August 1961

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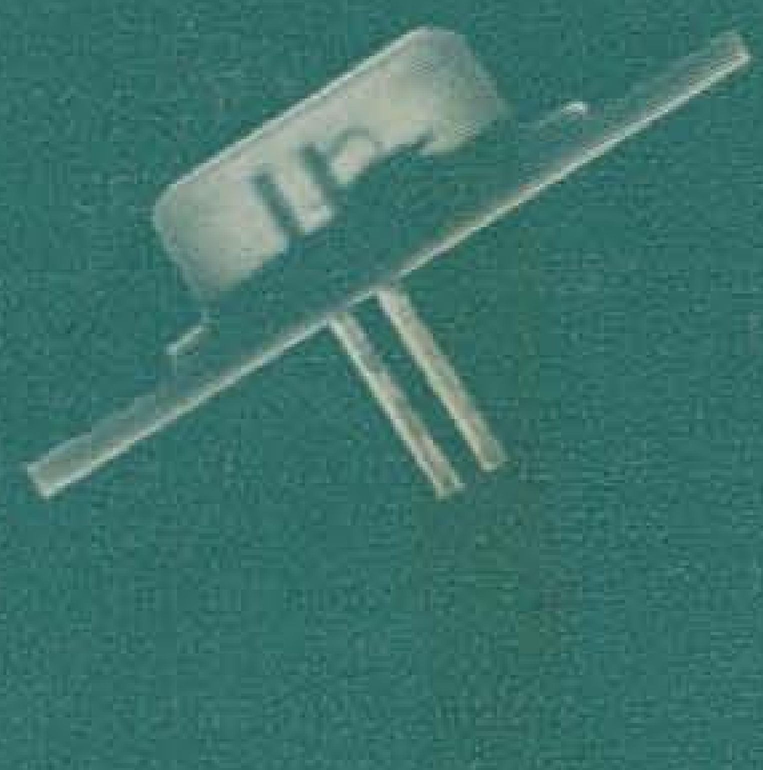
# 73

## Amateur Radio



# "Terrific!...Unbelievable... Best rig – ever"!

## Here are a few unsolicited comments from owners of Clegg VHF equipment

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**From Ohio:**

". . . I am a quality control supervisor with a leading electrical manufacturer and this Zeus transmitter is to me the finest piece of workmanship that I have ever purchased or inspected . . ."

**Richard E. Hayes, K8UXU**

**From New Hampshire:**

". . . We feel that our new Zeus is the best thing that ever happened to us since we have been in ham radio (5 years) . . ."

**Hazen & Beatrice Bean, K1JFQ**

**From Florida:**

". . . We are well satisfied with the results of this unit as we have worked forty DX contacts in little more than three hours on May 23, 1961, including six new states which we were unable to work in the past two years with a 120 watt, 6 & 2 transmitter of a different mfg. . . ."

**Jack Edlow, K4YIW**

**From California:**

". . . Never before have I been more pleased with a piece of gear than I am with my Zeus. In two days I have worked 24 states with several contacts in each, (phone) on six meters. And the signal reports — yow! For the most part unbelievable . . ."

**Jeanne & John Walker, WA6GEE**

**From Pennsylvania:**

"Words cannot express the pleasure and performance of ZEUS. I have worked 5 states 5-9, plus I have given you $1,000,000 advertisement . . ."

**Dr. A. Schlecter, K3OEC**

**From Puerto Rico:**

". . . I want to inform you of the excellent results obtained with the Zeus Transmitter I bought one month ago. Taking advantage of the band opening, I have been able to work up to the present thirty-eight states, including California . . ."

**Pedro Fullana, KP4AAN**

**From New Jersey:**

". . . I would like to tell you I am more than delighted with the operation of the Zeus. Have had nothing but good reports from other Ham's . . ."

**Donald E. Gillmore, WA2QCQ**

**From Georgia:**

". . . This set is terrific. I've had terrific results with it. It's the best rig — ever."

**George E. Missback, K4QOE**

**K8CHE in Ohio tells about 99'er**

". . . with the 99'er haywired in from a four element beam, through 100 feet of coax, through a matching network, through a length of 72 ohm twinlead, and then through a length of 300 ohm twinlead to reach the 99'er, we could read the Michigan stations Q5! and back through the above haywire we were able to put 4.4 watts into the antenna as measured by a RF ammeter! . . ."

**Ken Phillips, K8CHE**

## Clegg LABORATORIES

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

August 1961
Vol. 1, No. 11

# Contents



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**COVER:** Power Transistor innards as seen by James Tonne W5SUC.

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# . . . de W2NSD

## (never say die)

Back at first I was running hamfest and convention announcements. Several postcards have mentioned that they are not particularly anxious to have space taken up with local announcements in a national magazine. I'm in agreement with this notion since we're trying to make sure that everything in the magazine will be of the widest interest. For that matter, though you may be looking particularly for VHF articles, you will find that just about everything we publish will be good reading. Some of the best articles may be hidden with unlikely titles too. Heh! If you disagree about our leaving out announcements all you have to do is pound the table a little and we'll start an (ugh) Announcement Column.

### Cover

The July cover brought interesting reactions. Several readers wrote in to mention that, though their cover was OK, they found the rest of the magazine to be printed upside down. Subway and bus readers startled their fellow travelers. There were a few fellows who called up to find out if we knew the cover was upside down. These chaps should know all the trouble we went to, to make sure that it got printed that way. This included verbal and written instructions to the entire work force of our printer's New York office where the magazine is set in type as well as the entire force in Norwalk, Connecticut where it is printed. We really expected that someone wouldn't get the word somewhere along the line and would "fix" the mistake.

Our printers are getting used to us now. They no longer shudder at our printing a 73 page magazine, no doubt the only magazine in history to do so. They are getting used to our surplus ads with the five point mice type, though they fight every one we bring in and charge until our heads spin for them.

We have made great strides on the delivery of magazines to our office. We almost fainted the first month when the truck drove up with 10,000 copies on a huge skid. The office was on the second floor and Virginia and I had to hand carry 2500 pounds of magazines upstairs. The next month we got them to mail a lot of them directly from the plant and deliver the rest in cartons. Virginia has gotten very good at hefting those 65 pound cartons up the stairs now . . . somehow I always seem to be away when the truck comes. They increased the cartons to 85 pounds last month. Virginia almost broke her back. I complained. The following note came from the printer. "Your lastest epistle decrying the weight of our cartons has caused me deep chagrin, pain and a wart on my left index finger. It has never been the policy of Ye Olde O'Briene Presse to cast a Dresden-like beautiful orchidious creature like Virginia in the role of a Russian weight lifter. The dastardly culprit who sponsored this hernia-inviting operation right now is on his way to the salt mines, minus both thumbs. Rest assured most kind sir that our cartons in the future will be of a gossamer quality and of a weight that can be handled by the midget masquerading as a little girl in the Castro Convertible Ads. Regards, Charles Joseph Hauser III* (*The first two were executed for mopery.)"

### Answered Plea

The small call for help last month was answered. Volunteers arrived from all over. One of the long distance helpers was Hall Bond K5ZSB of Dallas, a pilot for Braniff Airways, who dropped in and lent a hand for a few hours of stencil sorting. All this extra help has enabled us to get out a lot more mail recently and we've sent out the first mailing to advertisers announcing the First Annual Almanac, Yearbook and Buyers Guide which we plan to publish this fall.

One thing that has bugged me for years is the problem of finding out about a product when I want to know about it. Someone will mention over the air that he has one of the new Super-Bandbangers and that he thinks it it great. I immediately plunge into the ham magazines looking for more info. Well, it seems I've heard about it a bit late and they are now advertising the newer Rx-7388. After much searching through back issues I finally find some ads for the Bandbanger, but they sure don't tell very much. Being persistent, I

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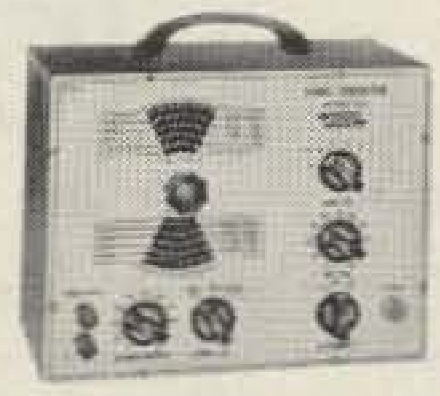

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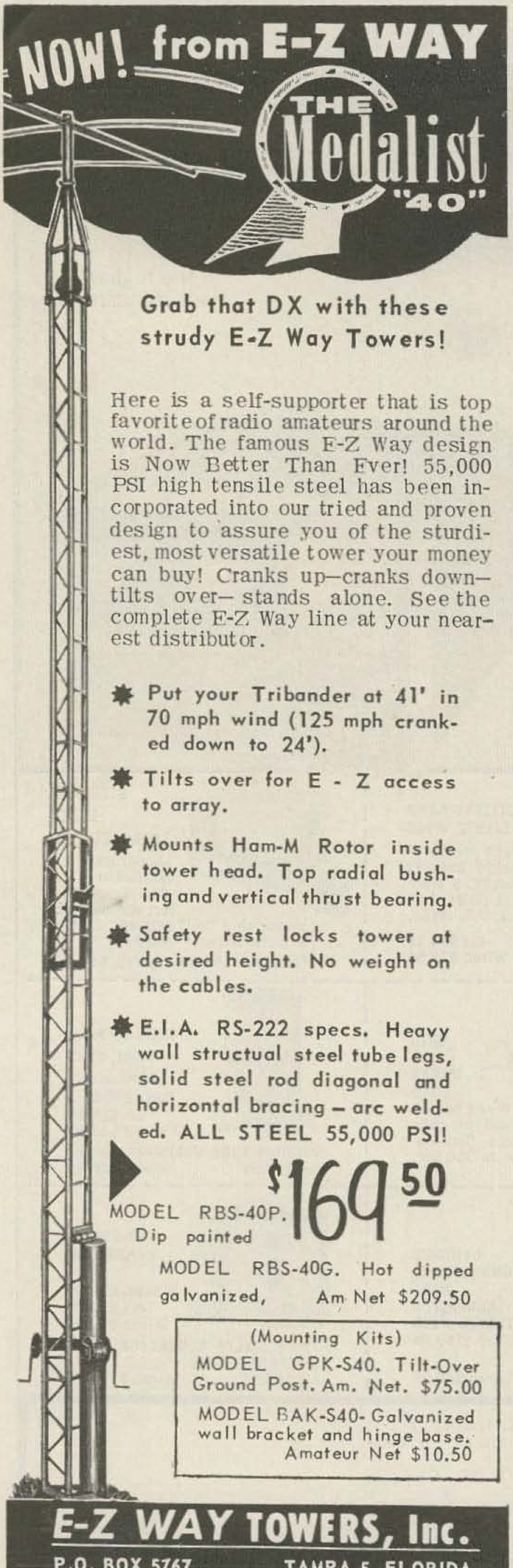


hunt around until I find some letter paper, an envelope, and a stamp. This usually is quite a hard combination to round up all at one time. Then I start drafting the letter asking for a spec sheet. I am rewarded two weeks later when the info comes in the mail . . . only I wonder why they sent me all this, did I write for it? Maybe I did a couple weeks or so ago.

I've tried to solve this difficulty by laying in a good selection of the larger distributor catalogs. Unfortunately only a few distributors seem to carry the Bandbanger line and all they have is a short paragraph on it, telling less than the magazine ads. Even Radio Master doesn't do much for the ham contingent. The answer, I think, is a yearly Buyers Guide for ham products. We're going to try to get just such a thing started. I hope it doesn't turn out that I am the only chap who has suffered through these problems. A letter is now out to all of the ham manufacturers to see their reaction . . . will it be enthusiasm or apathy? I'll let you know.

### Yearbook Articles

This is going to be a real low budget production in order to get as many advertisers to come in as possible. The ad rates will be ridiculously low. This means that there won't be much budget for articles for the book. I've a solution that should make almost everyone happy . . . and that's the best type of solution, eh? Material should be received by the end of September at the latest, which gives us about two months.

The Yearbook, it strikes me, is an excellent place to run quite a few tests of commercial equipment. This should be a snap for many of you who have the equipment on hand and also have a reasonable test setup to check it out. We'd like to have articles on any of the newer pieces of equipment that we have not

(Turn to page 41)

## Club Subscriptions

As announced a few months ago, clubs may send in group subscriptions at the rate of $2.50 per one year subscription in groups of five or more subscriptions. These subs must start with the next published issue and be for just one year. Orders for back issues should be sent in separately. By simplifying the procedure we can offer this reduced rate.

The regular subscription rate is $3 per year; $5 for two years; $4 per year for DX operators outside North America. All back issues are 50¢ each. Send your name, call and address to 73 magazine, 1379 E. 15th St., Brooklyn 30, New York. Include money.


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# Let's Make it a Frequency–Deviation Meter

A frequency-deviation meter allows one to read the deviation plus or minus that a received signal is off frequency. Depending on the meter range desired and used, a deviation of ten or less cycles can be read either high or low. Such a device is especially useful when used on MARS nets or when frequency checks are desired of any incoming signal and the answer must be in cycles low or high of a desired frequency. Those grinding their own crystals or desiring to compare crystals will find this device especially useful.

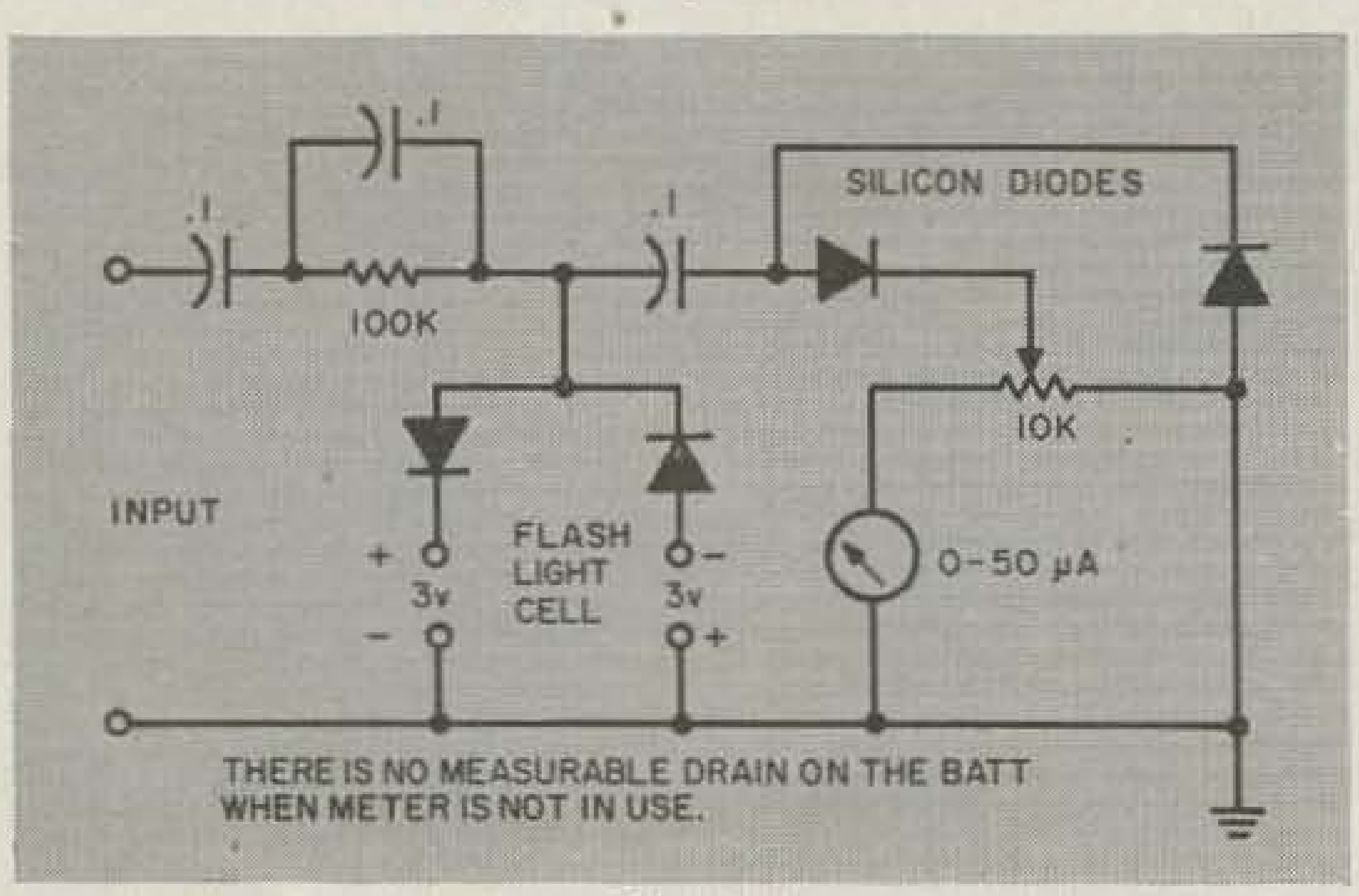



Fig. 1

Two fundamental circuits were investigated, one using diodes only and the other using transistors only. These are shown in Fig. 1 and 2 respectively. A 0-50 microampere meter should be used for the diode type and a 0-1 milliampere meter will serve nicely for the transistor type, although a 0-50 or 0-100 microampere meter will also serve nicely in the transistor type frequency-deviation meter system. Silicon diodes were used for the diode type and 2N123 for the transistor type. An input voltage of 25 is needed for the diode type and 7 volts or less for the transistor type depending on the meter sensitivity, being 2 volts when a 50 microampere meter is used.

Whatever scale reading is desired, be it 250 cycles low or high or 500 cycles low or high, the meter cover is removed and new figures are added below the meter scale with a zero in the center of the scale and maximum readings at each end of the scale as appropriate. Pencil markings will do. The 250 cycle can be read to 10 cycles per division and the 500 cycle scale can be read to 20 cycles per scale division. Each can be read to half these values or 5 and 10 cycles respectively.

In use, you set your frequency meter, LM or 221 either 250 cycles or 500 cycles lower than the frequency to be checked. If the frequency to be checked is right on, the frequency-deviation meter will read zero at the center of the scale on the meter; if the frequency is low, the meter will read low and if higher, the meter will read higher. The answer in cycles will be the value indicated by your new markings. In use the frequency-deviation meter is connected across the high impedance output of your receiver in the case of the diode type and across the low impedance output in the case of the transistor type.

In those cases where a definite frequency will be under observation, it will be found advantageous to grind or obtain a crystal that is adjustable to 250 cycles low or 500 cycles low, as appropriate, and to use it in the transistorized oscillator shown in Fig. 3. Any crystal holder that has an adjustable air gap will do. Some of the TCS surplus crystal holders have a three point adjustable top plate and are about the best obtainable. Since your best and probably only method of adjusting the crystal is by the use of your LM or BC221, be sure that your frequency standard is accurate. It is best to use the low frequency position and with the 1 mc crystal switch on, tune the meter to that portion of the desired frequency less the mc part. For instance, to set the LM for a reading of 2,732,000 cycles, set the LM on the low frequency for 732,000 cycles or 732 kc. The 1 mc crystal will furnish the

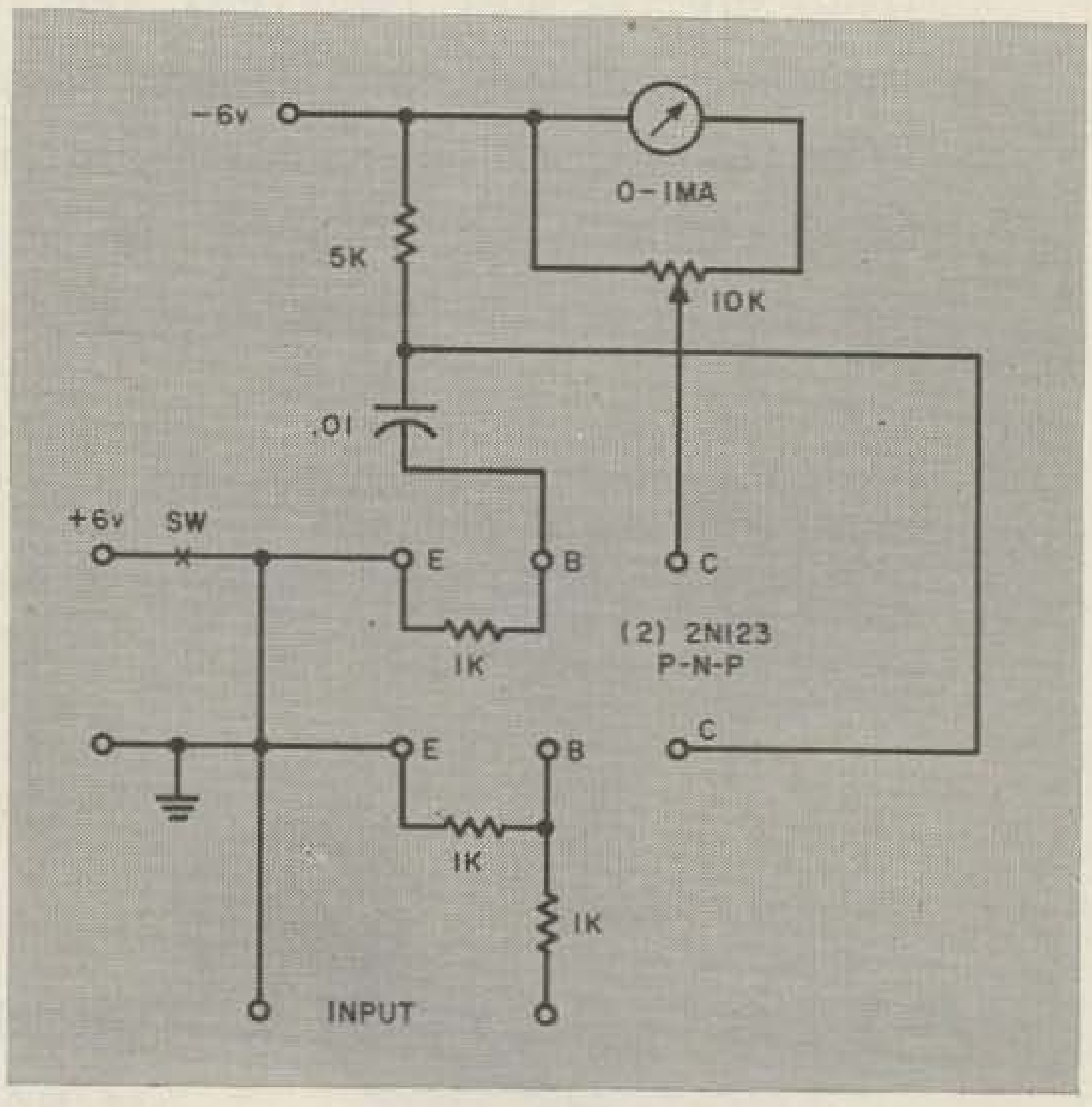



Fig. 2

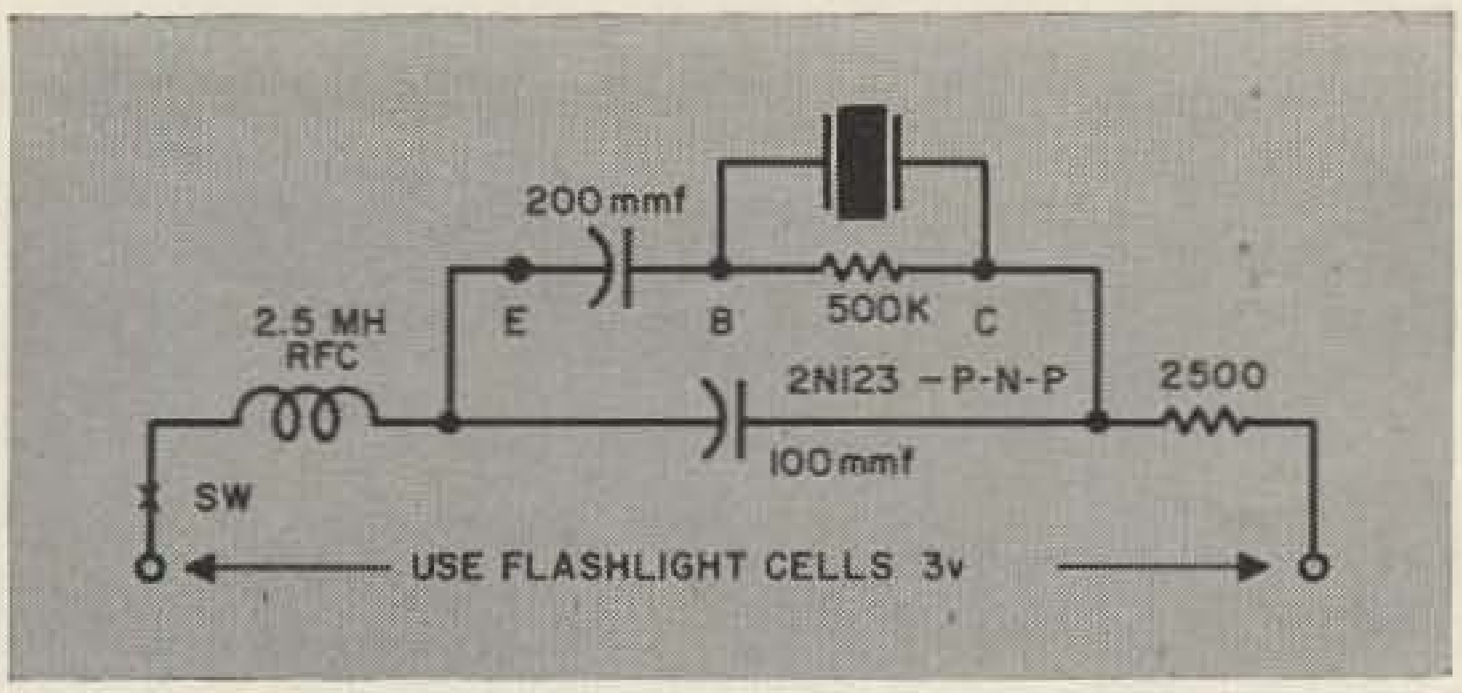



Fig. 3

mc part of the reading. In my case I set the LM to 731.5 kc and adjust the crystal to that frequency in the adjustable TCS holder. The transistorized oscillator holds the frequency to such a close tolerance it has not been necessary to make adjustments in weeks. A hand held push switch connected into the positive battery lead allows the oscillator to be turned on as needed to check the frequency of a MARS station on 2732 kc to an accuracy of plus or minus 10 cycles of that frequency. The frequency-deviation meter is of course checked against the 440 or 600 cycle tone of WWV, no other check is necessary since the scale is linear. . . . K6BJ

Circuit board for this meter available soon from Irving Electronics.

## Letters

**Dear Wayne:**

First let me congratulate you upon your fine layouts, content and presentation in "73." It's about time the ham radio literature again emphasized some home constructed equipment, rather than the ever increasing emphasis on commercial gear.

I constructed the transistorized grid dip oscillator which was described in the March 1961 issue. I found, however, that there were two errors, which perhaps you would be interested in calling to the attention of other readers:

1. Switch S1A is in the wrong line. It should be connected in the 9 volt battery line which, under the present circuitry, is constantly under drain conditions.
2. Besides the minor detail mentioned in item 1, I could not get the oscillator to oscillate until I finally discovered that a .0047 disc ceramic condensor connected between the base of the 2N247 to ground did the job beautifully.

Being an "old timer" in the radio field, I thought perhaps you might be able to steer me towards some article on conversion data to bring the Abbott TR4-B 2-meter transceiver up to date, so as not to invoke the wrath of the FCC. If you have any knowledge of this I would certainly appreciate your passing it along. I was intending to do some revamping of the TR-4, and thought it would be wise to investigate any work done on it in the past.

Again, many thanks. Keep up the swell job.

**Sigmund G. Bookbinder K2PFG**
Boy Scouts of America
25 W. 43rd Street, N. Y. 36

*Thanks, Sig, for your compliments. The note on the GDO may help a bit too, though we pointed out last month that the battery switch was hooked in wrong. Perhaps a difference in transistors made the .0047 necessary as many readers have written in saying that the circuit works fine for them. It is a good hint for anyone who might run into problems. I haven't any info on the TR-4, but maybe you're letter will bear fruit and bring you what you need to know.*

# Printed Circuit Noise Limiter Using Semiconductors

Thomas C. Sowers W3BUL
47 Bethlehem Pike
Colmar, Pennsylvania

After being mobile for several months we had the misfortune of having to change cars as the 1952 Pontiac, which we used for mobile, was beginning to fall apart. The mobile gear was moved from the Pontiac to a 1953 Studebaker. This gear included a TNS limiter which was installed in the Pontiac radio to reduce ignition noise. It was a great disappointment after all the labor involved in transferring the equipment from one car to the other to find we were troubled with ignition noise from other cars. The TNS limited performed very well in the Pontiac but performance was just plain poor in the Studebaker. The diode load resistor in the auto radio was reduced and finally eliminated entirely. The diode in the second detector was grounded and a crystal diode installed in its place. Shielding was tried here and there and just about everything in the handbook and in mind was tried without success. We finally gave up and decided on building a full-wave series noise limiter.

After some serious thinking we set on the idea that the noise limiter would use semiconductors and would have a printed circuit board. The 10 meter converter used in conjunction with the auto radio uses semiconductors and also a printed board. The target of the writer is a compact transistorized transmitter or at least a hybrid using only one tube on the final.

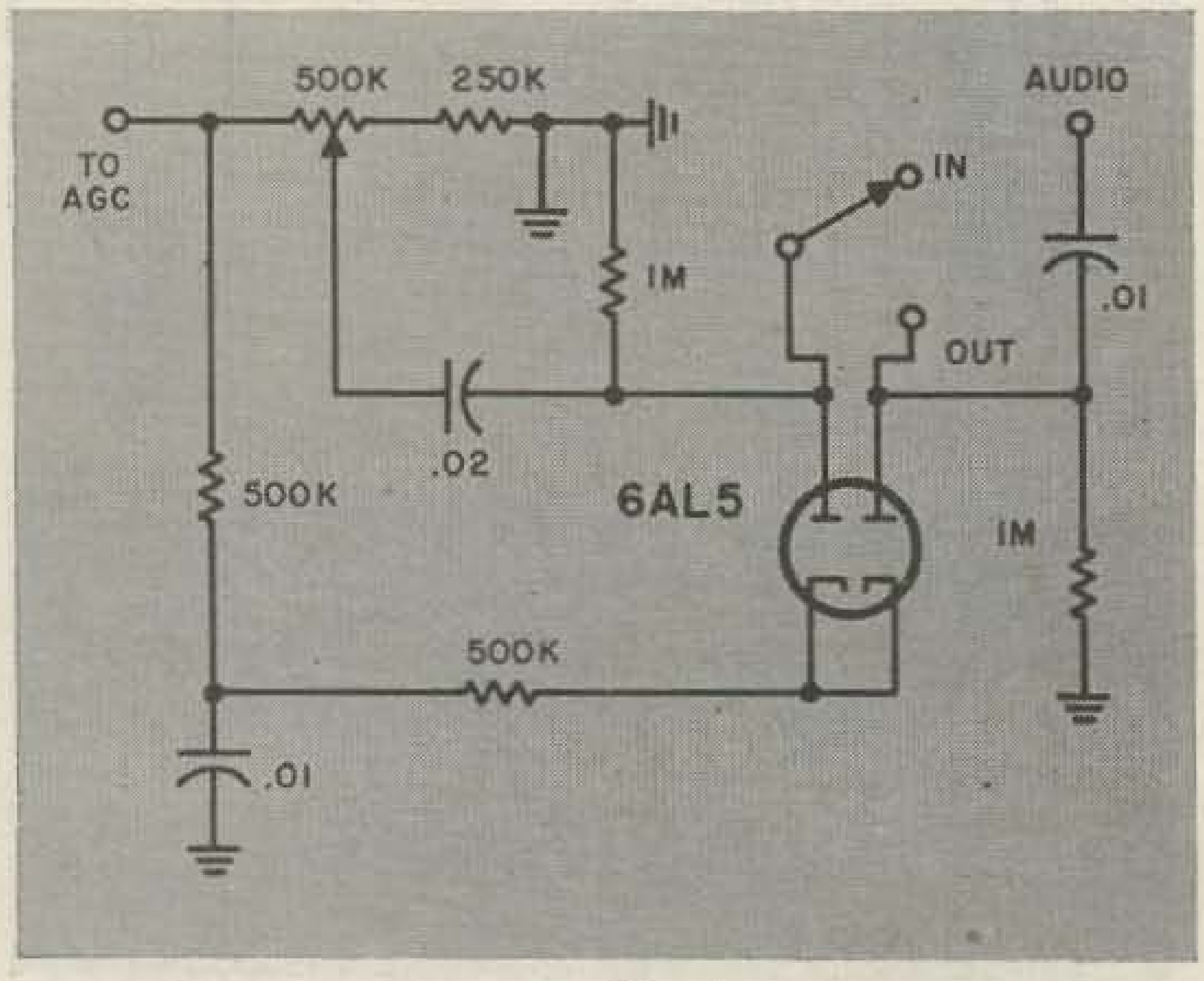



Fig. 1

In starting off, a conventional full-wave series noise limiter circuit Fig. 1 was considered. This type of limiter usually uses a 6AL5 and 12AL5 dual diode. The only changes made on this limiter was replacing the 6AL5 or 12AL5 tube with two suitable crystal diodes Fig. 2.

## Construction

The early experiments using various types of diodes were made on a circuit which was constructed on a punched phenolic board.

