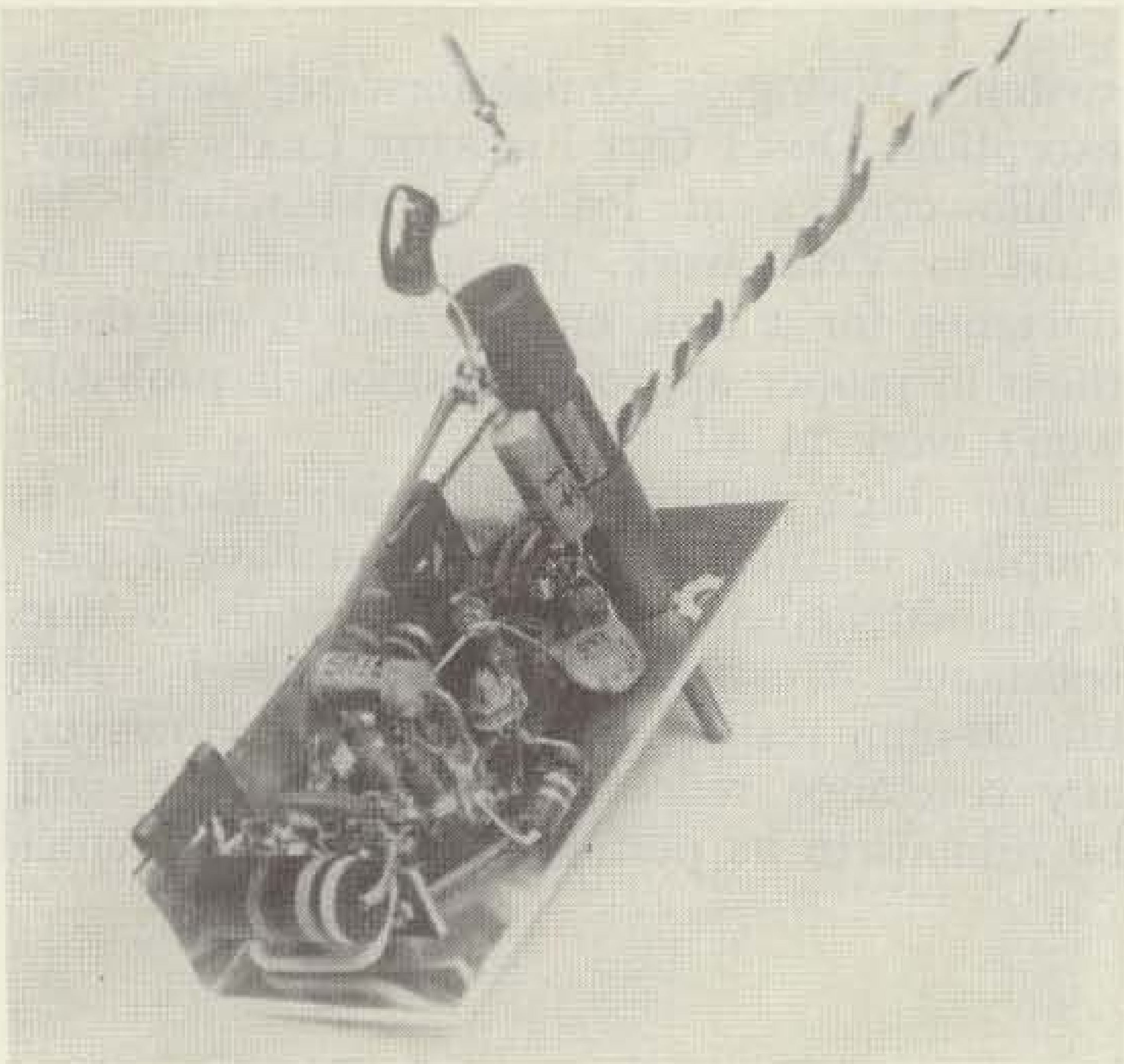
8 MC Crystal Modification

Donald A. Smith W3UZN
Associate Editor

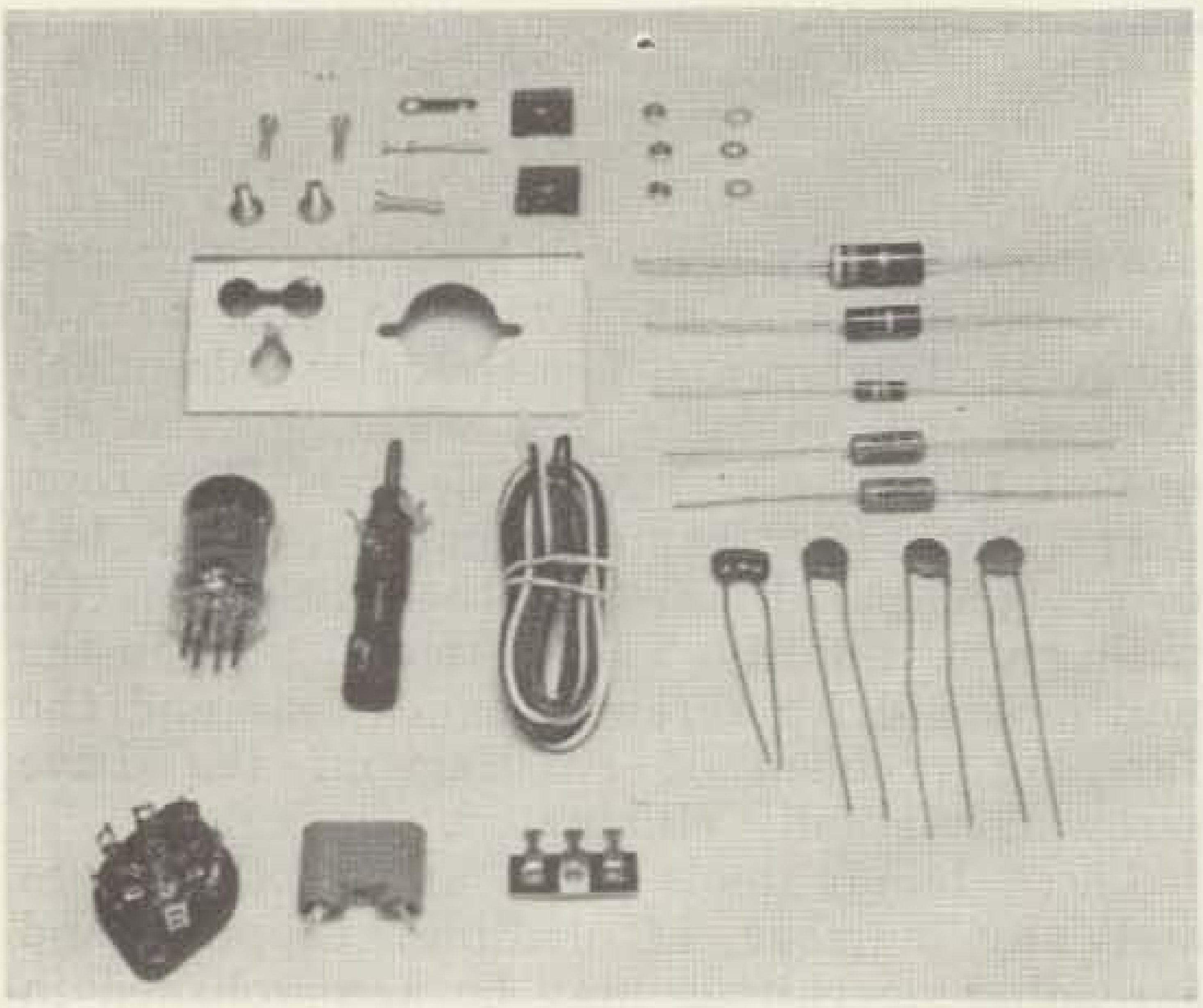
THE very popular Heath 6 meter transceiver can now be modified for 8 mc crystals, with Heaths new Modification kit, HWM-29-1. Following Heath's policy of improvement for existing kits, this modification has been released to all previous purchasers of the 6 meter transceiver for $4.95. This includes *all* parts, even the necessary hardware! All new HW-29's purchased will be shipped with this modification kit and the customer billed for $4.95. Kits shipped after the first of the year will incorporate this change in the main chassis and no modification will be required.



Close up of oscillator and xtal before modification.



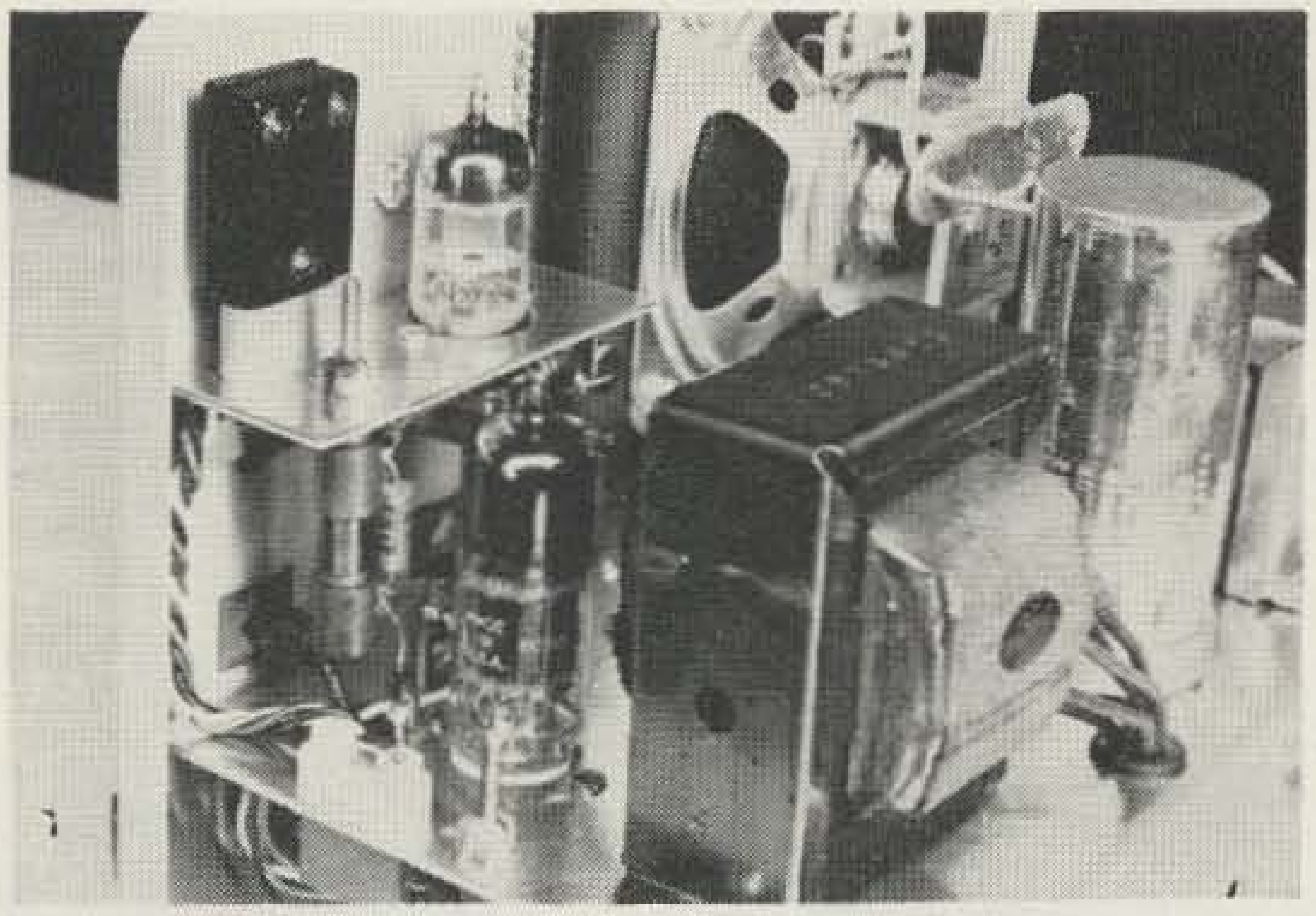
Another view of completed chassis.



Parts furnished with HWM-29-1 Modification kit.

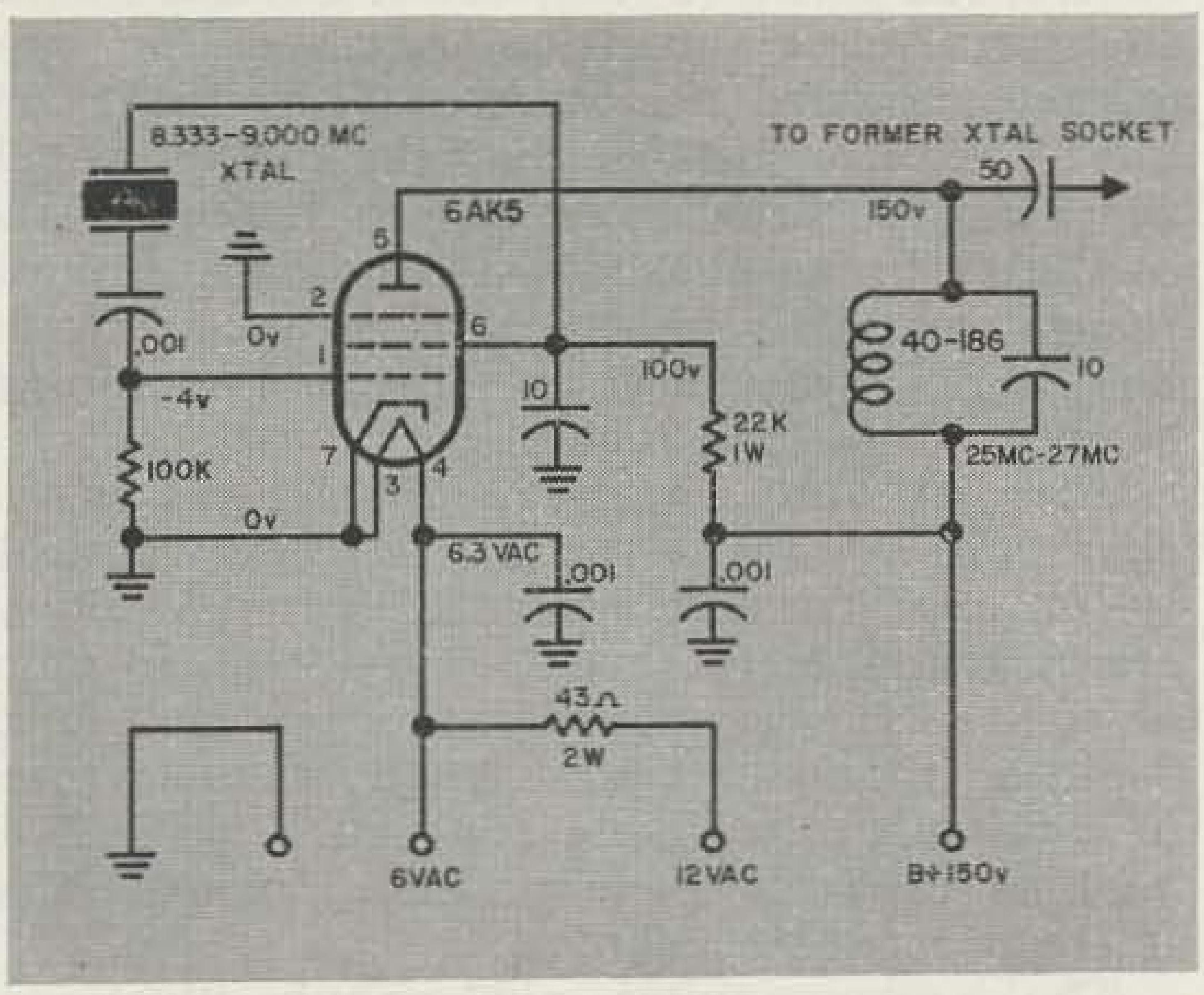
The advantages of this modification are numerous. Probably most important is frequency stability, which is improved for two reasons. First, the fundamental quartz crystals are inherently more stable than the fifth overtone types and secondly because the crystal oscillator is isolated from the final amplifier. Other advantages include; 8 mc crystals are *much* cheaper and more readily available than the overtone type. Power output is also increased, as the final amplifier operates straight through and has more drive than with the old circuit.

A modified Pierce oscillator circuit is used for the oscillator stage, employing a 6AK5 tube. 8.333 to 9 mc crystals are used in the grid circuit and the plate is tuned to the third harmonic of the crystal. The output of the new oscillator is fed to the grid of the old oscillator stage, which now becomes a doubler stage. The new circuitry does not overload the ac power supply and one Heath vibrator supply is still ample to operate the unit while mobile.



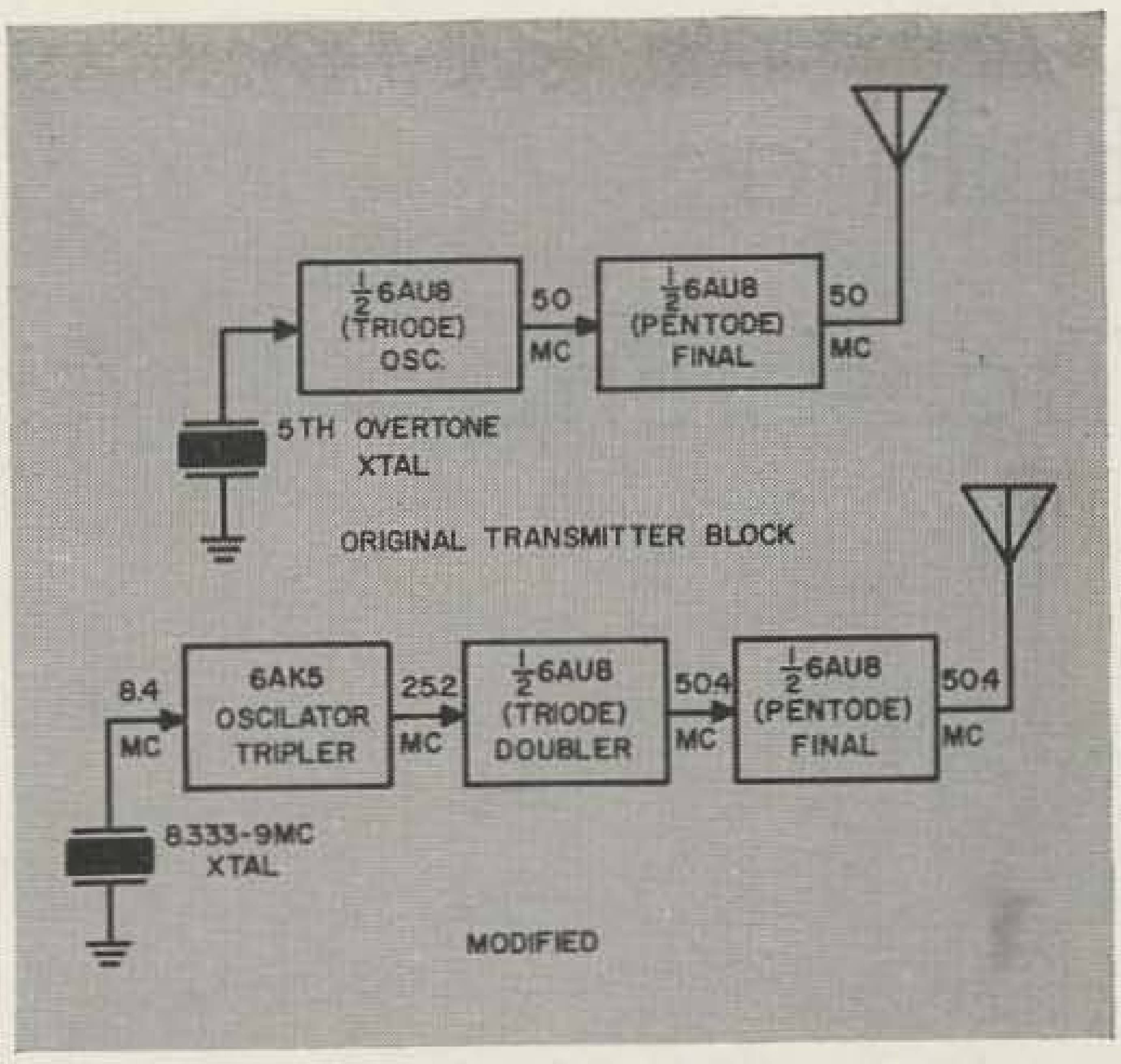
Close up of transceiver with new circuit installed.

One of the photos shows the parts included in the modification kit. Note that a miniature chassis is furnished and all new parts are mounted and wired on it. The new crystal socket for the 8 mc xtals is mounted on one end of this chassis and takes the common FT-243 size. Complete instructions for wiring the new oscillator circuit are included, as they are with all Heath kits. It is necessary to drill two holes in the front panel of the transceiver to mount the new chassis. A template in the manual simplifies the layout of these holes. The photos show the unit completely wired before installation in the unit so that you may see the wiring.



Circuit diagram of new, added circuit.

No difficulties were encountered in the building or installing of the modification kit and it required about an hour or so to complete the job. The real enjoyment began when an 8.4 mc xtal was installed, 6AK5 placed in its

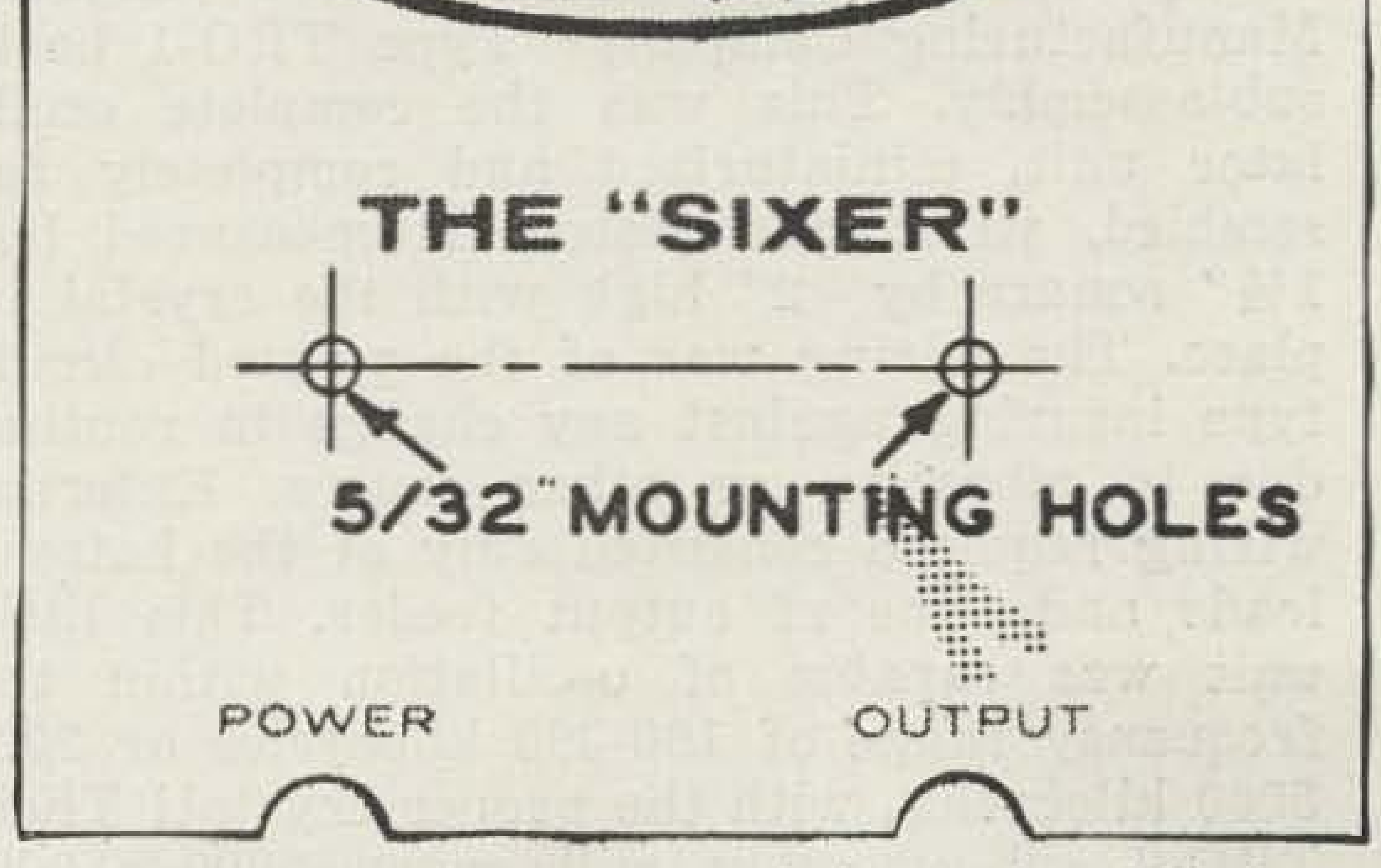


Block diagram of transmitter before and after modification.

socket and the rig turned on. Tune up was then like any other rig. The oscillator slug was tuned to 25.2 mc, the doubler to 50.4 and the same for the final. No parasitics could be found and the circuits would not double tune.

Air trials were most encouraging. Stations worked in York, Pa., approximately 100 miles over the mountains asked if I had increased power! Frequency stability was terrific. I had a station in York zero beat my signal with his BFO. Then I cut my carrier for 60 seconds or so and then turned back on. He said that I was still zero beating with his BFO! All in all, signal reports were somewhat better than before, plus frequency stability and a lack of FM.

For an investment of $4.95 a great deal more pleasure and reliability can be had from your little HW-29. 73



Template for locating two holes to be drilled in front panel of the transceiver.

Build a Transistorized Crystal Frequency Standard

Howard S. Pyle, "YB" W70E
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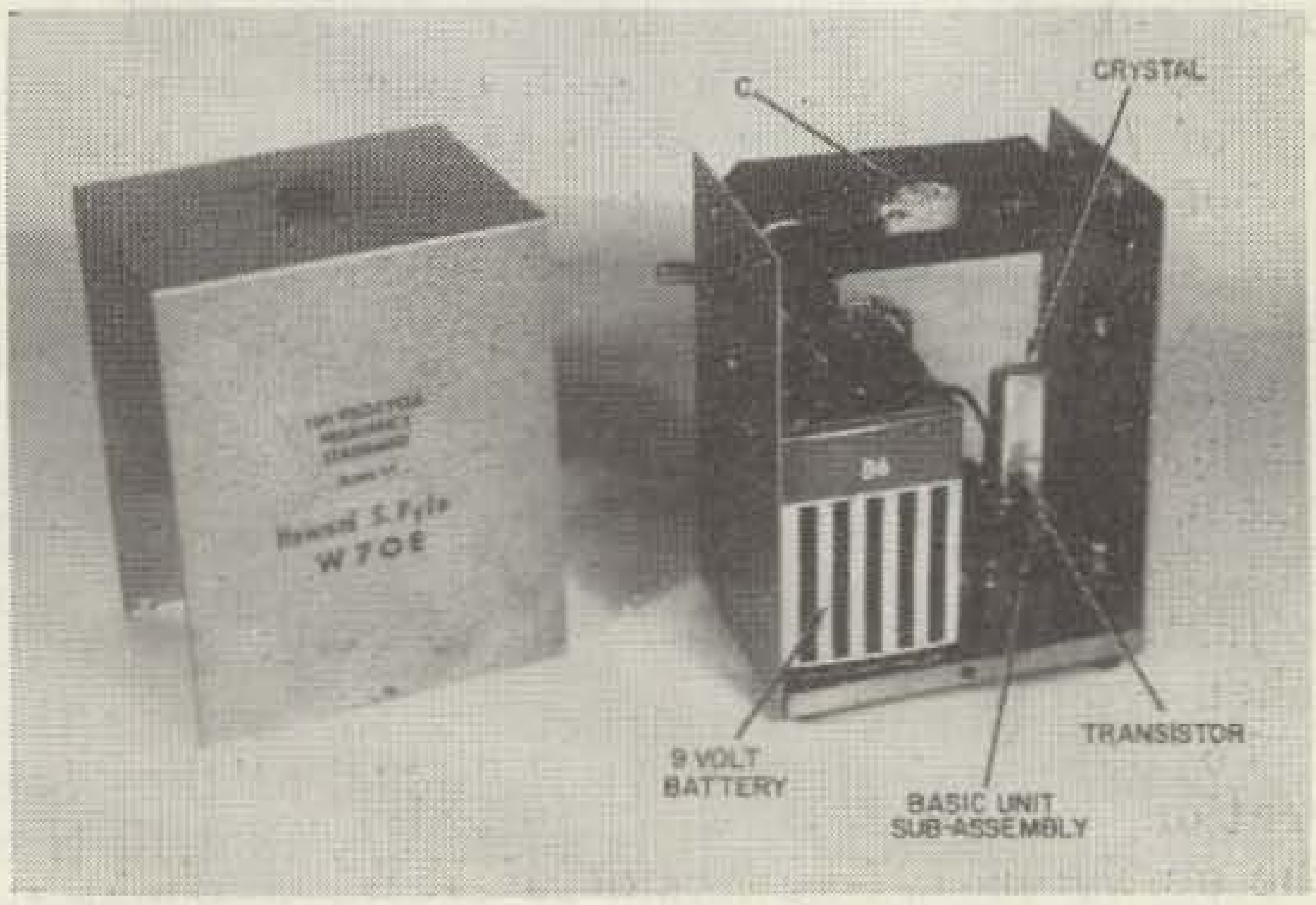
FOR some time I had been debating construction of a transistorized crystal frequency standard. A number of crystal authorities whom I consulted warned me that not only would the crystal and the transistor be rather critical but that lead length and routing of the wiring would affect the frequency of even the best crystals. All suggested procuring a basic unit sub-assembly, wired and tested by an established factory specializing in precision crystal/transistor work. I could then build around it with the assurance that performance would equal expectations.

