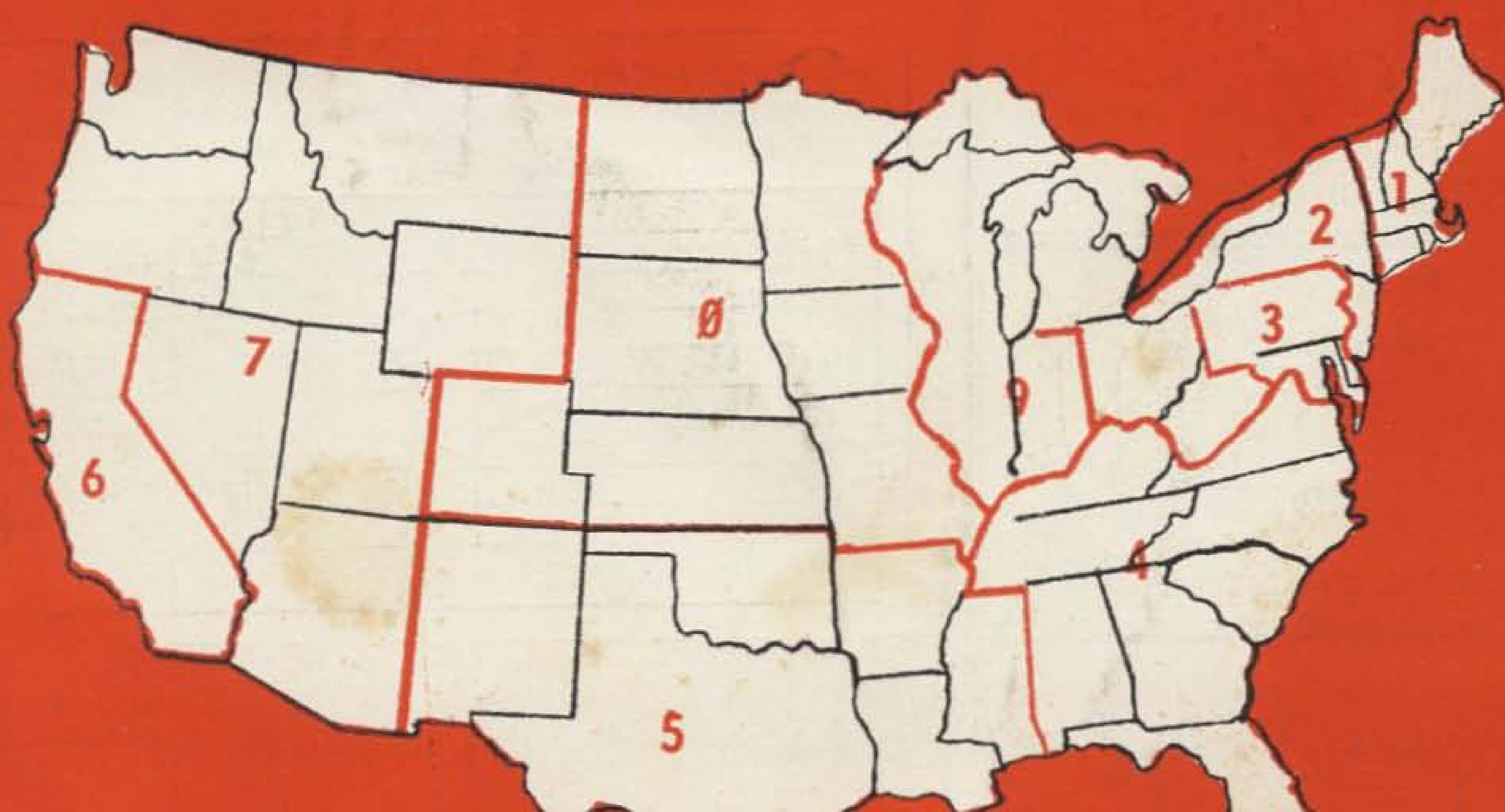
AMATEUR RADIO

73

January 1963
A Teensy
40¢



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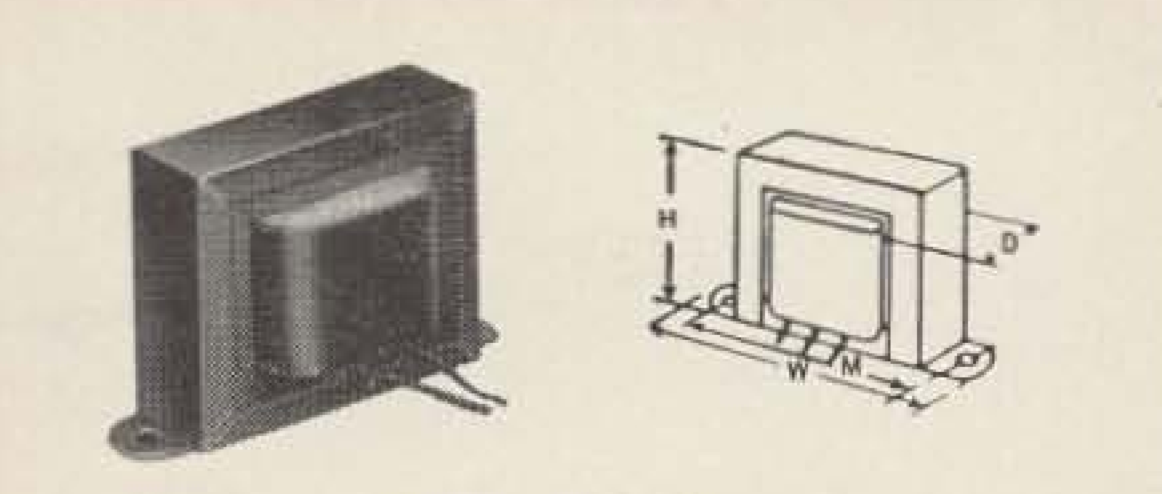
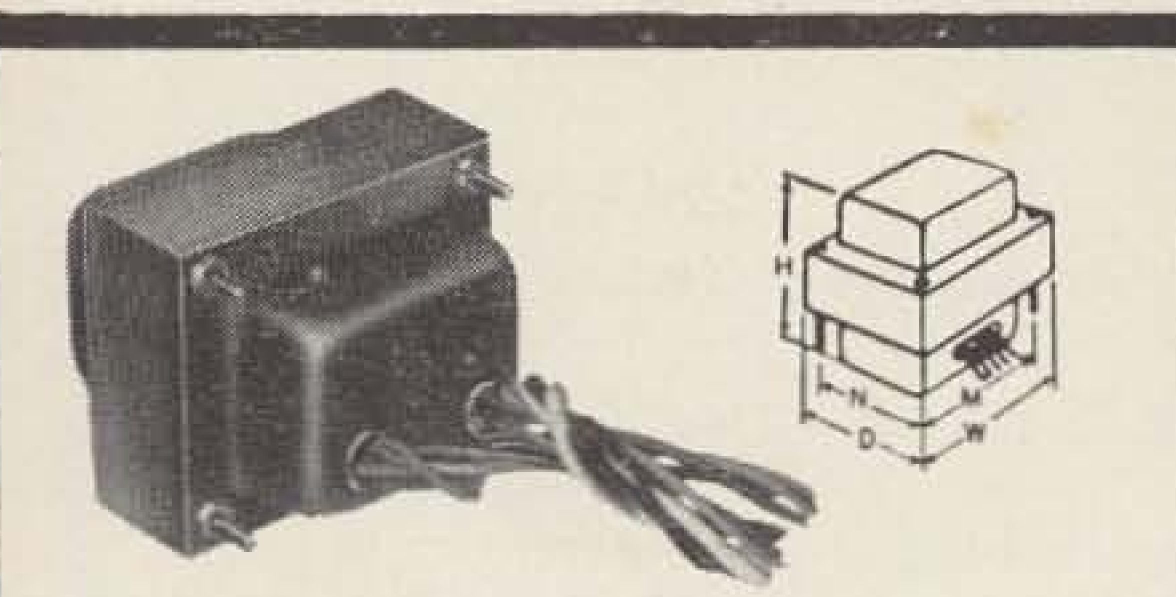
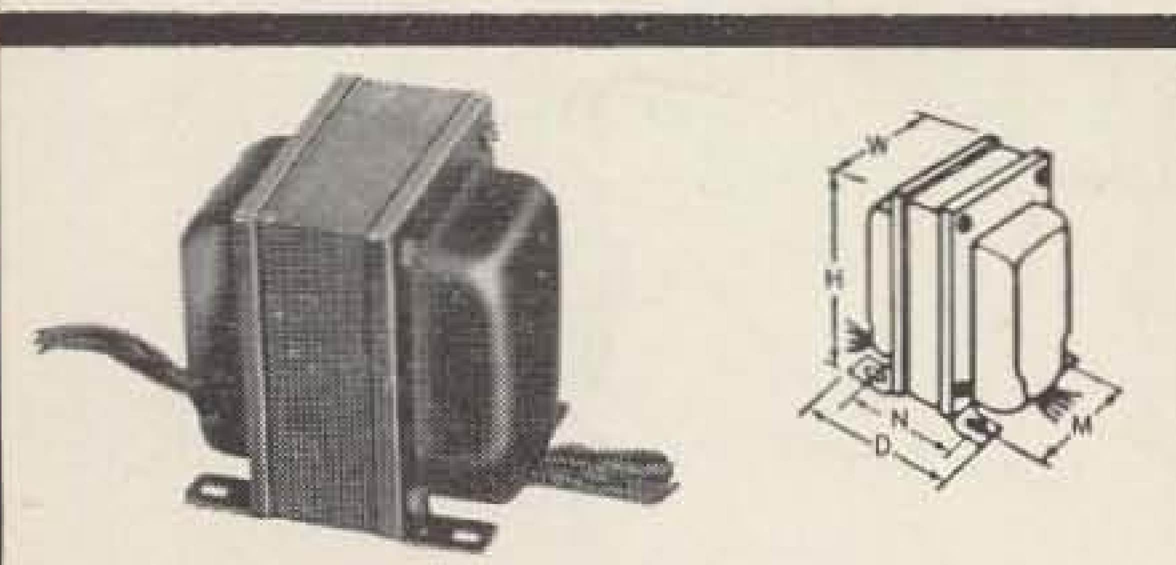


CHANNEL TYPE



DOUBLE SHELL TYPE



VERTICAL SHELL TYPE

CHANNEL FRAME FILAMENT/TRANSISTOR TRANSFS.

Pri. 115 V 50/60 Cycles—Test Volts RMS: 1500

Type No.	Secondary	W	D	H	M	Lbs.
FT-1	2.5 VCT-3A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-2	6.3 VCT-1.2A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-3	2.5 VCT-6A	3 5/16	1 7/8	2	2 13/16	1
FT-4	6.3 VCT-3A	3 5/16	1 7/8	2	2 13/16	1
FT-5	2.5 VCT-10A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-6	5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-7	7.5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-8	6.3 VCT-8A	4	2 1/2	2 5/8	3 9/16	2 1/2
FT-10	24 VCT-2A or 12V-4A	4	2 5/8	2 5/8	3 9/16	2 1/2
FT-11	24 VCT-1A or 12V-2A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-12	36 VCT-1.3A or 18V-2.6A	4	2 5/8	2 5/8	3 9/16	2 1/2

Taps on pri. of FT-13 & FT-14 to modify sec. nominal V, −6% +6%, +12%

Type No.	Secondary	W	D	H	M	Lbs.
FT-13	26 VCT-.04A	2 1/8	1 3/8	1 1/4	1 3/4	1/4
FT-14	26 VCT-.25A	2 7/8	1 5/8	1 11/16	2 3/8	3/4

DOUBLE SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-101	275-0-275	50	2A	2.7A	3	2 1/2	3	2 1/2	2	2 1/2
R-102	350-0-350	70	3A	3A	3	2 1/2	3 5/8	2 1/2	2	3 1/2
R-103	350-0-350	90	3A	3.5A	3 3/8	2 7/8	3 15/16	2 13/16	2 1/4	4 1/2
R-104	350-0-350	120	3A	5A	3 3/4	3 1/8	3 7/8	3 1/8	2 1/2	5 1/2
R-105	385-0-385	160	3A	5A	3 3/4	3 1/8	4 5/16	3 1/8	2 1/2	7

VERTICAL SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-110	300-0-300	50	2A	2.7A	2 5/8	2 13/16	3 1/4	2	1 3/4	2 1/2
R-111	350-0-350	70	3A	3A	2 5/8	3 7/16	3 1/4	2	2 3/8	3 1/2
R-112	350-0-350	120	3A	5A	3 5/16	3 11/16	4	2 1/2	2 5/16	5 1/2
R-113	400-0-400	200	3A	6A	3 7/8	4 5/16	4 5/8	3	3 1/8	8

CHANNEL FRAME FILTER REACTORS

Inductance Shown is at Rated DC ma—Test Volts RMS: 1500

Type No.	Induct. Hys.	Current	Resistance Ohms	W	Dimensions, in. D	H	M	Wt. Lbs.
R-55	6	40ma	300	2 3/8	1 3/8	1 3/8	2	1/2
R-14	8	40ma	250	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-15	12	30ma	450	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-16	15	30ma	630	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-17	20	40ma	850	3 5/16	1 5/8	2	2 13/16	1
R-18	8	80ma	250	3 5/16	1 5/8	2	2 13/16	1
R-19	14	100ma	450	3 3/4	1 7/8	2 5/16	3 1/8	1 1/2
R-20	5	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-21	15/3	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-220	100/8 Mhy 25/2 Mhy	2.5A 5A	.6 .16	3 3/4	2	2 5/16	3 1/8	1 1/2

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73

Magazine

Wayne Greane, W2NSD
Editor, etcetera

January, 1963

Vol. XIV, No. 1

Cover: W2NSD
drawn by W1MEL

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates are still abysmally low at $3.50 for one year, $6.50 for two years, and $9.00 for three years in North American and U.S. possessions. Foreign subscriptions are $4.00 per year. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A. Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire. Readers should stop reading the fine print and stick to the articles and editorial.

de W2NSD/1

Never Say Die

New Year . . . reminiscences. I remember back to our first office, two tiny rooms in the wilds of Brooklyn over a fruit store and delicatessen. Virginia and I did everything, including the subscription stencils. We worked seven days a week, sixteen hours a day, and were always so far behind we couldn't see how we could ever catch up. We took two hours off in January and got married. By April we had caught up the two hours and gotten enough ahead to manage a terrible seven room apartment, most of which was devoted to office.

Outside of a few fast trips to ham conventions we were pretty well chained to the office. By the next April we had an employee to take care of the subscriptions and make and occasional pass at the books. We took a month off and drove all over Europe, our first vacation. This was so much fun that we decided to try our darndest to put on a ham charter flight to Europe in 1963.

The day and night operation of our busy office on the floor above the landlord shortened our lease amazingly and we discovered shortly after our return from Europe that even though we were months behind in our work that moving time was only a few weeks away. We had been dreaming of getting out of New York ever since we had started the magazine and this seemed like a good time to make the move. We were so far behind in everything that it really didn't matter if things got worse. Authors were screaming for decisions on their articles, advertisers were getting very impatient with our almost non existant bookkeeping, and the mail to be answered lay in huge piles everywhere.

A vague idea of the horror of the move has already been described in my editorial. The full impact of it can only be appreciated by taking a guided tour through our new headquarters and seeing the incredible amount of debris that was moved. Counting everything we have about 35 rooms here, all are in use and many quite full!

What of 1963? Since moving up here we have expanded our staff to include Lenny Tamulonis W1MEL, an artist/draftsman who helps make up our covers, works on the various books, booklets and other publications that we publish (ATV Bulletin, Care & Feeding of Ham Clubs, etc.), special promotions to advertisers, distributors, and subscribers, and hundreds of other jobs. He also is a whiz on 20M CW and helps keep the HQ station on the air and active. Val Barnes K1APA tries to keep up with the subscriptions and orders for books, booklets and other stuff we peddle. He also tries to keep the keeper of the subscription stencils down in Brooklyn up to date. The Brooklyn end just about broke down recently when almost 10,000 renewal subscriptions came in and swamped everything. Val had to placate several hundred "Where is my October issue?" complaints while things got caught up.

Pamela, WN1???, a real cutie, bookkeeps.

Virginia still handles all of the processing of the articles, layout of the magazine, proofreading, coordination of typesetting, drafting of circuit diagrams, specifying of engravings, setting up of many of the ads, and hundreds of other jobs as well as looking after the house and food supply. I con advertisers into trying 73 and hope that you'll back me up with some buying of their products or at least requests for information to make them think that you might buy something. Other little tasks fall to my broad shoulders: signing pay checks, reading manuscripts, solving unsolvable problems, and generally managing the headquarters and magazine.

In the next few weeks we will be expanding a bit more with the addition of a circulation manager. Bob, W5HJV, will be moving up here from Oklahoma to see what he can do about coordinating our efforts to get the best possible sales from newsstands, parts distributors and subscription. We're still looking for someone to check out new equipment, keep the headquarters station on the air, set up more antennas, write special articles, and answer technical questions that arise.

This year looks pretty good. The Institute of Amateur Radio has been founded, the trip to Europe is taking shape for the fall, 73 readership is increasing by leaps and bounds while many other ham publications are just holding their own or suffering catastrophic losses of circulation. We have some fabulous articles coming up and many more promised. We've

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carefully scheduled the arrival of the jr. op. for about April first so he'll (?) be old enough to appreciate the October flight. We won't be moving to our new mountaintop headquarters location until June.

Institute Membership

Consistent with the Institute policy of encouraging amateurs to improve their technical knowledge we have established different classes of membership which will reflect the status of the member as measured by his class of amateur license. SWL's and other non-licensed members are Participating Members, Novice licensees are Junior Members, Technician and Conditional licensees are Associate Members, General Class are Regular Members, Advanced Class licensees are Full Members, and Extra Class licensees are Senior Members.

Charter Members should all have received their Membership Cards and all should have the IAR Gold Seal on them. This Gold Seal will be placed on all renewal memberships where there has been no lapse of membership. We have some interesting benefits for Charter Members, but we cannot divulge them yet because this issue of 73 will be distributed a few days before the deadline for Charter Membership closes on December 31, 1962. We'll let you know next month when it is too late to do anything about it. Note: LIFE subscribers to 73 will automatically be enrolled as Charter Members of the Institute.

Club Membership in the Institute of Amateur Radio

Amateur radio clubs may affiliate with the Institute for a one year period by submitting the following:

1) A complete list of the members, including calls, and the officers of the club. Indicate those that are subscribed to 73.

2) A registry fee of $2.00 must accompany the application.

3) A statement of ARRL or non-ARRL affiliation must be included.

4) A list of all annual or regular club events such as hamfests, picnics, dinners, etc., which would be of enough interest to be generally announced or which might require prize donations.

Advantages of club affiliation:

1) Members whose names and calls appear on the club rosters may subscribe to 73 Magazine, the official organ of the Institute, at a reduced rate.

(Turn to page 64)

A Nu 1¼ Meter Converter

Larry Levy WA2INM
1114 East 18th Street
Brooklyn 30, New York

Although it is claimed that it is as easy to build a 1¼ meter converter as it is to build a 2 meter converter, this is usually not the case. It is true that construction details are quite similar, but it is also true that it is harder to get a good noise figure. Most 1¼ meter converters have very poor image rejection (with the exception of those using coaxial lines, but these have very poor bandwidth and have to be retuned to cover more than a small section of the band) and a larger number of spurious responses than a lower frequency converter.

A close look at the design of these converters will reveal the same common faults in the design. 220 mc is the borderline in the design of converters. The frequency is too low to require the use of crystal mixers and cavities, although they *can* be used and are entirely practical. The frequency is also too high to successfully use some of the design features common to 6 and 2 meter converters. One of these is the use of a low frequency *if* output. With an output of 7 or 14 mc, the tuned circuits don't have enough rf selectivity for satisfactory image rejection. There is also the disadvantage of a long multiplier chain for the oscillator. The average converter uses a crystal in the 30-50 mc range and multiplies 4 or 5 times. This results in many unnecessary spurious responses. I have actually seen the design for a converter for 1¼ meters that started with a 6 mc rock. Needless to say, the only things that will probably be heard on that converter are spurious responses and TV hash. I decided to build a converter that would have as few of these design faults as possible.

To keep the spurious responses and images to a minimum, I decided to use the highest *if* possible. There was a choice between 6 or 2 meters and I chose 2 meters because of the smaller number of times the crystal frequency would have to be multiplied. If a 6 meter (or any other) *if* is desired, the only changes necessary are the frequencies of L3, L4, L5 and the crystal. This principle could be applied to another band successfully. For example, I don't know why most 2 meter converters don't have an *if* of 6 meters for those amateurs who already own a 6 meter converter or receiver. Another reason why 2 meters was chosen was that I already had a good low noise nuvistor converter (see 73 Aug., 1961) for 2 meters and, in all probability, so does every other amateur who is interested in 1¼.

By using one or two good low noise rf stages ahead of a low noise mixer and then feeding the output into a low noise 2 meter converter, the performance of the entire receiver should be excellent. Nuvistors were chosen for the rf amplifiers and mixer because of their excellent noise figure, their high transconductance, their performance at 220 mc, and their low cost and high uniformity. The grounded grid configuration is the least critical, has the best stability, and has the lowest noise figure. The gain-per-stage is not very high, so two rf stages are required before the mixer to give a good noise figure, although with the low noise mixer and the low noise stages after the mixer it is not too necessary to have much rf gain before the mixer. The antenna lead is connected directly to the cathode of the rf amplifier (V1), the low impedence cathode being a close enough match to the line to not require additional matching. An Ohmite Z-1235 is used in the cathode circuit to block the rf while passing the dc cathode current. A three turn air-wound coil is used in the plate circuit. This coil (L1) is tapped about one turn from the cold end and coupled to the next stage with a 39 mmfd ceramic disc.

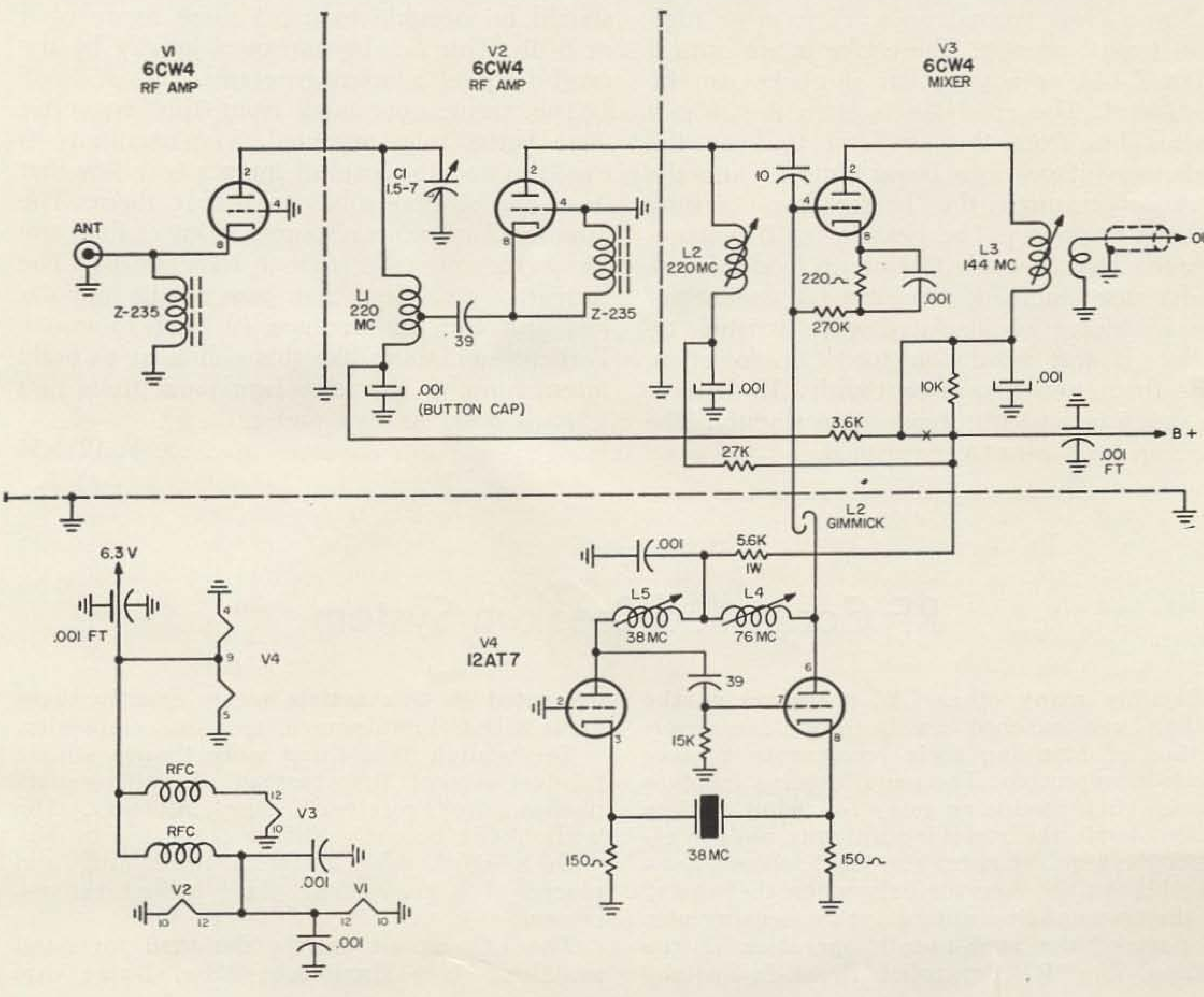
After the converter is completed, the tap on L1 should be adjusted for the best noise figure, moving the tap ¼ or ⅛ turn up or down and using a noise generator or some other means to obtain the best noise figure. L1 is tuned by a 1.5-7 mmfd ceramic trimmer (C1).

The second rf stage is similar to the first except the plate coil is not tapped and is slug tuned. The coil form used came from a discarded piston trimmer. It is about ¼" in diameter and has a brass slug. Any similar coil form can be used.

The mixer is conventional except for the fact that it uses a nuvistor. The oscillator is a modified butler circuit and it was chosen because of its stability and ease of construction. The crystal is a 38 mc 3rd overtone type mounted in a holder with flexible leads. This can be improvised if necessary and leads can be soldered to a holder such as the International FA-5 or FA-9. Care must be used when soldering to the crystal as excess heat can damage it. If you prefer not to solder to the crystal, a socket can be used.

The converter is constructed on a 4" x 6" piece of copper. This is mounted on a 4" x 6" x 3" aluminum chassis. All wiring is done on the copper plate. The four tubes are mounted in a straight line along the center of the chassis. The first rf amplifier tube is first, followed by the second rf stage, the mixer, and finally the oscillator. A shield is placed across the rf amplifier tube sockets to keep the possibility of self-oscillation to a minimum. A shield is also placed between the oscillator stage and the rest of the converter to minimize spurious responses. The shields are made from the tops of beer or soft drink cans. These cans have tops that are tin plated on one side and copper plated on the other. They are very easy to solder and are ideal for use as shields. The tops are cut in half for use as shields and are soldered between two screws mounted approx. 2" apart. These screws should be brass, which is easy to solder to.

Button condensers are used for bypassing the plate coils because they are the only type that will bypass this frequency effectively. At 220 mc, the inductance of ceramic discs make them less effective as bypass condensers. This is also true of two meters, where most ceramic discs start to lose effectiveness because of their inductance, but will still do a passable job as a bypass. Better performance can be obtained if button condensers are used. The surplus type button condensers will work fine in this converter (they are available for approx. 5-10c each) but if you are a perfectionist you can use new silver mica buttons. The buttons are soldered directly to the shields to minimize the leads on the coils. Do not try to



eliminate the leads entirely because they are part of the inductance of the coils. L1 should have a *total* lead length of 1 inch. L2 should have a ½" lead between the cold end of the coil and the bypass condenser and a slightly less than one inch lead between the coil and the plate pin of V2. The lead length on L3 should total about 1 or 1¼ inches. The lead lengths of coils L4 and L5 are not as critical, but should be as short as possible. A grid dip meter will be very helpful in determining the resonant frequencies of the coils, although the coil table is enough if the directions are followed carefully.

The output is taken from a 1 turn link wound over the cold end of L3. The link is connected to a length of RG-58/U with a connector on one end of the type used on the two meter converter. The other end of the coax is soldered to a terminal strip in the converter and connected to the link. No problems should be encountered with the wiring of the converter. A ⅜" hole should be drilled where C1 is mounted so that it can be adjusted from the top of the chassis. This will make the tune-up considerably easier. The rf chokes in the heater circuit are made from 20 turns of #30 enameled wire close wound on a ¼" form or high value 1 watt resistor. The choke is not critical and a Z-144 or any similar rf choke can be substituted. The rf choke isolates the rf and mixer tubes from the oscillator to keep the oscillator voltage from being coupled into the rf stages through the heater line, causing spurious responses. The heater and B voltages are connected through .001 mmfd feed through condensers. Gimmick capacitor C2 consists of two 1" pieces of insulated wire twisted together. If this results in too little injection, twist them together more tightly. If there is too much injection, untwist them slightly. The injection level is not very critical.

After the wiring is completed the next step is to try the converter and see if it works. The power can be taken from the receiver, the 2 meter converter, or a separate power supply. The converter requires about 100-130 v at approx. 30-40 ma and 6.3 v at 700 ma. With voltage applied and the tubes warmed up, couple a grid dip meter or absorbtion wavemeter to L5 and tune L5 for maximum output at 38 mc. Next tune L4 for maximum output at 76 mc. Tune L3 for maximum noise. Connect a weak signal source to the input and tune L1 and L2 for maximum signal. Using a noise generator (see 73, Dec. 1960 P. 37 for details on a very inexpensive one that will work fine) tune L1 and L2 for the best noise figure. Move the tap on L1 ¼ or ⅛ turn and see if the noise figure improves (after returning the coil). If it does, move it another ⅛ turn, etc., until the best noise figure is reached. If it does not improve when it is moved in one direction, move it in the other direction and repeat the above steps. Now repeak L3 to give the flattest response over the full 5 mc. It should be possible to get a flat response within a few db over the 5 megacycles of the band. Without the use of a noise generator it should be possible to get a noise figure of 5 or 6 db. This can be improved greatly by the careful use of a noise generator.

The results obtained from this converter were better than expected. The sensitivity is excellent and the level of images is so low that it is almost impossible to detect them. The number of spurious responses is lower than any 1¼ meter converter that I have heard. The converter costs less than any of the popular kits and the performance is hard to equal. Perhaps something like this will help to build interest in the 1¼ meter band and prove that it is as good as two meters.

. . . WA2INM

RF Controlled Break-in System

Possibly many other CW operators as the author have searched in vain for a clean simple method of blanking their receiver to achieve break-in operation. The usual scheme involves a noisy click producing relay following the key which shorts the receiving antenna and/or reduces the receiver gain. The ideal scheme, however blanks the receiver only when there is rf on the transmitting antenna, thus serving also as part of the push-to-talk operation of the station. The "RF Controlled Break-in Switch" presented in this article meets exactly these goals with the minimum of cost and complexity.

The 'switch' is nothing more than a simple receiver except that instead of driving earphones, the "receiver" closes a relay. The 'switch' can be enclosed in a 3 x 4 x 5 in. box with a short whip antenna protruding and placed at a convenient place behind the receiver.

The LC_2 circuit can be designed for band switching (see Handbook; Misc. Data: cap,

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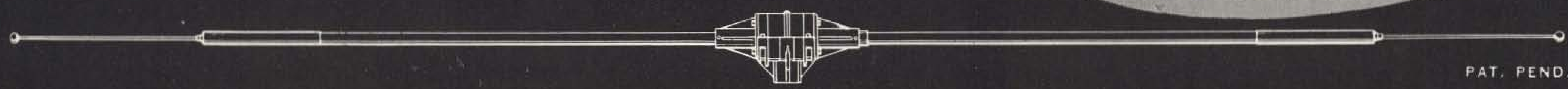
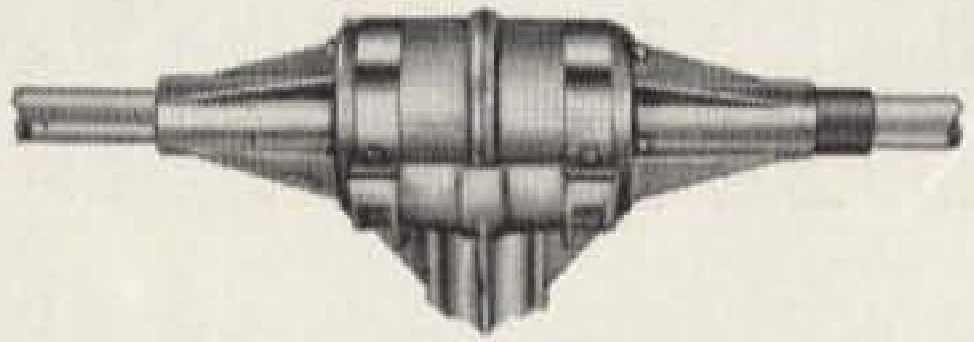


PAT. PEND.



Housing for motors and gear trains with mounting yoke

Resonance and band switching control

ELECTRICAL FEATURES

- Antenna resonance finger tip controlled from transmitter location in shack.
- VSWR: 1.1 to 1 or less across entire band
- Feed-point variable to compensate for antenna environment
- No traps . . . no baluns . . . no matching devices of any kind
- Feed direct with any length 52 ohm cable
- Power handling capacity — maximum legal limit

The CLIFF-DWELLER is another New-Tronics first. Here's a tuneable dipole ideal for hams who live in apartments or in homes on small lots. The CLIFF DWELLER will give you unbelievable performance even in limited space.

MECHANICAL FEATURES

- Approx. lengths

28'-6" — 26'	7.0-7.3 mc
30'-6" — 26'	3.5-4.0 mc
31'-4" — 26'	Two-Bander

- Self supporting, accepts 1¼" threaded pipe for mounting in standard rotators
- Maximum turning radius approx. 15'-8"
- Sturdy aluminum die cast housing for motors and gear trains which drive end sections of dipole
- Heat treated aircraft type, 1¼" heavy wall aluminum tubing
- Completely waterproofed resonators and housings

MODEL NO.	FREQ. MC	WEIGHT	NET PRICE
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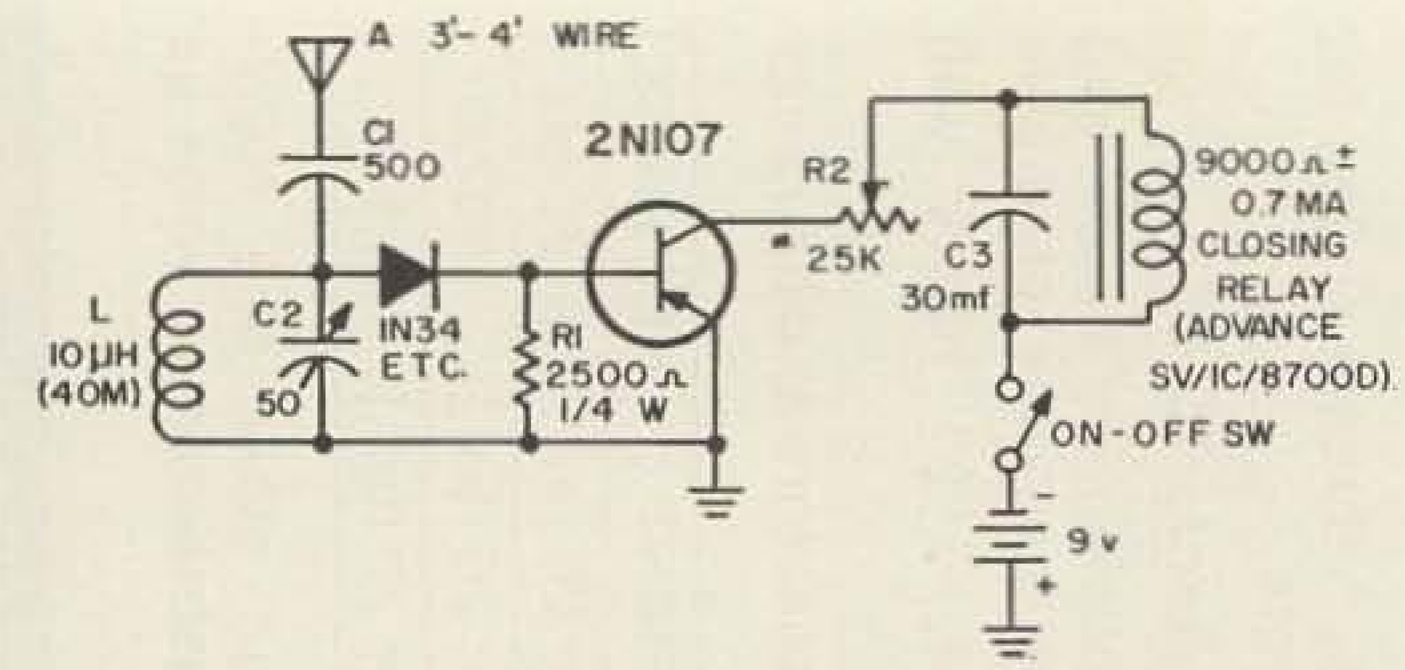

ind, freq. chart). However in this case the 'switch' was designed for 40 meters exclusively. Once the LC_2 circuit is tuned for the middle of the band, it is not necessary to retune to each transmitting frequency due to the high impedance of L.