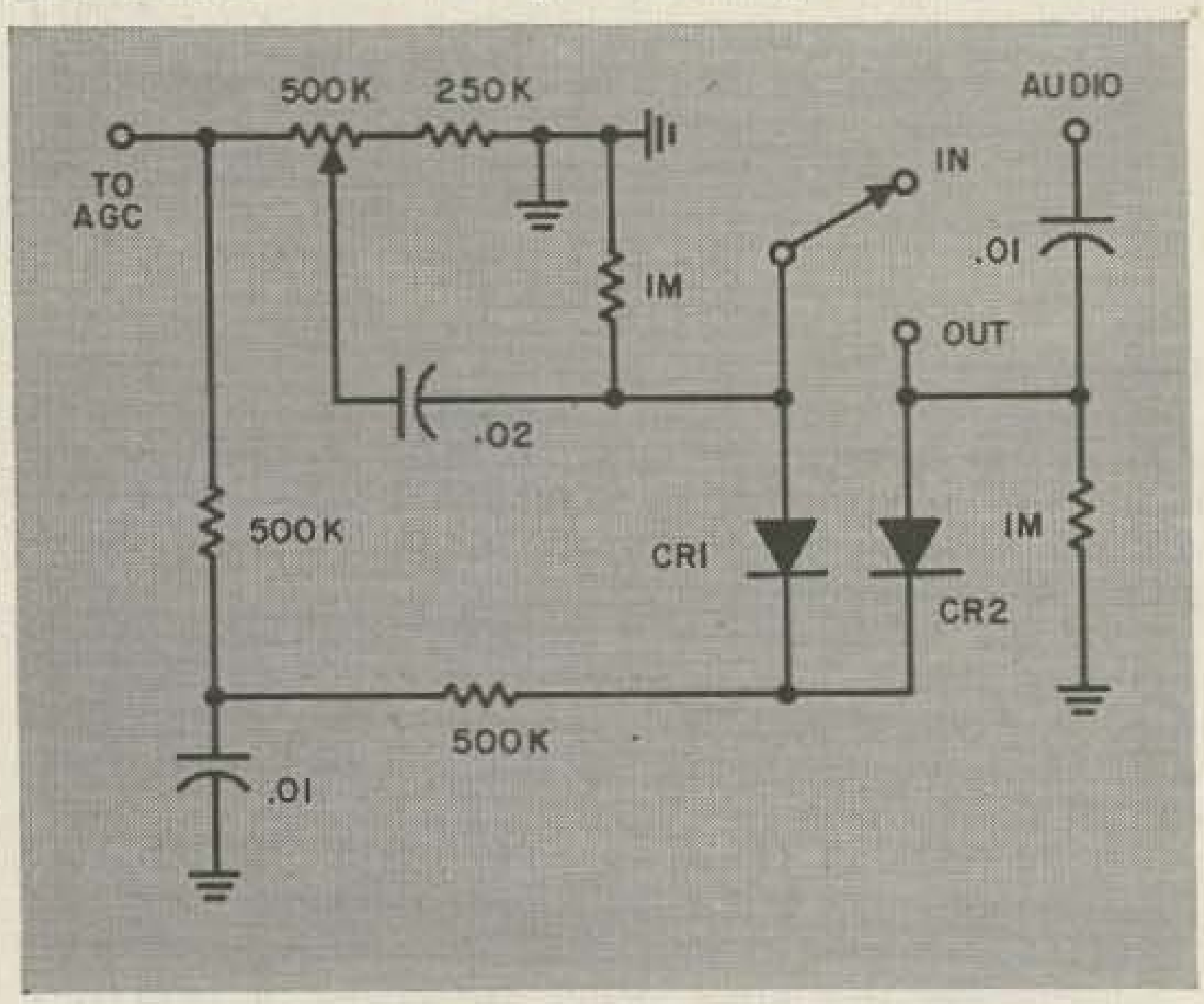
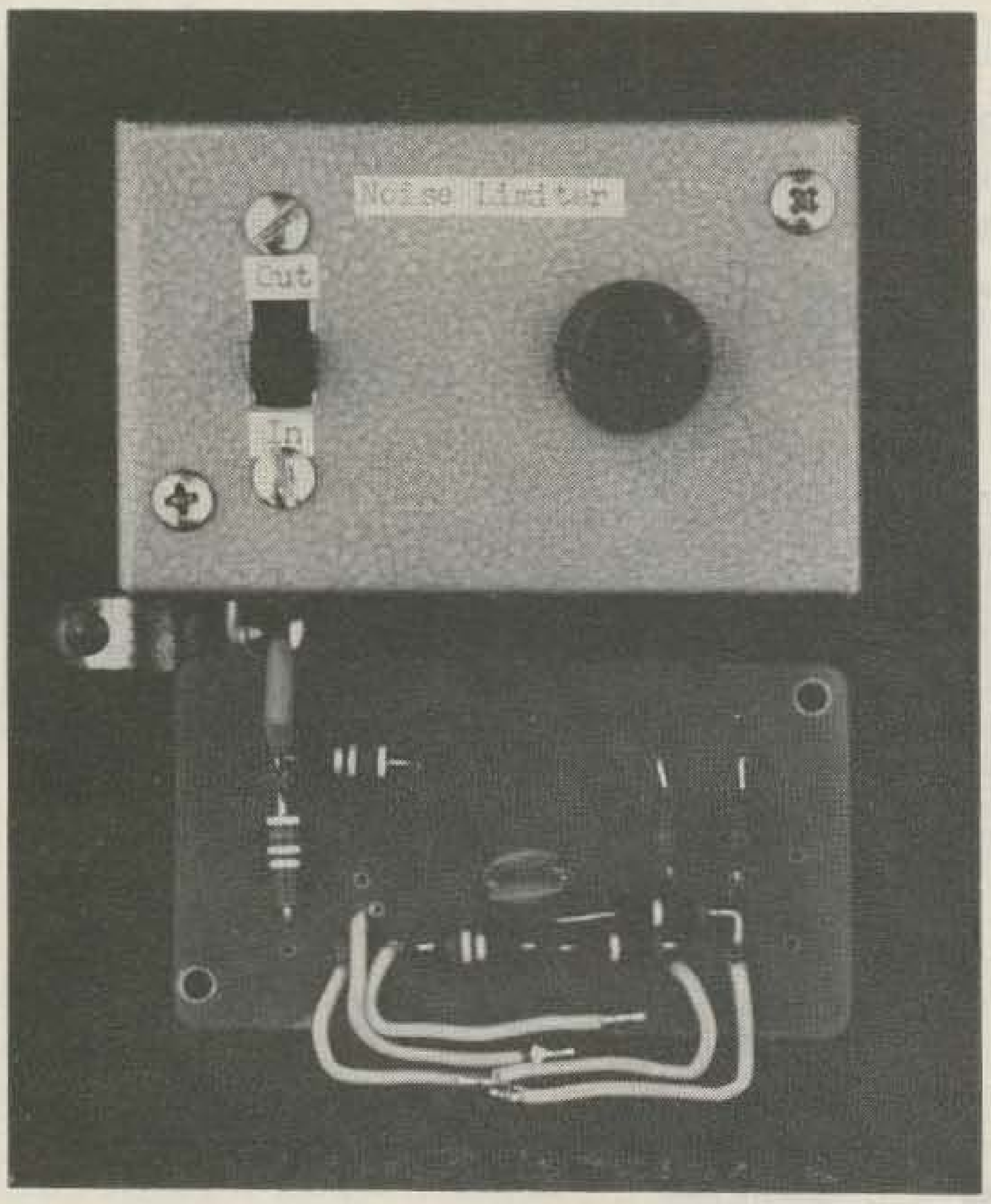



Fig. 2

Three general purpose crystal diodes, the 1N60, 1N91 and 1N93 were tried with little success. It was found that any signal into the receiver was large enough in amplitude to cause the diode to conduct and chop off the audio and what signal did get through was very much muffled. From the above results we knew we would need diodes with a high inverse resistance and low forward resistance. These characteristics are found mainly in the silicon diode and not types produced from germanium. Another test was made using two *Philco* SAT transistors having only one good diode in each. The ICO or IEO on these units measured less than .1 $\mu$a at 20 volts so the inverse resistance on the diodes is well up in the megohms. The base lead of the transistor is used as the cathode and emitter or collector lead as the anode. This proved to be the right diode as noise from passing autos was brought




down well below signal level and even performed as well as the TNS limiter in the Pontiac except for the squelch action. A printed circuit board was then constructed and components were transferred from the phenolic board.

## Printed Circuit

*Material List for Circuit Board*

1. Copper clad laminate board 1⅝ x 3 inches cut from 3 x 4½ piece, No. MS-512.
2. Tape resist circles 3/16 inch diameter, No. MS-737.
3. Tape resist 1/16 x 320 inches, No. MS-735.
4. Etchant 6 oz., No. MS-729.

All materials for printed circuit board ordered through Lafayette Radio, Jamaica 33, New York.

The construction of printed circuit boards was described in length in November issue of 73, "Transistor Printed Circuit 10 Meter Converter." The procedures for constructing the circuit board for the noise limiter will be described very briefly in ths article. Lay Fig. 3 drawing over copper clad board with a piece of carbon tracing paper between and trace out all circles and connecting bars. After tracing, apply resist circles and 3/16 inch resist tape to circuit board. Etch board for 20 to 30 minutes in etchant solution to remove all excess copper. Remove resist tape

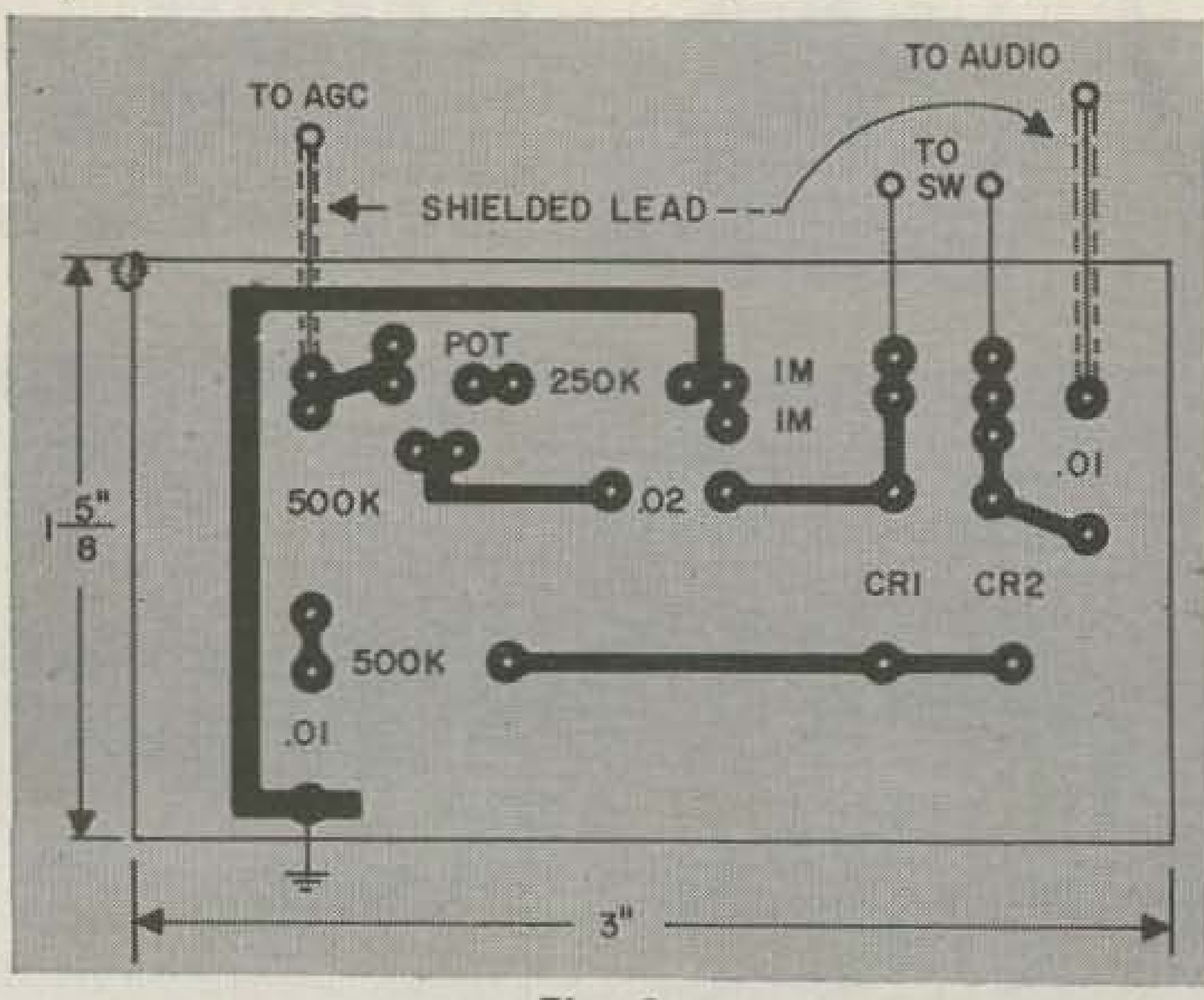
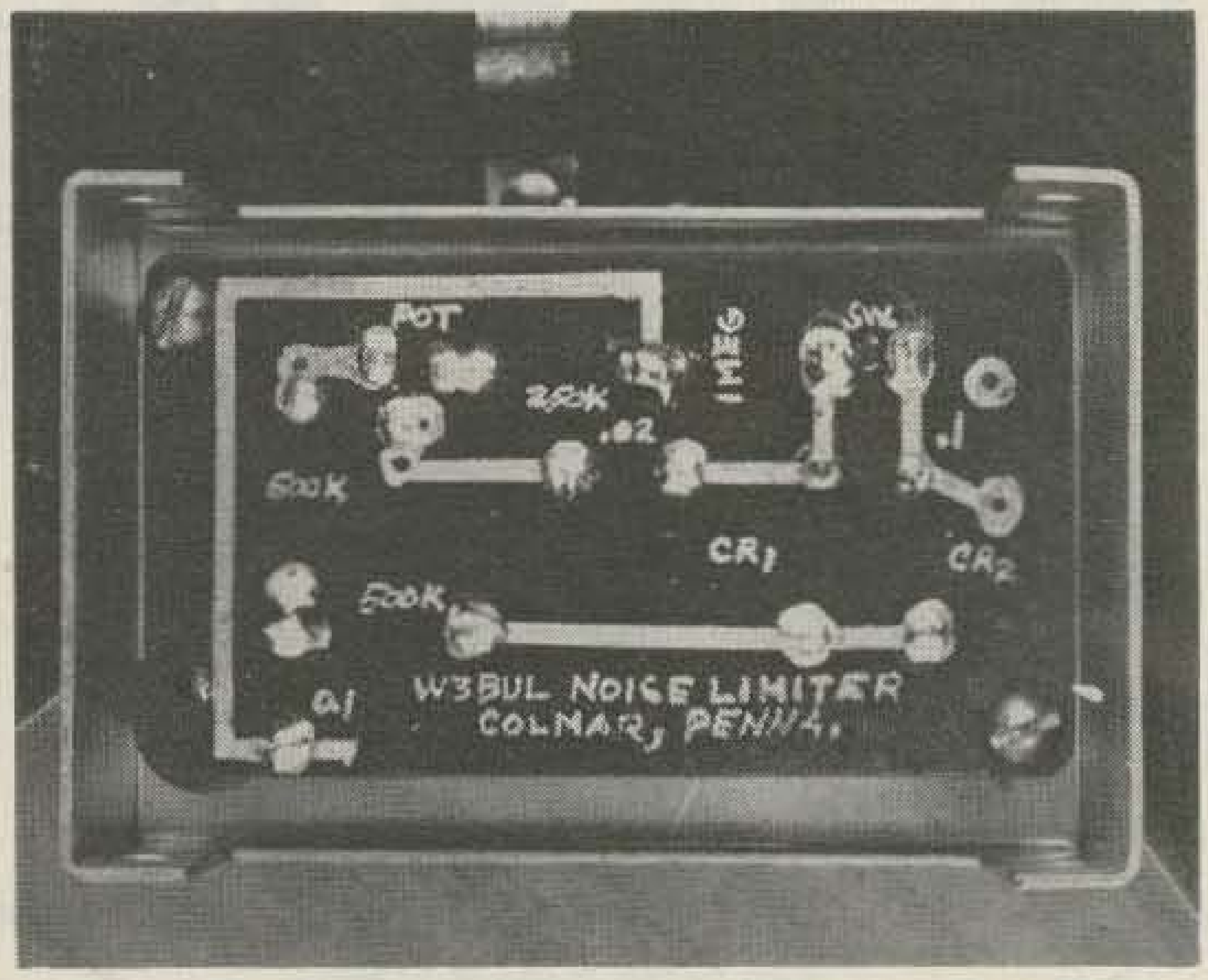



Fig. 3




and drill 1/16 inch holes for mounting component parts. Mount components as shown in Fig. 4 and solder in place using a good rosin core solder.

The author mounted the circuit board, .5 megohms potentiometer and a small slide switch in a small *Bud* Minibox 1⅝ x 2 x 3¼ inches in dimensions. The small box was then mounted under the dash of the auto near the receiver. Shielded leads are brought out from the auto radio to the noise limiter to reduce

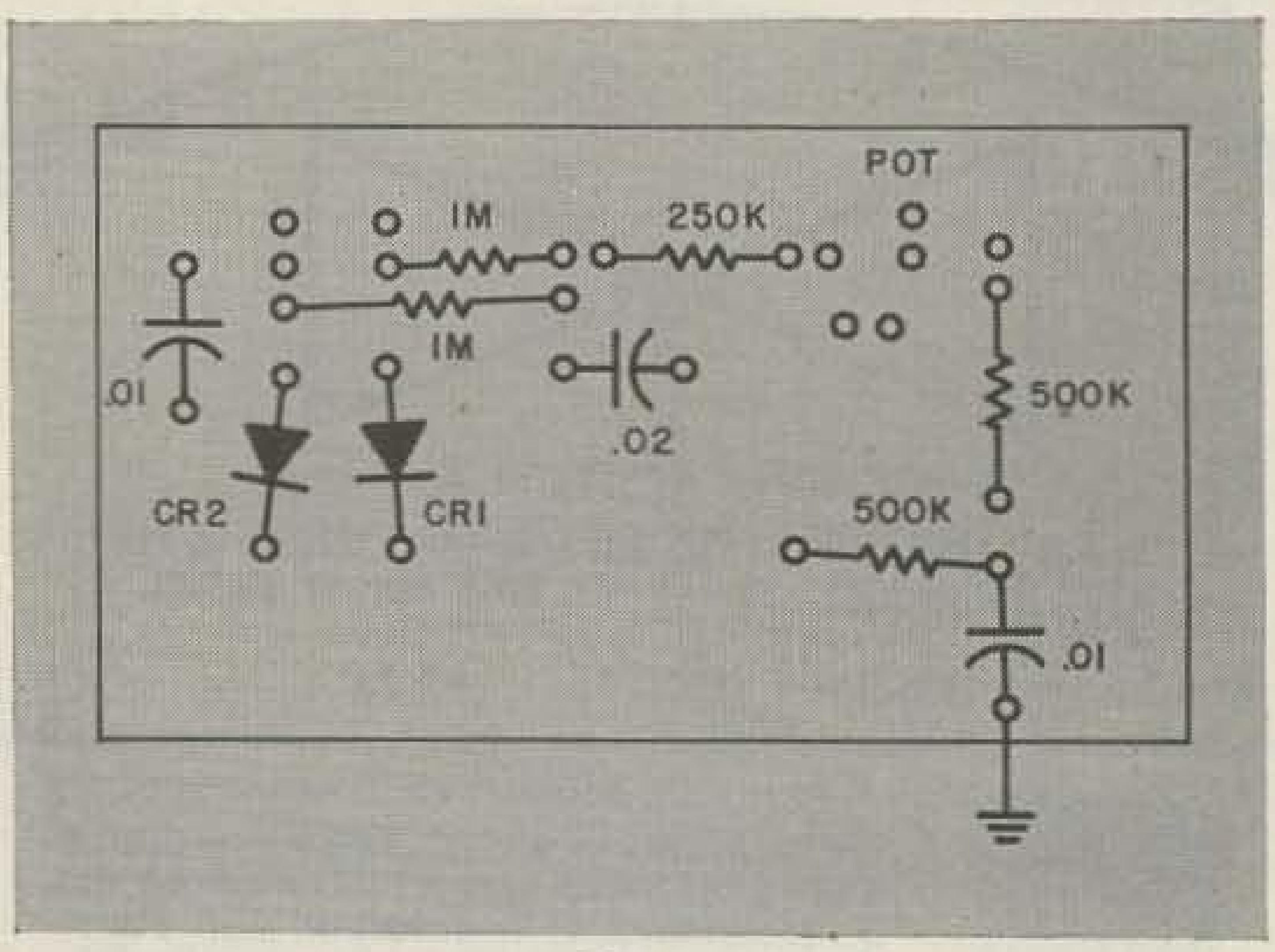



Fig. 4

hum and pick up. The circuit board is small enough to mount in the receiver of most any auto radio for those wishing to do so. The .5 megohms potentiometer may be mounted in any convenient location on the receiver and the switch may be left out. With the limiter switch on the *IN* position some gain is lost on the receiver, but most auto radios have gain to spare. The author uses the switch

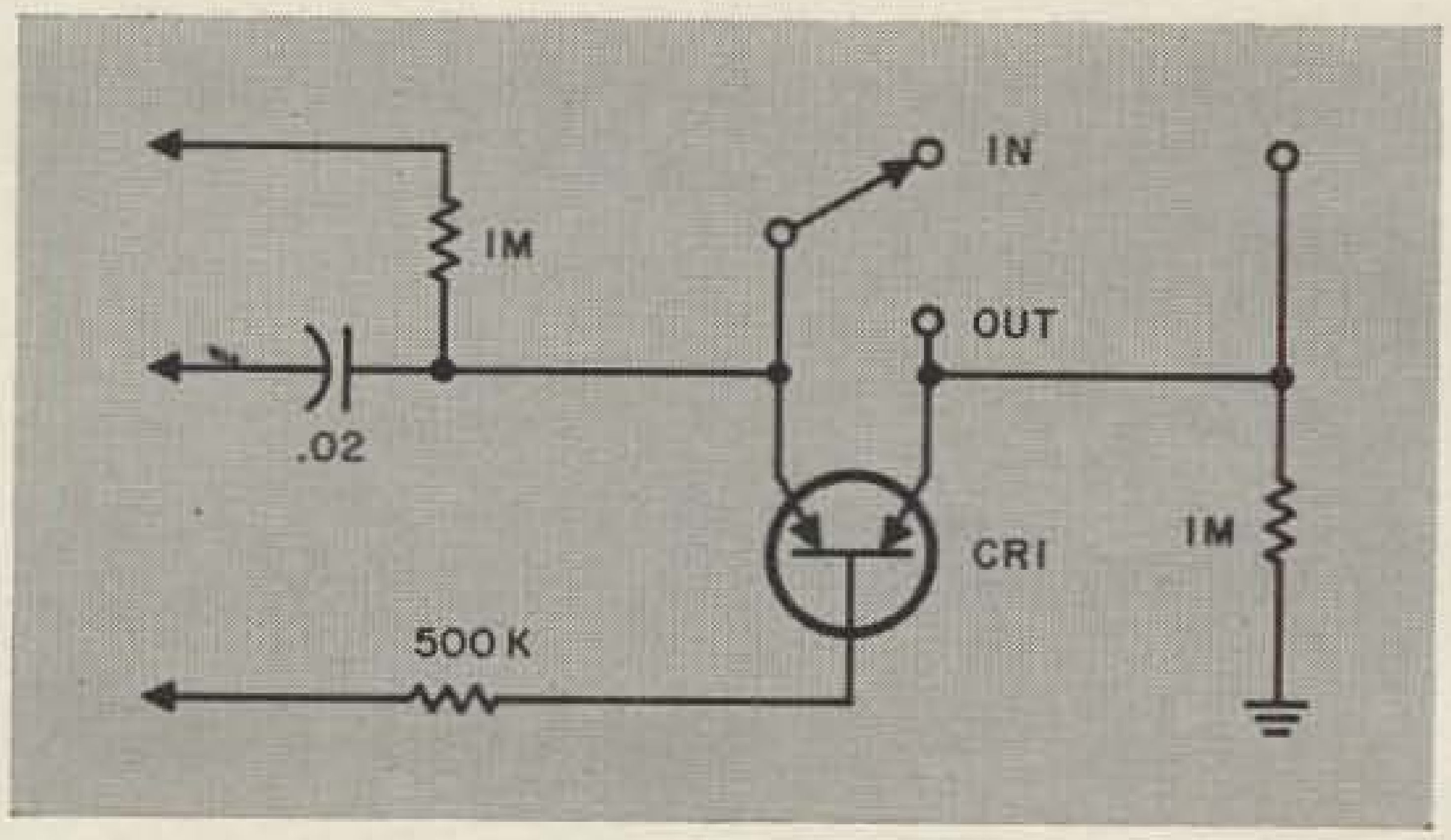



Fig. 5

mainly to prove to himself and others in demonstration how well the limiter really works.

After the circuit board is made and the noise limiter completed the maker may wish to experiment with various types of diodes. Its simply a matter of tacking diodes in place with the soldering iron. We recommend using silicon diodes with high back resistance and low forward resistance. We have used the 1N536, 1N537, 1N538 and 1N625, with the 1N625 diode giving best results. It is known that at least 50 diodes are commercially available suitable for noise limiters. The author is presently using a dual silicon diode Fig. 5 manufactured by the *Philco Corporation.* The unit uses a common cathode and two anodes and is mounted in the small TO-18 package and should be on the market shortly. It is expected to be seen in some of the communication receivers in the near future.

The described noise limiter using various diodes has been in the author's car for over six months and is still doing a satisfactory job. Several amateur friends have constructed the noise limiter and are using it with equal results. A noise limiter used in conjunction with a 10 meter rig makes the difference of making contacts in motion or just plain talking to yourself. . . . W3BUL

The circuit board for this noise limiter is available from Irving Electronics, P.O. Box 9222, San Antonio, Texas, for $1.00.

## O. O. T. C.

The OLD OLD TIMERS CLUB is making a canvass to determine the number of Amateurs holding a license and call today who were listed in the first Government call book, in 1913.

If you are one of those, please write the OLD OLD TIMERS CLUB, Earl C. Williams, Secretary, 507 Wayside Road, Neptune, N. J. giving first call, present call, and any other details believed pertinent.

Walter W. Reed K$\phi$AXY
St. Joseph's Hill Infirmary
Eureka, Missouri

# SSB vs. AM

**Brother Brenden checks one ear to see what damage extended listening to 75 meters may have done while Nurse Lea tries to clean out the 40 meter hokum from the other.**

SINCE the advent of SSB, its popularity has been steadily gaining. At its present rate of growth, SSB will account for almost all the phone signals heard on the ham bands in a few years.

While contemplating the purchase of SSB gear, my Scot soul asked the question: "Is there sufficient occupancy on SSB and enough favorable facts about SSB to justify the purchase of SSB gear?" A careful search through the magazines and other literature revealed that there was insufficient proof as to the amount of SSB activity.

Consequently, in the Octobers of 1957, 1958, 1959, and 1960, I endeavored to count all the "Q5" AM and SSB signals on the 10, 15, 20, 40, and 80 meter phone bands. Being a shut-in invalid, plenty of free time was available for counting. Even the night nursing brother cooperated by awakening me at the hours requested. For a number of statistical reasons, October was selected as being the best month.

The results are shown in the following table.

Almost 4000 signal counts were made, each one documented by call letters. Each hour of the day was checked on at least 7 days in October. Some hours had as much as 20 days of sampling.

It certainly looks as if SSB is beginning to live up to its often bragged about reputation as the most efficient mode of phone transmission. The percentage charts clearly show how SSB is gaining on AM. It is now apparent that SSB occupies a major segment of the phone bands. The remaining question is now: "How long will it be before AM becomes obsolete?"

. . . K$\emptyset$AXY

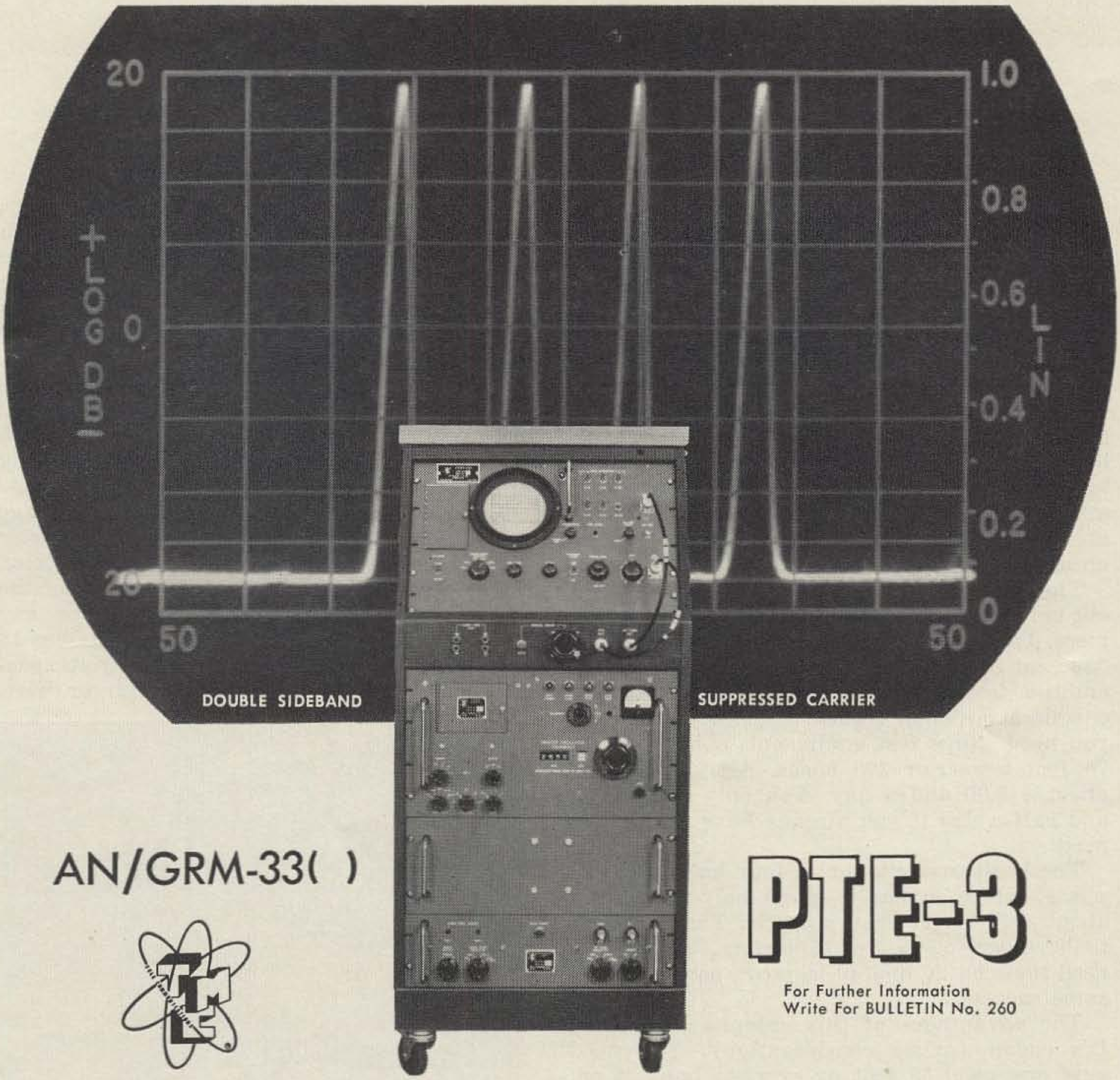
**PERCENTAGES OF SIGNALS THAT ARE SSB ON THE HAM BANDS**

| HOURS— | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24:00 C.S.T. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **80 Meters** | | | | | | | | | | | | | | | | | | | | | | | | |
| %-1957— | 19 | 24 | 22 | 14 | 13 | 17 | 15 | 15 | 15 | 12 | 08 | * | * | * | ” | 12 | 18 | 20 | 22 | 30 | 37 | 33 | 33 | 15—% |
| %-1958— | 29 | 18 | 14 | 17 | 29 | 21 | 13 | 11 | 23 | * | * | * | ” | ” | ” | ” | ” | 17 | 28 | 32 | 32 | 34 | 36 | 30—% |
| %-1959— | 25 | 26 | 16 | 18 | 19 | 15 | 21 | 17 | 09 | * | * | * | ” | ” | 33 | 24 | 35 | 37 | 40 | 44 | 42 | 40 | 30 | 32—% |
| %-1960— | 51 | 30 | 29 | 26 | 32 | 27 | 31 | 38 | 33 | * | * | * | ” | ” | 37 | 36 | 42 | 41 | 52 | 51 | 49 | 54 | 56 | 45—% |
| **40 Meters** | | | | | | | | | | | | | | | | | | | | | | | | |
| %-1957— | 13 | 10 | 00 | 06 | 03 | 10 | 13 | 13 | 11 | 15 | 13 | 09 | 15 | 40 | 16 | 13 | 20 | 27 | 27 | 34 | 33 | 36 | 33 | 28—% |
| %-1958— | 10 | 07 | 08 | 13 | 09 | 09 | 10 | 15 | 21 | 17 | 16 | 14 | 16 | 18 | 14 | 20 | 14 | 25 | 29 | 31 | 42 | 40 | 33 | 31—% |
| %-1959— | 23 | 30 | 25 | 13 | 22 | 21 | 24 | 20 | 24 | 17 | 20 | 20 | 19 | 21 | 18 | 22 | 35 | 33 | 42 | 34 | 39 | 35 | 37 | 35—% |
| %-1960— | 34 | 19 | 28 | 27 | 27 | 21 | 26 | 29 | 25 | 27 | 41 | 33 | 31 | 34 | 21 | 34 | 42 | 43 | 44 | 39 | 38 | 47 | 43 | 39—% |
| **20 Meters** | | | | | | | | | | | | | | | | | | | | | | | | |
| %-1957— | 30 | 40 | 25 | 24 | 30 | 40 | 33 | 27 | 31 | 30 | 32 | 27 | 39 | 35 | 30 | 30 | 33 | 37 | 39 | 43 | 29 | 35 | 35 | 35—% |
| %-1958— | 34 | 32 | † | † | 34 | 37 | 36 | 39 | 36 | 38 | 38 | 40 | 35 | 32 | 28 | 37 | 31 | 35 | 34 | 39 | 40 | 41 | 41 | 41—% |
| %-1959— | ** | ** | ** | ** | 34 | 42 | 43 | 38 | 38 | 50 | 47 | 45 | 47 | 43 | 47 | 39 | 41 | 44 | 44 | 44 | 43 | 53 | † | †—% |
| %-1960— | ** | ** | ** | ” | ” | ” | 48 | 53 | 45 | 40 | 50 | 47 | 46 | 50 | 50 | 48 | 50 | 51 | 54 | 53 | 61 | 31 | 36 | 30—% |
| **15 Meters** | | | | | | | | | | | | | | | | | | | | | | | | |
| %-1957— | * | * | * | ” | ” | ” | ” | 03 | 26 | 18 | 17 | 11 | 17 | 15 | 17 | 00 | 19 | 21 | 20 | 15 | 17 | 17 | 17 | 23—% |
| %-1958— | * | * | * | ” | ” | ” | 27 | 21 | 26 | 20 | 16 | 15 | 19 | 18 | 29 | 18 | 24 | 22 | 16 | 22 | 27 | 33 | † | †—% |
| %-1959— | * | * | * | ” | ” | 20 | 21 | 25 | 33 | 27 | 27 | 22 | 23 | 21 | 23 | 30 | 27 | 32 | 25 | 32 | 34 | ** | ** | **—% |
| %-1960— | * | * | * | ” | ” | ” | ” | 25 | 13 | 33 | 41 | 40 | 32 | 41 | 36 | 37 | 33 | 36 | 37 | 26 | * | * | * | *—% |

**10 Meters**
Insufficient SSB signals—less than two percent.

† Out
* Band Out
** Poor Band

# MANUAL SWEEP CONTROL




AN/GRM-33( )

# PTE-3

For Further Information
Write For BULLETIN No. 260

## SINGLE SIDEBAND ANALYZER

Manual Sweep Control, a new feature, has been added to our versatile side band analyzer PTE-3. Minute inspection of every segment of the entire sweep is possible with this device.

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In addition to SSB analysis, the PTE-3 is ideally suited to Production Line testing and analysis of equipment for "noise", "distortion", hum, location and identification of spurious frequency interference, carrier suppression and setting of tone and carrier levels.

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# A Square Antenna

THE story of the square antenna should be preceded by one or two Twentieth Century observations. First is: hams are vacating the cities for the promised land of suburbia. Unfortunately, there is no more land in suburbia than downtown. This writer recently moved from a downtown Baltimore row house (with a spacious yard) to a Los Angeles suburb (with a putting green). The second observation deals with antennas and, in a sense, with lot size. I can't remember the last time I talked to anyone who wasn't using: a beam, a quad, a vertical, a dipole, or a "long wire." How about you? Have you talked to anyone using an antenna-exotica lately?

The square antenna about to be described not only works but is an amazing conversation piece. The user of this antenna is automatically "one cut above" the dipole or vertical user. In addition to these benefits, you don't have to be a whiz at antenna theory to put it up, nor do you need fancy test equipment, a big yard, a 70 foot tower, or 200 bucks. All you need is about $15.00 and a day. You only need $5.00 and half a day if you already have a tower or mast.

The bi-square antenna is four half-waves in phase, which makes it three half-waves and about 4 db better than a dipole. The bi-square to be described is for 15 meters, but I have used them on 20 and 40 in years past with the same success.

The advantages of this antenna are many. It's cheap (prime consideration). You need only one pole, 35 feet or over, to hang it on. It is bi-directional. You can hang two of them on one pole and cover 360 degrees. It's easy to tune. It has 4 db gain, which puts it in the well tuned two-element beam class. It is also good competition for the "pre-tuned" or untuned three-element beam. In short, it's a great little antenna. And yet it's as rare as a democrat in Maine.

The bi-square filled my needs perfectly. It's a foolproof wire with adequate gain which can be erected in a small space (see Fig. 2). My first three contacts were Hawaii twice and a maritime mobile off the East coast of South America. S-9 or better all the way around, with a mere 150 watts of sideband.

Figure one almost tells the whole story. Each side of the bi-square is a half wavelength at the high end of 15 meters. It is open at the top, terminated at a dipole insulator. The ends are held aloft by strain insulators to ropes to fenceposts to trees, lightpoles, or other handy anchors. The base of the bi-square, which in my case is about 4 feet from the ground, is terminated in a quarter wave, shorted stub, 12 feet long. The whole fandangle is fed with twinlead. The only stopper is the matching stub and that's no hill for a climber.

Since the base of a bi-square is a voltage point, it has to be matched with a quarter wave, *shorted* stub. The stub is 12 feet long, before shorting, and can be an extension of the legs of the bi-square or "ladder-line" or any other size wire that's handy. I used number 18 enamelled wire spaced at 3 inches. Stub spacing should be 4 to 5 inches for larger wire.