Their arguments seemed logical, although it did begin to look like a rather expensive procedure. At any rate, I commenced shopping around. I didn't want a frequency standard for which I had to use a compensation curve; I wanted 'on-the-nose' accuracy without a lot of namby-pamby, although I had visions of the greatest part of a fifty dollar bill going down the drain! That it *didn't*, continues to amaze me. You know what? I came out with a total cost for the basic unit including transistor, precision ground crystal, cabinet, battery and toggle switch for around *fifteen dollars*, give or take a few cents!

After poring over several excellent 'dope sheets' sent me by various manufacturers, I finally selected the International Crystal Manufacturing Company* Type TRO-1 basic sub-assembly. This was the complete oscillator unit, miniaturized and completely assembled, wired and tested. It measured but 1½" square by 2" high with the crystal in place. The wiring was of the printed circuit type insuring against any change in routing due to vibration or other causes. External wiring required consisted only of the battery leads and the rf output feeder. This little unit was capable of oscillation within the frequency range of 100-300 kilocycles or 200-5000 kilocycles, with the proper crystal! Their TRO-2 sub-assembly will cover 3000-20,000 kc and the TRO-3, 15 to 60 megacycles, in five ranges! Any one of the three basic units will cost exactly *four* dollars; the first surprise! The precision ground crystal is, of course, the greatest cost; $8.50. Several manufacturers offer precision crystals for frequency standard use at from $6.00 to $10.00, but it is recommended that the crystal which the manufacturer has used to calibrate the oscillator be purchased with the basic unit to insure complete accuracy. The same would hold should you elect to purchase a sub-assembly of another make.



This little unit can be mounted right on the chassis of your receiver if you like; practically all modern receivers still have a bit of space available for such a tiny item, in spite of their many components. Or, you can do as I did so that you have a really flexible piece of equipment available for bench testing as well as checking your receiver; mount it in its own separate cabinet.

The accompanying photograph illustrates the treatment which I used. As its power requirements are only 9 volts dc at 2 ma, I chose a Burgess type D6 battery and used a conventional, bat-handled toggle switch with which to turn the power on and off. I wired this into the *negative* battery lead; note that the *positive* lead is grounded. Actually, with

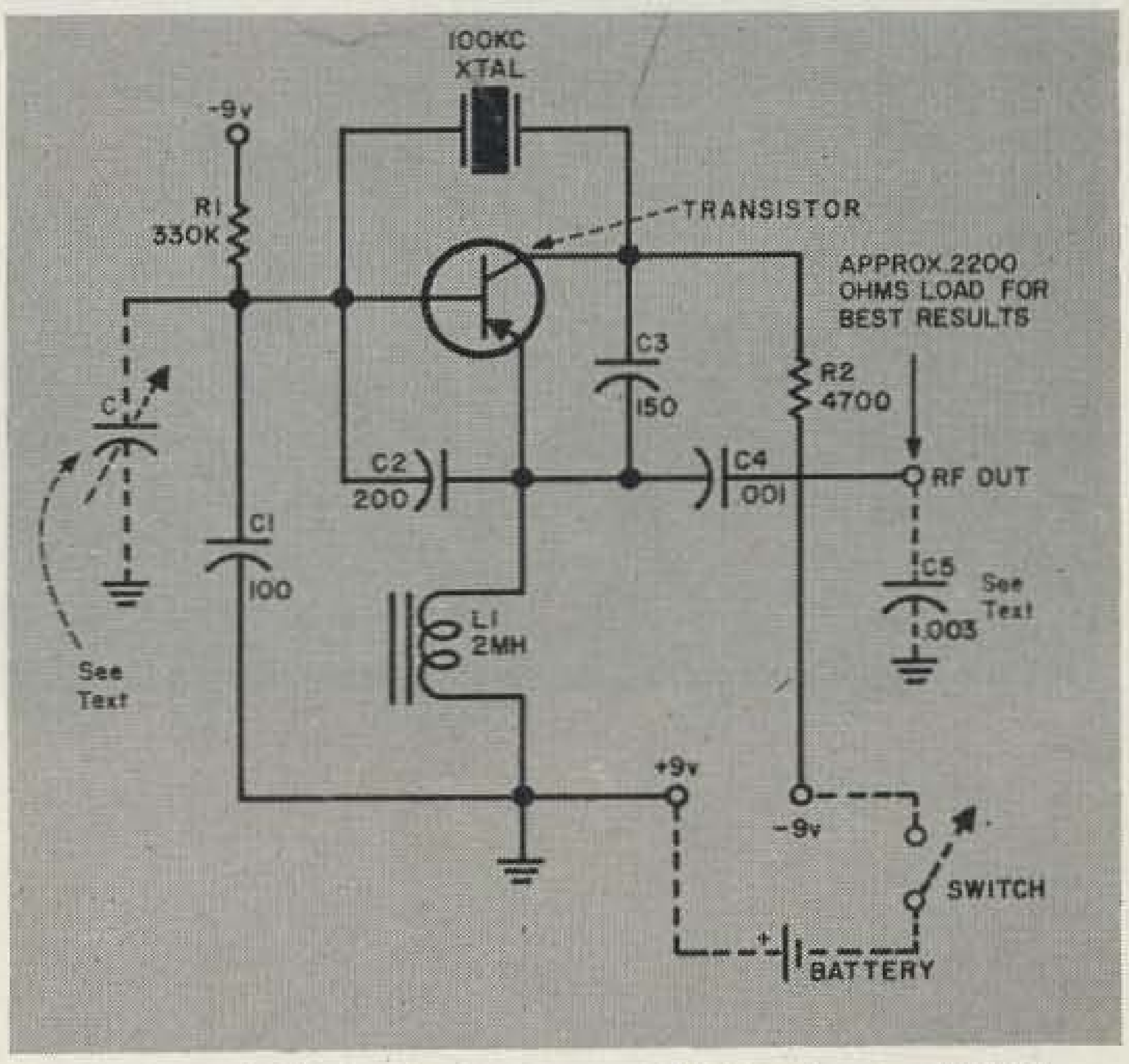
*19 North Lee, Oklahoma City, Okla.

this small current drain, such a battery will last for many months *without* turning it off, but for complete flexibility, particularly when installed in your receiver, use a switch.

For the rf output I used a standard phono pick-up jack available at any ham radio store. A short length (6" in my case) of flexible, stranded hook-up wire fitted with an alligator clip at one end and the plug of the phono jack at the other permitted feeding the rf output of the oscillator into my receiver or any other device as required.

The enclosing cabinet which I used was an LMB chassis box which is also a stock item with most ham distributors. The one I chose was LMB's #140 of hammartone grey finish and which readily accommodated all components including the battery. I fitted this with small rubber feet and bent up a small aluminum sub-chassis on which to mount condenser C. This is merely a small trimmer condenser of 7-45 mmfd; the one I used was an Erie, N-500 (most distributors); any equivalent will do. It permits compensating for any minor variation in frequency which may be introduced by the cabinet and the internal wiring therein; though you may not need it, put it in, just in case. A ⅜" hole in the cabinet top, insulated by a rubber grommet, permits adjustment of this condenser externally, if and when required.

To put your frequency standard into operation, set your receiver initially on one of the on-the-nose frequencies of WWV, WWVH or some other known accurate frequency transmission of the fundamental or harmonic frequencies of your standard. Clip the rf output of your frequency standard on your receiver antenna post in place of your regular antenna, and turn the switch on the frequency standard to the 'on' position. If you don't hear the CW tone from the frequency standard, adjust C slightly; it should bring you right on with a minute fraction of a turn. Set for zero beat and you've got it made . . . that's all there is to it!



If you still feel that you'd like to build 'from scratch' without benefit of a basic unit and make your own calibration (it may prove tricky!), the International Crystal Manufacturing Company has been kind enough to give permission to reproduce the circuit which they use on their TRO-1L sub-assembly, together with component values. Like the trimmer condenser C, the fixed condenser C5 is an accessory item, not supplied with the TRO-1L sub-assembly and which you may or may not want to add. It merely serves to improve the wave shape of the output which was of no concern to me, therefore I ignored adding it.

Go to it but remember that just any old crystal, transistor and circuit are liable to cause you headaches! A frequency standard is a precision device; better play it safe! 73

Polarity Test Paper

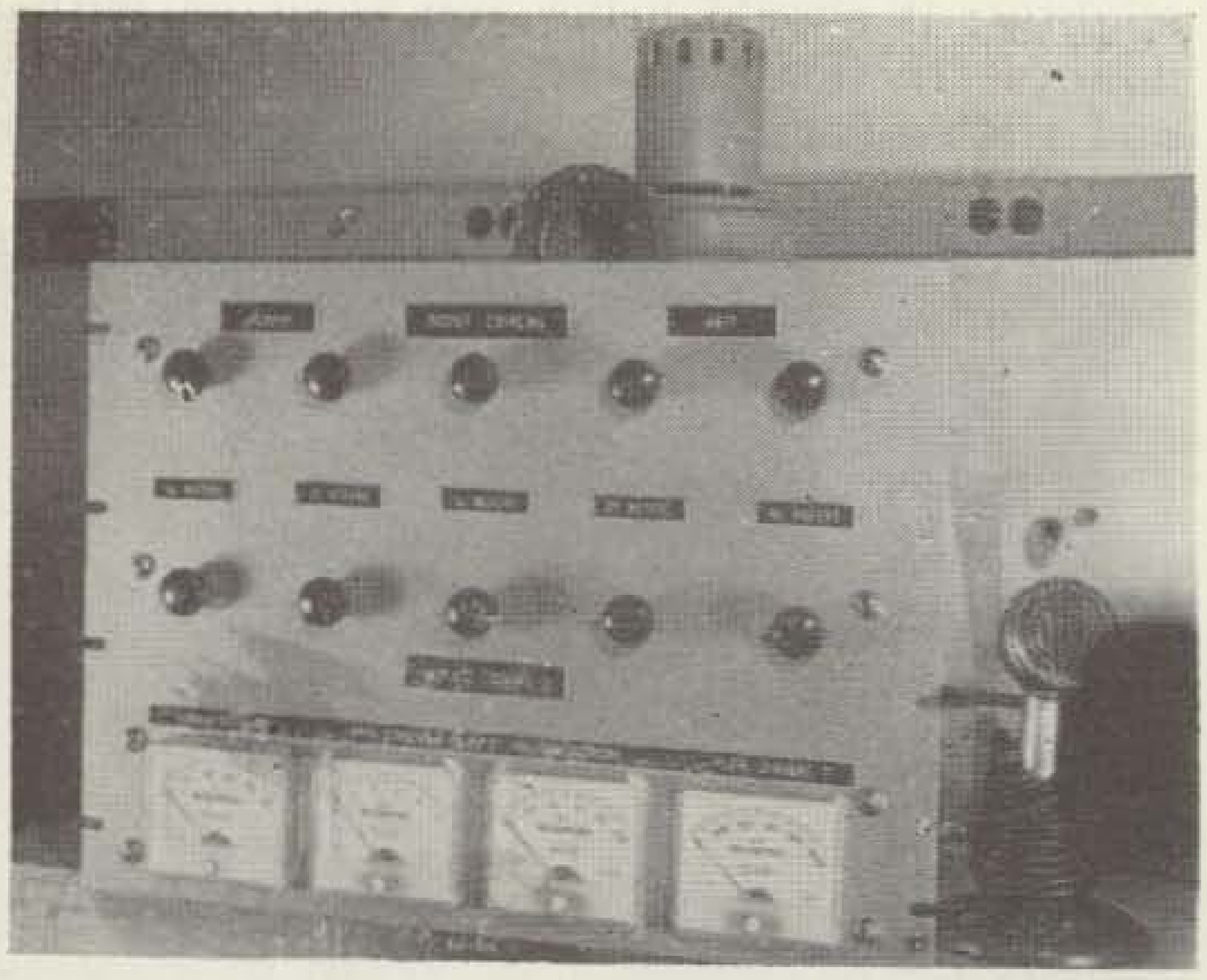
Bob Rooney, W2QCI

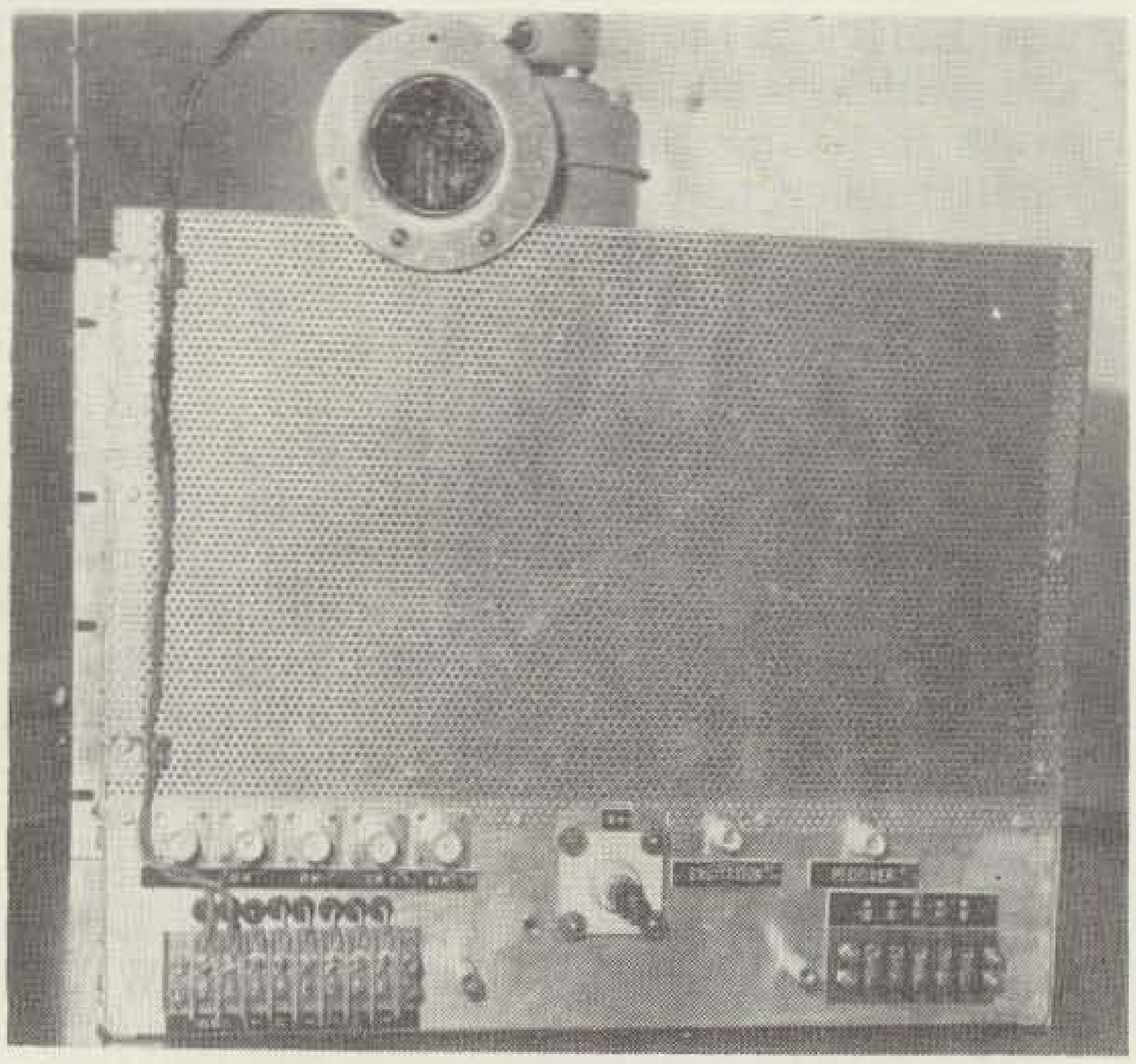
One of the simplest ways to find the polarity of current is through the use of polarity test paper. From two common chemicals which can be obtained at the neighborhood pharmacy, it is possible to make an almost unlimited supply of this paper quickly and economically.

In use, the paper is slightly moistened and placed in contact with the two terminals of the current supply so that the terminals are separated from each other by one or two inches. In the case of direct current a bright red stain will appear on the test paper near the negative terminal. When alternating current is used the red stain will appear at both terminals.

To prepare the test paper we can take any fairly absorbent paper ("Slick" paper such as that which **73** is printed on is not recommended) and briefly soak it in the solution described below. Allow the paper to dry and merely moisten with water before use.

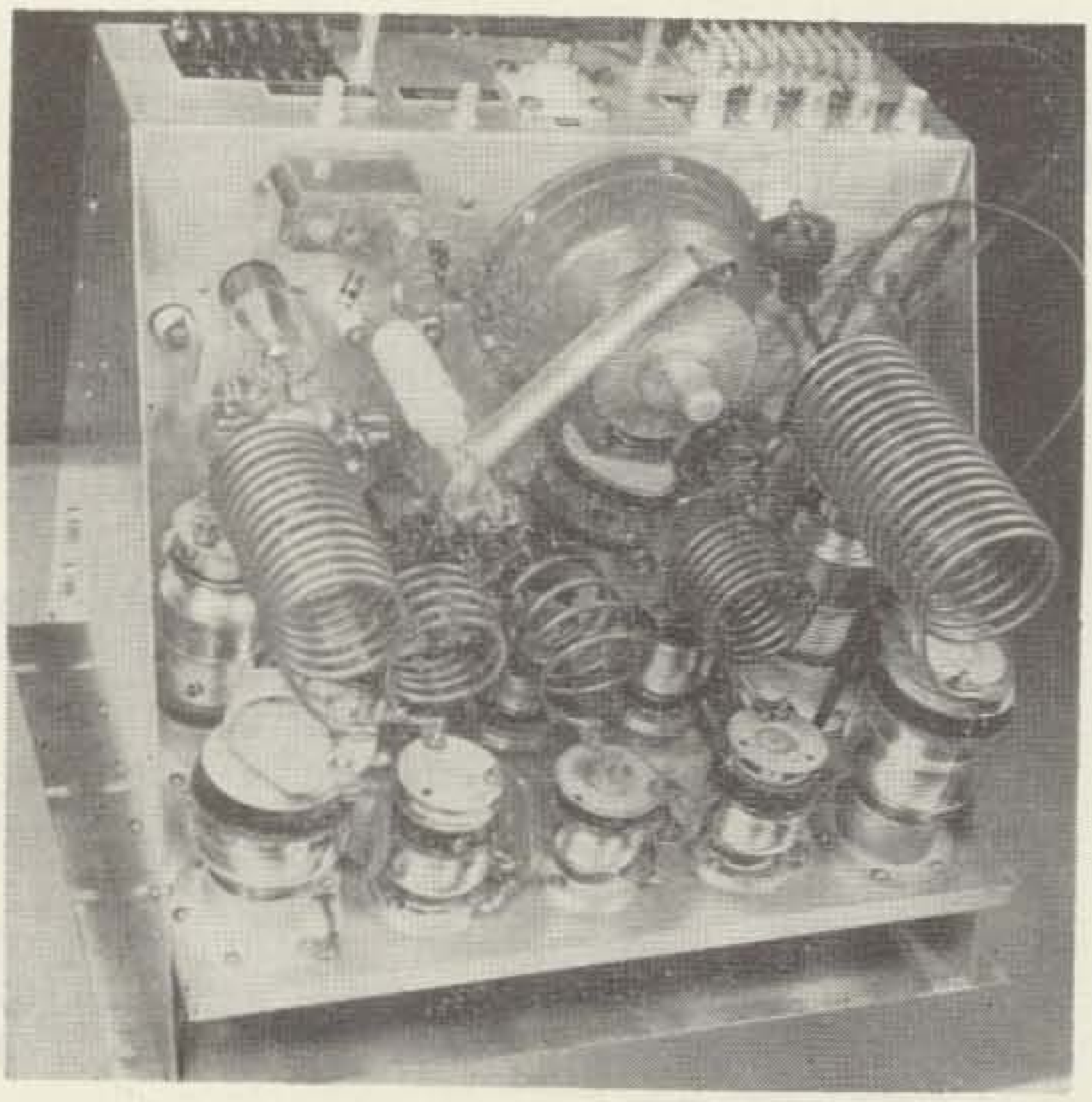
The solution is prepared by mixing one part phenolphthalein solution to three parts of 10% potassium chloride solution. ■





Suction vs Whooosh

Fig. 1



Paul M. Barton W6JAT
Jennings Radio
P. O. Box 1278
San José 8, Cal.

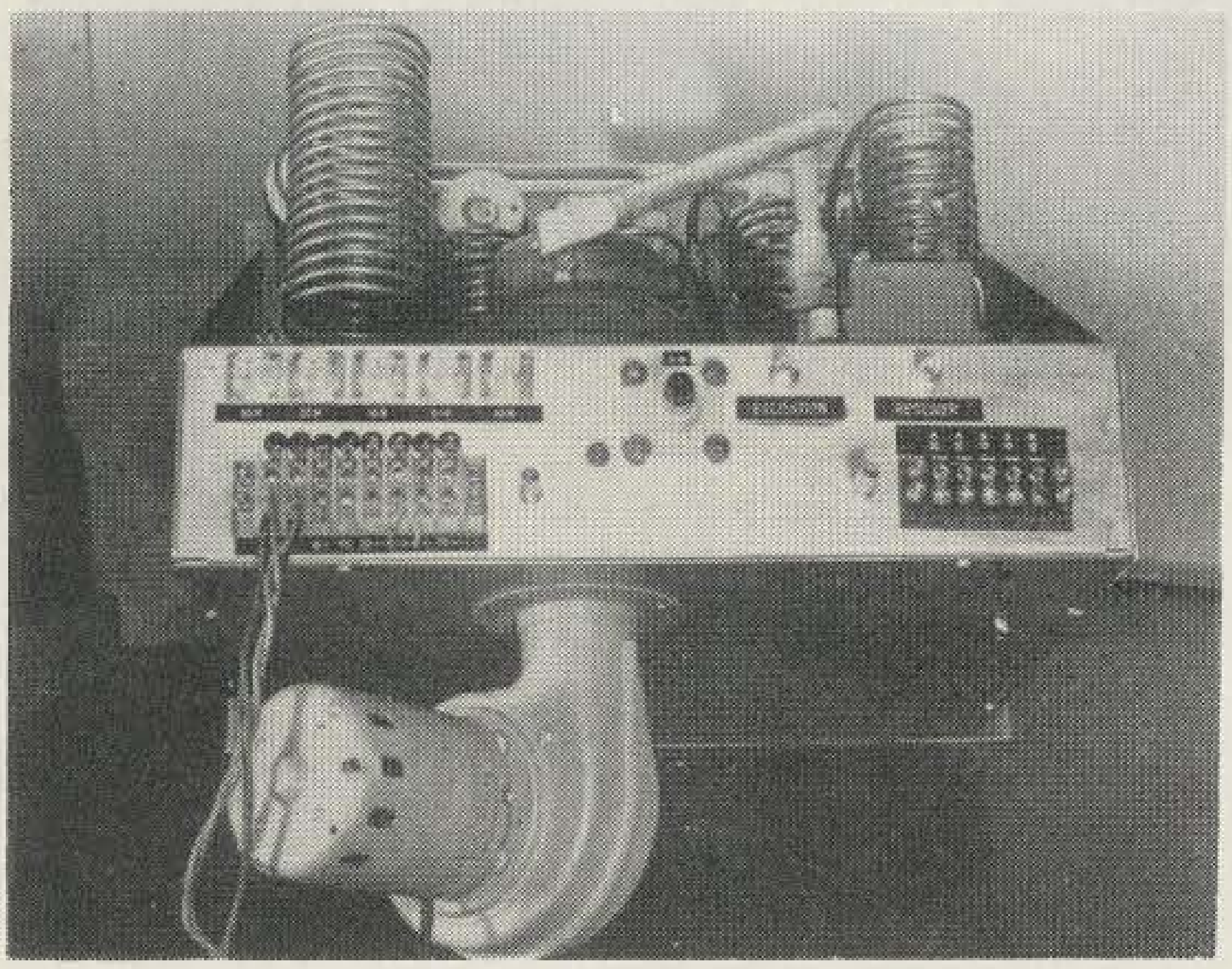
A SSB Linear Amplifier using a 4CX1000 tube was set up in Jennings type construction, but with provisions for supplying cooling air either from the bottom, or the top of the tube in several ways.

Fixed bias batteries and a variable screen supply were used to set the plate current where desired. 3500 volts of plate voltage was used. As there was no rf power involved, all the dc plate input was being dissipated by the plate. With different types of blower systems, and for several amounts of dc plate input, the resulting plate temperature was measured with a thermocouple and alternately with temperature indicating waxes.

First, the chassis was pressurized in the more common manner, by blowing directly into the chassis, as in Fig. 2, but with the bottom plate removed, rotated 180° and replaced. This places the blower to one side of the tube socket instead of directly under the tube socket. With 700 watts plate input, the anode temperature came up to 260°F. All tests were run until the resulting temperature stabilized.

It is generally assumed that this simple method of pressurizing the chassis is inefficient due to turbulence, so the blower was plumbed into the bottom of the tube socket with a carefully fitted short direct duct (Fig. 2). The resulting plate temperature was the same, however. The assumption now is that the tube socket itself makes so much air losses that the chassis turbulence is of minor importance (Fig. 1).

Fig. 2



Next, the above two tests were repeated but with two blowers in series, the first blowing into the second, and the second blowing into the chassis or tube base. Now the temperature only came up to 220°F, as one might expect.

Now the plate input was increased slowly until the plate temperature came back up to what it has been with only one blower (260°F). One blower required 700 watts to bring the plate up to 260°F, and two blowers in series required 940 watts for the same temperature. This is an increase of 29%. This *small* increase with two blowers instead of one should be expected as two blowers in series only yield a small increase in air through the tube.