If another general purpose transistor T is used (such as 2N34, CK722) or a relay other than the one used here, the value of R_1 might require change in order to drop the idling current of T below the holding current of the relay. (The relay used was found to close at .6 ma. and release at .2 ma. and so R_1 was adjusted to give an idling current of .1 ma.). The resistor R_2 serves as a sensitivity control to conserve battery drain; its position depends on the distance between the transmitter and the 'switch.' Above all note: *not every relay will work;* only those with closing current of .4-.6 ma. will do the job.

The large electrolytic C_3 serves to hold down the relay during the transmission of CW characters and can be adjusted to the operator's CW speed by the formula: "Holding time in seconds = resistance of relay in ohms × capacitance of C_3 in farads." The contacts of the relay can be used to short the receiving antenna and/or cut the gain of the receiver (see Handbook: Keying and Break-in).

A 3 ft. piece of bus wire was used as an antenna although a nearby screen or a few turns around the coax feed line of the transmitting antenna would suffice. With the bus wire antenna it was found that the 'switch' would operate at a distance of 85 ft. from the transmitter.

. . . Charles R. MacCluer W8MQW

The NTSC Signal

for ham TV

Richard Taylor K2HQY
308 Stratford Road
Brooklyn 18, New York

Many hams seem to be taking the opinion that the easiest approach to Ham TV is by means of free-running oscillators and simple non-interlaced signals. While these methods will give quite good results the standard NTSC (National Television Systems Committee) TV signal is, in this ham's opinion, infinitely superior, just as easy to use and not at all difficult to understand if you take it step by step. Let's look at a simple NTSC-type signal and then see how to make use of it.

Let's start at the very beginning. By this time, most hams should be aware that in the TV camera light variations in the photographed scene are changed to similar electrical variations. Even if you think this process is pure sorcery, realizing this you've got a good start. Now how to use this mystical signal? Television receivers, like most machines are quite moronic and unless you tell them what to do at regular intervals they are no use at all. You have to supply some form of control. This is where the sync and blanking signals you've undoubtedly heard about come in. They act as policemen who give the recalcitrant set a good swift kick at appropriate times and in appropriate places to keep it in line. By combining the camera signal (called the video signal) and the sync and blanking signals we get a composite signal which can be fed to the set. It would, of course, be possible to transmit and receive each of these signals separately, but that would be kind of expensive wouldn't it? Hence the combined signal; it acts as its own policeman.

Let's go back to the camera again and build up our composite signal piece by piece. The process begins when the camera dismembers the scene into a series of horizontal lines which are then transmitted in time sequence, that is, one right after the other. Let's look at a typical TV scene (Fig. 1). Not so typical you say, well maybe not, but it will serve for our pur-

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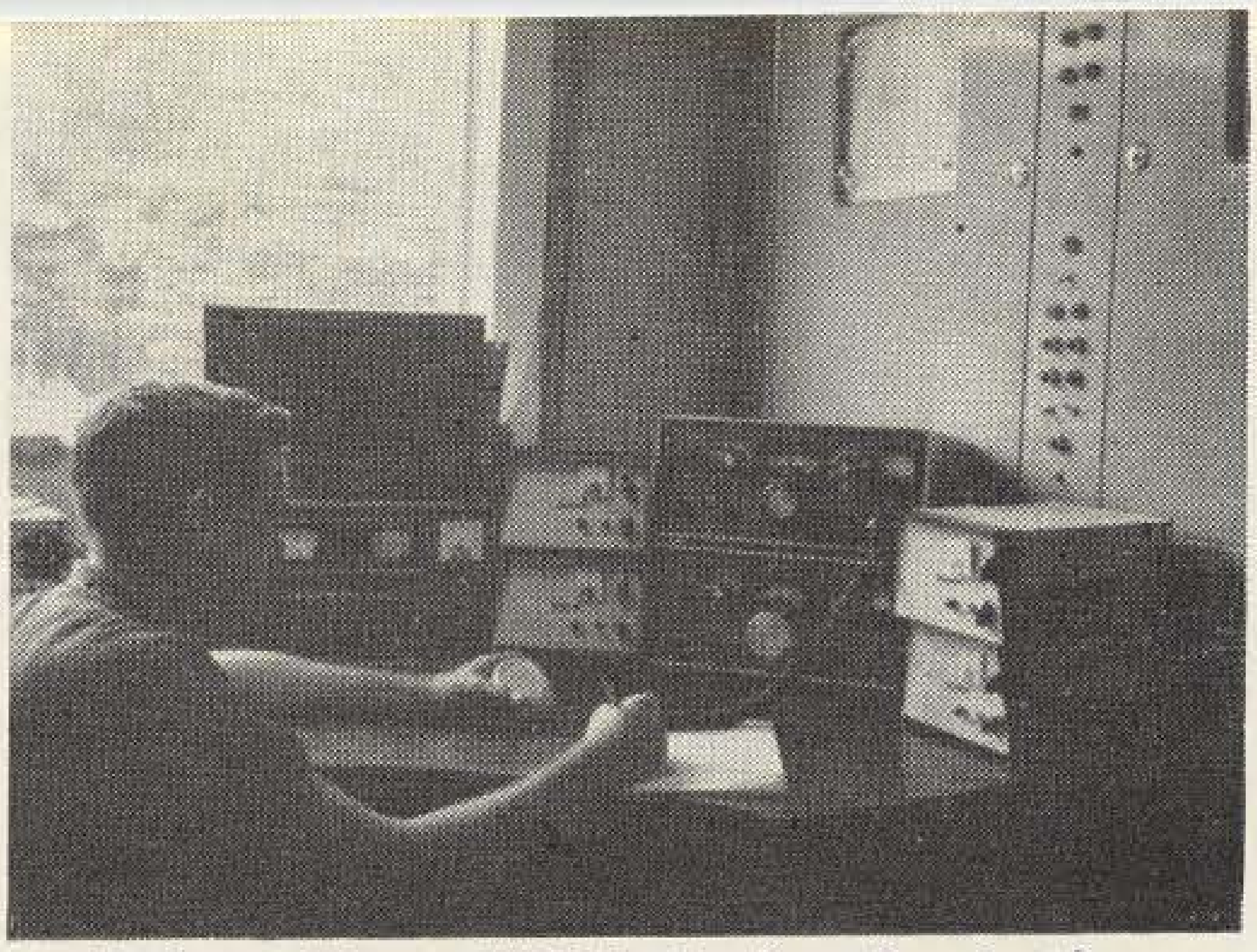

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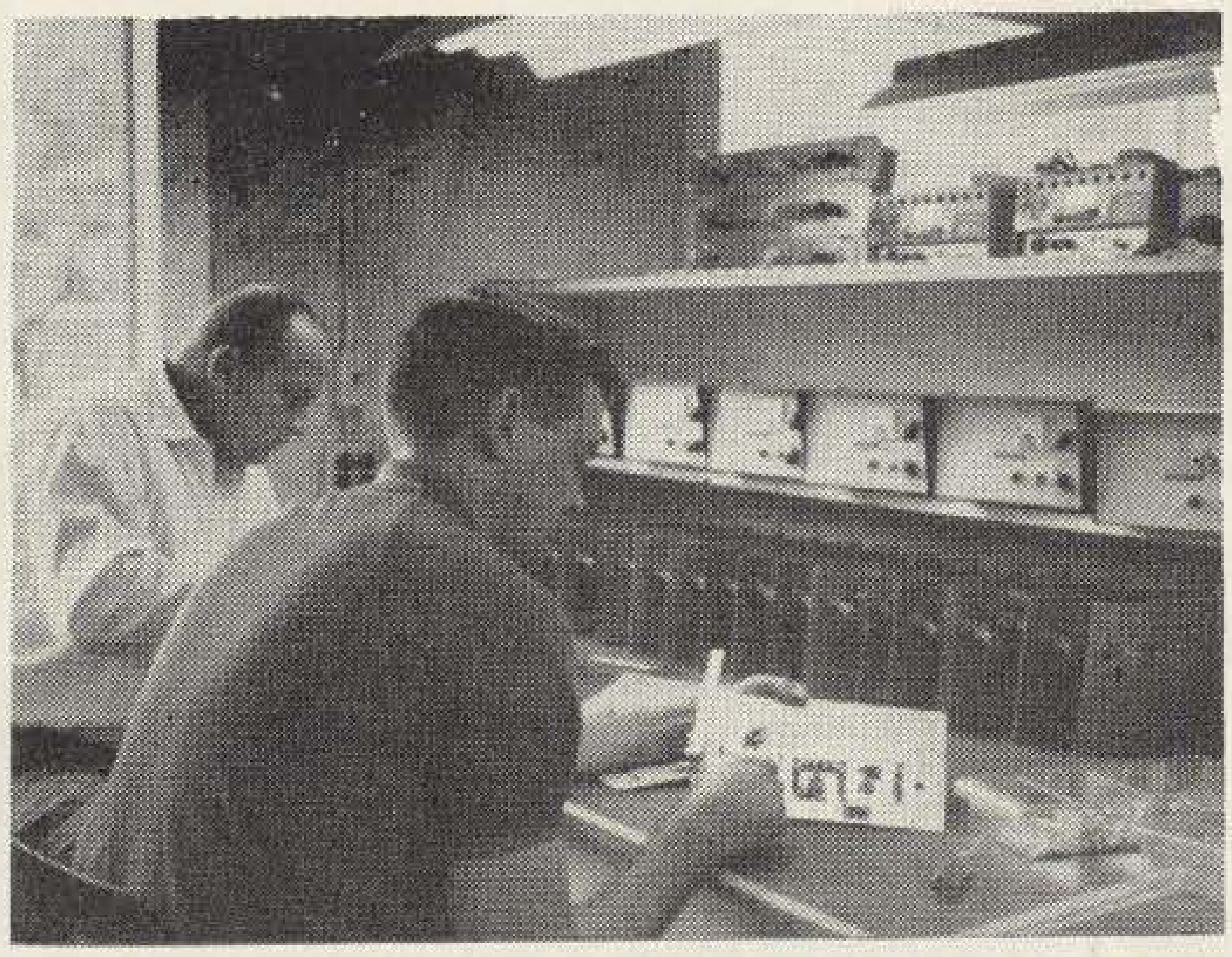

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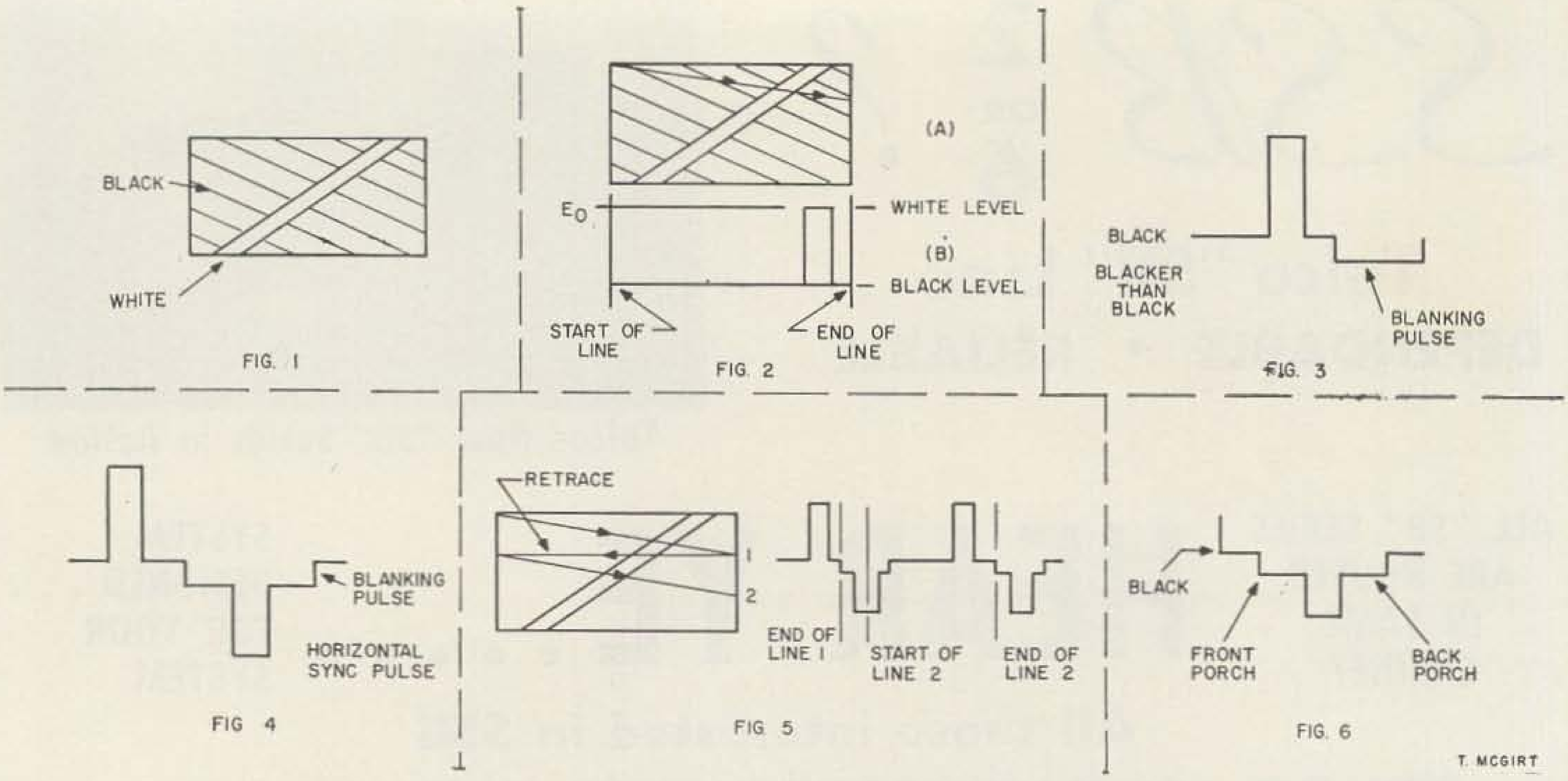

pose. Let's assume for simplicity that we will only use ten horizontal scanning lines. Starting from the upper left hand corner the camera scans to the right and down—but much faster to the right than down. Like Fig. 2(a). The signal from this scan is shown just below it in Fig. 2(b). The positive pulse corresponds to the white portion of the picture. The two levels are labeled as shown. At this point it is necessary to inform our imbecilic receiver that something new is going to happen. First we turn off the electron beam by mixing in a blanking signal which drives the signal into the so called "blacker-than black" region. This video plus blanking combination is commonly called a non-composite signal. The signal now looks like Fig. 3. With the electron beam safely off and out of the way we kick the horizontal oscillator once to make the spot scoot back across the screen to the left so it can start another line. Sync is added in Fig. 4. This new pulse is your horizontal sync pulse and is somewhat narrower than the blanking pulse so that we can be sure the electron beam is off all the while, and for some time after the horizontal oscillator has gone through its retrace act. We are now free to begin line two—see Fig. 5. Notice that the position of the "white" pulse has moved slightly to the left during the second scan. This is because the white line in the scene was reached by the scanning beam sooner in the second line than it did in line one. At the end of this line we add in the usual sync and blanking pulses. Those little "shelves" just to the left and right of the sync pulse, incidentally, are called the "front porch" and the "back porch" of the signal. (Fig. 6). The back porch is usually slightly larger (longer in time) than the front porch.

This same process now repeats itself ten times, each time the position of the "white" pulse moving slightly to the left until, in the tenth line, it is residing all the way to the left of the scanned line.

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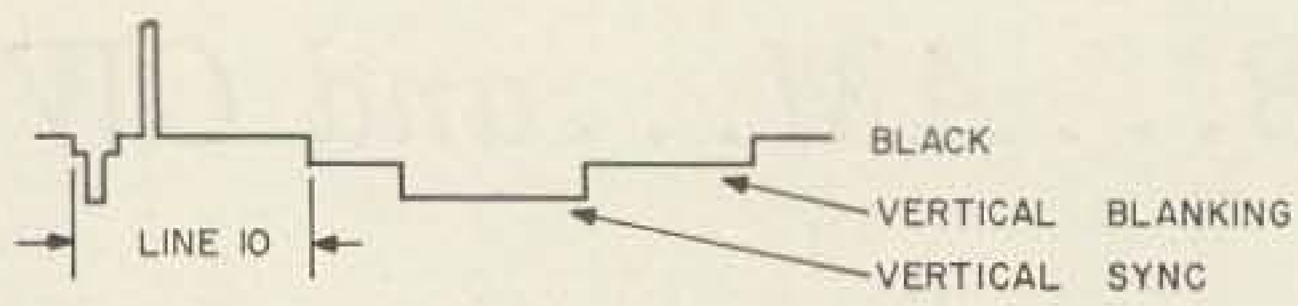


FIG 7

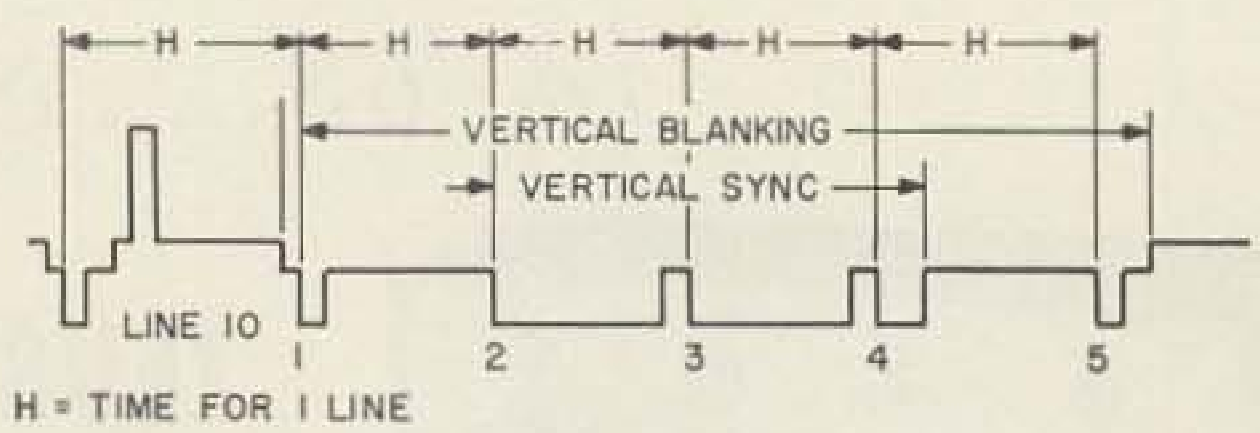


FIG. 8

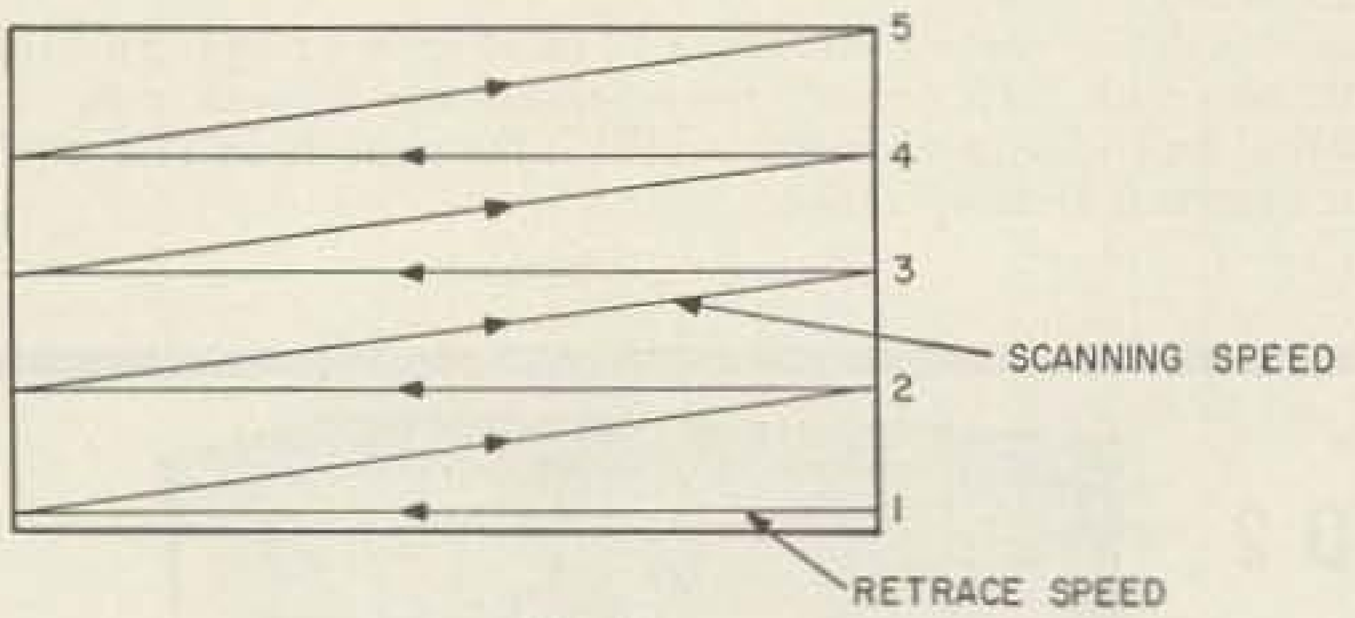


FIG. 9

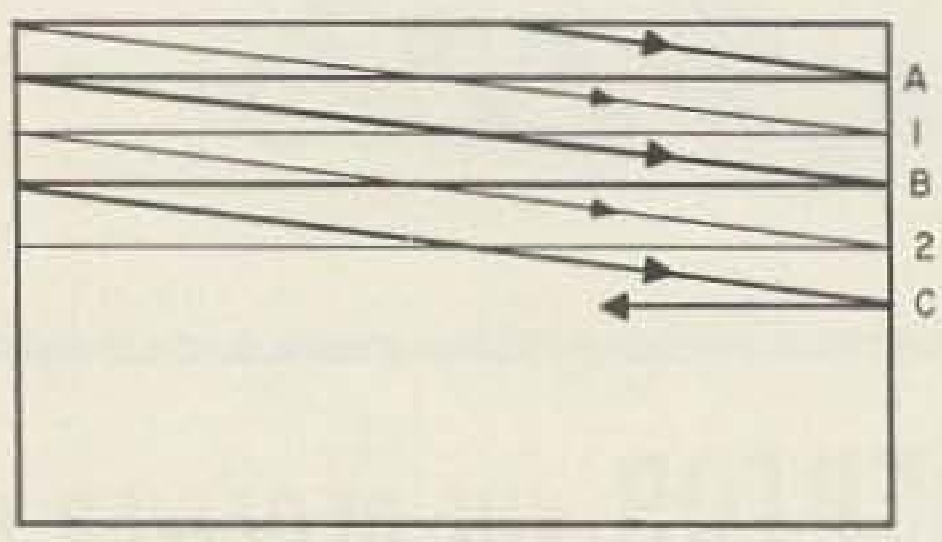


FIG. 10

T MCGIRT

three speeds. The scanning beam runs across the screen at a moderate rate, scoots back across the screen during retrace at a tremendous rate, all the while creeping down vertically.

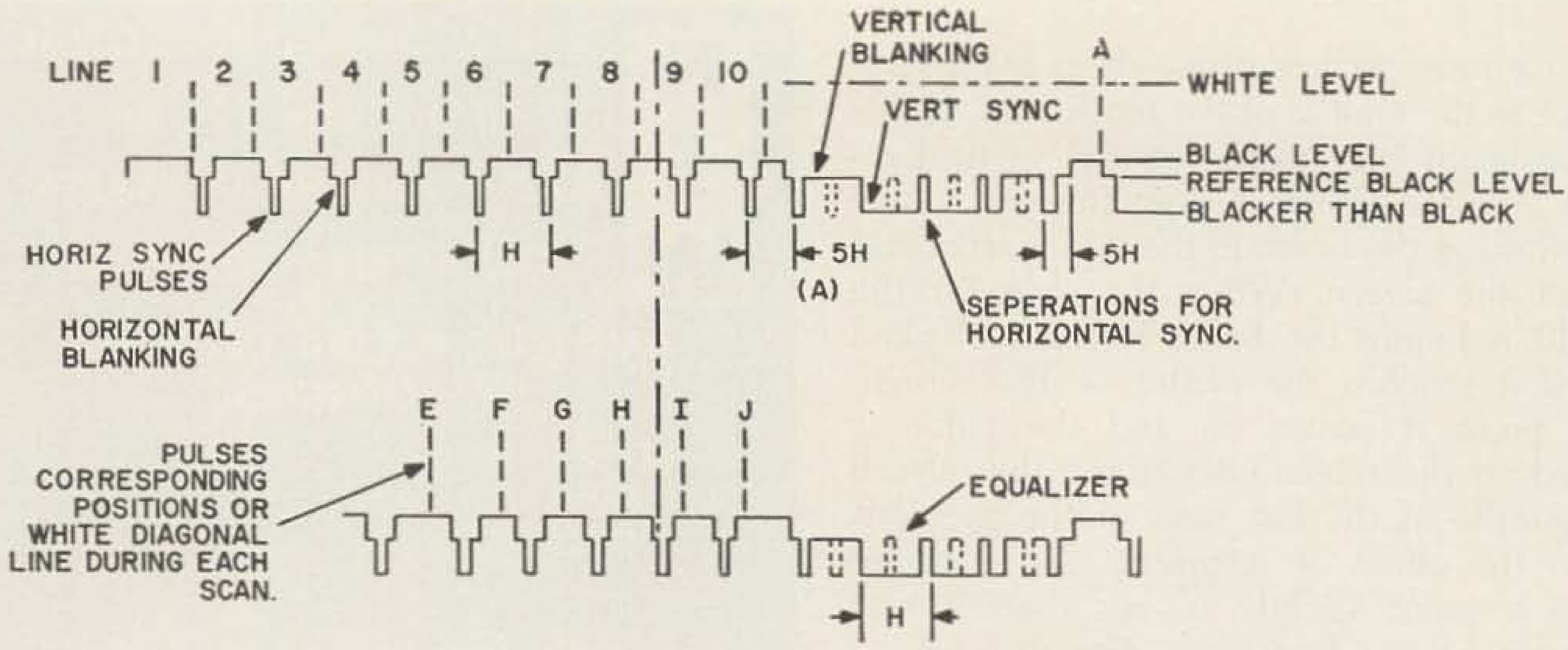
We have reached another critical point in our scanning process. It is time to move the scanning beam back up to the upper left hand corner of the screen. So, just as we added a horizontal sync pulse to make the beam retrace horizontally we now add a vertical sync pulse to make it move back vertically. As usual, we begin with a blanking signal to cut the picture tube off, called "vertical blanking". See Fig. 7. You will notice that these pulses are quite a bit longer than the horizontal pulses. The vertical retrace rate, being quite turtle-like compared to the others, takes a time equal to quite a few horizontal scanning lines. And what is the horizontal oscillator going to do all this time? Take off on it's own if we don't keep it in check. So we firmly apply control by modifying the vertical blanking and sync pulses by placing horizontal sync on top of vertical blanking and "serrating" the vertical sync pulse. Let's say it takes four horizontal lines for the vertical retrace to take place. Our composite pulse would then look like Fig. 8. Notice that horizontal oscillator is keyed (caused to retrace) on the trailing edge (the right hand edge, the one later in time) of the serrations. The reason for this is that it is a negative going pulse which operates the oscillator. The scanning beam moves up the screen about like Fig. 9.

So we have come round robin. Having returned to the top of the screen the whole sequence can begin again. Here we have one kind of composite signal but you wouldn't want to use it would you? After all, with only ten scanning lines the picture would be fairly horrible. We say it would have poor vertical resolution. That is, if you were photographing a geometrical pattern of horizontal lines the greatest number of lines you could photograph would be ten, one for each scanning line. This is pretty poor. We see from this that our vertical resolution (the ability to resolve details which are horizontal) is highly dependent on the number of scanning lines used. The greater the number of scanning lines, the greater the vertical resolution and the better the picture. Horizontal resolution, on the other hand, is independent of the number of scanning lines used and depends on the frequency response of the system (How high a frequency can it pass? how narrow a pulse?). These names may seem backwards to you. If they do just remember that horizontal resolution is connected with the horizontal scanning operation and vertical resolution is connected with scanning in the vertical direction. Resolution is commonly measured in the number of lines (horizontal or vertical) that are clearly defined on the face of the monitor when viewing a test pattern. Two numbers specify the system. One for horizontal and one for vertical.

Let's talk about another problem. How many pictures are you going to present each second? Have you ever watched home movies? Did you notice anything that is not present in a theater presentation? The home movies probably had quite a flicker in them. Right? Your eye can remember that still picture for only so long before it fades. If the next picture doesn't come up fast enough a flicker will be produced. The eyes can be fooled though. By turning the light source on and off, say twice for each frame the eye will be fooled into thinking that twice as many pictures are being shown and the light source appears constant. Something similar to this is done in TV.

The scanning process proceeds as before until we get to the middle of the tenth line. At this point the beam is blanked out and vertical retrace is initiated. Retrace now follows a new path, returning the beam to the upper left hand corner of the screen. When the scan for the next field is begun the beam remains blanked out until it reaches the center of the screen. At this point it comes on and the video is presented on the screen. Beginning the retrace at the middle of the last scan of the previous field has the effect of returning the scanning beam to a point slightly higher than it was at the start of the first field. The distance of vertical retrace is the same for each field but when retrace is begun early the beam does not get as far down the screen as it had the previous scan, so it ends up higher. The distance that it is higher is equal to one-half the distance between successive scanning lines of the same field. Because of this the scanning lines for the new field fall in between those of the old one. This is called interlaced scanning. Confused? Go back and read it again and think about it awhile—eventually it will make sense. Have a look at Fig. 10 to see how the two fields fit together. In the American standard system, each field consists of 262½ lines; two fields making a frame. The field rate being 60 cps (which is fast) eliminates flicker and the 262½ lines per field reduces the bandwidth required by a factor of two over that which would be required for a 60 cycle 525 line system with no loss of quality. Ingenious, huh? Our ten line composite signal now appears as shown in Fig. 11.

Now this is starting to look like those pictures you've seen of the composite TV signal in textbooks. There is just one more kind of pulse we must add in order for it to correspond directly. These are the so called equalizing pulses, or equalizers (shown dotted in Fig. 11). These are very narrow pulses which come at twice the horizontal scanning rate and so, fit midway between the horizontal sync pulses on the vertical blanking pulse (this is the only place they appear). My simple system (which is obviously not very practical) has room for only four equalizers but the standard American system uses 12 or 13, depending on which field you look at. The mechanism by which these equalizers operate won't be talked about here. Suffice to say that they serve to insure stable interlace. They make sure the two fields fit together exactly. One other thing you will find in the NTSC signal that is absent here is the presence of a number of otherwise



normal horizontal scanning lines that carry no video (called inactive lines). These follow both the vertical sync pulse and equalizers. These provide a kind of guard band to make sure the horizontal oscillator is operating stably before actually beginning the picture.

So that's the kind of signal that is used in broadcasting today. Amazing, isn't it? That vertical sync pulse hardly looks like one pulse anymore. It's there though, you just have to look for it.

Now that the system is not a mystery any more let's apply it to ham TV. To be sure, you can't be expected to buy a television sync generator (they run to four figures) but you sure can come by a used television set. We're going to steal sync from a local TV station and let them worry about maintaining the quality of the pulses.

Take a gander at Fig. 12 which is a block diagram of a system the author has been experimenting with. To get sync out of the set (and here I'm referring to the entire pulse train and not just horizontal or vertical sync) the audio stages were removed and replaced with a sync amplifier and output stage which would give about 4v into a 75 ohm load. This was done so RG-59/U could be used to feed the sync signal elsewhere. A 5FP7 was substituted for the original 10BP4 and a photomultiplier was mounted in front of the tube. The slide is placed on the face of the 5FP7.

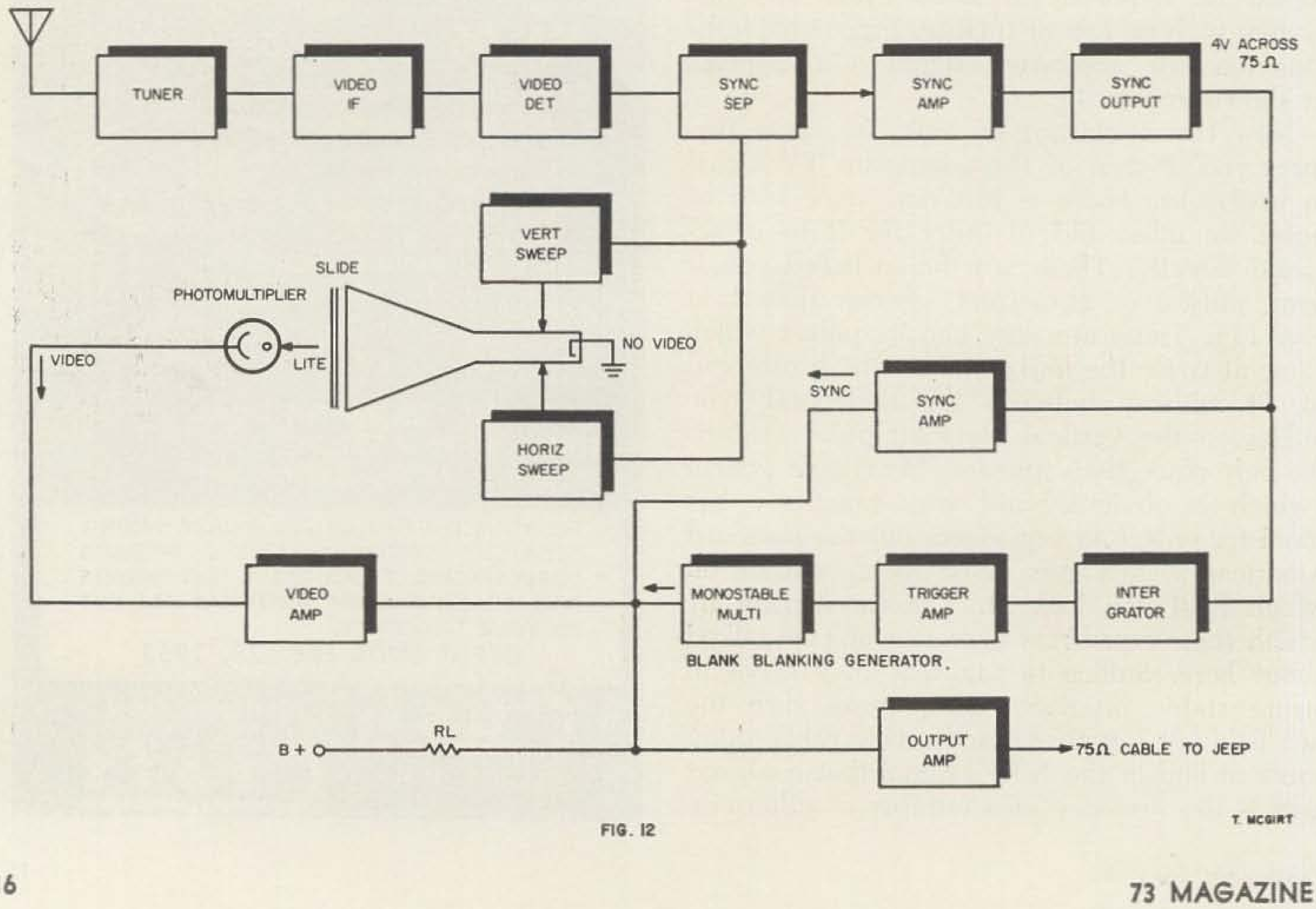


FIG. 12

Video from the photomultiplier is amplified and then mixed with sync from the TV set. Now it's not possible to get a good blanking signal from the sync separator in the set. While the absence of horizontal blanking caused little trouble, the absence of vertical blanking gave some beautiful retrace lines through the picture. The blanking generator was constructed to eliminate these lines. First the sync signal is fed through a three stage integrator as is found in most TV sets, the output pulse from the integrator is amplified and used to trigger a monostable multivibrator. Don't let that name scare you. This device just gives a nice square output pulse in return for each jagged one fed in. The pulse width was adjusted to blank the retrace lines over the entire screen. These three signals; video, sync and blanking are then mixed in a common resistor (a plate load in this case) and the composite signal fed to an output stage which in turn feeds the monitor, or "jeep" as its sometimes called. The results so far have been quite good although a lot more has to be done before the scanner is airworthy. The interlace obtained is good.