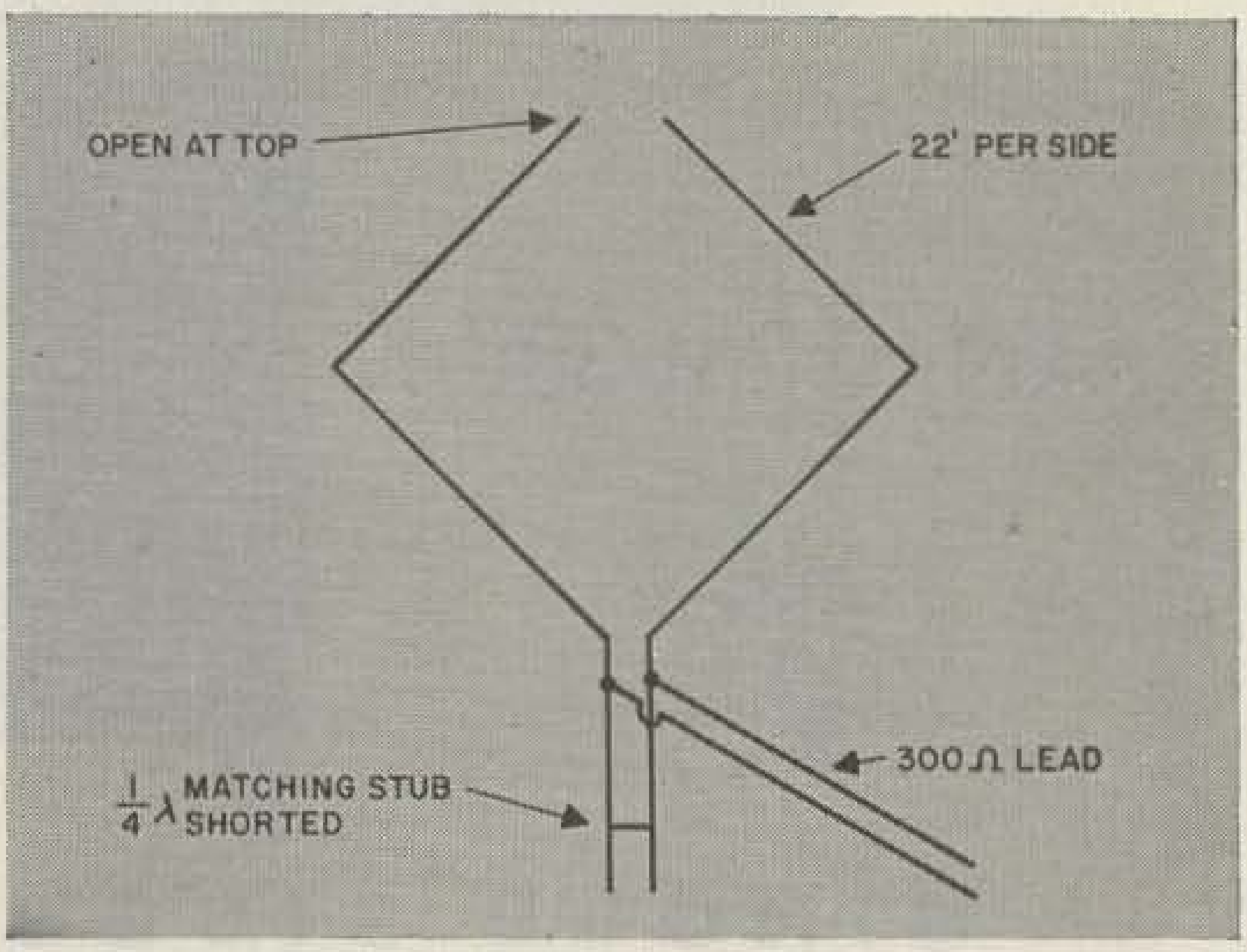



Fig. 1. Bi-square antenna for 15 meters. A horizontally polarized, broadside, bi-directional array with a gain of about 4 db. It is constructed with ordinary antenna wire and fed with twinlead. It requires only one 35 foot (or taller) pole for support.

As can be seen in Fig. 3, stub wires are held a constant distance apart by TV standoffs, but the purist would want spacing insulators. My stub runs vertically up the mast from the base of the bi-square. This is probably not the best direction to take a stub, but I had little choice. At least it keeps everything symmetrical, which is a consideration.

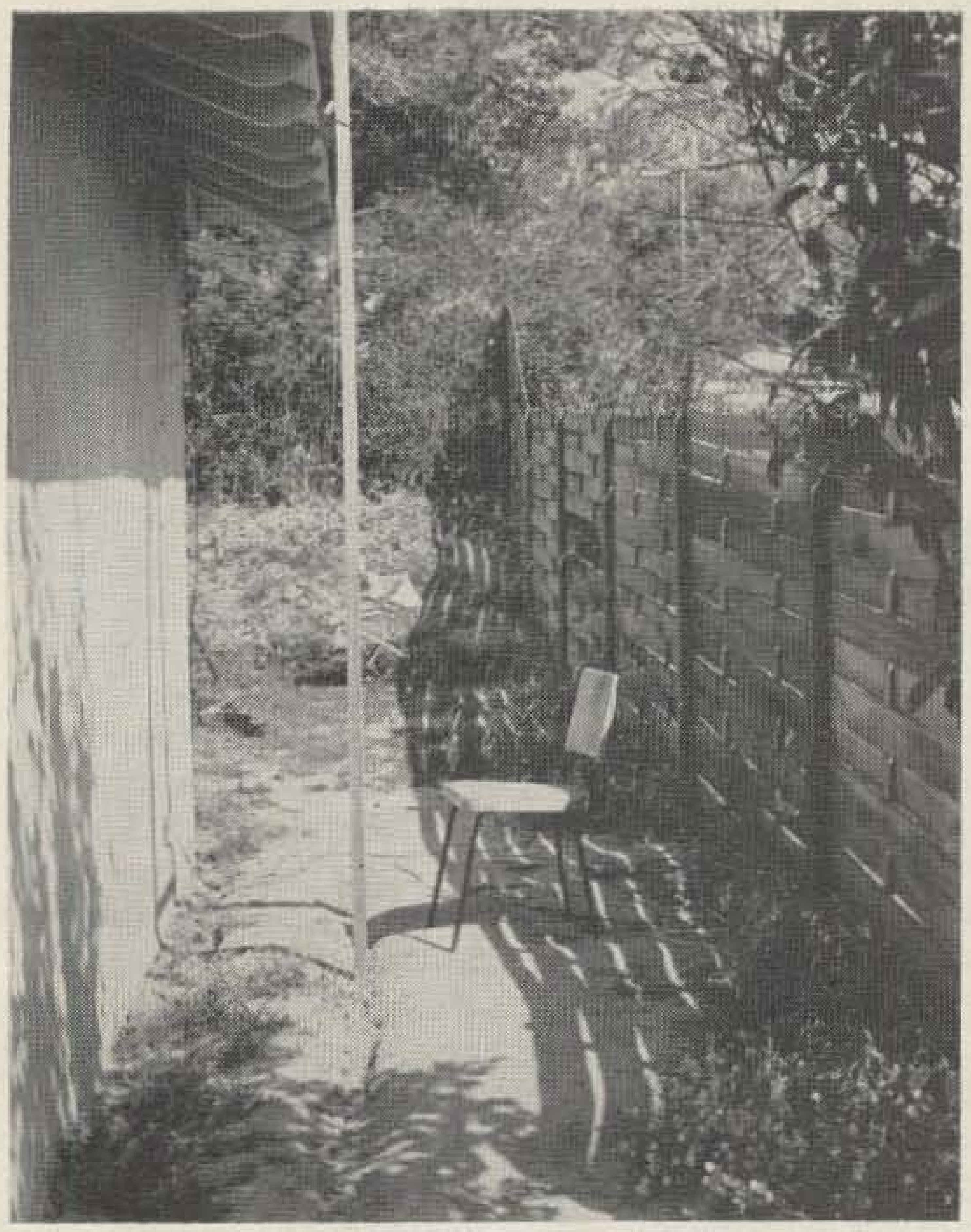


Fig. 2. The wide open spaces of Suburbia. The vertical board is actually an "A-frame," end view. The broadside of the bi-square is parallel to that lovely fence, dividing my tenth-acre estate from my neighbors.

The first step is to get the antenna in the air and get the stub attached. My mast has a rope-pulley arrangement a la flagpole. The next thing is to locate the point at which the stub is to be shorted. An easy way to do this is to "shock-excite" the bi-square. Fire up a nearby antenna with 15 meter energy and check for a high current spot on the bi-square stub. This can be done by using your simple light bulb rf detector. Shorting the stub with this gadget, find the point of maximum bulb brilliance, and that's where you make a permanent short. Use a low-current bulb (dial lamp) and be sure to scrape enamel from the portion of the stub you're testing. The short will probably come within thirty inches of the end. If you have a grid dip meter you may find it simpler to use that handy device in tuning the stub. Place a temporary short near the end of the stub, and with your dipper, check the frequency. Move the shorting wire until you're on the desired frequency. Instructions covering this procedure are detailed in your grid dip meter manual.

After the stub is properly shorted, the next step is to connect the twinlead feedline. I soldered alligator clips to my twinlead for this little chore. All you have to do is move the feedline up and down the shorted stub until you have a desirable standing wave ratio. After only about 10 minutes of fooling I got

(Turn to page 16)

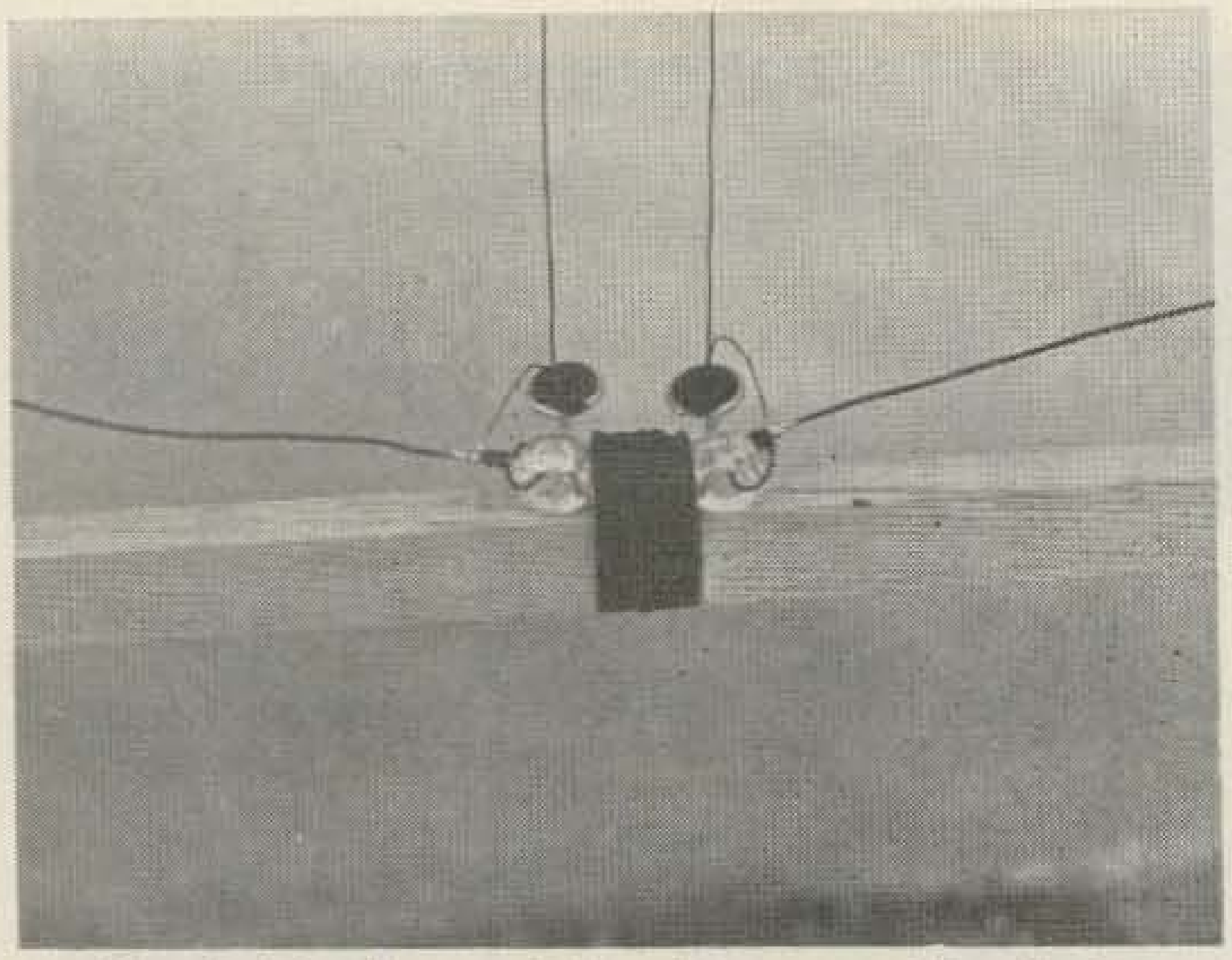


Fig. 3. The base of the bi-square. The timber is the crossmember of the "A-frame." TV standoffs are used to space the stub wires about 3 inches apart. (The small wires are the stub, the heavy wires are the beginnings of the antenna.) That's friction tape securing the base insulator.

my SWR down so low it's not worth mentioning.

Once, before the popularity of the SWR bridge, I connected a bi-square feedline merely by finding the point on the stub where the transmitter loaded best. So, if you don't own an SWR bridge and can't borrow one, just hook the feedline for maximum output. (I am assuming that if you don't have an SWR bridge you don't have field strength measuring equipment. If you do, the use of said equipment would be preferable, of course. Field strength checks are worthwhile under any circumstances).

The only other problem is that of matching your transmitter to the 300 ohm feedline. If you have balun coils you're all set. If you don't, you might be interested in the balun I constructed. This particular balun idea was first given me by Jack, W8LI0. It is used occasionally to match coax to beams, but rarely as a balun, matching coax to twinlead. It's both simple and cheap. Fig. 5 shows the hookup. A 15′ 2″ (.66 times ½ wavelength) piece of 72 ohm coax is made into a loop and the outside shield is soldered together. (.66 is the velocity factor of coax. See April 73, p. 27 for details.) A similar 72 ohm coax from the output of the transmitter connects braid to loop broid and center conductor to one center conductor of the loop. This is, as is a balun, a re-entry transformer, effectively quadrupling the impedance of the line, which puts you at around 288 ohms. Close enough. The 300 ohm line is hooked to the center conductors of the loop as in Fig. 5. This, of course, is good for only one band—but what a simple device.



As might be expected, there are other ways to feed the bi-square. The chore is to transform the antenna impedance to the line impedance and then in turn match the line to the transmitter tank circuit. If you're feeling experimental, you might try a different method. Several are outlined in detail in the Handbook. I picked the quarter wave shorted stub system because of its simplicity.

As noted, this antenna is four half-waves in phase and a broadside radiator. There is a moderate null off the ends of this antenna. One interesting aspect is that despite the diagonal positioning of the elements, the array is horizontally polarized. In some quarters, this will be thought to be an advantage, especially when talking to the squad, beam, dipole group.

The mast used here is a simple "A" frame made of knotless, Douglas Fir. It is supported by nylon rope. The 40 meter bi-square I used a few years ago was supported by a 70 foot, steel tower. The air was full of steel guy wires and I had to string the bi-square elements between them. The successful use of both of these antennas would lead me to believe that you can use any available support, but probably a non-metal one is desirable.

Fig. 5. Poor Man's balun. 72 ohm coax to the transmitter is at left, the balun loop is vertical in this photograph, and the 300 ohm twinlead is at right. All coax braids are connected. This system is sometimes used for matching feedlines to beams, but has been neglected in matching a transmitter to 300 ohm line—the use it's put to here.

If you already own a huge tower, by all means hang the bi-square as high as possible. In order to tune from the ground, you can use a ¾ wave shorted stub with nearly the same efficiency as a ¼ wave shorted stub. The same rule applies to this antenna as to all others—the higher the better.

It was mentioned earlier that two bi-squares could be hung on the same pole for 360 degree coverage. The only caution is that the stubs and feedlines do not parallel each other. Separate them by as close to 90 degrees as possible.

Now is the time to get out that old roll of antenna wire and try something different. If you're burning with ambition, you might try putting a reflector on your bi-square. Space it at around 0.15 wavelength and tune it with a stub too. In fact, with a little ingenious switching, you ought to be able to make either element in your "reflected bi-square" the driven element, and thus have a "reversible, reflected bi-square." There's an 8.5 db conversation piece for you. As Fig. 2 attests, I don't have room for a reflector—but if I did, I'd be out there tuning right now.

The bi-square was introduced to me years ago by Jack, W8LIO, who has used this and hundreds of other "far-out" antennas. When I got my first 40 meter bi-square into the air and talked to South Africa with 100 watts of AM phone, I was sold. You will be too.

... W8GUE/6

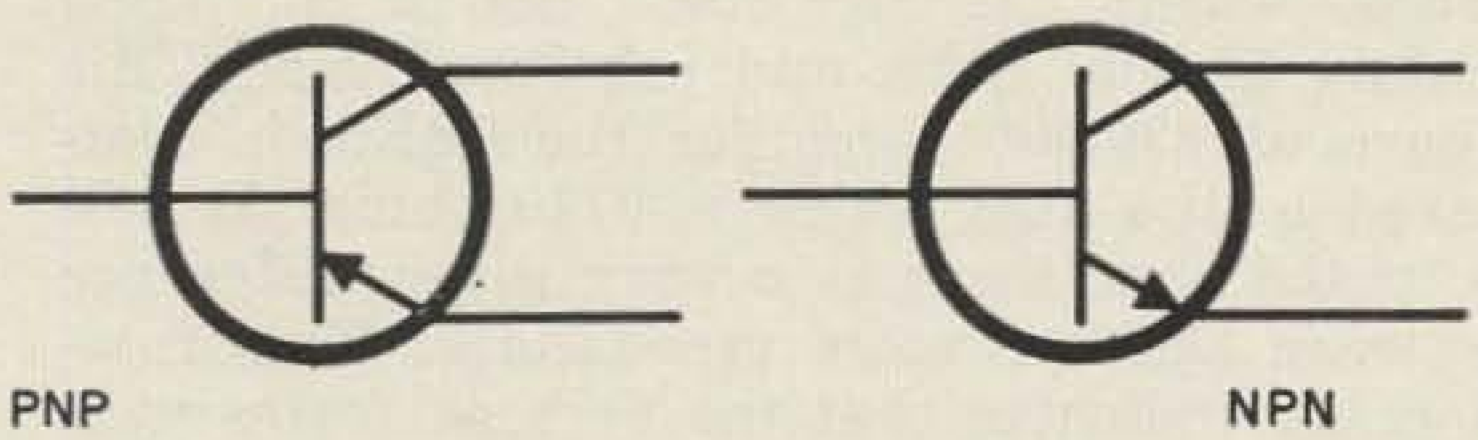
---

Easy Method to Remember

## Transistor Symbols

Many people, especially those not working daily with transistors, have trouble identifying and telling the difference between the standard PNP and NPN transistor symbols as shown in Fig. 1.

The direction of the arrow, of course, tells the difference. That is, whether the symbol represents a PNP or an NPN transistor. But this in itself can cause confusion, not to mention embarrassment, when the ole' memory fails. Use of a simple memory "hook," or associated mental picture will prevent such forgetfulness.




An excellent memory "hook" is one involving the positive and negative extremes of potential difference. When a difference of potential is visualized, ground potential is thought of as negative (N) and "down below" the positive (P) potential point. Likewise, the positive (P) potential point is thought of as "up above" ground. By picturing in your mind positive-P-up and negative-N-down and comparing this picture with the arrow direction of the transistor symbol, you will see that the arrow of a PNP transistor points *up* towards P, the first letter of the transistor type, and the arrow of the NPN transistor points *down* towards N, the first letter of this transistor type.

... W2VSP

Frank Merritt

# The Drake Receiver

ALTOGETHER too seldom is a new receiver introduced that is really "state-of-the-art." The Drake 2-B receiver is an improvement of the 2-A, which was a modernization of the original 1-A model. All three incorporate many very fine principles of receiver design. Physically the receiver is quite small. Its dimensions are: 12" long, 7" high and 9" deep. Weighing only 14.5 pounds this receiver only uses 40 watts from the power line. This is significant since there is much less heat dissipated in this unit than many standard types of receivers. The top cover is made of perforated steel to aid in heat dissipation.

### Circuit Operation

The block diagram in Fig. 1 shows the basic operation of the receiver. A 6BZ6 is used as a pentode rf amplifier. This tube exhibits semi-remote cutoff characteristics thus providing good control characteristics and low intermodulation. This stage is tuned by one dual control. As the BAND switch is positioned to the various bands additional inductances are switched across the basic tuned circuits allowing complete coverage of from 3.5 to 30 mc. Enough gain is provided by the rf amplifier to effectively mask any noise generated by the 1st mixer. The pentode section of a 6U8 is used as the 1st mixer. On all bands except 80 meters, this tube is operated as a mixer. When used for 80 meter operation, the oscillator is disabled and the pentode section of the 6U8 is used as a second rf amplifier.

A low-pass filter is used in the output section of this tube. This is used to prevent undesired mixed products being presented to the input of the *if* section. This filter is packaged as T1. The choice of a pentode-6U8 as the mixer is a good one. In any receiver most of the noise generated is created in the highest frequency mixer stage. The function of an rf amplifier is two-fold in that the rf amplifier must provide enough signal so that the noise of the mixer is not objectionable and selectivity at rf is also achieved. The basis for comparing tubes in terms of noise generation is that of comparing the equivalent noise resistances of the tubes involved. For instance, a 6BE6 exhibits a conversion transconductance of 475 micromahs which results in an equivalent noise resistance. Req, of about 230,000 ohms. The noise resistance is a function of the noise generated within the tube itself and is composed mainly of shot noise and partition noise. This figure of 230,000 ohms for the 6BE6, is compared to the 6U8 which is 9120 ohms. It will be noted that there is a very great difference between the two noise resistances. This relationship indicates that the 6U8 performs very well in mixer service at HF and VHF. This prediction is borne out in practice. A number of hams have dropped by to see the "new goodie." Almost every one has mentioned how quiet the 2-B sounds.

### First IF Section

A frequency from 3500 to 4100 kc is presented to the first IF section. A 6BE6 is used as a combination variable frequency oscillator (VFO) and mixer. The output of the 6BE6 is 455 kc. Since the oscillator is variable, tuning is accomplished in this section. Since only one frequency range is converted by the oscillator and this frequency range is very low, 3955 to 4555 kc, unusual stability is made possible.

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New frame grid mixer tubes are used for less heat and better production uniformity with the same reduction in spurious radiation products as properly adjusted 12BY7's.

Temperature compensation has been added to the high frequency crystal oscillator circuit for improved stability.

The 200V sounds best and operates the easiest of any transmitter on the market today.

Why don't you like try one?

73

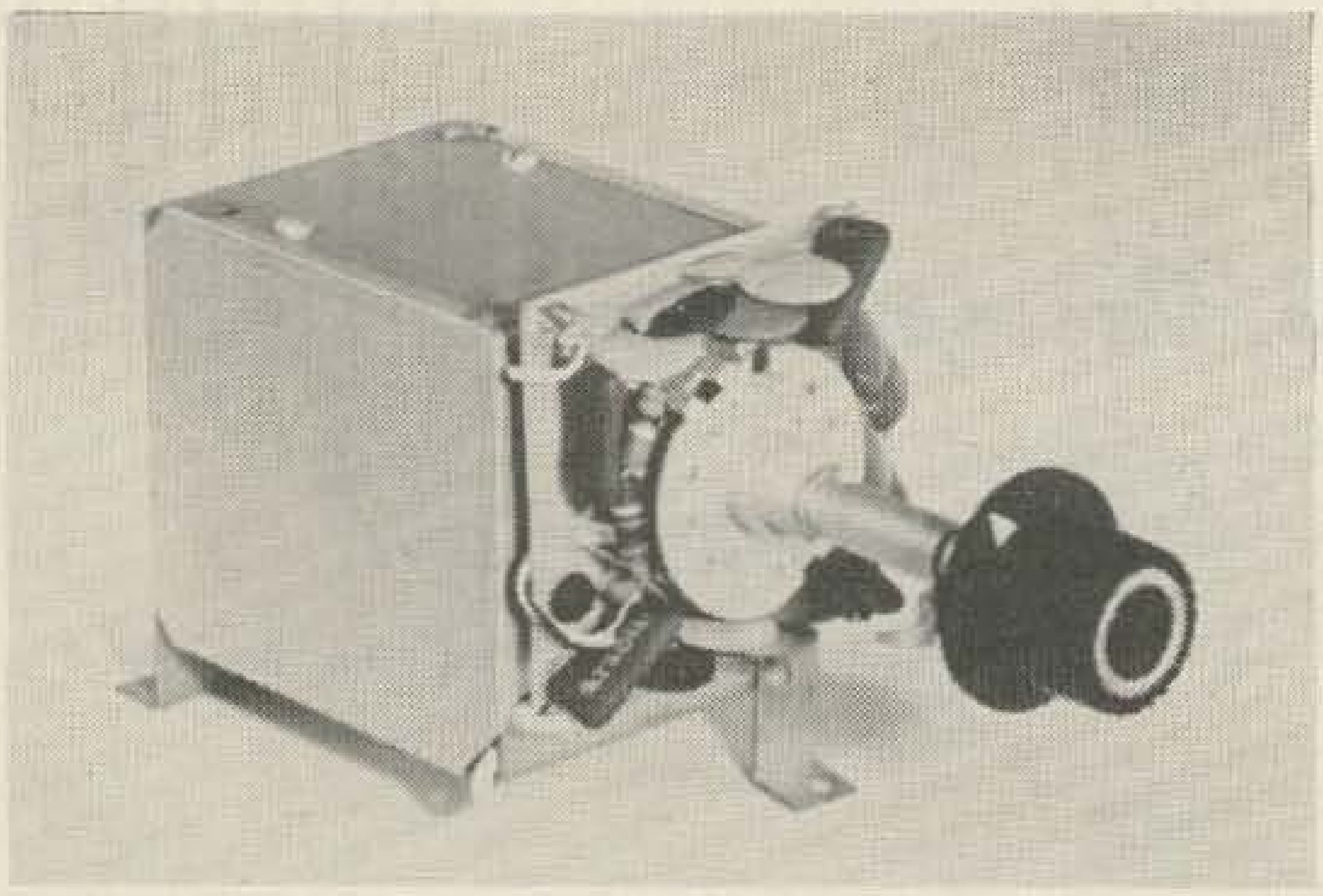
Wes

Wes Schum, W9DYV

Hope to see you at the:

Central Division ARRL Convention at Springfield, Illinois on August 26 and 27.

Western Single Sideband Convention at Santa Maria, California on September 29 through October 1.



Great pains have been taken to result in an oscillator design that is extremely stable. In repeated experiments it has been found that the test receiver tested achieves 90% of its frequency stability in the first 30 seconds. This is well within the specification of less than 500 cps warmup and 100 cps thereafter. In fact, it has been noted that the warmup drift in a normally heated room is inconsequential. With this receiver, no longer is it necessary to indulge in long receiver warmup periods. It is significant to note that during sideband operation no drift is noted in normal operation.

### Third Converter, Filter and IF Amplifier

The output frequency from the VFO-mixer circuit is 455 kc. This frequency is converted down to 50 kc for filtering. The tube used for this purpose is another 6BE6. The oscillator section of the 6BE6 is fixed-tuned at 405 kc. The output frequency, 50 kc, is presented to a passband filter/tuner. This is the heart of the 2-B and establishes the selectivity characteristics of the receiver. A switch lever selects bandwidths of 0.5 kc, 2.1 kc or 3.6 kc and a concentric shaft moves the passband, without changing its shape, above, through and below the fixed BFO frequency. This combination works wonders on CW, SSB and AM.

On CW, with a crowded band like the Novice portion of 40 or 80, put the lever in the .5 kc position and you can select and separate any signal out of a possible 10 or 15 just by tuning around with the passband tuning knob.

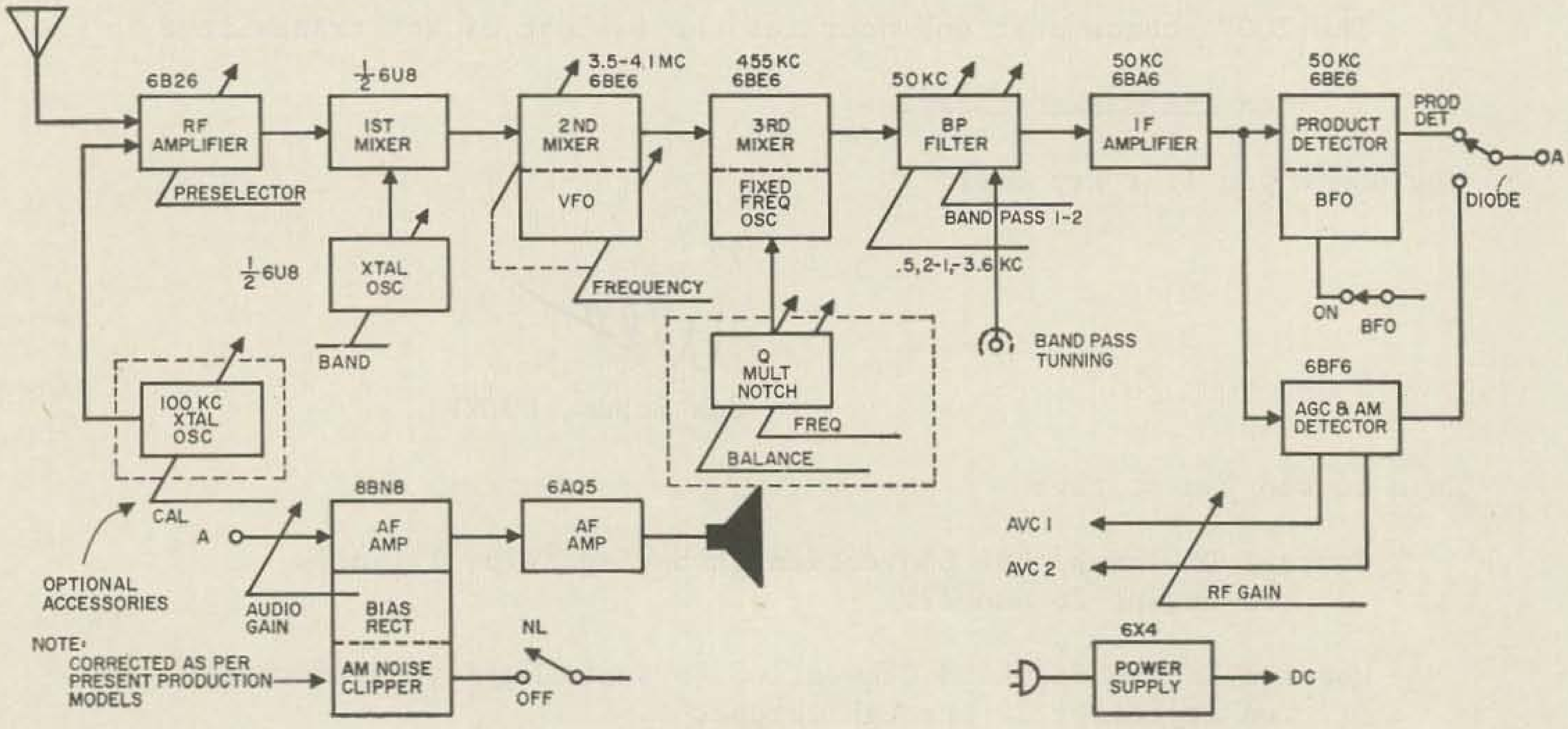
Normal SSB reception is made with the lever in the 2.1 kc position, though it can be copied in the .5 kc position when the QRM gets rough. You can get "hi-fi" SSB with the switch in the 3.6 kc position and the skirts on this new filter are steep enough for good unwanted suppression even in the wide position. At any bandwidth the passband tuning knob permits selection of upper or lower sideband and adjustment of voice quality without retuning the frequency.

The 3.6 kc bandwidth is just right for AM. However, if receiving conditions become unbearable due to interference or selective fading, switch on the product detector and cut the bandwidth to 2.1 kc or even .5 kc!

On the remote chance that someone might want even more selectivity Drake has a combination loudspeaker and Q-multiplier available as an accessory. Adding the action of the Q-multiplier and the passband filter you get such a sharp notch that it can separate almost anything. The Q-multiplier is much more valuable when used in the notch position. Reception through almost any ham band bedlam is possible. The Q-multiplier may also be used as a notch filter for phone operation. After the *if* filter an *if* amplifier is provided to raise the level of the signal to be suitable for detection. This amplifier uses a 6BA6. The S-meter circuit is in the plates of the *if* and rf amplifiers. A bridge-type circuit is used with a 100 microfarad capacitor shunting the meter for critical damping.

### Detector

One of the strongest points of this receiver is the product detector. A 6BE6 is used as a



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**Maximum power input:** SSB—1000 watts P.E.P., CW—1000 watts, AM—400 watts (500 watts using carrier controlled modulation), RTTY—650 watts. **Driving power required:** 50 to 75 watts—depending on frequency. **Output circuit:** Variable pi-network (50 to 75 ohms). **Input circuit:** Broad banded—requires no tuning. **Input impedance:** Approx. 70 ohms. **Band coverage:** 80, 40, 20, 15, 10 meters. **Panel metering:** Switch-selected, grid current, plate current, high voltage and relative power output for ease of loading. **Tube complement:** 4-811A, 2-866A. **Size:** 19½" W x 11⅝" H x 16" D.

This inside view shows the neat circuit layout and husky components that emphasize quality. Note the internal shielding of plate circuit for maximum protection against TVI.

## CHECK THESE FEATURES . . .

*Completely self-contained* . . . HV, Fil. and Bias supplies built in.
*Versatile* . . . May be driven by any 50 to 125 watt transmitter or exciter—no matching or swamping network required.
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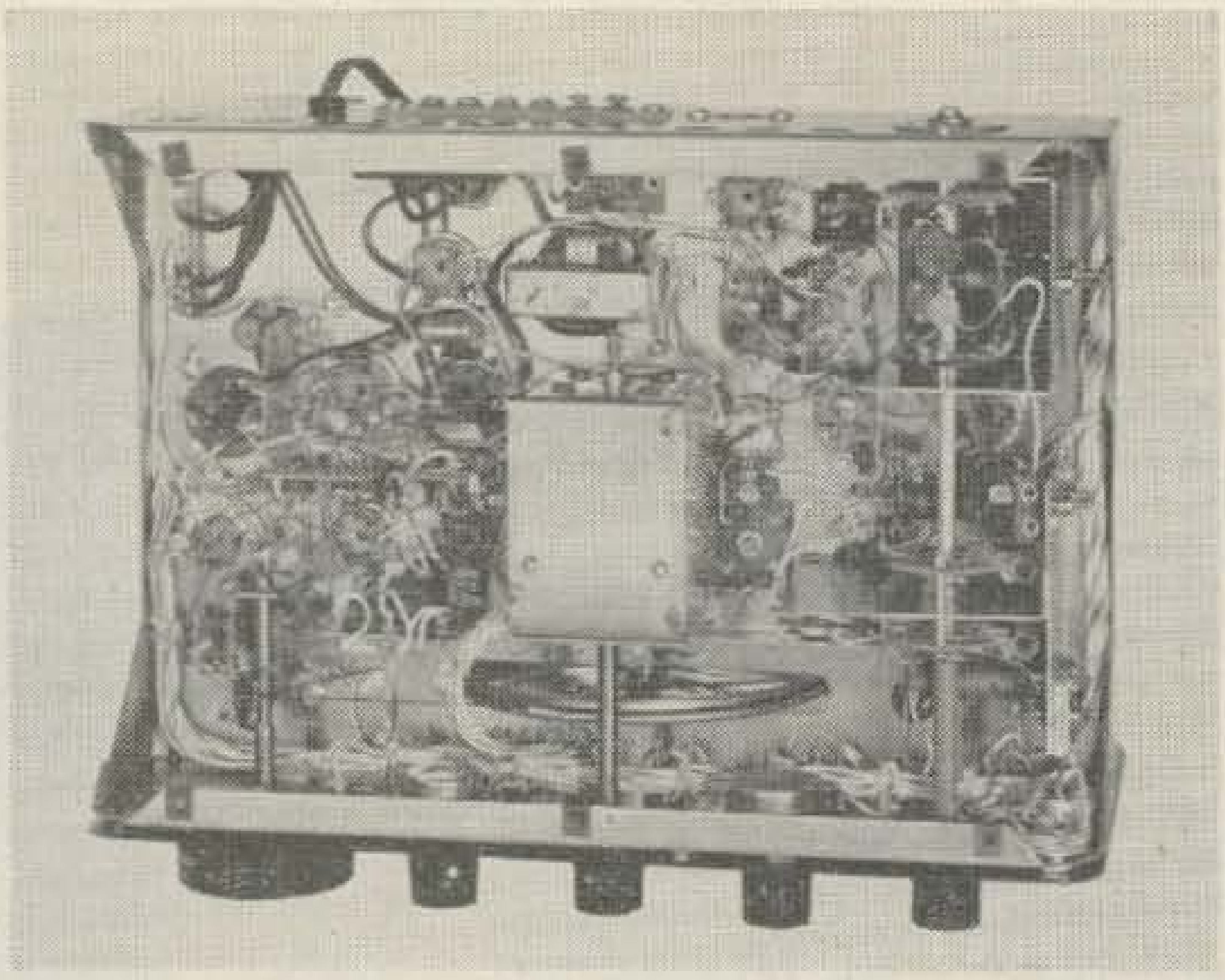
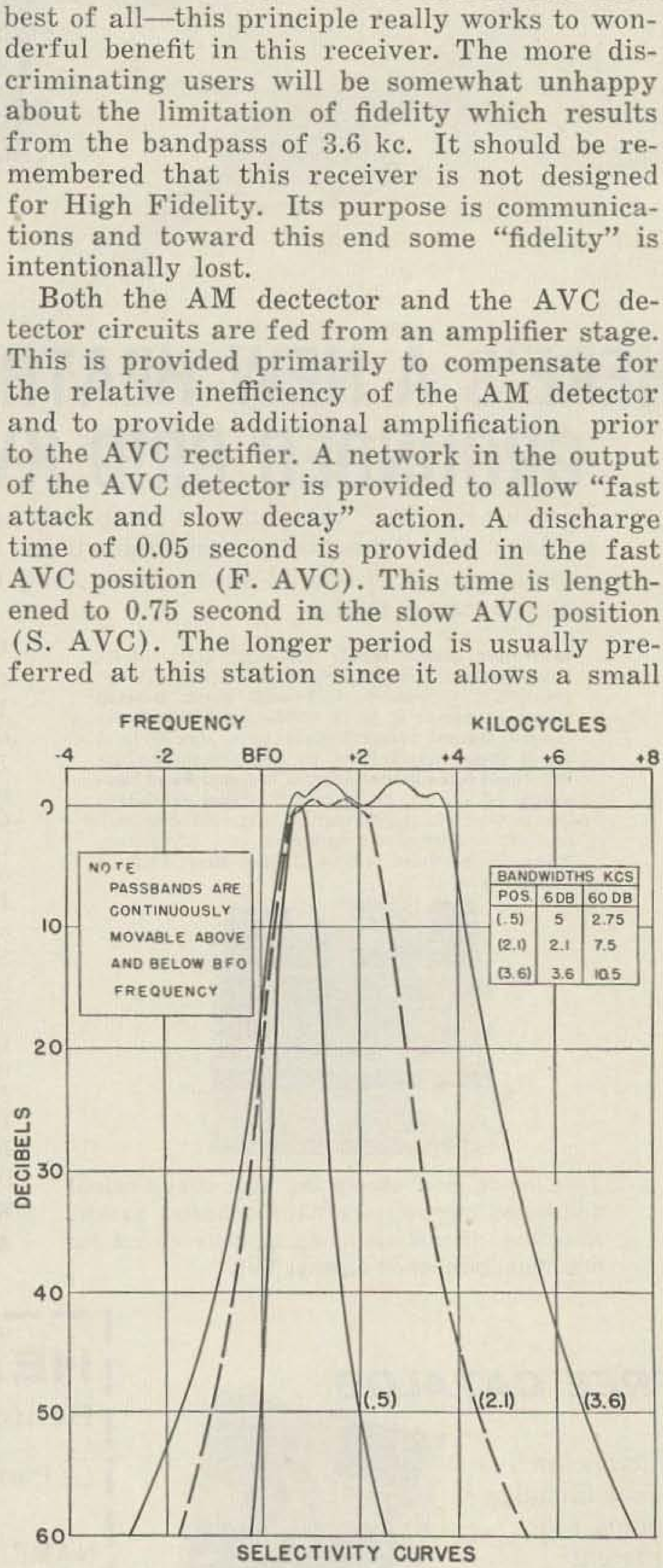


product detector and BFO. No provision is made for tuning the BFO. This is indeed a radical change from conventional circuits. Let us, for a moment, analyze the two usages of the BFO. First, the BFO is used to create a beat frequency when the BFO is heterodyned against the CW signal. This example may be thought of as two frequencies beating against each other to result in an audio tone when the received CW signal is present. In using this receiver for CW, it is necessary to select the desired tone by the main tuning dial and then positioning the PASSBAND control for the desired operation. In order to achieve single-signal selectivity it is usually most convenient to present the PASSBAND control to either 1 or 2. This action selects the upper or lower sideband of the heterodyne. Strong adjacent channel interference can usually be eliminated by carefully tuning the PASSBAND control to drop the interfering signal off the edge of the passband. When the Q-multiplier is used, the selectivity is increased very greatly. In peak operation the Q-multiplier provides a frequency selective boost of 20 to 30db.