Now a glass chimney was placed over the tube plate fins and a blower was set on top of this chimney so the blower drew its air through the tube, and blew it out into free air (Fig. 3). With 700 watts plate input, the anode came up to 230°F, compared to 260°F with the same blower acting as a blower instead of a sucker.

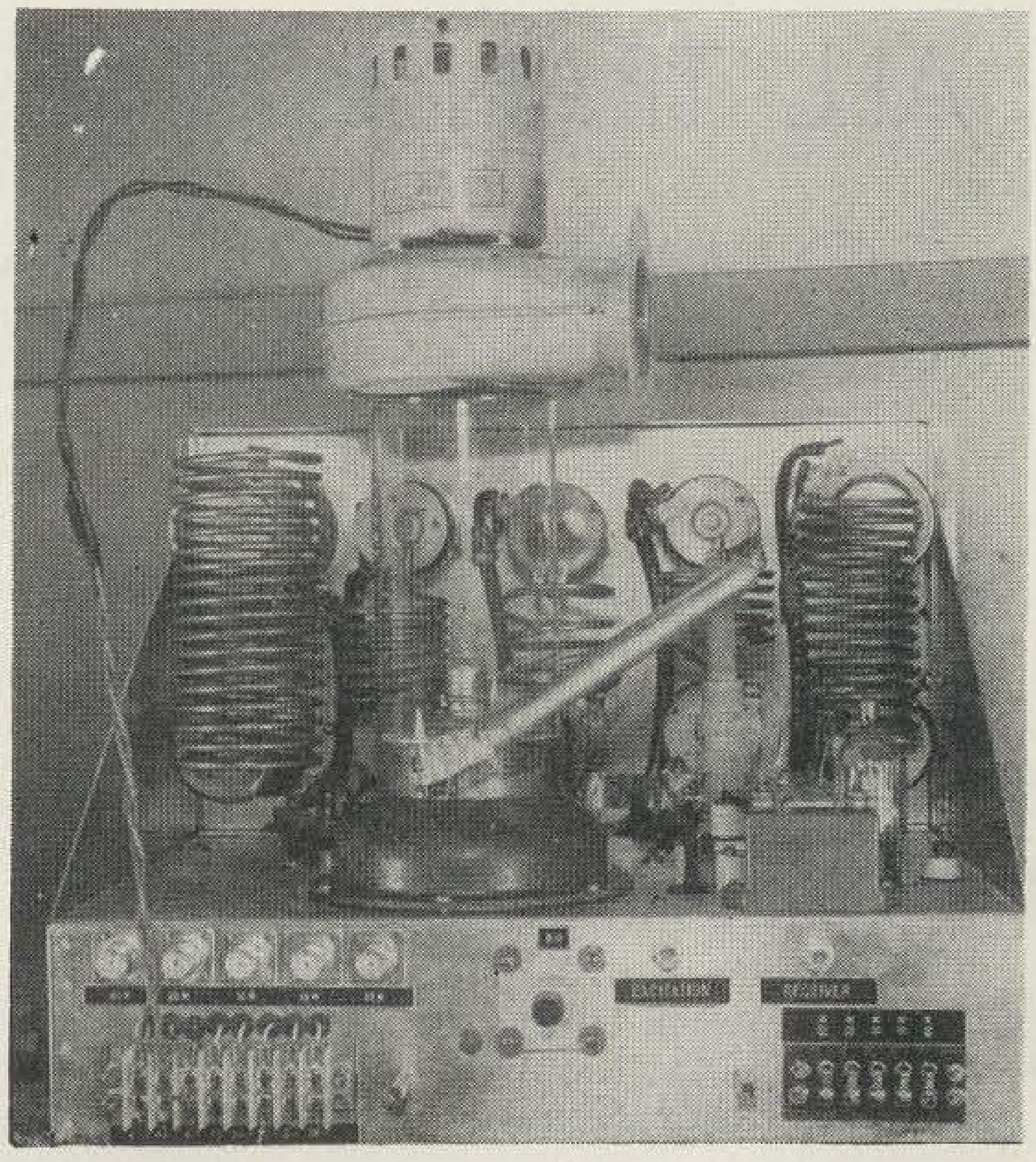
The asumption here is that the sucker arrangement is able to draw more air through the radiators due to less losses in the tube socket, as considerable air will be drawn through the tube radiators that did not have to go through the socket at all (the tube base and filament seal still remained cool enough, however).

Now the power was increased, using the sucking arrangement, until the plate temperature came back to 260°F. This required 825 watts, an increase of 18% over the blow system.

As an adequate blower for air cooled tubes is quite expensive, this apparent 18% increase in effectiveness, is well worthwhile. It is not held that sucking air through the tubes is more effective, but that it is possible to plumb to the tube more efficiently by sucking.

This system has been used in a number of 1 kw amateur amplifiers with excellent results. The rig pictured belongs to Elvin Feige, W6TT, the well-known dx hound and boating enthusiast. **73**

Fig. 3



AN ALL TRANSISTOR COMMUNICATIONS RECEIVER

Hans Joergen K. Rasmusen, OZ7BQ
31 Borgevej Lyngby
Denmark

ALTHOUGH transistors have been available for several years, they are not as widely used in amateur equipment as one might expect. Amateurs tend to believe they are difficult to work with and troublesome. The transistorized communications receiver to be described should prove that this is not the case.

The receiver uses 14 transistors and covers all bands between 80 and 10 meters. To obtain the best stability, the main receiver covers 3.5 to 4.1 mc. Other frequencies are obtained by using a bandswitched converter. Selectivity is obtained with two sections of a half-lattice filter on 480 kc.

The Converter

The "front end" uses 3 transistors as the rf amplifier, mixer, and crystal oscillator. Although the first *if* is rather high (3.5-4.1 mc), and images are no problem, it is necessary to use high "Q" coils in the rf section to prevent *if* and spurious signals from feeding through. The antenna coil is tuned with a 4- 40 mmfd. trimmer. The collector coil is tuned broadly to the center of the band. The crystal oscillator works directly on the crystal frequency and harmonics are used for the injection voltage. On 7 mc there is a problem in choosing the oscillator frequency. To obtain 7 mc, we must add 3.5 and 3.5 mc (crystal oscillator and variable *if*), but since the receiver will tune to 3.5 mc a "birdie" will be heard. Actually the "birdie" will be an eagle, it blocks the receiver 20 kc on either side of 3.5 mc. A practical solution is obtained when the 40 meter crystal oscillator operates on 3.3 mc. The receiver will then tune 6.8 to 7.4 mc.

Since the oscillator operates on the crystal frequency, no coils are required, and output is applied to the mixer through a 10 mmfd. capacitor. Signal mixing takes place in the base circuit of the transistor.

The collector of the mixer is not resonated at the variable *if* but uses an rf choke to obtain a broad bandwidth, and easily covers the 600 kc range.

The Variable IF

The first, or variable, *if* tunes between 3.5 and 4.1 mc, and also uses three transistors. The operation of this circuit is quite similar to the converter but, of course, is tuned to the lower frequency.

Input to the *vif* mixer base arrives from the antenna on 80 meters and from the converter on the other bands. To avoid tracking problems the mixer base and collector tuning capacitor is not ganged to the oscillator. These two adjustments are set near opposite ends of the band for a flat response across the variable *if*.

The variable oscillator is the heart of the receiver for it must be very stable. This is not difficult for the transistors are low voltage and current devices and therefore are not able to heat the adjacent components. The coils and capacitors should be of rugged construction and solidly mounted to the chassis. For the most part stability will be determined by the dc stabilization and, to a certain extent, the room temperature.

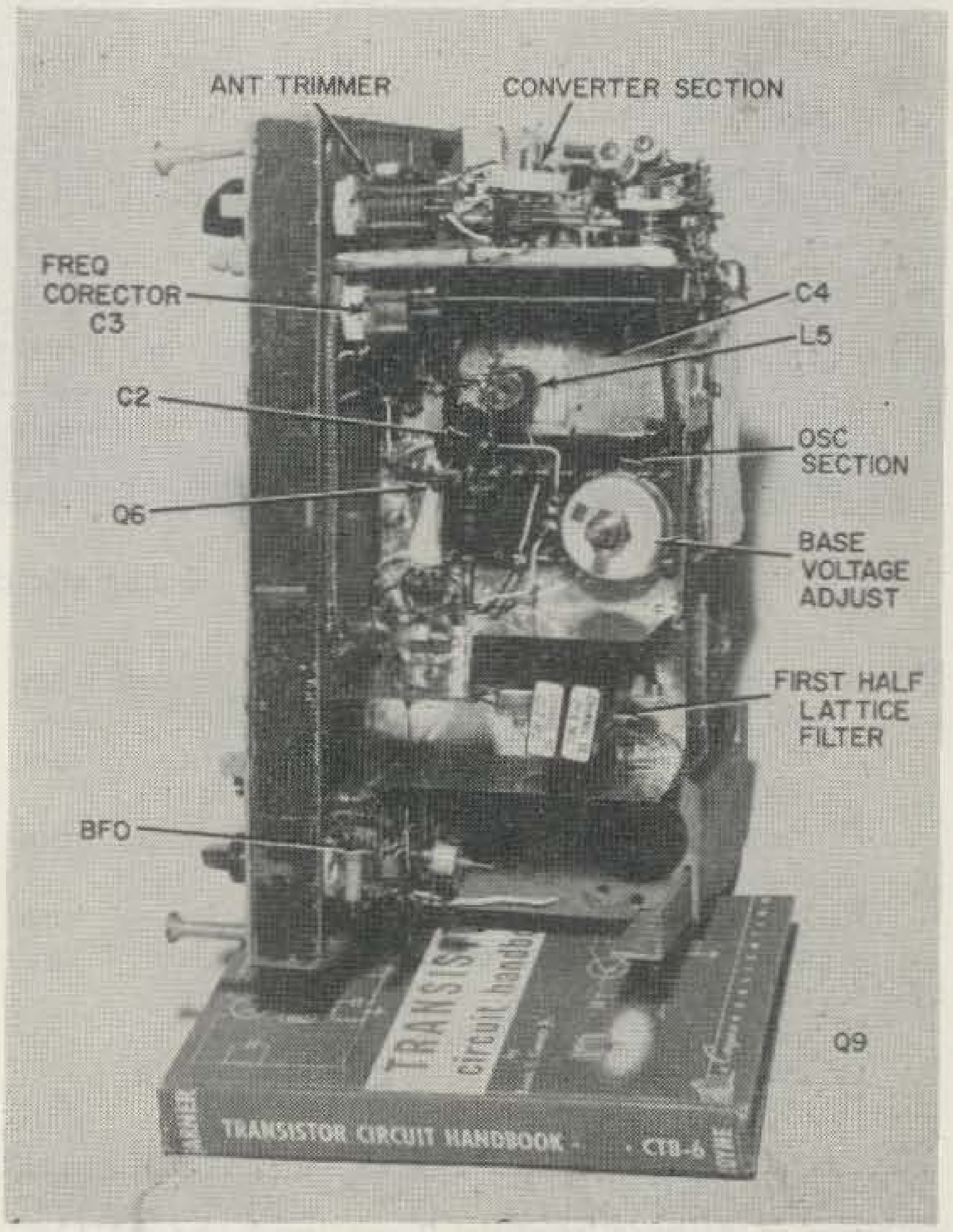
To provide the correct impedance match to the oscillator coil, the collector is tapped ⅓rd from the hot end and the emitter about ⅙th from the cold end. The output is taken from a link wound over the cold end of the coil. One end of the link is soldered to the emitter of the mixer transistor, and the other end is connected to ground. The oscillator and signal frequencies mix to produce a second *if* of 480 kc.

The Second IF Amplifier

In the second *if* selectivity is obtained by means of two section half-lattice filter using FT-241 crystals. The two filter sections must be well shielded to prevent stray coupling between the input and output leads. The filter is followed by two amplifier stages and a diode detector. A beat frequency oscillator is also coupled to the diode, and its frequency is controlled by a variable capacity pitch control. The transformers are standard vacuum tube types to which 50 turn base windings have been added.

The Audio Amplifier

The audio amplifier consists of five transistors, including a class B, push-pull, output stage. Between the first and second amplifier will be found an FL-8A war surplus audio filter to increase CW selectivity. The third transistor is a driver for the output stage. The transformers are standard impedances and American equivalents will make excellent substitutions. The sidetone connection is wired to a neon bulb oscillator and is keyed by the CW transmitter.



The Transistors

The transistors used in the receiver were made by Philips of Holland, but are available in the United States under the name Amperex. If your distributor does not carry them, Radio Corporation of America makes an interchangeable series. The OC170 and OC171 types may be replaced with the RCA 2N384. The OC44 is a junction transistor with a cut-off fre-

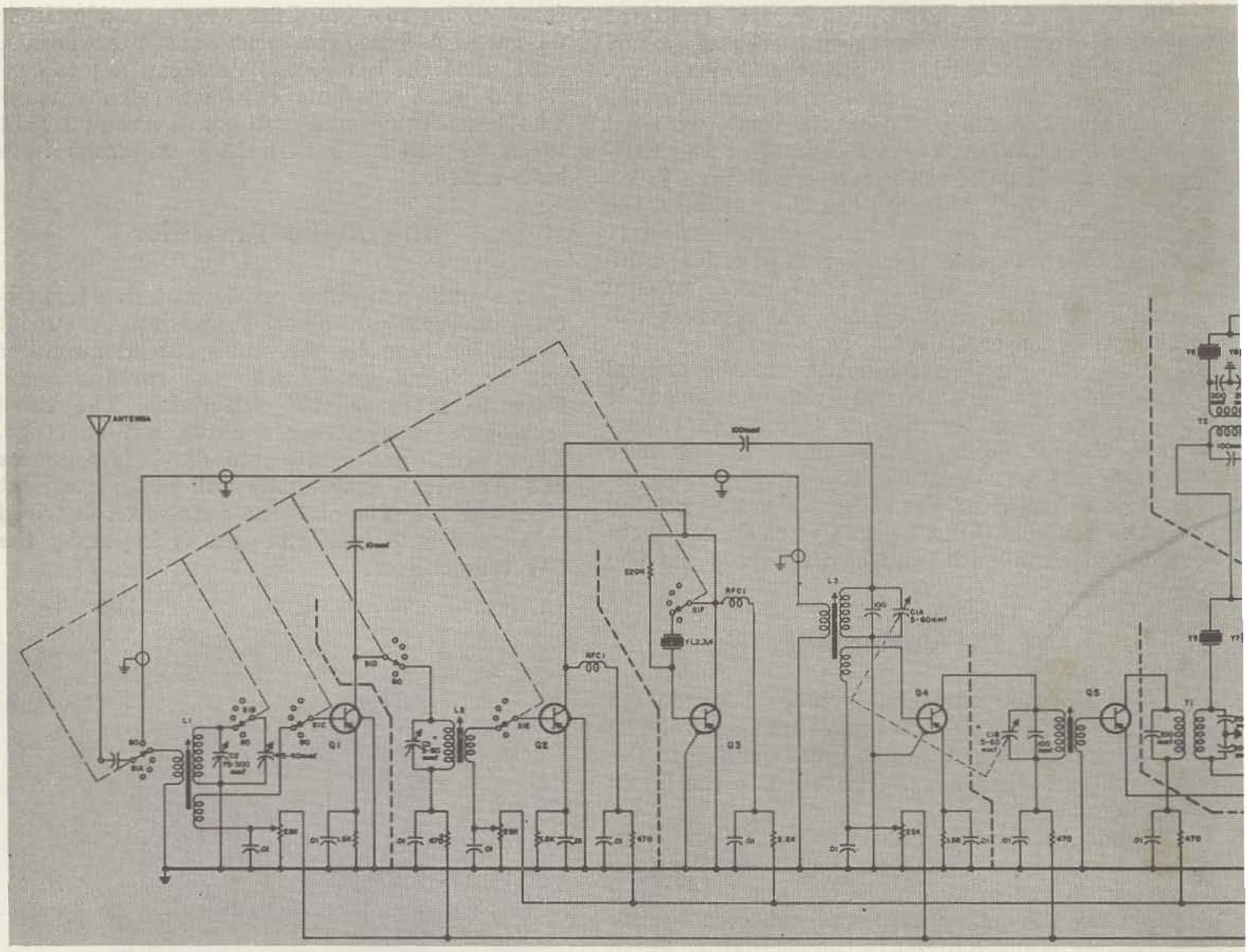
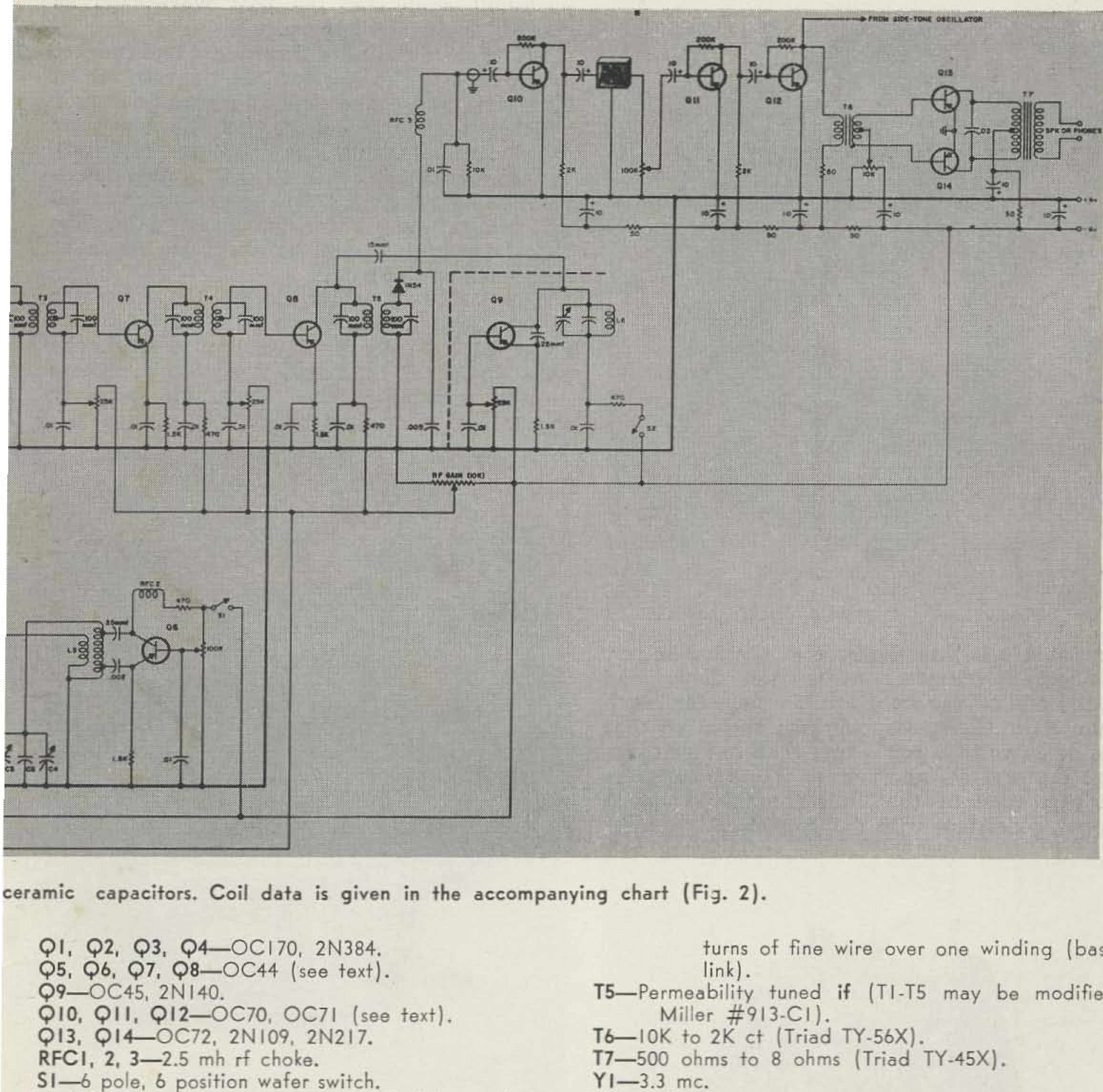


Fig. 1—Schematic diegram for the transistorized receiver. All 0.01 capacitors are

L1—40 meters, 4.05 μh, 15 turns, tap 3 turns up from cold end. Link is 3 turns at cold end.
20 meters, 1.01 μh, 5 turns, tap 1 turn up from cold end, link 1 turn.
15 meters, 0.77 μh, 4 turns, tap 1/2 turn up from cold end, link 1 turn.
10 meters, 0.77μh, same as 15. Spacing—1 turn covers two grooves on 10 and 15 meters.
L2—40 meters, 16.9 μh, 35 turns, link 5 turns.
20 meters, 4.2 μh, 15 turns, link 3 turns.
15 meters, 1.9 μh, 8 turns, link 2 turns.
10 meters, 1.05 μh, 4 turns, link 1 turn.
On 40 wind 2 turns per groove, others 1 turn per groove.
L3—40 turns, 12-65 μh, tap 10 turns up from cold end, link 5 turns.
L4—Same as L3, but no tap.
L5—36 turns, 12 μh, collector tap 12 turns from hot end, emitter tap 6 turns from cold end, link 5 turns at cold end. L3, L4, L5 wound two turns per groove.
C1a, b—Variable if peaking, dual 5-60 mmfd.
C2—100 mmfd on 40, 20, and 15, noneon 10 meters.
C3—50 mmfd on all bands.

quency of approximately 7 mc, and the 2N113, 2N114, or 2N137 should make an excellent substitution. The OC45 is a junction transistor and has a cut-off frequency of 3 mc. The 2N140 will replace this transistor. The OC70 and OC71 may be replaced with any general purpose PNP type. The OC72 is a medium power transistor and has a maximum dissipation of 165 mw at 25°C. The 2N109 can be used in place of this transistor.

To prevent transistors from burning out at high temperatures it is necessary to incorporate dc stabilization. This can be obtained in one of two ways. One method uses a resistor in the collector and one in the base. This circuit is employed in circuits where constant base voltage is not essential, such as the audio amplifiers in this receiver. The best method uses four resistances. One is in the collector, one in the emitter and two (as a voltage divider) in the base. This system provides excellent stabilization and therefore is used in variable oscillators and rf amplifiers, as in this receiver. To make base bias adjustment easier, potenti-



ceramic capacitors. Coil data is given in the accompanying chart (Fig. 2).

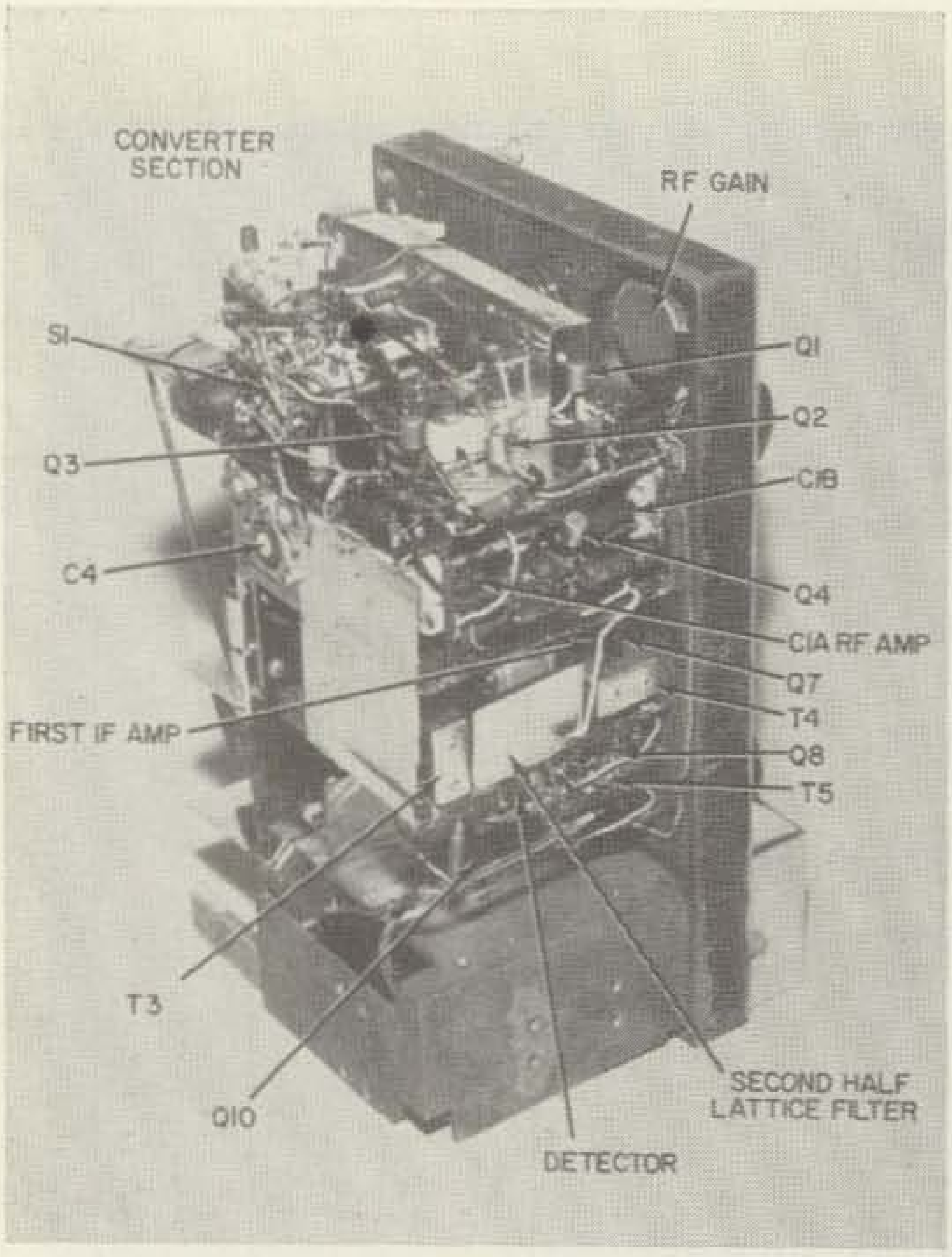
Q1, Q2, Q3, Q4—OC170, 2N384.
Q5, Q6, Q7, Q8—OC44 (see text).
Q9—OC45, 2N140.
Q10, Q11, Q12—OC70, OC71 (see text).
Q13, Q14—OC72, 2N109, 2N217.
RFC1, 2, 3—2.5 mh rf choke.
S1—6 pole, 6 position wafer switch.
T1, T2—Permeability tuned if modified by replacing one capacitor with two series connected capacitors providing the same total capacity.
T3, T4—Permeability tuned if modified by winding 50 turns of fine wire over one winding (base link).
T5—Permeability tuned if (T1-T5 may be modified Miller #913-C1).
T6—10K to 2K ct (Triad TY-56X).
T7—500 ohms to 8 ohms (Triad TY-45X).
Y1—3.3 mc.
Y2—10.5 mc.
Y3—8.75 mc.
Y4—12.25 mc.
Y5, Y6—FT241 surplus, Channel 57.
Y7, Y8—FT241 surplus, Channel 58.

ometers are used as the bias divider.