So there you have it. A way of getting good TV pictures on a ham type signal. The signal is non-standard due to the absence of horizontal blanking but it works quite nicely. That NTSC signal isn't so confusing after all is it? Now go have a look at a good book on television and see if the diagrams of the signal are still confusing. They shouldn't be.

. . . K2HQY

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Fink, **Television Engineering Handbook**; Donald G. Fink, Editor in Chief, McGraw-Hill 1957.
Ennes, Harold E.; **Principles and Practices of Television Engineering**; Howard W. Sams 1953.
Millman and Taub; **Pulse and Digital Circuits**; McGraw-Hill 1956.

73 Tests The

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SIX METERS IS ONE of the finest mobile bands we have these days, particularly if you aren't planning to spend several hundred dollars in a sideband transceiver. It is virtually impossible to find a section of the country remote enough to be without contacts and the infrequency of band openings assures you of QRM free local contacts most of the time.

Six meter mobile is not only one of the best bands for keeping in touch with the local gang, but if you do any traveling it is the finest for getting to know the bunch when you drive into a new town.

Those of you contemplating six meter mobile operation would do well to take a careful look at the World Radio Labs Tech-Ceiver TC-6A. This transceiver sells for only $39.95 in kit form less power supply and gives a lot for the little money it costs. WRL sells power supply kits to match the rig for $15.95 for the ac unit and $24.95 for the 12 vdc model just in case you don't have something satisfactory kicking around.

The receiver is a superhet, which is remarkable at this price level. Naturally they have gotten it down to basics with one rf stage, an oscillator-mixer stage, a 2.1 mc *if* stage and two audio stages. Diodes are used for second detector and noise limiter. The loud speaker is mounted right in the front panel. The receiver tunes from 49-54 mc, and has a selectivity of 20 kc at the 6 db points, which is ideal for mobile operation since it allows some flexibility in the tuning and is not as apt to bring about expensive car damage while you are attempting to zero a signal into the receiver.

The transmitter, which runs about five watts input and one watt out, utilizes a 6CX8 triode-pentode tube. One great benefit of this transmitter is its use of the inexpensive 8 mc crystals. The oscillator triples the crystal frequency and feeds it into the pentode half of the tube where it is doubled and presented to the antenna (SO-239) connector via a built-in push-to-talk operated transmit-receive relay. The two audio stages used in the receiver are switched over and used as a high gain mike preamplifier and plate modulator.

The whole unit is quite small. As far as we know this is the smallest six meter transceiver on the market, measuring only 5" x 9¾" x 6" and weighing in at 5½ lbs.

The unit provided us for test was assembled and wired in one evening following the almost exasperatingly simple instructions in the 50 page instruction book. Not only were all the parts there, but they all worked! We hooked the rig to a test power supply and fired it into the five element beam up on the chimney and practically had to beat calling stations off with a stick. Even way up here in the remote wilderness of New Hampshire this little old one watt output was attracting attention. All the reports were the same: good signal, good modulation. There was a dismaying lack of difference between the sensitivity of the receiver and the home station converter-communications receiver setup. We did beat it on selectivity, though this didn't make a lot of difference most of the time.

OK, it works in the home shack . . . how will it do in the car? We decided to mount it in the VW station wagon, which presented some problems due to its six voltishness. This took some digging into the junk box. Down deep we came across a Kupfrian transistorized supply which was small enough to fit in one hand and worked from six volts!

The Kupfrian supply was screwed to the bottom of the rig and the rig mounted under the dash. I suppose there is no use in revealing the little turmoils that plagued us before everything was working smoothly. Much of it was our own fault. For instance the first mounting place looked fine and seemed just right. The only trouble was that you smashed your knuckle on the rig whenever you shifted into first gear. It was a little trouble to mount there and we tried to make do with a handy supply of Band-Aids. As more and more cripples reported back from trips to the post office every day we decided to move the rig.

Then there was the little matter of the high pitched whine in the receiver from the supply. Hmmm, no filter . . . what do you know! We should have solved this one on the workbench instead of under the dash for fellows get to acting funny when they have been upside down for an hour or two and the blood has drained down into the head cavity.

Someone could have warned us about the six meter output of the VW engine too. I think it has more output than the rig. We put Sprague condensers in everything but the gas line and got the noise down to an acceptable level.

First we tested the unit by talking to it from the home station while someone was out for mail or food. This was easy for in a small town like this everything is almost within shouting distance. We then peaked up the rig as best as we could and headed for our little nearby mountain top: Pack Monadnock, just 3.5 miles down the road and 2600 feet high. Up there we ran into QRM. There were stations on all over southern New Hampshire and we could hear them right down through Massachusetts into northern Connecticut. The band was really quite crowded and we had a fine time working one station after another until way after midnight. We've been up there a few times since and the response is always the same: lots of contacts.

Though we really haven't had time, we've kind of looked the Tech-Ceiver over rather carefully to see what we could do in the way of modification. About the only change we would make would be to add a separate oscillator stage in there somewhere and change the present one over to a doubler, allowing us to run straight through in the final. This would be mostly just for something to do for we never have had much trouble as a result of the low power output of the rig . . . but then we've never tried to use it for DX'ing during a band opening.

Taken as it is, this is an excellent low cost, small, portable, six meter transceiver which easily mounts in any car and turns in a creditable performance.

Fast Bandswitching Linear Amplifier

Paul Barton W6JAT

Photos: Ernie Peterson W6NNS

The main "claim to fame" of this amplifier is its ability to switch bands quickly. It can be switched to another band ready to go on the air as quickly as you can turn the knob to the desired band.

This amplifier was built by "Buddy" Alvernaz, W6DMN, who sees with his fingers, to demonstrate Jennings Radio's special kilowatt bandswitching assembly. It is currently being service tested in Buddy's ham shack.

The Jennings Radio RX-274 band switch assembly is housed in a cast aluminum housing, visible against the panel behind the ten-fifteen meter tank coil, in Fig. 1, and the partially completed chassis, Fig. 2. Two Jennings Radio UCSL-500 type vacuum capacitors are mounted on the housing for the input and output capacitors of a PI net. For each band, each vacuum capacitor can be preset to any desired setting with an allen wrench through the

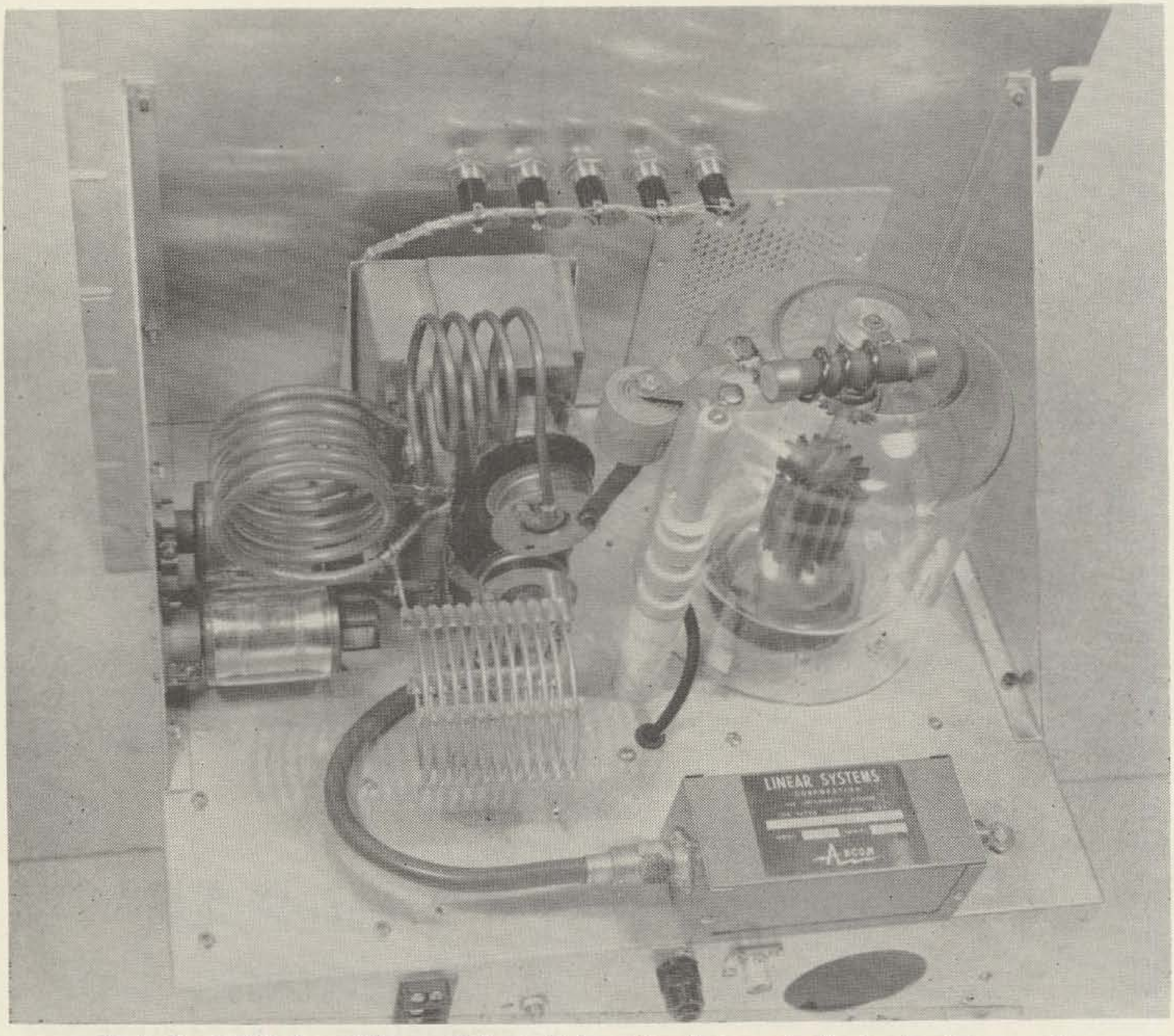
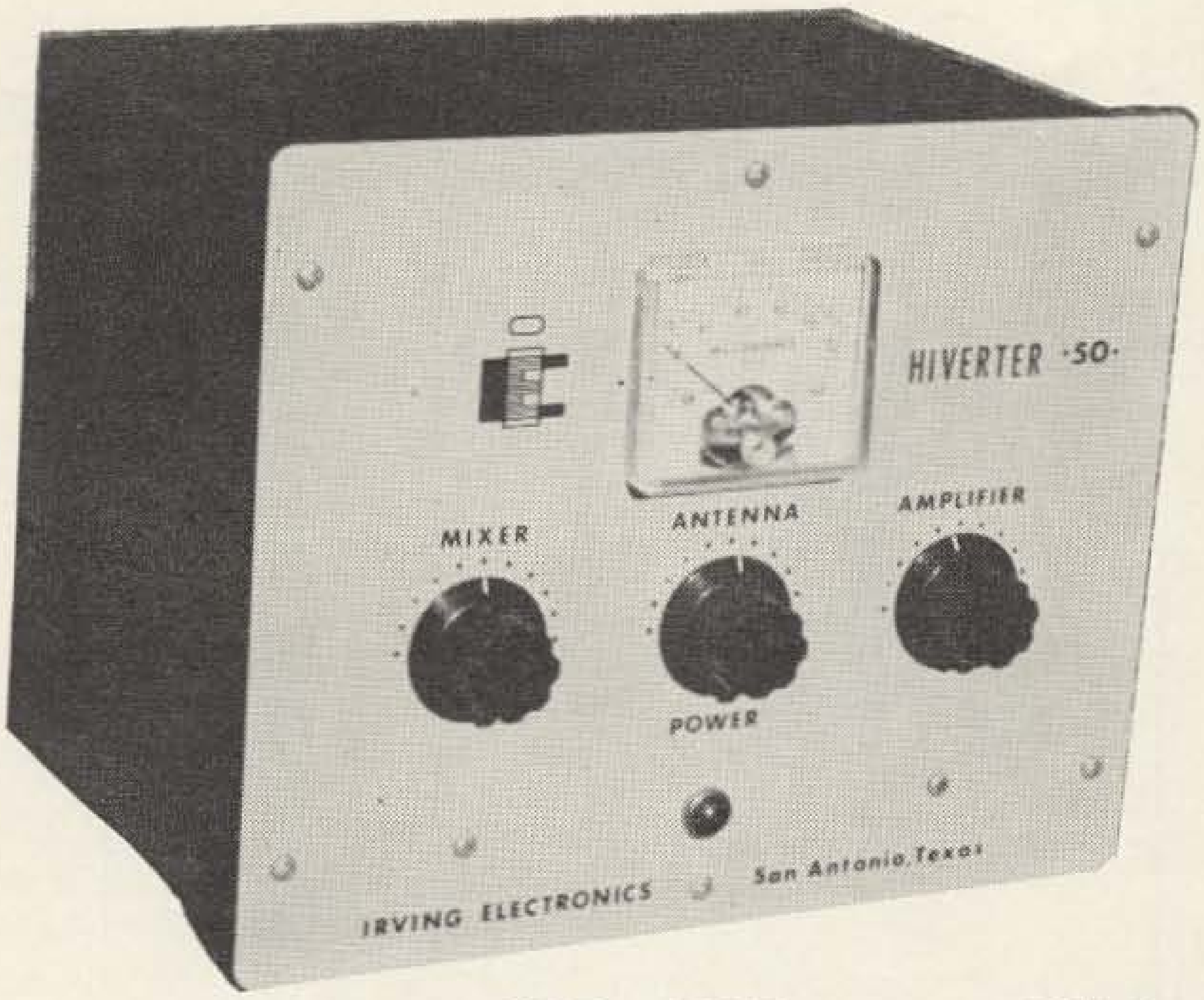


Fig 1. The 3-1000 Z amplifier could be built from this photograph. The band switch assembly is visible against the panel.



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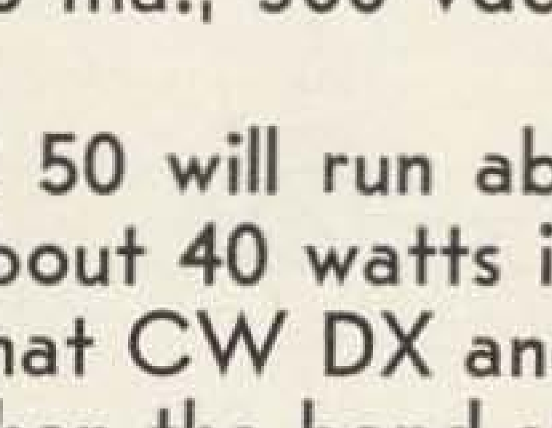
AM—CW	**6146 amp.**	**2 OB2 regulators**

SIDEBAND extends your range amazingly . . . gives you VOX operation . . . makes amplifiers extremely simple for higher power. SIDEBAND gets through first when the band starts to open . . . even works through aurora flutter. Now you can go on sideband on six meters with the Hiverter with utmost simplicity. You'll need a source of 20 meter sideband, the HIVERTER and a power supply. Any of the popular sideband exciters or transceivers will give you the ten watts needed for the HIVERTER 50. The $29.95 Heathkit HP20 power supply delivers the voltages needed: 600 vdc @ 150 ma., 300 vdc @ 60 ma., 130 vdc bias, and 6.3 vac @ 2.65A.

The HIVERTER 50 will run about 50 watts PEP input (30 watts output) on sideband, about 40 watts input on AM phone and 50 watts on CW. You can work that CW DX and all the transceivers with this unit . . . and still be ready when the band starts to open up to blast away on SSB.

The HIVERTER 50 is available wired and tested, complete with all tubes and crystal, less power supply, for $99.50
HIVERTER 50 KIT, complete with tubes, crystal and two prewired and tested printed circuit modules (very little to do, really), less power supply $59.95

PREVERTER 50 & 144



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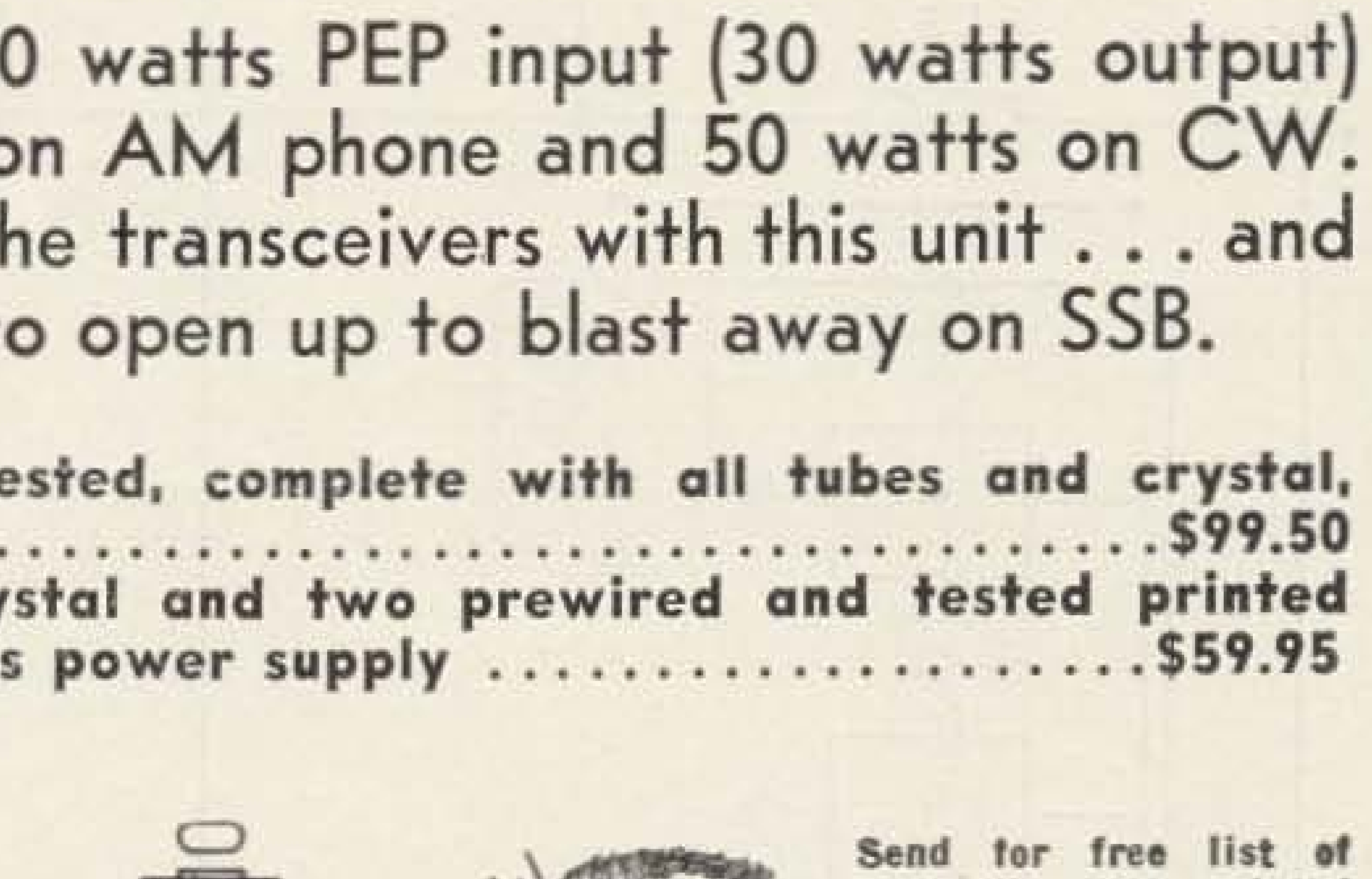
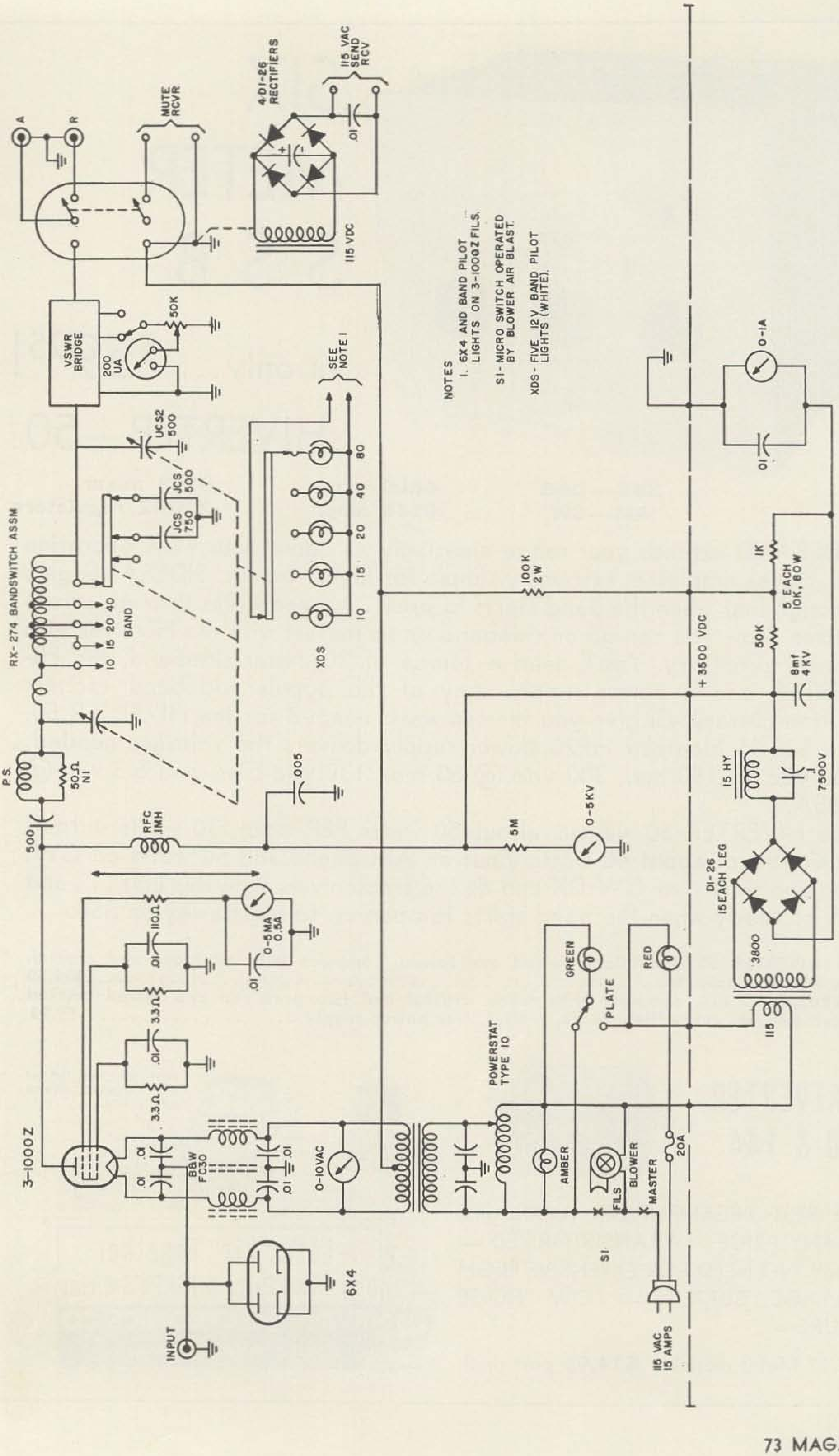




A
R
MUTE RCVR
4 DI-26 RECTIFIERS
115 VAC SEND RCV
.01
115 VDC
VSWR BRIDGE
200 UA
50K
UCS2 500
SEE NOTE I
NOTES
I. 6X4 AND BAND PILOT LIGHTS ON 3-1000Z FILS.
SI-MICRO SWITCH OPERATED BY BLOWER AIR BLAST.
XDS-FIVE 12V. BAND PILOT LIGHTS (WHITE).
RX-274 BANDSWITCH ASSM
JCS 500
JCS 750
10 15 20 40
BAND
10 15 20 40 80
XDS
P.S.
50Ω NI
500
RFC 1MH
.005
100K 2W
+3500 VDC
IK
5 EACH 10K, 80W
50K
8mf 4KV
0-1A
.01
5M
0-5KV
15 HY
.1 7500V
DI-26 15EACH LEG
3800
115
3-1000Z
.01
.01
3.3Ω
3.3Ω
110Ω
0-5MA 0.5A
B&W FC30
0-10VAC
POWERSTAT TYPE 10
GREEN
RED
PLATE
AMBER
BLOWER
FILS
MASTER
20A
SI
6X4
INPUT
115 VAC 15 AMPS

front panel. The allen wrench adjusts a set screw which raises or lowers a cam which determines the setting of the capacitor.

A sliding progressive-shorting tap switch is mounted on the housing to switch the tank coils and to add more output capacity at the lower frequency bands. Vacuum capacitors have been used for this purpose due to their excellent current carrying capabilities.

There is also an auxilliary switch that can be used for bandswitching other stages (probably through relays), or for pilot lights, or what have you.

These two slide switches and the cam actions are ganged and set up for five bands.

Turn to the desired band, initially tune up the amplifier for that band, and thereafter when you turn to that band it will be perfectly pretuned. The re-setability of this arrangement is excellent.

The grounded grid-driven cathode circuit is used for greater simplicity and stability. No neutralization is needed on any band.

A tuned grid (or cathode) circuit is always recommended but has been omitted here for simpler band switching. In its place a 6X4—visible in Fig. 3 has been connected to the cathodes to load the positive half cycle of excitation when the linear amplifier is non-conducting. This keeps the load on the exciter reasonably symmetrical. A SSB-100F drives this amplifier to full output with ample excitation margin.

The B & W FC-30 filament choke (Fig. 3) is a natural for this application, though a homemade choke can be made that works very well. Ten turns of #10 cotton enameled wire wound on a broom handle then the broom handle removed, for each leg of the filament, works fine.

It is important to maintain the filament volt-

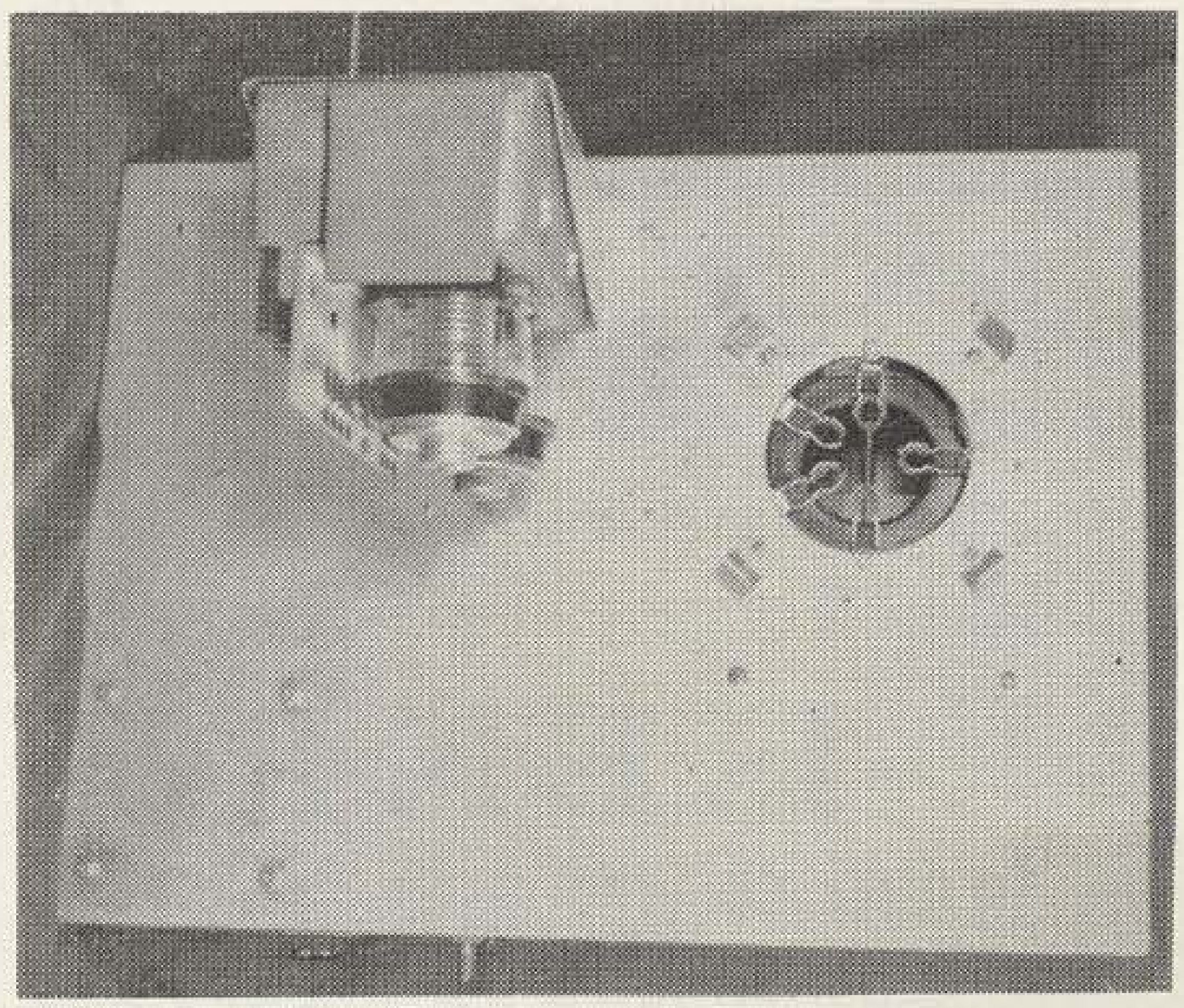


Fig 2. Partially completed chassis showing bandswitch. Close inspection will show the grid bipass from each grid pin to the chassis.

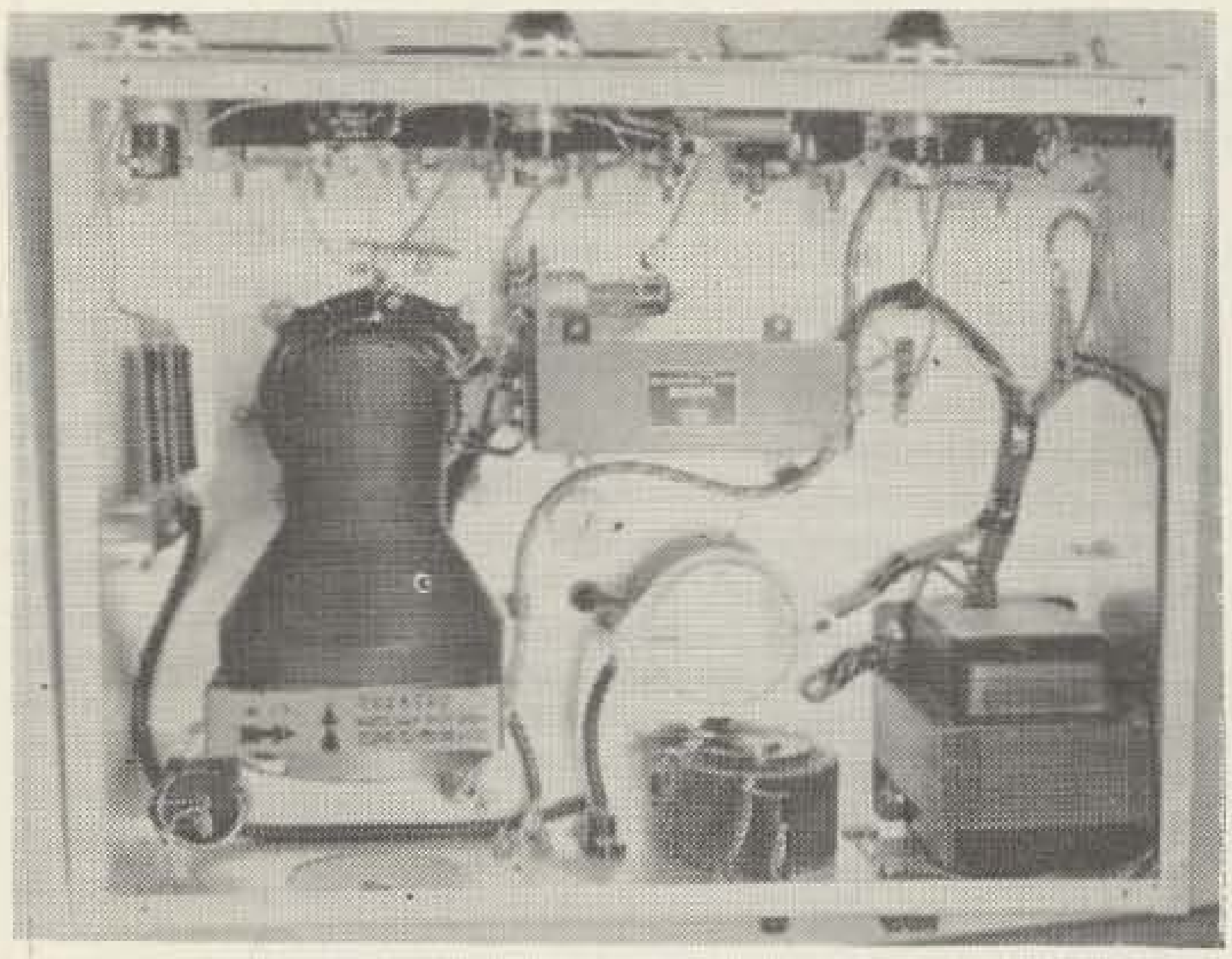


Fig 3. Sub chassis view. All parts were mounted & wired by W6DMN.

age at the proper level, so a Powerstat Type 10 and filament volt meter is installed. (Fig. 3). On initial operation, an accurate laboratory meter should be connected directly across the tube filament *terminals* and the powerstat brought up to 7.5 volts on the accurate meter. Then note the reading of the panel filament meter that is connected across the filament transformer. After that the filaments may be adjusted by reference to the panel meter.

The grid metering circuit was lifted verbatum from a pamphlet by Bill Orr W6SAI, Eimac. It works fine. Each of the three grid terminals are bypassed to ground through a .01 disk capacitor and a 3.3 ohm resistor. As the grids are tied together internally, the three 3.3 ohm resistors are in parallel also. This gives 1.1 ohms of grid leak. A half ampere of grid current across this 1.1 ohm grid leak will give .55 volts. So connect a .55 volt dc voltmeter across the grid leak and call it a half ampere meter. Use any available, low range milliamp meter and put enough resistance in series with it to make a .55 volt meter. For instance if a 5 ma meter is available (which could then be read as a 0-500 ma), 110 ohms in series with the 5 ma meter (assuming negligible meter resistance), would make the 5 ma meter read full scale when .55 volts was impressed. Precision metering at this point is unnecessary, so precision calculations or resistors or meters is also unnecessary. 260 ma of grid current at full load and drive is normal.

The grid terminals are bypassed with a .01 disk cap *above* the chassis, to get as close to the grid as possible. This can be seen by very close inspection of the picture of the incomplete rig showing the tube socket mounted (and bypassed) and the RX274 band switching unit. (Fig. 3)

A 4-1000 A tube works in this linear amplifier with no changes except that the three grid terminals should be tied together at the socket to make the grid metering circuit read properly.

It is important to use a tube socket that puts no strain on the glass seals around the tube pins. The Eimac SK 510 is recommended. The Eimac SK 500 socket, which is the older cast aluminum, air system socket has been reported to put too much strain on the 3-1000Z.

The cooling fan is a PAMOTOR*-Axial Fan Model 1000, made in West Germany and is exceptionally smooth. (Fig. 3) It is rated at 125 CFM. The sheet metal adapter from the blower to the bottom of the tube socket would not work until vanes were installed inside to prevent the air from cavitating. Then the air came through very well.

Pressurizing the chassis is simpler but less efficient. Also, this arrangement soon blows the chassis full of dirt.

The switching arrangement is simple and safe. A line cord comes into the amplifier chassis and goes through a 20 amp fuse and a master toggle switch. This switch carries the line current for the entire rig, including the power supply. When this switch is first thrown, it only turns on the fan. When the fan gets up to speed, it actuates an air micro-switch—actuated from a vane in the air stream. The air micro switch then turns on the filaments. Loss of air turns off the filaments.