The second usage of the BFO is as a reinserted carrier oscillator. The reinserted carrier provides a signal for the sidebands to heterodyne against thus producing the original audio modulation. The PASSBAND control selects the sideband that is used to heterodyne against the reinserted carrier. The advantages offered by a product detector are twofold. First, the amplitude of the incoming signals, sideband intelligence, does not have to be matched against a fixed amplitude of BFO to result in a condition of 100% modulation. Since the process of detection is one of frequency conversion only enough signal to cause a heterodyne is necessary. Secondly, only the audio products are heard in the output and no other signal or signals have any control in the output. In diode detectors it is common for a strong signal, that may be 10 or 20 kc off-frequency, to capture the detector and block it. This is impossible in a product detector due to the basic nature of the frequency conversion process. With ALL types of modulation it is possible, with this receiver, to turn the RF GAIN control to the full CW position (maximum sensitivity) and leave it there. In fact, for all practical purposes don't bother with it. The AF GAIN control is all that is needed to control the output of the receiver.

A diode detector is provided for the reception of AM signals. This is a common type of circuit and will not be discussed in detail. It will be found that the PASSBAND control is a boon even for AM. A common situation is that interference may be predominate on one sideband but not on the other. In this case it is only necessary to tune the sideband that has the least amount of interference. And best of all—this principle really works to wonderful benefit in this receiver. The more discriminating users will be somewhat unhappy about the limitation of fidelity which results from the bandpass of 3.6 kc. It should be remembered that this receiver is not designed for High Fidelity. Its purpose is communications and toward this end some "fidelity" is intentionally lost.

Both the AM dectector and the AVC detector circuits are fed from an amplifier stage. This is provided primarily to compensate for the relative inefficiency of the AM detector and to provide additional amplification prior to the AVC rectifier. A network in the output of the AVC detector is provided to allow "fast attack and slow decay" action. A discharge time of 0.05 second is provided in the fast AVC position (F. AVC). This time is lengthened to 0.75 second in the slow AVC position (S. AVC). The longer period is usually preferred at this station since it allows a small



period of time before maximum sensitivity is restored. A terminal is provided on the rear of the chassis to provide additional capacitance to increase the decay period. In the STBY position, the STDBY-RCV switch permits full negative bias voltage to be provided to the AVC controlled circuits thus muting the receiver. Access is provided at the rear of the chassis so that this function can be provided by an external circuit such as a switch or relay.

### Audio

Post detector amplification of the audio signal is provided by a 6AV6 triode amplifier. It should be noted that in the output of the product detector there is a low-pass filter that has a 3-kc cutoff frequency to further limit the high frequency response of the product detector. The power output stage is a 6AQ5 in a conventional-type circuit. The audio output is available at the front of the receiver at a phone jack. When headphones are plugged into the jack, audio power is automatically removed from a loudspeaker that may be connected to terminals on the rear of the chassis. While not overwhelming, the audio output is adequate for all normal purposes. If additional power is desired, for some reason, little problem is presented in connecting an auxiliary power amplifier to the receiver.

### Summary

The *if* skirt selectivity of this receiver is almost as sharp as that provided by mechanical filters or crystal filters and is a pleasure to use. The stability factor is of the highest order. In general, this is undoubtedly one of the finest receivers to be produced for the Amateur market. It has been a very pleasant discovery to find that the PASSBAND control functions just the same as the bandpass tuning control on the Collins 75A-4. The serious CW operator will be completely satisfied with the selectivity, but, again, complete satisfaction is a matter of several hundred dollars more.

Recent correspondence with the factory has disclosed that a noise limiter can be installed and recent production modifications added for the nominal sum of $15. It is expected that these changes will be incorporated in future models of this very fine receiver.

It should be noted that any small non-linearity in tuning can be corrected, in a limited range, by sliding the dial glass with a pencil eraser. No attempt was made to design the tuning mechanism as a frequency meter. For virtually all operating requirements the calibration of the dial is unusually good.

All four units checked by the author have indicated good consistency of manufacture. In summary-summary, this receiver is very highly recommended as an excellent communications receiver.


J. R. "Bob" Barbay W5SFT
6811 Toland St.
Dallas 27, Texas

*All Silicon Transistor*

# RTTY Converter

MANY articles have been published about radioteletype converters (TU's); the newcomer should be getting thoroughly confused, so let us help by putting another in the pot.

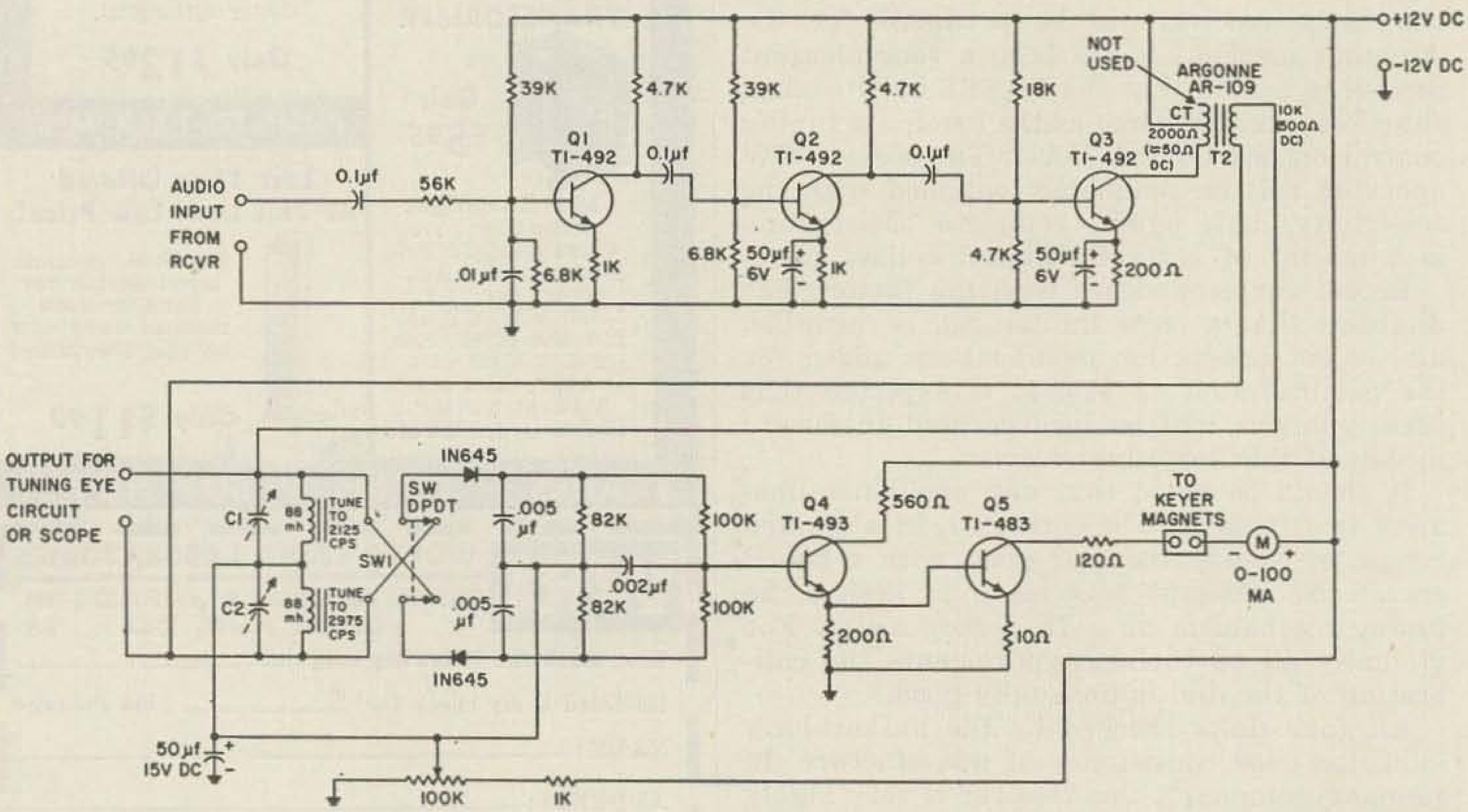
We have all decided that a TU should be as simple as possible to build, adjust, and cost as little as practicable. The TU should be usable on a.f.s.k. or f.s.k. It should have provisions for filters such as bandpass and/or narrow shift, it should provide for some sort of tuning indicator (meter, oscilloscope, or tuning eye), a provision for auto-start, and an a.f.s.k. oscillator for v.h.f.

Next we should decide what type TU would best meet most of these conditions.

The a.f.s.k. seems to be the best suited for versatility.

The silicon transistor is a good type of device to handle the current that we will be working with, about 200 ma, so the cost becomes practicable. The voltage, being low (12 v dc), makes other components cost very low, as we can work with ratings of less than 100 volts.

The building is simple because the TU is built on a printed circuit board, which is available at a small cost.



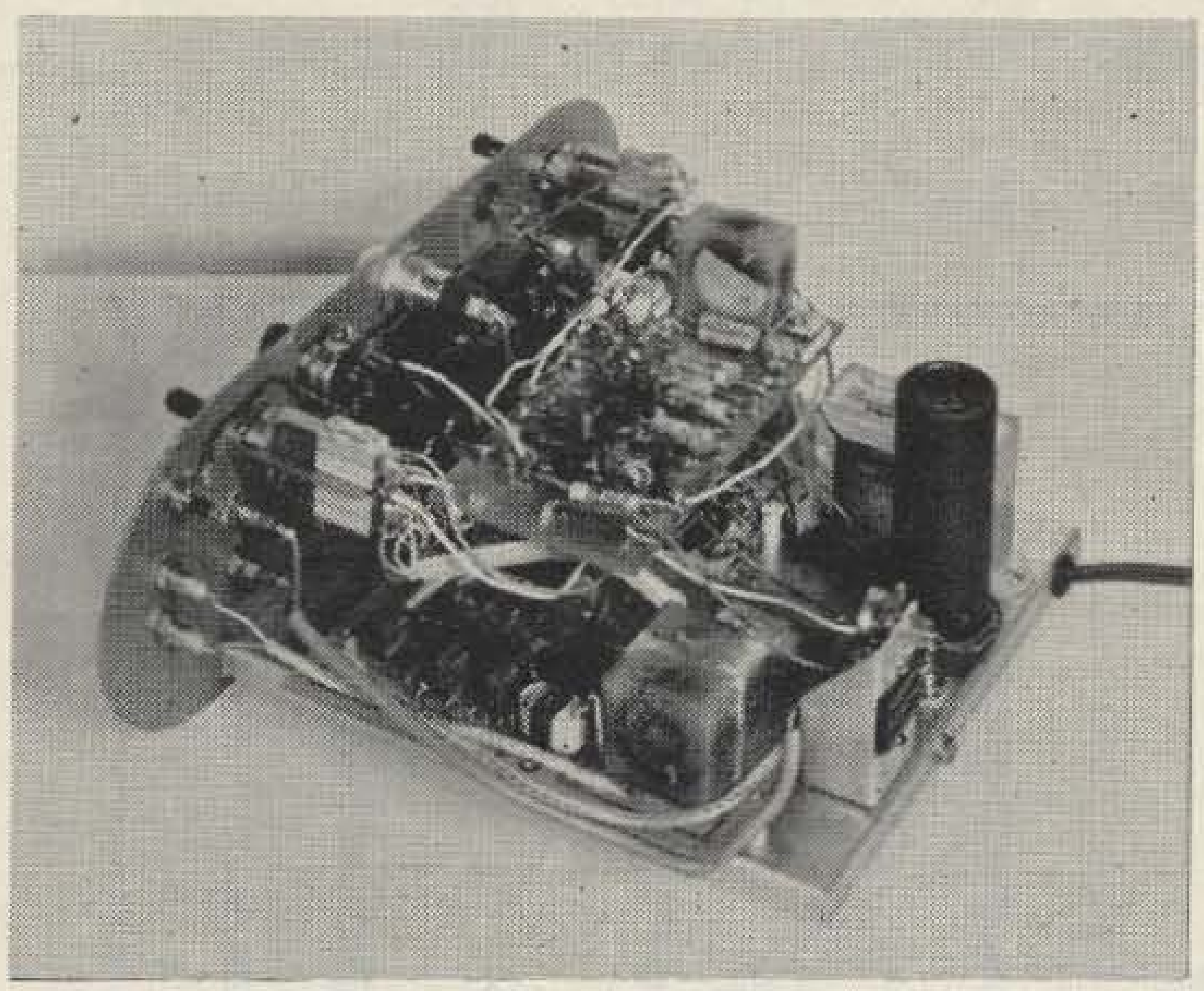

Schematic of converter. C1 will use approximately .068 mfd to tune to 88 mh choke to 2125 cycles. C2 should tune to 2975 cycles with about .033 mfd. T2 can be a Stancor TA-35, a Thordarson TR-7, or an Argonne AR-109.

The adjusting is simple, because you only need an audio oscillator, and V.T.V.M. to adjust the two 88-mh toroids. (These toroids or telephone loading coils are available from Jack Pitts W6CQK at a cost of $1.00 each postpaid, or Irving Electronics Co., P.O. Box 9222, San Antonio 4, Texas.)

An L-C filter or bandpass amplifier can be added to the front of the converter to improve reception when there is heavy QRM. A bandpass amplifier is at present under construction on a printed circuit board and will be described in a future article.

The provisions for tuning have been made for an oscilloscope, a tuning eye, or frequency meter. The frequency meter, and the oscilloscope will be on printed circuit boards, and are under construction also.

The circuit construction is simple. The schematic that comes with the circuit board has numbers in a circle for each lead of the component, these numbers will match hole numbers on the printed circuit board for leads to be soldered. There are six holes for as many as three capacitors, to tune each of the 88-mh toroids for the standard 850 cycle shift, the



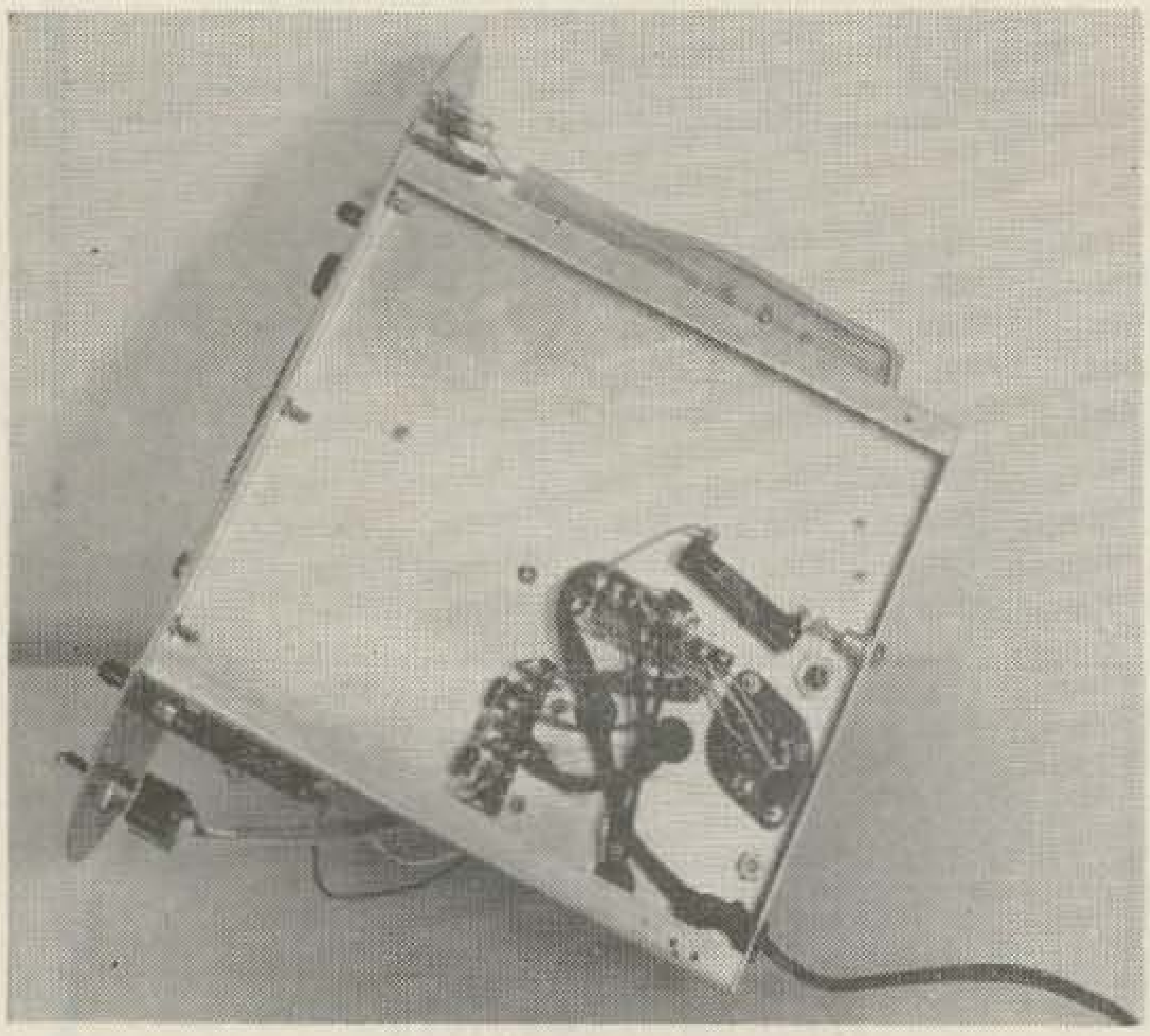
space filter is tuned to 2975 cps. This takes a total capacity of about 0.033 mfd, and about 0.068 mfd capacity for 2125 cps for the other toroid. We may note here that when tuning these two toroids they should be mounted on the board and in the circuit. An audio signal is applied to the input at the frequency each of the toroids is to be tuned to. Watch for a peak on a V.T.V.M. across the toroid being tuned. NOTE:

*Use only mylar, mica, or paper capacitors. Do not use disc ceramic capacitors.*

The input circuit shown is an RC type input into the base of the first transistor. A transformer may be coupled between the output of the receiver to match the input impedance of the converter. None is shown here because we are working on an emitter-follower bandpass filter. Though the converter works very well

(Turn the page)

(RTTY from page 25)



with four ohm input from the receiver, it will work much better with a matching transformer of four ohms to twenty thousand ohms into the converter.

The output of the converter is placed in series with the local loop. The output transistor acts as a switch, or relay, and does away with the polar relay.

## PARTS NOTES

All parts are available from your local scrap box, or your local dealer. The transistors and diodes are Texas Instruments, Inc., obtainable at your local TI distributor. These silicon transistors are the industrial type and do a real good job for a reasonable price.

The prices are as follows:

| | |
|---|---|
| TI-492 | $2.35 each |
| TI-493 | 2.55 each |
| TI-483 | 4.20 each |

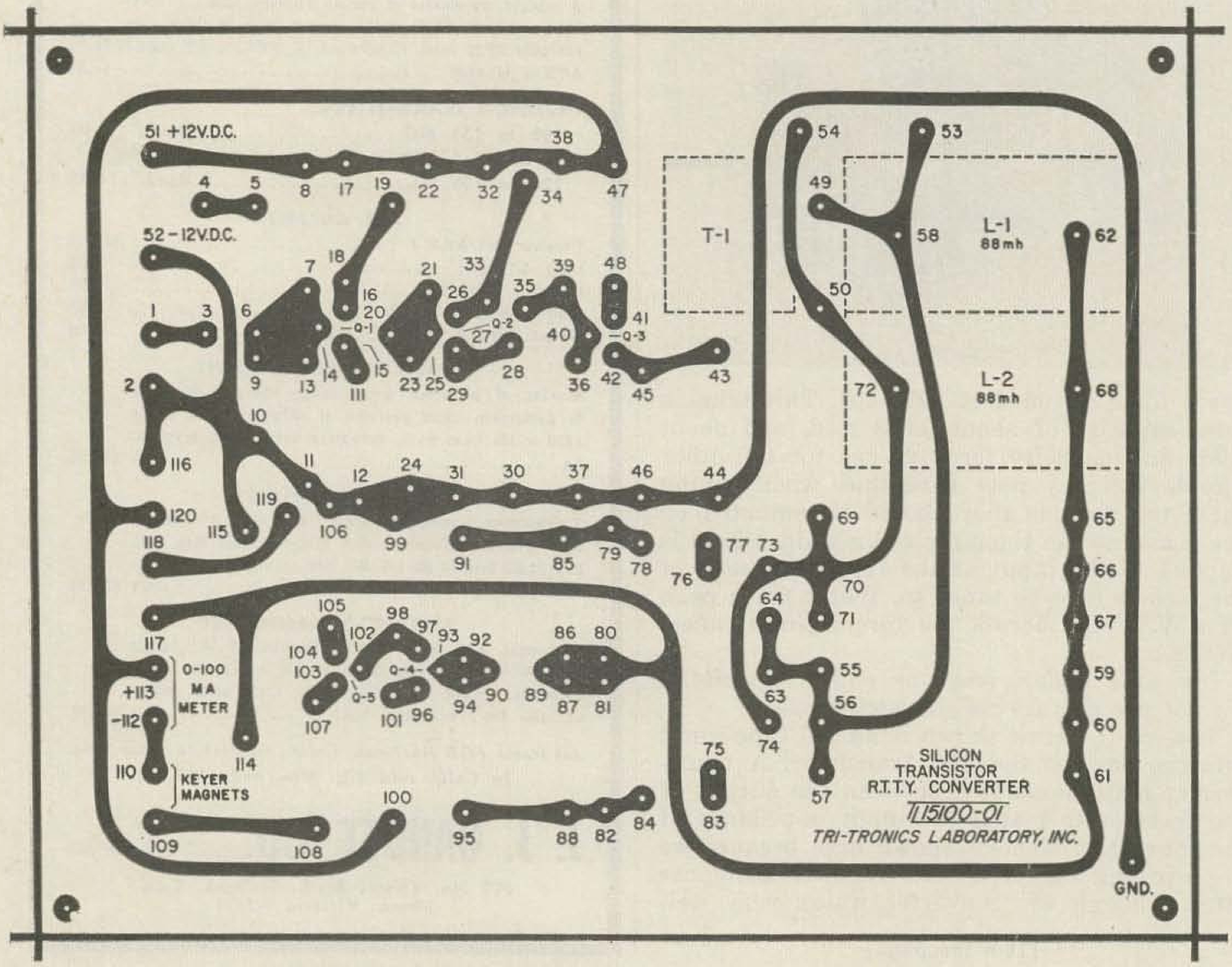
The toroids, or loading coils can be obtained from several places other than those listed in the parts list.

Jack Pitts W6CQK, 1307 Alemeda, Redwood City, California, can supply a complete plug-in filter unit for $3.50 each, postpaid. These units may be mounted off the printed circuit board, and wired into the board. This way you may want to build a tube type, and transistor type, and see how the two compare.

The printed circuit boards, and all instructions can be obtained for $2.00 p.p. from Tri-Tronic Lab. Inc. (part number TL-15100-01) P.O. Box 238, Euless, Texas, or though most of the dealers who stock Texas Instruments, Inc. industrial type transistors.

. . . W5SFT

Printed Circuit—Shown Full Size

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# Two Meter Nuvistor Converter

Larry Levy WA2INM
1114 East 18 Street
Brooklyn, New York

THE fact that nuvistors are available at a very nominal cost invalidates any excuses from two meter operators for not having a low noise converter. Even the cascode circuit is now practical though a year ago a cascode converter using 417-A's was out of reach of most amateurs.

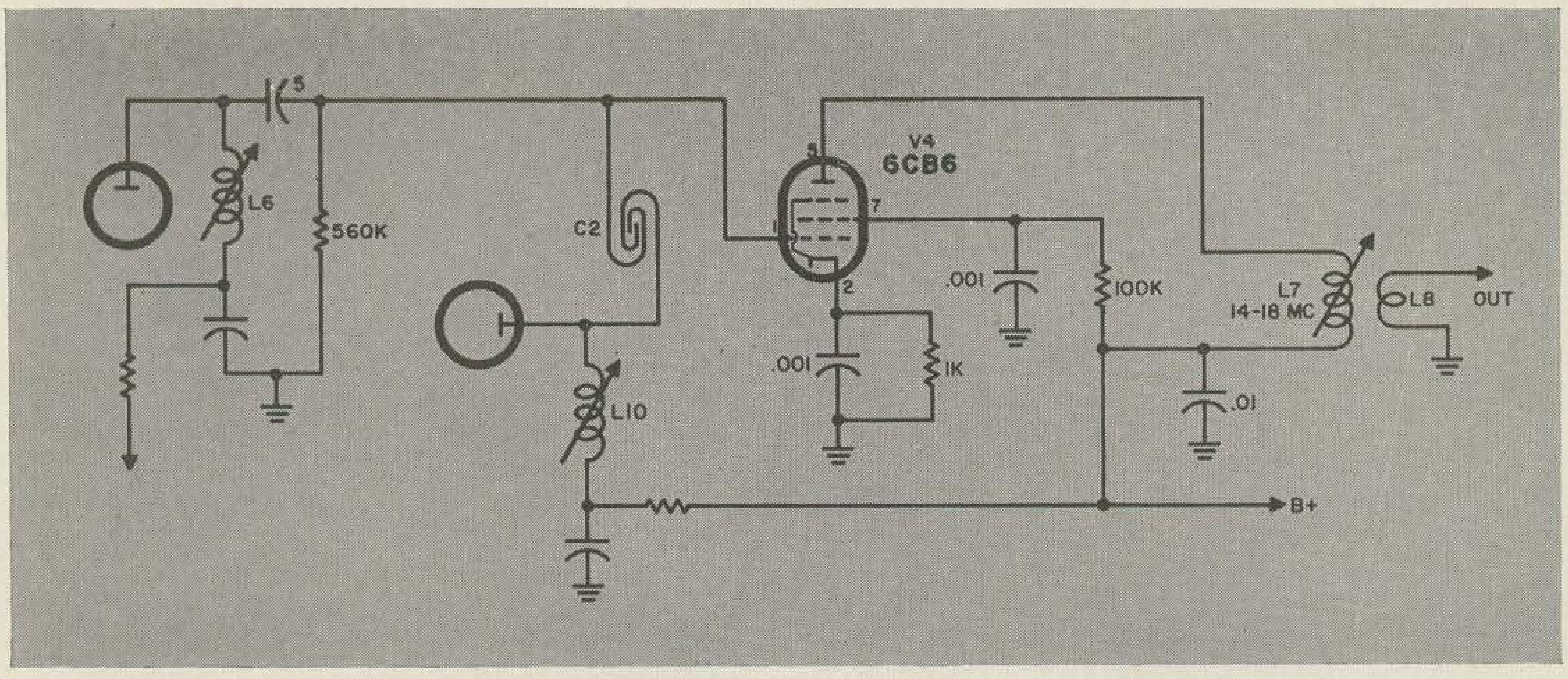
The advantages of the cascode circuit are many. One major advantage is the relative ease of neutralization. This is a blessing, as anybody who has spent hours cursing at a neutralization coil in a triode rf amplifier, such as one using a single 417-A, or any other high transconductance tube, will testify.

After reading pages of praises to the Nuvistor, I went out and purchased a small pile of them, including some of those elusive sockets. The design of the converter in its original form was quite different from the finished product, in which all the values were adjusted for the best signal to noise ratio. The converter uses only triodes. Having had some experience with pentodes in low noise converters, I figured that a lower noise converter could be made without them. After the unit was completed and working, I tried substituting a 6CB6 for the mixer. I found that while it had little effect on the noise figure, there was an improvement in the overall gain. This will be an advantage to those whose receiver lacks spare gain.

For the most stable operation all the coils should be shielded from each other, as even the small amount of regeneration, caused by feedback, will raise the noise figure. A beer can is an excellent source for shields, and a 12 oz. can will provide all the shields you need.

The circuit used is a double cascode. This provides plenty of gain with very little noise. The first cascode uses a pair of 6CW4's, capacitively coupled to the following cascode and neutralized by L2. The tap on L1 and the setting of C1 will have a great deal to do with the overall noise figure of the converter. A 5 turn coil was used, with the best tap position being about 2 turns from the grounded end. A turning wand, which is a plastic rod having a brass slug on one end and a powered iron slug on the other, will be a great help in aligning and neutralizing the converter. The one I used was a GC 8278. This has a diameter of slightly more than ¼" and was used as a winding form for L1, L2, and L5. This made it easy to adjust those coils by slipping the wand into the centers of the coils. L3, 6, 9, and 10 are wound on ¼" slug-tuned coil forms. L4 is an Ohmite Z-144 rf choke. A 250k resistor can be substituted, with very little, if any, loss of performance.

If you are going to use the range of 14 to 18 mc for the *if* the crystal frequency and the frequency of L9, L10, and L7 can be used as given. For other *if* frequencies they will have

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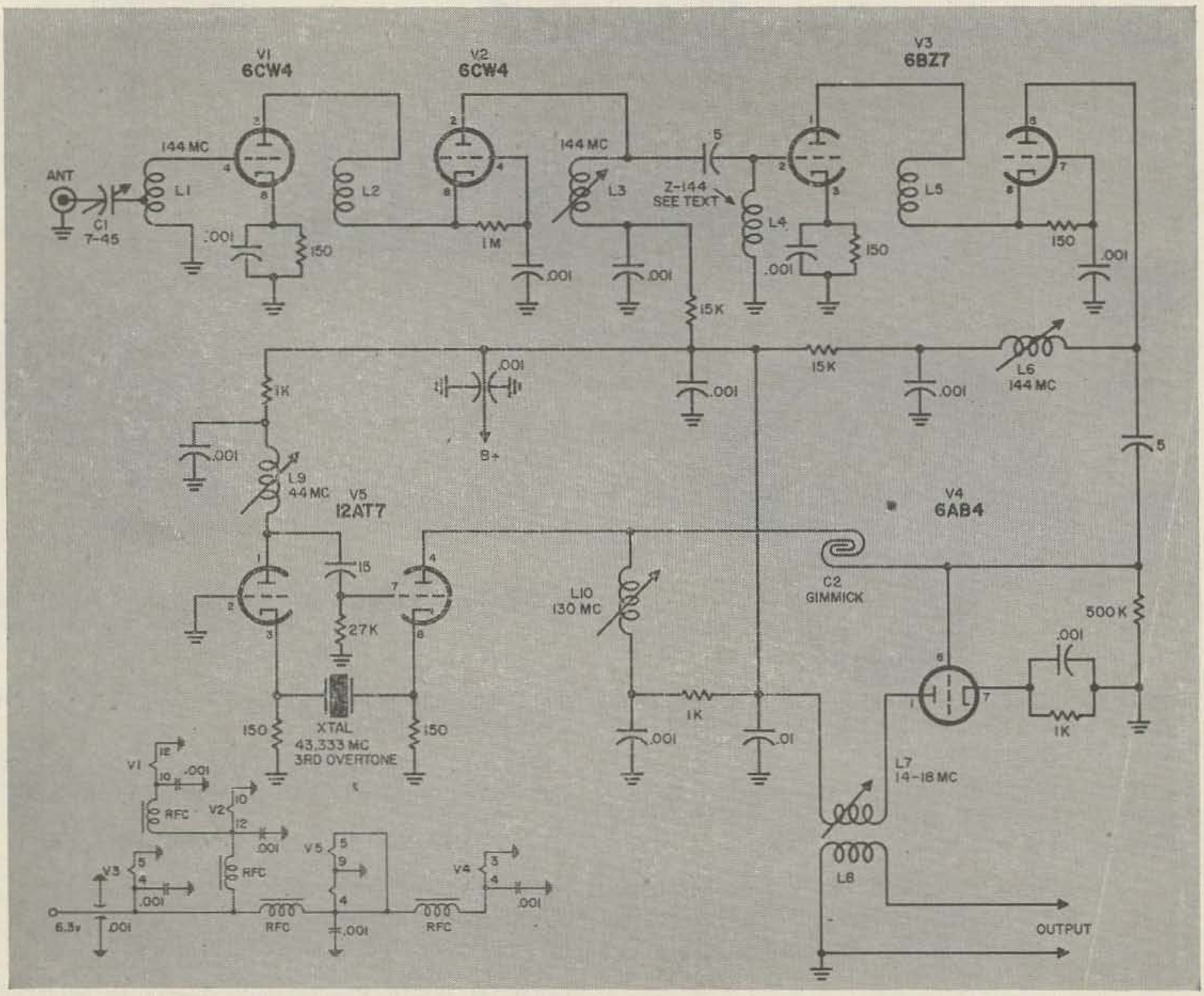
to be changed accordingly. One possibility might be the use of a 50-54 mc *if* for receivers like the HQ170 or other ham-band—only receivers that cover 6 meters. This would give you the necessary 4 mc spread to cover the two meter band. For a 50 mc *if*, use a 47 mc crystal and tune L10 to 94 mc, doubling in the multiplier instead of tripling. L7 is tuned to 50 mc with L8 being 1 or 2 turns.