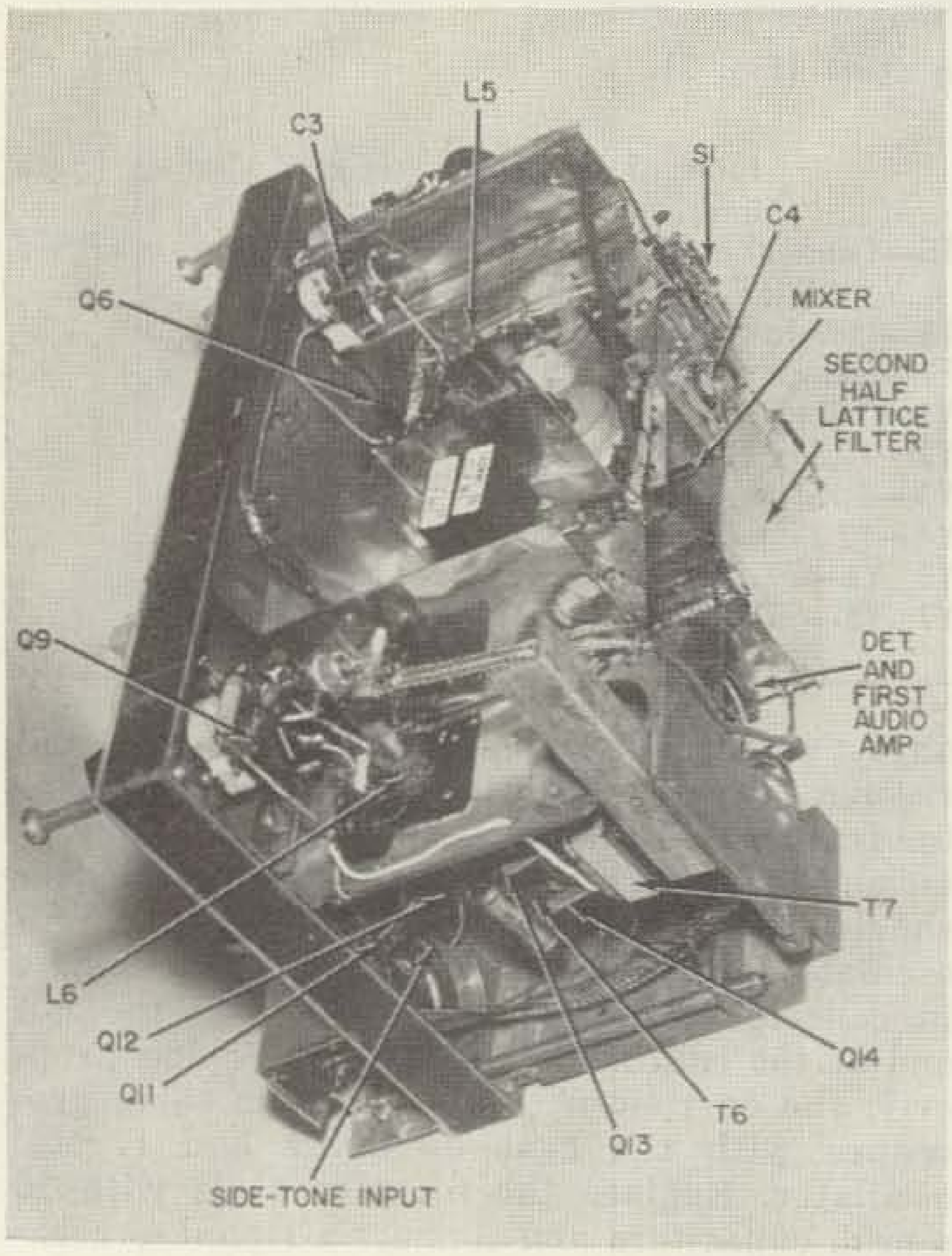
Adjustments

After the wiring has been completed and checked, it is time to adjust the receiver. Measure and set the drain of the transistors, using the potentiometers, at one milliampere. Set the push-pull stage to draw 5 to 7 ma.

Next, remove the transistors from the rf amplifier, mixer, oscillator, and 1st *if* mixer and oscillator sockets. With a grid dip meter, adjust the frequency of each coil to its normal resonant frequency. Insert the variable oscillator transistor in its socket and listen for oscillation on another receiver. The oscillator should tune between 3.01 and 3.61 mc. An oscillation will also be indicated by a change in collector current when you touch the hot end of the coil. If the circuit is working properly, the current will rise. Use the same procedure with the beat oscillator and crystal oscillator. Replace the filter crystals with 10 mmfd. capacitors and connect a signal genera-



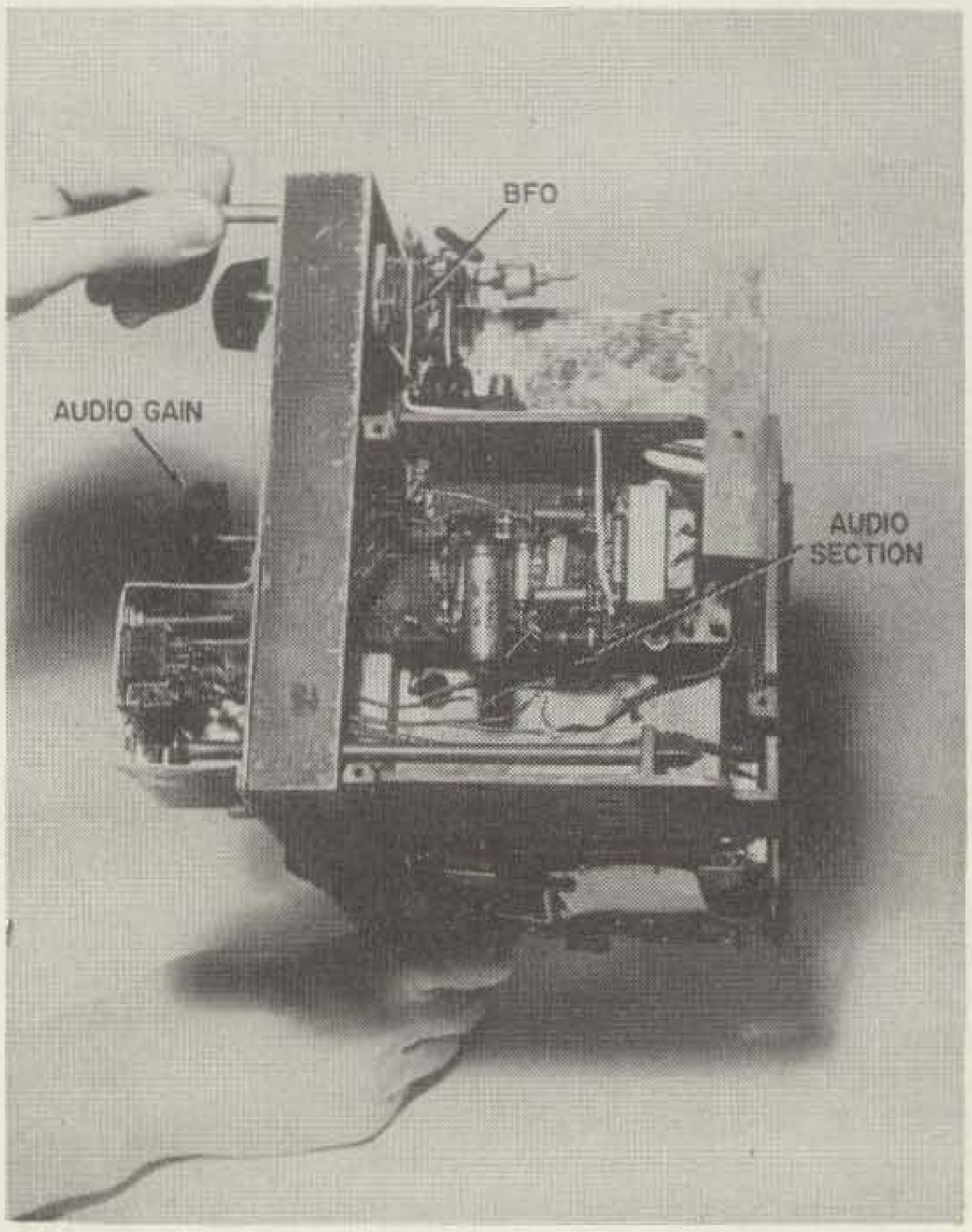
tor (at 480 kc) to the base of the 2nd mixer. Connect a voltmeter across the diode load (10K) and adjust the *if* transformers for maximum gain (keep reducing the signal so that the diode voltage reads less than one volt. Insert the crystals and repeak the transformers on each side of the filter for the strongest signal, consistent with flat response.



Connect an audio signal to the second af stage and adjust the collector current of the push-pull stage for the best waveshape as viewed on an oscilloscope.

Insert the remaining transistors and connect an antenna to the receiver. Set the receiver on 80 meters and connect an rf signal generator which tunes 3.5 to 4.0 mc. Set the generator at 3.5 mc and adjust the coil slugs (L3, L4) for maximum gain with C1a, C1b, near maximum capacity. Next tune the generator to 4.0 mc and retune C1 for maximum gain. The signal strength should be about the same at both ends of the band.

The last step is setting up the converter section. Switch to 40 meters and adjust the 40 meter L1, L2 coils for flat response across the ham portion of the band. Repeat this process on the remaining ham bands. The receiver should now be ready for use.



Transmitting

Since transistors are voltage sensitive, it is necessary to protect the rf amplifier transistor with some form of switch or relay in the line. At OZ7BQ a TR switch of the cathode follower type (connected to voltage divider on transmitter tank) is used. This system gives good protection on a 100 watt transmitter and the final amplifier tank does not function as a trap. The final tube(s) must be run cut-off in receiving periods so that noise is not generated. Several methods of receiver blocking have been tried. The smoothest break-in was obtained when the variable oscillator was keyed off with a positive base bias.

Layout

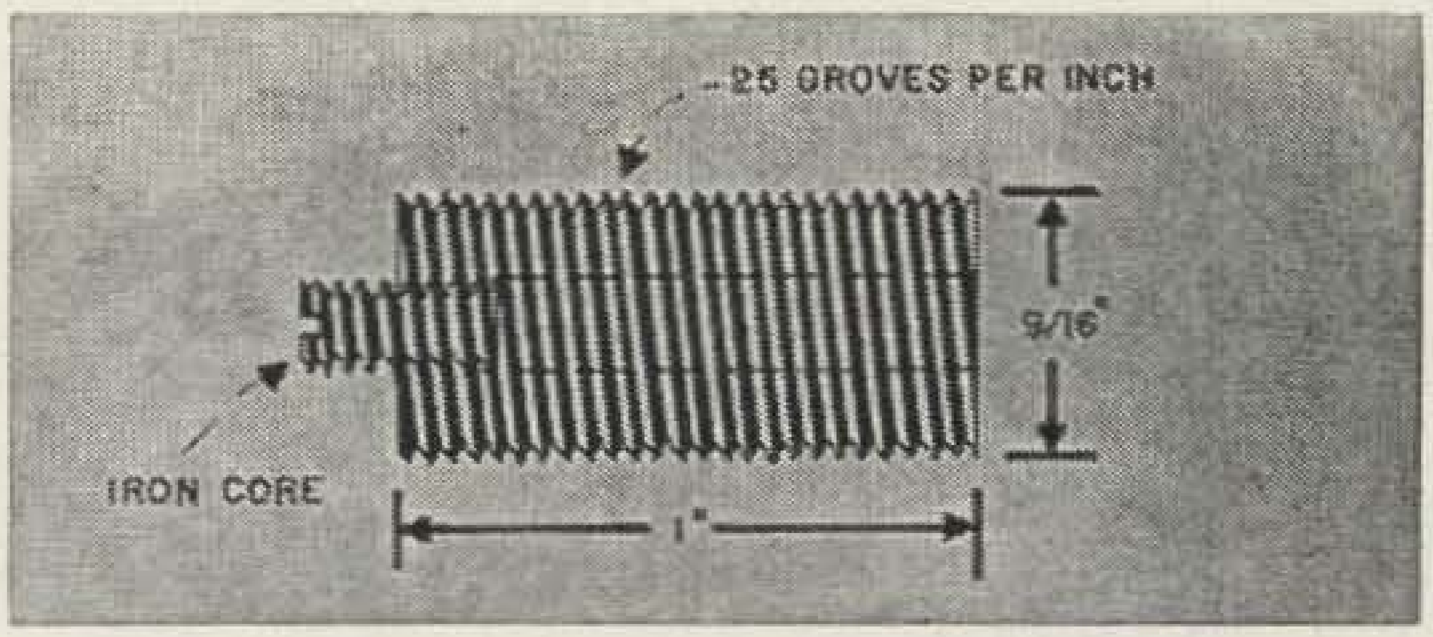
The chassis layout is somewhat unconventional. Each stage is mounted in a small box. This provides excellent shielding and permits each stage to be removed for circuit changes. The boxes are made of tinned metal from coffee cans. The boxes are soldered in such a manner that you can reach the parts when they are mounted on the front panel. For rigid construction, these boxes are mounted to the front panel with several screws. The oscillator variable capacitor is mounted directly on the front panel. Even when the receiver is given quite a blow it shows no signs of frequency instability. Layout of the components is not critical if the rules of tube construction technique are followed. Photos of the receiver, which measures 7" x 8" x 12", show the assembly and layout.

Conclusions

Many things have been learned by constructing and operating the transistorized communications receiver. The oscillator drift is less than 1 kc in warmup. The sensitivity has been compared with modern American receivers and is equal to them on all bands. The maximum volume, of course, is somewhat lower, and reception is best with headphones. The power could be increased from 200 mw to more than one-half watt by using a 12 volt supply on the class B stage.

With no signal the current drain is 15 to 20 ma, and it kicks up to 140 ma on audio peaks. The use of a 6 volt supply permits the receiver to be used at home, in an automobile (new or old), or portable with the same excellent results. 73

Fig. 2—The coils with the "L" prefix are wound on this type of form. Any slug tuned form of this approximate diameter and length should be satisfactory, atlhough the grooves make winding easier. Number 26 enam. is used for all coils.



New Products

Two Meter Transmitter-Receiver

The Heath "Pawnee" is a complete two meter transmitter with VFO or crystal control and 10 watts rf output to the antenna through a low pass filter to eliminate TVI. The receiver is double conversion and of high stability. A three-way power supply is built in: 117 vac, 6 or 12 vdc. Comes complete with built in speaker, mounting bracket and ceramic mike. Measures 6" x 12" wide x 10" deep, 34 lbs. Price in kit form: $199.95 from the factory. There are a lot more juicy details you'll want to know about on this so drop Heath a line at Benton Harbor, Michigan so they can fill you in.

Grounded Grid Kilowatt

Heath is at it again. Here is a neat little linear running four 811A's for 1000 watts PEP, 1000 watts CW or 400 watts AM phone. It requires 50-75 watts drive and may be driven by any exciter of up to 125 watts without any swamping network being needed. Built in power supply. TVI suppressed and all that. 80-40-20-15-10 meters. 90 lbs. $229.95. You do want to know more about this beau . . . holy smokes! Did you see that price? Unbelievable. Quick, before they discover their mistake, write for info. Heath Benton Harbor, Michigan. And if you forget to mention 73 when you write please cancel your subscription

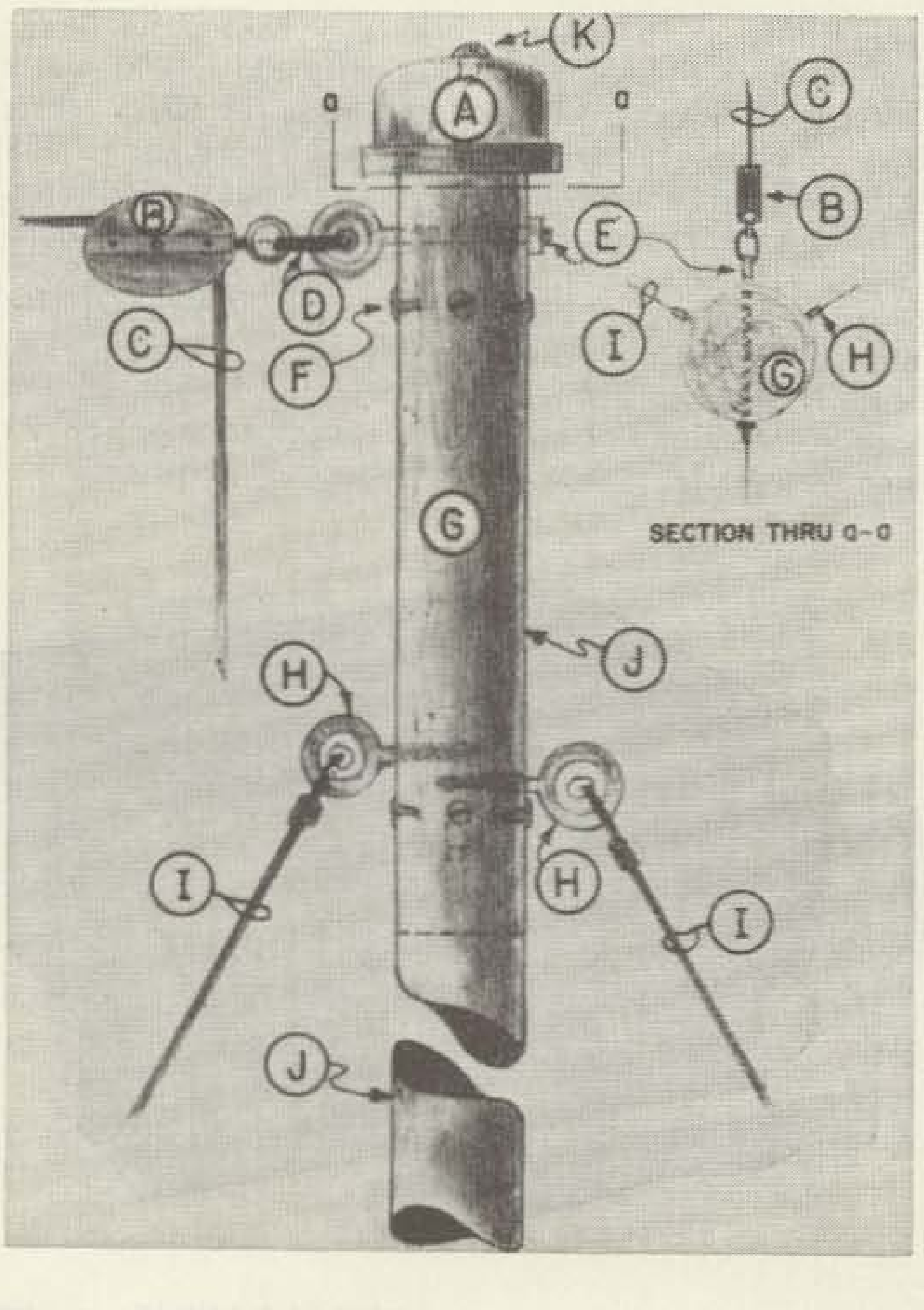
A Novel, Light-Weight, Low-Cost

ANTENNA SUPPORT MAST

and Vertical Radiator

This unique design results in a sturdy, easily handled and effective support for a horizontal wire antenna as well as 'doubling' as a vertical radiator. Weight is less than 35 pounds and the cost is under $15.00!

Howard S. Pyle W7OE
3434—74th Ave., S.E.,
Mercer Island, Wash.



MORE substantial and less costly construction of both vertical and horizontal wire antennas should prove a welcome addition to amateur radio design practice. Presented here is an innovation in the way of a combination antenna support mast for wire antennas which can serve as well as a vertical radiator for those who desire to experiment with both antenna types. Better still, it is so light in weight that it can easily be erected by two men, one holding down the base while the other 'walks it up'. If more help is available, put a man on each of two of the center guy wires for added insurance against bowing and swaying during erection.

Parts List

A—2" galvanized iron pipe cap
B—Pulley block of your choice
C—Down-haul rope or cable —about 35 feet required
D—Shackle or auto tire chain repair link
E—Galvanized eye-bolt, ¼" x 3" with nut (insulated eye type)
F—#8 x ⅜" galvanized sheet metal screws (42 required)
G—Wood re-inforcing plug, 2" diameter by 18" long (4 required)
H—Porcelain insulated screw eyes—(6 required)
I—#14 solid galvanized iron wire
J—2" diameter galvanized iron rain pipe (4 ten foot lengths required)
K—2" #12 brass or galvanized iron round-head wood screw
(Unless otherwise specified, only 1 each of above items required.)

While some difference of opinion exists among various authorities as to the proper height of a vertical radiator for amateur usage, popular pratice seems to favor 33 feet, plus or minus a foot or so, depending upon the desired resonant frequency of operation, calculated from existing formulas. Such a height is the equivalent of a quarter wave-length in the 40 meter band, a half-wave on 20 and full wave on 10 and works well on all. On 15 meters, the efficiency is but slightly impaired and is really a matter of no concern. In the 75/80 meter band, functioning as a vertical radiator, the mast is somewhat less effective than at higher frequencies, but as the 75/80 meter band is not considered a 'DX' band, the excellent ground wave propagation of a vertical of this height assures reliable communication over several hundred and often a thousand or more miles, dependent upon transmitter power. We have therefore settled on the mechanically practical height of between 32 and 34 feet which, in addition to being very effective as a vertical radiator, also permits a horizontal wire antenna to be installed at a satisfactory height above ground level, if desired.

The mechanical structure itself is somewhat unique in that instead of using a wooden mast or pole, with copper tubing down the side and topped with a 'whip' antenna, or using water pipe, electrical conduit or irrigation piping, *rain-pipe* of the 2" galvanized, round type is used. This is available from hardware stores, builders supply houses and plumbing dealers practically anywhere and at nominal cost. In the writer's area, it is priced at 15c per foot and comes in ten foot standard lengths. This means that you will need four of the ten foot sections and must necessarily discard a portion of one if your mast will 'double' as a vertical radiator and is cut to resonance. The few feet you discard however, represent a very small loss which can be disregarded in view of the low over-all cost of the complete mast.

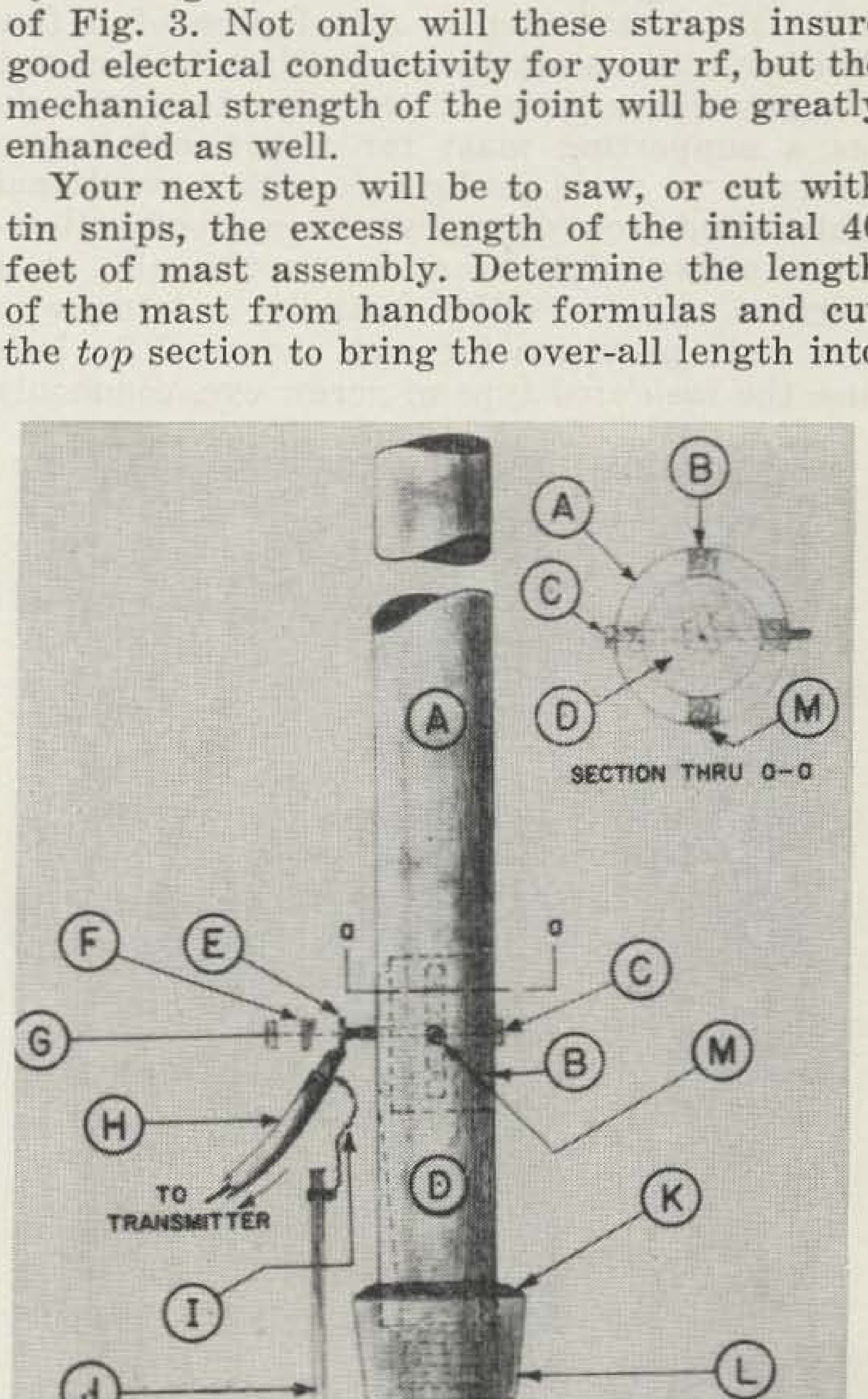
Mast Assembly

As supplied, pipe sections are fluted at one end for a few inches to permit telescoping. Cut off the fluted end with a hack-saw or tin snips. Procure from your local lumber yard, a six foot length of what is known as "full-round" wooden stock in the 2" size. Cut it into four 18" lengths. These will serve as 'plugs' or connectors between sections and are shown at "G" in Fig. 1, and as "A" in Fig. 3. Use these to connect the sections, driving about half of their length into each end of the rain pipe and securing them with sheet metal screws as shown in the drawings. Butt the ends of the metal pipe closely together and run a generous solder bead completely around the metal joint for electrical contact between mast sections. Do not depend on this however; mechancially, the wooden insert will be adequate. Electrically, a litle wind sway in the mast could conceivably break the solder seal and destroy the electrical conductivity. So, make sure of this by strapping the sections together with galvanized plumbers tape or ground straps of copper at all three points (120 degrees apart) as shown at "D" in Fig. 3. This 'tape' or strap metal is generally sold in ten foot coils and one roll of ten feet will be sufficient for all joints. Use sheet metal screws as in Fig. 3 to hold it in place and then make it a *good* electrical joint by flowing a solder bead around it as in "E" of Fig. 3. Not only will these straps insure good electrical conductivity for your rf, but the mechanical strength of the joint will be greatly enhanced as well.

Your next step will be to saw, or cut with tin snips, the excess length of the initial 40 feet of mast assembly. Determine the length of the mast from handbook formulas and cut the *top* section to bring the over-all length into

Parts List

A—2" diameter galvanized iron rain pipe (4 ten foot lengths required)
B—Balsa wood spacer strips (see text)
C—10-24 Galvanized or brass stove bolt, 3" long
D—Wooden cross-arm insulator pin (see text)
E—Solder lug to fit "C" and "H"
F—Galvanized split lock washer to fit "C"
G—Galvanized or brass 10-24 nut
H—Co-axial cable (RG8/U or RG58/U) (length as required)
I—Braid from co-axial cable to ground clamp on "J"
J—Five or six foot copper-clad steel ground rod
K—Mastic or roofing pitch waterproofing (see text)
L—Petticoat type of pole line insulator (see text)
M—¾" x #10 pan-headed sheet metal screws (2 required)
(Where no quantities specified, one only of item listed, required.)