The plate switching uses a single pole double throw toggle switch, and takes its power after the air switch. So loss of air will also turn off the plate power. The double throw plate switch energizes a green pilot light in the off

* PAMOTOR, Inc., 312 Seventh St., San Francisco 3, California

[Turn to page 58]

Fig 4. The silicon diode rectifier system is comparable in cost to the thermionic system and saves space, heat and switching.

James L. Weeks, W6FNG
P. O. Box 307
Wrightwood, California

A Review

The PMR-8

THE LAST FEW YEARS have seen several entries into what I will call the compact-receiver market. Notably among these entries were the PMR-series by Multi-Elmac, the KE-93 by Automation Electronics and the G-66 series by Gonset. However, the Multi-Elmac people are still marketing their line now represented by the PMR-8. Vital statistics —4⅝"h, 7"w, 11"d @ 8½ lbs.

There has and I guess always will be a requirement in my ham operations for a receiver that is small enough to put in a suitcase for a trip yet be usable on a field day excursion in the car or can double in the home shack with performance equal to a "big set." And, last but not least, it has to fit my budget of around $200.00. My old KE-93* filled that bill, but in a moment of financial greed, I disposed of it. I still had the need; so I looked around and settled on the PMR-8. I am so pleased with it that I want to pass the good word along.

Band coverage is 80, 40, 20, 15, 10 and 6 plus the broadcast band. Dual conversion is employed. The 1st *if* operates at 2238 kc, the 2nd *if* at 262 kc. Because of physical limitations and for reasons of pure economics, the band-pass width or selectivity of the *if's* is limited to a fixed 3 kc—i.e. the selectivity is 6 db down at ± 3 kc. The bandwidth is a compromise between reasonably good audio quality and selectivity acceptable for average band conditions. Skirt selectivity (or cut-off) is exceptionally good, which compensates in some measure for lack of a more narrow and controllable bandwidth.

After a nominal warm-up period, the drift factor was excellent, even without a regulated B+ supply to the hf oscillator. Mechanical stability is truly outstanding. One can literally drop the receiver from a height of several inches above the table top without even a flutter on the pitch of a CW signal.

I primarily use the set for CW. The avc action on CW is just right. It is fast enough to adequately block the receiver so as to give me a good monitor copy of my own sending without cracked ear drums; yet it (the avc) does not introduce objectionable lag so as to seriously distort the characters. For mobile CW operation, the bfo is quite good as an auxiliary tuning function for keeping the signal peaked.

The mechanical-electrical layout is such as to permit neat, rigid point-to-point wiring. There are no stray or haywire leads, which is unfortunately a too-often-noted trademark of receivers in this price category. The various switches, condensers, coils, etc. are of top-quality grade. Components are unusually accessible for servicing and circuit tracing, notwithstanding the compact geometry of the receiver.

Operation of the filaments on 12 or 6 volts (ac or dc) can be had by optional strapping of the connections on the Jones-type power plug.

While designed primarily for 250/105* volts plate voltage, I obtained good results by running everything on as low as 90 volts. An external "S" meter can be tied into the same Jones plug. The "S" meter will have to be fabricated by the individual as it is not available as a manufacturer's item. However, sufficient data is contained in the instruction manual for "rolling your own."

The Operating Manual is generally good. Data on alignment could be easily understood and handled by the most rank novice. Circuit diagrams are better than average from the standpoint of readability. There are two full-page drawings showing identification and layout of every major component of hardware both on top and underneath the chassis.

The receiver requires (which I like) an outboard power supply. As I stated earlier, plate voltages are not critical. If you purchase the M-1070 power supply, which is a companion supply for the associated AF-68 transmitter, then you also have a supply for your receiver. But for the receiver alone, you can build a perfectly adequate supply for less than $10.00.

I must point out that performance on 6 meters is surprisingly good for a receiver not designed for VHF operation. If you like 6 meters for general utility, it does a commendable job.

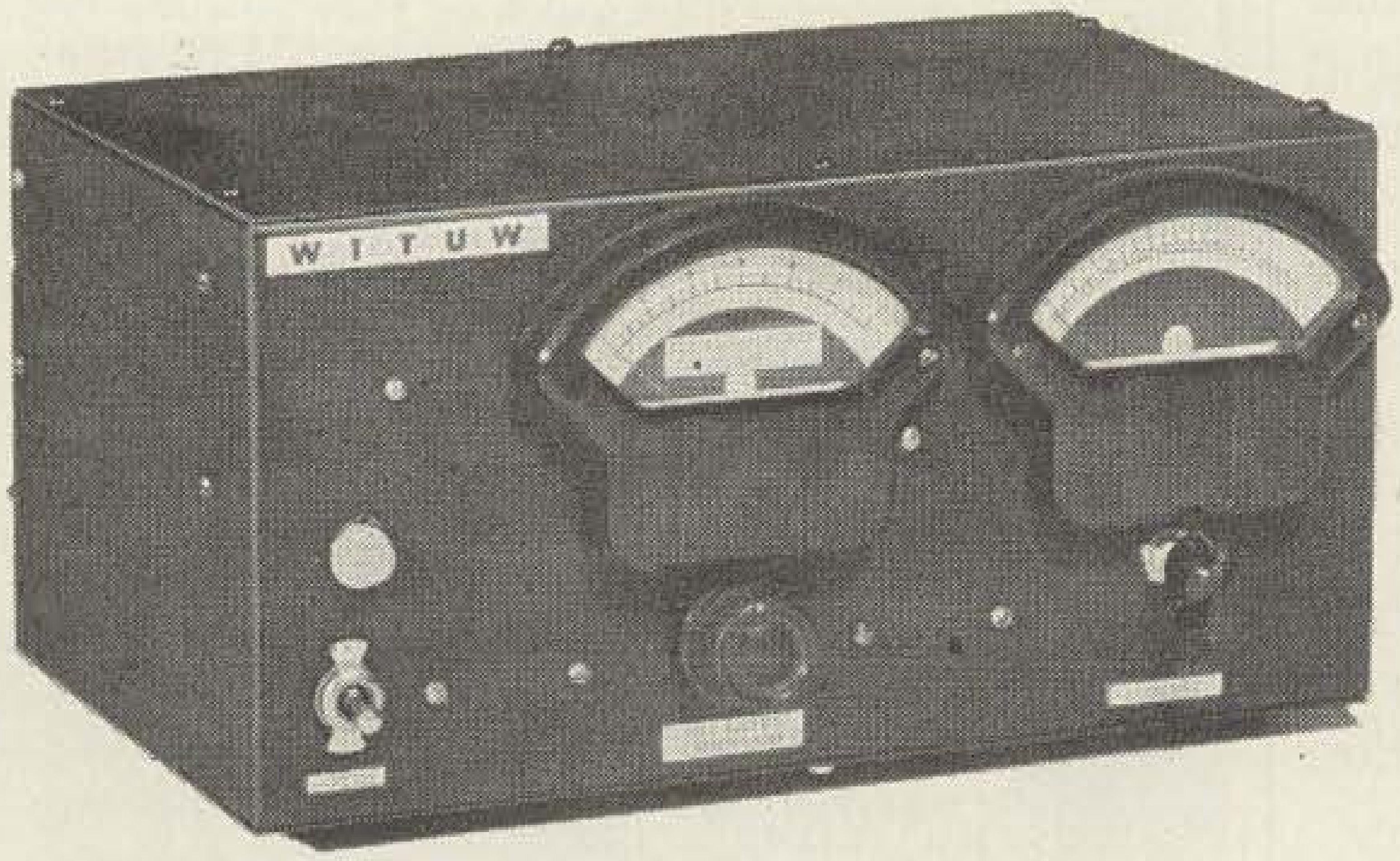
Now, does the set have any deficiencies? Yes, but they are not serious. Ease in SSB tuning could be immeasureably enhanced by replacing the main tuning shaft with a planetary reduction drive-shaft. Such an arrangement would give the receiver really good SSB handling even under mobile operation with one hand on the steering wheel and one hand on the dial knob. The bfo vernier control while handy in SSB tuning does not entirely compensate for a better degree of vernier control needed on the main tuning knob. I would also replace the output transformer with one having a 500 to 1000 ohms output winding. I use headphones exclusively of the 2000 ohms impedance variety. The receiver develops all sorts of audio, but the bulk of it (the audio) flows to ground through a 6.3 ohms resistor that is connected across the phones and the 3.2 ohms secondary of the output transformer. All of this comes about when you plug your phones in. If you use a speaker or low impedance phones, then there is more than ample audio volume. But me, I like to have the old "cans" rattle loud and clear!

In summation—for the money involved, you get operating features and quality of construction generally found only in receivers costing considerably more. And, if you'll make the two changes I just suggested, I would stack it up against anything up to twice its cost.

. . . W6FNG

*June '60 CQ, **KE-93 Review, J. L. Weeks.**

*105 volts is for the hf/bfo oscillators, screens, etc.

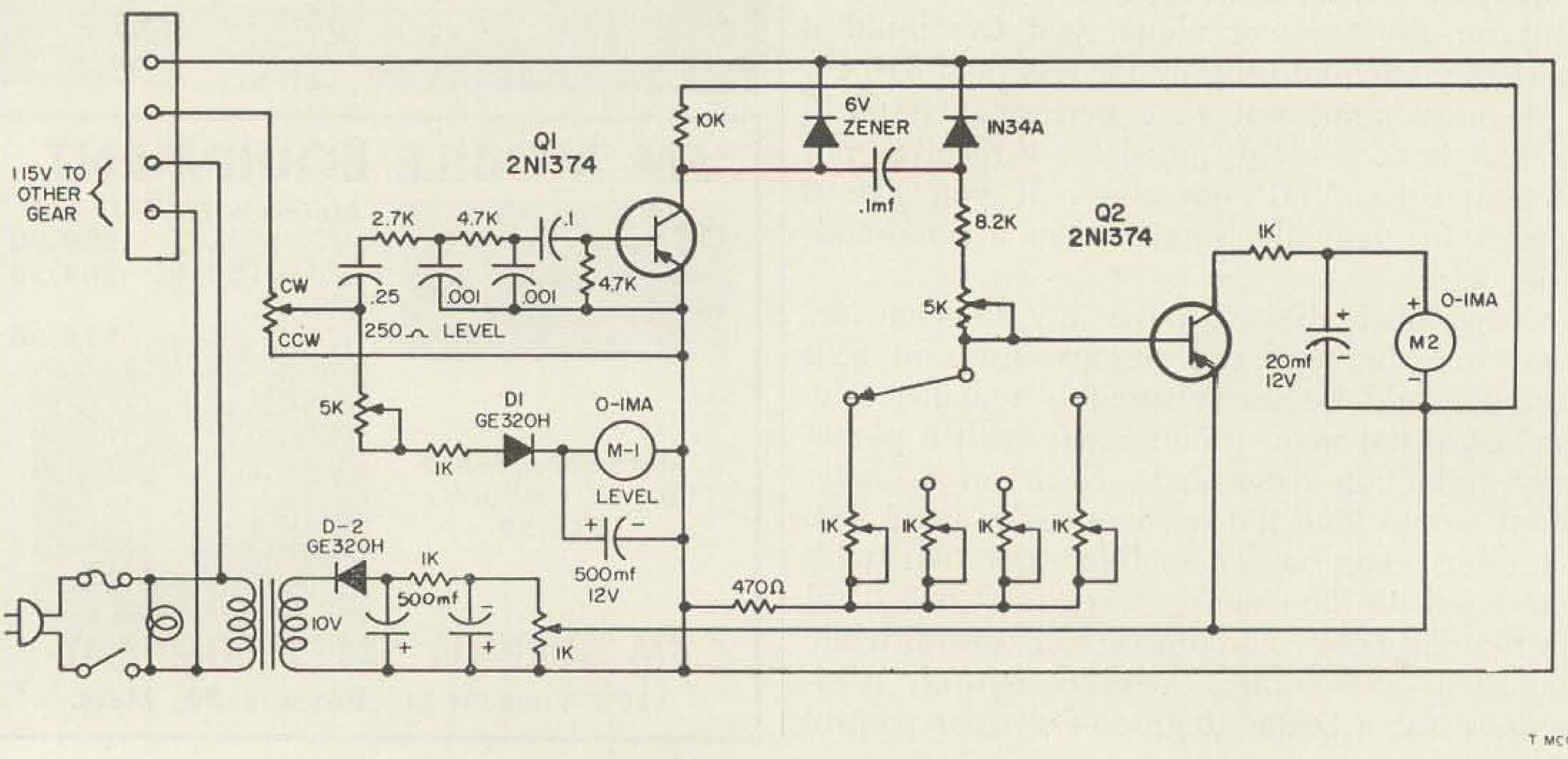


Transistorized Audio Frequency Meter

David Cabaniss W1TUW
22 Matthews Street
Terryville, Connecticut

Here is a simple piece of gear that will be a worthwhile addition to any amateur's line of test equipment. The various applications of an audio frequency meter are numerous and therefore will not be covered in this write-up. Those interested in constructing a simple and accurate audio frequency meter will find this outline very helpful. The circuit diagram, parts list, and photograph should provide the builder with all of the information necessary to construct a unit similar to that of the author's. Parts layout is absolutely non-critical, and a large quantity of the required components may be found in the well-stocked junk box. Briefly, here is how the circuit operates.

An ac voltage of an unknown frequency is



B&W

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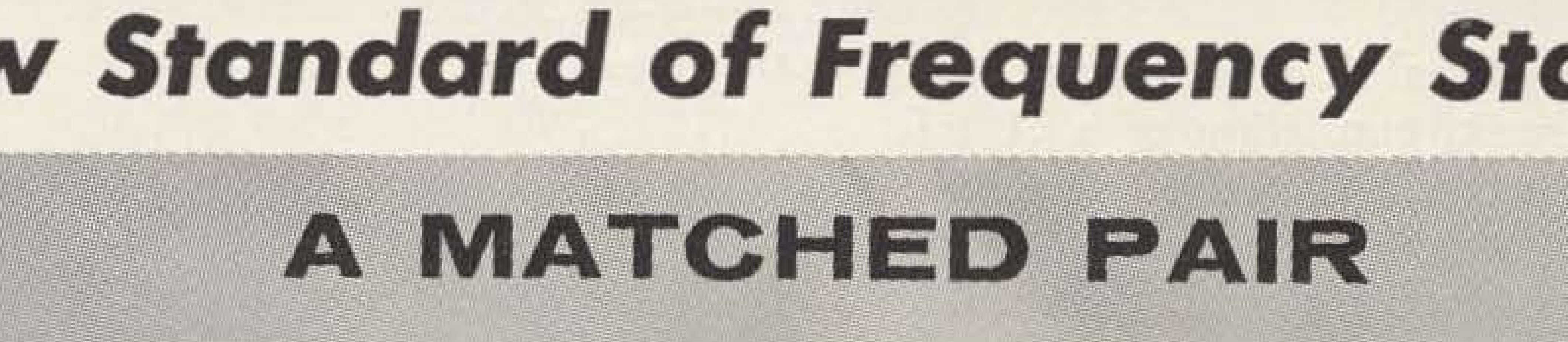


Model 6100 Transmitter

Model LPA-1 Grounded Grid Linear Amplifier

MODEL LPA-1
PRICE!
$375.00
(less Power Supply)

THE B & W KILOWATT

BARKER & WILLIAMSON, Inc.
BRISTOL, PENNSYLVANIA • STillwell 8-5581

applied across the 250 ohm input potentiometer (Level Control), and then applied to a filter circuit, which is designed to cut off at about 7000 cps. At the same time, this ac input voltage is rectified by diode D-1, and applied to the Level Indicator meter, M-1. The purpose of the Level Control and Level Meter, M-1, is to insure that the input voltage is at a sufficient level to drive the first transistor amplifier-clipper stage to saturation prior to taking any frequency readings with meter M-2. The 5K ohm potentiometer in series with the ac signal to meter M-1 is set to keep the meter "on scale." In the author's unit, with the 5K ohm level pot at ½ resistance, and the 250 ohm Level Control at the full clockwise position, an input voltage of .2 v ac was required to drive the first transistor amplifier-clipper stage into saturation. The input Level Meter, M-1, at .2 v ac input, read 300 microamperes on the unit shown in the photograph. (This is only a reference reading, which depends upon the setting of the 5K ohm Level Meter potentiometer.) In other words, any reading of 300 microamperes or better will indicate that the input ac voltage is at a sufficient level to take an accurate frequency reading with M-2.

With a sufficient level of ac voltage applied to the filter circuit (on the base of Q1), the filter will pass all frequencies below 7000 cps (approximately) on to the base of Q1. The Zener diode on the collector of Q1 prevents any dc voltage variations in the power supply from effecting the operation of Q1. With a 6 v Zener diode on the collector of Q1, the 1K ohm power supply potentiometer should be set so that the potentiometer arm reads about -8 volts dc to ground.

The clipped ac signal is then passed to a pulse counting circuit, consisting of a .1 mfd capacitor, a 1N34A diode, and the "range" potentiometers and resistors connected to the base of Q2, the meter amplifier transistor. The four 1K ohm potentiometers connected to the switch are the range potentiometers, and are set up for 0-50, 0-500, 0-1000, and 0-5000 cps. The 5K ohm potentiometer at the base of Q2 is a coarse adjustment affecting all ranges. Three of the four ranges can be set by WWV, with the tones of 440 and 600 cps. The 0-50 cps range can be set up with an accurate af generator.

Transistor Q2 has the calibrated frequency meter, M-2, in series with its collector circuit. The frequency of the pulses applied to the base of Q2 will be indicated on meter M-2.

The scale for meter M-2 should be made as linear as possible. The scale for meter M-1 is not critical. Only one point on the scale need be marked—the point at which the level of input voltage no longer effects the reading of meter M-2.

The preceding circuit description may give you some ideas of your own. Refinements are always possible. Good luck, and I hope you are as pleased with your new piece of gear as I am with mine!

. . . W1TUW

PARTS LIST

(3) 500 mfd, 12V capacitors
(1) .25 mfd, 200V capacitor
(2) .1 mfd, 200V capacitors
(2) .001 mfd, 200V capacitors
(1) 20 mfd, 12V capacitor
(2) 1K, 1W resistors
(1) 1K, 2W resistor
(1) 8.2KK, ½W resistor
(1) 470 ohm, ½W resistor
(1) 10K, ½W resistor
(1) 2-7K, ½W resistor
(1) 4.7K, ½W resistor
(1) 47K, ½W resistor
(5) 1K, 2W potentiometers
(2) 5K, 2W potentiometers
(1) 250 ohm, 2W potentiometers
(2) GE 320-H diodes
(1) 1N34A diode
(1) 6V Zener diode
(2) 2N1374 transistors
(2) O-1 ma meters
(1) Transformer, 115V pri, 10-12V Secondary
(1) 115V pilot light assembly and bulb
(1) 2A fuse and holder
(1) SPST Toggle Switch, 115V 5A
(1) Line Cord and Plug
(1) Jones, 4-Terminal Strip
(1) Bud Cabinet, 12 x 7 x 6
Assortment of nuts, bolts, grommets, washers, component mounting boards and terminal strips, hookup wire, etc.

Tale of a Dark Night

Walter Mull W3MFA

IT was indeed a wild night. Such a night as was made to order for the commission of foul deeds. Ragged, low hanging clouds, urged on by a moaning wind alternately hid and revealed a moon that, discouraged by the night, was already setting. In the distance, a dog feeling the eeriness of the night, howled forlornly. The few people hardy or foolhardy, enough to be out on such a night hurried along bent against the wind. High on the hill that rose just outside the village a single light glittered from the window of the lonely old house. The house where local legend maintained, murder had once been committed. It was to learn more about this legendary house and its solitary occupant that had brought me to the village.

No one really knew the strange, dark man who lived in the tottering ruin. He rarely showed himself by day. Except for the aura of evil that seemed to surround him he might have been an object of pity. On his infrequent appearances he engaged in conversation with no one nor bothered to answer those who spoke to him. Always the single light shone from the barren window until far into the night.

I pondered these things in my mind as I stood now at the foot of the weed choked path that wound from the road toward the drooping porch. I hardly knew what real reasons brought me to this lonely place. Ever since I had first heard of the oddly unorthodox man I had been driven by an almost un-natural urge to find out more about him. There was a rustling sound in the weeds behind me. I whirled about in time to glimpse a frightened rabbit dash for deeper cover. Slowly the feeling of stark terror faded and my pounding pulse returned to near normal. I began to ascend the path toward the dark, forbidding bulk of the house. At last I stood just below the porch.

As I cautiously stepped on each of the half dozen sagging treads of the steps it seemed that each one creaked more loudly than the other. Fortunately the banging of a shutter that swung back and forth in the wind masked the sound.

I stood, now, on the porch. Although the night was cold, my palms were wet. I was conscious of the brassy taste of fear in my mouth. The lone lighted window looked out upon the porch but the dozen or so feet to it from where I stood seemed as many miles. I began to ease slowly across to where I could see into the room being extremely careful not to make any noise that might give away my presence to the man in the house. Suddenly I was frozen in my tracks by a shout of wild, demoniac laughter. My, by now completely disorganized, mind conjured up visions of unspeakable violence. Of bodies being hacked to pieces by some deranged fiend.

I don't know how long I stood there poised for retreat yet drawn by a sense of macabre curiosity. At last, screwing my courage up, I resumed my slow progress toward the window. One more step and my view into the room would be unobstructed. Now——!

Dante, with all his imaginative powers, could not have painted with words such a scene of wild disorder. The room was barren of furnishings except for two tables and two chairs. It was evident that the man lived always on the edge of starvation. On the one table that stood across the room was a loaf of dried up bread, an opened can of some sort of concoction and a bottle partly filled with an amber colored liquid. On the table at which the cavernous figure of the man sat was a typewriter and a strange looking black box from which dangled a profusion of wires. Beside the typewriter was a pile of what seemed to be manuscripts each with an editor's rejection slip pinned to it. Scattered about the room in complete disorder were what must have been dozens of black boxes much like the one on the table.

As I stared transfixed, the man rose from the table. Grasping one of the boxes he began to attack it with a pair of diagonal pliers, pulling wires, tubes, resistors and capacitors from it. Again came that peal of wild laughter.

When the box had been reduced to junk the man's rage seemed to abate. He seated himself at the typewriter and began to laboriously peck out a few lines of print. I inched closer to the window. I could almost make out the words on the paper. Closer, yet closer. Only now was the mystery cleared up. The first sentence was ——To convert the BC 999 transmitter to an all band double conversion receiver, first remove all wiring and components except the fuse holder in the upper left hand corner.

. . . W3MFA

SSB or AM

at the turn of a switch

Edgar Wagner G3BID
5, Ferncroft Avenue,
London, N.W. 3.

I HAD BEEN working AM for many years and had made many delightful friendships and contacts throughout the world.

Then something happened.

Some of my regular contacts I never heard any more. Various of my friends went on to SSB and I missed the pleasure of my frequent QSOs.

The world seemed to be divided into two. Those on SSB who seemed reluctant to work those on AM and those on AM, like myself, who experienced some difficulty in resolving the SSB. It seemed as though I was faced with a choice of abandoning many of my old friends and going on SSB, or losing many of my old friends when they went on SSB.

I felt there must be a solution to this problem. After all, when the Novice goes on phone he doesn't throw away his key, or abandon his CW facilities. Why was it that those who had gone on SSB seemed to have lost the ability to communicate on AM?

The problem worried me.

I scanned the advertisements to find a receiver that would receive AM, SSB and CW equally well. This I found and as my old receiver was not too good on SSB, I bought a new receiver and found that I could receive all three modes very well.

I then searched the advertisements for a transmitter that would operate on SSB, AM or CW, but here I ran into trouble. There did not seem to be one. Those which were designed to transmit SSB would admittedly put out some sort of an AM signal but the final was always linear, the efficiency for AM was low, and the power also low in many cases. The AM was merely SSB with a carrier inserted, so I tried to design a transmitter where the final could be switched from linear to class "C" with plate and screen modulation.

I was sure it could be done but it was too difficult for me. The change in the operating conditions of the final were too great to make this an easily switchable proposition.

Yet, I did not want to lose my friends on

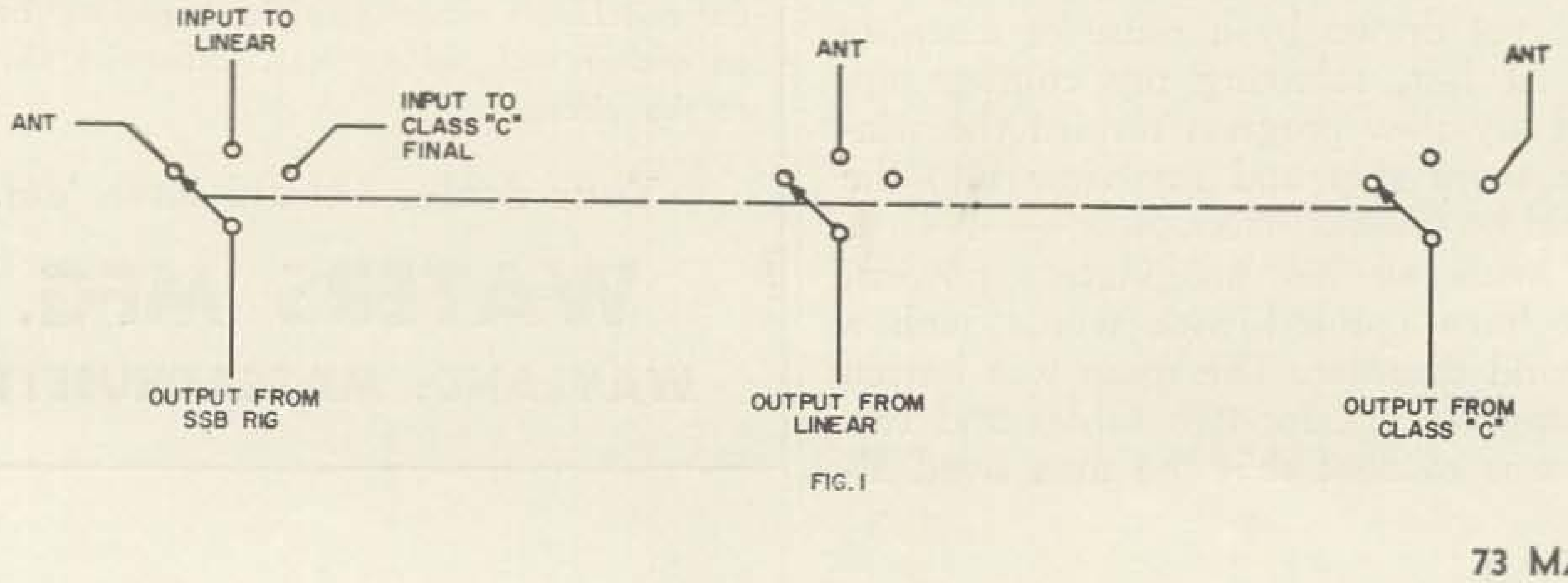


FIG. 1

AM if I went to sideband.

The problem remained, but then I remembered that I had a perfectly good AM rig. I could, of course, keep the AM rig and get a sideband rig as well, but this was clumsy. It took up a lot of space, and it meant keeping two rigs warmed up all the time, and even then it would have meant zero-ing and 2 VFO's every time if I was to make a quick switch from one to the other.

It was at this stage that I realized that I had nearly found my solution. Every SSB rig which I have seen has CW facilities. Why not switch the SSB rig to CW and use that as an exciter to drive the old class "C" final plate and screen modulated?

Here was my solution and as I imagine that most of the other people who are going sideband have got an AM rig, I thought they might be interested to do the same.

All that is necessary is to arrange a switch so the output from the sideband rig can be switched either directly into the antenna or, when operating it as a CW exciter, into the input of the class "C" final, and, if you like, a further position of the switch could feed the output of the sideband rig into the linear final.

Thus, with one switch one could have the choice of a low power SSB rig, a high power SSB rig using the linear, or full-blooded plate and screened modulated AM, using the old class "C" final and its modulator.

All that remains is to ensure that the SSB rig does not overdrive the class "C" final as it will probably have far more output than is needed to drive the final.

This can be done either by loading the Pi output of the SSB rig very lightly or, in most rigs, by reducing the carrier insertion to an appropriately low level.

In my own case I am using a KW Viceroy. This can be switched so that I can either use the Viceroy barefoot straight into the antenna, or to drive the KW 500 linear final, or to drive the old class "C" final, plate and screen modulated. The switching is done as shown in Fig. 1 —of course a high insulation ceramics switch must be used which must have low loss contacts.

It is a complete joy to be able to tune over the band and go back to any station, be they operating SSB, AM, or CW, by merely the turn of a switch and not to have that horribly frustrated feeling when you hear a station on AM whom you are very anxious to work but who for one reason or another, possibly because his receiver is not capable of it, has difficulty in receiving sideband.

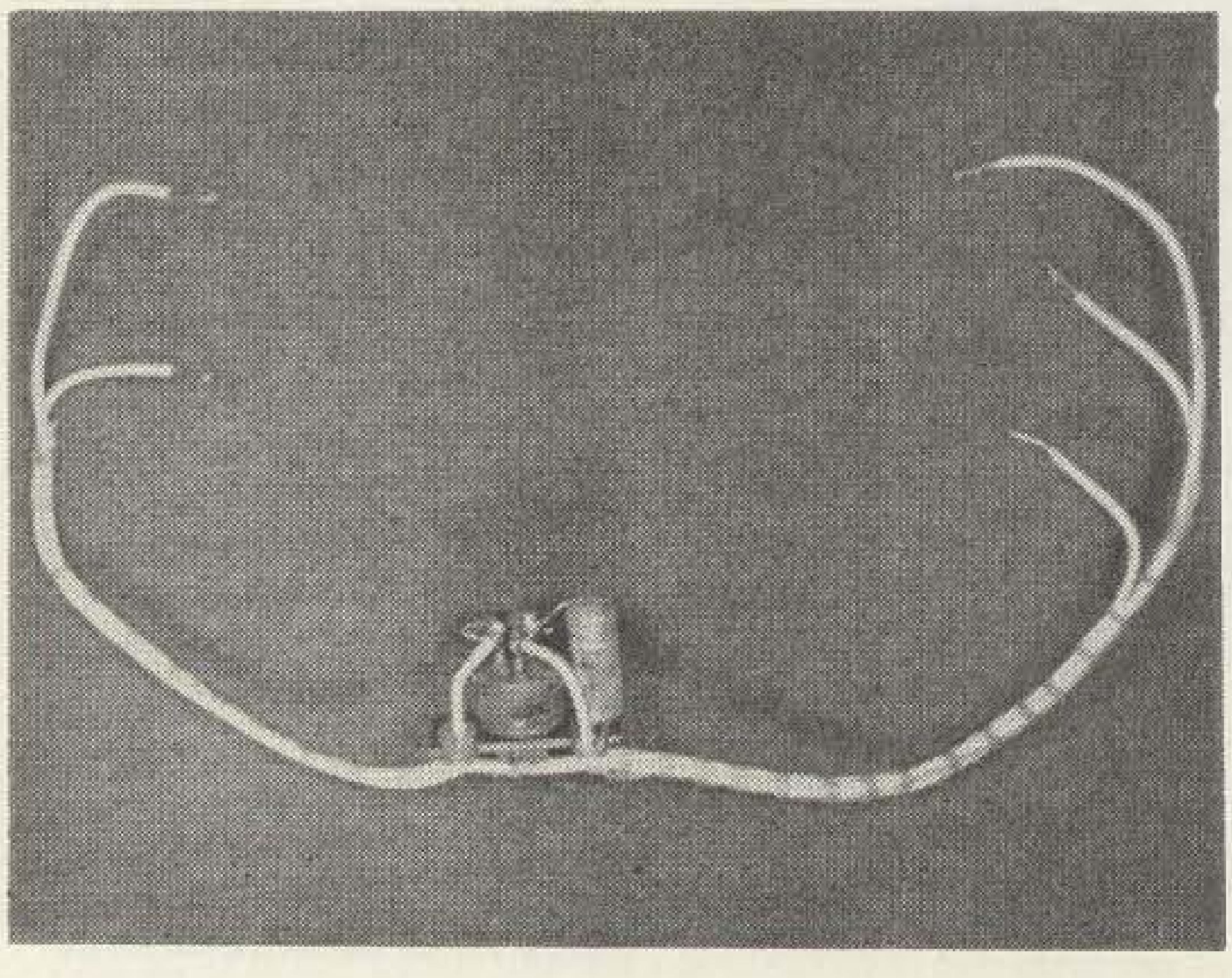
. . . G3BID

Transistorized Dynamic Mike Adaptor

Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

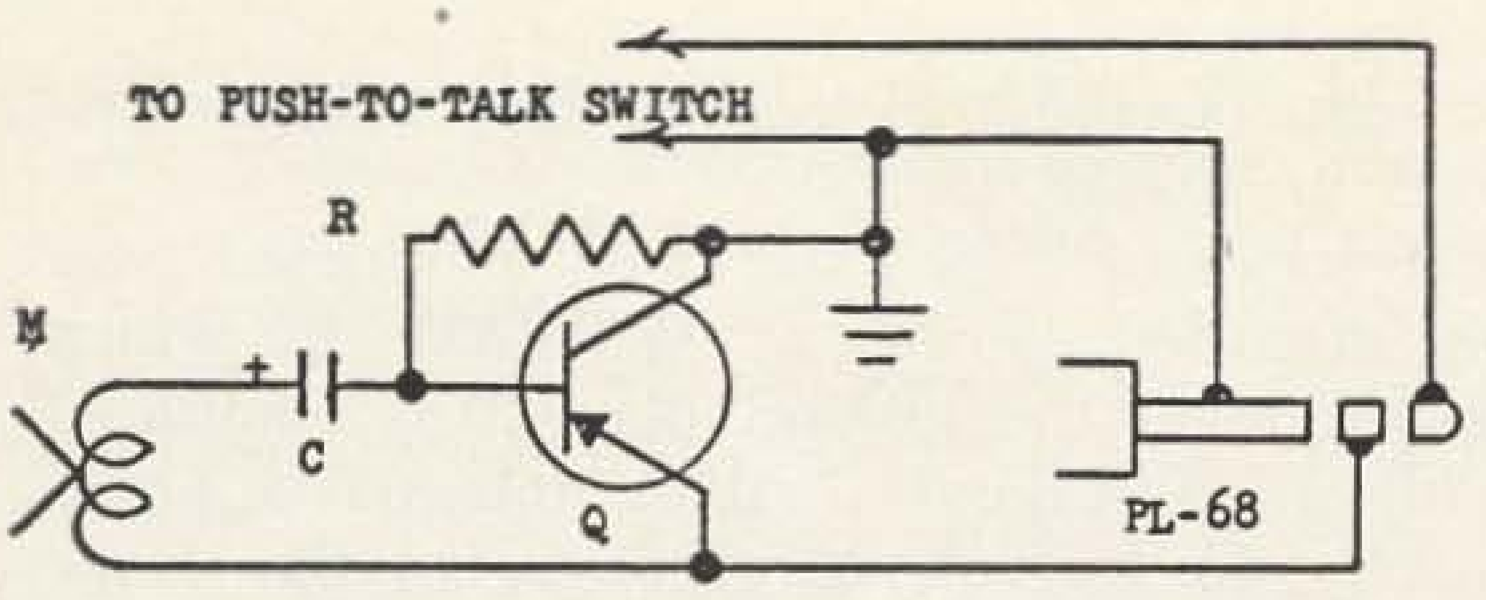
Photograph by: Morgan S. Gassman, Jr.

SURPLUS military transmitters were almost always designed for use with carbon microphones. These units have the advantages of rugged reliability, low impedance and high output with reasonable intelligibility. However, for many amateurs, reasonable intelligibility is not good enough and the choice of a dynamic or crystal microphone is made for surplus conversions. In this case, the usual course of action is to rip out the existing audio input circuitry and install a vacuum tube speech amplifier.



The little device shown in the photographs is a much simpler answer to the problem and requires a lot less work. The output of a low impedance (50 ohm) dynamic microphone drives a single stage transistor amplifier which plugs into and is supplied power by a standard, positive battery, carbon microphone circuit. The assembly is small enough to fit inside of many microphones, may be installed in the mike stand base or may be housed in a small metal case inserted in the mike cable. While the unit may be installed in the equipment, this would require replacement of the mike jack since both leads of the microphone coil must be above ground.

The diagram shows the simplicity of the amplifier-adaptor. High gain with low noise is achieved by operating a power type transistor



C.....50 MFD, 15 WVDC ELECTROLYTIC CAPACITOR
M.....LOW IMPEDANCE DYNAMIC MICROPHONE
Q.....PNP POWER TRANSISTOR (SEE TEXT)
R.....1/2 WATT COMPOSITION RESISTOR (SEE TEXT)

at low collector current. The characteristic low input and output impedances of the power type transistor are retained in this class of operation, making the circuit ideal for the task at hand. Those interested in pursuing the subject further are referred to the short article, "Low Impedance Transistor Preamp," by W. F. Jordan, which appeared on page 78 of the March 28, 1958 issue of ELECTRONICS.