Gimmick C2 is made by twisting two 1" pieces of insulated wire together. The only precaution necessary in laying out the converter is to make sure that the chassis is divided well with a shield to prevent any of the oscillator fundamental from mixing with the two meter signals, especially in the early stages. The rf chokes in the filament leads are made from 10 or 15 turns of fine enameled wire, wound on a high value 1 watt resistor.

For stability, a modified Butler oscillator was used. Another reason it was used was that, because of an error on my part, I had neglected to drill holes for the crystal socket. Since I was using a 12AT7 I could get away with mounting the crystal socket underneath the tube socket, held in place by a 4-36 screw and bolt through the center hole of the 12AT7 socket. Since pins 3 and 8 are opposite each other and of the same spacing as the pins on an FT243 crystal socket, with a Butler oscillator it is possible to mount the crystal socket in this manner. It also has the advantage of having no leads on the crystal socket.

After wiring is complete the next thing to do is to check for errors and test out the converter. The B-plus required is between 150 and 200 volts. Tune L9 to the crystal frequency and adjust for maximum output using a grid dip meter. Do the same for L10. If you are lucky with the settings of the rest of the coils you will probably be able to hear some strong local signals at this point. If not, adjust the coils to a signal from either your own transmitter or some other source. Neutralization is accomplished by removing plate voltage from the rf stage being neutralized and adjusting the coil for minimum feedthrough. The tuning wand will be helpful here. If the feedthrough decreases with the brass slug, spread the turns on the coil. The opposite goes if feedthrough decreases with the iron core. L1 is adjusted to resonance by the same procedure. After the converter is aligned properly it should have quite a low noise figure. To get optimum, a noise generator should be used. The settings of C1 and the tap and tuning of L1 will have a major effect on the noise figure and should be adjusted very carefully.



If you live in an area where there are very strong locals, cross modulation may be experienced. It might be helpful to lift the cathode resistor of V3 off ground and connect it to a 5K pot. Triode mixers overload less easily than pentode mixers.

The results from this converter have been excellent. No problems were experienced with images or spurious responses. The converter was well shielded, being built on a 3″ x 4″ x 5″ Minibox. Feedthroughs were used for B-plus and filament leads.

The overall cost of the converter was less than some of the more popular converter kits and the performance exceeds any of them. The converter has been in use for a period of time and has the ability to really dig out the weak ones. . . . WA2INM

**Coil Table**

L1—5 turns #20 bare wire wound on 3/8″ form spaced 1′. The coil is tapped 2 turns from the grounded end.
L2—6 turns insulated wire wound same as L1.
L3—3 turns #20 wire wound on 1/4″ slug-tuned form.
L4—ohmite Z144.
L5—8 turns wound same as L2.
L6—same as L3.
L7—depends on output frequency.
L8—2-4 turns insulated wire wound over L7.
L9—approximately 15 turns of insulated wire on 1/4″ slug-tuned form. The exact coil will depend on the crystal frequency used.
L10—depends on if used.
Note: All slug-tuned forms use ferite cores.

## Almost Universal Rectifier Sockets

It is very annoying to find that a rectifier tube has gone bad on a Sunday afternoon while working a new state or country and there is no replacement in the house. There are usually several other types of rectifiers available but they have different pin connections. The base connections on most of the 5v rectifiers fall into three general groups. Each one is different from the other by just a small change. When constructing equipment, it is easy enough to make the low voltage rectifier socket almost universal by the addition of 3 jumpers. Connect pins 3 and 4 together for one plate, pins 5 and 6 for the other plate, pins 2 and 7 for one side of the heater and take the high voltage off pin 8, which is the other side of the filament. After these changes are made, it is possible to substitute different types, providing none of the ratings are exceeded. A socket wired in this manner will accept the following type tubes; 5AU4, 5AW4, 5AS4-A, 5R4GY/A, 5T4, 5U4G/A/B, 5V3, 5V4GA, 5W4GT, 5X4G, 5Y3G/GT, 5Y4G/GT and 5Z4. . . . WA21NM

# Versatile Control Techniques

*Use of TV Replacement Components Can Help Salvage the Resale Value of Your Modified Equipment and Permit More Compact Layout in New Construction.*

Roy E. Pafenberg W4WKM
709 North Oakland Street
Arlington, Virginia

THE average amateur, when faced with a problem of equipment construction or modification, thinks in terms of the conventional, single gang variable resistor or control. Use of dual, concentric shaft controls and the new push-push or push-pull control switches which make switch action independent of control shaft rotation can simplify construction, save time and effort and permit more compact arrangements in construction projects. These new components, developed for the mass entertainment equipment market, can go a long way in reducing the butchery normally associated with modification of manufactured or home constructed equipment. Nothing reduces the resale value of communications equipment so much as a few extra, randomly spaced holes chewed through the front panel.

Equipment modification calling for the addition of a variable resistor can best be accomplished by replacing an existing single potentiometer with one of the concentric shaft, dual units. The concentric drive assembly consists of a ¼" hollow shaft which drives the front section of the control and an inner, ⅛" or 3/16" shaft which drives the rear unit. Most control manufacturers make these resistors for the television replacement market and they are available as exact replacement types or as "on the job" assembled components. The controls made up from stock parts are better for this purpose since the shafts will probably have to be cut to the proper length.

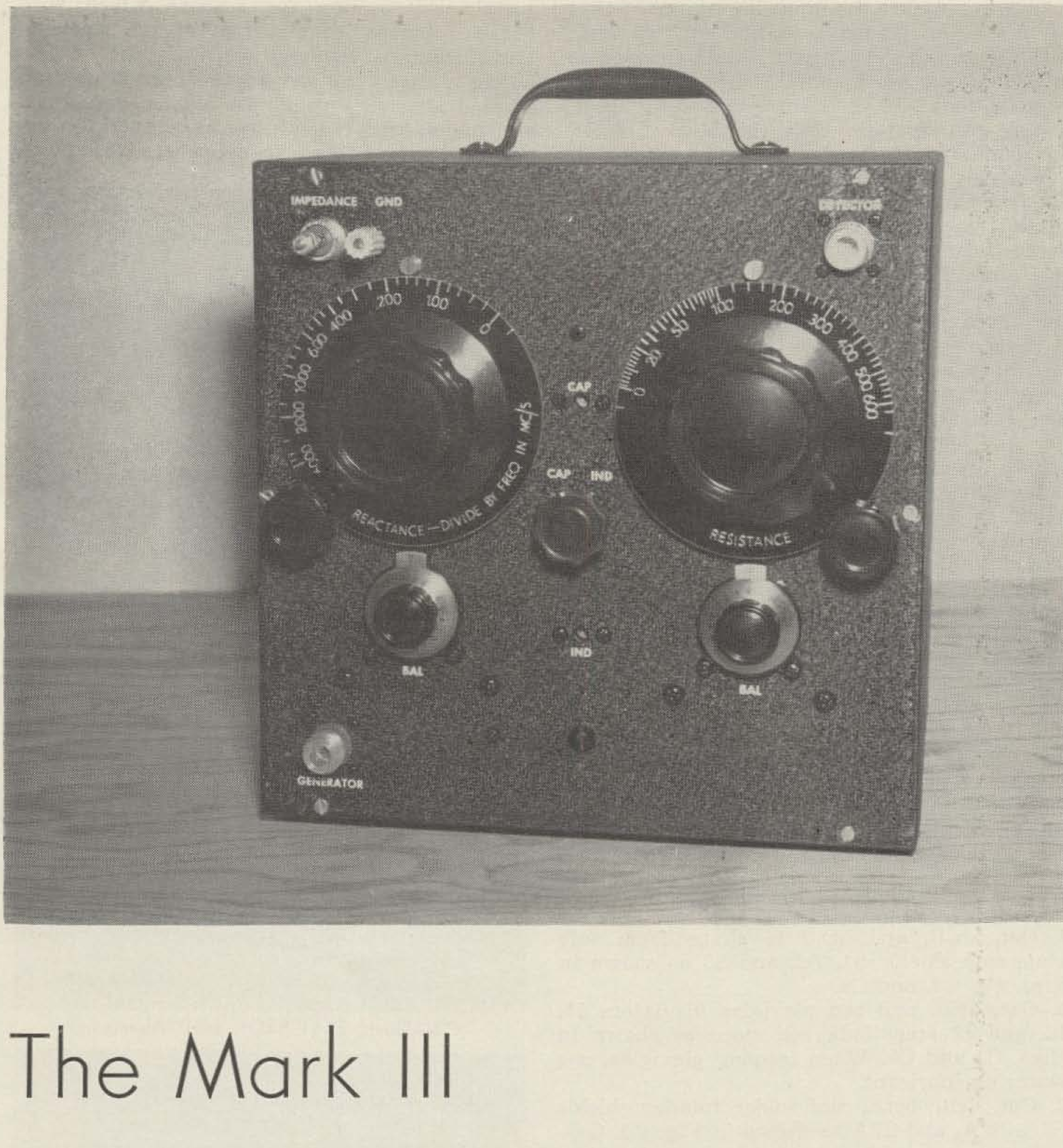
One manufacturer, to ease the shaft cutting task, makes available an ingenious and convenient shaft cut off jig. These are stocked by the jobbers that handle the line of controls. It will often be possible to have the shafts cut to the proper length and the control assembled for the cost of the component parts. If not, it is a simple task with hand tools and well worth the effort. The resistance elements are available in a wide range of values and tapers, so getting the right combination to meet your exact requirements should be easy.

A source of knobs for the dual controls is a slightly more difficult problem. Most available sets are decorative creations scarcely suited to the functional motif of communications equipment. In addition, knob springs are usually employed to rather insecurely fasten the knob to the shaft. The requirement is for a set screw type knob set of color and configuration to match the usual communications equipment knobs. Allied and Newark catalogs list a 1¼" diameter, Harry Davies knob set Number 1915 which will prove suitable for most applications. Matching, black Bakelite single knobs are available in ¾", 1¼" and 1½" diameters. Alternatively, an existing, flat top knob can be drilled through and used for the ¼" shaft and a harmonizing, if not matching, ⅛" bore knob used for the center shaft. It may be necessary to drill out the ⅛" shaft hole to a nominal 3/16" to fit most controls. A suitable combination for new work is the National type HR and the Millen Number A006 dial.

Much communications equipment uses control mounted switches to perform various functions. Special purpose use and modes of operation not contemplated by the manufacturer often make it desirable to have switching capability independent of control rotation. The new push-pull and push-push control and switch assemblies make such isolation easy since the switch can be actuated at any setting of the control. Equipment modification calling for the addition of a SPST switch may be easily accomplished by replacing an existing single section variable resistor with one of the new assemblies. The cost is low and there is no hole drilling involved. Typical of the push-pull switch-controls is the Mallory type PP. Values range from 1,000 ohms to 5 megohms, with some resistances available in both audio and linear taper.

Few precautions are necessary in applying the techniques outlined, although care devoted to functional grouping of the dual controls will pay off in operating convenience. There is little cross-coupling between sections of the dual controls and normal attention paid to lead dress and shielding will minimize circuit interaction. Use of the control assemblies described will eliminate hole drilling in many equipment modifications and under these circumstances, restoring the equipment to normal for sale or trade is a simple task. Give these new components a try. They will save you work and money.

. . . W4WKM




# The Mark III RF Impedance Bridge

L. A. (Mark) Cholewski, K6CRT, ex-W8SVK
110 Camino de las Colinas
Redondo Beach, Calif.

NEED to measure the input impedance of that new beam? Or maybe to find out just what is the Q of the coils in your final? Or even to determine how much signal is being soaked up by your coax? If you ever want to do these, or any similar jobs, then the Mark III RF Impedance Bridge is the thing for you.

You can build it for a total cost of about $30 (exclusive of sheet metal) and, if you follow instructions closely, it will be accurate to closer than 10 percent throughout its operating range. Unlike the more common resistive-bridge and reflectometer methods of measuring impedance, the Mark III operates equally well at resonance or far away. It will measure both resistance and reactance present in resistors, capacitors, inductors, antennas, and transmission lines at any frequency between 2 and 30 mc.

Before we start into the actual construction of the Mark III, one thing must be emphasized. Accuracy can be assured only if the components, circuit, and parts layout are absolutely duplicated. The original instrument's calibration was obtained through tedious laboratory techniques. If you make any changes, the calibration curves will no longer apply. However, if instructions are followed to the letter you need have no worries about accuracy. A test model, built by W6BJU following these instructions, checked out to 2 percent accuracy at 2 mc and 10 percent at 30 mc.

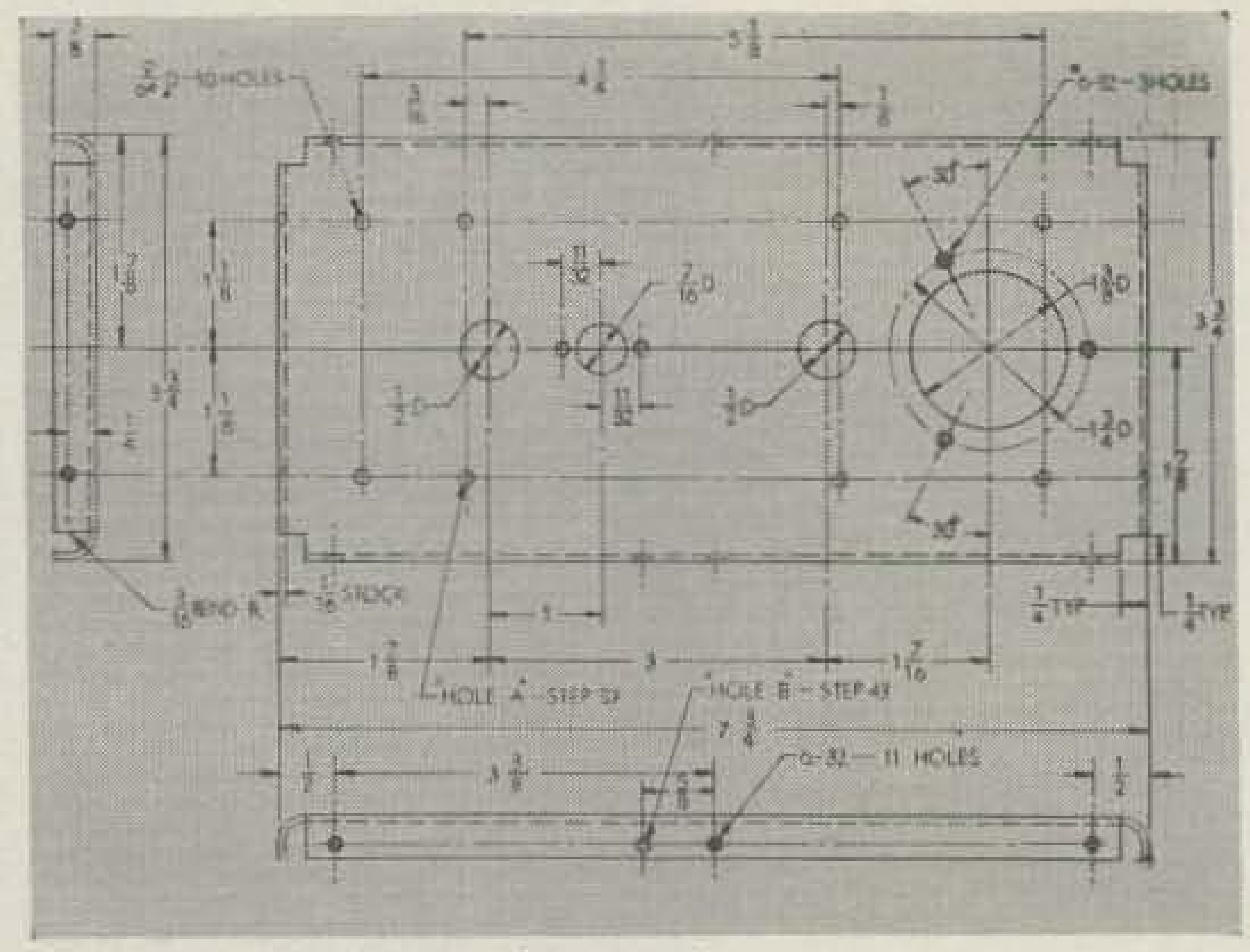
Construction of the Mark III divides into three major sections: Preliminary metalwork, actual wiring, and calibration. Each will be described separately. Ready? Let's go!

## Preliminary Metalwork

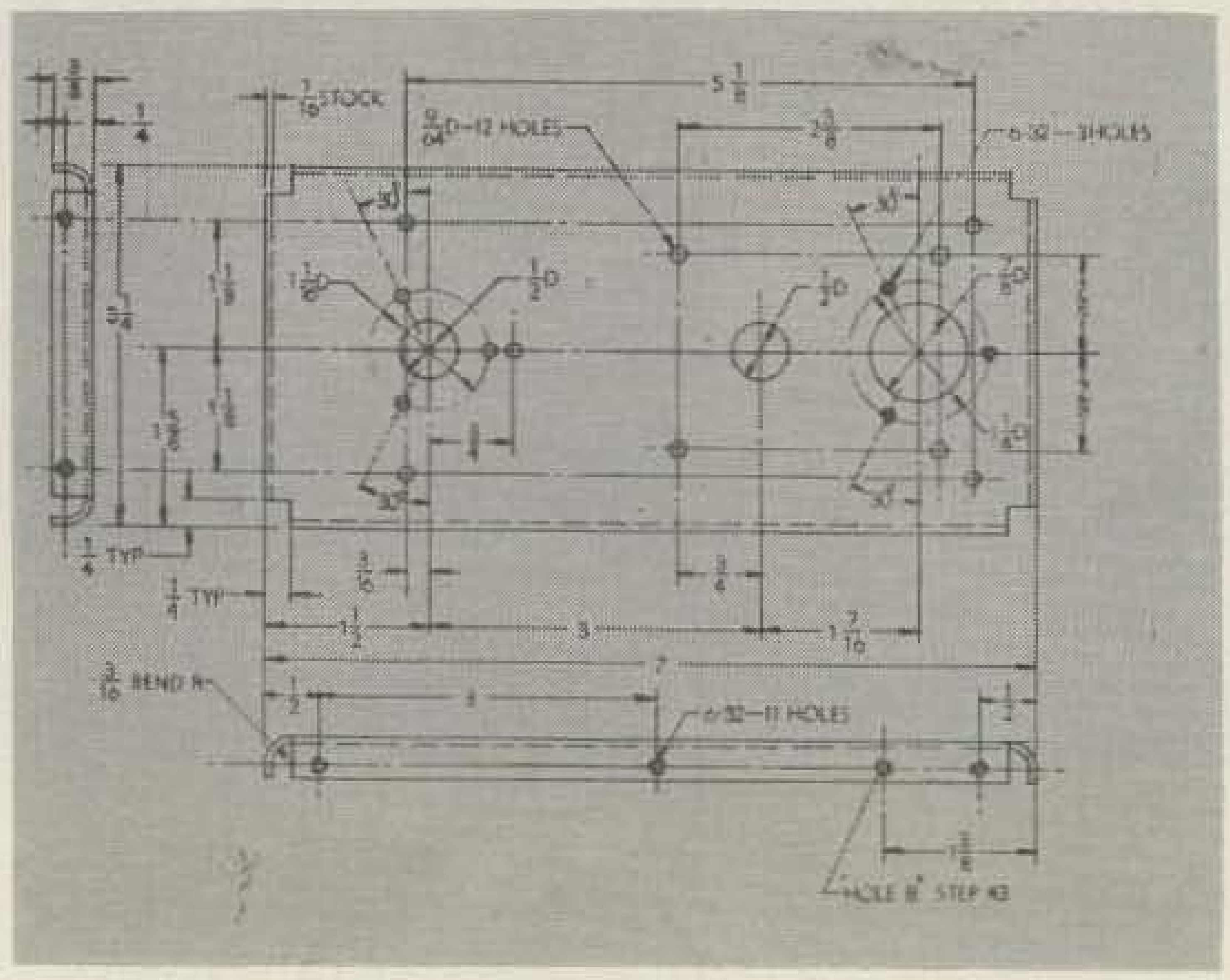
1. Cut, drill, and bend to shape from soft aluminum shields S1, S2, and S3 as shown in Figs. C1, C2, and C3.
2. Cut, drill, and tap plexiglas insulators I1, I2, and I3 from bulk rod stock as shown in Figs. C4 and C5. When tapping plexiglas, use water as lubricant.
3. Cut, drill, bend, and solder tubular shields S1A, S2A, and S3A as shown in Fig. C6. Copper or brass may be used; aluminum should be avoided because of solding difficulties.
4. Assemble shielded resistor assembly R2/S4 as shown in Fig. C7. The copper tubing must be drilled out to clear the body of R2. When soldering, hold the assembly in a vise to protect R2 from excessive heat.
5. Cut, drill, bend to shape, and solder box shields S1B, S2B, and S3B as shown in Fig. C8.
6. Drill S5 (a 3x4x6 LMB unpainted chassis box) as shown in Fig. C9.
7. Cut, drill, and bend to shape shield partition S5A as shown in Fig. C10.

## Shielded Transformer

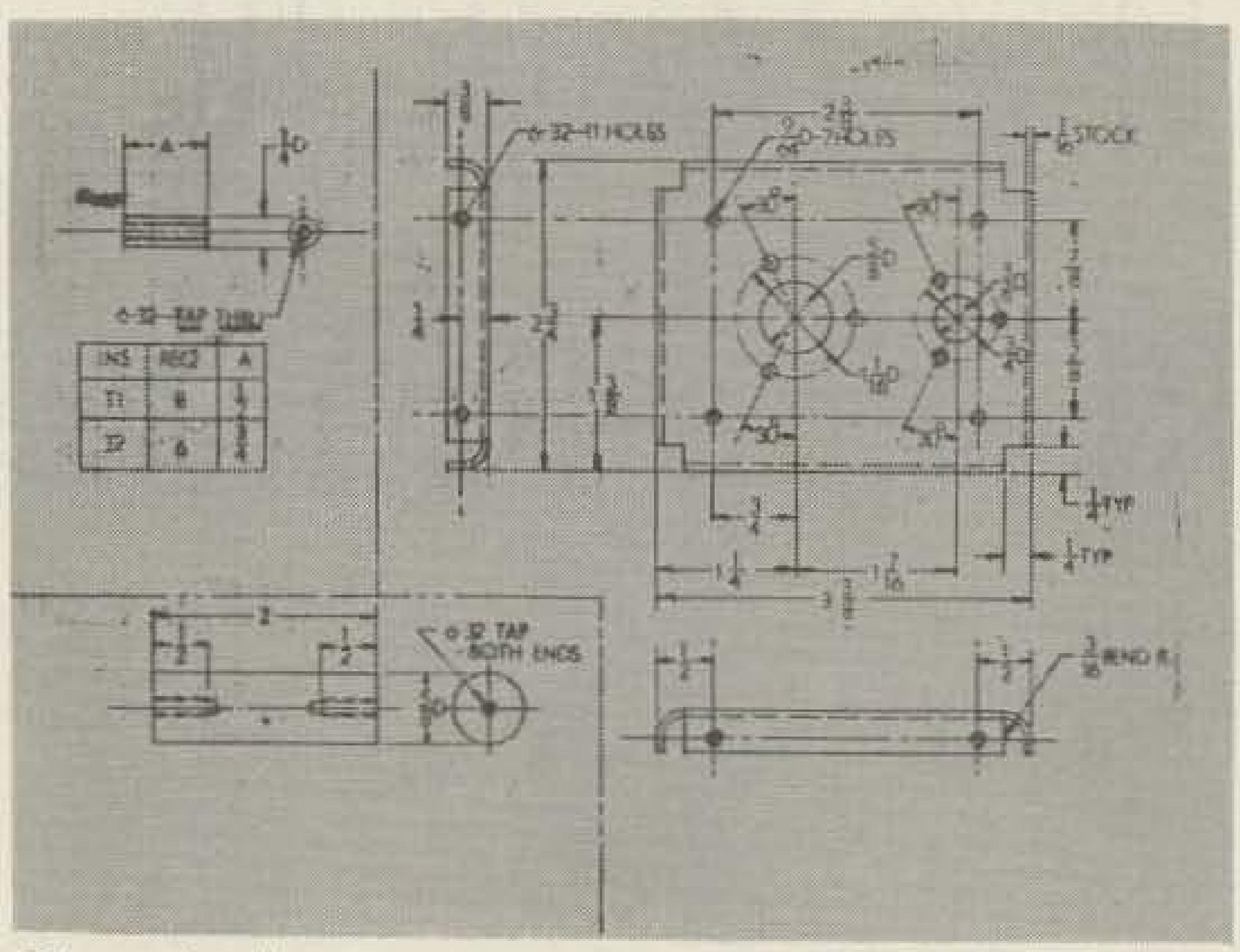
While classified under the "preliminary metalwork" section for reasons which will become obvious, construction of the shielded transformer is the most critical part of the entire project. Before proceeding, read and re-read steps 8 through 24 and be sure that you understand them fully. Take special care when soldering—three transformers were built



C1—Shield S1 (1 REQ), Mat'l Aluminum



C2—Shield S2 (1 REQ), Mat'l Aluminum



C4 — Insulators, Mat'l Plexglas rod

C5 — Insulator I3 (8 REQ), Mat'l Plexiglas rod

C3—Shield S3 (1 REQ), Mat'l Aluminum

for the original instrument before a non-shorted one was achieved.

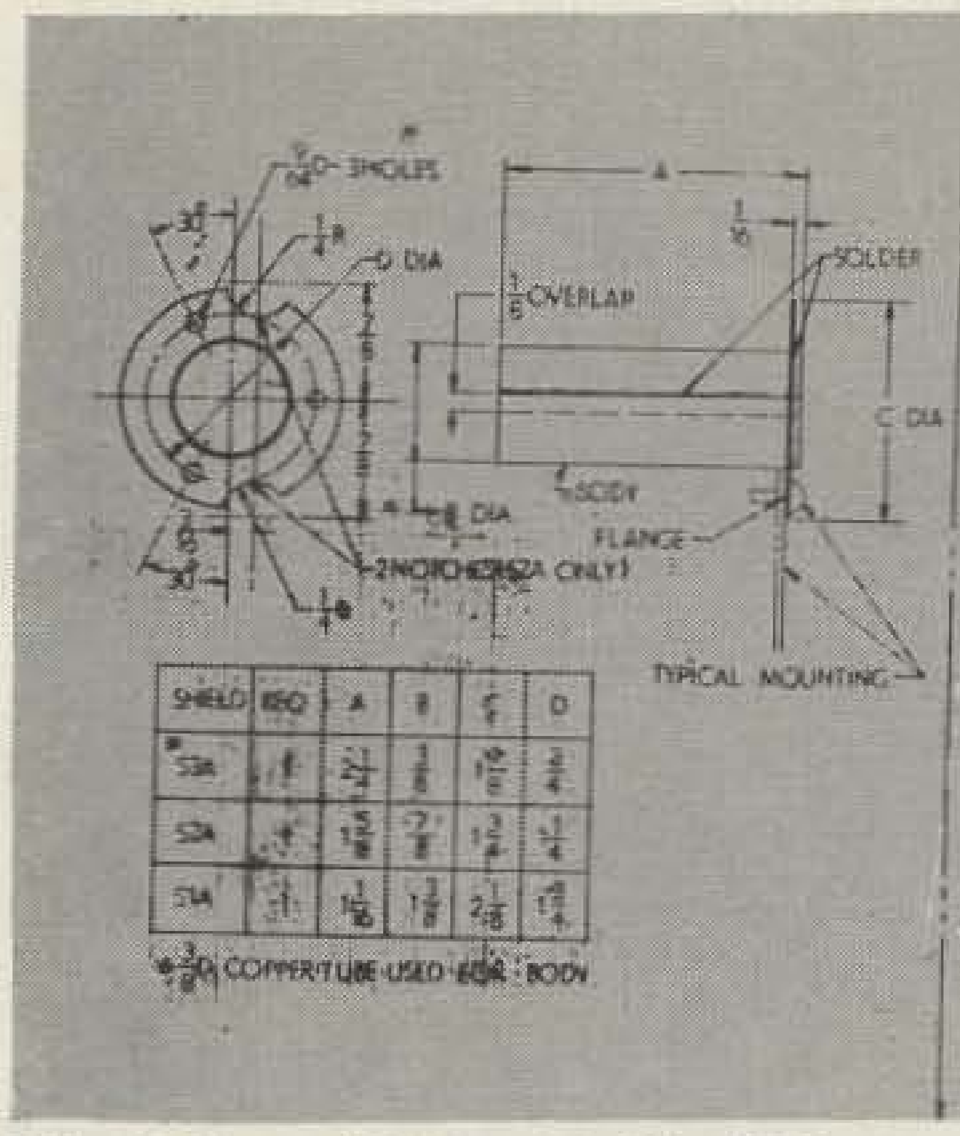
8. Cut to length, drill, and tap transformer mounting insulator 14 from 5/16-inch plexiglas rod.

9. Cut and drill two bobbin-end washers as shown in Fig. C12 and solder them to a length of copper tube as also shown. Then cut halfway through the bobbin with a hacksaw.

10. Pull the shielding from an 18-inch length of RG58/U. Save 8 inches for step 19 and use the rest in step 11.

11. Solder one end of the 10-inch shielding into the U-shaped slot on the bobbin end, using an aluminum rod or small drill to keep the inside of the shielding open. It must pass No. 26 plastic-covered wire. Clean off all metal burrs and solder splatters.

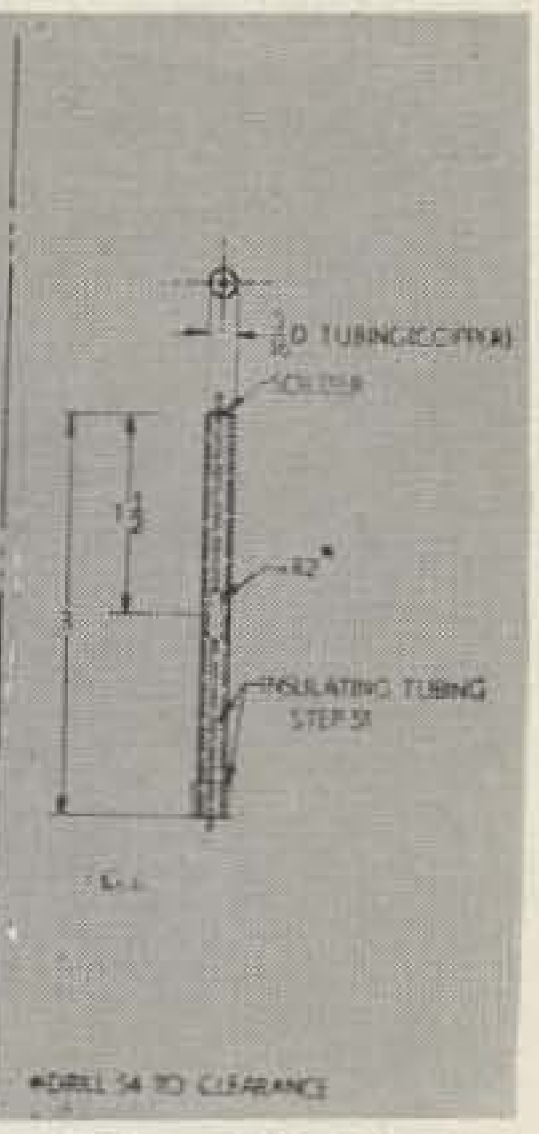
12. Wind 48 turns of No. 26 plastic-covered hookup wire on the bobbin in three lays of 16 turns each. Solder the start of the winding at



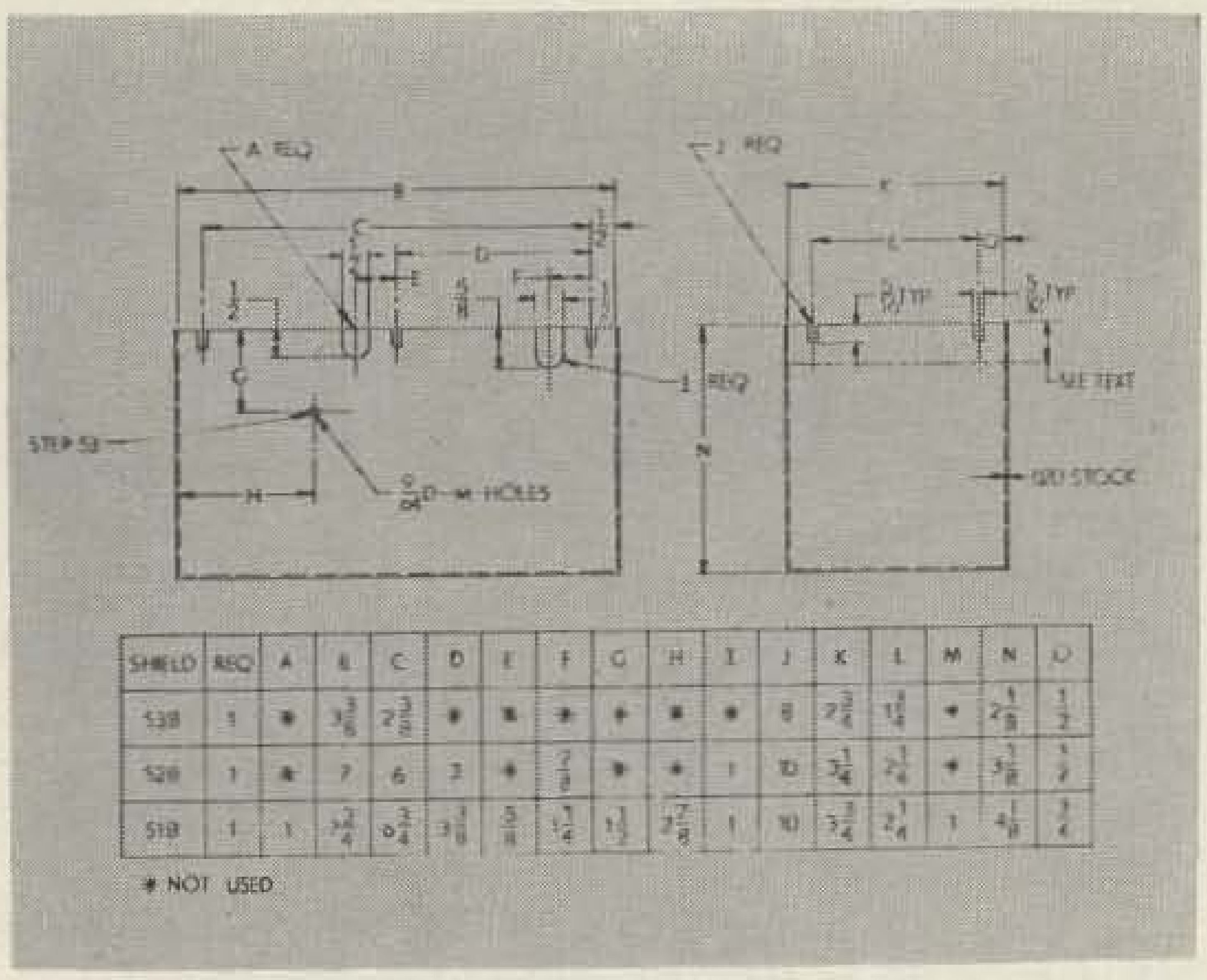
| SHIELD | REQ | A | B | C | D |
|---|---|---|---|---|---|
| *S3A | 1 | 2 1/4 | 3/8 | 1 9/16 | 3/4 |
| S2A | 1 | 1 5/8 | 7/8 | 1 3/4 | 1/4 |
| S1A | [illegible] | 1 1/16 | 1 3/8 | 2 1/16 | 1 3/4 |