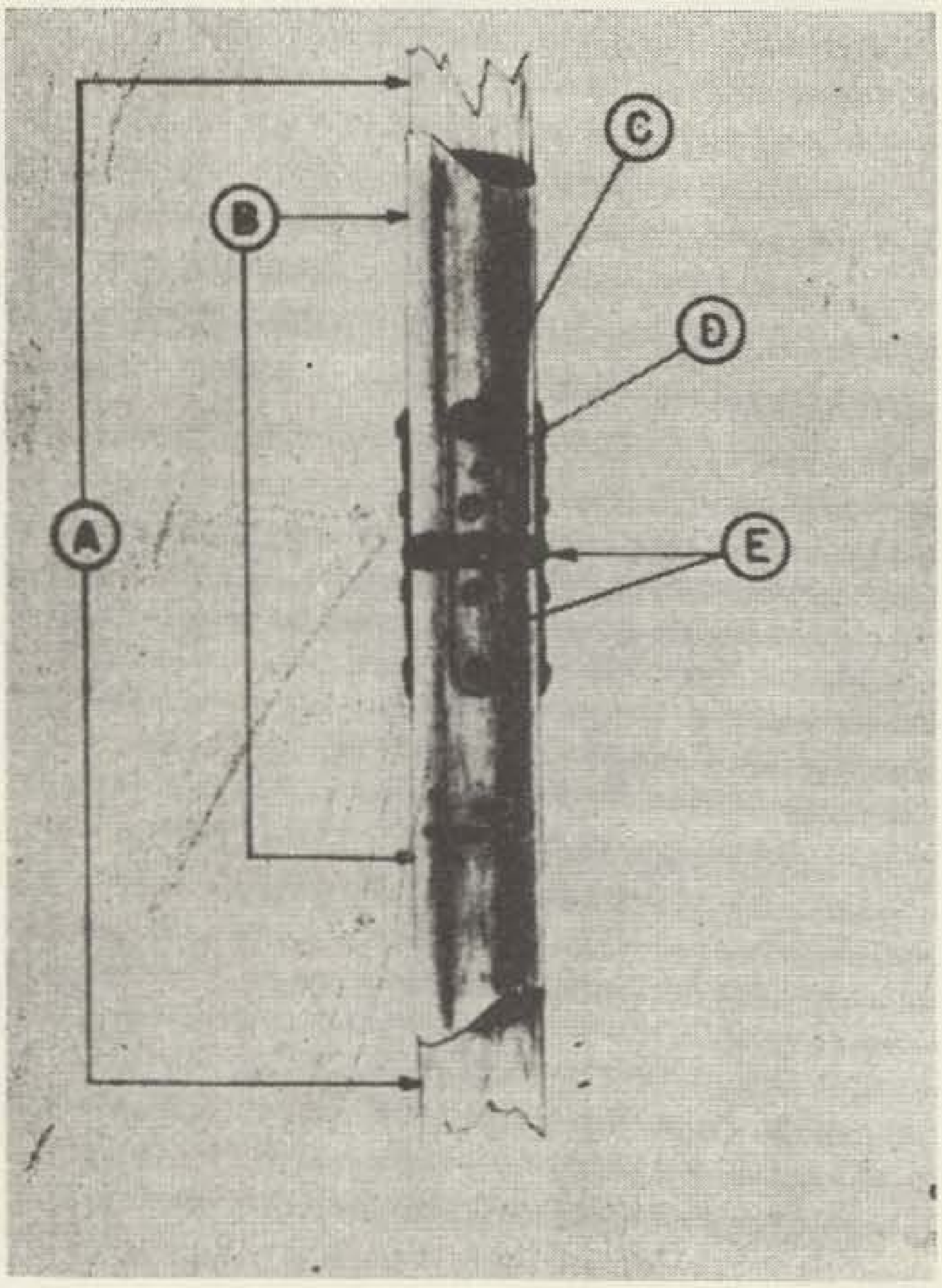


conformity with your calculations. Remember to measure from the point of feeder connection at the base ("C" in Fig. 2) to what will be the top of the mast.

Insert the final plug into the top of the mast and drive it flush, securing with sheet metal screws as shown at "F" in Fig. 1. To prevent rain drip from going down the interior of the mast and rotting the wooden plugs cap the top either with a 2" galvanized pipe cap ("A" in Fig. 1) or a coffee can lid and a wooden, rubber or plastic ball, if you want to be really decorative. Toilet tank float balls, either plastic or metal will serve well here if you don't care for the flat treatment of a pipe cap.

Mast Hardware

Your assembly of the mast itself is now complete. We assume that you have, of course, paid proper attention to supporting it on saw horses or boxes so that it assumes a perfectly level formation which will insure a plumb and pleasing appearance when erected. A sixteen or twenty foot length of ¼" x 1⅝" lattice (real cheap at lumber yards) makes a good straight edge, when used edgewise, to check this. Your next step is installation of a few hardware items on the mast. First, let's mount the guy wire anchors. If this were to serve *only* as a supporting mast for a horizontal wire antenna we could get by here with conventional galvanized iron screw eyes or eye-bolts. However, as we might want to use this also as a vertical radiator, either initially, or later, why not make provision for such use now? So, let's use the *insulated* type of screw eye, commonly available in all TV and radio stores for a few cents. By so doing you don't have small radials and poor rf contacts to upset your theoretical calculations for antenna height vs. frequency. And you'll find it a big help in avoiding TVI which could result from microphonic contact between guy wires and mast!



OK; mount three of these insulated screw-eyes about 16" down from the top of your mast, spaced 120 degrees around the circumference. They will serve as anchors for your upper series of guy wires (see "H" in Fig. 1). Do the same at either the ten or twenty foot level of the mast; they will anchor your second set of guys. I prefer the twenty foot level but do as you see fit. You can even drive an additional wooden plug half-way into the second (from bottom) section of the mast if you want the lower guys at a point about half-way up; the decision is yours. Remember to 'stagger' the screw-eyes at least half an inch in the vertical plane or their shanks will collide!

And now, the final hardware mount; the eye-bolt at the top of the mast (a few inches below) which will receive the pulley block for the down-haul for the wire antenna. This eye-bolt should also be insulated and can be a galvanized type, three inches long, going clear through the mast and wooden plug as shown in Fig. 1 at "E". The pulley block itself can be anything you choose; galvanized iron, bronze, wood block with metal sheave, etc. Connect the eye of it to the eye-bolt in the mast with a conventional 'shackle' (hardware stores or marine supply houses) or, if no local source for shackles, use an automobile tire chain repair link, available at any automotive service station, tire shop or auto supply store.

Now, if you have your guy wires in place and your down-haul riven through the pulley sheave, you need only cut the guy wires every fifteen feet and insert a suitable insulator. This should preferably be of the compression type as, in the event of breakage, the guy does not let go. The small, glazed porcelain type known as 'airplane' strain insulators, are ideal; these sell for less than 10c each at most radio stores. With their installation, work on the mast itself is now complete, mechanically. We recommend that you now give it at least two thorough coats of a lead base paint in any color that suits your fancy. Not only will this act as a preservative against rust, but will considerably improve the appearance of your final mast.

Parts List

A—2"x18" length of 'full-round' wooden pole (4 required)
B—2" diameter galvanized iron rain-pipe (4 ten foot lengths required)
C—½" x #8 pan-head galvanized sheet metal screws (12 at each joint)
D—Perforated steel strap—about ten feet required (see text)
E—Solder application (see text)

Mast Base Mounting

While the paint on the mast is drying (two coats take several days you know) it's a good time to prepare the base mounting. This isn't too bad and involves only digging a hole in the ground about a foot square and approximately ten inches deep. Make a little form of scrap lumber if you're meticulous, let it protrude about two inches above the ground level. Fill the thing with concrete; you can get "ready-mix" sand, gravel and cement in a convenient bag at your lumber yard). Follow the consistency instructions on the sack and you'll come out all right. After it sets up about half hard, bevel the top four edges if you like for a more professional job. At the same time, scoop a circular depression in the center of the top of the concrete base to act as a 'socket' for the base insulator to be next described. Use a trowel for this operation or you can use the insulator itself in 'pestal' fashion to achieve this. Now you can leave the base alone while it sets up (about 24 hours). The base insulator should next be procured and mounted on the mast. See the 'outside line construction foreman' of your local power or telephone company and show him Fig. 2. He will immediately recognize "L" and "D" as a standard cross-arm insulator ("L") and wooden mounting pin ("D"). Wheedle, cajole or buy such a combination from him . . . it will cost you little. The insulator "L" can be either glazed porcelain or of blue/green bottle glass as used by the phone companies. Either is more than adequate electrically and mechanically.

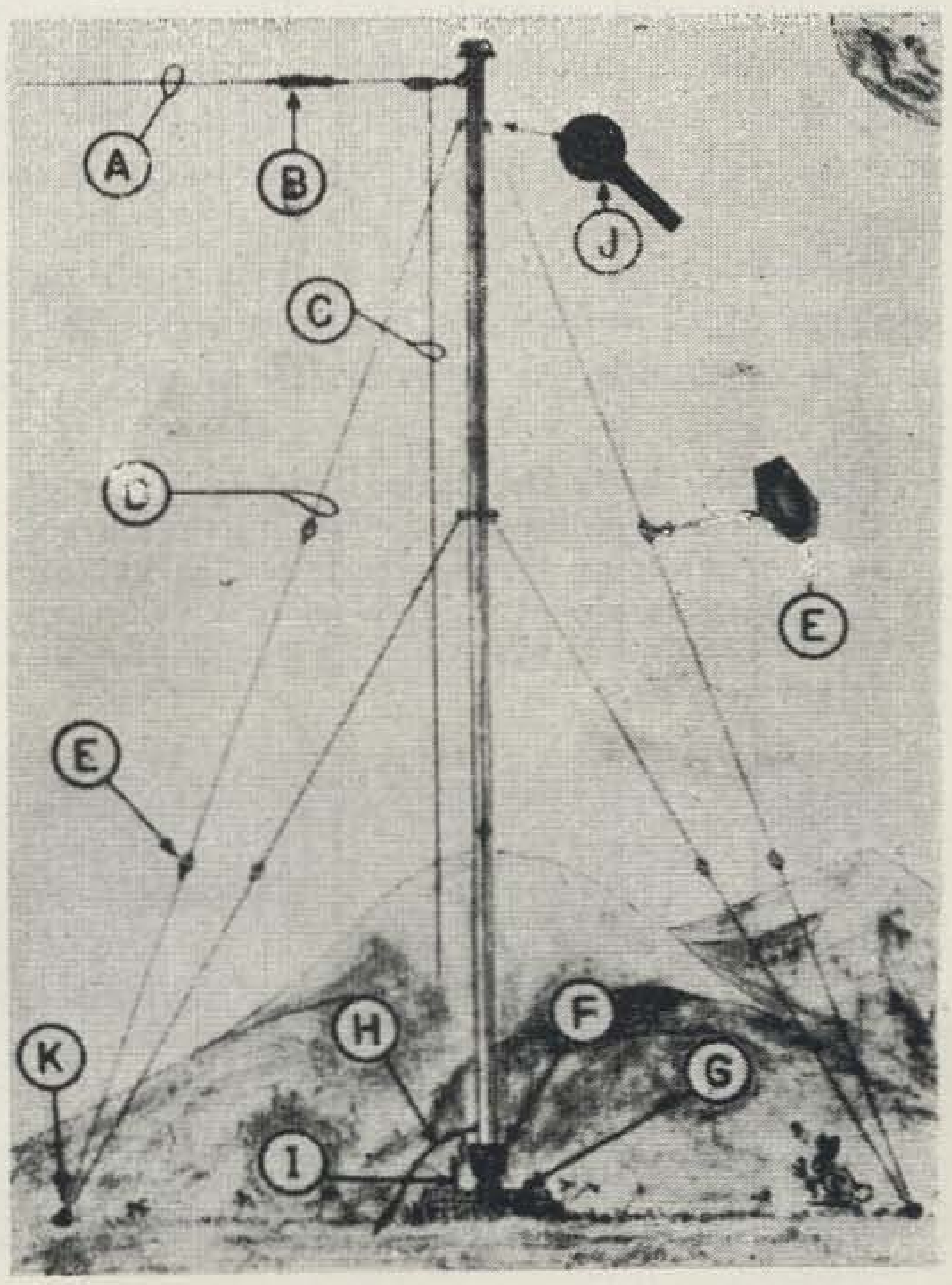
The end of the wooden pin opposite the threads will be too small for your 2" mast. Build it up to the 2" diameter required with short wood strips (4), nailed with small brads to the pin itself. Balsa wood, usually available at most lumber yards, variety stores and hobby shops, will work well here. Get something about half an inch wide and of a suitable thickness to fill the gap when installed as shown in Fig. 2 at "B". A foot of this stock will be adequate. Mount the insulator and it's pin as in Fig. 3 and you've got a complete antenna mast and vertical antenna ready for erection when the paint dries!

Your Completed Antenna Support Mast/Vertical Radiator Should Look Like This!

A—Horizontal wire antenna
B—Insulator for "A"
C—Down-haul rope or cable (use a sash weight at lower end or anchor to a cleat or eye-bolt near base of mast)
D—Guy wire (#14 galvanized iron)
E—Airplane type of "goose-egg" strain insulator
F—Glazed porcelain or 'bottle-glass' petticoat pole-line cross-arm insulator
G—Concrete base; about 1 cubic foot
H—Co-axial cable feeder (RG8/U or RG58/U)
I—Ground rod (5 or 6 foot, copper clad steel with clamp)
J—Porcelain insulated screw-eye insulator
K—Guy wire anchor

Again you don't have much of a problem in tying your guy wires into the ground. You'll need first three spots 120 degrees apart (approximately) and at a minimum of 7½ feet from the center of the mast base. 10 feet is better, but 7½ will do very well. With a piece of string, centered on the mast base, you can scribe a circle on the ground and determine your anchor points. Maybe you have a convenient tree, a stump or a building which will serve, in the approximate area. If so, use it. If not, you have several choices for guy anchors. You can *buy* conventional, drive-in or screw-in types of pole line anchors from your power company; they won't be cheap however. You can dig a hole about two feet deep and three feet square, make a cross of a couple of 30" 2" x 4" timbers and lay them in after wrapping some stub lengths of guy wire around them to which you can tie your guy wires above ground. Or, you can dig holes about a foot square and 18" deep, set a six or 8 inch eyebolt (galvanized of course) in the approximate center, pour the hole full of concrete mix and wait for it to set. Any of these methods are good; you choose the one which you like best. Even six foot lengths of 1" pipe, driven at about a 30 degree angle, will do the trick.

And, with all of the above done, you need merely raise your mast, tie on the feed-line as shown in Fig. 2, or raise your wire antenna in place, or both, and you're "on the air" with either a wire antenna or a vertical or both at will, as you choose! Lay back now and take it easy; *this* is a mast which will last you a l-o-n-g l-o-n-g time! 73



The Diligent Detector

73 Staff

So far as most of us are concerned, the detector is the "forgotten man" in a communications receiver. Ultra-simple circuitry, tried and true over the years, tends to make us think of the detector (when we bother to think about it at all) as one of the most nearly perfected parts of the set.

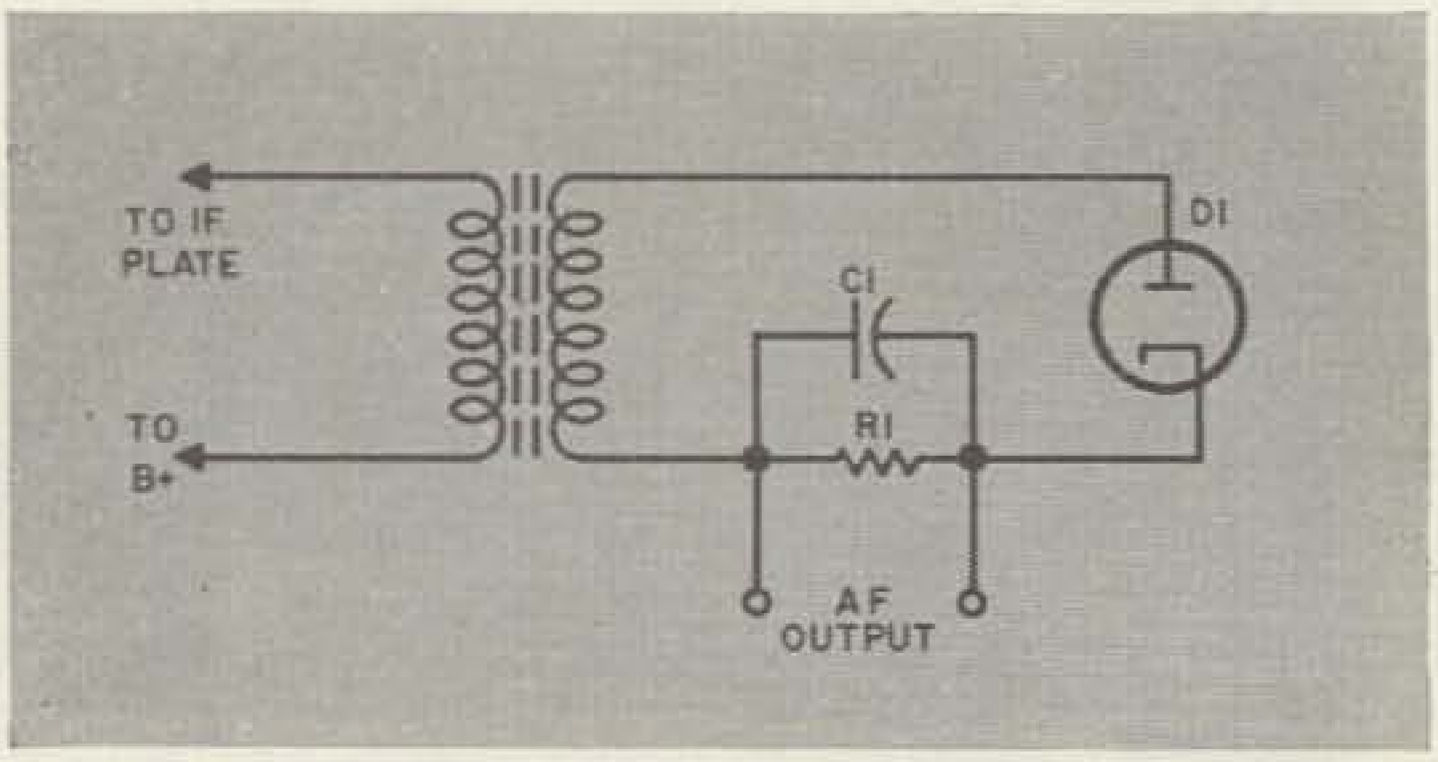
The general impression that detectors have little room for improvement isn't correct. For a few cents worth of parts and a few minutes time, you can reduce your set's detector distortion to a fraction of its previous value. This will do a near-miraculous job of cleaning up formerly-muddy signals whose only actual fault was 100 percent modulation, and may even restore broken friendships if bad signal reports caused the breach!

You can take your choice of a number of circuits to accomplish this end, thanks to the audio fraternity which devotes much of its time to reduction of distortion. Some are nearly as simple as the conventional detector, while others involve addition of one or more tubes to the set.

Each of these circuits has its own set of advantages and disadvantages, making the choice a bit more complicated than one of mere time and complexity. The purpose of this article is to list these circuits, together with their pros and cons, to make it easy for you to pick the one best suited to your own needs.

Before going into the newer and more-sophisticated detector circuits, a brief review of the conventional detector is in order. To clarify the approach used in this review, you know that an ordinary AM signal may be visualized in either of two ways: It may be considered to be a single, steady carrier wave varying in amplitude, or it may be thought of as an unvarying carrier accompanied by sidebands of varying strength which are later mixed with the carrier to produce sound.

Fig. 1. This basic circuit, or slight variations of it, is the second-detector in use in nearly every radio receiver on the market today. Except for the filter, the circuit is identical to a half-wave power supply but operates in a completely different fashion.



While the second visualization is more correct in the mathematical and physical sense, there is no measurable difference between the two. To avoid complicating this article with exotic mathematics, the first (and older) visualization has been used in explaining diode-detector action.

Since the most common detector in use today is the diode, let's look at it first. Most diode detector circuits are similar to that shown in Fig. 1. You may find a crystal diode instead of the tube in some receivers, but the principles of operation remain unchanged.

Similarity between this circuit and an ordinary half-wave power supply (less filter) is evident. However, the two circuits differ drastically in several important operational details.

In a power supply, the design factors are chosen so that current will flow over as much of the cycle as possible without flowing during the reverse half-cycle. This reduces ripple voltage in the output to a minimum.

In the detector, however, the objective is to make current flow through the diode in a series of extremely short pulses. This is accomplished by making the resistance of R1 very large compared to the diode's forward resistance, and by making the applied signal voltage as large as possible without running into overload.

Under these conditions, C1 is charged by the short pulses, and if the time constant is properly chosen the capacitor voltage will rise almost to the peak value of the applied signal. The voltage will vary in a linear manner with the strength of the applied signal as measured at the peak. For this reason the circuit is known to engineers as a "peak-linear" detector.

Note that the voltage impressed on C1 will follow the signal modulation envelope only if the tube voltage drop is negligible compared to applied voltage. At low signal levels, every rectifier becomes a "square-law" device whose voltage output varies with the square of input voltage rather than varying linearly. Square-law detectors produce excessive distortion of AM signals, but are useful as mixers.

Under normal conditions, the output of an ordinary diode detector contains about 5 percent harmonic distortion. While signals are perfectly readable with this amount of distortion, reception can become extremely tiring to the ears—as anyone who has ever operated in a contest knows.

In addition to introducing distortion, the peak-linear detector plays another sneaky trick on the signal—it cuts down the effective modulation percentage.

This can happen because the *if* amplifier feeding the detector has very poor voltage regulation. Output of the *if* transformer, with the same signal applied to the amplifier, is considerably less under load than it is with no load—and the diode detector represents a very appreciable load.

What's more, this load varies with strength of the applied signal since the diode's impedance will vary with voltage applied. This means that the *if* amplifier is under a heavier load for the sidebands of a signal than it is for the carrier, and the ratio of sideband power to carrier power as measured at the detector is reduced.

Bad as this sounds, it's actually no loss—since a peak-linear detector is not capable of reproducing a 100 percent modulated signal without severe distortion. In one typical case, breakup of the signal became objectionable at 75 percent modulation. Other authorities claim the effect is severe at 70 percent. By reducing effective modulation percentage, the diode makes itself able to handle a more-deeply-modulated signal than could otherwise be accommodated.

Distortion in a peak-linear detector is caused by three major factors. One—curvature of diode characteristics—is outside the control of the designer or the set owner. The other two can be controlled to some degree, but the control always represents a compromise.

Whenever the dc component of the signal and the ac component meet different load lines, distortion is sure to result. This situation occurs if AVC is derived from the detector, if an S-meter is connected to the detector circuit, if an automatic noise limiter is incorporated, or if the detector feeds an audio amplifier. The last condition is necessary if you're going to hear anything out of the set!

This condition, known variously to engineers as "clipping" and as "differential distortion," is the major factor limiting acceptable modulation percentage. Distortion in conventional circuits remains under 5 percent at moderate modulation levels, but rises rapidly to 12 to 20 percent when modulation depth approaches 100 percent.

The third factor introducing distortion is the RC time constant of the detector load (R1 and C1 in Fig. 1). If the time constant is too long, "bottoming" will occur on negative half-cycles of the incoming signal, producing a raspy and most objectionable sound. If it is too short, detector output will be low and rf ripple will be too high. This is not usually a problem, since design values found in most sets represent a highly acceptable compromise between output level and distortion.

With this background established, we're ready to examine some low-distortion circuits and to compare them to existing detectors in your receiver.

One of the simplest of the low-distortion circuits is the "diode integrator" described a couple of years ago by Leonard Geisler. It's shown in Fig. 2.

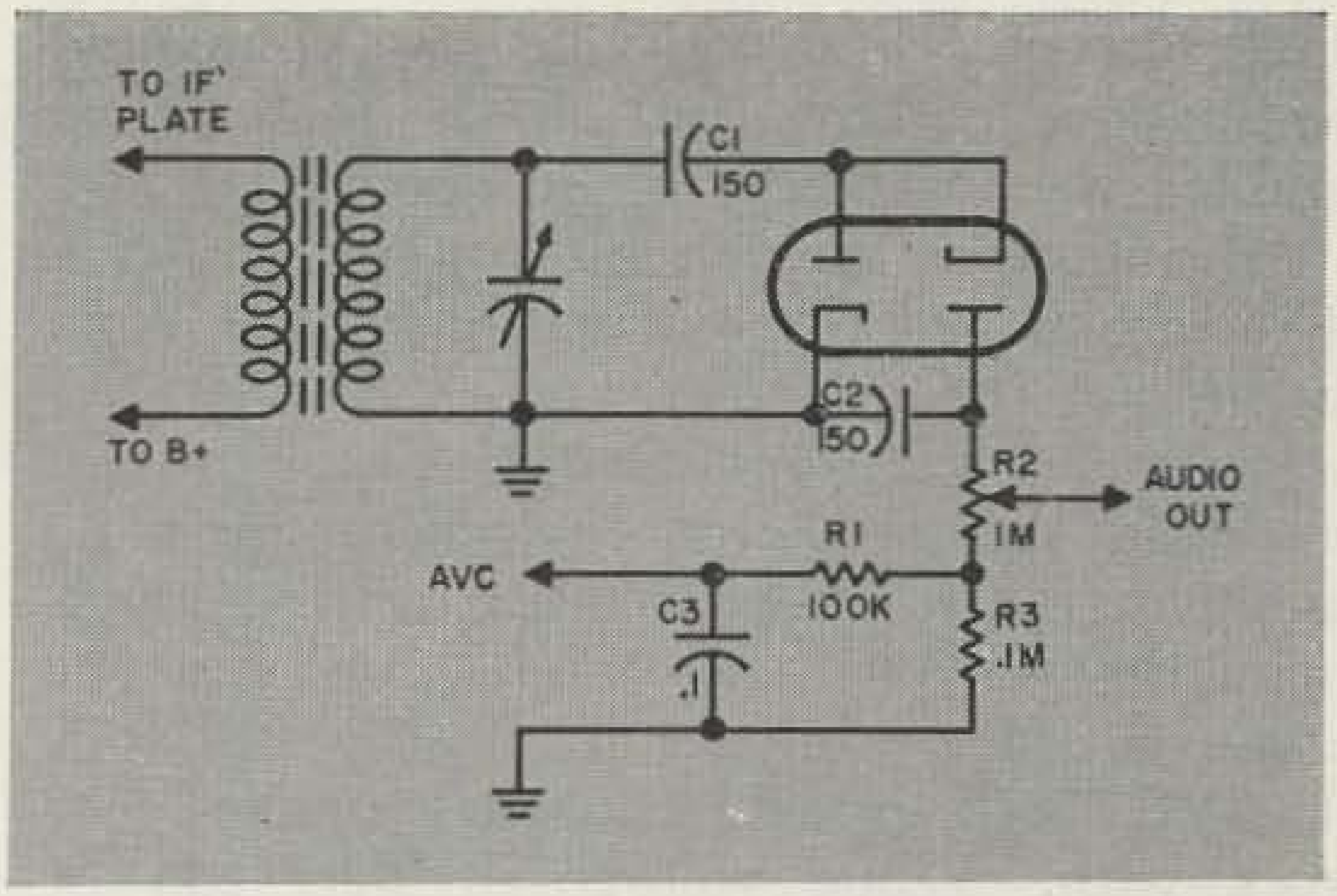


Fig. 2. The diode integrator, sometimes called a peak-to-peak detector, provides a virtually open-circuit load to the *if* transformer secondary. All distortion resulting from assymetrical transformer loading is thereby eliminated, and detector efficiency is increased.

Instead of being patterned after a half-wave rectifier, this circuit is an adaptation of the full-wave voltage doubler. Since it is a full-wave device, it utilizes both halves of the input-signal cycle rather than only one, with resulting increase in efficiency.