Almost any power transistor may be used in this circuit. Install the transistor of your choice and clip in a 25,000 ohm variable resistor in lieu of "R". Connect the microphone, plug into the transmitter mike jack and adjust "R" for maximum gain consistent with low distortion and noise. Measure this resistance and install the nearest stock value ½ watt resistor. This value will probably be in the vicinity of 10,000 ohms.

Performance of the unit is remarkably good. Tests were conducted using a Turner Model 999 50 ohm dynamic mike. The circuit was terminated in the microphone input of an AN/ARC-2 Transmitter-Receiver which is considered more or less typical of surplus equipment. Numerous types of 1 ampere and up, PNP power transistors were tested with consistently good results. The 2N538 transistor shown in the photograph was used because it was the smallest power type transistor on hand. This unit gives substantially higher output than the old reliable T-17 microphone.

There are other applications of this circuit which have not been explored. A negative battery microphone circuit, though virtually unknown in surplus equipment, would permit the transistor stage to be reversed, placing the emitter at ground potential. This would ground one side of the microphone coil, reducing hum and noise pickup. The same result could be obtained with the circuit shown if an NPN transistor were used. While scarce in the power types, these units are available. One further possibility lies in the use of this circuit with vacuum tube input amplifiers which place the carbon mike in the cathode circuit of a triode.

As pointed out, this circuit is ideal for use with surplus equipment since no changes are required in the audio input stages. Also, the simplicity and low cost of this device make it very attractive for other applications.

. . . W4WKM

A Practical Six Band Ground Plane

James Young W6WAW
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The antenna described in the following article is unique in the fact that it operates with an SWR of under 2:1 on all amateur bands between 7 and 144 mc. The basic principles of the multi-band ground plane antenna are not new, but it is felt that the extended frequency coverage (20 to 1 ratio) offered by this simple antenna will prove of interest to other amateurs faced with space limitations while desiring "all band" operation.

Basically the antenna consists of a full sized wire element ground plane on the lowest frequency to be used, in this case 7 mc. To this 7 mc antenna have been added separate resonant radiating sections and radials for each successively higher frequency band. The entire antenna is then fed at a common point with a 52-ohm coaxial transmission line (either RG-8/U or RG-58/U).

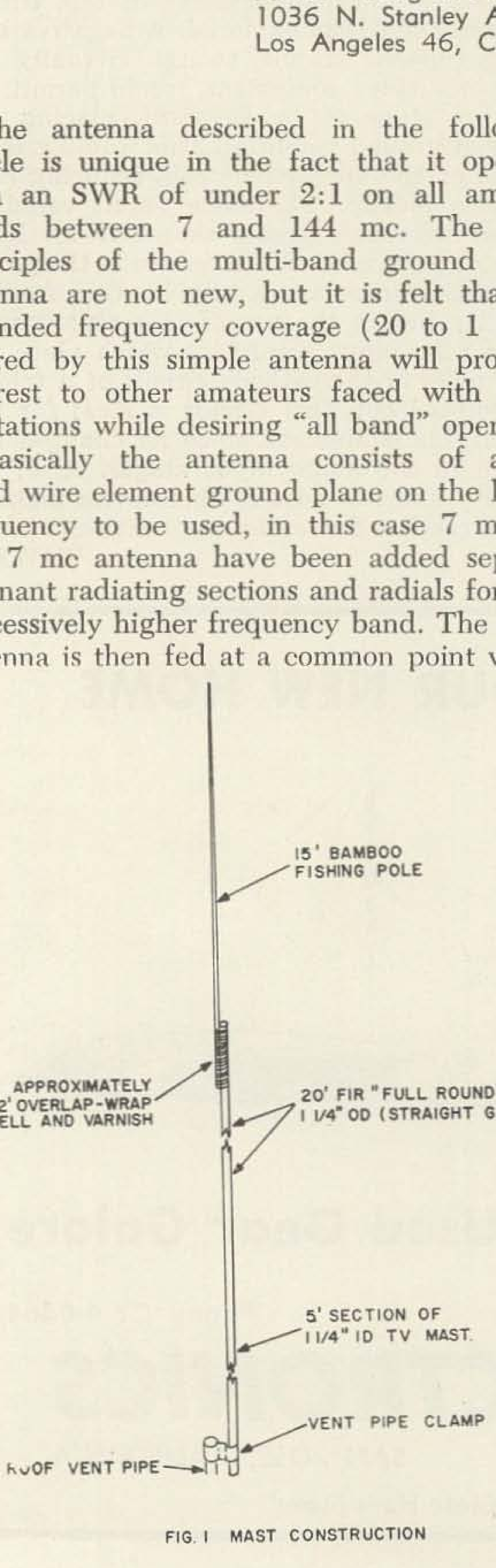


FIG. 1 MAST CONSTRUCTION

A series of tests have been conducted over an extended period at W6WAW in which operation of the ground plane was compared with a multi-band doublet antenna approximately 45 feet above ground. On the 7 mc band reports from the East Coast began to show the ground plane's advantage from the lowered angle of radiation achieved, while reports from Africa, Asia and South America have shown a consistent 12 db (two "S" units) increase in signal strength over those obtained on the doublet.

On VHF (50 and 144 mc), comparison of the multi-band ground plane's operation with two conventional single band ground plane antennas at similar height have produced exactly the same reports at distances up to 150 miles, thus the advantage to the casual VHF operator is simply one of having a single antenna for "all band" operation.

One note of caution should be observed however; as in any multi-band antenna system radiation of harmonics becomes a serious problem, thus the use of an antenna coupler between output of the transmitter and the feed line is mandatory in most cases on the lower frequencies. For VHF operation this has not proven to be a problem however, and only the normal lowpass filter has been required at output of the transmitter.

Construction and erection of the antenna will take approximately 4 hours, and can normally be completed without assistance unless you are mounting it on the roof, where a second set of hands are invaluable.

First, perform an inspection tour of the roof as this is the best spot for installation, although the antenna should work equally well at ground level provided the surrounding area is reasonably clear of obstructions. Look for a vent pipe, or similar spot for attachment of the base section. This is not critical in regards to load strength, as very little actual weight is applied to the mounting. The vent pipe (or similar support) should be approximately centered on the roof for ease in running the three sets of radials. The mast (Fig. 1) consists of three sections. The bottom section is a 5-foot length of 1¼-inch ID galvanized TV mast. The center section is a 20-foot length of 1¼-inch fir "full-round" closet pole, while the top section is a 15-foot bamboo fishing pole.

Securely lash the fishing pole to one end of the "full-round," allowing approximately 30 inches overlap. Wire may be used for this, or heavyduty fish-line, however if the latter is

used it would be wise to coat the joint heavily with spar varnish. In turn, insert the other end of the "full-round" into the flared end of the TV mast section. Now screw in three eye-bolts, 120 degrees apart, at the junction of the fishing pole and the "full-round" for the top guys (Fig. 2). A second set of three eye-bolts should also be positioned 120 degrees apart approximately at the mid-point of the "full-round."

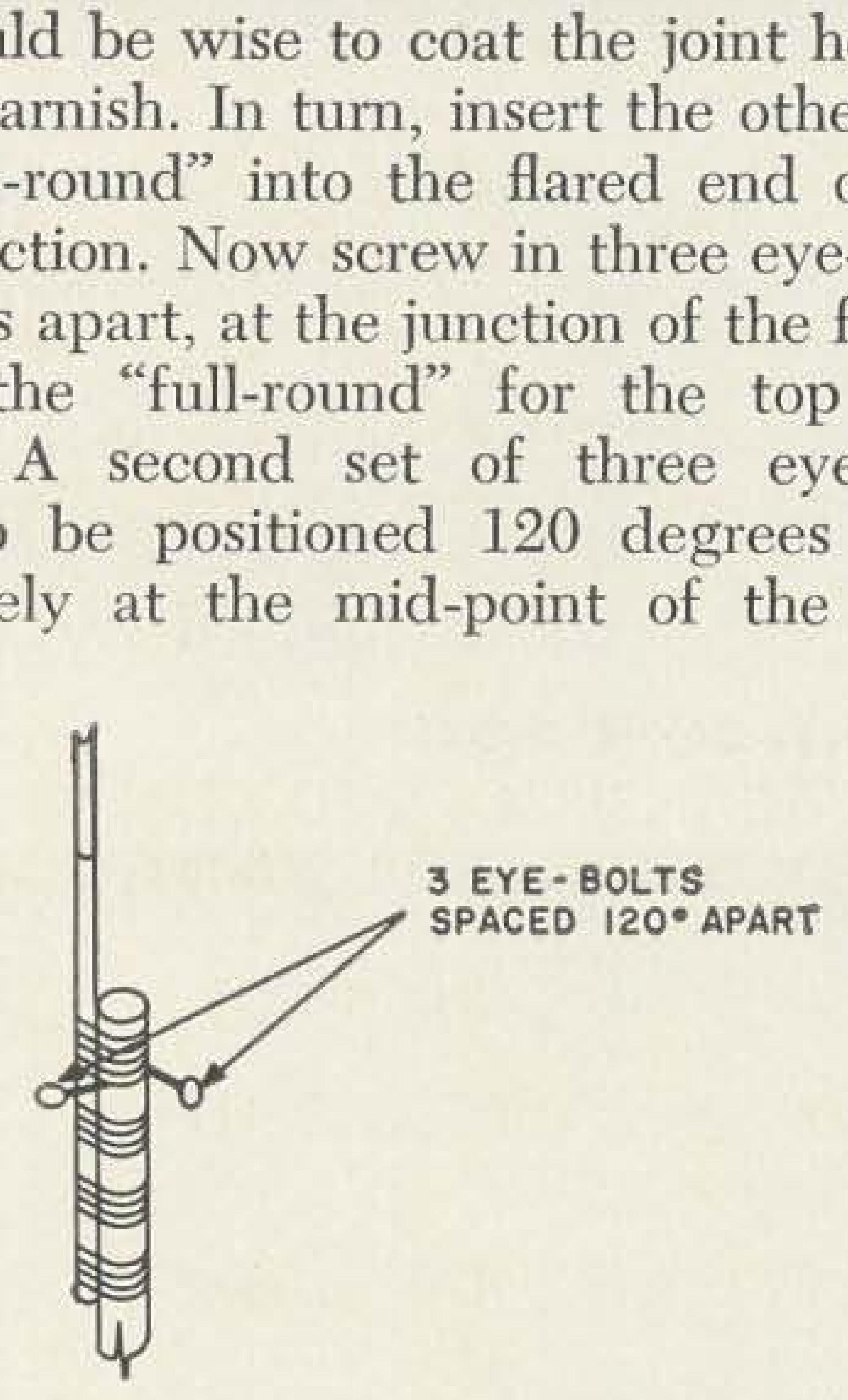


FIG. 2 TOP DETAIL

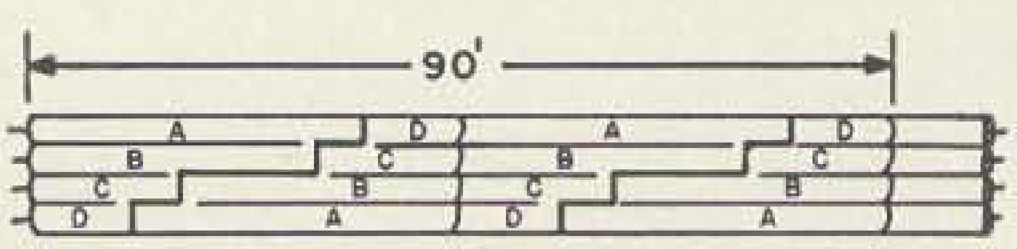


FIG 3 CUTTING DETAIL

The radiating sections, plus three sets of radials are cut from a single 100-foot section of 4-wire TV rotator cable (Fig. 3). Exact length of these sections will be dependent upon what portion of the bands you wish to operate in, however they may be easily computed from the standard ground plane formula; length = 234/f (mc) for the radiating section, and; length = 240/f (mc) for the radials. Typical element lengths are given in Table 1 for the prototype antenna constructed, and these should suffice in most cases. The completed antenna exhibits an SWR of less than 2:1 over 200 kcs at 7 mc, and less than 1.5:1 over 300 kcs at 14 mc. On all higher frequencies you can cut for the center of the band and still be under 1.5:1 over the entire band.

Attach a stand-off insulator to the "full-round" at the junction with the TV mast section, and place a water-pipe ground clamp directly below the insulator, screwing down tightly until it bites the support.

After cutting the 4-wires of the radiating

TABLE 1

Element	7 mc	14 mc	21 mc	28 mc	50 mc	144 mc
Vertical	32' 6"	16' 6"	11' 0"	8' 2"	54"	18"
Horizontal	32' 8"	16' 8"	11' 2"	8' 4"	56"	19"

section for 7, 14, 21 and 28 mc, as shown in Fig. 3, strip back the insulation at the common end and twist all 4 wires together. Install a lug at this point and solder. Tape each spot where a particular radiating section ends and attach the lug to the stand-off insulator.

Now cut the three sets of radials from the remainder of the rotator cable and prepare the same way as the radiating section. These are identical to the radiating section, except being slightly longer. The 50 and 144 mc radiating sections and radials are then made from 2-wire scrap left over. Fasten a strain insulator to the end of each 7 mc radial and attach a sufficient length of clothesline guy to permit the radials to be tied off.

Attach the 50 and 144 mc radiating section to the stand-off insulator in the same manner as that for the lower frequencies, and tape both radiating sections to the "full-round" approximately 8 inches above the insulator. Stretch the complete radiating section along the mast and tape securely every 36 inches. If the radiating section is longer than the mast, spiral wind the tape until it fits. This should not affect operating unless you wind the turns too close together.

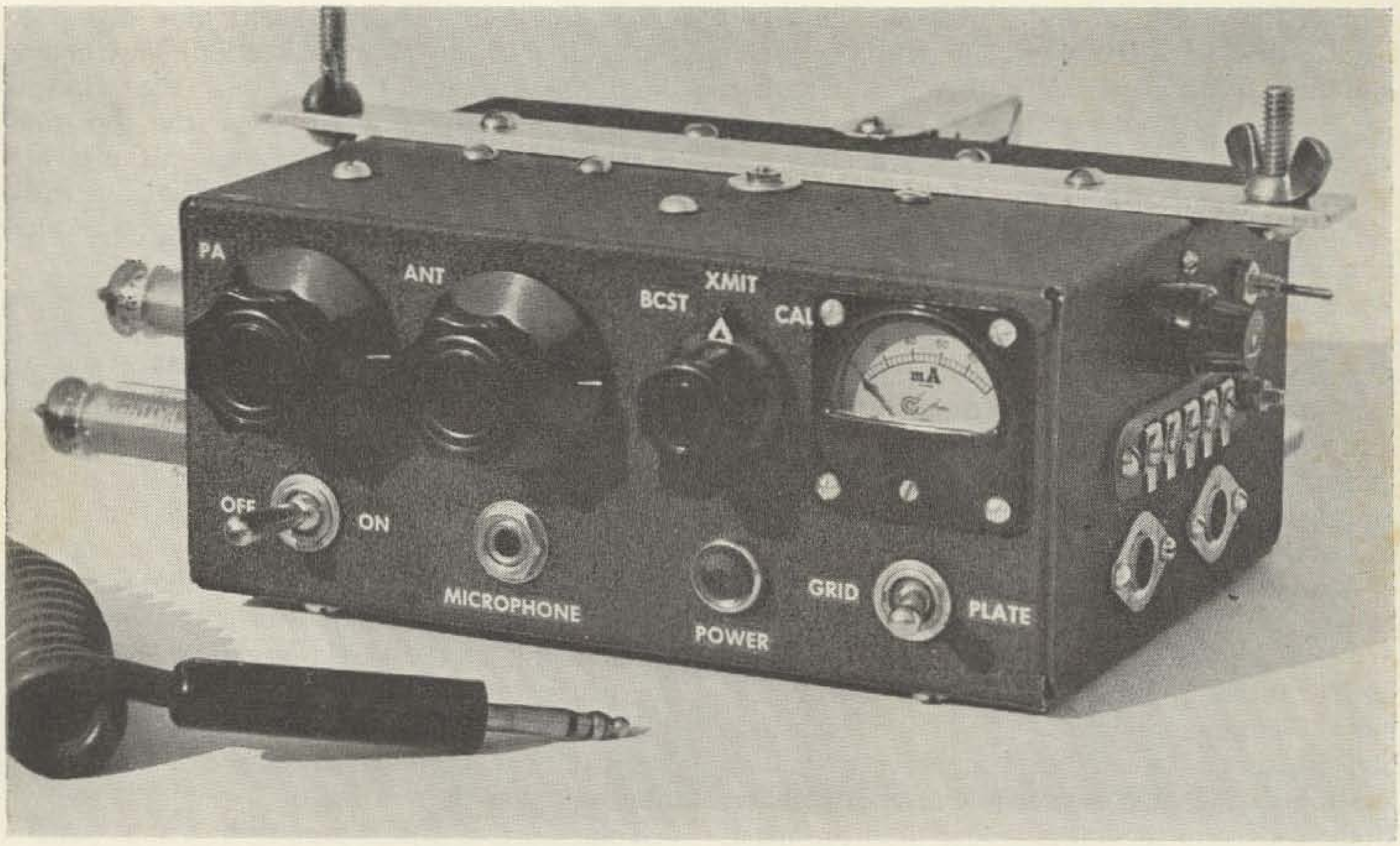
Attach the two sets of guys (clothesline works fine) and secure a vent pipe clamp to the bottom of the TV mast section. Now comes the job; *Don't* try this alone if the wind is blowing . . . Roughly tie down the top guys and walk the mast upright, slipping the clamp over the vent pipe. It should hold fairly steady while you secure the remaining guys. Once this is completed the worst is over.

Attach all three sets of radials to the water pipe ground clamp on the TV mast section and run them out approximately 120 degrees apart. The radials should slope if possible but this is not absolutely necessary. Tape the 50 and 144 mc radials to the lower frequency radials and erection of the antenna is complete.

Solder a lug to the inner conductor of the coaxial feed line and attach to the radiating section at the stand-off insulator. Similarly, solder a lug to the shield braid and attach to the water pipe groump clamp. Length of the feed line between the transmitter and antenna is not critical, however in some cases the SWR may be lowered by a bit of "pruning."

Total cost of the complete antenna (exclusive of the coaxial transmission line) should run a bit under ten dollars, and that figures out to slightly over a "buck and a half a band."

. . . W6WAW



75 Meter Mobile Transverter

Bruce Goewey WA6FPG
1931 S.E. Rainbow Drive
Santa Ana, California

Do you have a hankering for a really compact mobile rig? If so, and if you can get along with single-band AM operation, the 10-watt transverter described in this article may be exactly what you've been looking for. It offers ample power for most contacts, husky modulation, reception that is both sensitive and selective, and full push-to-talk operating convenience. Yet its cabinet measures only 3" high, 5" deep and 7" wide. This size is made feasible by external mounting of tubes, crystals and modulation transformer.

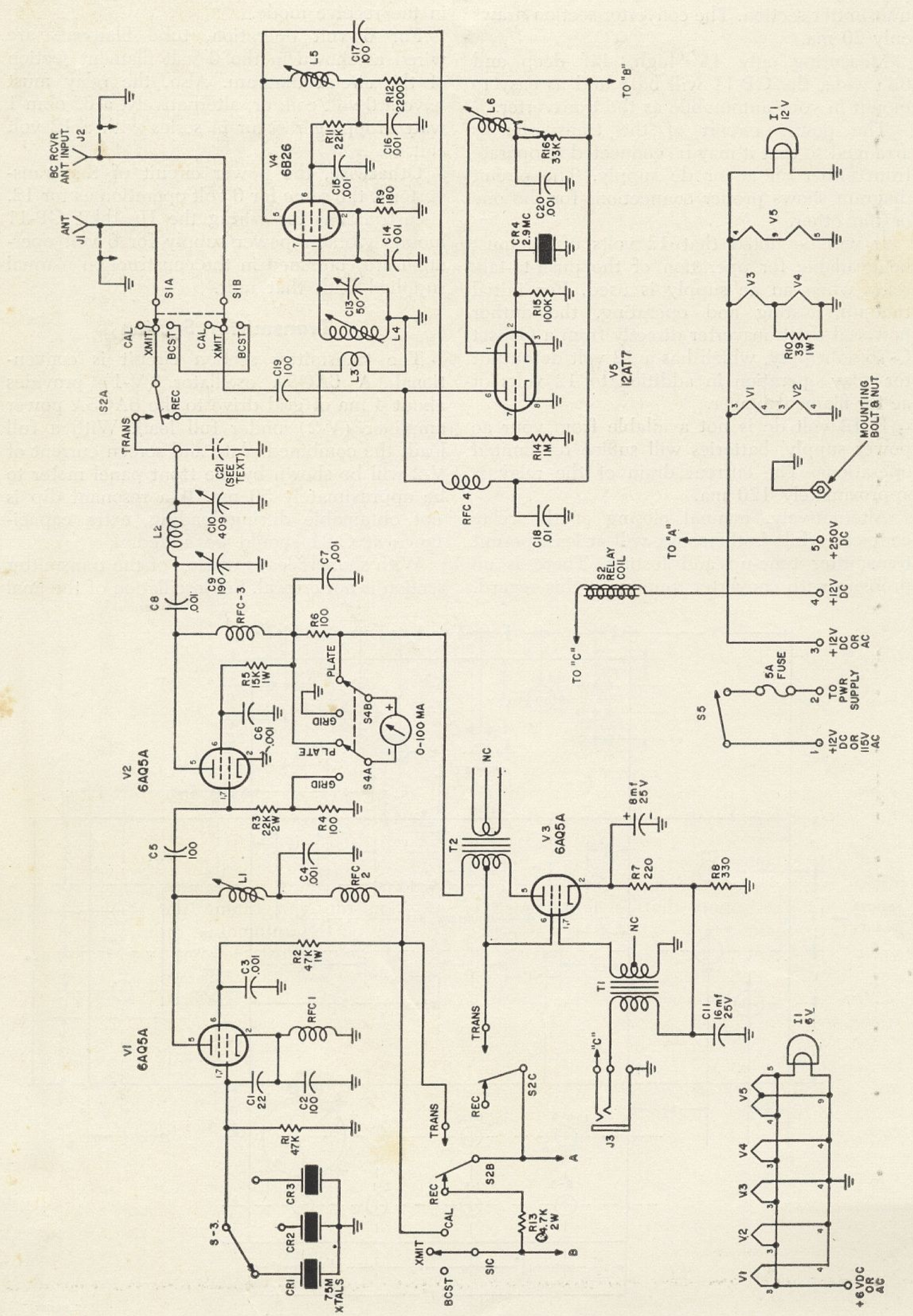
The transverter illustrated and described was designed for the 75 meter phone band because this band, in the opinion of the author, is the best for all-round mobile operations in the southern California area. With appropriate inductance modifications, however, the transverter should be equally effective on 40, 20, 15 or 10 meters.

Design features of the transverter are calculated to simplify "under way" operating procedures. Push-to-talk relay switching of B+ and antenna circuits provides basic operating convenience. Multiple crystal switching permits quick transmitter frequency selection. A front panel switch permits instant selection of either broadcast band reception or transverter operation in conjunction with a companion automobile radio. It also provides a "calibrate" position for spot tuning the transmitter frequency on the automobile radio.

Externally-adjustable slug-tuned coils in the transmitter and converter circuits permit peaking of tuned circuits after automobile installation. An externally-accessible fuse protects the entire transverter circuit and permits disabling the circuit to discourage tampering if your car must be left unlocked in a parking lot.

Power Supply

Power supply requirements are very modest. The described transverter is being fully powered by a Heathkit GP-11 mobile vibrator power supply that is tapped into the 12 volt electrical system of a Fiat 600. This power supply draws 3 amperes at its full rated output of 250 volts and 100 ma, which happens to


V1
6AQ5A
V2
6AQ5A
V3
6AQ5A
V4
6B26
V5
12AT7
CR1
CR2
CR3
7.5M
XTALS
CR4
2.9MC
R1
47K
R2
47K
1W
R3
22K
2W
R4
100
R5
15K
1W
R6
100
R7
220
R8
330
R9
180
R10
39
1W
R11
22K
R12
2200
R13
4.7K
2W
R14
1M
R15
100K
R16
33K
C1
22
C2
100
C3
.001
C4
.001
C5
100
C6
.001
C7
.001
C8
.001
C9
190
C10
409
C11
16mf
25V
C13
50
C14
.001
C15
.001
C16
.001
C17
100
C18
.01
C19
100
C20
.001
C21
(SEE TEXT)
8mf
25V
L1
L2
L3
L4
L5
L6
RFC 1
RFC 2
RFC-3
RFC 4
T1
T2
NC
0-100 MA
PLATE
GRID
S4A
S4B
S1A
S1B
S2A
S2B
S2C
S1C
S5
CAL
XMIT
BCST
REC
TRANS
ANT
J1
BC RCVR
ANT INPUT
J2
J3
TO "A"
TO "B"
TO "C"
S2
RELAY
COIL
5A
FUSE
TO
PWR
SUPPLY
+12V
DC
OR
115V
AC
+12V
DC
OR
AC
+250V
DC
MOUNTING
BOLT & NUT
I1
12V
I1
6V
+6 VDC
OR
AC

perfectly match the B+ requirements of the transmitter section. The converter section draws only 20 ma.

Measuring only 4⅝" high, 4⅛" deep and 6½" wide, the GP-11 will be found as easy to mount in your automobile as the transverter.

The power circuit of the transverter is arranged so that it may be connected to operate from either an ac or dc supply. The circuit diagram shows proper connections for the one or the other.

It will be noted that 12 volts of dc must be available for operation of the push-to-talk relay when an ac supply is used. For initial tune-up, testing and operating, the author powered the transverter directly from a Gonset G-76 ac supply, which has a 12 volt dc output for relay operation in addition to 12 volts of ac for filament power.

If 12 volt dc is not available from your ac power supply, batteries will suffice for limited operations. The current drain of the relay is approximately 120 ma.

Alternatively, manual closing of the relay contacts, while bothersome, will at least permit transmitter tune-up and testing. There is no problem with converter tune-up in this regard, of course, since the relay coil draws no power in the receive mode.

For 6 volt operation, tube filaments are wired as shown in the 6 volt filament section of the circuit diagram. Also, the relay must have a 6 volt coil; or, alternatively, a 62 ohm 1 watt dropping resistor in series with a 12 volt coil.

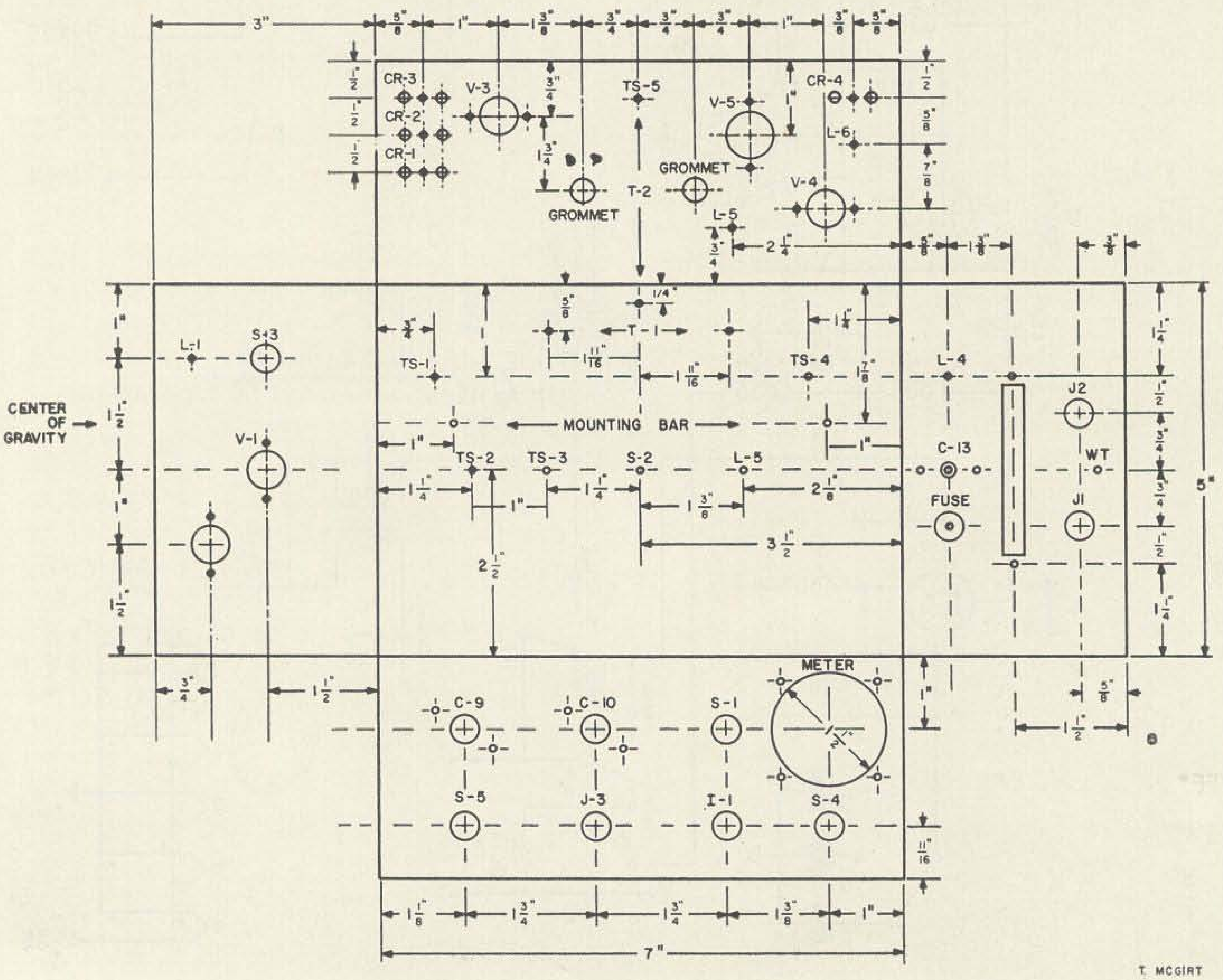
Otherwise, the power circuit of the transverter is the same for 6 volt operation as for 12.

Instructions for wiring the Heathkit GP-11 mobile vibrator power supply for 6 volt operation are contained in the construction manual supplied with that unit.

Transmitter Section

The transmitter section circuit is conventional. A 6AQ5A oscillator (V-1) provides about 4 ma of grid drive to the 6AQ5A power amplifier (V-2) under full load. With a full load, the combined plate and screen current of V-2 will be shown by the front panel meter to be approximately 50 ma. If a resonant dip is not obtainable during loading, extra capacitance at C-21 should be added.

With short rf leads, wiring of the transmitter section is not critical. Self-oscillation of the final



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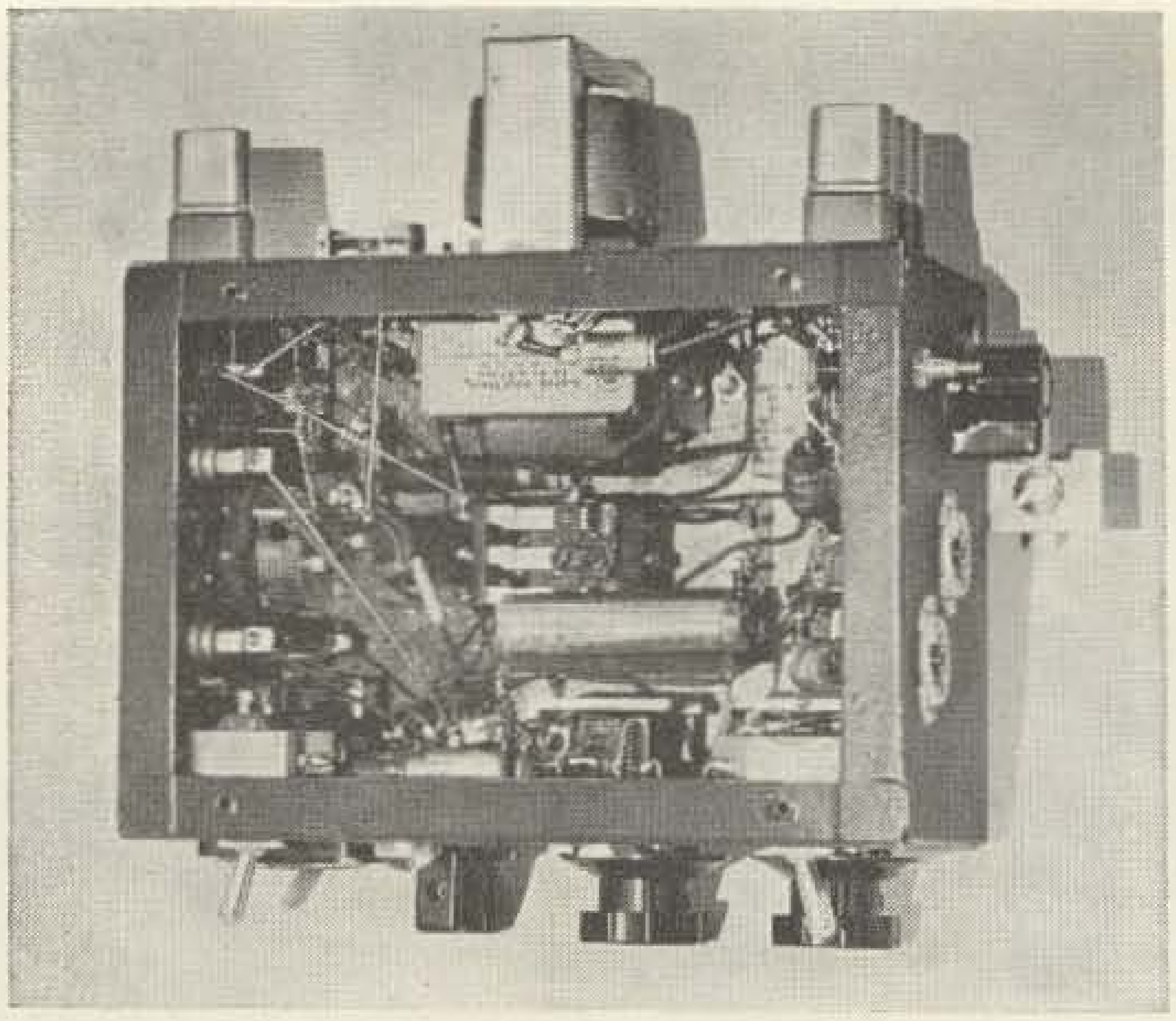


may occur, however, if the cathode of V-2 is not tied to chassis ground as directly as possible. A ground lug under the nearest socket retaining nut can be positioned so as to permit the socket cathode lug to be bent down and soldered almost directly to chassis ground. Also, grid and plate leads of V-2 should be kept separated as much as possible.

L-1 (as well as L-3, L-4, L-5 and L-6 in the converter section) were wound on slug-tuned forms, using the cut-and-try method in conjunction with a grid dip meter. If a grid dip meter is not available, manufactured coils such as those designated in the parts list will ensure required resonances.

Modulator

High level plate and screen modulation is achieved through use of a 6AQ5A (V-3) that is biased for Class A operation and driven by a push-to-talk high output carbon microphone. Voltage developed across R-8 provides the dc power required by the microphone.

Use of a carbon microphone eliminates the need for space- and power-consuming preamplifier and modulator driving stages. Also, a good quality carbon microphone provides excellent voice frequency "punch" that is optimum for cutting through QRM and QRN during mobile operations.

Converter Section

The converter section is also conventional. The oscillator is crystal controlled at 2.9 mc. Mixing with incoming signals between 3.8 mc and 4.0 mc, this oscillator frequency spreads the 75 meter phone band between 900 kc and 1100 kc on an automobile radio, which functions as a tunable *if* amplifier for the converter output.

Wiring of the converter section is not critical, but, as in the case of the transmitter section, all leads carrying rf should be kept short. Use VHF wiring techniques and you'll not go wrong.

As with any converter, if a local broadcast station with considerable power is located between 900 and 1100 kc, some degree of feed-through of its signal at its normal position on the broadcast receiver dial may be experienced while the converter section is operating. A simple wave trap mounted between and below the antenna input and output jacks (as shown by "WT" on the layout diagram) will be effective to suppress the interference.