*3/8D COPPER TUBE USED FOR BODY

C6—Tube shield, Mat'l .010 Brass



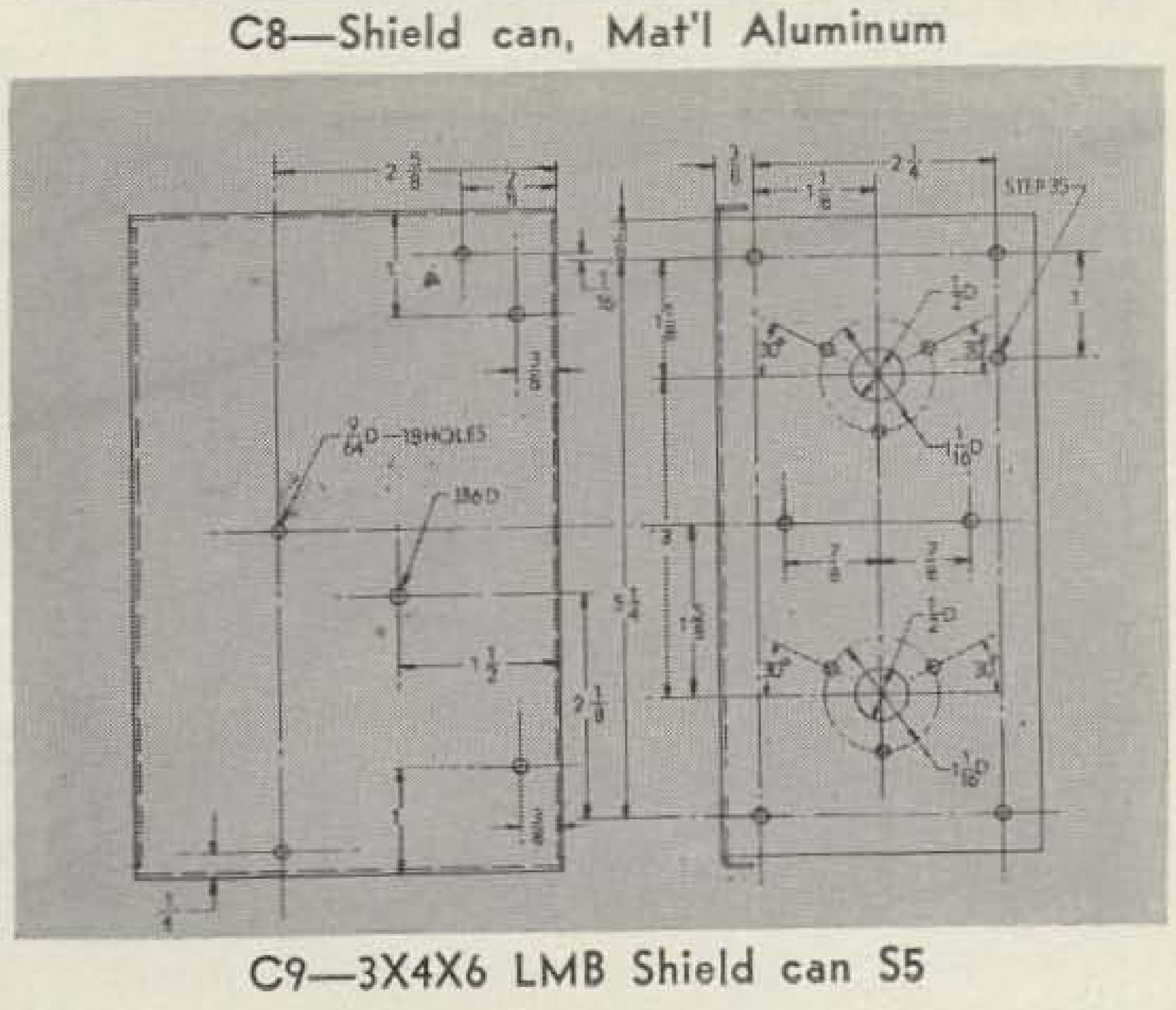
C7 — Shield Assembly S4



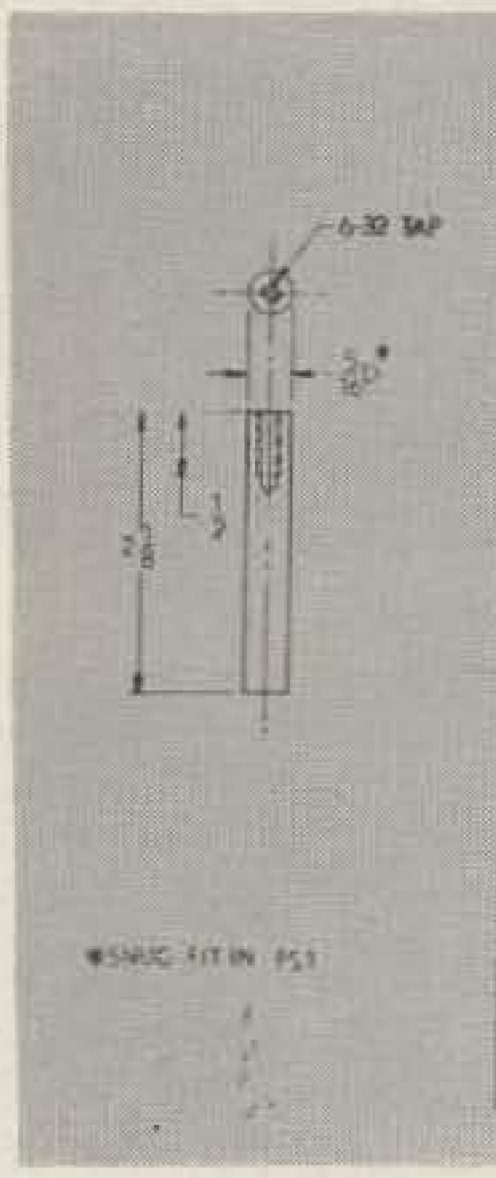
| SHIELD | REQ | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S3B | 1 | * | 3 3/8 | 2 3/8 | * | * | * | * | * | * | 8 | 2 3/4 | 1 1/4 | * | 2 1/8 | 1/2 |
| S2B | 1 | * | 7 | 6 | 3 | * | 7/8 | * | * | 1 | 10 | 3 1/4 | 2 1/4 | * | 3 1/8 | 1/2 |
| S1B | 1 | 1 | 3 3/4 | 6 3/4 | 3 1/8 | 5/8 | 1 1/4 | 1 1/2 | 2 7/8 | 1 | 10 | 3 3/4 | 2 1/4 | 1 | 4 1/8 | 3/4 |

* NOT USED

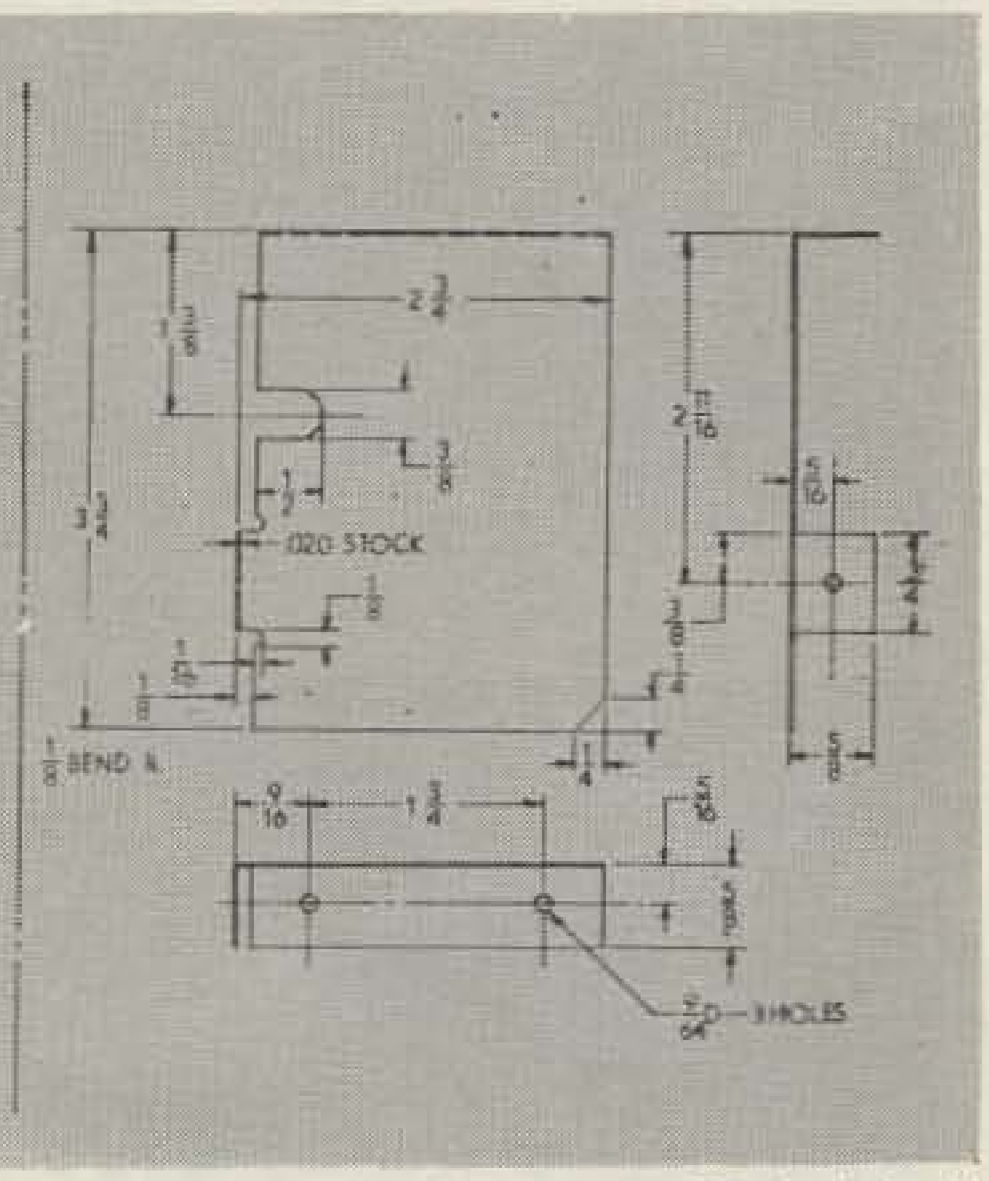
C8—Shield can, Mat'l Aluminum



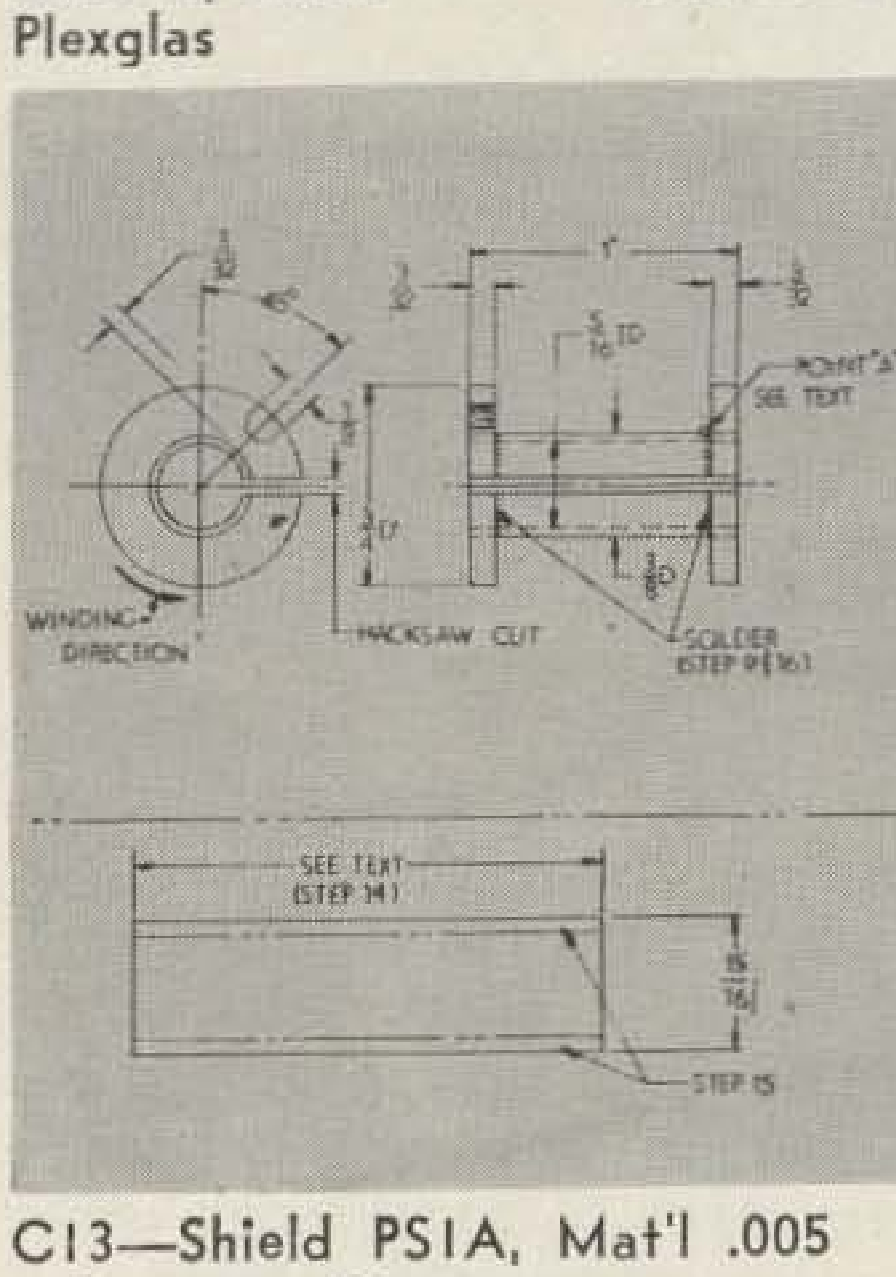
C9—3X4X6 LMB Shield can S5

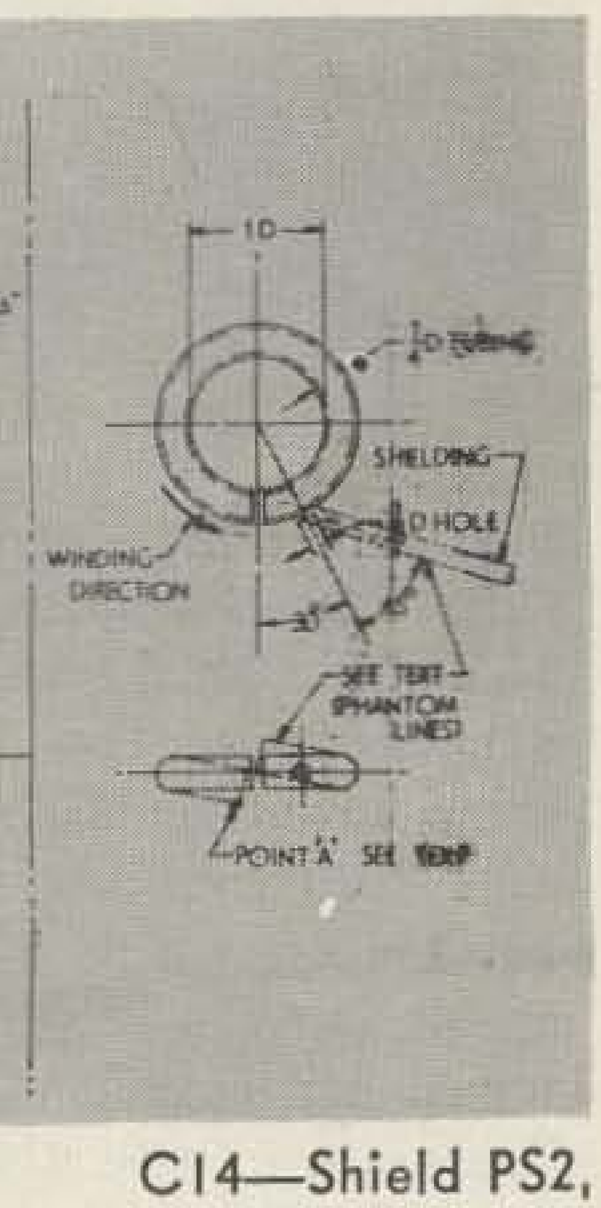


C11 — Insulator 14, Mat'l Plexglas



C10—Shield Partition S5A, Mat'l Aluminum

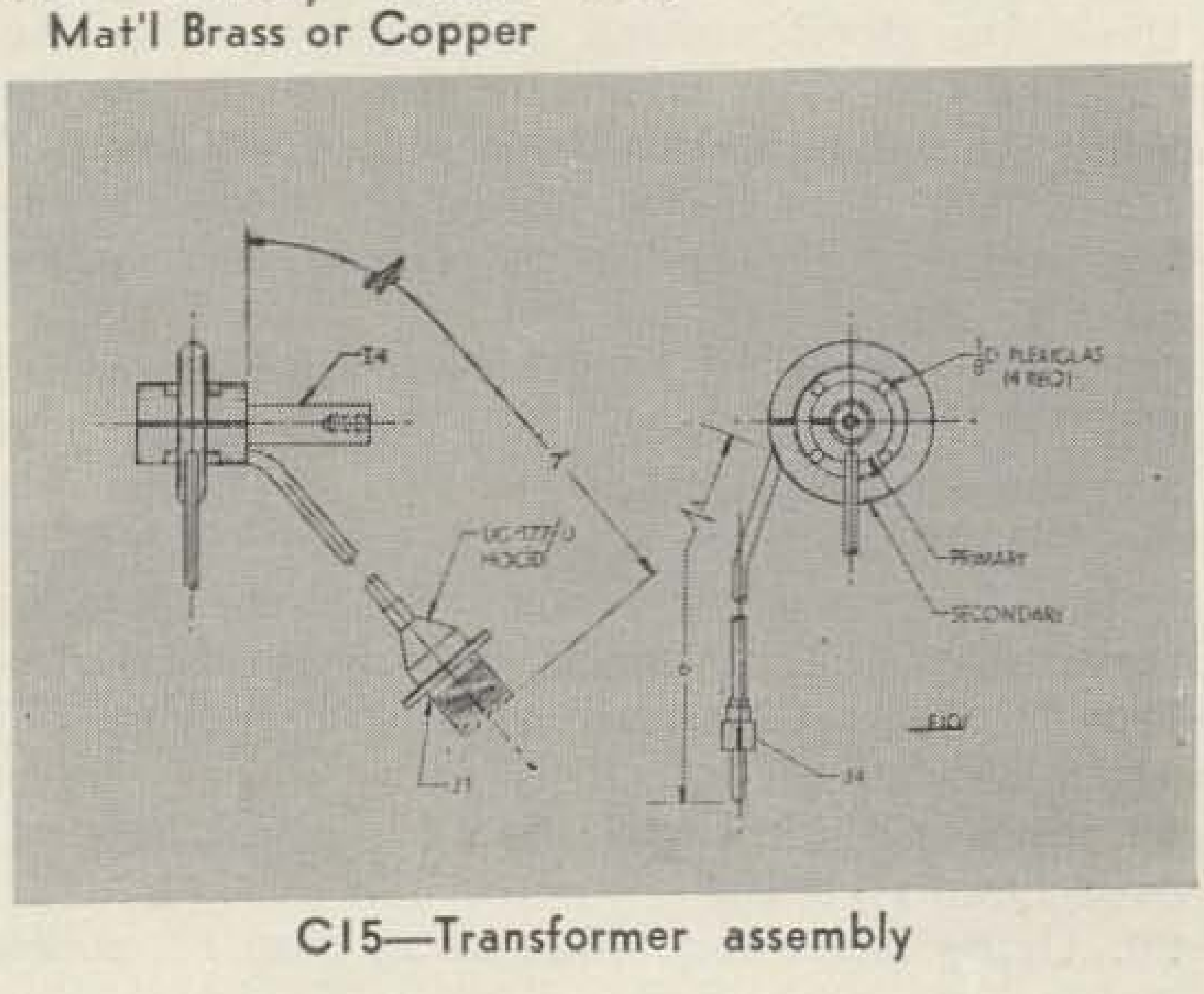




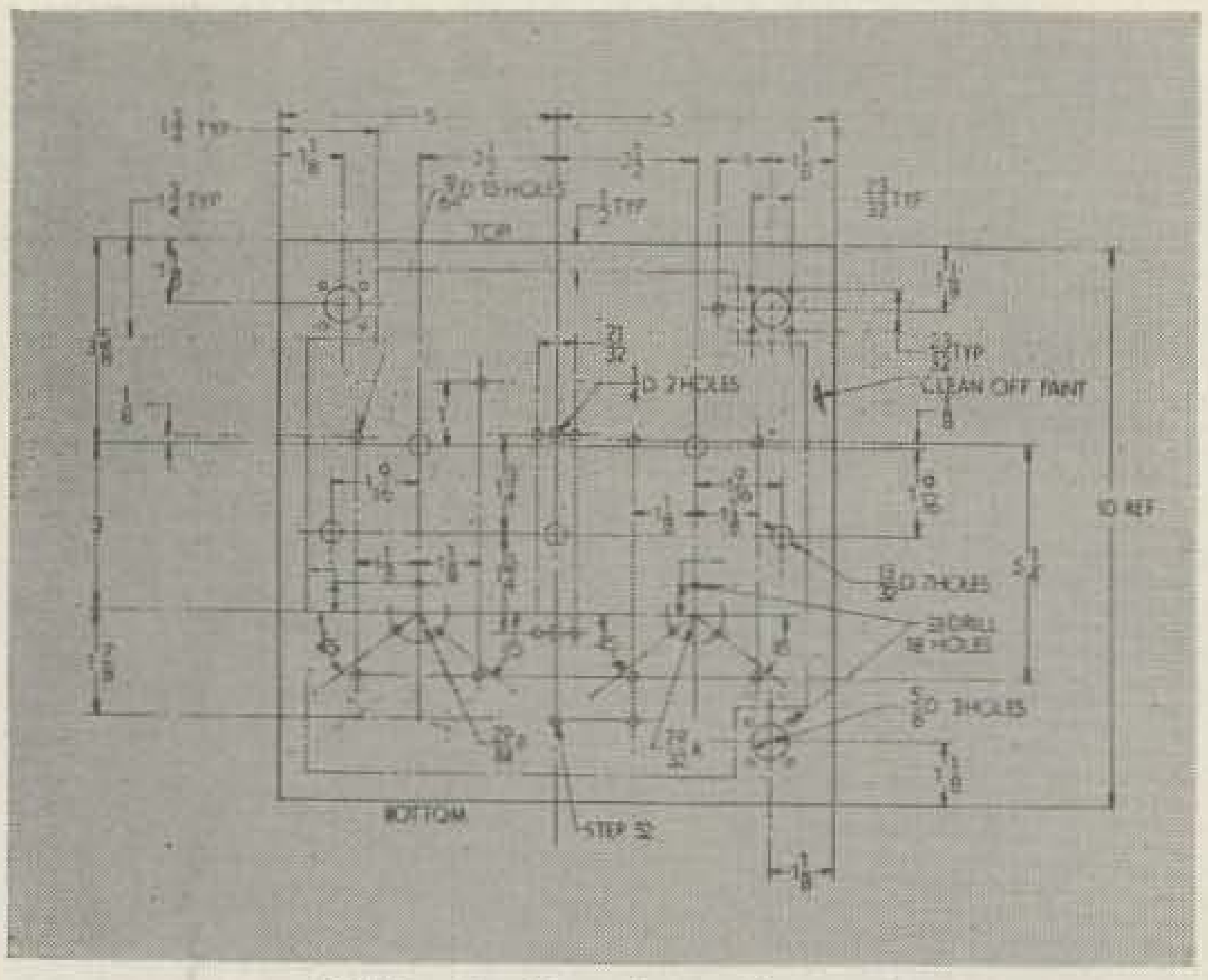
C13—Shield PS1A, Mat'l .005 Brass or Copper

C12 — Primary bobbin PS1, Mat'l Brass or Copper

C14—Shield PS2, Mat'l copper



C15—Transformer assembly



C16—Inside view of panel

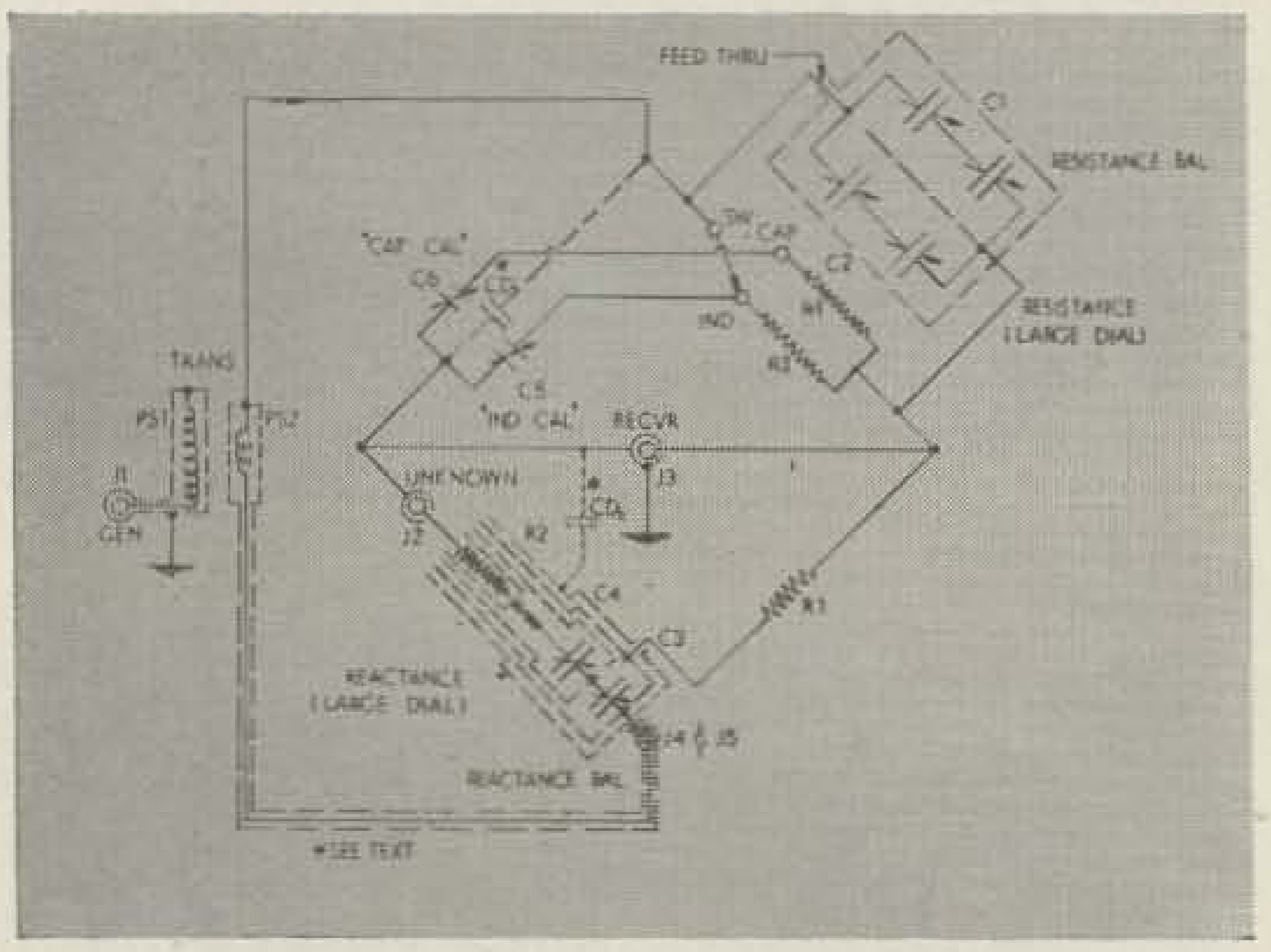


Fig. 1—HF. RF. Bridge Mark III Schematic

point A (see Fig. C12) and wind in the direction shown by the arrow.

13. The last turn will end at the shielding attached in step 11. Feed the free end of the wire into the shielding, draw the turns tight, and secure the winding with plastic tape.

14. Cut a piece of brass or copper shim stock as shown in Fig. C13 to a length which will wrap around the bobbin but will not allow the ends of the shim stock to touch each other.

15. Tin the shim stock along the edges.

16. Place the wound bobbin in a vise, wrap the shim stock around it, lining up the free ends of the shim with the slot cut in step 9, and solder the shim to the bobbin ends. **Caution.** *Do not overheat the winding; the plastic covering melts easily and a short is almost impossible to detect.*

17. Connect an SO-239 coax connector and UG-177/U hood to the shielded primary lead as shown in Fig. C15.

18. Wind one turn of ¼-inch diameter half-hard copper tubing around a 1-inch diameter form. Saw the tubing as shown by "phantom lines" in Fig. C14. Drill as shown in Fig. C14 and clean off all burrs.

19. Locate the 8-inch piece of shielding left over from step 10.

20. Using same technique as in step 11, solder one end of the shielding into the ⅛-inch hole. **Clean off all solder splatter and burrs.**

21. Solder one end of another length of No. 26 plastic-covered hookup wire to point A (see Fig. C14) and wind three turns inside the tubing in the direction shown.

22. Feed the free end of the hookup wire through the shielding. Bend the tubing into final shape as shown in Fig. C14. Pull up the three turns snugly, making sure that the plastic coating is undamaged.

23. Connect a male phono plug to the free end of the shielded wire as shown in Fig. C15. Length of the wire is critical.

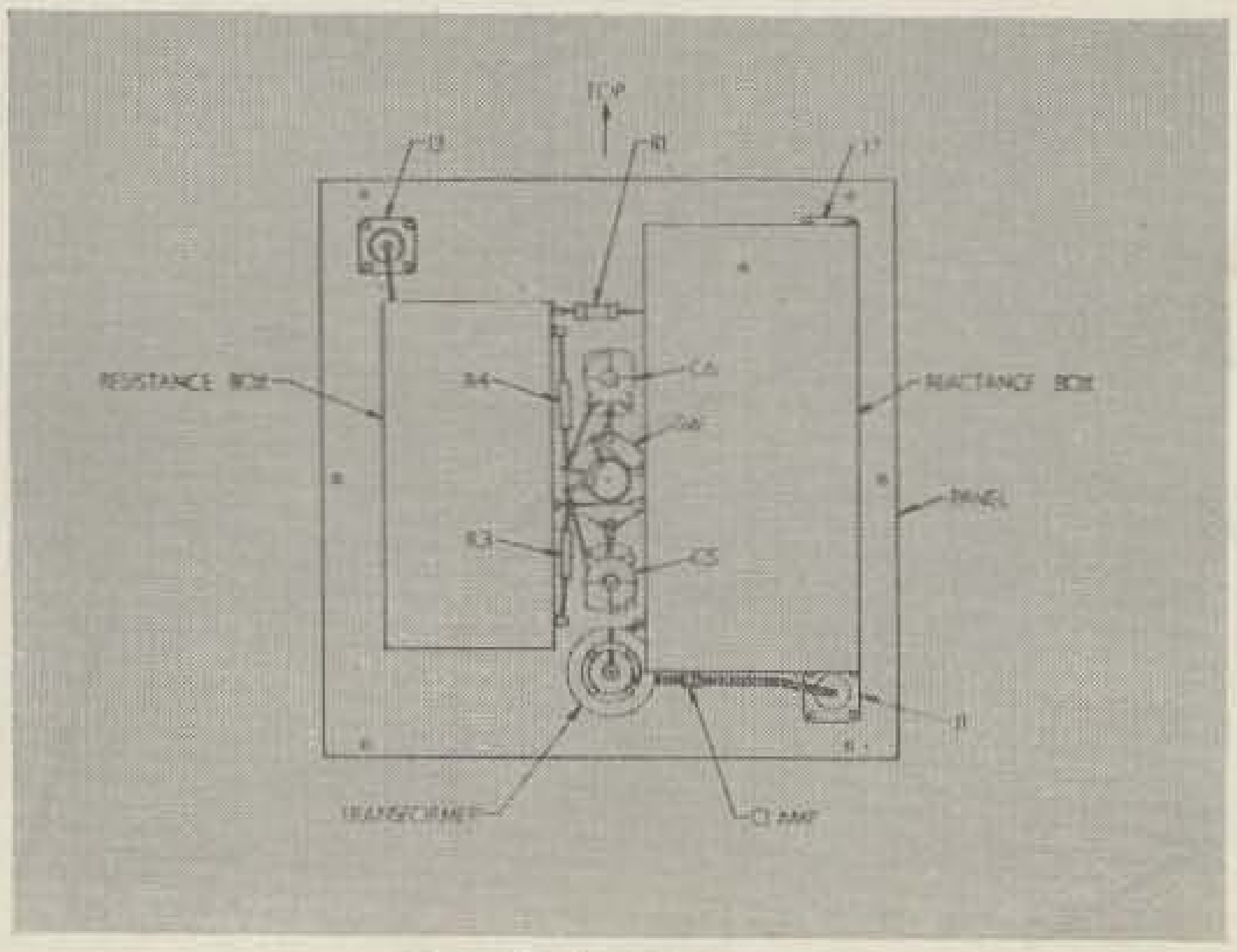


Fig. 2—Inside view

24. Using four pieces of ⅛-inch diameter plexiglas rod as spacers, assemble the primary and secondary shielded windings as shown in Fig. C15. Attach insulator I4 to the transformer by cementing it into the bobbin hole with Duco. Cement both windings to spacers with Duco and allow to dry overnight. This completes the transformer.

25. Remove top and bottom from the 8x10x10 utility box. Remove all paint from flanges; clean to bare metal to provide adequate rf shielding on reassembly.

26. Remove paint from inside of bottom plate for ½ inch in from each edge.

27. Remove paint from inside of top plate as shown in Fig. C16 by "phantom lines."

28. Drill the top plate as shown in Fig. C16.

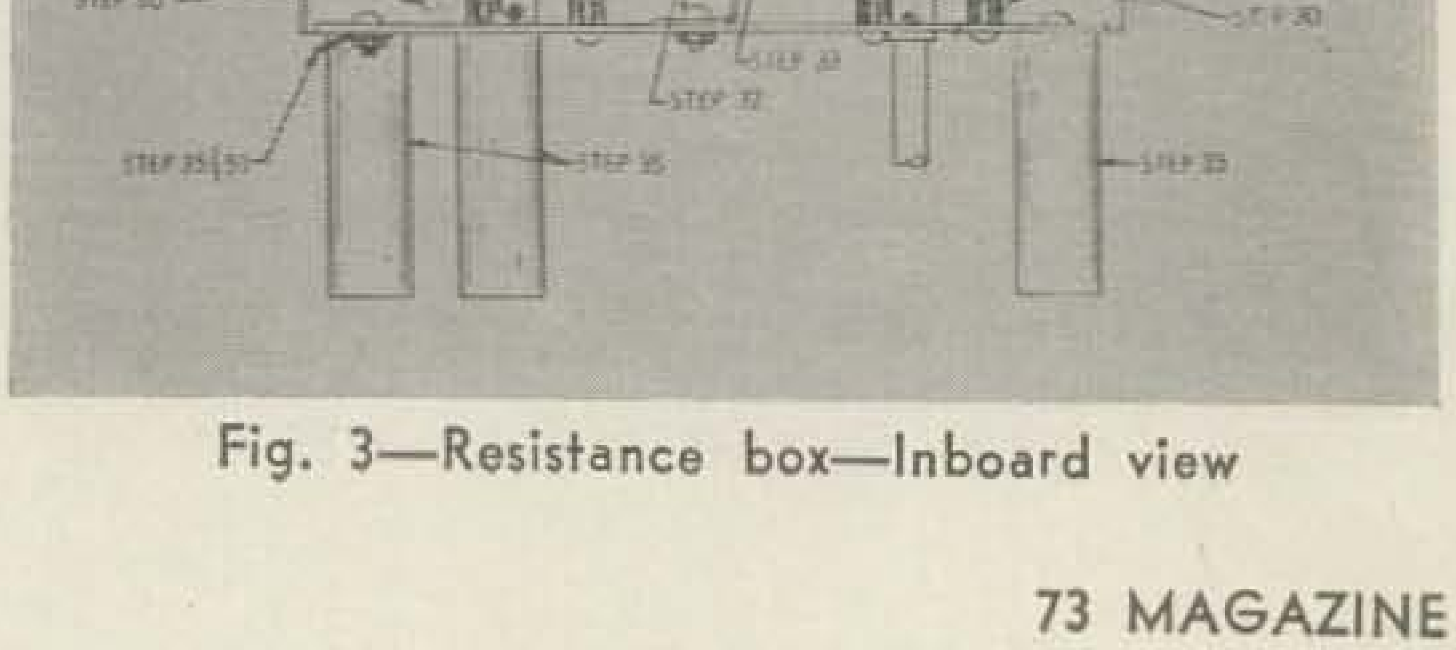
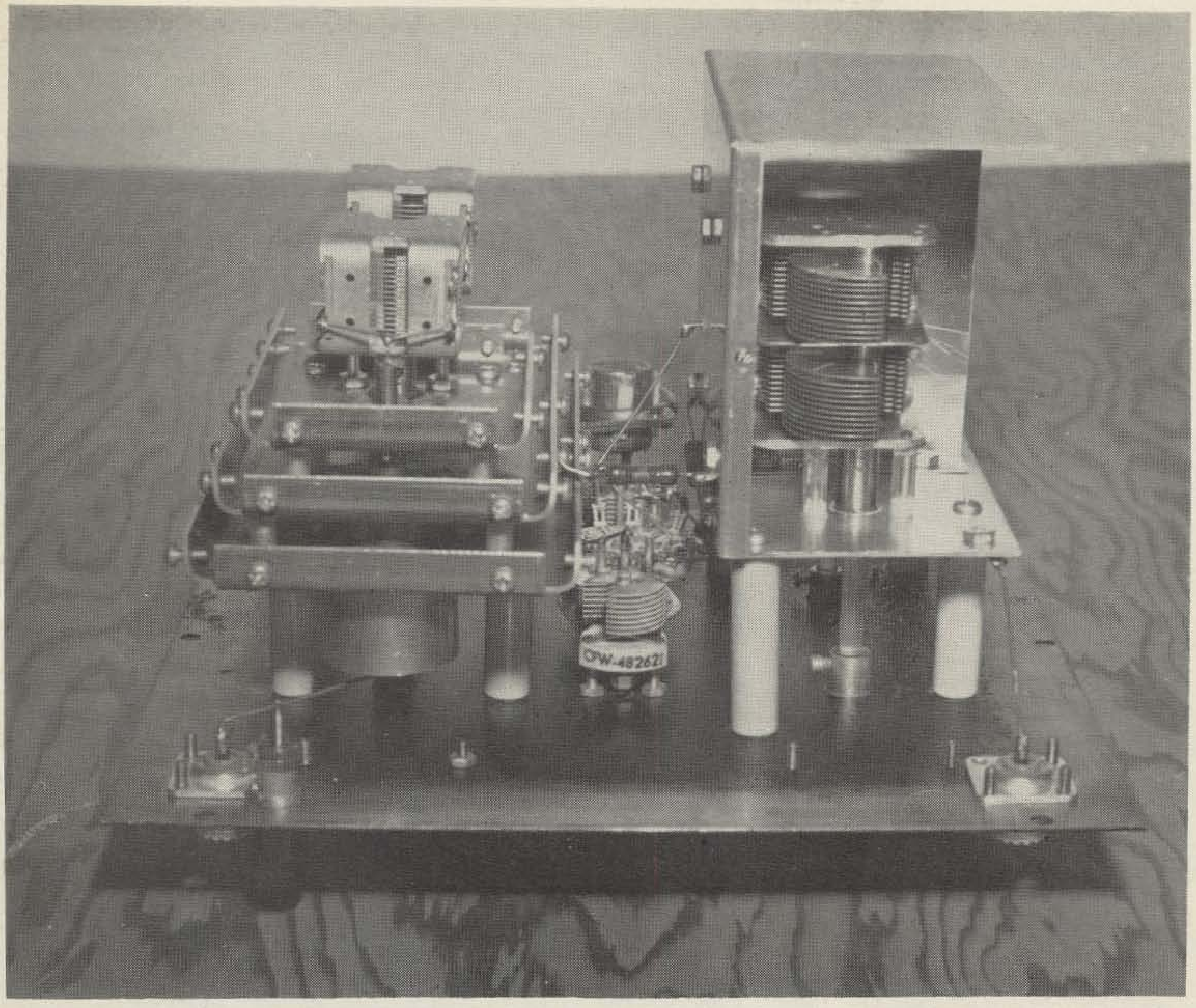


Fig. 3—Resistance box—Inboard view



Note that drawing shows INSIDE surface of plate.