The reduction in distortion is brought about by the fact that one of the two diodes is conducting at all times, and both diodes never conduct simultaneously. With both C1 and C2 set at the same value, the *if* transformer always sees a capacitive load—and under this

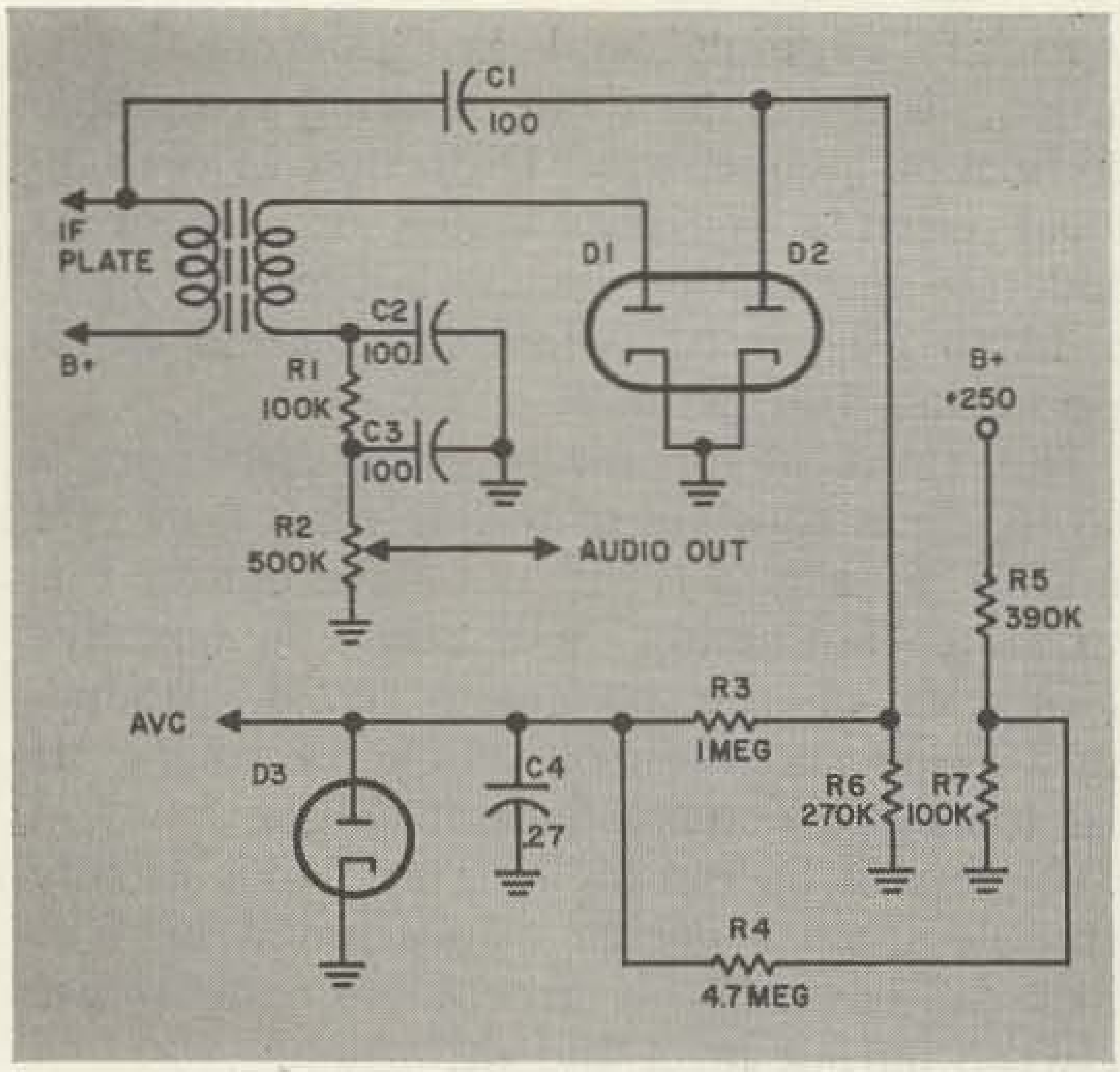


Fig. 3. Most complex of the detector circuits shown here is the "sinking diode" arrangement which includes delayed AVC and reduces distortion. Crystal diodes can be substituted for D1 and D2, but D3 must be a tube to achieve extremely high reverse resistance.

condition, the capacitance can be trimmed out by returning the *if* transformer to resonance. This results in an effective load of nothing at all; at one fell swoop you have eliminated modulation cutting and have more than doubled the efficiency of the detector.

Advantages of this circuit are the reduction of distortion and the removal of loading from the output *if* transformer.

Its major disadvantage is the high output produced; in new-design equipment this is no handicap, but when you modify existing equipment the 35-volt peak-to-peak audio which comes out of the integrator and the 100 volts of AVC both prove somewhat unhandy to work with. While voltage dividers can be used to trim them back to more conventional values, the dividers will then introduce frequency distortion and differential loading effects which may cancel out the advantages of the circuit.

Another low-distortion circuit is the "sinking diode" arrangement described by Langford-Smith and shown in Fig. 3. This circuit eliminates differential distortion and also produces delayed AVC, at the cost of several additional components. It has been applied in at least one receiver-updating technique, and excellent results have been reported.

This circuit is identical to the peak-linear circuit insofar as the detector itself is concerned. The only departure from conventional techniques is use of a voltage divider and a clamping diode (D3) to first apply a positive bias to the AVC line and then to clamp the line to ground.

The result is that the AVC line must overcome the positive bias to become effective, but can never go positive itself. The voltage-divider circuitry provides a constant load for the AVC diode, preventing interaction with the detector diode coupled to the same transformer and thus eliminating differential distortion due to the AVC action.

The advantage of the circuit is its reduction of distortion, coupled with DAVC provision.

Major disadvantage is the requirement for added components. A secondary disadvantage is the requirement for "cut-and-try" tailoring of component values in the AVC circuitry.

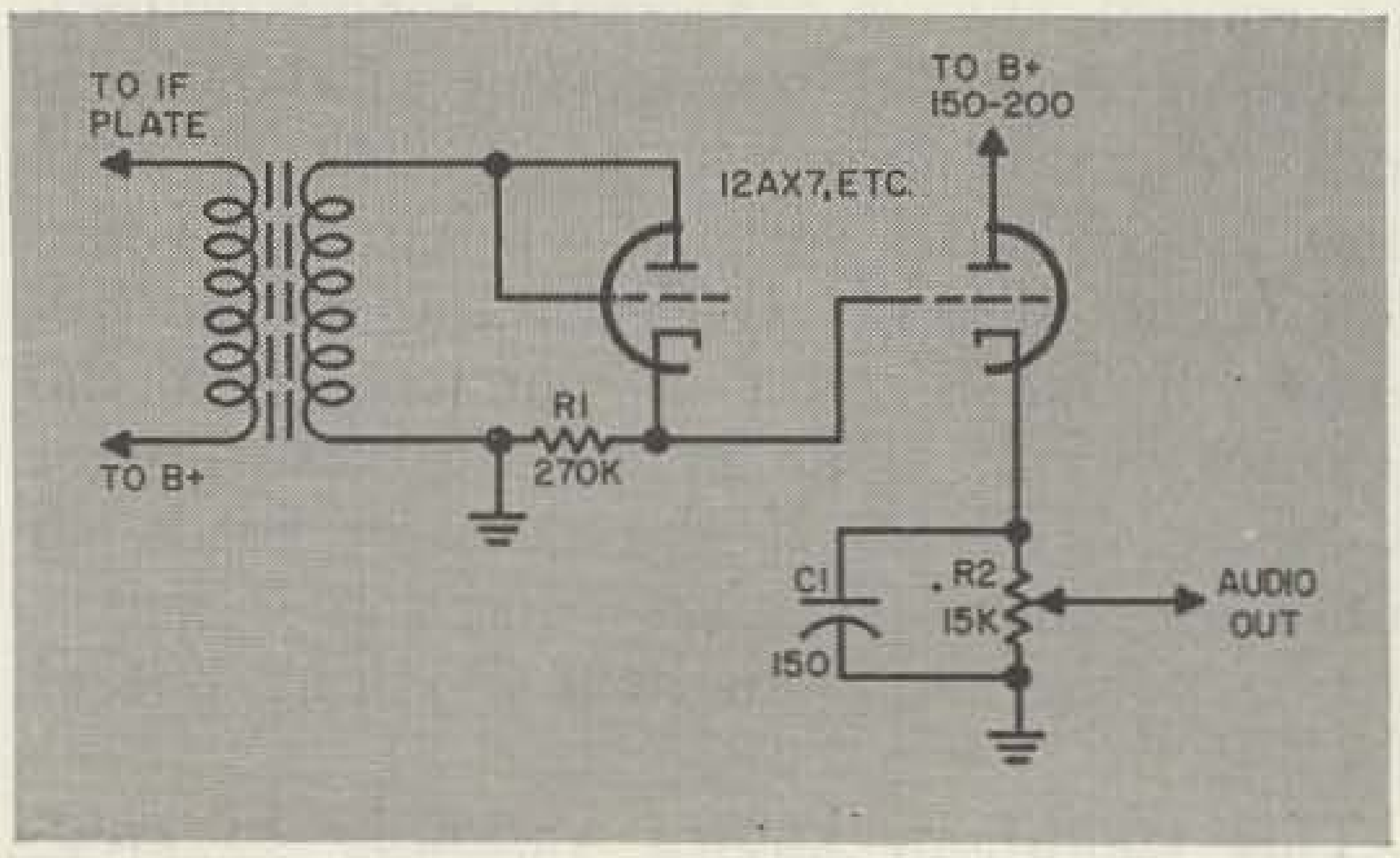
Since much of the distortion in a peak-linear detector is caused by interaction with associated circuits, use of some sort of isolation device appears to be a natural to eliminate the distortion. One of the simplest and most popular such devices is the cathode follower.

Two circuits combining the diode detector and the cathode follower have been published, and excellent results are reported with each.

The simpler of the two was developed by W. T. Selsted and B. H. Smith in the Radiation Laboratory of the University of California, and appears in Langford-Smith's writings. In it, the cathode follower follows the detector (see Fig. 4) but precedes the load capacitor and filter components.

Claimed distortion reduction is from 12 percent to less than 1 percent at total modulation. This is achieved because the isolation presents an essentially resistive load to the detector, completely eliminating all causes of distortion except diode characteristic curvature. Curavture effects are minimized by keep-

Fig. 4. Less than 1 percent distortion at 100 percent modulation is the claimed performance of this cathode-follower plus diode detector circuit. Shunt impedance is eliminated from the diode load (R1) by the direct-coupled cathode follower.



ing applied signal voltage high—greater than 10 volts in most receivers.

Major disadvantage of the circuit is its requirement for an added tube. However, should your receiver use a 6AL5 as detector, it can be replaced with a 12AX7 with little difficulty. The 6H6 can be replaced with a 6SL7.

There is no hard-and-fast rule that the isolation must be between the detector and its load. Similar advantages may be gained by isolating the detector from the *if* transformer as described by Sareda.

In this circuit (Fig. 5), two major advantages appear. Loading of the output *if* transformer is substantially reduced, since it feeds only the high-impedance input of the cathode follower. Differential distortion is also slashed by an appreciable amount, since the detector load resistor (R2) is so much lower than any associated shunt impedance. This means that any variation of shunt impedance with frequency or modulation depth becomes only a minute fraction of the impedance of R2.

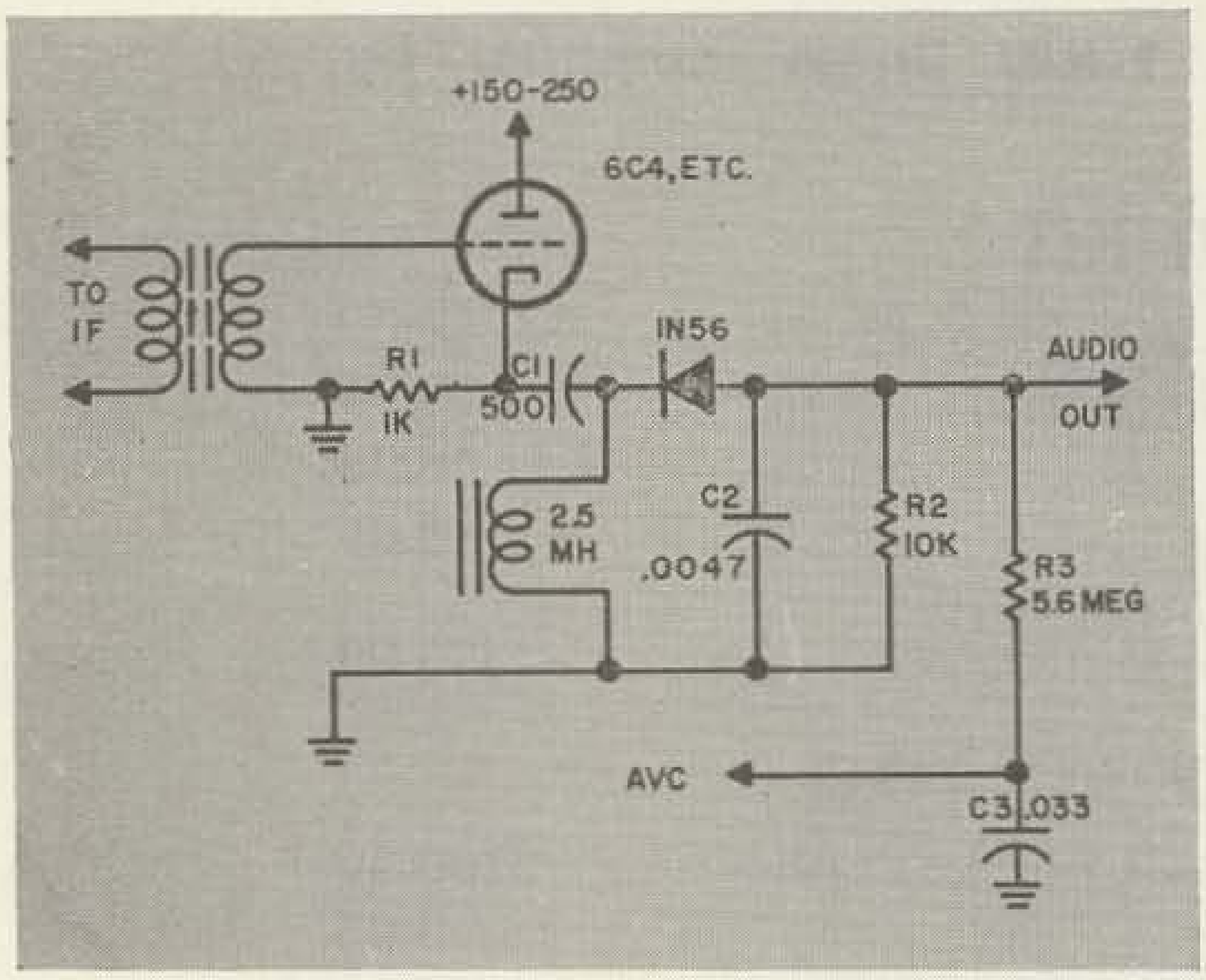


Fig. 5. This cathode-follower detector circuit provides both audio and AVC from a single diode. It eliminates differential distortion by keeping diode load resistance R2 at a low value so that all shunting impedances will have minimum effect

Use of the low-valued load resistor requires that a high-conductance crystal diode be used as detector. If a tube is employed, its forward resistance will be an appreciable fraction of the load resistance and distortion will skyrocket.

No figures for distortion reduction have been obtained for this circuit. However, it appears that its performance should be comparable to that of the diode integrator.

Major disadvantage of the circuit is its complexity, requiring addition of one triode stage and three other components to the receiver. However, it should be a natural for inclusion in a homebrew receiver.

Another approach to detection, basically different from the peak-linear diode circuit, is the "infinite-impedance" detector. Frequently used in hi-fi gear, it is seldom seen in communications receivers because it makes no provision for AVC voltage.

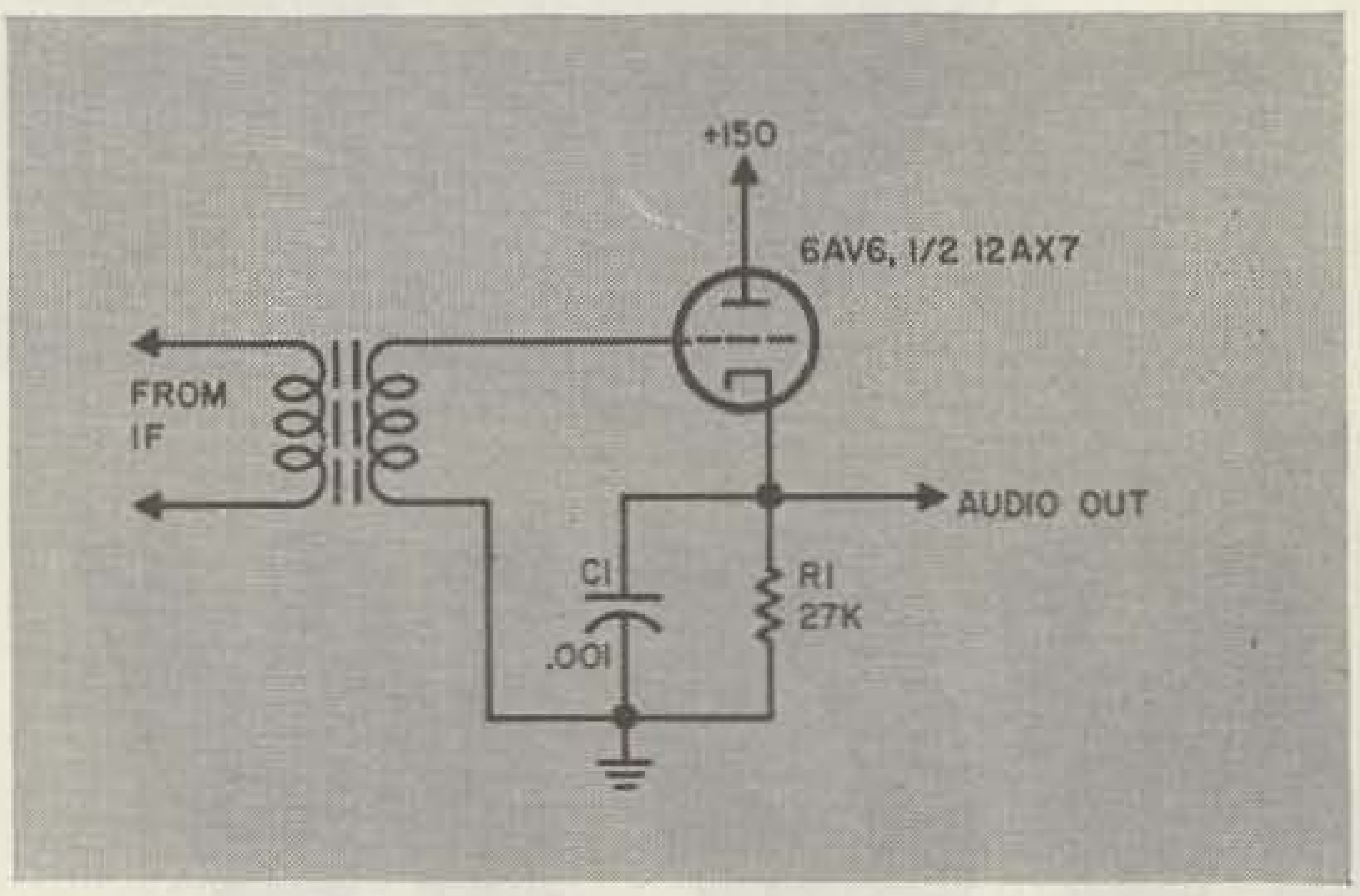


Fig. 6. The infinite-impedance detector appears similar to a cathode-follower amplifier but operates differently. It reduces distortion and increases selectivity, but can be overloaded more easily than the conventional diode circuit.

A typical infinite-impedance detector is shown in Fig. 6. You can see that it appears identical to a normal cathode follower type amplifier—and so far as the circuit goes, it is identical. The difference lies in the tube's operating point.

While circuit constants in the cathode follower are chosen so that the tube acts in a linear manner, an infinite-impedance detector is biased almost to the cutoff point. This is accomplished by the extremely large cathode resistor, R1.

With no signal, little plate current flows and the voltage drop across R1 is small and steady. When an rf signal is applied, more plate current flows at positive peaks, increasing voltage drop across R1. The voltage across R1 reproduces the signal's modulation envelope in the same manner that the envelope is reproduced in a peak-linear diode detector.

Since the tube is operated in cathode-follower configuration with a large amount of feedback, its input impedance is high. As a result, the *if* transformer is not heavily loaded and selectivity is increased. The large amount of feedback prevents overload effects until the grid is driven far into the positive region, at which time distortion suddenly becomes extreme. Since this doesn't happen until input nears 50 volts, its effect is usually absent.

Distortion level of the typical infinite-impedance detector at 100 percent modulation is in the neighborhood of 3 percent. This is not so low as some of the more sophisticated diode circuits, but appreciably lower than the 10 to 15 percent produced by the conventional diode.

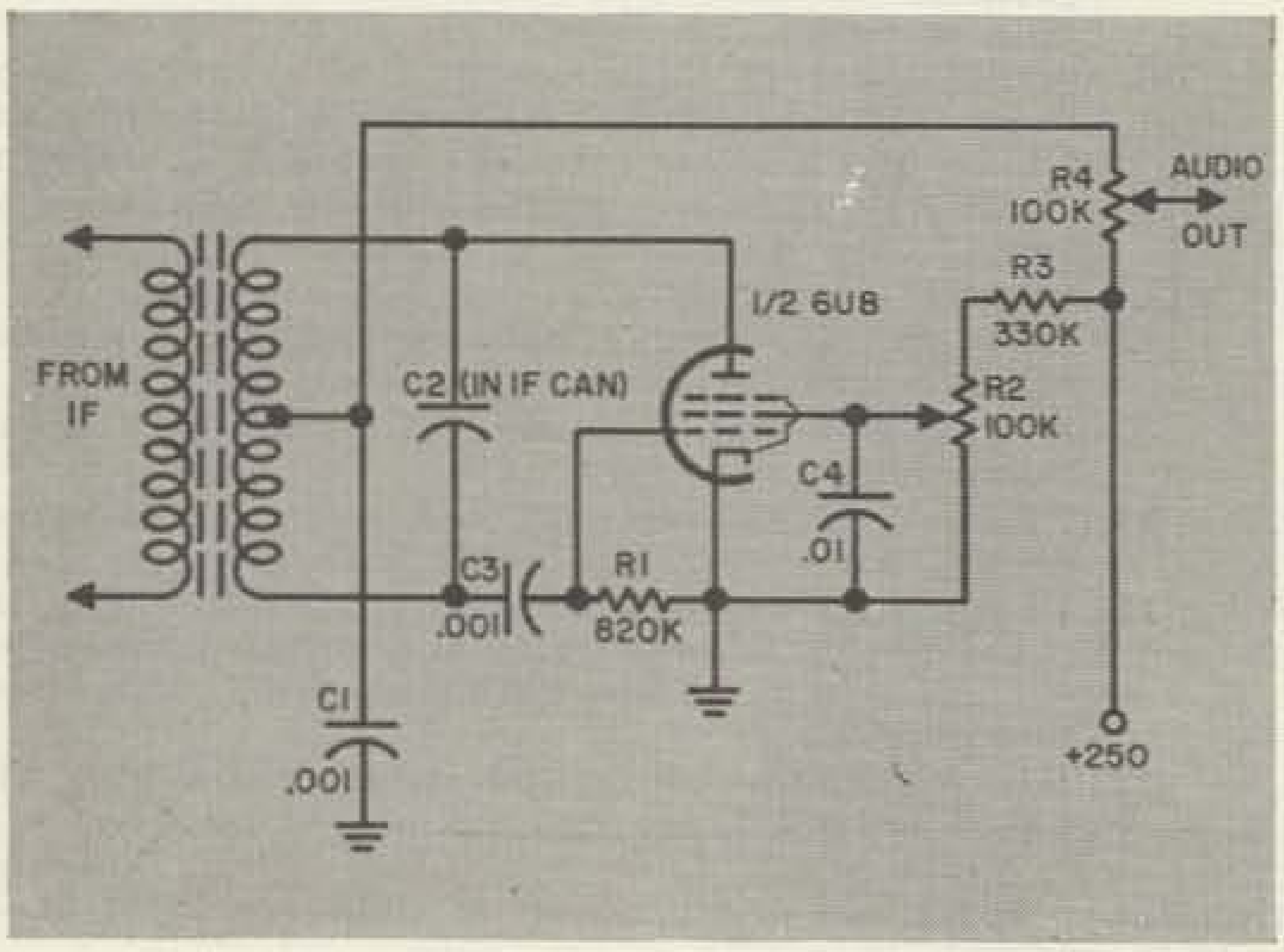
Aside from circuit complexity, the major disadvantage of this detector is that it makes no provision for AVC takeoff. With the receivers using amplified AVC such as the Super-Pro and the SX-28, this poses no problem.

The only other AM detector still in anything like wide use is the superregenerative circuit, developed by Maj. Armstrong. Relegated to the UHF bands before World War II, it was brought back from obscurity for use in Class D Citizens Band equipment and, with some modifications, can find a permanent place in ham equipment.

Too many superregen circuits exist for us to list them all here. One easily-handled version is shown in Fig. 7. Note its strong resemblance to a grounded-cathode Hartley oscillator. As a matter of fact, the superregen *is* an oscillator, with its grid-circuit time constant chosen to produce "squegging" at a supersonic rate. The ear doesn't hear the oscillation or the squegging, and the nearly-infinite amplification produced when the circuit is oscillating makes it possible to hear even the weakest signals.

One major characteristic of the superregen is its characteristic hiss. At one time, they were known as "hiss-boxes." This hiss is actually the noise produced by random movement of electrons in the coil and in the antenna—indicative of its great amplification ability.

Fig. 7. This superregenerative detector for use in VHF mobile receivers combines AVC, noise rejection, and extreme amplification. R2 controls regeneration and R4 is the audio gain contol. The transformer secondary must be centertapped.



The superregen has other advantages besides extreme amplification. It automatically limits its own output, making noise limiters and AVC circuitry unnecessary.

However, in most applications its disadvantages outweigh these advantages. The superregen produces extreme noise output in absence of signal (the hiss mentioned before). It radiates an interfering signal, not only on the frequency to which it is tuned but at all integral multiples of its quench or squegging frequency for several megacycles in either direction. Its sensitivity is low despite the gain because of the high noise output. And finally, its distortion is high. The superregen is definitely not a low-distortion detector.

With a couple of modifications, though, it can fill a major need as the second detector in mobile sets designed for VHF use. In this application, its amplitude limiting and great gain become major advantages. Use of superhet configuration for the receiver eliminates the low sensitivity, interfering radiation, and broad-tuning characteristics of the superregen used alone.

Care must be taken to shield the detector completely. Otherwise, signals at the *if* will leak through and be detected because of the great gain. The *if* frequency to be used must also be chosen carefully. Quench or squegging frequency should be approximately 1/1000 the signal frequency for best results, but in no case should it be in the audio range (or even lower than twice the highest audio frequency desired in incoming signals). This means that the *if* chosen should not be lower than 10 mc and can never be lower than 5 mc if good results are to be obtained.

The circuit shown in Fig. 7 is designed for use with an *if* of 17 mc. It can be used without change through the range from 10 mc upward. Should you desire to change the quench frequency, the components which determine it are R1 and C3.

Automatic Volume Control

While AVC circuits are rightfully a subject unto themselves, they are so closely related to detectors in so many ways that they will be treated briefly here.

The basic AVC circuit is identical to the peak-linear diode detector shown in Fig. 1, except that the AVC output line includes a low-pass R-C filter to eliminate all audio components and leave only the dc voltage developed by the incoming carrier.