Use a North Hills 64 to 105 uh slug-tuned coil (No. 120-G), or equivalent, with a 270 mmfd mica capacitor parallel-connected at the lug end of the coil. Wire the trap in series with the lead running from S-2A to L-3. Tune by adjusting the coil slug until the offending broadcast feed-through signal is nulled.

The maximum null point is very sharp, so it is best to visually adjust for it while feeding the output of the converter section into an S-meter equipped receiver that will tune the broadcast band.

Construction of the transverter is simplified by the external mounting of tubes, crystals and modulation transformer. This arrangement permits a "straight-line" circuit layout for almost all rf components, and ensures low ambient temperatures, and thus long life, for all cabinet-enclosed components.

A standard 3" by 5" by 7" aluminum chassis with bottom plate is used for the cabinet. Holes can be drilled, punched, filed to size, or "nibbled," depending on the metal working tools you have on hand.

The physical layout diagram shows the location of all mounted parts. Retaining screw holes for which dimensions are not given can best be located by using the component to be mounted as a template (tube sockets, meter, etc.).

After all holes in the illustrated converter were finished, the cabinet was given two spray coats of charcoal gray wrinkle finish varnish (about 20 minutes between coats). The cabinet was then placed in a kitchen oven. The baking heat was turned on full and the oven door was left in the ajar position to permit observation. After some 8 to 10 minutes, the varnish wrinkled. A minute or so later, the cabinet was removed and allowed to cool. The cabinet was safe to handle (carefully) at this point, but no furthre work was done on it for several hours to ensure that the wrinkle finish had dried to a point of maximum hardness.

Decals on the front panel were positioned after all chassis-mounted components were in place. Despite the wrinkle finish, decals adhere satisfactorily.

Tube sockets should be mounted so that pins 1 and 7 (1 and 9 in the case of V-5) face in the direction of the arrows shown on the layout diagram socket holes. Ground lugs should be mounted under socket retaining nuts as needed—that is, wherever placement will permit the shortest possible ground connections for associated components.

Five terminal strips are used to facilitate placement of certain components. Mounting holes for these are indicated on the layout diagram by "TS-1," "TS-2," etc. The terminal strips are used as follows:

TS-1 (two lugs, one grounded): mounts R-8 and C-11; ties associated leads.

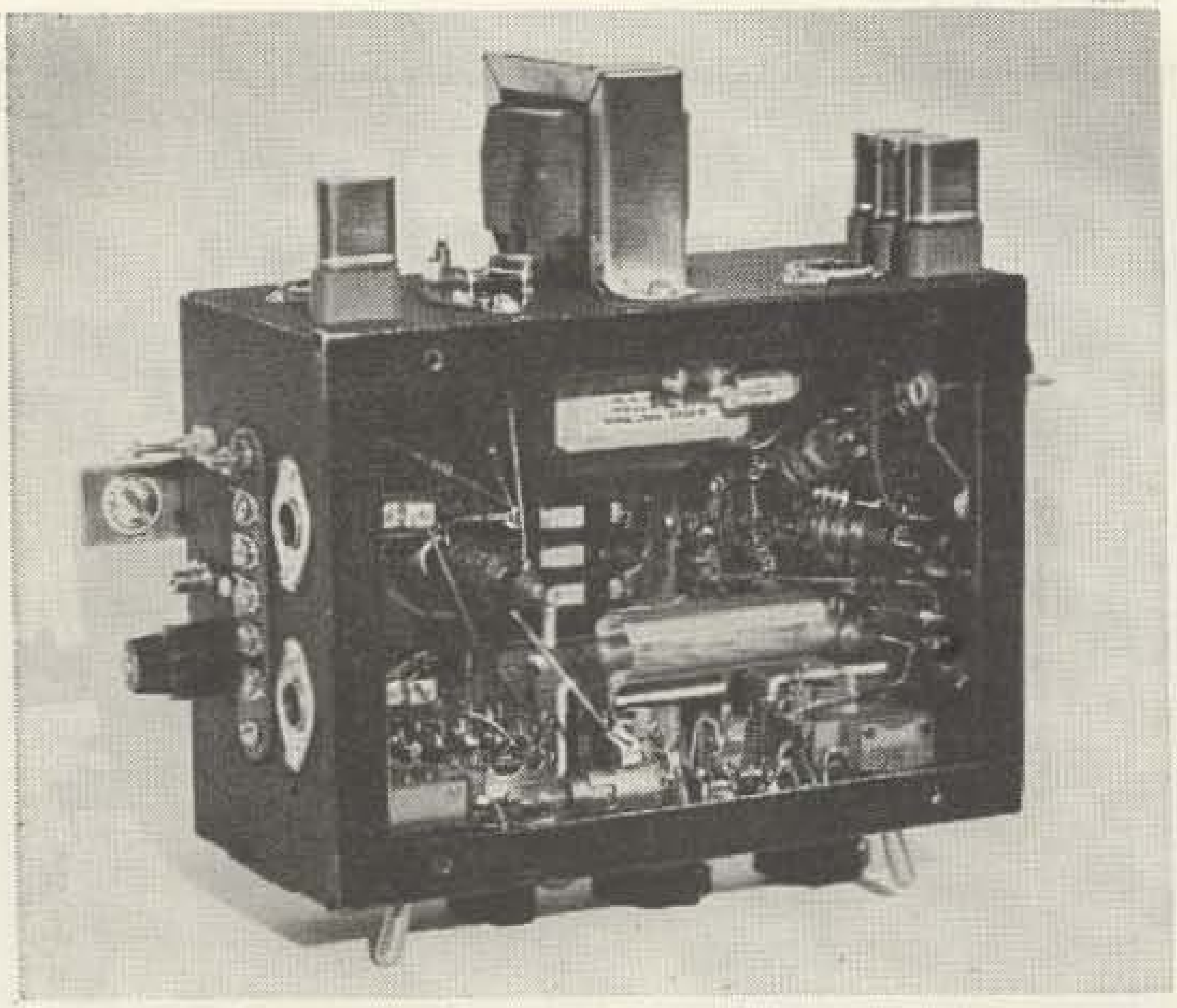
TS-2 (four lugs, one grounded): mounts R-6 and C-7; ties RFC-1, RFC-2, RFC-3, R-2, R-5 and associated leads.

TS-3 (two lugs, one grounded): mounts R-4; ties R-3 and associated lead to S-6A.

TS-4 (two lugs, one grounded): ties R-13 B+ input lead, and B+ lead to S-1C.

TS-5 (two lugs, one grounded): ties C-12 to ground and T-1 primary lead to a lead that runs under the flange of the cabinet to J-3.

Non-rf carrying leads such as those for



filaments, switches, and so on, can be tucked away out of sight under the bottom flange of the cabinet.

L-2 will be sufficiently self-supporting if its leads are wrapped and soldered tightly around the ends of ¾" lengths of bus bar. The unsoldered ends of the bus bars may then be soldered directly to terminal lugs on C-9 and C-10.

It will be noted from the parts list that L-2 is used as is. There is no need to remove turns or otherwise modify the coil.

The mounting bar shown in the photographs of the transverter is located at the center of gravity of the cabinet, thereby facilitating proper mounting. It measures ¾" by 9", clearing all component mounting screws in the cabinet by a comfortable margin.

As shown in the photographs, it is necessary to bend down one mounting flange of T-2 to permit it to be secured to the top surface of the cabinet.

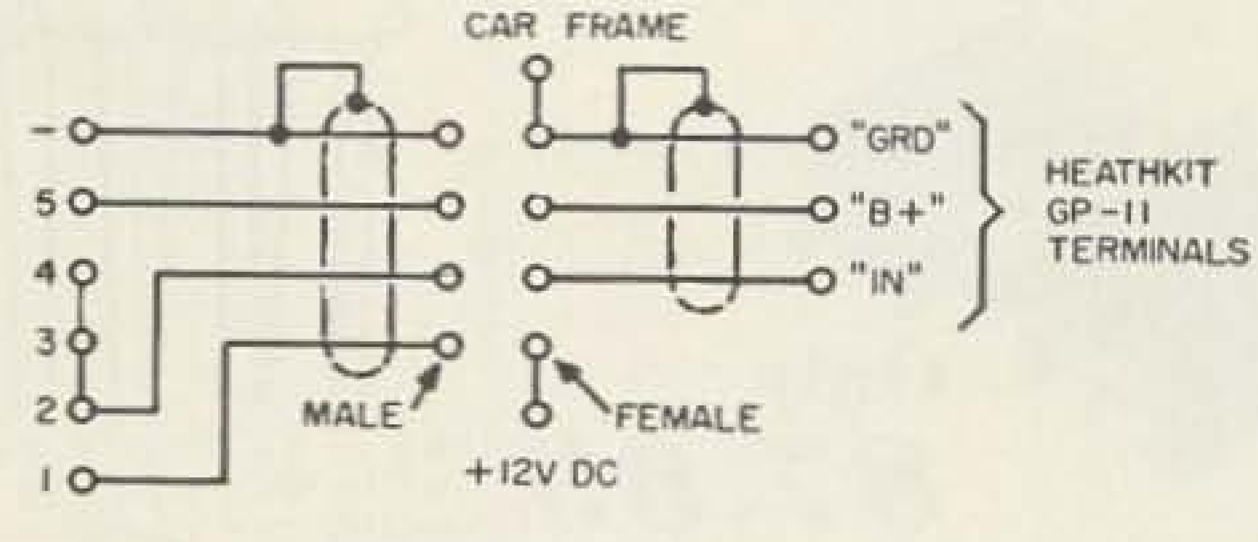
The two screws appearing farthest forward on the top of the cabinet in the front view photograph, incidentally, are merely hole plugs. The chassis used by the author originally mounted a home-brew power supply and the holes in question proved excess to transverter needs.

Tuning Procedures

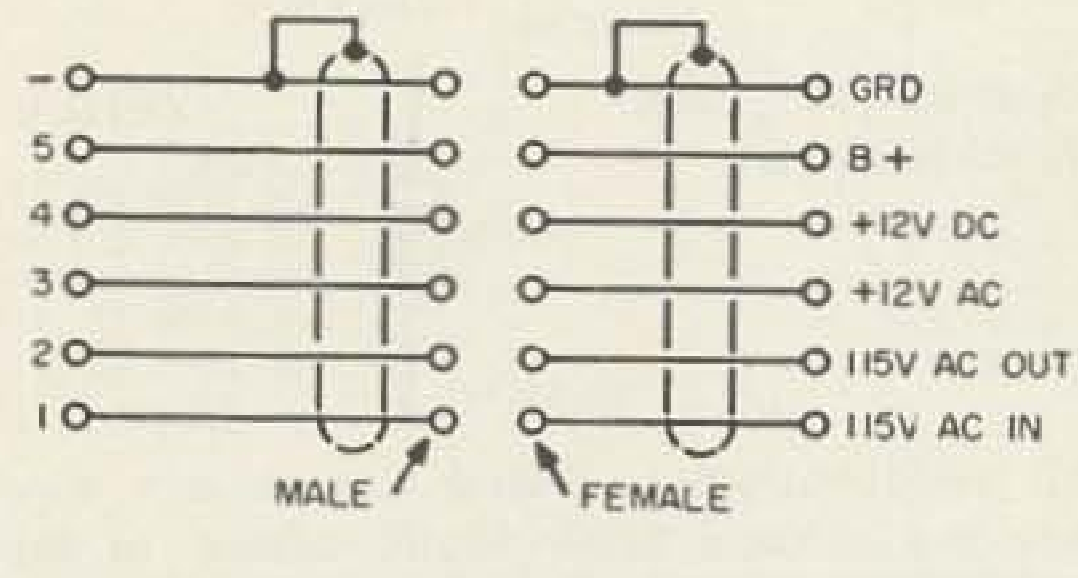
Peaking of L-1 prepares the transmitter section for on-the-air operation. Preferably, a crystal in the vicinity of 3.9 mc should be used for this purpose, or a VFO tuned to this frequency. Place S-1 in the "calibrate" position and switch S-6 to read final grid current. Then peak L-1. About 6 to 8 ma should be indicated by the meter. This will drop to 3 to 4 ma when the final is loaded.

To ensure that L-1 is in fact tuned to the 75 meter phone band it is well to check the fundamental frequency with a communications receiver, comparing the output with that of the second harmonic. The second harmonic should be noticeably weaker.

The pi-network tuning capacitors C-9 and C-10 are tuned in normal fashion to put the transmitter section on the air. Use of a dummy antenna is recommended (by the FCC) for initial tune-up and testing.



DC SUPPLY CONNECTIONS



AC SUPPLY CONNECTORS

T M

The first step in tuning the converter section is to adjust L-6 for proper oscillation action. The simplest way to do this is to tune a communications receiver to 2.9 mc and adjust L-6 until oscillation occurs. Adjust for peak output consistent with rapid starting of oscillation upon application of plate power.

If a signal generator is available, set it for approximately 3.9 mc. With a broadcast receiver connected to the transverter, tune for the 3.9 mc signal in the vicinity of 1000 kc on the broadcast receiver dial. Once tuned in, peak L-5 for maximum output. Then set C-13 to half-capacitance and peak L-4. Once L-4 is adjusted, C-13 may be used for subsequent antenna peaking.

If test equipment is not available, the converter section can be satisfactorily tuned by using an on-the-air signal within the 75 meter phone band. Oscillator action will be evidenced by a rushing sound in the broadcast receiver as L-6 is tuned to resonance. Once oscillation has been achieved, look for a signal and then peak L-6, L-5 and L-4, as described above.

An S-meter on the broadcast receiver will, of course, facilitate tune-up of the converter section irrespective of whether test equipment or an on-the-air signal is used.

Parts List

All fixed capacitors are disc ceramic except C-11 and C-12, which are miniature electrolytics, and C-17 and

C-19, which are tubular ceramics

All resistors are ½ watt unless otherwise indicated on circuit diagram

- **C-9**—409 mmf variable, midget TRF type, with 9 rotor plates removed to reduce capacitance to about 190 mmf (Allied Radio 61 H 009)
- **C-10**—409 mmf variable, midget TRF type (Allied Radio 61 H 009)
- **L-1**—36-64 yh slug-tuned coil (North Hills 120-F)
- **L-2**—Air wound coil, 32 turns per inch, ⅝" diameter, 2" long (Miniductor 3008)
- **L-3**—12 to 16 turns of No. 28 d.c.c. wire at cold end of L-4
- **L-4**—36-64 μh slug-tuned coil (North Hills 120-F)
- **L-5**—64-105 μh slug-tuned coil (North Hills 120-G)
- **L-6**—105-200 μh slug-tuned coil (North Hills 120-H)
- **S-1**—4 pole, 3 position, non-shorting, single gang rotary switch (Mallory 3243J) (one pole not used)
- **S-2**—12 volt DC, 3 pole, double throw relay switch (Potter & Brumfield KA14 D)
- **S-3**—2 pole, 3 position, non-shorting, single gang rotary switch (Mallory 3243J) (one pole not used)
- **S-4**—Double pole, double throw toggle switch
- **S-5**—Single pole, single throw toggle switch
- **RFC-1, -2, -3**—2.5 mh, 200 ma radio frequency choke (Miller 6302)
- **RFC-4**—10 mh, 125 ma radio frequency choke (National R-100U)
- **T-1**—Single button carbon microphone input transformer to push-pull grids, ratio 1:64 primary to secondary (stancor A-4742) (secondary center tap not used)
- **T-2**—14,000 ohm, 10 watt fixed impedance output transformer (Stancor A-2312) (secondary not used)
- **J-1, J-2**—Motorola-type auto radio jack
- **J-3**—Military-type jack for PL-68 plug (Little-Jax C-12B)

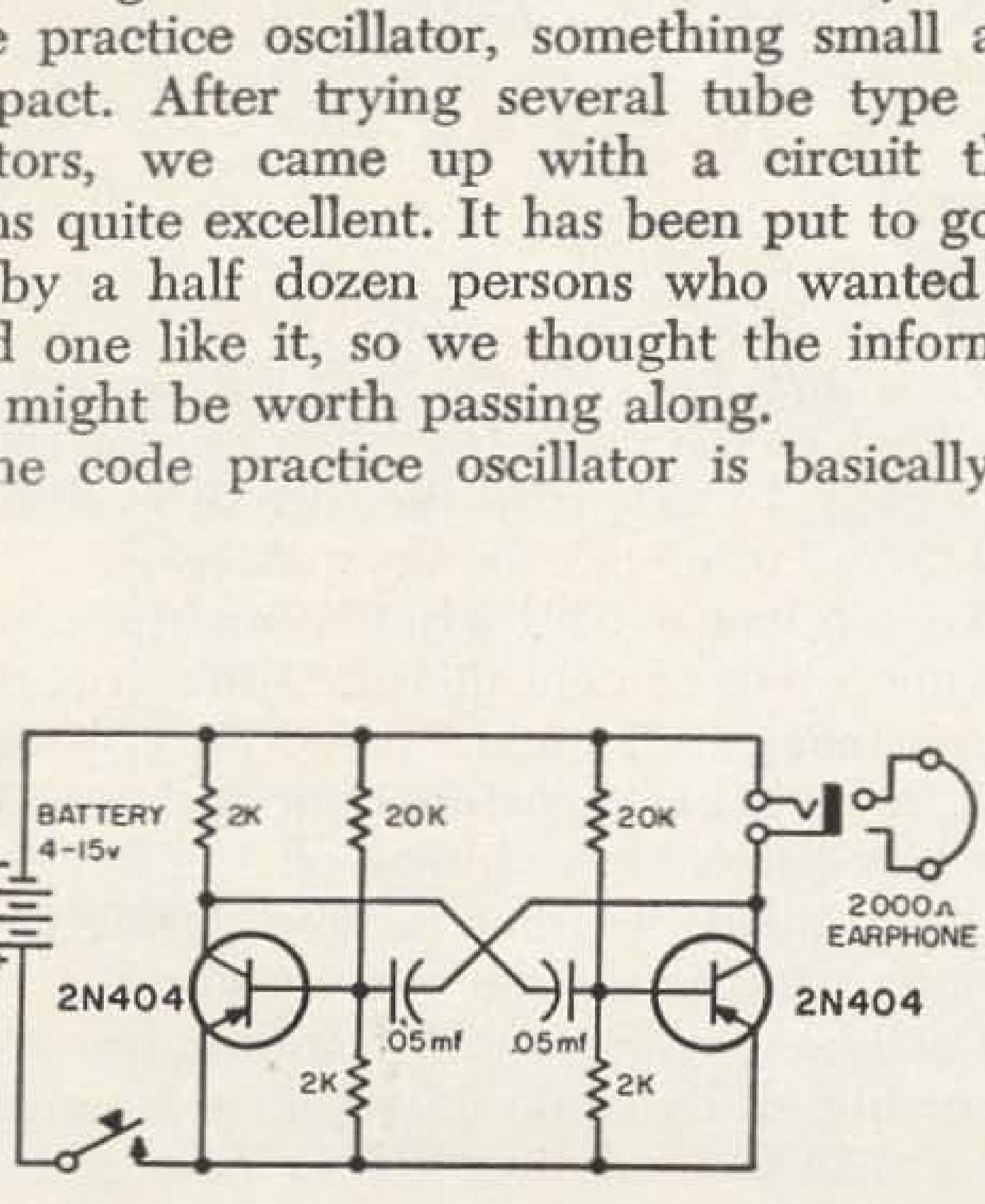
. . . WA6FPG

Transistor C P O

Anthony Savicky W3JYL
and
Robert Buzzard W3RRV

Having helped a neighbor and several of the fellows that we work with get their Novice and Technician licenses, we decided to build something a bit different in the way of a code practice oscillator, something small and compact. After trying several tube type oscillators, we came up with a circuit that seems quite excellent. It has been put to good use by a half dozen persons who wanted to build one like it, so we thought the information might be worth passing along.

The code practice oscillator is basically a



transistorized free running multivibrator generating a square wave signal at an audio frequency rate rather than the conventional audio sine wave oscillator that is normally used for code practice. The multivibrator produces a higher amplitude output than is ordinarily obtained from the same transistors generating a pure sine wave. The square wave signal has a higher harmonic content, resulting in a crisp tone very closely resembling the output of a communications receiver tuned to a good CW signal.

The capacitance coupling between the two transistors cause them to alternately switch from a heavily conducting to a non-conducting state. Transistor Q1 going into conducting will cause Q2 to be cut off for a definite period of time and vice-versa. The rate of switching (the multivibrator frequency) is determined by the resistance (20K) and capacitance (.05) of the circuit. The values given will cause the frequency to be in the proper audio range.

The unit is housed in a 2¼" x 2¼" x 4" aluminum mini-box. Two phone jacks are mounted on the box, one for the key and one for the headphones. The "chassis" is a terminal strip 2" wide and with six sets of terminals. All the components were mounted and soldered. The two terminals on one end were bent in slightly to hold the battery in place. The "chassis" was mounted on ½" insulated stand-offs and then secured to the mini-box. An Eveready #504 (15 volts) was used three to four hours a day for a week and showed no appreciable drop in the volume.

Rummaging around in the junk box, we came up with a small speaker with an output transformer which we hooked in place of the phones. The volume was enough for the unit to be used in a 9 x 12 room with five people copying code.

. . . W3JYL & W3RRV

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The Knight-Kit T-150

a test report

AT THE RISK OF HAVING the Hon. Ed. shake his old gray head in dismay over the corruption of the younger generation, I must admit that the Knight T-150 transmitter kit appeared this summer just in time to cause me to shelve plans for a home brew 150 watt rig at K9PWT. Since the T-150 is a new piece of equipment and is not yet too widely known, I have prepared a table of condensed specifications which appears elsewhere in this article.

The rf circuitry begins with a 12BY7 in a Clapp VFO, developing output voltage across one of three tank circuits: 3.5 mc (80M), 7.0 mc (40-10M), or 8.3 mc (6M). The next stage is a 6CL6 buffer which also serves as a modified Pierce oscillator when crystal control is desired. In this case the 12BY7 is disabled and 3.5, 7.0, or 8.3 mc crystals used.

Next in line is a 7189 buffer/multiplier stage driving a pair of neutralized 6146's in parallel. All rf stages are cathode keyed for CW operation. A 2.2K bias resistor connected across the key jack keeps high voltage off the key terminals and allows current to flow during key-up periods, stabilizing the power supply.

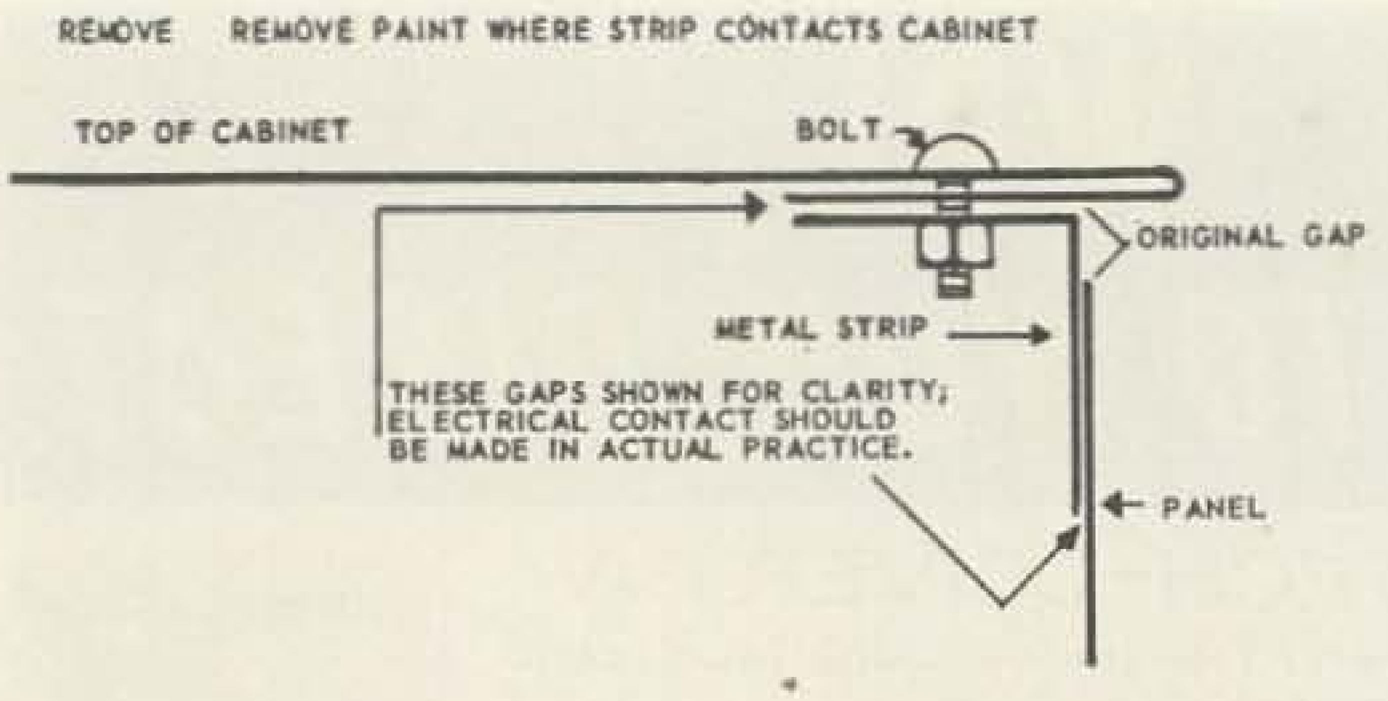
For phone work, audio voltage from a crystal or high-Z dynamic microphone is amplified by a 12AX7 and coupled to one grid of a

6DR7 twin triode modulator. A portion of the cathode voltage of the second half of the latter tube is applied to the 6146 screens to provide screen modulation with a type of carrier control. The operator at the other end of a QSO will report wide fluctuations in his S-meter reading, which is typical of controlled-carrier reception.

The power supply employs two solid state diodes in a voltage doubler, thereby saving both space and filament power, and eliminating a major source of heat.

Inspecting the 36 page assembly and operating manual, we find a page of illustrated soldering instructions and one of parts photographs; these are especially valuable in the sorting of the various types of machine screws, solder lugs, etc. There is also a page containing the resistor color code and photos of the common types of capacitors, and even a list of common CW abbreviations! Knight's usual enlarged assembly drawings are of course included. The schematic bound in the manual is 8½ x 11 and perfectly legible.

Evidence of the T-150's recent birth is provided by three supplementary sheets included with our manual. Two of these are devoted to minor circuit changes (2 resistors have been changed in value—the new components are



packed with the kit) and supplementary tuneup instructions, while the third contains additional comments on VFO alignment. To round out the manual we note three suggested methods of VFO calibration, operating instructions, a resistance-check chart, trouble-shooting hints, a circuit summary, and a parts list. However, we noticed that the tuneup instructions (which will be covered in detail later) did not mention explicitly the plate meter indications to look for when using the type of controlled-carrier/screen modulation employed in the T-150. Briefly, the story is this: while the final power input ratings are the same for both AM and CW, the AM rating refers to peak envelope power input[1], which is not followed by the plate meter. Call the plate current when tuned up for maximum CW output I milliamps. Then on AM, the no-signal plate current is about ½I, and the meter should kick up on voice peaks to around ⅔I. Any attempt to get more indicated power input by cranking up the gain control will only result in splatter as peak clipping sets in. Of course, an outboard clipper will help to raise the average modulation percentage.

In addition, we should mention for the record one typographical error in the manual: page 9, 12th construction step—"S-1A" should instead read "S-1B."

Actual construction time was 20½ hours, broken down roughly as follows: preliminary mechanical assembly—3 hrs.; wiring—16½ hrs.; final wiring check—1 hr. VFO calibration took less than one additional hour. No effort was made to rush construction. Most of the following notes on construction were made while assembling the kit.

The VFO tuned circuit components are mounted on a 2-piece subchassis for added rigidity and convenience in prewiring. The rotary switches used for band, xtal/VFO, and function switching are prewired before installation in the chassis. Perhaps this technique could be extended to some of the tube sockets, as there are a few tight spots in the layout. A pencil-type iron is indispensable here.

During the later stages of construction, L-shaped support brackets are temporarily screwed to the chassis to prevent damage to topside components when the transmitter is inverted for wiring. These are removed before installation in the cabinet.

There exists the possibility of momentary confusion when it comes to the identification of the multiplier tank coils, two kinds of coil identification being employed in our kit (although the manual indicates that one or the other will be used exclusively in the future). The surest way to avoid trouble here, and the best advice for any kit builder, is simply *read the entire manual and inspect the parts before starting construction.*

The only physical aspect of the transmitter in which I feel improvement could be made is the matter of rf shielding. The T-150, like its low-power predecessor the T-60[2], employs a one-piece wraparound cabinet fastened to the rear chassis apron with self-tapping screws; these provide the only positive contact between the chassis/panel assembly and the cabinet. In our kit, normal production tolerances permitted a gap to exist between the top of the recessed panel and the top of the cabinet when the transmitter was assembled. This provided a fine unwanted slot antenna. The most direct way to remedy this is to use a strip of electronic weatherstripping or aluminum angle stock placed so as to bear on the panel and cabinet after assembly, thus sealing the gap. See sketch. No TVI has been noticed with this seal.*

A welcome feature of the T-150 is the inclusion of provisions for an external plate modulator for those wishing to realize maximum output power. All necessary circuit connections are brought out to an octal socket at the rear of the chassis, and the manual includes details of the hookup required. (Remember to include the screen current if you use plate modulation). Similarly, an 11-pin socket provides switched 117 vac for an external antenna relay, a pair of terminals for externally controlled transmit/receive switching, and power connections. Voltages supplied to the pins are 700 vdc @ 50 ma, 300 vdc @ 50 ma, and 6.3 vac @ 0.5 a. This assortment is particularly attractive for the powering of a signal monitor of the Simplescope type[3]. In addition, an adaptation of Pafenberg's breakin and push-to-talk circuit[4] appears to be quite feasible.

The tuneup procedure is somewhat different from that usually employed with pi-net trans-

*Mfgr's. Note: K9PWT reviewed an early production of the T-150. Present units do have top of panel fastened to case, plus extensive added internal shielding. Present owners can obtain added shielding from Allied no charge.

mitters. The panel meter can be switched to read buffer grid current, final grid current, final plate current, and relative output. For relative output measurements, a sample of the rf output voltage is rectified and applied to the meter. After tuning the oscillator and buffer tank circuits to obtain maximum buffer and final grid currents respectively, the meter is switched to Relative Output. Now one of two procedures is followed, depending on whether operation will be on 6M or 10-80M. For 10 through 80, the Function switch is set to AM and the Final Tune and Load controls are simultaneously adjusted for maximum indicated output. The Function switch is then thrown to CW and the operation repeated. You are then ready to plug in your mike or key and get on the air.

On 6M, after tuning up in the AM position the capacitance of the Load capacitor is decreased enough to bring the key-down plate current to 250 ma. The Final Tune control is then adjusted for maximum indicated output.

Notice that the familiar "dip and load" procedure has been eliminated. Knight points out that maximum power output may possibly not occur at the plate current dip. The "Final Plate" position of the meter switch, besides being used in 6M tuneup, is employed in making sure that the plate current does not exceed 250 ma at maximum output. If it does, the buffer tank can be detuned slightly to bring it back down.

The entire tuneup procedure takes longer to describe than it does to perform. As I did not have an rf wattmeter available when testing the rig, the trusty light bulb dummy load was pressed into service to check the manufacturer's claims of output power. On 80-15M, the T-150 drove a 100 watt bulb to nearly full brilliance; on 10 and 6 it did a very creditable job with a 60 watt bulb. It appears that the Knight people know whereof they speak.

The rig is unusually handsome. The panel is two-tone gray with mirror-finish trim, while the cabinet is a medium gray hammer-tone. Meter and VFO calibrations are white on black, and the control knobs have aluminum disc inserts. A touch of color is provided by the red pin jacks used as a front panel crystal socket. The philosophy of the panel design seems to be to assign knob sizes in proportion to frequency of use during an operating session. A result is that the Function (i.e., transmit/standby) switch has a medium-sized knob which stands out from the five small knobs aligned with it along the bottom of the panel. This can be a great boon at the conclusion of a hard night's operating.

The T-150 has been in operation at K9PWT for only a short time. However, I can say that it has proven fully satisfactory for a controlled-carrier rig of the 150 watt class. I have not checked the VFO drift rate (Knight claims 200 cps in 20 minutes after a 10 minute warm-up), but I have held 45 minute QSOs without having to touch the knob to get back on frequency. As should be evident by this time, I think Allied Radio Corp. and the Knight-Kit division have come up with a fine low-cost transmitter in the T-150. . . . K9PWT

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[2]73 Tests the Knight T-60 Transmitter, W4WKM, March 1962, 73.

[3]The Simplescope, WϕOPA, p. 10, September 1961, 73.

[4]Break-in and Push-to-talk for the Knight T-60, W4WKM, p. 58, August 1962, 73.

CONDENSED SPECIFICATIONS

Frequency Coverage:	80-6 meters crystal or self-contained VFO.
DC Final Input:	150 watts on 80-10 meters; 100 watts on 6 meters, CW or controlled-carrier phone.
RF Output Power:	90 watts on 80-15 meters; 55 watts on 10 meters; 40 watts on 6 meters.
AC Power Required:	115 volts nominal; 180 watts on standby, 280 watts on AM, 350 watts on CW.
Output Circuit:	Pi network, matches 40-600 ohm load.
Size:	8½ x 17 x 10½ inches, height x width x depth; 28 lbs.

Scopes and Such

Staff

Undoubtedly, you've heard about using a scope to monitor modulation level. If you're an SSB addict, you might even have one in your shack. But do you know just how much you can actually see with a simple scope?

For instance, did you ever check your carrier for harmonics, using the scope? Or measure the *other fellow's* modulation (a good way to lose contacts rapidly, we might add, if you give honest reports)?

Other uses include determination of proper operating bias (even for AM transmitters), tracking down of parasitics, neutralization of the transmitter, and determining the proper impedance match between the modulator and the final. Except for the technique of measuring modulation percentage at the receiver, all of these things can be accomplished easily with a completely basic scope; by swiping high voltage from the transmitter power supply, you can build a perfectly adequate instrument for almost pennies (later on, we'll tell you how).

For a start, though, let's examine these various uses of the scope.

In checking out transmitters, you have a choice of three basic types of screen pattern. They are the trapezoid (most popularized), the wave-envelope, and the block.

The trapezoid, obtained by applying modulated rf from the rig's output to one pair of the scope's plates and audio from the modulator to the other pair, is basically a picture of the relationship between instantaneous af voltage and the corresponding rf output voltage. A typical pattern showing 100 percent modulation with no transmitter troubles appears in Fig. 1.

The wave-envelope, obtained by applying modulated rf from the rig to one pair of plates as before but feeding a regularly recurring sweep voltage (such as 60-cycle ac from the power lines) to the other pair, is more a picture of individual audio cycles as they are transmitted. Fig. 2 is a typical pattern showing clean, 100 percent modulation.

The block, not so well known as the other two patterns, is obtained by applying rf output (either modulated or unmodulated) from the rig to one pair of plates. The other pair is fed a recurrent sweep voltage, which again may be 60-cycle ac from the power line. The difference between the wave-envelope display and the block display of a modulated wave is that the modulating frequency should not be greater than four to five times the sweep frequency for a wave-envelope, but should be at least 10 to 12 times sweep frequency for a block.

The trapezoid and wave-envelope patterns are useful primarily for checking modulation percentage, operating bias values, locating parasitics, and determining proper modulator-to-final impedance matching.

The block pattern, though it may be used to determine modulation percentage at the 50- and 100-percent points, is useful primarily for finding harmonics in the radiated carrier.

Neutralization may be checked with either the trapezoid or the wave-envelope patterns, but is most easily done with a special hookup which is described farther down in this article.

To show more clearly the hookups for getting the three main types of patterns, Fig. 3 details the connections for each. Note that in each case, the rf is shown connected to the vertical plates. The scope will work just as well with rf on the horizontal plates, but the pattern will be rotated 90 degrees to the right or left, from that shown in the illustrations.

If you get patterns which appear drastically different from the illustrations, such as those in Fig. 4, you probably have phase problems. Try getting the audio voltage from a different point; this will usually solve the problem.

Let's examine the carrier for harmonics first; connect the scope for the block diagram and fire up with unmodulated carrier. Then look at Fig. 5, where approximations to the pattern you'll see are shown (since the block appears as a rectangle of light, it can't be shown accurately on the printed page).

If the pattern you see is like that at the left of Fig. 5, a rectangle of light bright at the upper and lower edges and without streaks inside, your carrier is relatively free of harmonics.

If, however, your pattern resembles that at the right of Fig. 5, with irregularly spaced bright horizontal streaks within the light rectangle, you have some checking to do. The carrier is badly harmonicized, and you're courting FCC troubles.