29. Cut shafts of all four variable capacitors to ⅜-inch length. Remove all trimmer capacitors.

30. Tap the threeholes on the face of each capacitor, using a 6-32 tap. Take care not to damage the first stator plate; a bottom tap may be necessary. Attach three type I2 insulators to C1 and C2, using ¼-inch-long 6-32 set screws as shown in Fig. 3. This completes preliminary metalwork.

## Actual Wiring

31. Attach C1 and C2 to shield box S5 using six ¼-inch-long 6-32 machine screws. Connect stator lugs of C1 to those of C2 with No. 18 tinned wire, as shown in Fig. 3.

32. Mount two soldering lugs as shown in Fig. 3 and connect remaining stator lugs to them, using No. 18 tinned wire.

33. Press the Erie CF-408 feed-thru into the 0.136-inch diameter hole in S5. Solder a short No. 18 tinned lead from the inside terminal of this insulator to the wire installed in step 31, as shown in Fig. 3.

34. Attach shield partition S5A, using three ¼-inch-long 6-32 machine screws. One of the screws installed in step 32 must be temporarily loosened and removed.

35. Attach four type I3 insulators to shield box S5 as shown in Figs. 3 and C9.

36. Attach three more soldering lugs to S5 as shown in Fig. 3, using ¼-inch-long 6-32 machine screws.

37. Attach four type I3 insulators to shield platform S1, using the 4¼-inch-spaced holes in S1 and 6-32 screws. Attach S1A to S1, using 6-32 screws from the inside of S1. Attach the female phono socket to S1 in the 7/16-inch diameter hole. Attach four type I1 insulators, using ¼-inch-long 6-32 screws. Do not tighten the screw in the hole marked "Hole A" in Fig. C1; this screw will hold a cable clamp later. See Fig. 4 for details of insulator placement.

38. Attach four type I1 insulators to shield platform S2, using the 2⅜-inch-spaced holes in S2 and ¼-inch-long 6-32 screws. Attach S2A to S2. Attach capacitor C3 with 1-¼-inch-long 6-32 screws, using two nuts on each screw as shown in Fig. 4. Mount a soldering lug under one nut as shown. Align the capacitor by adjustment of the mounting screws and nuts.

39. Solder a No. 18 tinned wire to the female phono socket and pass the wire through the corresponding hole in S2. Attach S2 to S1 with

¼-inch-long 6-32 screws going into the type I1 insulators attached to S1 in step 37.

40. Attach C4 to shield platform S3 using ⅝-inch-long 6-32 screws with dual nuts (same as in step 38). Attach S3A to S3.

41. Connect two of the stator lugs of C4 with No. 18 tinned wire as shown in Fig. 4. Slide shield assembly S4 into S3A. Center assembly S4 in S3A, using a piece of ¼-inch-long insulating tubing. Make certain that opposite ends of S4 and S3A are even as shown in Fig. 4, and cement tubing in place with Duco. Solder the shorted end of resistor R2 (which is in S4) to the wire connecting stator lugs of C4.

42. Attach shield platform S3 to S2, using ¼-inch-long 6-32 screws going into the type I1 insulators installed on S2 in step 38.

43. Place a ¼-inch-long 6-32 screw in the flange of S3 as shown in Fig. 4, with a soldering lug. Connect this lug to the stator lug of C3 with No. 18 tinned wire. Using ¼-inch-long 6-32 screws, mount a soldering lug in Hole B (see Fig. C1) of S1 and another in S2 as shown in Fig. C2. These lugs are mounted in a direction opposite to that of the platform flanges.

44. Attach the "unknown" ground lug to the panel next to the "unknown" coax connector hole, as shown in Fig. C16. Attach the "receiver" coax connector to the panel, from the inside. Attach the "IND-CAP" switch to the center of the panel, using an extra nut to position the switch as far as possible from the panel. Orient the switch as shown in Fig. 5. Place a soldering lug under each nut. Mount C5 and C6, using ⅜-inch spacers between the capacitor frames and the panel. Connect the

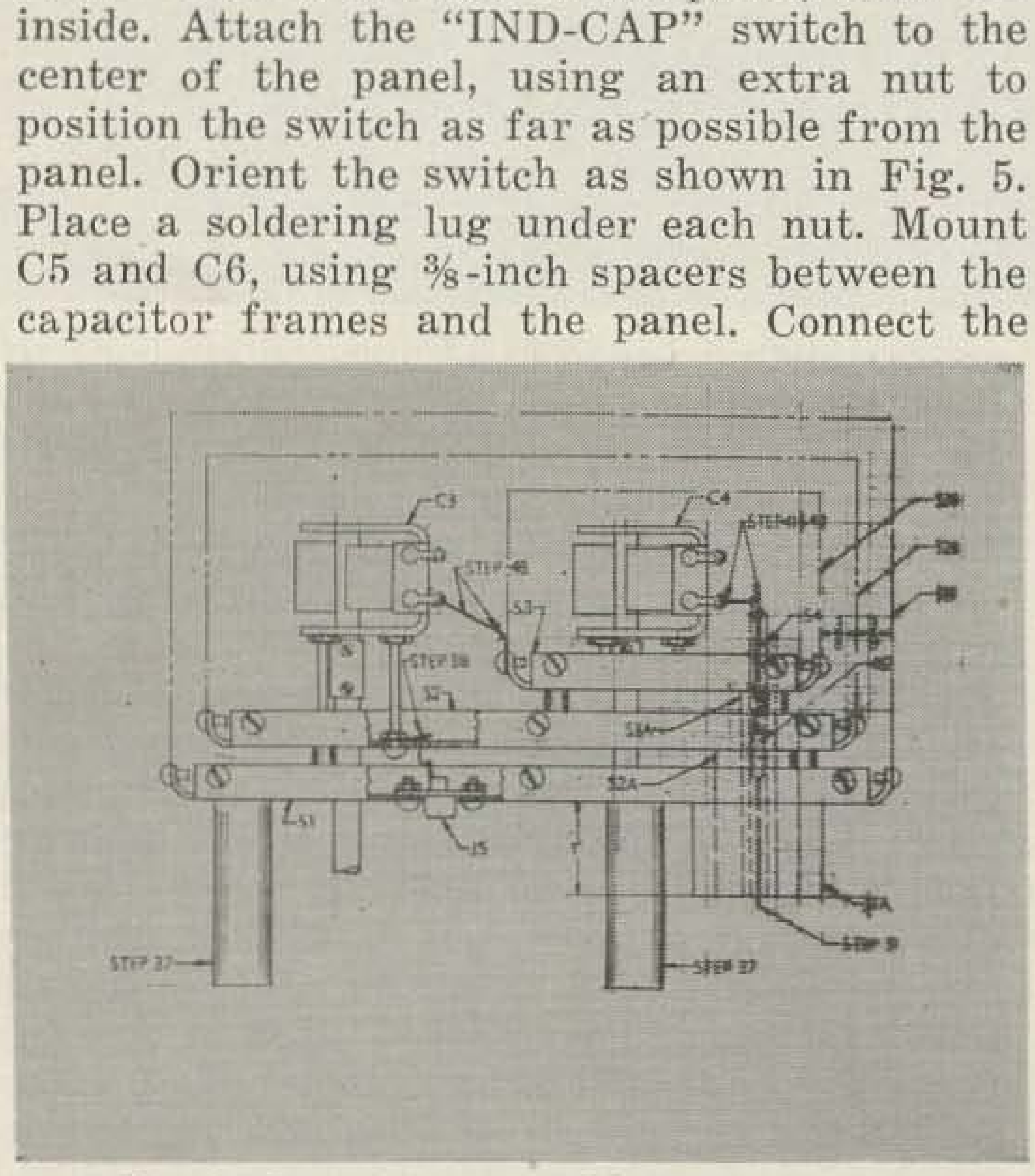



Fig. 4—Reactance Assembly—Inboard view

rotors of C5 and C6 to the lugs of the switch with No. 18 tinned wire as shown in Fig. 5.

45. Solder a 2½-inch length of No. 18 tinned wire to the "COMMON" terminal of the switch. Connect the stators of C5 and C6 to the remaining switch terminals, as well as resistors R3 and R4. Complete connections are shown in Fig. 5.

46. Attach the "unknown" coax connector to the panel, placing a soldering lug under one mounting screw. Connect the "unknown" ground lug to this soldering lug to provide a good bond.

47. Mount panel bearings for capacitors C2 and C4. Mount the special panel bearings furnished with the Johnson Vernier Dial assemblies in place. Attach the two large dials to dummy shafts and mount the dial indicator in the position you prefer. Remove the large dials and dummy shafts after placing the dial indicators.

48. Mount S5 at the left side of the panel (as shown in Fig. C16) and mount the assembly of S1, S2, and S3 at the right side. See Fig. 2.

49. Attach shaft couplers to the four capacitors. Cut the plexiglas shafts to length and mount them in place. Attach the large vernier dials. Set the dial of C2 so that it reads "0" at minimum capacity. Set the dial at C4 so that it reads "100" at maximum capacity. Mount the two Calrad dials on the panel, setting them so that they both read "0" at maximum capacity. Attach the knob to the "IND-CAP" switch.

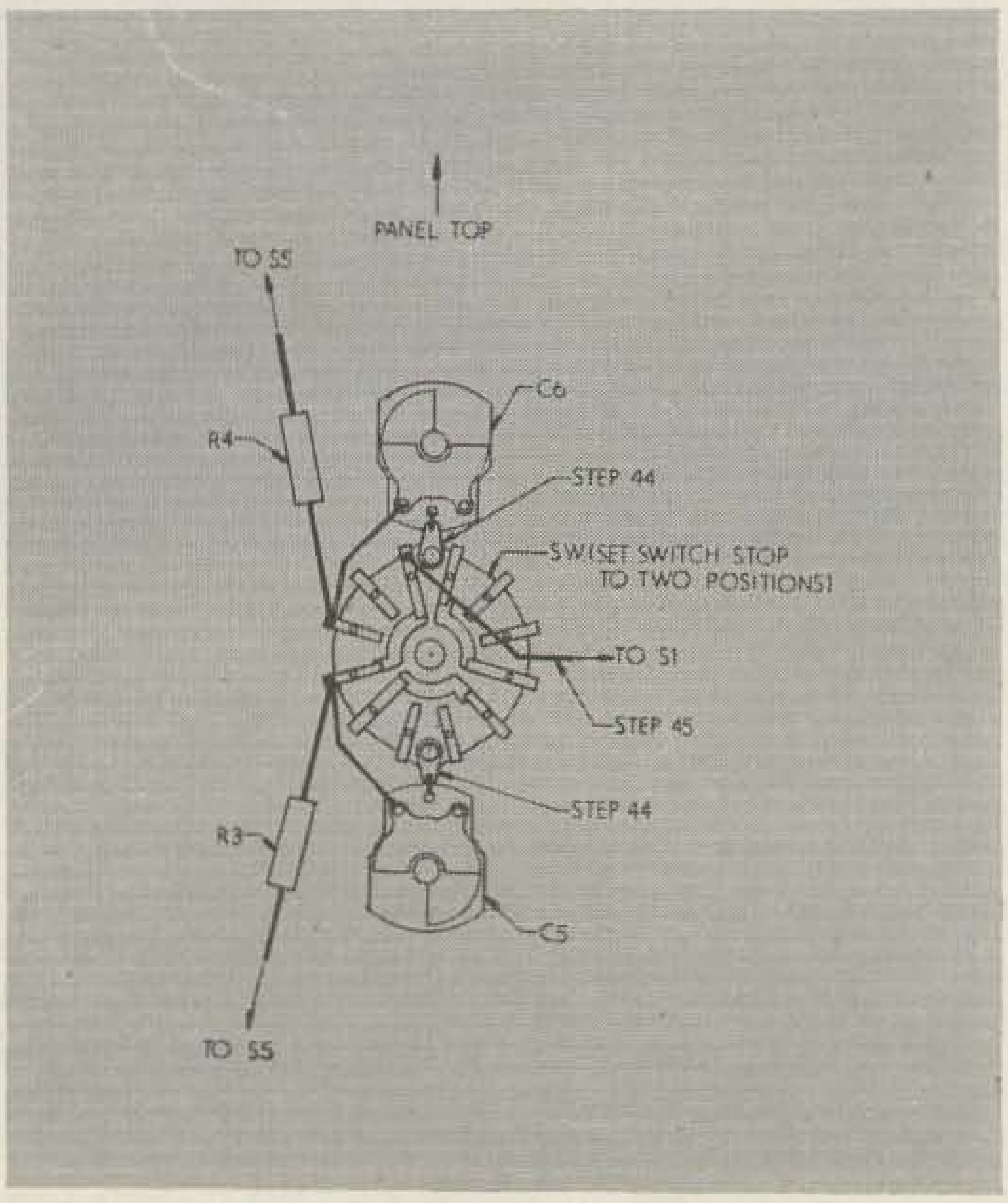



Fig. 5—Switch Assembly

50. Connect resistor R1 (270-ohm deposited-carbon) from the soldering lug on S2 to the lug in line on S5. Connect R3 (220 ohms) and R4 (100 ohms) to the soldering lugs on S5 which were installed in step 36. R3 will be the resistor nearest the bottom of the panel.

51. Connect a No. 18 tinned-wire lead from the "detector" coax connector to the lug on S5. Connect a No. 12 (note different wire size) lead from the "unknown" connector to the free end of R2. *Make sure that* R2 *is not shorted to any shield.*

52. Attach the transformer, completed in step 24, to the bottom of the panel as shown in Fig.

2. Attach the coax connector connected to the transformer to the panel in the "signal generator" hole. In the hole between the transformer and the connector, mount a cable clamp to hold the shielded primary lead. Secure the

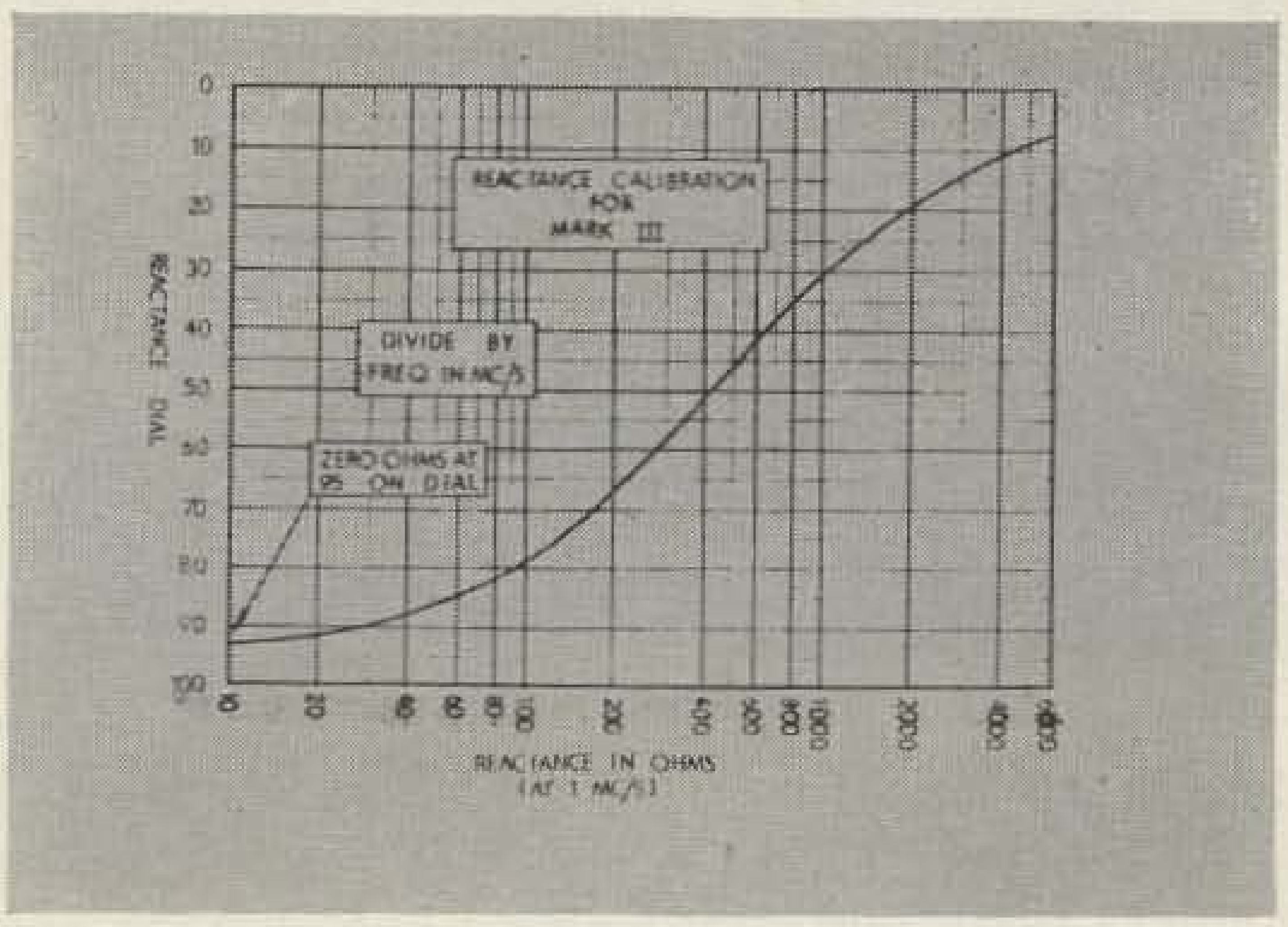



Fig. 7

shielded secondary lead with another clamp held by the loose screw installed in step 37.
53. Mount a soldering lug to S1B with a ¼-inch-long 6-32 screw, placing the lug in the direction of the box opening.
54. Place ¼-inch-long 6-32 screws in all remaining tapped holes in S1, S2, and S3. Starting with S3, place all shield boxes in place and secure screws. Connect a No. 18 tinned lead from the soldering lug installed in step 53 to the Erie feed-thru on S5. Set C5 and C6 to mid-capacity.
55. Attach four rubber feet to the bottom plate of the case and four more to the bottom side of the utility cabinet. Restore the front plate in place and secure with the sheet-metal screws provided. This completes construction of the bridge. After calibration, it will be ready for use.

### Calibration and Use

Since the Mark III is a null-type instrument (adapted from the Schering bridge circuit) it can only be used with a signal generator and a detector. Both must be shielded; however, a Heath SG-8 will do nicely as the signal generator and any decent communications receiver will serve as the detector. For best results, it should be calibrated with the signal generator and receiver with which it will be used.
56. Connect the bridge to the signal generator and the receiver, using coax cable from the panel connectors to each.
57. Set both the signal generator and the receiver to 2 mc.
58. Short the "unknown" terminal and ground terminal using a banana plug in the connector or a coaxial short made by soldering the pin of a PL-259 connector to the shell through a copper disc.
59. Set the "IND-CAP" switch to "CAP."
60. Set the "Reactance" dial to 15.
61. Set the "Resistance" dial to 5.
62. Tune the signal generator, only, for maximum signal in the receiver.
63. Using the two small "balance" dials, reduce the signal in the receiver to the lowest level possible. This is the "null" or "balance" condition. The dials will interact, and multiple adjustment will be necessary. However, all receiver and signal generator adjustments must be left alone during this step.
64. Replace the short across the "unknown" connector with the 620-ohm deposited-carbon "test" resistor.
65. Using only the large "resistance" and "reactance" dials, null out the signal once more. Record the final reading of the "resistance" dial. If this reading is 95, you are extremely lucky and the first half of the calibration is complete. If not, proceed with step 66.
66. If the "resistance" dial reading is less than 95, increase the capacity of C6 slightly and repeat steps 60 through 65. If the reading is larger than 95, decrease the setting of C6 and repeat steps 60 through 65. Continue this process until the reading comes out at 95.
67. When capacitive calibration is complete, set the "IND-CAP" switch to "IND," and the "reactance" dial to 30.
68. Repeat steps 60 through 65; if the final reading of the "resistance" dial is other than 95, proceed with step 69.
69. If the reading is less than 95, increase the capacity of C5 slightly and repeat steps 60 through 65. If the reading is larger than 95, decrease the setting of C5 and repeat. Continue

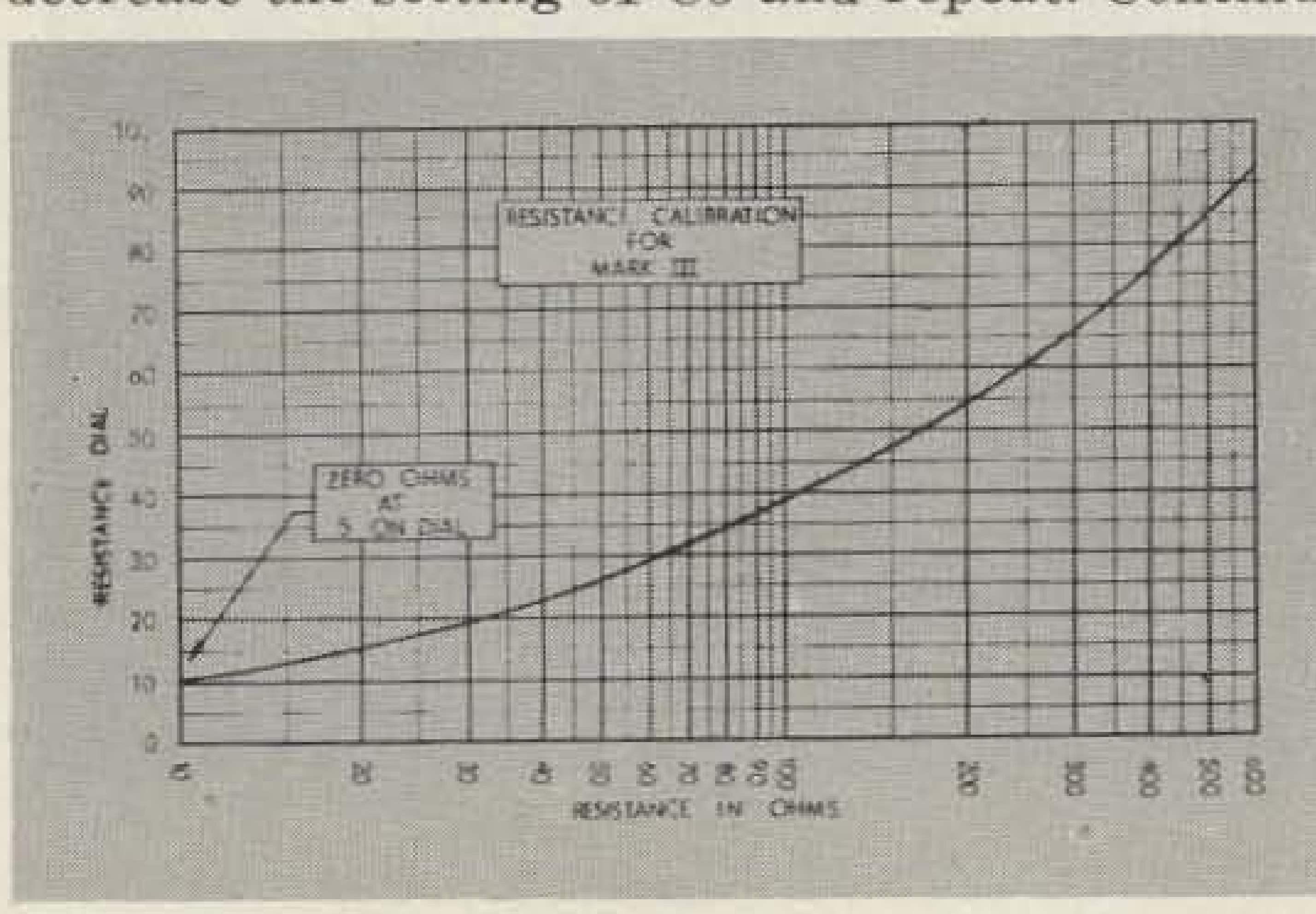



Fig. 6

until the reading is 95. This completes calibration, and the curves shown here can be used for readings.

### Using the Mark III

To use the Mark III, set the instrument up as described in step 56 of the calibration procedure. Set the signal generator to the desired frequency and short out the "unknown" terminal of the bridge as described in step 58.

If you're measuring an inductive impedance, set the "IND-CAP" switch to "IND," the reactance dial to 95, and the resistance dial to 5. Null the signal with the small balance dials.

Now remove the short and connect the unknown. Rebalance the bridge using the large dials, note the readings, and convert the readings to ohms by use of the calibration curves.

These initial values must be corrected. The reactance value is corrected by dividing the value read from the curve by the frequency (in mc) at which the reading was taken. The resistance value is corrected by obtaining the correction factor due to frequency from Fig. 8 and multiplying the reading by this factor.

If you're measuring a capacitive impedance, set the switch to "CAP." Then estimate the reactance of the unknown and set the large reactance dial to a value just larger. Set the resistance dial to 5 and short out the "unknown" connector. Null the signal with the short and again with the unknown, the same as for an inductive impedance.

Correct the resistance reading in the same manner as for an inductive impedance. However, the reactance reading is corrected differently: Subtract the value taken from the calibration curve from the value originally set on the reactance dial. Now divide this remainder by the frequency (in mc) at which the reading was taken. The result is the true value of capacitive reactance.

A few minutes' practice will make operation of the Mark III far more simple than the detailed directions would indicate; in practice, you can make a reading in less time than it takes to read these paragraphs.

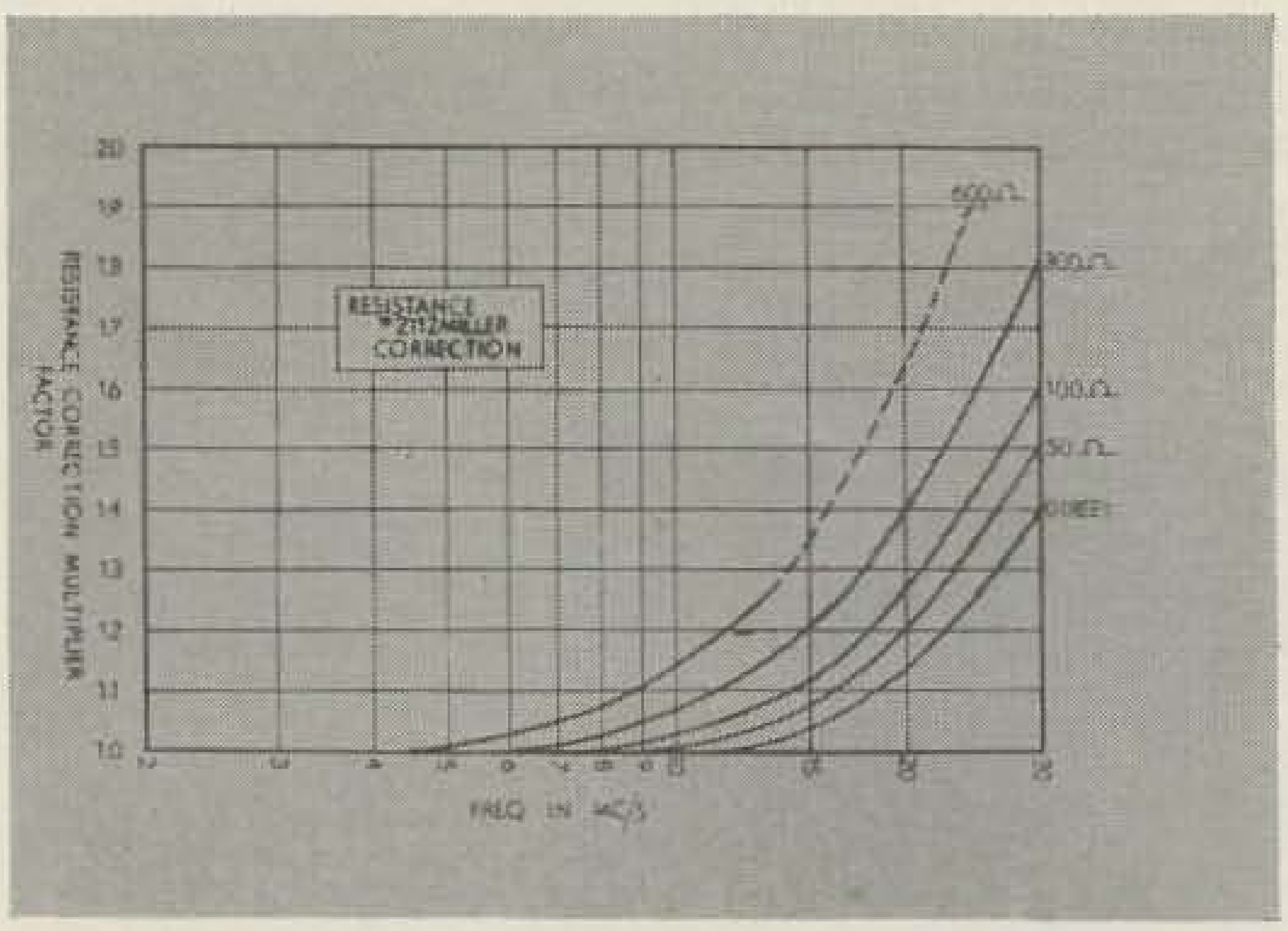



Fig. 8

## Parts Substitutions and Design Changes

Since few hams are content to build a "Chinese copy" of someone else's design, a few words on the effect of changes are necessary.

Naturally, the Mark III doesn't represent the only possible—or even necessarily the best—way in which such a bridge can be built. Any part, or all, may be changed. However, any such change will invalidate the calibration curves, and is not recommended unless the builder has access to laboratory equipment.

Even then, before making any substitutions, these three design articles should be read and fully understood:

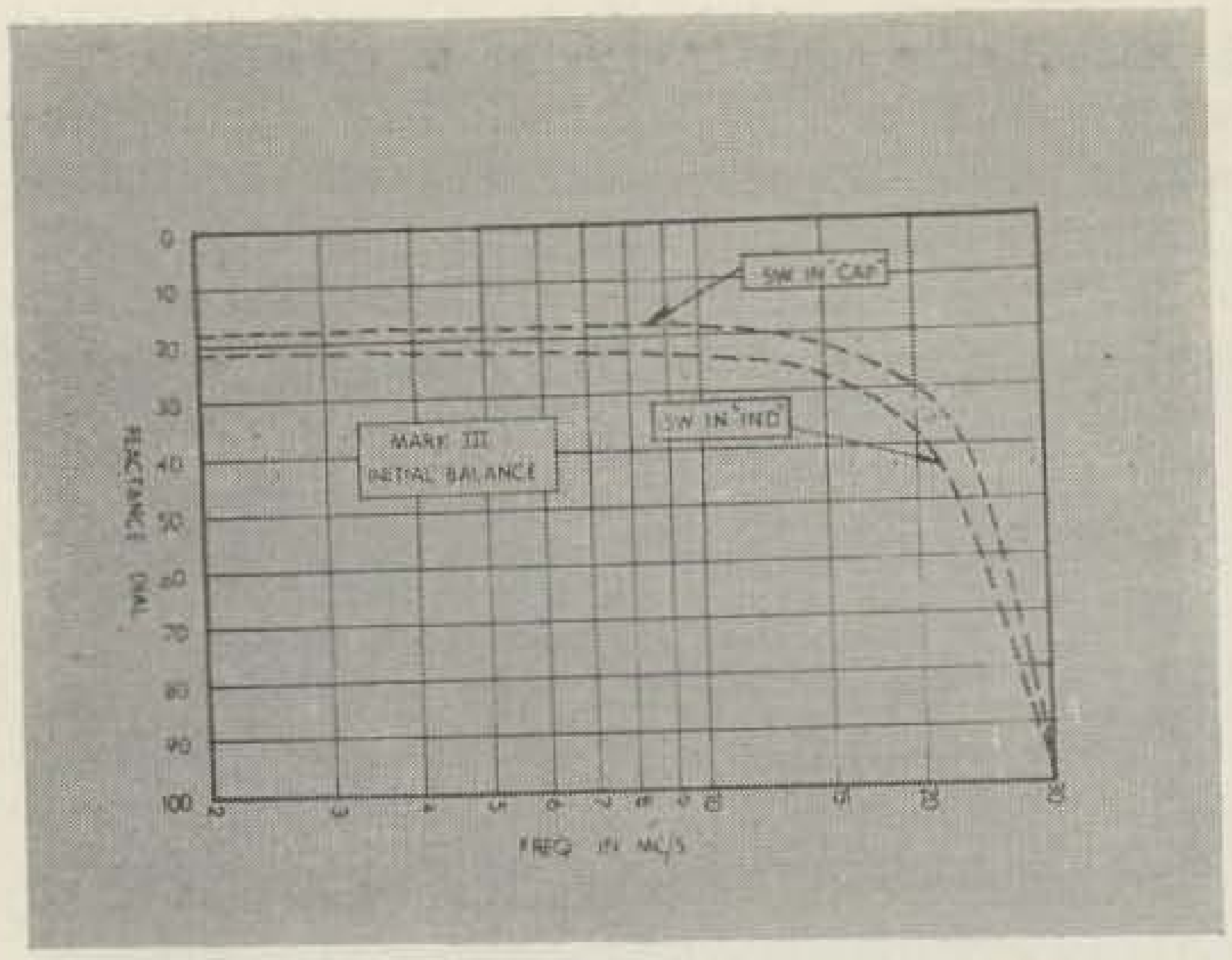



Fig. 9


"A Radio-Frequency Bridge for Impedance Measurements From 4000 KC/S to 60 MC/S," D. B. Sinclair, Proceedings of the I.R.E., November, 1940, pages 497-502.

"A High Frequency Model of The Precision Condenser," D. B. Sinclair, General Radio Experimenter, October-November, 1938, pages 1-7.

"The Effect of Stray Capacitances to Ground in Substitution Measurements," M. Reed, Wireless Engineering, May, 1936, page 284 ff.