The time constants of this filter determine

how rapidly the AVC will act, as well as the speed with which it will release after the signal stops. For communications use with normal AM signals, an overall time constant of about 0.2 second (for both attack and release) is optimum. Shorter time constants enable the receiver to follow fading more rapidly, but result in loss of bass from the audio. Longer time constants emphasize fading effects. However, in hi-fi tuners where excellent audio response is more important than freedom from fading (since most reception is local in nature), time constants for this circuit average one second.

A major disadvantage of the ordinary AVC circuit is that it applies a control voltage for weak signals as well as for large ones. In other words, it cuts back the gain of the set even when you want all the gain you can get.

To overcome this disadvantage, delayed AVC was developed. The delay refers to voltage, not to time. It means that no AVC is applied to the set until signals are above a predetermined level. Past that point, AVC action is normal. One of the best delayed AVC circuits is the sinking diode arrangement, Fig. 3. Another is included in a squelch circuit shown in "The Perfect Squelch" (73, December, 1960, pg. 26).

When receiving CW or SSB, neither conventional nor delayed AVC is in itself acceptable. Means must be found to apply AVC quickly, while retaining it even with no signal incoming. Such circuits are known generally as "hang AVC" circuits because the AVC voltage hangs on for an instant after the signal is gone. These circuits, together with detectors for CW and SSB, must form the subject for another article. **73**

BIBLIOGRAPHY

Eastman, *Fundamentals of Vacuum Tubes,* Third Edition, pages 564-576.

Geisler, *Rejuvenation for the AM Detector,* Radio-Electronics, October, 1959, page 58.

Greenleaf and Chandler, *Low Noise AM Tuner Uses Triode Input,* Audio, September, 1959, Page 19.

Langford-Smith, *Radiotron Designer's Handbook,** Fourth Edition, pages 1072-1086, also pages 326, 1108, and 1117.

Sareda, *Better Diode Detection,* Radio-Electronics, August, 1956, page 103.

Terman, *Electronic and Radio Engineering,** Fourth Edition, pages 547-558.

Tschannen, W9LUO, *The "Club Saver" 2-Meter Portable,* QST, October, 1957, page 11.

Vogelgesang, *Unique AM Tuner Improves Audio Quality,* Radio-Electronics, December, 1956, page 80.

*Available from Radio Bookshop.

Ham Headlines

If ham radio makes the newspapers in your town please send a clipping to Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Marvin runs the 73 News Service, a montly publication sent to all editors of club bulletins. He will digest the most important stories that are submitted each month for us to print in 73.

Ham Station in Bomb Shelter

A ham station, operating on all amateur bands from Six to Eighty meters, has been installed in the cafeteria, which doubles as a bomb shelter, of the Cleveland Twist Drill Company. There are both indoor and outdoor antennas, just in case. Call letters are K8UFN. (*Cleveland Plain Dealer, Cleveland, Ohio . . . from Parma Radio Club*).

Hams and Doctor Aid Stricken Hunter

W5FFX, W. C. Lendon, at a ranch in Folsom New Mexico put a phone patch through W6MLZ, Ray Meyers, to a doctor in the San Gabriel Hospital. The doctor prescribed emergency treatment for a hunter who had been stricken with a heart attack at the isolated ranch. Another amateur alerted an ambulance which rushed oxygen to the scene. The new Mexico Highway Patrol later notified W6MLZ that the hunter had arrived at the hospital in Folsom and was out of danger. (*Los Angeles Times*).

Tower Legislation

The Menlo Park City Council has decided to make a blanket ruling about ham radio towers. The issue was brought to a head by the 70 foot tower of William Orr W6SAI which the Council ordered him to take down. Orr disputed the ruling and refused to take it down. A second tower was recently discovered by the City Planner, this one only 50 feet high. Since the city height limit is 35 feet this was added to the Orr tower difficulty and a single comprehensive ruling should result. (*Daily Palo Alto Times, Palo Alto, California*).

Letters

Dear Porsche Pusher,

Hullo There! Just grabbed a copy of ur new magazine today (last copy of the October issue) which made me pretty happy. Dunno why I made that trip to the local Clip & Gip joint—but maybe that "One Step Beyond" program knows what it's talking about.

Anyhoo, I'm sure glad that the ex-"Editor of a leading technical magazine in the electronics field," to quote a sports car magazine which once published an article by some guy named Green on Rally(e)ing, is back in the business again. "XX" lost me about the same time that it lost you (well maybe 2-3 minute later), and I've been hoping you would return. I realize that the opinion of a teenager who can't even afford $3 for a subscription may not count for too much, but I sure like the new "73" and you can be darn sure that my next $3 is headed directly to you cats.

Speaking of teenagers, why don't you maybe devote some space to this growing facet of the ham fraternity? A quick glance at the local high schools' regional Science Fair will show that we young-uns have a fair amount of know-how.

210 (seventy 3's) . . . Wm. Swope K7HXP
Tacoma, Washington

OK Wm., put down that switch-blade and start writing. A lot of teenagers are doing interesting things if they'd only write 'em up. I've seen some great home-brew stuff built by teenagers, but darned if I have been able to get 'em to article-ize the stuff.

CUT IT OUT!

Yes, cut this out and send it in right away . . . we need it yesterday. The problem is this: we need some facts and figures to help snow advertisers. The main figure we need is one which will give them an idea of how many 73 readers do not carefully read other ham magazines so they can see why, though they may advertise elsewhere, they must also use the pages of 73 to approach our elusive readers. If you don't like to chop up your magazine then send us a postcard. IMPORTANT: send **something.**

Questionnaire

In addition to 73 I carefully read the following ham magazines ______________

. . . (Oh, while you're sending something in you might as well vote on the articles).

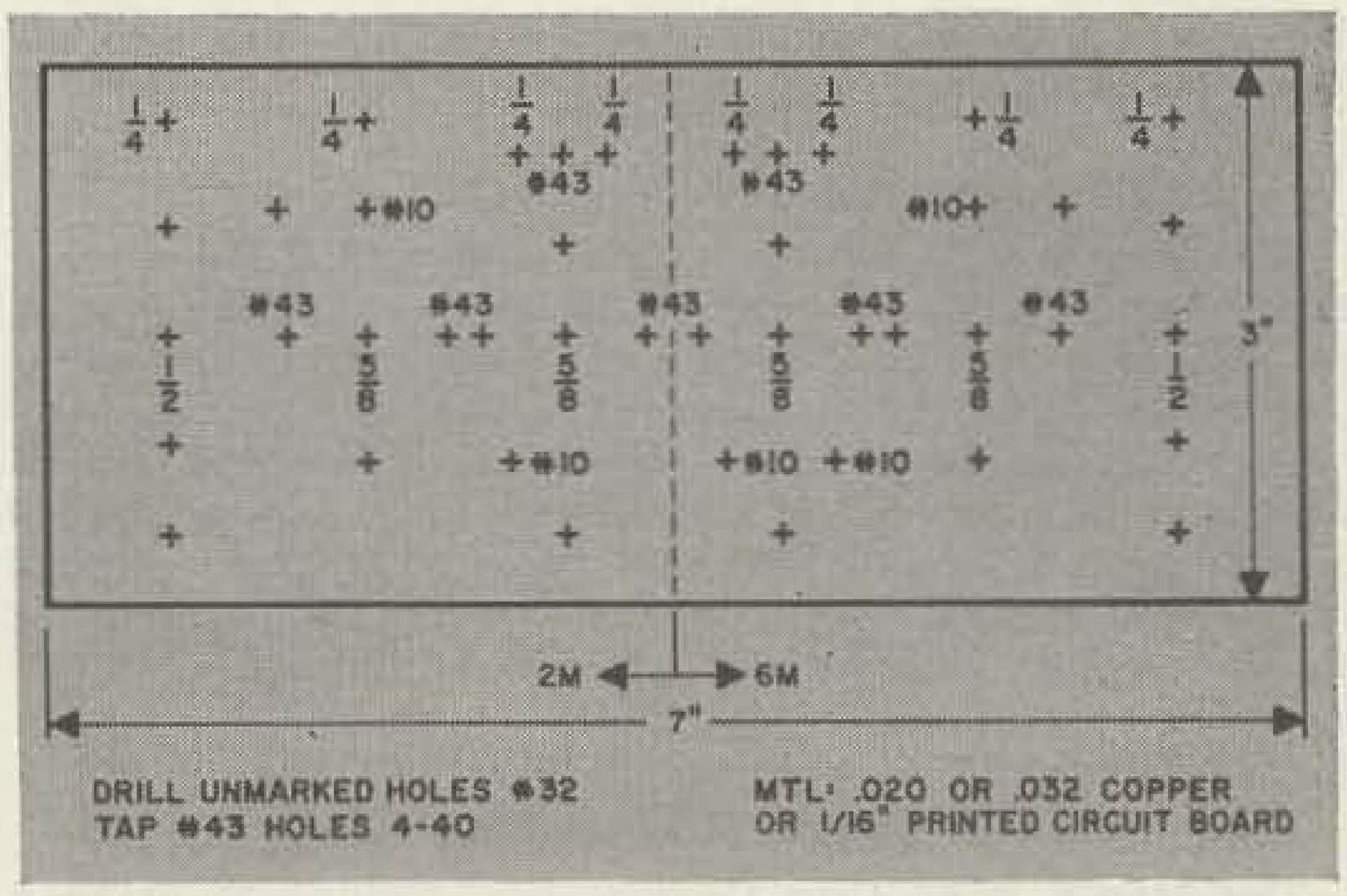
—Nuvistor Converters	—Suction or Whoosh
—Down With Drift	—Xstr Comm. Receiver
—6N2 Complete	—Vertical
—1296 mc	—A-M Detectors
—Goblin Patrol	—T-17 Switch
—Lost in a Tunnel	—Propagation Chart
—8 mc Conversion	—Spot Freq. VHF Nets
—Transistor Freq. Std.	—See-Saw Bleeder

(Please list order of your preference . . . 1-2-3, etc.)

(6 and 2 from page 11)

Construction

The converters are built on a 3″x7″ piece of copper sheet with the edges bent 90° for strength. If copper is not available try using printed circuit board as a chassis material, without etching. Drill all holes first; then mount the Nuvistor sockets, filing the necessary slots in the ½″ mounting holes. Next mount the shields by soldering to the chassis.



The printed circuit board is considerably easier to solder to than is the copper sheet. Now mount all parts, and wire. The small color coded wires removed from 8-wire TV rotor cable are ideal for the hookup and the coil links. If only one converter is to be built simply split the chassis layout down the center. Except for the extra hole for C9 the 6&2 layouts are identical.

I hope some of you ø's and 1's will build this converter and listen for K8ERV on 2!

73

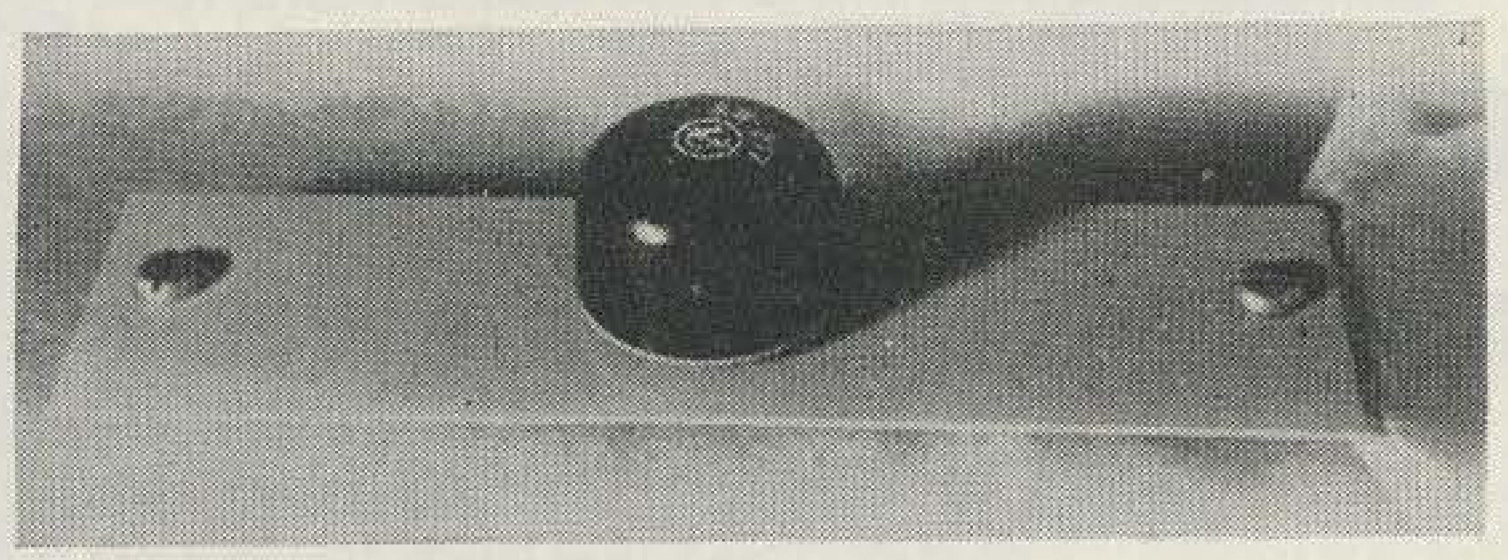
New Product

International Crystal Catalog

If you look carefully in the smaller type in the International Crystal ads you will notice that a catalog is listed as being available. Their new 1961 model is just off the presses and it is a darb. Theoretically you are supposed to be interested in home brew if you read this magazine, thus you automatically become a first class candidate for this home brewers paradise. To be blunt: send immediately for this catalog and join the rest of us in hungrily ogling page after page of goodies. They have dozens of circuit kits in there, both with tubes and transistors. You can build almost anything you want with these basic kits. If this catalog doesn't get you all excited then turn in your ham ticket and subscription to 73, your Novice license has expired. International Crystal Manufacturing Company, 18 North Lee, Oklahoma City, Oklahoma.

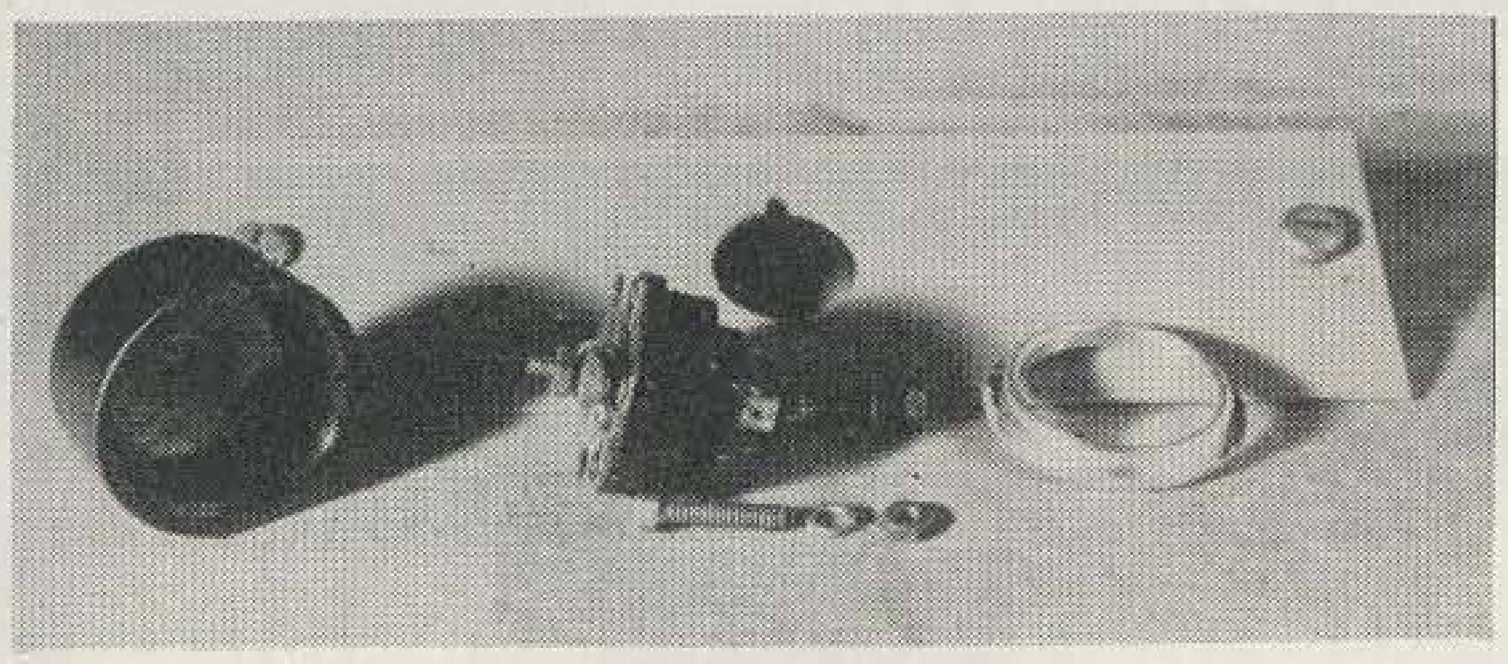
A Versatile Switch from Surplus

THE worthy T-17 Microphone has performed yeoman military service through one war and a major "police action" and, in addition has served many thousands of amateurs as a rugged, high quality carbon microphone for mobile and portable use. However, the best of equipment does give up the ghost or is replaced by newer and better (?) gear. The T-17 is no exception to this and repairs of the models in which the carbon element is assembled in the plastic case are difficult.



"Chassis mounted view of the push-to-talk switch from a surplus T-17 Microphone."

Before discarding this venerable survivor, examine the push-to-talk switch carefully. It is a sturdy double pole, single throw unit that may be easily removed from the microphone and installed to meet any number of push-to-operate requirements. It is particularly suited for use where the precision finger jabbing required with todays miniature components can not be tolerated.

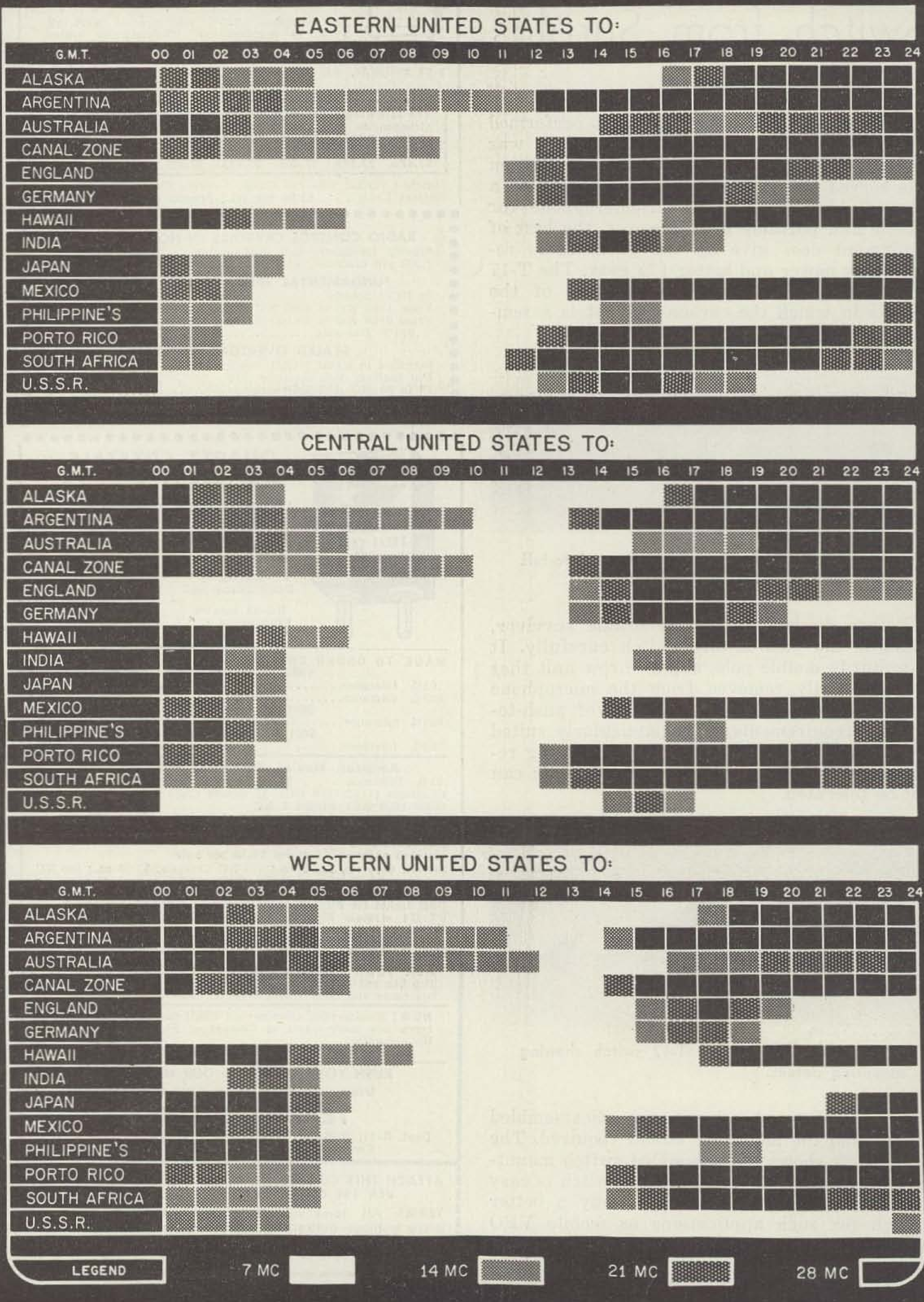


"Dismantled view of the T-17 switch showing mounting details."

The photograph shows the disassembled switch and the mounting cutout required. The other view shows the assembled switch mounted on a small control panel. The switch is easy to mount and where could you buy a better switch for such applications as mobile VFO spotting?

. . . Pafenberg

PROPAGATION CHART



Propagation Charts

David A. Brown K2IGY
60 New York Avenue
West Hempstead, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham band openings for the month of January, 1961 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

Advanced Forecast: January 1961

Good 1-3, 10-19, 23-31

Fair 4-5, 8-9, 20, 22

Bad 6-7, 21

Spot Frequency Operation Of VHF Nets

Robert B. Kuehn WØHKF
1212 Bellows St.
St. Paul 16, Minn.

ONE of the problems faced by users of commercial FM gear in amateur operation is placing all of the units on exactly the same frequency. Slightly off frequency operation with this equipment results in a marked falling off in sensitivity, and in the absence of other symptoms, everything else may be suspected but the true cause.

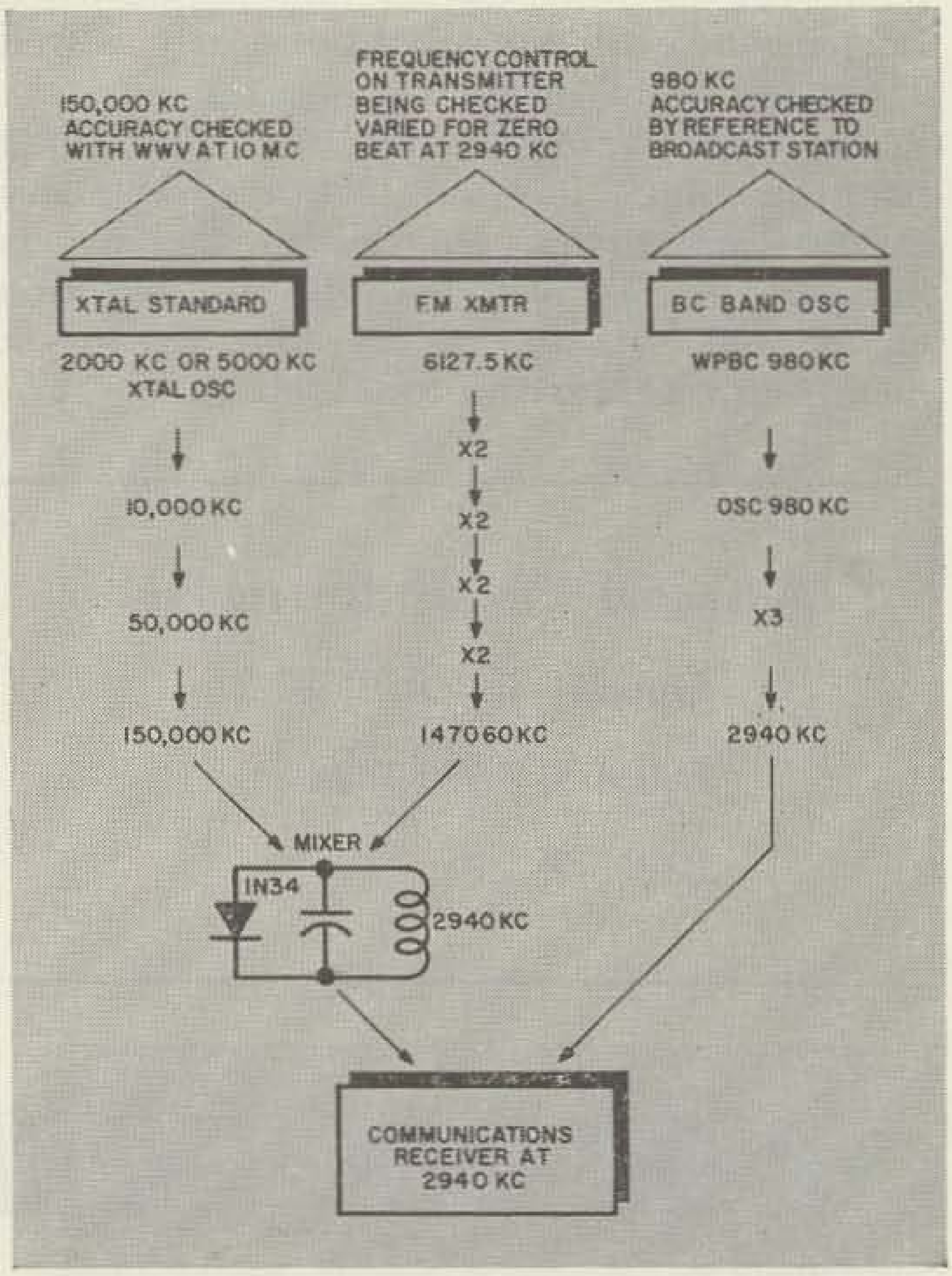
In amateur operation being on the exact frequency is unimportant as long as all stations are on the *same* frequency. A convenient way of ensuring this is to designate one station, usually the net control, as a standard and zero all other units on that one by means of this modified heterodyne frequency standard.

When the outputs of two transmitters within 10 kc of each other are combined in an rf detector the result will be an audible beatnote representing the difference in frequency. When the frequency of one of the transmitters is varied until the beatnote becomes as low as possible and finally disappears, both transmitters will be on the same rf frequency. A mobile can draw up to the curb at the standard station, place this 'difference meter' on the fender or trunk floor and with both carriers on, zero his transmitter exactly on frequency in a matter of seconds. In like manner the mobile can then carry the standard frequency to other fixed or mobile stations. Since sensitivity is no problem, the most rudimentary type of rf detector will do; in fact a portable grid dipper or a field strength meter with phones can be used. The circuit illustrates a tuned circuit, diode detector and transistor amplifier which, together with two penlight cells, can be built into a very small aluminum box. A piece of wire a foot or two long serving as an antenna gives enough pickup for an audible signal in the phones.

When it is desired to establish a net on an exact frequency it does not necessarily demand an expensive frequency meter. It can be done with equipment and parts found in any ham shack. The following procedure is used to set one of our nets on 147,060 kc. With obvious modifications it can be used for most 2 or 6 meter channels.

A 2 mc crystal oscillator is followed by a quintupler to 10 mc, another quintupler to 50 mc and a tripler to 150 mc. Two dual triodes suffice, since little power is needed. A 5 mc crystal could be used as well. A comparison with WWV at 10 mc ensures output on exactly 150,000 kc.