Now, without changing the setup, apply modulation. Just talk into the mike, if you like (no need for sine-wave input at this stage). Streaks, similar to those caused by harmonics, should appear. Absence of the streaks indicates that you have no "talk power."

If you get a single bright line dividing the pattern in half horizontally, you're in business: this indicates 100 percent modulation. Two lines dividing the screen into thirds indicates 50 percent modulation, and a greater number of lines indicates even lower modulation percentage.

However, to measure modulation percentage more accurately, you'll have to switch over to the trapezoid pattern. With the trapezoid, you need a steady sine-wave input (but 60-cycle from a filament line is okay) to provide a steady pattern on the screen if you're going to measure accurately. For a rough indication, you can just talk. But no whistles, please!

To get an accurate measurement of modulation percentage, measure the vertical edges of the pattern. You can use millimeters, inches, or any other units you prefer. When you have measured both edges, take the sum and the difference of the two measurements. Divide the difference by the sum, multiply by 100, and the result is your modulation in percent.

Thus, if the left edge of your pattern is 1 inch high and the right edge is ⅛ inch, call your unit of measurement eighths of an inch. The sum becomes nine and the difference 7. Dividing 7 by 9 gives you 0.7777777. Multiplying by 100 gives you the answer: 77.77 percent modulation.

This is the main use of the trapezoid pattern by most of us who use scopes at all; however, it can tell you much more. If the final isn't modulating properly, the trapezoid pattern will show you exactly what's wrong. Fig. 6 shows some typical "problem" patterns; the letters in the following paragraphs refer to patterns in Fig. 6.

If you don't have enough grid drive, the output can't be linear on the positive peaks of audio. The resulting trapezoid is shown as A; the bulge outwards on the narrow end indicates lack of drive.

Over-drive, or too much bias, produces a pattern almost the opposite, with an inward curve (B).

A combination of too little drive and too much bias produces the pattern of C; this is

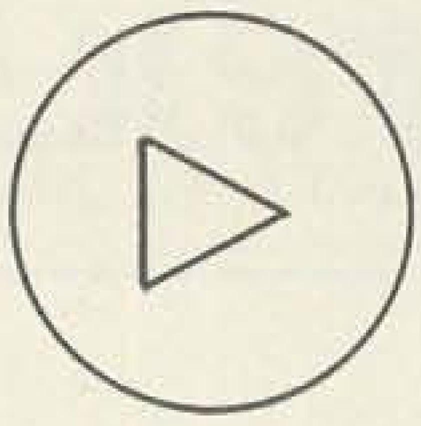


FIG. 1 NORMAL TRAPEZOID PATTERN

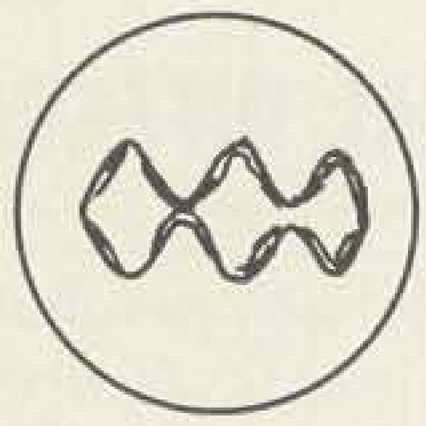
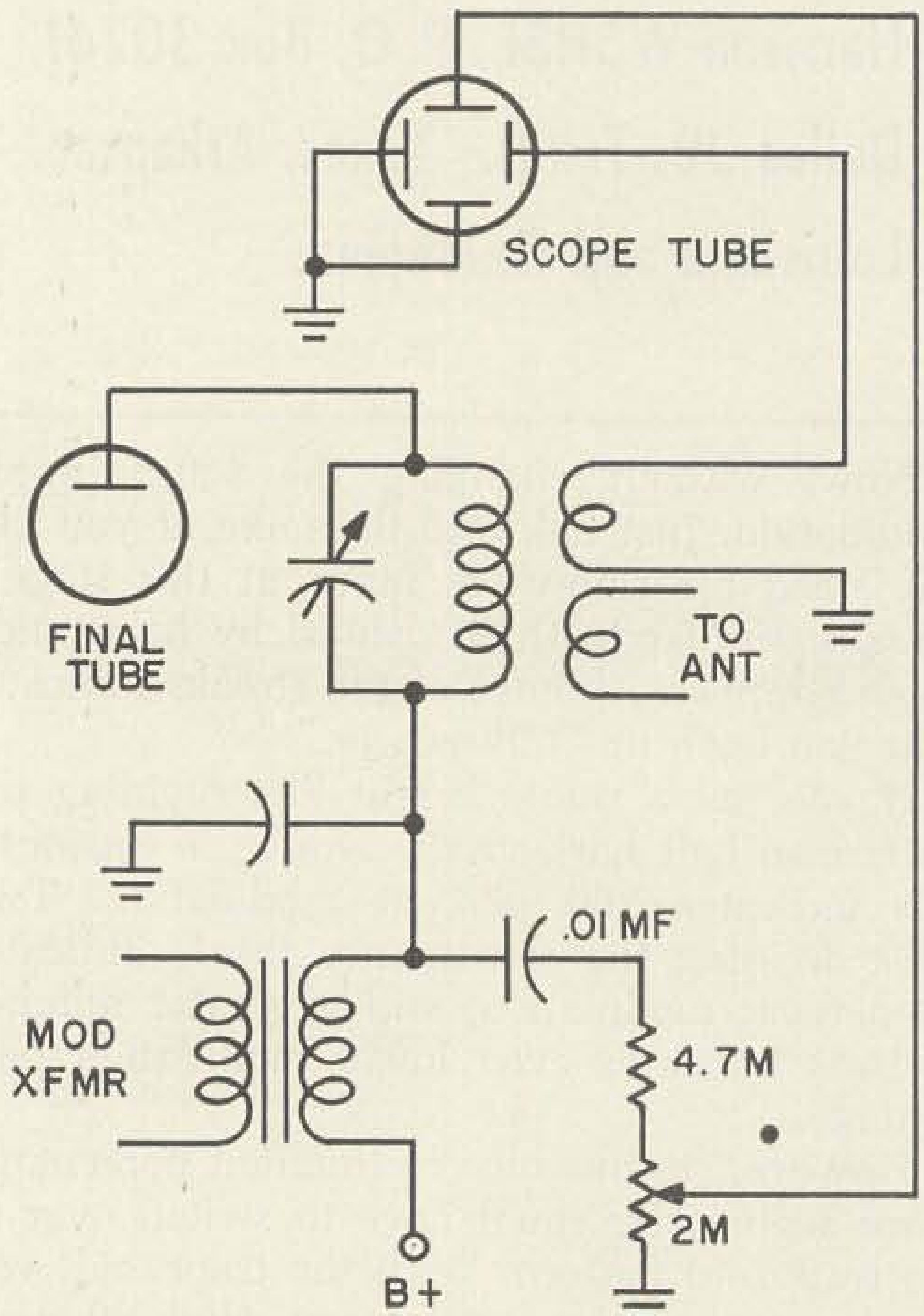
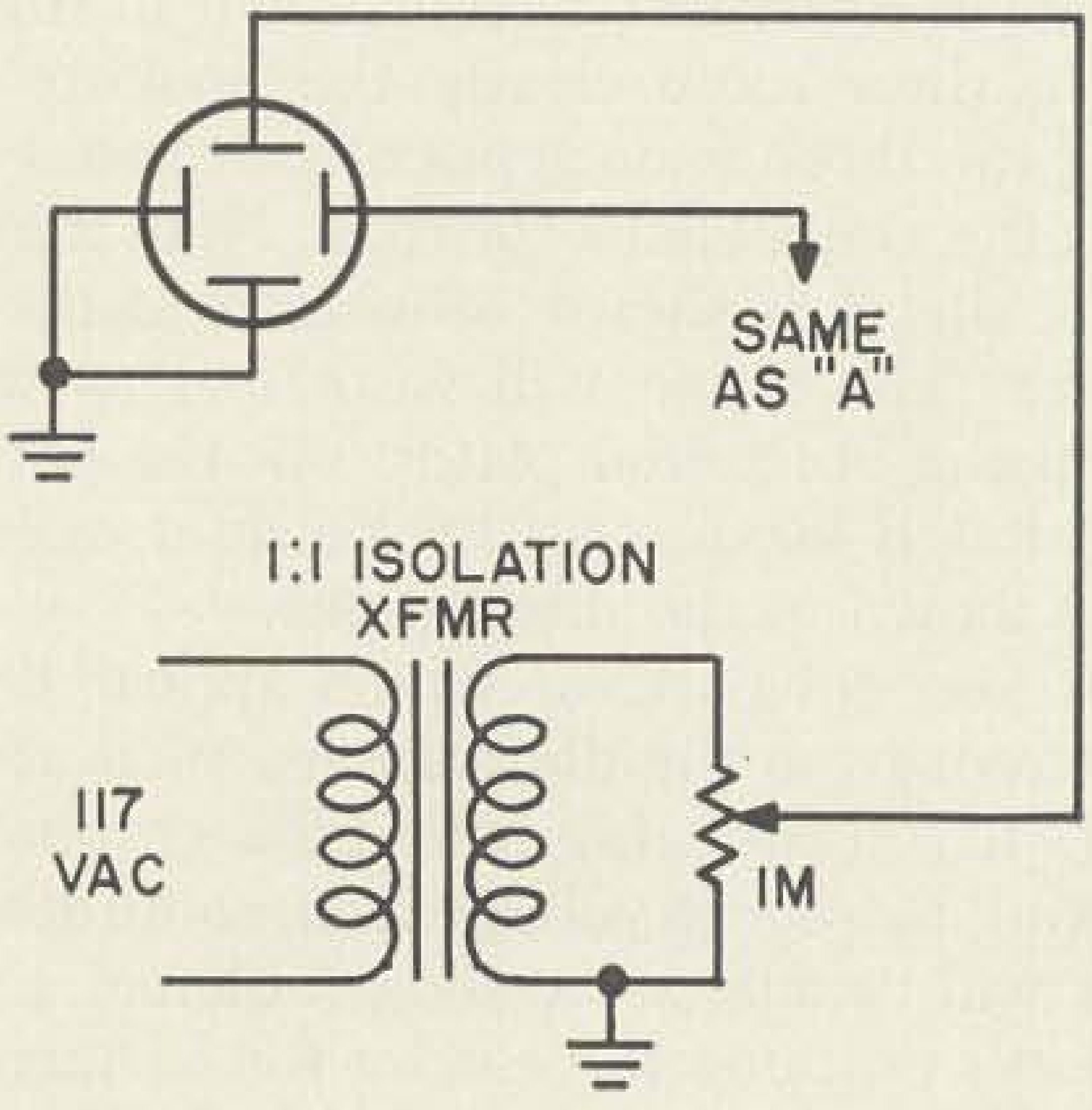


FIG. 2 NORMAL WAVE-ENVELOPE PATTERN



"A" TRAPEZOID HOOKUP



"B" WAVE-ENVELOPE HOOKUP (MODULATE WITH 180 CPS SIGNAL)

"C" BLOCK HOOKUP — SAME AS "B" BUT MODULATE WITH 1 KC SIGNAL

FIG. 3. SCOPE HOOKUPS

similar to the over-modulation pattern of D, but close examination shows the difference. The over-modulation pattern has straight sides and a narrow tip; the over-bias under-drive pattern has curved sides and a wider, sloping tip.

Not all the troubles are traceable to bias and drive. Parasitics are frequently troublesome in AM rigs; even when they're absent under CW conditions, they may appear during portions of the audio cycle and break the modulation up so badly that it's unreadable.

An example is shown in E; this rig is breaking into oscillation at the peaks of the audio cycle. Although the pattern is reasonably clean during most of the cycle, the sharp pip at the left indicates the oscillation; the on-the-air effect may range from "splatter" to complete unreadability, depending largely on the frequency of the parasitic.

Another example appears in F. This time, the oscillation starts as the audio cycle starts upward, but stops at the audio peak. The emitted signal would be completely unreadable.

Many such examples could be shown, but the most general way to look at it is this: if you get a pattern showing a sharp pip anywhere in it, look for a parasitic or two.

If the trapezoid pattern fails to show you what's wrong, the problem is probably distorted

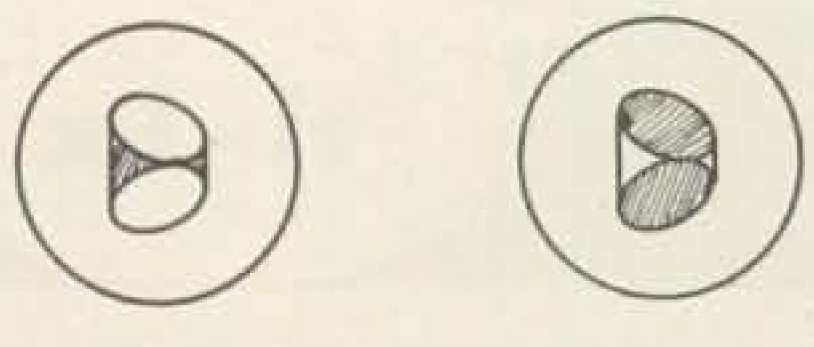
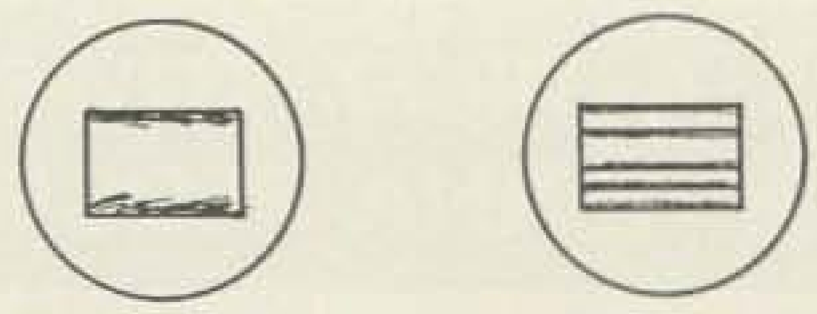


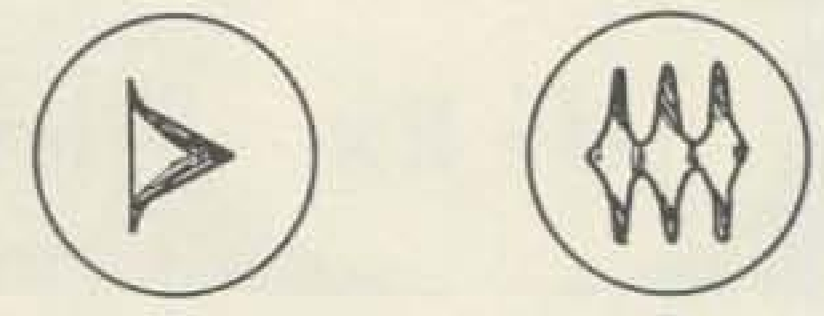
FIG. 4 TYPICAL OUT-OF-PHASE TRAPEZOID PATTERNS



HARMONIC-FREE CARRIER

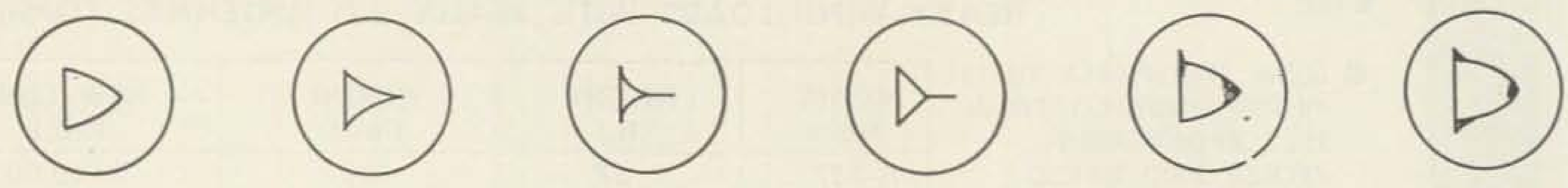
CARRIER WITH BAD HARMONICS

FIG. 5 CARRIER BLOCK PATTERNS



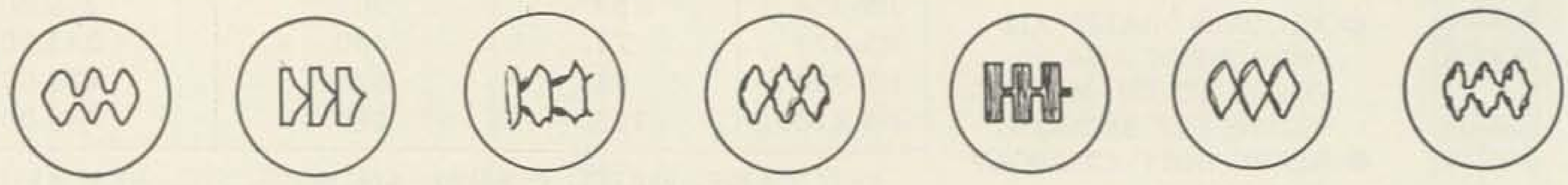
A B

FIG 8. IMPERFECT NEUTRALIZATION DISPLAYS



A B C D E F

FIG. 6 TYPICAL "PROBLEM" PATTERNS



A B C D E F G

FIG. 7 TYPICAL WAVE-ENVELOPE PATTERNS.

audio. The trapezoid pattern, being a picture of the modulating process itself, doesn't care about the *shape* of the modulating signal. It gives the same picture for square waves or sine waves, providing the final operates in the same manner for each. This is the time to switch over to the wave-envelope pattern.

Like the trapezoid, the wave-envelope pattern requires a sine-wave input. Its frequency should be three to five times that of the sweep, and they should be synchronized so that the pattern displayed is stationary.

For best results, a service-type scope with a sawtooth ("linear") sweep is recommended, since with this instrument you can get a true picture of your sine-wave input.

If everything is working right, you should get a pattern that looks something like Fig. 7-A. However, if everything *was* right you probably wouldn't be going to the trouble of using the wave-envelope presentation.

So the other patterns in Fig. 7 are typical representations of some common and not-so-common difficulties as displayed in the wave-envelope pattern.

Shown at B is the display resulting from an over-driven speech-amplifier stage. At C is another display resulting from the same cause but with a much lower percentage of modulation.

Overdriving the *first* speech-amplifier stage resulted in the pattern shown in D, while "saturation" operation of a speech amplifier caused E. The pattern at E, incidentally, is typical of audio-clipper patterns and—if controlled—is not a defect. Without proper filtering, though, such an audio signal produces rf signals many, many kc wide!

Unbalance of a push-pull modulator will show up looking like F. Note the non-symmetrical sides of the peaks, and the sharp "V" at the valleys. Overdriving of the modulator stage itself may show up as in G, or may look the same as E.

A while back, we mentioned using the trapezoid and wave-envelope patterns to check neutralization. Fig. 8 shows some typical patterns of this sort. The trapezoid is shown at A (note similarity to Fig. 6-E) and the wave-envelope pattern at B. If you leave the scope hooked up permanently to measure and check modulation, these patterns can show you how your neutralization is at the same time.

But a simpler way of doing it is to make a special scope hookup. Fig. 9 shows how. The Vertical input of the scope is hooked through blocking capacitor C1 to the plate of the stage being neutralized, while the Horizontal input is hooked through blocking capacitor C2 to the grid.

With plate voltage to the stage turned *OFF* but all other operating voltages (except screen, in the case of tetrode and beam-power tubes!) applied, first tune the grid circuit to obtain maximum horizontal deflection of the scope trace. Next, tune the plate circuit to obtain a horizontal ellipse such as that shown in Fig. 10 at I. Finally, tune the neutralizing adjustment to obtain a single-line horizontal trace (II, Fig. 10).

If the output contains a fair percentage of second-harmonic energy, you won't be able to get the straight-line display of II. Instead,

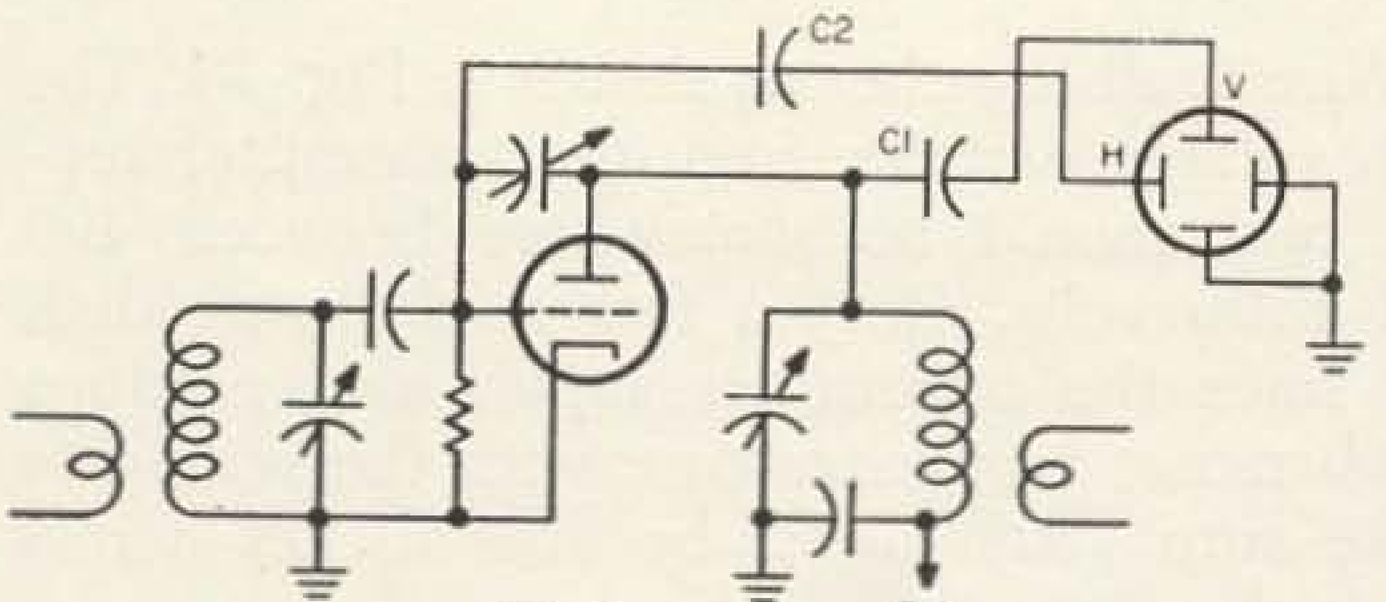


FIG. 9

FIG 10

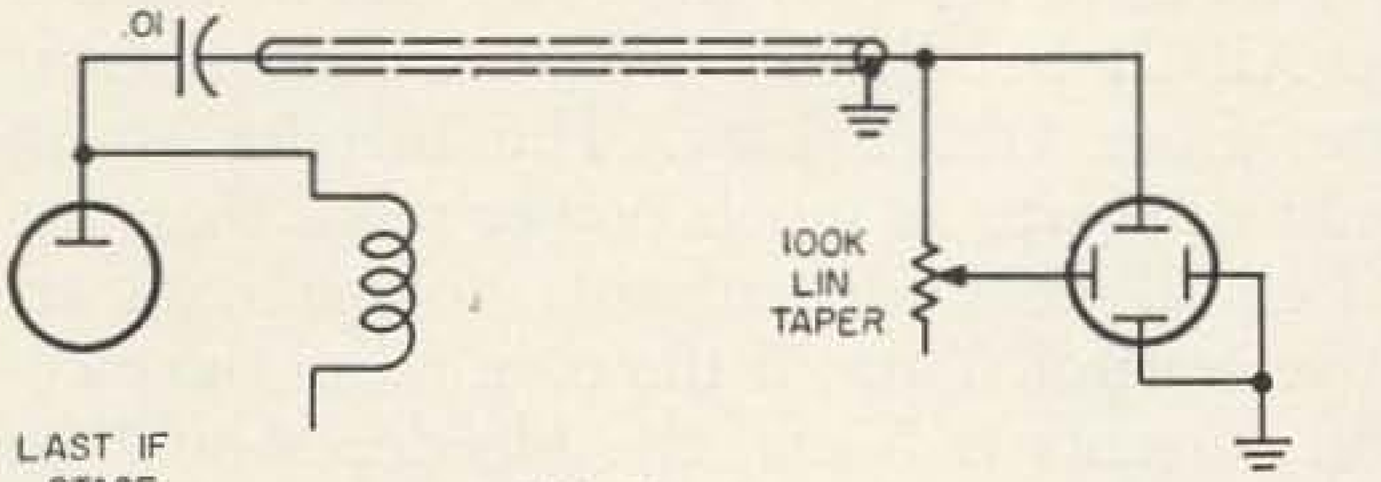


FIG. 11

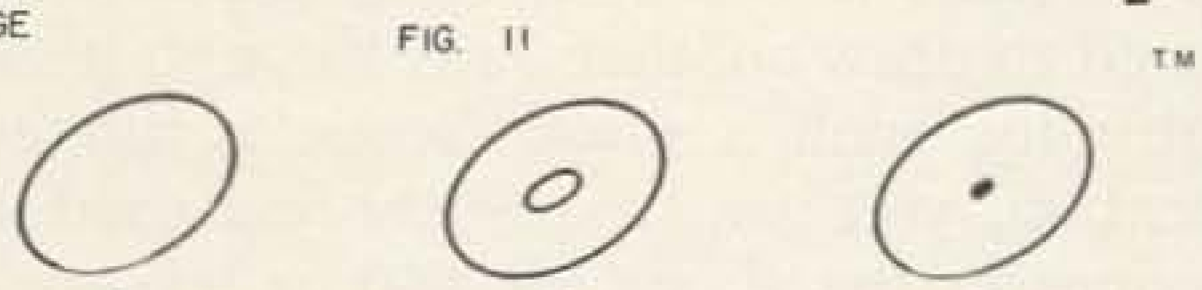


FIG. 12

you'll get the "infinity" sign of III when neutralization is proper.

If the plate tank is not properly tuned, your ellipse will be tilted to one side or another, as in IV.

The hookup for measuring the other fellow's modulation at the receiver has been published before, but is still not widely used. It is similar to the trapezoid display but shows up as a "doughnut" on the screen. Only one connection to the receiver is required.

Make the connections as shown in Fig. 11, to the final *if* stage of your receiver. Then tune in a steady, unmodulated carrier, such as the signal from a frequency marker oscillator, and adjust potentiometer R to get an ellipse such as A in Fig. 12. This completes the set-up.

Tuning across your favorite band, you'll find that the ellipse appears sharp only when you're turned to an unmodulated carrier. Modulation makes the sharp line blur into a ribbon, or a "doughnut of light" on the screen. When modulation reaches 100%, the dark spot in the center (or the hole of the doughnut) vanishes as the edges touch. Overmodulation replaces the dark spot with a bright patch of light.

To measure modulation of an incoming signal in percent, measure the inner and outer diameters of the doughnut at its widest point. Take the sum and difference, divide the difference by the sum, and multiply by 100. But be cautious about giving modulation reports with this system, since an alarming number of signals on the air today carry only 10 to 25 per-

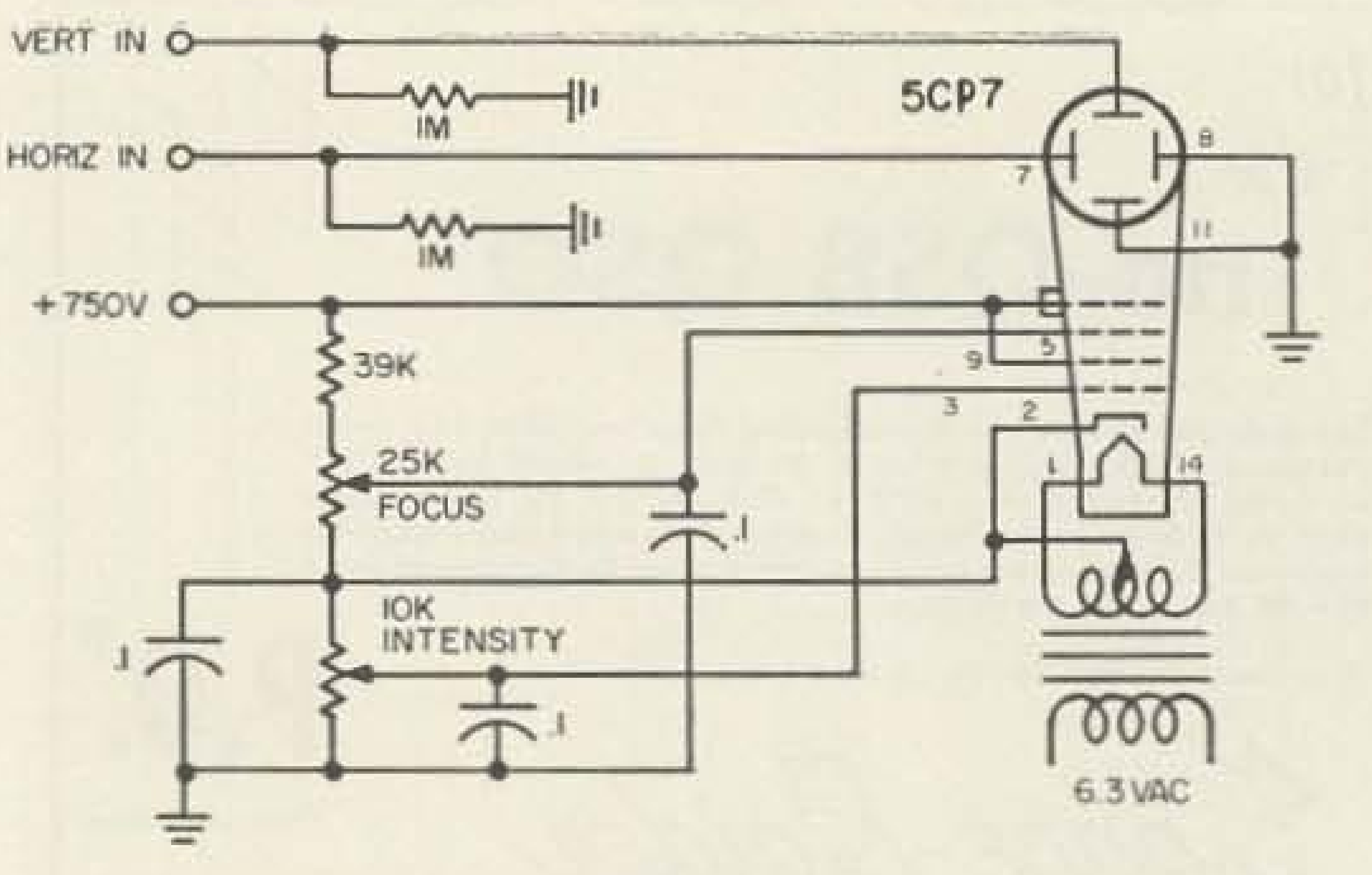


FIG. 13

T M

cent modulation!

By now, you should be sold on the advantages of having a scope. Here's a fast and simple way to build one.

Materials required are a scope tube (many 3- and 5-inch radar-type tubes are available in surplus for fantastically low prices, such as the 15 cents we paid for a 5CP7), a filament transformer to match, four potentiometers, a small handful of 1-watt resistors, and a box to house it all. The box can be made of wood if you prefer.

Wire it all together as shown in Fig. 13. The high voltage is stolen from the transmitter supply, and should be somewhere between 400 and 1500 volts. Only a few mils are needed, but since the transmitter supply can produce much more, take extra care with the wiring to make sure you'll never be able to get across the high voltage!

Resistor values shown in the schematic are for a 5CP7 with 750 volts applied to the HV input; for other tube types or other voltages, you'll have to refer to the tube characteristics (see ARRL handbook) and calculate resistor values from Ohm's Law. The bleeder string should dissipate as much power more than the total of all electrode currents, to maintain effective control. Thus, if the total of all the electrode currents is 5 ma, the bleeder should be designed to draw another 5 ma through it alone.

Naturally, such a simple scope is limited in application; you can frequently find used service scopes in the shops for $40 or less—or you can put one together from a kit for only a few dollars more. Either way (build, buy, or kit) you'll soon find yourself wondering how you ever got along without one.

[Linear from page 25]

position for a positive-off indication. In the on position, it energizes the power transformer and a red pilot light. A 117 volt outlet on the rf amplifier chassis provides a connection for the separate plate supply transformer.

The plate power supply can be any conventional power supply. The 3-1000 Z needs a minimum of 2500 volts. It will barely make the kilowatt level before limiting at this voltage. It works very well at 3000 volts, and will deliver 1300 measured watts into a dummy load at this voltage. It works even better at 3500 volts and is perfectly safe as far as tube failure is concerned.

The power supply shown in the schematic uses a Thordarson 3800 volt 1200 volt-amps power transformer #T-44928. A full wave bridge of Diodes Incorporated* DI-26 rectifiers is used. These rectifiers have the reputation of being under rated, so only 10 rectifiers in series per leg is used. But it is recommended that more, up to 15 per leg, be used. The picture of the rectifiers and the transformer shows only ten. (Fig. 4) The rectifiers are mounted on a tie point strip from a piece of surplus gear. The larger DI-56 rectifiers would give more safety margin (and more current), at more cost.

The cost of the silicon rectifier system is comparable to the cost of four 872 rectifiers plus the bridge type filament transformer and has the advantage of saving space, less heat, and simpler switching. However, the silicon rectifier system will not stand short circuit overloads as well as the thermionic systems.

Power supplies, built since this rig was designed, using solid state rectifiers have shown better transient resistance by the addition of a .0001 mfd discap capacitor and a 1 meg ¼ watt resistor in parallel with each individual rectifier of the system. This is on the advice of Ozzie Jaeger, K3OKX who designs and manufactures many solid state devices for Westinghouse.

The filter system uses the resonant filter choke (120 cycles) and 8 mfd at 4 kv. The filter choke is a Thordarson .5 ampere *smoothing* choke, tuned with a .1 mfd at 7500 volts oil filled capacitor. The resonant filter system makes it possible to use a higher value bleeder resistor (less wasted watts), and still maintain good voltage regulation. The voltage drops 150 volts from plate idling current of 200 ma to full power of 800 ma.

The T-R switch shown in the schematic is a Jennings type RB-3 vacuum switch. It is mounted in the co-axial line some distance from the amplifier, but could have been advantageously mounted on the amplifier deck. The RB-3 TR switch is in two decks. The upper deck switches the antenna from receiver to transmitter. The lower deck removes the blocking bias on the final and mutes the receiver in the transmit position, or blocks off the final and actuates the receiver in receive position. The interesting feature is the timing on the vacuum switch. The RB-1 Jennings vacuum switch is timed so the top deck (antenna T-R) closes 5 milliseconds before the bottom deck. This means the antenna will be switched to the transmitter 5 ms before the transmitter is energized, assuring a load on the transmitter. Then on opening, the lower deck releases 5 milliseconds before the upper deck, assuring that the transmitter will be turned off before the load is removed.

These vacuum relays are available with various coil voltages. Here a 115 volt dc coil was used with four DI-26 silicon rectifiers mounted in a bridge on its terminals, converting it to 115 volts ac. Then, the 115 vac terminals of the T-R switch are brought out and connected to the keyed 115 vac on the back of the exciter, a SSB-100F. From this the voice operated relay in the exciter actuates the final and mutes the receiver.

The blocking bias for the final is obtained from a thousand ohm 10 watt resistor in series with the bleeder resistor. The bleeder resistor is made up of five 10,000 ohm 80 watt surplus resistors.

This standby and metering circuit looks (and is) simple, but it took quite some figuring. The credit goes to Buddy Alvernaz W6DMN. The plate current meter, in the negative lead of the power supply, reads only plate current—no grid current, and the grid blocking system

* Diodes Inc., 7303 Canoga Ave., Canoga Park, California

[Turn to page 61]

The Care and Feeding of a Ham Club

Carole Hoover K9AMD decided to do a survey and find out just what it was that made ham clubs tick. She did a thorough job of visiting hundreds of clubs, sending letters and questionnaires to many more, and interviewing club officers of successful and failing clubs in depth to find out everything possible to help other clubs to be successful.

In this delightful book Carole spells out the results: the secrets of success and failure as they emerged from this study. There is virtually no way to read this book and still have trouble in keeping a club not only alive but alive and expanding. This is not a book of dry statistics, it is a live and interesting how-to-do-it manual for successful club managing.

Every club officer in the world should have a copy of this book to use for reference. Clubs would do well to consider ordering copies for their officers. The fellow who has a copy of this book can stand up in his club and speak with authority and fight through the usual heel-dragging that slows down meetings and bores members.

Profusely illustrated in case you can't read.

price: **$1.00**

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[Linear from page 59]

works. It was difficult to get a circuit that would do both.

A Linear System* directional coupler is connected in the output to give indications of SWR & output.

The plate blocking capacitor is a TV ceramic 500 mmfd 10 kv unit. The parasitic suppressor is made from a 50 ohm 16 watt surplus globar resistor with 3 turns of #10 wire around it. The use of the heat radiator on the plate of the 3-1000Z is a must.

The plate rf choke could be a national R-175-A. The one shown is a home made version, cut on a lathe from teflon, to the R-175-A dimensions and wound full of #24 manganin cotton insulated resistance wire.** The use of resistance wire in rf chokes is a real winner. This spoils the Q of the inevitable self-resonances in the choke. With a lower Q goes lower circulating rf currents, which is the Gremlin that usually burns up your plate choke. Unfortunately, the insulated resistance wire is hard to obtain. Due to lack of demand, retailers seldom carry it, and the manufacturer will sell only full spools.

If all interested in some of this wire were to channel their inquiries to the same distributor, he would have enough requests to warrant putting in a small stock of it. A telephone call to Pete Phelps W6ERP, Quement Electronics,*** confirms this theory.

I suggest that all who are interested, write to Pete for fifty feet of #26 Manganin cotton covered resistance wire. This can be wound on a ceramic insulator, a tooth brush tube, or what have you for a really fine KW 3-30 mc rf choke, The National R-175-A is even better than the original when rewound with resistance wire—after they burn up from internal resonances as purchased. Another way to prevent the rf choke from burning up is to put a 50 ohm resistor in series with the hot end. This should be an rf type such as a globar.

This particular arrangement of a 3-1000Z linear amplifier has proven to be quite satisfactory. In general however, the 3-1000Z grounded grid triod tube has proven to be a real winner. Give it a try for a linear with authority and reliability.

. . . .W6JAT

* Linear Systems, Inc., 605 University Ave., Los Gatos, Calif.

** Driver Harris Co., Harrison, N. J.

*** Quement Electronics, 161 W. San Fernando St., San Jose, California

SAY YOU SAW IT
IN 73

Donald A. Smith—W3UZN
Associate Editor

The Heath Cantenna

MOST OF US HAVE made dummy loads out of everything from light bulbs to resistors. No problem for the lower amateur bands, or if the power into the load was small. When a dummy load is needed for VHF frequencies however, the problem becomes somewhat more complex. High power finals have also always created a problem.

Heath Company has solved these problems with a new low priced dummy load kit. From the outside it looks just about like a gallon bucket of paint, with the paint can black. A closer look reveals some interesting "guts," as we will see later. The specs on the dummy load are as follows:

Impedance	50 Ohms
VSWR	1.5 up to 300 MC 2.0 up to 400 MC
Power Dissipation Capability	1 Kilowatt max (ICAS)
Size	Gallon Paint Can (8⅞" high by 7" diameter)
Weight	1½ lbs. (without oil)
Building time	1½ to 2 hours
Price	9.95

A very special "resistor" is used as the load, which is a special combination of carborundum and other materials. It will withstand considerable amounts of heat, without making any great changes in it's resistance. Impedance is maintained by a special shield placed around the 50 ohm resistor. Transformer oil is placed in the can surrounding the load resistor and stabilizes the heat dissipation of the load.

It is interesting to note that both mineral oil or transformer oil have about the same heat conduction properties up to about 400 watts. Above that power level, transformer oil becomes considerably better. At full input power of one kilowatt, the power can be left connected for only about 2 minutes using mineral oil, while it may remain for almost 10 minutes if transformer oil is being used.

The type of oil you use in your particular "Cantenna" will be determined by the type of oil which is available to you in your locality. If both are available, the price will no doubt help you decide which to use. By the way, a good place to try to secure transformer oil is from your local electric company. I find that most of them use it themselves and in some cases will even let you have the relatively small amount which you need for nothing.

The little dummy load is very easy to assemble, though care should be taken in securing the silver plated connections on the 50 ohm load resistor. Also when mounting the shield tube, as this will have an effect on the over-all impedance. The top of the resistor is connected by tabs to a porcelain feed-through terminal, then into a small metal box. The top of the "paint" can is where this box is mounted and contains special circuitry which permits the measurement of a dc voltage for monitoring relative output power.

I have used the load on amateur frequencies (also commercial "CAB" frequencies of 152 mc @ 100 watts), from 3.5 mc to 220 mc. Powers ranged from less than 1 watt to over 600. I have not as yet had a chance to connect a "full gallon" to the load, but I have fed it with the Heath Linear and found that the load can really take it. It's a real aid in checking out a rig, making adjustments, and looking for troubles without causing interference to amateur or other services. At less than ten bucks, it's a real good buy.

New Product

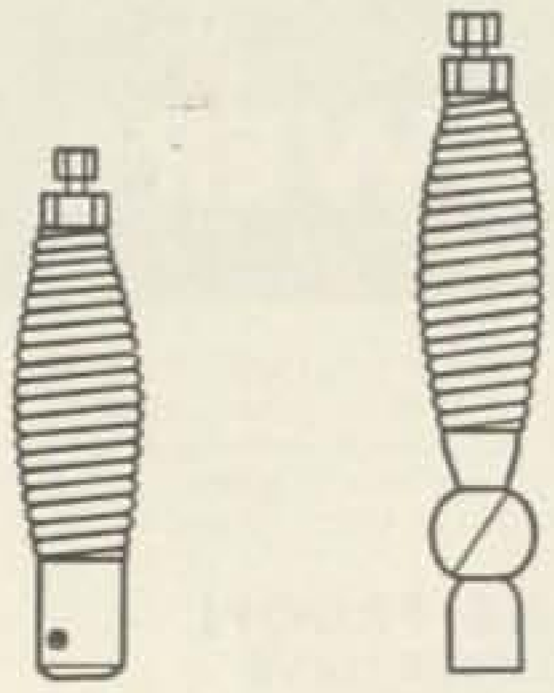
16th Edition Radio Handbook

Bill Orr, W6SAI, has done it again. Never mind the $9.50 price of this volume, it has over 800 pages and is the best text book for learning about radio that we've ever seen. It covers all aspects of radio theory and practice, is beautifully illustrated and climaxes each section of theory with some of the most up to date construction projects you'll see anywhere. This is like a huge long issue of 73, carefully indexed and integrated . . . and probably without as many mistakes.

The book is particularly strong on higher power transmitters, which is not too surprising since Bill spends his days at Eimac and obviously talked several of the Eimac gang into building up the beautiful rigs in the handbook.

No active ham . . . and particularly no newcomer should be without this monumental reference work. It is available through many parts distributors or Radio Bookshop.

New Products



Mobile Antenna Springs

G.A.M. Electronics has two new antenna springs on the market. These use a special ferrule fitting to absolutely prevent your losing your whip. They are made of stainless steel to be non-corrosive. They are stiff enough to hold your antenna straight, but will bend when the clearance is low. Available in the standard base or ball joint base for mounting on angular surfaces. Write G.A.M., 138 Lincoln Street, Manchester, New Hampshire.

DX'ers Meeting

The yearly DX gathering will be held January 26-27 at the Continental Wayside Inn, Paso Robles, California. For exact details and tickets write Lloyd Colvin W6KG, 111 Purdue Ave., Berkeley 8, California.

Scope Kit

Incipient scope purchasers would do well to drop EICO a line and ask about their new Model 427 Advanced General Purpose Oscilloscope. They've packed a lot of features in this one and the kit price of $69.95 should be interesting. EICO, 3300 Northern Blvd., L.I. City 1, N.Y.

[W2NSD from page 4]

2) A discount will be allowed on all 73 publications.

3) Club members will learn of Institute activities through bulletins sent to affiliated clubs and thus can keep up to date on their hobby.

4) Club members will be able to participate in the affairs of the Institute through their club.

5) Clubs with 50% or more members subscribed to 73 will receive one each of all new 73 publications to be used as door prizes for meetings.

Virtue Rewarded, Sort Of

About a dozen editors of club bulletins have me on their mailing list. I have greatly enjoyed reading the papers and have been trying to figure out some way of making their extra effort in keeping me on their list worthwhile. When the next issue of these bulletins comes out I hope the members will be pleasantly surprised at the Christmas Certificate that is printed in there. Too bad if your club isn't sending me your bulletin.

Ten

Among the felows who liked my ideas last month about our setting up a channel on ten meters was W2HBQ who suggested that it would be very simple to set up an ac-dc radio with a small converter and a squelch (such as in Dec., 73). Old radios are all over the place . . . or you can get one of those $5.50 ones from Meshna . . . or for maybe 50¢ from a car cemetery. A thought.

Green Light for 420 mc

The FCC has announced that effective January 2, 1963 the power limitation on the amateur 420-450 mc band will be increased to the full legal limit of 1000 watts input with the exception of three areas of the country. Amateurs operating in these restricted areas will have to continue the present 50 watt power limit. The 50 watt areas are Central and Southern California (too bad fellows) below the 37° 10′ parallel (about halfway between Redwood City and Santa Cruz, leaving the Eimac boys the full gallon limit up in Palo

Alto), and on across Southern Nevada (Las Vegas). The entire state of Arizona is 50 watted. A little area around El Paso, Texas, reaching about 125 miles north, 10 miles west, 50 miles east and all the way south is limited too. Then there is the entire state of Florida plus a 200 mile radius of Patrick and Elgin Air Force Bases near Crestview and Cape Canaveral. These remove about 2/3 of Alabama, a good bit of Georgia and a little hunk of South Carolina. Fortunately New Orleans suffers a near miss. Near Miss. doesn't.

Even with these restricted areas this is a major step ahead for us. With the new power limitation we can start some earnest 432 mc work and step up Ham-TV operation. I'm wide open for articles on high power 432 mc rigs. If I ever get caught up enough on the magazine here I'll be down there on 432 myself. I've got some of the basics here, all I have to do is find the time to get 'em perking.

Ham Publication

It is frustrating to operate a booth at conventions. I find myself being repeatedly congratulated by well-wishers who like the magazine, a pleasant experience which is intermixed with anguish as other fellows walk by, obviously uninterested in the whole idea. These chaps are radio amateurs too. Here we are publishing a magazine that thousands of amateurs think is wonderful and yet thousands more couldn't be less interested. What gives? If I leap out of the booth and grab their lapel they protest that they already get a lot of magazines which they don't read, so why get one more. Or else they admit that they don't read any ham magazines and don't see why they should.

The problem probably is that I take ham radio too seriously. I've lived so intimately with the hobby all my life that I can't project myself as a casual participant. I've been gung-ho for all amateurs to subscribe and support all amateur publications ever since I started in the hobby, and many years before I even had the faintest hint that I would ever be working for a ham magazine. It is axiomatic that the more you know about what is going on the more enjoyment you receive from anything.

Maybe they are saving the money. How much could it cost to support all amateur radio publications and encourage them? 73 is $3.50; QST is $5; Western Radio Amateur is $2; VHF Horizons is $4; The Monitor is $1.50; Auto-Call is $1; and (ugh!) CQ is $5. This totals $22 a year. If you are interested in DX add $7 for DX Magazine. Twenty-two dollars, spread out over the year, is little enough to invest in your own enjoyment and the support of the hobby through its publications.

This sort of talk is detrimental to my own survival since most of the magazines are competing for the advertising dollars and the fewer magazines there are the easier it will be for the others. Even so, I feel that I don't mind sacrificing a little bit to keep most of the ham publications going. Three ham publications have sunk from sight in recent months and three or four more are rapidly headed in that direction unless you step in there and support them. You'll get better publications if you support the ones that are trying to make a go of it now instead of waiting to see how they make out with the result that they don't. True, new publications seem to spring up to fill what little gap has been left, but these too fade away when the money runs dry.

Choosy

If you look over our ads I think you'll find that we are the most particular of all of the ham magazines about advertisers. I refuse to knowingly accept an advertisement from a company that I believe is not manufacturing a good product. Even though we emphasize the VHF's quite a bit there are two VHF equipment manufacturers that you will not see in 73, though they do advertise elsewhere. There is one large antenna manufacturer in the same boat.

Please let me know if you disagree with my decisions on advertisers for I don't want to have any readers run into troubles. We will not be bribed into accepting ads from chislers no matter how much we need the money.

Classified Ads

How come we don't have 'em? Mostly because we don't have enough staff to handle the work involved. We're already trying to tackle more than we can handle efficiently. We have been overwhelmed recently by subscription renewals, articles, book production, newsstand expansion, changing printers, and advertising. We have been underwhelmed by money.

Homebrew Contest

The Schenectady Amateur Radio Association has a little idea that many clubs might think about. They are running a homebrew contest which will come to a head next May when they have a special meeting for everyone to bring in their homebrew gear and prizes will be given for the neatest wiring job, the best looking workmanship and the most unusual application or design features. I'm sure that local parts distributors will offer up some prizes if your club decides to put on an event like this.

Hands

We're pretty well set right now on staff here at 73, but come this summer we can use two or three poor but honest fellows who would like to live neck deep in ham radio for a couple of months. I guess I'd better warn you, we work hard here, we don't know what a weekend is, we work from morning until late at night, there is hardly any pay at all, absolutely no smoking or drinking, and we have a heck of a lot of fun dodging bankruptcy and other emergencies by frantic bursts of effort.

That doesn't sound very encouraging I suppose, but the whole staff lives right here together and we have a lot of fun. There is an unlimited number of things to learn and nobody to stop you. If you really want to learn and are 19 or over drop me a note.

Printed Circuit Kit

Though most of the printed circuits that are published in articles in 73 are available from Irving Electronics, there unquestionably are a lot of fellows who would like to either make their own boards for these articles or perhaps whip up some boards for gear of their own design. This is good . . . this is progress. And Ham Kits down in Cranford (Box 175) New Jersey has a little kit for you with complete instructions, a couple of 5" x 7" copper clad boards and everything else you could want to make your own printed circuits. $2.00.

Hy-Gain

We're not the only ones with new buildings. Hy-Gain has just moved into a huge new building out in Lincoln, Nebraska where they will be able to better keep up with the demand for their beams. We're hoping that they'll make some of the results of their antenna test site available for us to print in 73. In the meanwhile we're doing fine with our Hy-Gain tribander here at the 73 HQ.

RTTY

Fellows keep asking how they should go about getting on amateur radioteletype. I'll encapsulate it for all interested parties.

1) You'll need a printer, a converter, and the usual receiver and transmitter. Printers can be purchased for a very reasonable sum ($100 or less, frequently) through your nearest RTTY Society. MARS programs have been distributing them rather freely too. And there always are the ham ads. You might check with W1AFN, W2ZKV, W3CRO, W4RWM, W5ANW, W6AEE, W9GRW, or WϕATM. There are two commercial converters on the market (see Alltronics ad in this issue for one), a couple available surplus and any number of simply build home-made units. One of the best we've seen was in the August 1961 issue of 73 and consisted mostly of an inexpensive printed circuit board.

2) You plug the converter into the phone jack on your receiver and the printer into the converter. Presto: the written word.

3) After the initial shock has worn off you will get the hankering to talk back. If you have a transmitter like the Central 200V all you have to do is plug into the converter and you are in business. If your oscillator does not have an FSK circuit you'll have to build one. Fortunately this is a matter of a few minutes. A small variable condenser in series with a 1N34 or other small diode will allow you to key a small added capacity across the oscillator and vary its frequency by the required 850 cycles. A dc voltage fed through an isolating rf choke to the diode switches the capacity off and on.

4) Have fun.

RTTY Sweepstakes

Though I'd read in the RTTY bulletin that there was going to be an RTTY contest, I really hadn't given it a lot of thought. Then, the other night, I had just returned from a trip down into Massachusetts to pick up some tropical fish for Virginia and, as I tuned the bands, I heard a terrific clatter on the RTTY channels. Fortunately my Model 15 was all tuned up and ready to go . . . John, WA2FMF, had visited that day and checked it for us.

We quickly hunted around and dug up the patch cords for the new Alltronics Converter and soon were getting good copy. The 200V had only to be plugged into a polar relay and we were on the air. It didn't take long to find out that the 80 meter antenna had come apart . . . and the tribander was down with rotator troubles. I fumed. Even with the broken antenna I managed a few 80 meter contacts and a QRZ on 20 meters from a YV.

Bright and early the next morning we set to work getting the antennas back up. I cut a folded dipole for 80, which we hung from the 100' Rohn tower to a tree. The tribander was swung back up on the E-Z Way tower and we were all set.

Unfortunately there was a lot of magazine work to do so I couldn't spend the entire weekend on the air. I worked about 25 states and four countries . . . and heard ten countries more that I didn't have the patience to work, including a ZK1! RTTY has come a long way. One contact that stood out was with W6NRM. The last time Bob had copied RTTY signals from me was over 13 years ago.

RTTY BOOK

It took us a lot longer than we figured to turn out our promised RTTY book. Naturally we have a whole set of lame excuses for this and by the time we got through explaining you would probably be moved to tears.

The book is frankly written for beginners and does not go into the complications of designing circuits or heavily into the theory of RTTY. It tells you what you need to put an RTTY signal on the air, where to get your printer, how to build or buy a receiving converter, how to connect into your transmitter, and just about everything else you really need to know to get on the air and have fun without becoming an expert. A great deal of space is taken up with photographs of the various types of available commercial equipment and considerable valuable discussion is presented to help you choose your printer, tape equipment and other accessories. MARS members will find the data on military gear invaluable.

The book is designed to compliment the articles that appear in 73. There are a couple of reprints from our earlier issues, but other than that all of the material is new and unavailable elsewhere.

The original price of the book was $3.00. We have cut a lot of corners in the production of this book. Most of the photographs were taken of my own equipment, many of the pages were prepared on our own Varityper and IBM Executive and the book has been printed by the less costly offset process. The finished product is very good (both the ARRL and Radio

Handbooks are offset printed now), and these economies enable us to sell the book for only $2.00 instead of the expected $3.00.

Fellows who have already sent in their $3.00 for the RTTY book will receive not only the book but a one year extension of their subscription to 73 as a reward for their patience in waiting for us to fuss around and get the book the way we wanted it before publication.

Two other books have appeared in the past on this subject. The first one was largely written by me and compiled by W2JTP. Much of the material in that book was lifted enmass out of the earlier RTTY columns I wrote for CQ magazine from 1951 to 1954. When that book finally went out of print W2JTP redid it with a few small changes and it was published by Cowan earlier this year at $3.95. It seemed to me that after ten years that someone should sit down and write something a little more up to date. W4RWM provided the framework and I filled in the bulk of this latest book. I'm betting $2.00 that you like it.

Special Sections

We're working on several special features for 73 which may be of more permanent interest than usual. The plans are to have a section devoted to a survey of the equipment that is available for six meter sideband work; one devoted to quad antennas, complete with a comparison of the various commercially built models; one on towers, comparing all of the makes of towers and a big special section in March on all of the receivers that are presently available either new or second hand. This receiver section will show pictures of just about every receiver made in recent years and give the specifications. We're short a few photographs and would appreciate readers sending them in for the: 75S1, S-27, S-37, S-41, SX-42, S-77(A), SP-400X(SX), AR-1, AR-2, HR-20.

A new manufacturer of sideband transceivers seems to pop up every few days. We're planning on a comprehensive on the commercial transceivers for April and would appreciate hearing from any manufacturers that have not already sent us photos and specs of their gear. It would be a shame to be left out of this section.

Motivational Research

Even a casual inspection of our subscription ads should show you that I have been trying every tack that I could think of to get more subscribers. None of my brainstorms seem to produce any special results, entertaining though they may be. OK, I give up. I'm appealing to you to tell me what factors have influenced you to subscribe or might influence you.

You may not be a subscriber to 73 at present, but in all probability you are subscribing to some magazines. Think back; what was it that tipped the scales and convinced you to send in your subscription? Perhaps you can let me know so I can tip the scales for other readers and speed up our expansion a bit.

Did they reach you through reason: it is cheaper to subscribe than buy on the newsstand; you sometimes can miss an important issue by depending on newsstands; you often have to look around quite a bit to find a stand that has a copy; etc. Or was it just persistence in sending you subscription reminders?

Are there any changes in 73 that would make you like the magazine more? Almost all of the fellows that write in now want us to keep it just as it is, but that doesn't mean that the fellows who are not subscribing like it this way. We are already publishing more feature articles than all the other ham magazines combined, so we can't do much more along that line. No, I believe that the magazine is good and it is only in our sales approach that we have failed. But maybe I'm wrong!

What do you think?

RM-341 Continued

In the interests of avoiding a court battle, for which I have neither the time nor money, it is prudent for me to retract the second sentence of the second paragraph on page 83 of the December 1962 issue of 73. This sentence said, "There were numerous reports of TVI in which he was uncooperative, complaints of overpower, complaints of excessively broad and splattering signal, complaints of malicious interference, and several other serious problems much too lengthy to cover here."

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (74 STAT. 208) SHOWING THE OWNERSHIP, MANAGEMENT AND CIRCULATION OF 73 Magazine, published monthly at Norwalk, Connecticut, for Sept. 27, 1962. 1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Wayne Green, Peterborough, New Hampshire. Editor, same as above. Managing editor, same as above. Business manager, same as above. 2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.) Amateur Radio Publishing, Inc., 1379 East 15 St., Brooklyn 30, N.Y. Wayne Green, Peterborough, N.H. 3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amounnt of bonds. mortgages, or other securities are: none. 4. Paragraphs 2 and 3 include, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the aff. nt's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not app r upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. 5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 33,708.

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October 1960—December 1962

Mo. Yr. Page

ALLOCATIONS

AM

ANTENNAS

ANTENNAS, BEAM

ANTENNAS, MOBILE

ANTENNAS, SUPPORTS, TOWERS AND ROTATORS

ANTENNAS, TUNING AND MATCHING

ANTENNAS, UHF AND MICROWAVE

ANTENNAS, VHF

AUDIO

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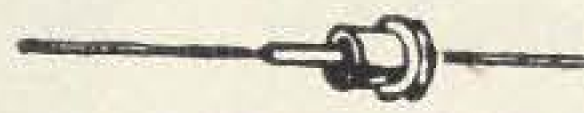

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280/400	350/500	420/600	490/700
.34	.44	.53	.69
rms/piv	rms/piv	rms/piv	rms/piv
560/800	630/900	700/1000	770/1100
.85	.96	1.08	1.50

Low Priced T300 Silicon Diodes Rated 400 pvi/280rms @300Ma @100°C .25 each; 30 for $7; 100 for $20;

Diode order $10 shipped Post free

ZENER DIODES 150 to 400 MW CASED TO24 Pckg. Within 20% V'Range $1, 3 for $2, 20 for $10. KIT ZENER DIODES up to 400MW, SINGLE & DOUBLE ENDED 2 for $1; 12 for $5; 100 for $36.

SILICON POWER DIODE STUDS*

Operation Up to 125°C Case Temp.

D.C. Amps	50Piv 35Rms	100Piv 70Rms	150Piv 105Rms
2	.23	.34	.42
3	.60	.85	1.10
6	.70	.95	1.15
12	.85	1.15	1.35
35	1.80	2.20	2.95
70	3.75	4.50	5.00
240	4.50	5.40	7.70

D.C. Amps	200Piv 140Rms	300Piv 210Rms	400Piv 280Rms
2	.49	.60	.84
3	1.25	1.50	1.80
6	1.40	1.65	1.95
12	1.68	1.85	2.07
35	3.25	4.90	6.10
70	5.60	8.80	Query
240	9.00	Query	Query

***Derate 20% for Battery or Capacitive Load or D.C. Blocking!**
***Stud mounted on Heat-sink**

LO PRICED SILICON TUBE REPLACEMENTS WITH BUILT IN SURGE AND SERIES BALANCING PROTECTION

TYPE	VRMS/PIV	AMPS	PRICE
T866	5000/10400	0.3	$16
T5R4	1900/2800	0.5	$7

"TAB FOR TRANSISTORS & DIODES!"

Full Length Leads Factory Tested & Guaranteed! U.S.A. Mfg.

PNP Hi Power 15 Amp. TO3 & TO36 Round Pckg. 2N441, 2N277 $1.25, 4 for $4; 2N442, 2N278 $3@, 2 for $5; 2N443, 2N174 $4@, 2 for $7; 2N677 $1@, 12 for $10; 2N677A $2@, 6 for $10; 2N677B $3@, 4 for $10; 2N677C $5@; PNP 2N123, 2N107, CK722 4 for $1, 25 for $5; NPN 2N292, 2N293, PNP 2N223 ¢30@, 15 for $4, 100 for $22; PNP 2N670/300MW ¢40@, 20 for $7; PNP 2N671/1W ¢60@, 10 for $5; 2N597, 2N598, 2N599 PNP $1.50@, 4 for $5.

$10 or more this item POSTPAID U.S.A.

RND(TO36), or Diamond (TO3) mica kit 30¢ ea. Power Heat Sink Finned (80" sq.) $1.25, 5 for $5.

GTD! Power-Diamond-Transistors Factory Tested

***MFGRD in U.S.A. Univ. Replcmnt 2N155, 2N156, 2N234, 2N256, 2N307, 2N554

SPECIAL TO3GP ....55¢, 10 for $5 40 for $18

$10 or more this item we pay P.P./U.S.A.

Kit Glass Diodes equiv. 1N34A, 46, 48, 51, 60, 64, 87, 105, 109, 147, 267, 268, 295. 12 for $1. 100 for $7.50.

WE BUY! SWAP & SELL TRANSISTORS, DIODES, ZENERS

"TAB" THAT'S A BUY

"TAB" Tubes Factory Tested, Inspctd, Six Months Guaranteed! No Rejects! Boxed! GOVT & MFGRS Surplus! New & Used

OA2	1.00	6J7	.99	5651	1.20
OA3	.95	6K7	.79	5656	3.00
OB2	.65	6L6	.99	5670	.89
OC3	.65	6SN7	.72	5687	.90
OD3	2/$1	6T8	.98	5725	.75
OZ4	.79	6V6GT	.70	5732	.65
1B3	.99	6X5	.49	5751	1.00
1L4	2/$1	12AT6	.59	5814	.60
1R4	5/$1	12AT7	.85	5879	2/$1
1S4	.60	12AU6	.63	5894	13.50

We Swap Tubes! What Do/U Have?

1T4	.60	12AU7	.69	2AP5	3.00
1T5	.55	12AX7	.75	3BP1A	5.00
1U4	5/$1	12AY7	.89	3KP1	6.00
1U5	.65	12BA7	.90	3SP1	3.00
1X2	.99	12BE6	2/$1	5GP1	5.00
2C39A	10.00	12H6	3/$1	5CP4A	6.00
2C40	5.00	12J5	.69	5MP1	6.00
2C43	5.50	12J7	.69	5MP4	6.00
2C51	1.25	12K8	.70	5NP1	6.00
2D21	2/$1	12SC7	3/$1	5ABP1	20.00

Send 25¢ for Catalog!

2E22	1.75	12SG7	.60	5AQP1	20.00
2E24	1.80	12SH7	.60	5AQP7	20.00
2E25	2.50	12SJ7	.60	5AP1	5.00
2E26	1.80	12SK7	.75	5ADP1	35.00
2K25	6.50	12SL7	.59	5ADP7	25.00
2V3G	2/$1	12SN7	.69	5BP1	6.00
2X2	2/$1	12SR7	.69	5BP2	6.00
3C24	3.00	24G	3.00	5BCP7	25.00
3D23	2.40	25A6	1.25	5BGP2	35.00
3E29	5.90	25L6	2/$1	5BHP2	25.00

Wanted 304TL Tubes

3Q5	.85	25T	5.00	5CP1A	7.00
4-65A	9.50	25Z5	.72	5CP5	4.00
4-125A	21.00	25Z6	.75	5CP7A	4.00
4-250A	33.00	35Z5	.85	5CP11A	5.00
4X150A	14.00	RK39	2.50	5FP1A	18.00
4X250	34.00	50L6	2/$1	5FP4A	18.00
4X500	37.00	75	.81	5FP5	3.00
5R4	1.00	83V	2/$1	5FP7A	3.00
5T4	2/$1	2000T	150.00	5FP14	3.00
5U4	.75	4X150G	12.00	5FP14A	6.00

125°C SILICON PNP TRANSISTORS 250 to 400 MW

FULL LENGTH LEADS
Factory Tested & GTD!

$5 to $11 — SMALL — TO5 & TO18 Pckg. Replaces 2N327A; 332, 3, 4, 5, 6, 7, 8; 474, 5, 6, 7, 8, 9; 2N480, 541, 2, 3; 2N935, 36, 37; 2N1034; 2N1131, 2; 1276, 7, 8, 9. "TAB" SPECIAL ¢69@, 7 for $4, 20 for $10.

$10 or more this item, we pay P.P./U.S.A.

5V4	.89	4X250B	30.00	5HP4	10.00
5Y3	.59	4-400A	33.00	5JP1	2.00
5Z3	.89	250TL	18.00	5JP2	1.00
6A7	.99	307A	3/$1	5JP14	25.00
6A8	.99	VR92	5/$1	5LP1	18.00
6AB4	2/$1	388A	2/$1	5LP1A	25.00
6AC7	.69	350A	1.00	5LP4	6.00
6AG5	.59	350B	1.00	5LP7A	6.00
6AG7	2/$1	6146	2.45	5RP1	25.00
6AK5	.69	450TH	25.00	5SP7	15.00

Wanted Test Sets and Equipment

6AL5	.59	450TL	24.00	5SP7A	21.00
6AQ5	.65	460	11.50	5QP4	8.00
6AR6	.75	707B	1.25	5UP1	6.00
6AS7	2.85	715C	10.00	5XP21	36.00
6AT6	.65	723AB	2.50	5YP1	25.00
6AU6	.70	725A	3.50	7BP1	5.00
6B8	.80	805	3.35	7BP4	5.00
6BE6	.59	807	1.10	7BP4A	5.00
6BG6	1.49	811	3.90	7BP7	2.00
6BH6	.79	811A	4.75	7BP7A	5.00

Top $$$ Paid for 304TL, 813, 811A, 812A Tubes

6BK7	.99	812	3.95	7EP4	5.00
6BL7	1.30	813	12.00	7GP4	7.00
6BX7	1.11	815	1.75	9AUP7	5.00
6BY5	1.19	829B	7.50	9JP1	5.00
6BZ6	.73	832A	5.00	9LP7	1.00
6C4	.45	833A	36.00	10BP4	6.00
6C5	2/$1	837	1.50	10KP7	11.00
6C8	2/$1	866A	1.50	12GP7	7.00
6CB6	.70	954	10/$1	12QP4	9.00
6CD6	1.49	957	10/$1	12KP4A	9.00

Top $$$ Paid for 304TL Tubes!

6E5	.79	991	5/$1	12SP7	11.00
6F4	1.85	1619	5/$1	14EP4	10.00
6F5	2/$1	1620	1.00	16GP4	12.00
6F6	2/$1	1625	3/$1	16DP4A	12.00
6F8	.74	1626	12/$1	17AVP4	14.00
6H6	4/$1	1629	4/$1	17AP4	14.00
6J4	1.72	2050	1.20	17CP4	14.00
6J5	2/$1	5517	2/$1	17KP4	14.00
6J6	2/$1	5608	3.95	19DP4	16.00

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Kit 65 Tubular Condensers
Kit 35 Precision Resistors
Kit 10 Switches
Kit 75 Resistors ½/1&2W
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Kit 15 Volume Controls
Kit 500 Lugs & Eyelets
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Kit 5 lbs. Surprise Package
Kit 10 Transmit Mica Cond's
Kit Glyptal & Cement
Kit 3 Phone/Patch Xfmrs
Kit 6 Insltd Tuning Tools
Kit 4 "Suneells" Asstd.
Kit 5 Sub-Min Tubes
Kit 75 Mica Condensers
Kit 8 Crystal Diodes
Kit 200ft Hook Up Wire
4 Rolls, 50ft/ea. Asstd. Color
Kit 100 Ceramic Condensers
Kit 5 FT243 Xtal Holders
Kit 4 Microswitches
Kit 8 Xtal Osc-Blanks
Kit 4 Asstd Rectifiers
Kit 100 Self/Tap Screws
Kit Adj Wire Striper & Cut
Kit Hi Gain Xtal Mike
Kit 6 ea Phonoplugs & Jacks
Kit 2 pair SO239 & PL59
Kit 12 Binding Posts Asstd

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Transistor Power
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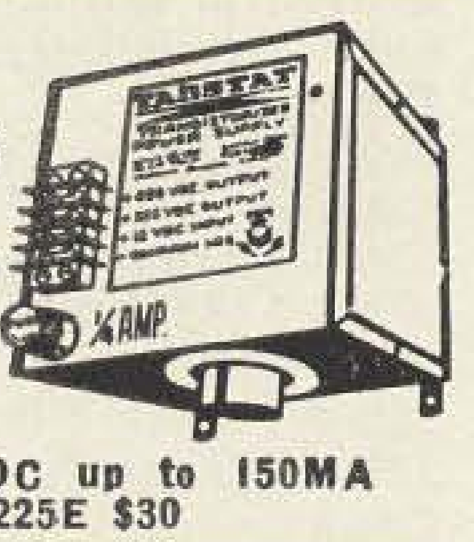

12VDC to 500VDC up to 200MA

100 Watts; Tap at 250VDC

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New Variacs/or equiv 0-135V/7.5A $15.30
New Variacs/or equiv 0-135V/3 Amp $10.65
DC-METER Dejur 800 Ma/2½" $3@,
DC MTR 100Ma/2½" ....$3@,
RF-MTG GE/475 Ma & 5 Amp $4@, 2/$7
DC-METER One Ma/4" Rd...$5@, 2/$8
SNOOPERSCOPE TUBE 2"...$5@, 2/$9
MINI-FAN 6 or 12VAC/60 Cys $2@, 3/$5
Xmitting Mica's .006 @ 2500V. 5 for $1.00
4x150 Ceramic/LOKTAL ......2 for $1.00
866A Xfmr. 2.5V/10A/10KV Insl...$3.95
Microswitch B1/SPNC/30 Amp 49¢@,
Tube Clamps Birtcher..........5 for $1.00
.012 at 25Kv CD Condenser....$4@,
WE Choke 4Hy/450Ma/27 Ohms $4@,
Line Filter 50Amp/250VAC...$10@,
Line Filter 200Amp/130VAC..$18@,
Bruning Parallel 6" Rule...69¢@,
KS15138 Linear Sawtooth Pot..2 for $1.00
"CTC" Delay Line 1 Microsec'd $1@, 3/$2
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D.C. Power Supply 115V/60 to 800 Cys. Output 330 & 165 VDC up to 150 MA. Cased SPECIAL $5.

SELENIUM F. W. BRIDGE RECTIFIERS

DC AMP	18VAC 14VDC	35VAC 28VDC	72VAC 54VDC	130VAC 100VDC
½	$1.00	$1.90	$3.85	$5.00
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2	2.15	3.00	6.25	11.10
3	2.90	4.00	8.60	13.45
6	4.15	8.00	18.75	31.90
10	6.10	12.15	26.30	41.60
12	7.75	14.90	30.95	43.45
20	12.85	24.60	*Write For*	
24	15.00	29.45	*Rectifier Catalog*	

One Year Gtd!

Send 25¢ for New Catalog

POTLUCK SEMICONDUCTOR KITS
(NO OPENS OR SHORTS)
SILICON STUD-DIODES ASSTD.
2 to 6 Amp.....................6 for $1
TRANSISTORS TO5 GERMANIUM
PNP ....6 for $1
TRANSISTORS TO5 GERMANIUM
NPN ....4 for $1
TRANSISTORS SILICON up to
400MW/PNP ....3 for $1
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OF RECONDITIONED EQUIPMENT!

All units are expertly reconditioned and covered by the same 90-day warranty as new gear. Some items are one-of-a-kind and subject to prior sale. If you don't see what you want, just ask—chances are we have it. Remember, you can own used equipment on our Credit Fund Plan for no money down and up to 24 months to pay. Please address orders and inquiries to Ron DeMarco W9NNR, Technical Service Dept.

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T-50 Transmitter	29.00
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Lincoln	
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Multi-Elmac	
AF-67 Transmitter	99.00
PMR-6 Receiver	59.00
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Output Power—Two-tone SSB and CW—50 watts at 10 meters to 65 watts at 80 meters for conservatively rated input of 90 watts DC, 130 watts P.E.P. AM is 25% of SSB/CW values.

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ONLY $449.50
AMATEUR NET

...and we are sure that you will agree that despite the new price tag we have had to put on the FABULOUS HX-50, it still gives you more dollar-for-dollar value than any other transmitter in the market today! The '50 is crammed full of outstanding features to deliver the performance you have always wanted—but have never been able to get in this price range.

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