We have a local BC station on 980 kc. A self excited oscillator is adjusted to 980 kc by reference to the BC station and followed by a tripler to 2940 kc. Since all BC stations keep within a cycle or two of assigned frequency, the 2940 kc can be assumed exact as long as zero beat is maintained.



150,000 minus 147,060 (the frequency being checked) is 2940. A small portion of the output of the transmitter and the 150,000 kc output are placed across a mixer consisting of a 1N34 diode and a tuned circuit at 2940 kc. The result is compared in the station receiver (tuned to 2940) with the output of the 980 kc tripler. Varying the crystal of the VHF transmitter for zero beat at 2940 kc will then indicate operation on exactly 147,060 kc. In making a frequency check the receiver is tuned quickly first to 980 kc then to 10 mc and then to 2940 kc for the final check. If a suitable BC channel is not available the self excited oscillator can be kept on any selected frequency by means of an ordinary 100-10 kc standard. **73**

(1296 from page 17)

You will note no mention has been made of use of modulated oscillators or radar *if* strips to get going on this band. Amateurs proved this type of UHF-VHF equipment obsolete 20 years ago, so consider such garbage a waste of time. I have e APX-6, much modified, etc., around to work out antenna patterns with and so will you, but consider the time spent trying to talk to someone else with it a waste. If you are going to use ¾ wave tanks anywhere in the 1296 mc portion of your Xmtr. don't use 432 mc equipment for drive to a tripler. Triple from 216 mc to 648 mc and use a doubler to 1296 mcs.

If the above seems like a lot of work and too much trouble—then stand on a mountain and use a flash-light to another such set-up—you will then have communicated on some real-high frequency energy, but meanwhile W1FZJ, W2CXY, W8LIO, W9QXP, K2GQI, W2TTM, K2HAC, K2TKN are involved in the most interesting phase of amateur radio yet. We have standards—the frequency is 1296 mc—exact, and polarization is horizontal when pointing at the horizon due south on a polar mount.

Most of us have no special test equipment, none have any money, any of us are more than glad to prove that any available equipment or parts provided by the few interested manufacturers will or won't work efficiently at 1296 mc, and we all welcome interest by any other amateurs. Please don't write asking for exact info on this or that, for I have no time to describe equipment that is obsolete by the time this gets in print—scream, holler, and insult W2NSD and he will see that articles appear in "73" on anything enough of you have interest in, besides we need the money!

Seriously, Grote Reber summed up the whole situation very well when he was the first amateur working on these frequencies some years ago—"There is much to be done!"

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Feb. 12—The Electronic Emission Microscope.

See-Saw Bleeder

Pat Miller KV4CI
P. O. Box 701
St. Thomas, V. I.

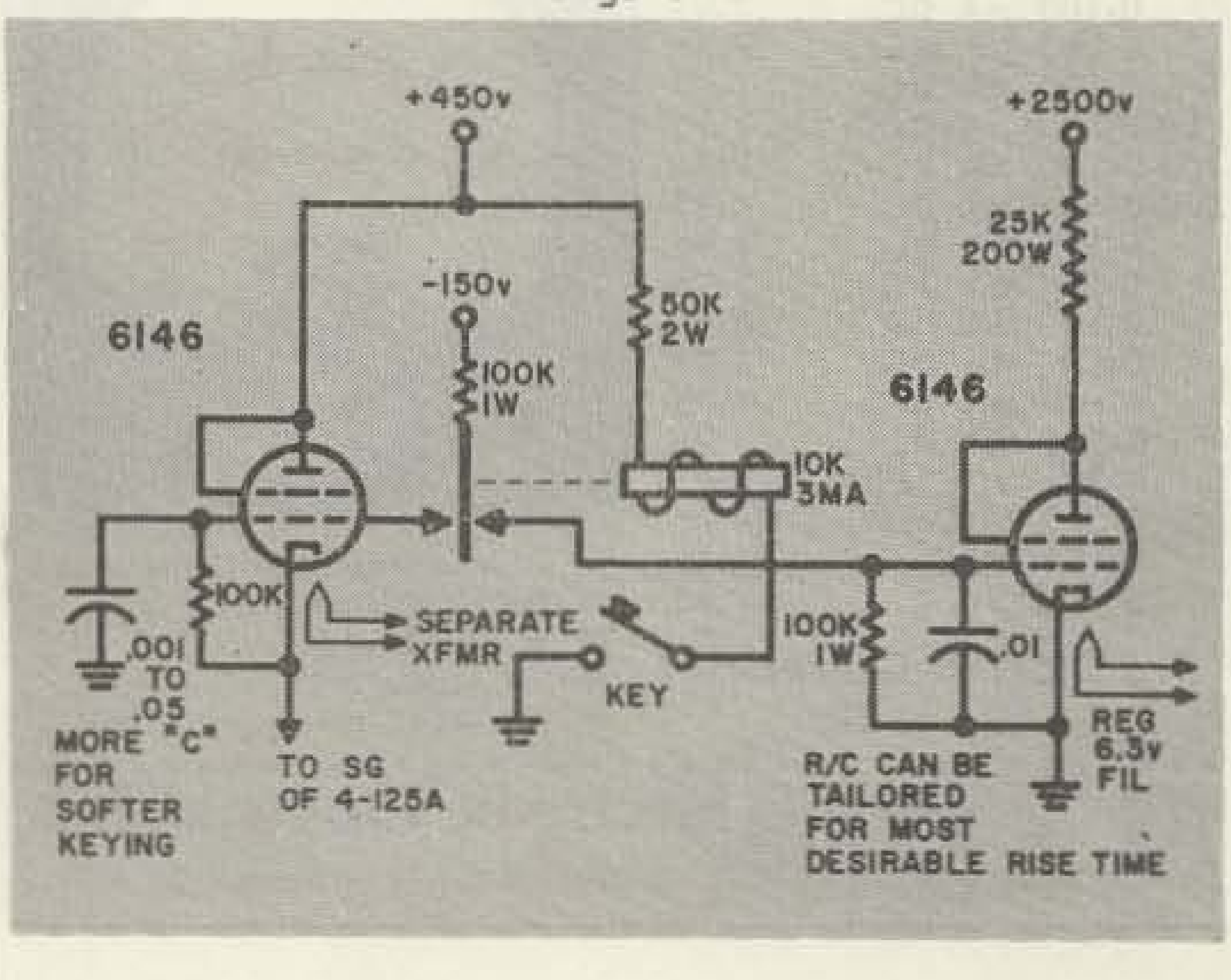
How would you like to save up to ten dollars a year on your ham rig? If you are an active CW ham, the following article will give you some good tip-offs on how to cut the cost of running your rig.

The term "Watts Per Dollar" has been used frequently in construction articles but invariably it has been in reference to the inital cost of the components. Little thought, by radio hams, has been given to the every day consumption of useless watts by their transmitters. The worst offender is the power supply bleeder, frying away and adding useless heat.

Commercial communications companies, with their eyes warily looking at their electric bills, took up this problem a long time ago and came up with what could be called a "See-Saw" bleeder. The design is a simple one and amounts to nothing more than a clamp tube in series with the bleeder which pulls a lot of current under "key-up" conditions and clamps off the bleeder under "key-down" conditions. We radio hams use this device as a source of screen voltage from the HV supply but then blindly proceed to add another bleeder in parallel with the clamp circuit. Such design does nothing but add heat and strain to the power supply.

At KV4CI one of several methods of putting a "See-Saw" bleeder to work was put into action; see Fig. 1. This circuit is a bit fancy as it uses a keyer tube to key the screen of the 4-125A final. However, the same bias that keys the keyer tube is used to unclamp the bleeder clamp tube. Under "key-up" conditions the bias cuts off the keyer tube. Under "key-down" conditions bias is shifted from the keyer tube, allowing it to conduct, and is put on the grid of the bleeder clamp tube cutting off the current in the bleeder. A small plate relay, single pole, double throw, is used to do the keying and steals a few mills from the low voltage power supply.

Fig. 1



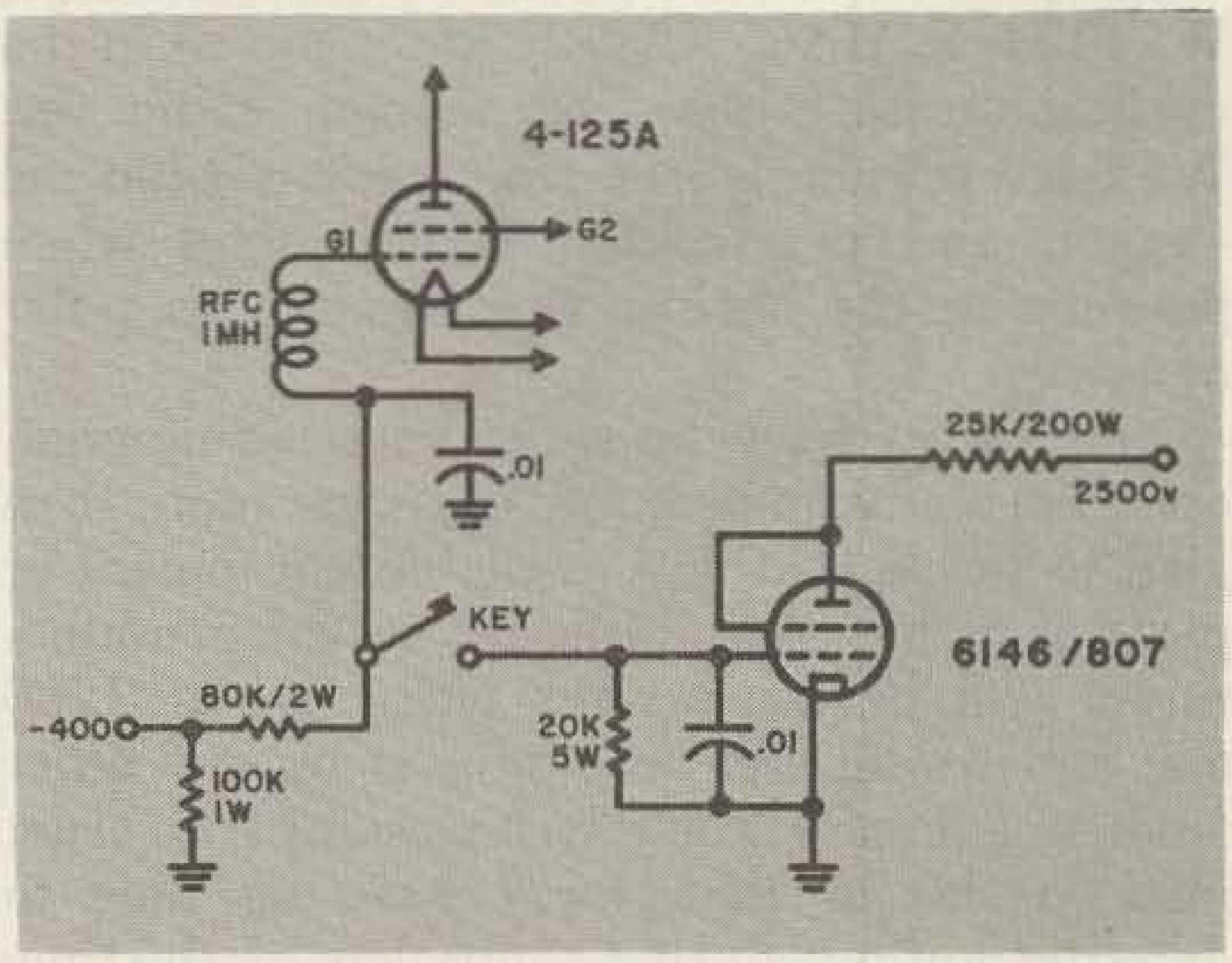


Fig. 2

For those that use grid block keying a suggested circuit is shown in Fig. 2. Here the normal grid leak is inactive under "key-up" conditions, acting only as a grid return for the bleeder clamp tube. Under "key-down" conditions the bias source is practically shorted out leaving only enough protective bias to keep the ampilfier cool if it should accidentally be off-tune. The same left over bias is used to clamp off the bleeder tube.

Fig. 3 is another variation wherein the voltage appearing at the plate of the clamp tube under "key-down" conditions is used to supply the screen voltage to the amplifier. A voltage regulator tube cuts off the screen voltage entirely under "key-up" conditions while a small amount of negative bias is impinged on the screen to assure full cut off. If you project your imagination on your own you can come up with at least a half dozen variations on this theme with one of your own possibly more suited to your circuit design.

(Continued on page 59)

Letters

Dear Wayne:

It's a helofanote when I have to get the information on **73 Magazine** from England.

I had heard a few feeble rumbles that you had started ram-rodding a new rag, but, think I could find anyone who knew the slightest thing about it? HAW!

Well, I finally snagged a copy of 73, thanks to W3NNK, who picked it up off a news stand back east and brought it with him to Texas. I was rather pleased with the familiar format and policy outline. I only hope you continue to follow your implication that **73 Magazine** will deal mainly with construction-type articles of advanced technical interest. Some of the other available magazines are getting rather pedantic.

A number of years ago, back before you were on RTTY—and still had hair, there were a couple of interesting, to me, columns in CQ. One was "Pages From an Engineers Notebook," dealing with old, new and unusual circuit applications, and mainly consisted of chatter and scribbled sketches, very much like coffee-break conversation. The other column, "The Brasspounder," was concerned with our primary mode of transmission, CW. It showered roses or threw brickbats at CW operators, with no holds barred. It was a very frank discussion of good and bad signals and/or operating techniques heard or worked by the writer of the column. I used to chat with him every evening on 7020 kc but haven't heard him for years. For that matter, I've been out of the States for years—met you in Wiesbaden, Germany last year. How about considering something like that for 73?

Wayne, you can see I'm rather partial to CW, and it has been a long long time since anyone had actively and frankly discussed the "art" of transmitting GOOD CW. Believe me, it was a pleasure the other day to hook up with an old retired Master Sgt. out in Alpine, Texas. It was the first time in years I was able to take the weights off the "bug" and blast. (I also have a COMPLETE RTTY station—professional grade.)

I have no arguments about A3, A3a, or A3b, but isn't it a fact that when the bands have gone dead, a few CW men are still manfully chugging away, reading copy, half imagination and half noise breaks. That 20 db advantage over AM is mighty hard to deny.

Off the record, Wayne, it looked like you shook the bucket a bit to come up with that collection of articles in the 2nd issue of 73, but it was a darn good start in the right direction.

Dwight B. Olson W9EAM
Von Ormy, Texas

Lots more in the bucket, Dwight . . . Wayne.

Wants

Dear Wayne,

Your "73" is great. I like it. Lets have some RTTY articles; 144 mc and up; information on how to build waveguides and cavity resonators; most common troubles with TT machines.

Stan Wilson W9IFZ

Somebody write those articles for Stan . . . please? . . . ed.

Dear Wayne:

Everywhere I go on the air, people are mentioning your magazine! I never fail to hear a fellow say **73**, right before he signs off. . . .

Al Brogdon W4UWA/K3KMO
State College, Pennsylvania

Subscription Department

Big Brother is watching closely to see if you are really in there subverting other hams with the insidious germ of home-brewitus. Please note the secret invisible ink markings on the subscription blanks so we can tell whether you have been leading to the mental ruin of your friends. We can tell, so you'd better get the old scissors out and get your friends in the same leaky boat with you. (Huh?).

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73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

(SEE SAW from page 56)

Not only is this a money saving device, it is also a method which improves the overall voltage regulation on a CW rig. For example at KV4CI the "load-no load" conditions for the 4-125A final were 2400 volts loaded to 250 ma and 2700 volts no load except for regular bleeder. The picture changed dramatically after installing the "See-Saw" bleeder with 2600 volts at 250 ma and 2750 volts under "key-up" conditions. So I enjoy the double bonus of money saved and a couple hundred more volts on the final to help fight the QRM.

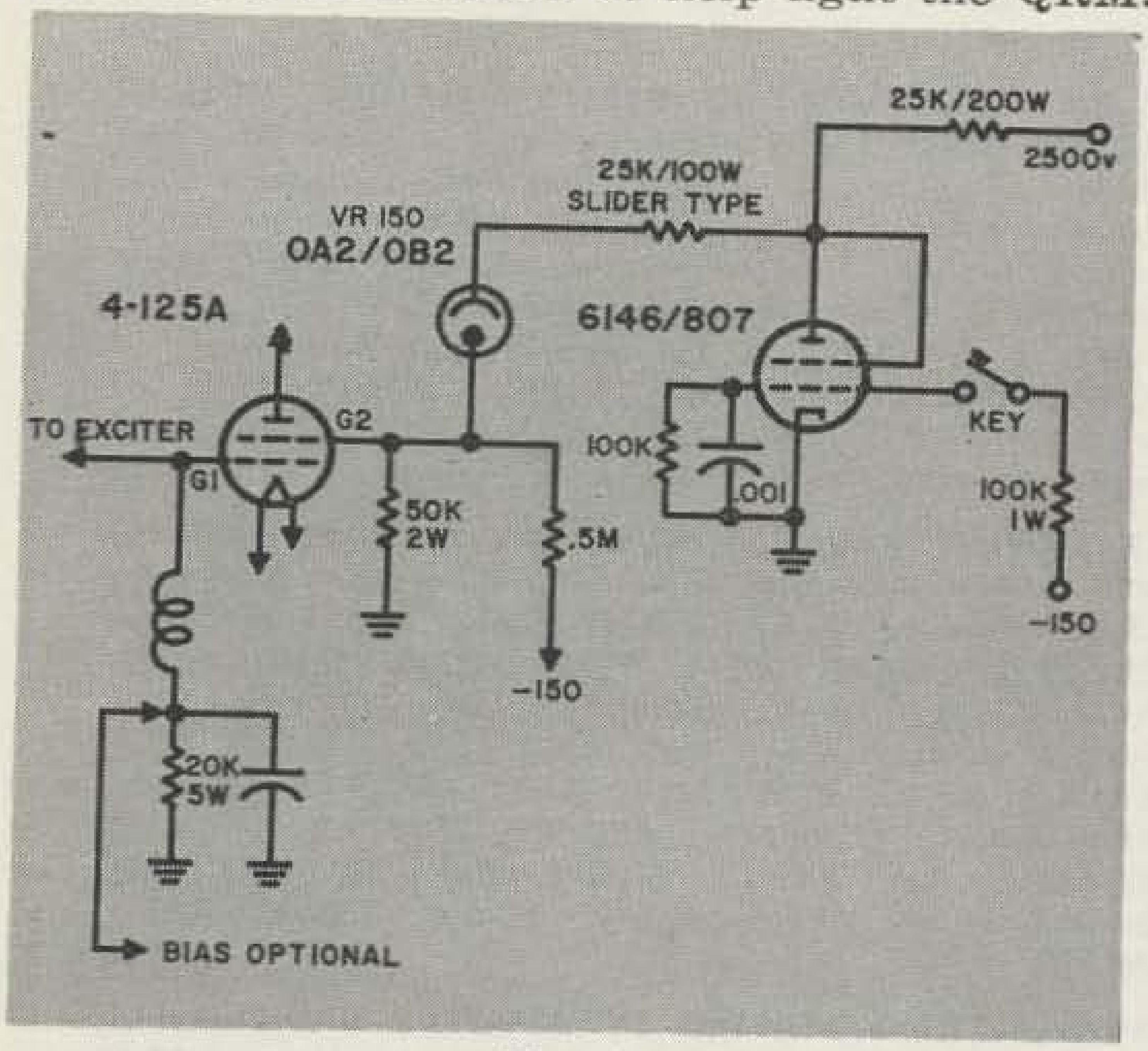

Fig. 3

You will note that 6146's are used in my circuits. I happened to have a half dozen used ones laying around. 807's, 6L6's, 6Y6's, all of them will do the job equally well. 73

(6 and 2 from page 15)

The clipping level is then increased with the clipping control, just above the point where the two bars meet, but do not overlap.

Tests were run on both 6 and 2 meters and the stations worked were asked for a report on signal strength, frequency stability, modulation percent and quality. Results were really great. Stations one hundred miles away and on the other side of 2000 foot mountains were worked with S9 plus signal reports! Most VHF amateurs agree, as I do, that 100 watts on 6 and 2 is almost ideal. Increases in power beyond this point do not result in much improvement, unless the power is increased to 5 or 6 hundred watts. (Oh the TVI!)

I can report TVI from the rig is *very* low. Trouble was experienced on channel two when operating on six meters, but channel two is a fringe area station in my area, being 80 miles away. This was the only channel effected when the rig was properly tuned and matched to the antenna. For a rig which will enable serious work on 6 and 2 meters, you will have to go a long way to beat this combination. 73

Radio Bookshop

On the off chance that someone may read this ad who has the bug to read a little on their favorite subject, we've laid in a stock of the following books:

1—ELECTRONICS & RADIO ENGINEERING—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. **$15.50**

2—ELECTRICAL ENGINEERING HANDBOOK—McIlwain. Formulas, tables, circuits. A real handbook. 1618 pages. **$10.00**

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$11.50**

20—RTTY HANDBOOK—Kretzman (W2JTP). A-Z of ham Teletype. Very popular book, low supply. **$3.00**

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

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

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

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **$1.75**

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

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53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. **$8.00**

57—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction and operation of cubical quads. Build-it yourself info. Feed systems, tuning. **$2.85**

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80—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. I (second edition). This book gives circuit diagrams, photos of most equipment, and rather good and complete conversion instructions for the following: BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-946B,

SCR-274N 453A series receivers conversion to 10 meter receivers, SCR-274N 457A series transmitters (conversion to VFO), SCR-522 (BC-624 and BC-625 conversion to 2 meters), TBY to 10 and 6 meters, PE-103A, BC-1068A/1161A receiver to 2 meters, Surplus tube index, cross index of A/N tubes vs. commercial types, TV & FM channels. **$2.50**

81—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. II. Original and conversion circuit diagrams, plus photos of most equipments and full conversion discussion of the following: BC-454/ARC-5 receivers to 10 meters, AN/APS-13 xmtr/rcvr to 420 mc, BC-457/ARC-5 xmtrs to 10 meters, Selenium rectifier power units, ARC-5 power and to include 10 meters, Coil data-simplified VHF, GO-9/TBW, BC-357, TA-12B, AN/ART-13 to ac winding charts, AVT-112A, AM-26/AIC, LM frequency meter, rotators, power chart, ARB diagram. **$2.50**

82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARR-2, APA10, APT-2. **$2.50**

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As inflation gets more headway the prices on books will be rising. On February first the price of #40 goes up to **$8.50**. This is a terrific book so you'd better order it now. #80-81-82 are going up to $3 each.

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RADIO BOOKSHOP

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(DRIFT from page 13)

tages vary, and this resistor between cathode and circuit swamps out the interface resistance variations. Naturally, the added resistor is NOT bypassed for rf.

The closing entry in this list of stabilizing techniques is the idea most hams think of first —but it comes last for a reason. The reason is this: If you employ the first six gimmicks, you won't need this one!

However, if you don't want to go through the trial and error technique of Number Five, you'll find this one helpful too.

Simply regulate the voltage applied to the oscillator and to the mixer screen, if it's not already regulated.

For best results, use the VR tube closest to the designer's voltage rating for the oscillator. If this rating doesn't happen to be 65, 75, 90, 105, or 150 volts, though, take the next-lower VR tube.

And if there's not room on the chassis for another tube, you can still regulate the voltage. Use two small neon tubes (NE-2 type works fine) in series, and place them under the chassis. Each neon tube will regulate at about 60 volts, giving you 120 volts for two in series. In many cases, you'll find, just 60 volts on the oscillator gives plenty of output. If it does, use it that way—you'll cut down the heat problem with the lower input.

At this point, you may be wondering just what to expect in the way of results from these tricks. While no promises can be made (there's no way of knowing how bad your present receiver is!) I *can* show you what improvements these tricks made for me.

Try them—they'll probably do as well or better for you! 73

Letters

Dear Wayne,

Your first two issues of 73 have been just dandy. I'm glad I subscribed early. In the future I hope you and 73 lay off all sponsoring of contests and awards for operating. It's so bad now that a ragchewer can hardly open his station without being besieged with contest numbers and requests for numbers. Or "Say, OM, just work none more of us Tail-Twisters and we'll send you a tail for you to twist for yourself." I'm not against good clean fun, and contests can be fun, nor am I against awards for outstanding achievement, but the present situation is amateur radio is slightly ridiculous. Don't make it worse, Wayne.

Harvey Pierce WφOPA

OK Harv, we'll curb what little enthusiasm we might have had in that direction. I've been proponenting shorter contests as a means of alleviating the congestion that has built up. Many of the contests that are with us today (on a yearly basis) are hangovers from the dim dark ages of ham radio when it took two long weekends to work any quantity of stations. Nowadays a good op can work more stations in one night that the winners used to work during the two contest weeknds. Apparently the footprints in time are frozen and unless a clamor is set up by disturbed inhabitants of our bands (like yourself) these things will go on forever. Note the SSB and VHF Contests which I helped set up a few years back, both of which are short and popular. . . . Wayne.

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Other Ham Publications

RATHER than devote half or more of 73 to the printing of news of interest to specialized groups we believe that it is our function to do everything possible to encourage the publishers of bulletins which cater to these interests. These bulletins bring you the news you want in far greater detail and in much less time than is possible in a monthly magazine where it usually takes two months for news to get into print.

HAM-SWAP. Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago 1, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published once a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

FLORIDA RTTY BULLETIN. Fred W. DeMotte W4RWM, P.O. Box 6047, Daytona Beach, Florida. $3 per year including membership in Florida RTTY Society. Mostly operating news with a bit of technical info now and then. All TT men should be getting this.

SOUTHERN CALIFORNIA RTTY BULLETIN. Merrill L. Swan W6AEE, 372 West Warren Way, Arcadia, California. $2.75 per year, not including membership in Society. Operating news and some technical articles. This is the oldest TT bulletin going. All TT men should also get this one. Monthly.

73 HAM CLUB BULLETIN. Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

WESTERN RADIO AMATEUR. Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

SIDEBANDER. Official organ of the Single Sideband Amateur Radio Association, 12 Elm Street, Lynbrook, L. I., N. Y. Subs include membership to SSBARA: $3 per year. Monthly. Primarily operating news and chit-chat for the SSB DX gang.

THE MONITOR. Mar-Jax Publishers, 507 West Davis Street, Dallas 8, Texas. $1 a year, 3 years for $2.50. Monthly. Largely operating news. Columns: YL, Club Meetings, Arkansas News, Mississippi News, Florida News, DX, Missouri News, MARS, California News, Louisiana News, VHF News, Oklahoma News, Rio Grande Valley News, Novice News.

VHF AMATEUR. 67 Russell Avenue, Rahway, New Jersey. $3 year. Monthly. Operating news for VHF men. Some technical info.

DX-QSL News Letter. Clif Evans, K6BX, Box 385, Bonita, California. Published quarterly. 40¢ each; Annual subscription $1.25 (four copies) by first class mail ($1.50 for DX stations). Lists all QSL Bureaus, managers for rare DX stations, etc. Why not send your old Callbook to a DX ham? Write Clif for the name of someone who needs it.

DIRECTORY OF CERTIFICATES AND AWARDS. Clif Evans, K6BX, Box 385, Bonita, Cal. Complete Directory plus one year of revisions (quarterly) $3.50. Add 75¢ for 1st class mail; $1.25 for airmail; DX stations 1st class mail add $1.00. Needless to say, this is the most complete collection of data on the hundreds of certificates and awards available.

MOBILE NEWS. Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E. 10, England. Joining fee and 1 year sub. is $2.50.

DX BULLETIN. Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly. 3rd Class mail $5 year; 1st class $6; Airmail $7.50. DX rates on request.

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