. . . K6CRT

**Parts List**

| Quan. | Item | Description | Cat. No. |
|---|---|---|---|
| 1 ea. | C1, C2 | Miller, 10-365 mmf/sect. | 2112 |
| 1 ea. | C3, C4 | Miller, 10-365 mmf | 2111 |
| 1 ea. | C5, C6 | 50 mmf air padder (good quality) | APC-50 |
| 1 ea. | J1, J2, J3 | SO-239 Panel coax connector | |
| 1 | J4 | Phono plug | |
| 1 | J5 | Phono socket | |
| 1 | R1 | Aerovox 1% 1/2W 270 ohm "Carbofilm" | Type-CP |
| 1 | R2 | 330 ohm 5% 1/2W Carbon Resistor | |
| 1 | R3 | 220 ohm 5% 1W Carbon Resistor | |
| 1 | R4 | 100 ohm 5% 1W Carbon Resistor | |
| 1 | Test | Aerovox 1% 1/2W 620 ohm "Carbofilm" | Type-CP |
| 1 | SW | Centralab 3p; 1 Sect; 2-3 Position (reset stop to two positions only) | 2506 |
| *2 | Dials | E. F. Johnson Vernier (0-100 CW) | 116-285-1 |
| 2 | Brgs | E. F. Johnson Panel Bearings | 115-255 |
| 4 | Cplrs | Metal ¼ shaft couplers | |
| 3 | Rod | ¼ inch diameter plastic rod x 12" | |
| 1 | Rod | ⅛ inch diameter plastic rod x 6" | |
| 2 | Rod | ⅝ inch diameter plastic rod x 12" | |
| 2 | Dials | "Calrad" 1-13/32 inch Vernier Dial | VD-36 |
| 1 | BP | Binding Post (ground lug) | |
| 1 | Case | Bud carrying case 10"x10"x8" | CC-1100 |
| 1 | Box | LMB box (plain) 3" x 4" x 6" | |
| 1 | Hood | UG 177/U coaxial cable hood | |
| 1 | Insul. | Erie feed-thru insulator | CF-408 |
| 1 | Short | PL-259 coaxial male connector | |
| 2 | Clamps | Walsco clamp for ⅛ to 3/16 cable | 7502-N |

Of the above list the critical parts are:
C1, C2, C3, C4, J2, R1, Test resistor, Case, LMB box, UG 177/U, Erie feed-thru.

* This author hand engraved these dials per Figs. 6 and 7.

W2NSD from page 4)

yet reviewed in 73. We have reviews on hand now for the Knight R-55, Heath DX-60, VTVM, IO-10, Eico 723, J-Beams and LW-51. We're open for articles on everything else. If you have something new and the facilities to test it we'll pay $10 each for the info. Photographs not needed since the mfr will supply them gratis. To avoid duplication drop me a line and ask. We want not only your impressions of the gear, but some statistics such as stability of receivers, actual power output of rigs, etc. Try to put in everything anyone could possibly want to know.

### Distributors

One of my first moves in getting 73 started was to find the name and address of all of the ham distributors that I could. This meant going through the back issues of magazines and club bulletins. This also meant that there were a lot that I didn't know about. Maybe you'll give 73 a little boost the next time you find a distributor with no copies on his counter. In addition to high pressuring him send me his name and address so I can send him information and maybe a sample copy. There are still hundreds of distributors that are not selling 73.

If you need any sales talk you can point out that he only pays for the copies he sells and that we pay the postage on all returns. You might mention that many distributors report that 73 is outselling all other ham magazines across the counter. Copies sell for 37¢ and wholesale at 24¢ in quantities of ten or more.

### Sixer

One card came in exclaiming that with our July issue we had at long last produced a magazine without a mistake. Look again, buddy. Like look carefully at the S-Meter for the Sixer on page 28 and note the utter lack of parts values on the transistor (a CK722 or equivalent), the 1000 ohm pot, the 3 volt battery, and the 0-1 ma meter. Guess one of our proofreaders missed the omission when he was checking the schematic. Sure wish we had a proofreader.

### June Votes

As I surmised from the early voting, Bill Ashby K2TKN came in first with his Abe Lincoln two meter antenna. Hi-Par heard about the antenna just before we printed the article and decided to have a go at making the contraptions. I haven't heard from anyone using it yet, but I suspect we'll be seeing a lot of those around before long. They sure are just what we've all been looking for in a mobile

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# Propagation

## *Part III*

David A. Brown K2IGY

PART I of this series discussed the Sunspot Cycle and gave predictions for the remainder of the cycle. In Part II we reviewed the different variations, diurnal, seasonal and cyclical that MUF's for a given path are subject to, along with a Special Propagation Chart for the coming Winter season, 1961. For the last part of the series, Part III, we are going to see what the radiation angles are that are involved for DX propagation and what kind of antenna heights are needed for effective DXing.

There are several modes that can be used and that occur for propagation over a given path. The simplest mode for purpose of our discussion, would be where the signals are propagated using the F-layer in a series of geometrical hops (from Earth to the F-layer back to Earth again being a Hop), the number of hops depending upon the path length, the height of the F-layer and the angle of departure of the radiated energy. In the Wintertime the average F-layer height is about 320 Km. If the radiated energy leaves the antenna at a radiation angle of zero degrees, the maximum great-circle distance (remember the Earth's curvature) that can be covered by a single hop would be about 4,000 Km. Fig. I shows the relationship between radiation angle in degrees and great-circle distance in thousands of kilometers assuming a virtual height of the F-layer at 320 Km, for numerous geometrical hops. Each time a hop is made, part of the radiated energy is absorbed by the F-layer and some is also lost by the reflection from the ground. It is therefore, important to have radiation angles small enough to use the least number of hops as posssible and as is practical. Examination of Fig. I will show you that radiation angles for DX propagation should be around 15° or less, to be practical. For example: the path New York to Alaska is 5,400 Km and from the chart the smallest number of hops is 2-Hops with a radiation angle of about 7°. If 3-Hops occur, the radiation angle will be about 15°. In general we find DX propagation having angles of departure and arrival from 2° to 5° to 10° and 12°

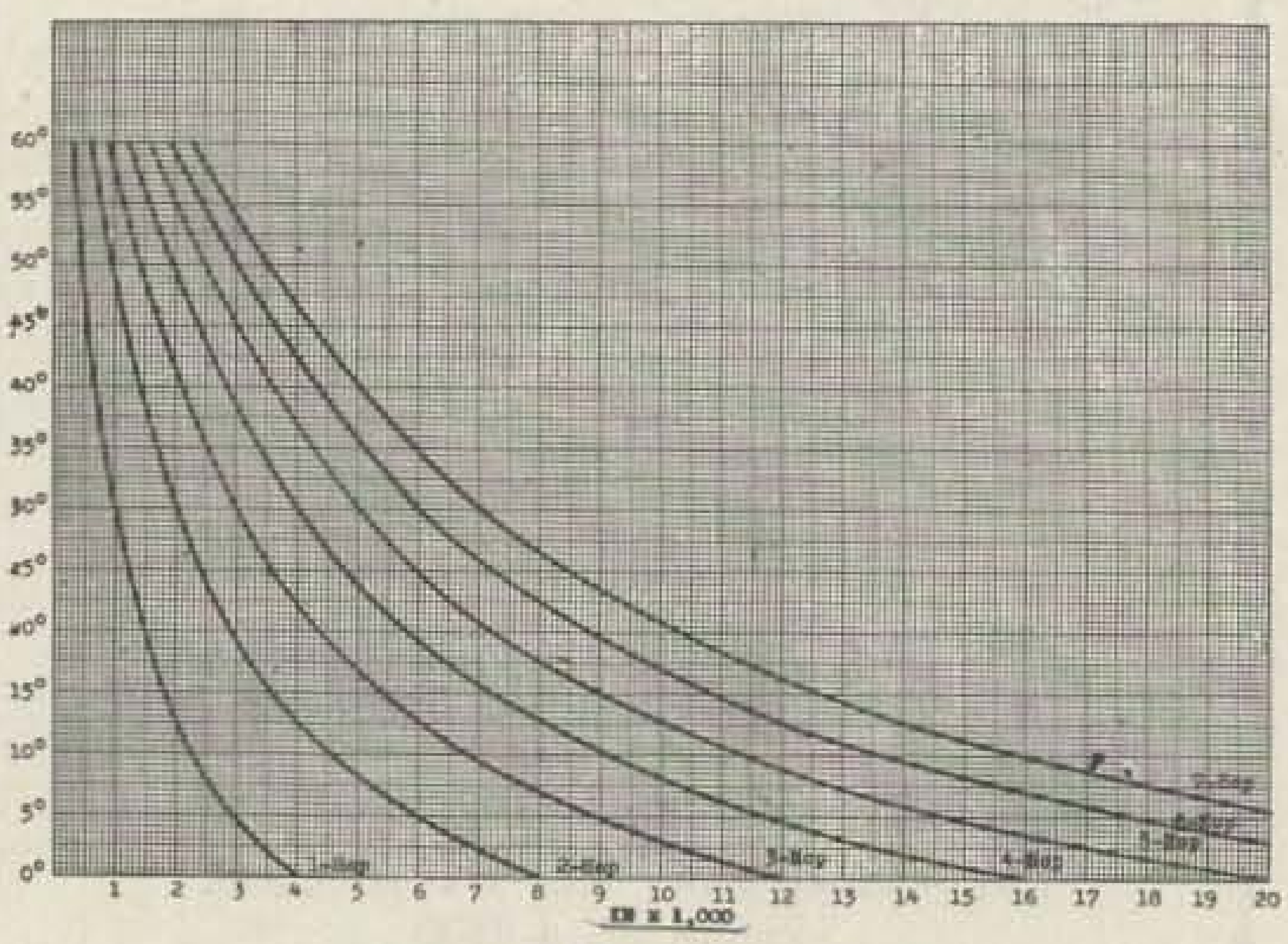



Fig. I

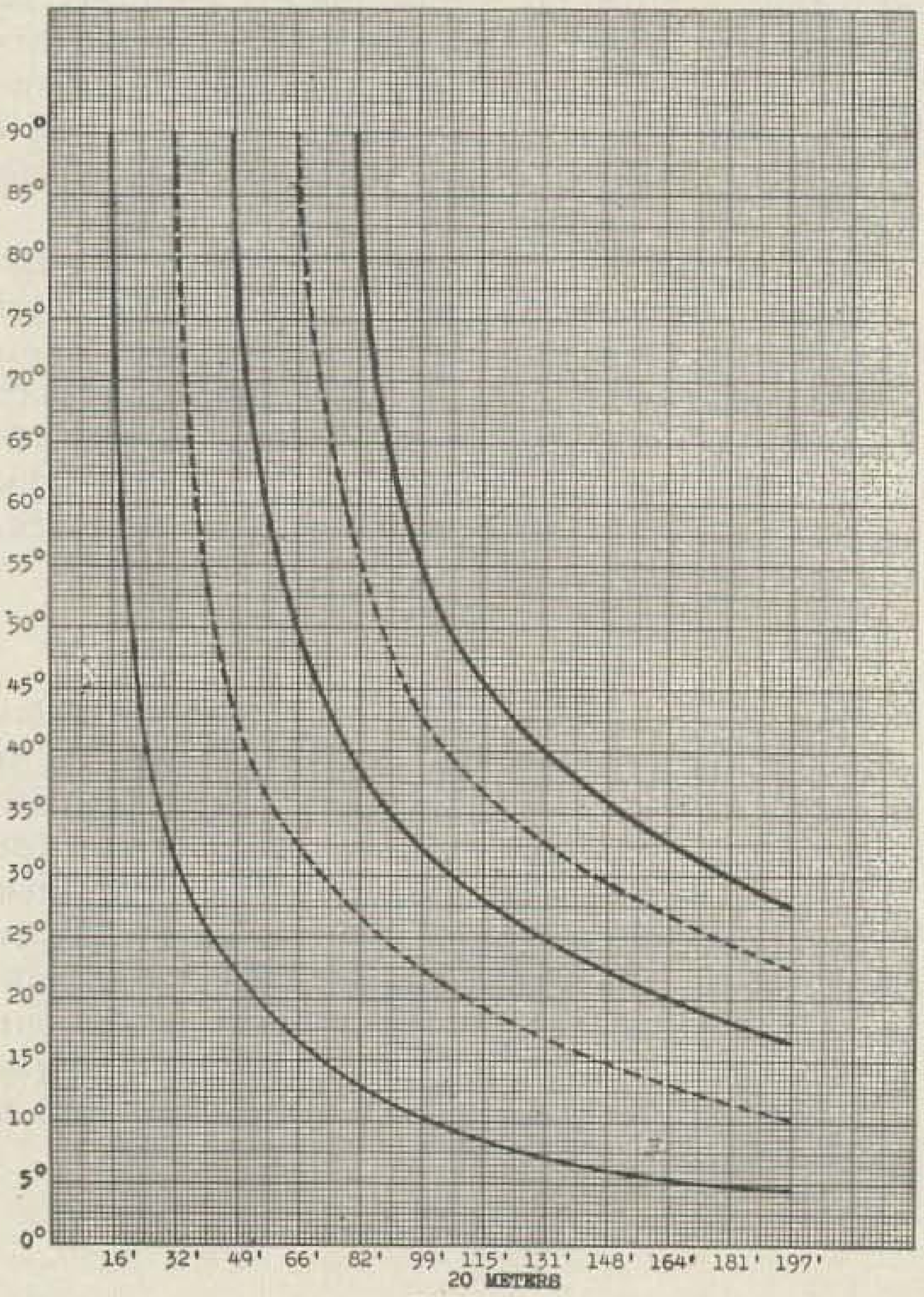



Fig. 2

to 15°. Angles of from 2° to 5° as far as Hams are concerned, are impractical because of the great antenna heights involved. Let us see what the correlation between height and radiation angle is.

The radiation that leaves a transmitting antenna leaves at many angles of departure. The sky wave is the radiation which leaves the antenna at angles above the horizontal to the Earth and is reflected from the ionosphere. At the same time the sky wave leaves the antenna, there is energy radiated below the horizontal which strikes the ground and is reflected up towards the ionosphere. These "reflected waves" will combine with the sky wave before striking the ionosphere and the resulting combined field strength will depend upon: 1.) The height of the antenna above ground. 2.) The size of the antenna. 3.) The condition of the "ground." 4.) The way the antenna is oriented with respect to the Earth.

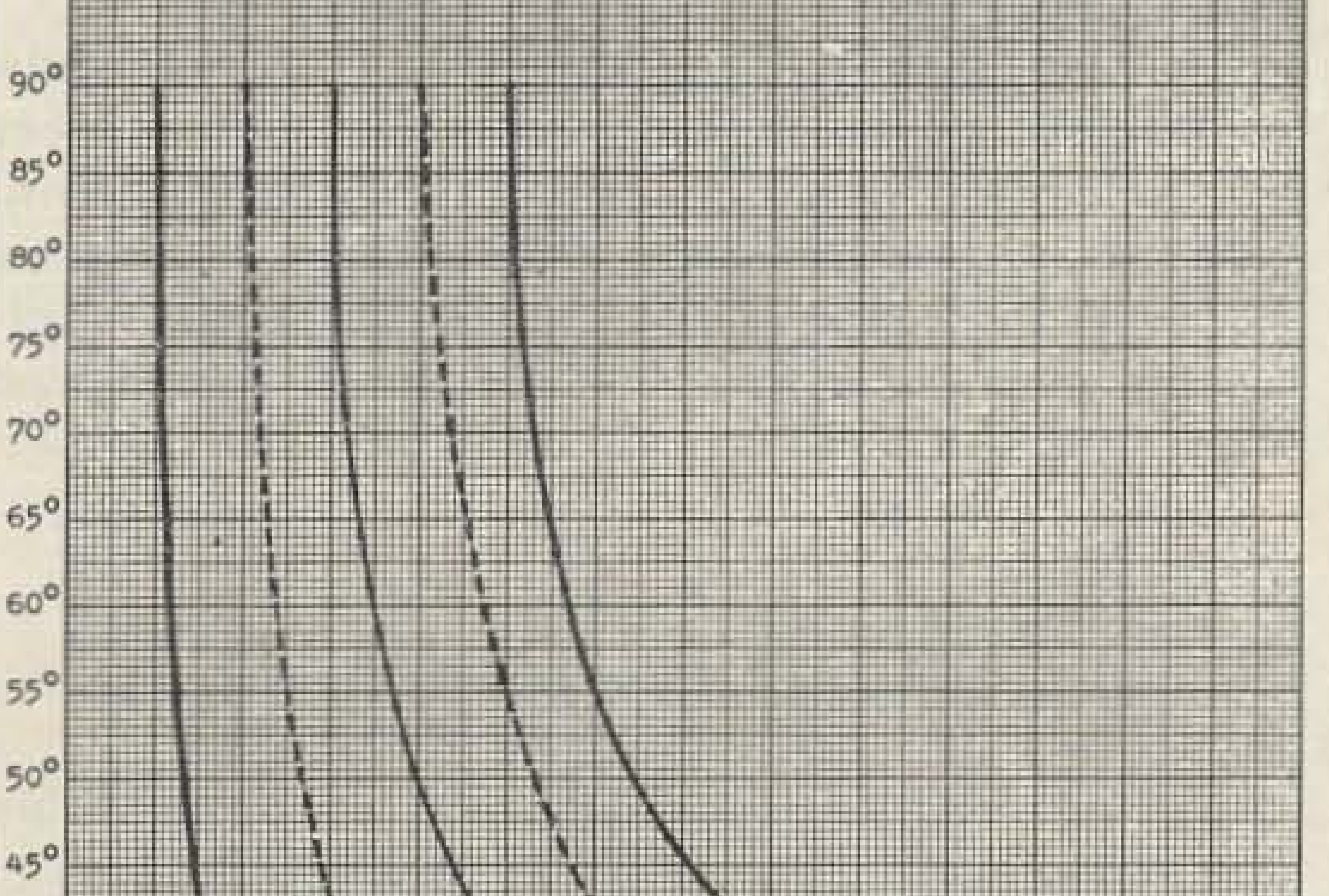



Fig. 3

The reflected wave must cover a greater disance before meeting the ionosphere than the sky-wave. When they meet in phase, the components add, and when they meet 180° out of phase the resulting field strength is the difference between the two. Fig. 2, Fig. 3 and Fig. 4 shows the height in feet above "ground" that antennas must be raised for different radiation angles to have the reflected wave in phase or 180° out of phase to the sky-wave, for the 10, 15 and 20 meter Ham Bands. These charts hold true for vertical antennas whose length is an even multiple of one-half wave

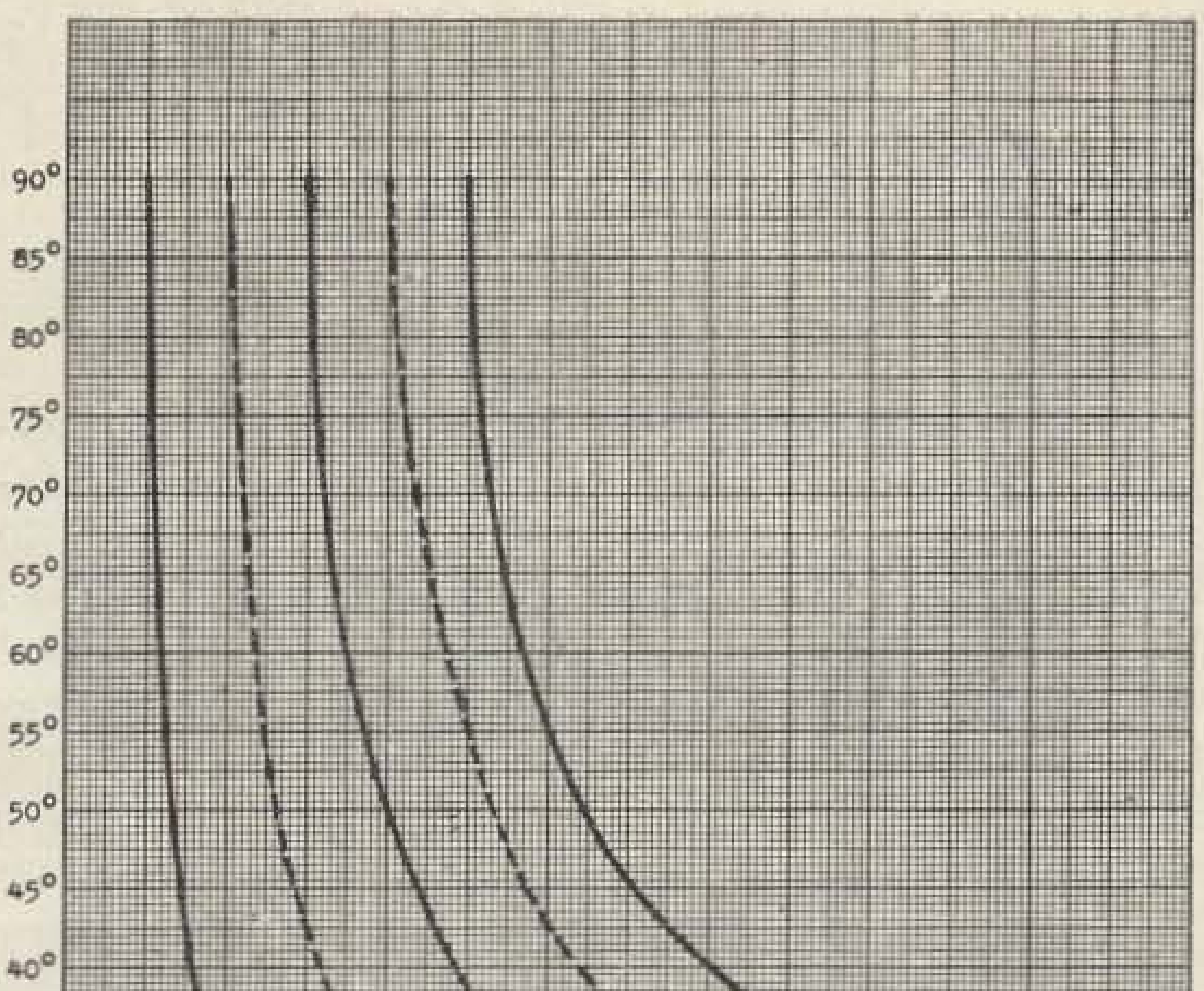



Fig. 4

length and for horizontal antennas. The solid lines being in phase and the dashed lines 180° out of phase. For vertical antennas that are odd multiples of one half wave length, the dashed lines are in phase and the solid lines 180° out of phase.

For DX propagation we are interested in low angles of arrival and departure (angles to the horizontal to the Earth). For radiation angles of 7° we find antenna heights of 123 feet for 20 meters, 82 feet for 15 meters and 62 feet for 10 meters. For angles of 15°, we find heights of 74 feet for 20 meters, 50 feet for 15 meters and 36 feet for 10 meters. These are the heights that our antennas must be placed for reinforcement of the sky-wave by the reflected waves above the "ground." By "ground" is meant the electrical ground which may be several feet below the Earth ground, the actual "ground" being found by raising or lowering your antenna for best results. As can be seen from the charts, sometimes the heights are unrealistically high for most of us to raise our antennas. For general all around tri-band operation, 65 feet seems to be about the minimum height for good DX operation, which results in radiation angles with in phase reflected waves for horizontal antennas of about 16° on 20 meters, 10° on 15 meters and 7½° on 10 meters.

For the greatest enjoyment in your DXing this coming Winter, I hope you all will consider getting the antenna up, as your "project" for this Summer.

# Simple as ABC?

Jim Kyle K5JKX/6

ALPHABET soup can be confusing, as anyone who's tried to decipher the alphabureaucracy along the Potomac in the last 30 years knows. Does this same confusion extend to an appreciation of amplifier classification? If you're in the same boat as most electronics specialists, it does.

Everyone knows the difference between Class A, Class B, and Class C amplifiers. Of course you do. But to give your knowledge of the difference a real workout, try explaining it to another ham—or better yet, a hi-fi enthusiast who knows his amplifiers.

Chances are great that you'll emerge from the experience with slightly shaken faith in your own knowledge, and a bit of curiosity as to just what this business of amplifier classification means.

The reason for the confusion is simple; the special characteristics by which amplifiers can easily be classified can be described in several different sets of reference terms, and in addition distinctive usage in various fields of electronics has added some objectives which mean different things in different places.

The result is equally simple and predictable; if the person to whom you're talking learned a definition just slightly different from the one you learned, he hears you but he doesn't fully comprehend your meaning. The result can range from ordinary comic confusion to violent arguments, and possible monetary loss if misunderstood design recommendations are followed.

And if you don't think the probelm can be serious, try discussing a Class B linear amplifier with a hi-fi bug. He'll tell you, quite seriously—and honestly, in his own frame of reference—that such an animal can't possibly exist. It's a contradictory term, by definition!

Let's take a look at the basic distinguishing characteristic, first. An amplifier's plate current can flow either during the entire signal cycle, for just half the cycle, or for less than half the cycle. In the first instance only, it can flow without change or it can vary with signal voltage. In addition, grid current can flow or it can be absent.

This set of six conditions is the basis of alphabetical amplifier classification. Let's see how the definitions are applied in practice:

By traditional teaching, Class A is defined as that condition in which plate current flows unchanged throughout the cycle. Class B denotes the half-cycle condition, and Class C describes the less-than-half-cycle situation. Subscript numbers are used to describe grid current; 1 means it's absent, 2 means it flows.

While this grouping describes six possible cases, in theory at least, in practice it omits some of the essential combinations and describes some that don't exist. For instance, a Class C1 amplifier is self-contradictory; to operate Class C, grid current must flow.

The omissions are made up for by introducing another classification—AB—to cover the case in which plate current flows throughout the cycle but varies with signal voltage. In practice, the grid-current subscripts are usually applied only to the Class AB instance, and are always included there.

The past three paragraphs have described the traditional grouping. If it were the only set of definitions, the situation wouldn't be so difficult. Let's look at another popular set, taught widely:

In this group of definitions, Class A indicates that plate current flows for 360 degrees of the signal cycle. Class AB indicates a conduction angle between 181 and 359 degrees. Class B indicates a conduction angle of exactly 180 degrees. Class C indicates a conduction angle of 179 degrees or less. Presence or absence of grid current is indicated by subscripts as before.

This may sound as if it's the same set of definitions restated in different terms. That's what it was originally intended to be, but a few significant differences have crept in along the way, with the result that frequent arguments arise about just what constitutes, for example, Class B operation? Or, where's the dividing line between A and AB?

If you look closely you can see, for instance, that the condition termed Class AB1 in the first group has become pure class A in the second, which is based entirely upon conduction angle with no regard for the plate current readings.

The confusion engendered by these not-quite-consistent sets of definitions apparently prompted the author of at least one electronics textbook to eliminate all mention of amplifier classification with the single exception of Class faction with his own equipment and methods A, which was subtitled "Linear Amplifiers" on the assumption that Class A circuits act in a linear manner at all times. Other amplifier circuits were lumped together under the term "Operation in the Switching Mode."

While elimination of the time-honored letter code made the explanations of circuit action much easier to follow than the usual text material, it's no help to the reader who must then go into the real world and communicate with others about his equipment. And this leads to another problem—

In circuit theory, quite properly, only the lass A circuit operated in such a manner ıat the output is a true reproduction of the ıput, free from distortion of any sort, can onestly be called "linear." This strict defini-ion is also accepted by the audio designers nd enthusiasts, to whom linearity means urity of original signal.

On the other hand, in broadcasting, televi-ion, and SSB ham radio, a "linear" amplifier requently means a Class B circuit operated in uch a manner that, although the exact signal pplied to the input is highly distorted at the utput, the modulation envelope of the original ignal is amplified in a distortion-free manner.

And if mention of this point and hints of imilar contradictions in usage between other ields seems ridiculous, bear in mind that hould you ever want to get a job in elec-ronics and be obliged to take an examination, hat examination may have been prepared by ın audio expert who wasn't familiar with ham ingo—and will almost certainly be graded by a personnel man who only follows the answer sheet and won't be impressed by explanations of semantic differences.

It's customary to draw conclusions as the end of an article is approached, but this happens to be a situation in which the only conclusion to be drawn is that we should all know all the definitions, the points of difference, and the cases in which they apply. A chart showing the points of agreement and differences is included (Fig. 1). If you don't want to memorize it, at least clip it out to keep handy the next time you have occasion to discuss amplifiers. Who knows—the embarassment you eliminate may be your own! . . . K5JKX/6

## Stencil Correction Tape Simplifies Drawing Changes

Changes and modifications to complex circuit diagrams are often difficult to make without creating an unsightly and confusing mess. The problem is compounded if the finished product must be reproduced.

Changes, particularly block out of long lines, are easily made with a pressure sensitive gummed tape designed for making corrections on fluid duplicator stencils. One very satisfactory product is made by the Avery Label Company of Monrovia, California and is available through office supply dealers. The white bond paper tape is 1/6" wide and is mounted on a "peel-off" backing. Simply trim to the desired length, peel off the backing and apply over the symbol or line you wish to delete.

Once applied, the tape is there for the life of the drawing, so be cautious. The tape takes typing, ink or pencil and its use will result in professional appearing drawing changes.

. . . Pafenberg

# The Romance of Dixie Dan

*Down below the Mason-Dixon line*
*In the mountains covered by fir and pine*
*Lived a rugged cuss named Dixie Dan*
*An all fired good amateur radio fan.*

*Dan lived alone with his trusty rig*
*And to him no woman was worth a fig*
*With his rig on the air, he'd rather yak*
*Than have a gal in his mountain shack.*

*One day Dan was tuning the band*
*When in roared a signal that sounded grand*
*With the lilting voice of a yl ham*
*And as Dan listened, his old head swam.*

*She was calling CQ, and when she signed*
*His transmit switch was hard to find*
*With a shaking voice, he gave her a call*
*And when she came back, he thought he'd bawl.*

*To the W4, this is Alaska Kate*
*A KL7 in the 49th state*
*Your signals sound good and so do you*
*So let's go ahead and have a rag chew.*

*The Q-so went on, lasted almost a day*
*And Dan's rugged heart melted away*
*The love bug had bitten, Dixie Dan fell*
*He vowed he'd make Alaska Kate his gal.*

*Dan went mobile the very next day*
*And started North up Alaska way*
*He kept a sked each day at dawn*
*And Alaska Kate's voice kept luring him on.*

*On the Alcan Highway, Dan nearly froze*
*In banks of snow as high as his nose*
*But the lilting tones of Alaska Kate*
*Kept him warm and feeling great.*

*He fought off wolves with his ten meter whip*
*And strangled bears with his mighty grip*
*Always forward he traveled along*
*With Alaska Kate's voice his guiding song.*

*Tired and weary, Dan made his way*
*To Alaska Kate's shack one cold day*
*He opened the door and stepped inside*
*And what he saw made him wish he'd died.*

*There sat Kate in front of her rig*
*And around her were kids, little and big*
*She hoisted her bulk out of the chair*
*And greeted her man like a damsel fair.*
*"My hero," she cried, in her lilting voice*
*Your handsome face makes my heart rejoice*
*You're the answer to a widow's prayer*
*With my nineteen kids, we'll make quite a pair.*

*With terrified scream, Dan turned and ran*
*To escape the fate of becoming Kate's man*
*She called and pleaded, as did every kid*
*But he ran like a man who's flipped his lid.*

*Dan quickly returned to his southern home*
*Determined for sure he'd never more roam*
*And there with his rig in his mountain shack*
*He's back on the air, and still likes to yak.*

*He never comes back to a yl ham*
*When he hears one call, he makes likes a clam*
*He's never forgotten Alaska Kate*
*And how he barely escaped a most horrible fate.*

Ken Johnson, W6NKE

# Letter

Dear Wayne:

In your July editorial you invited comment on that smashing idea of having the F.C.C. sell funny calls (special licenses was the elegant term) to hams. My comment is—it makes me sick.

Briefly, let's face the facts. Education is tightening up. A lot of us middle-aged guys are going to have difficulty this autumn getting into the college of our choice. Personally I'm going to have trouble with Mills and Vassar. Part of the trouble is my wife's fault. Her clothes won't fit me. Or suit me, if you like it punwise. However I should have foreseen the problem for there is quite a difference in our ages. I married her as a child. I was fourteen and she was thirty seven. But I couldn't resist her; she had a kilowatt and a two-letter call, while I was shy, with a 59 tri-tet and thick ankles. The shyness wore away but the thick ankles left me with a bum fist. As it turned out this was part of my charm—if anything so small could have parts. True, I was always a lid, but I tried to be a good one. One hand key for dots and another one for dashes. In time, as a result of much two-fisted practice, I was unique among beginners for I could copy with ease and knew that sending was my weakess. Of course there were the usual problems that plague a boy's life. One of them was the delusion common to the young and/or lazy ham that the maze of coils and spirals in a bedspring could be made to radiate energy as well as absorb it. Experiments along this line revealed the interesting behavior of people when they are awakened by blue arcs under their bed and the unmistakeable fragrance of scorched hair. But that was years ago, and if my ideas weren't fruitful one should remember that I was only a lad of twenty eight and at least my head was pointed in the right direction.

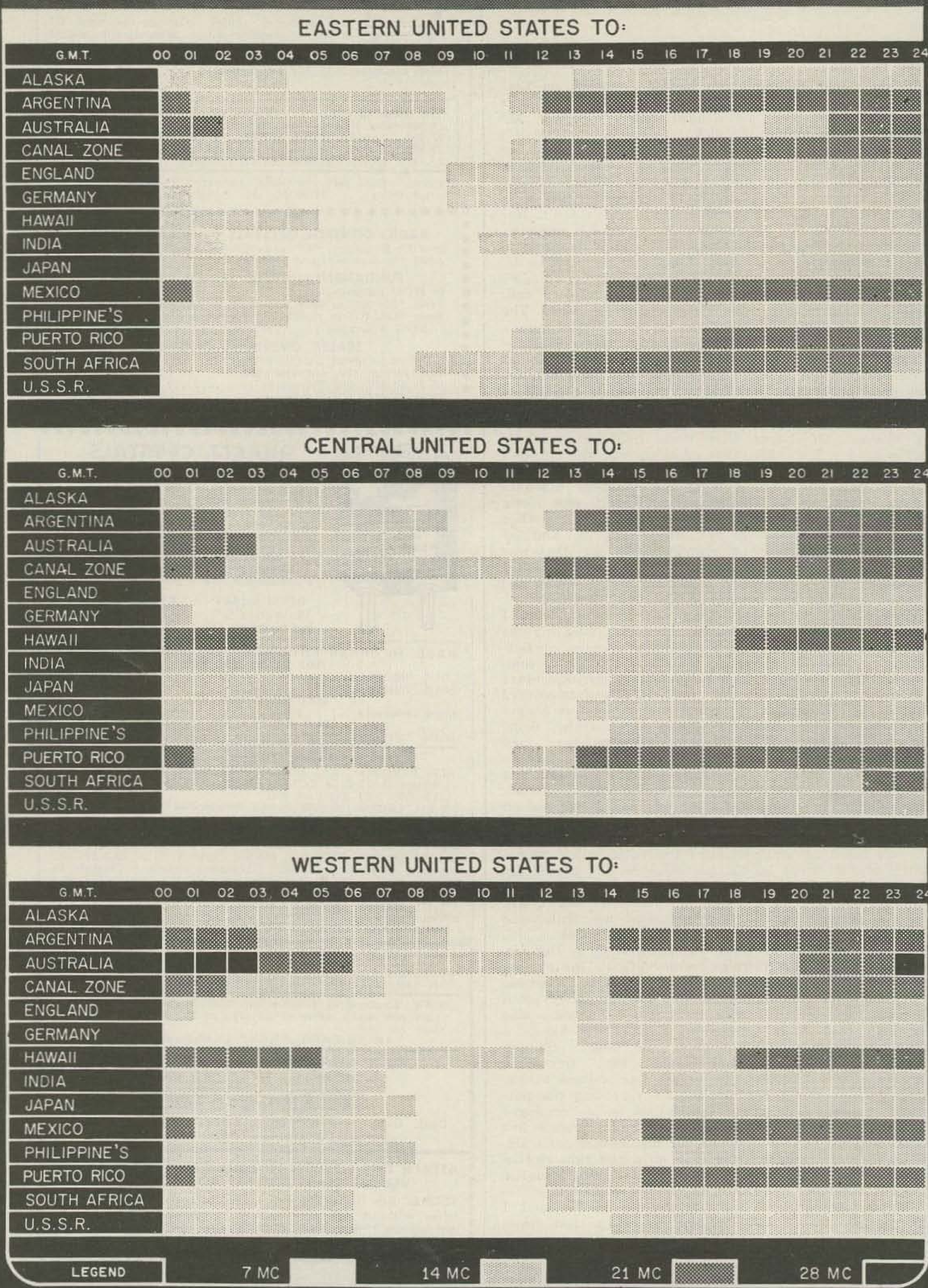
Time passed, as it does when one is typing, and I exercised my talents in a variety of fields, inventing the flesh-colored pistol for plainclothesmen, a series of self-solving problems for detecting schizoid syndrome in computers, the famous SSM (Schokoladespieronierenmaschine) device for exposing off-center fruit in chocolate-covered cherries, the concept of mounting tube sockets on hinges to provide storage space for stamps and marbles. Some ideas were simply too brilliant to find acceptance, such as rotating the stator plates rather than the rotor to do away with the need for a pigtail or spring contact. You and I know that superlative genius meets with skepticism and jealousy. In a vengeful mood one day I reflected on this and decided to forego creativeness, to concentrate more on exploiting what we already possessed. Working late one night on an exhaustive test of a typical toggle switch to find what hidden potential in this device my wit would illuminate it suddenly came to me that it could be operated in a horizontal position! But I had forgotten something, in the horizontal my rhinestone cut painfully into my navel. I gave up research.

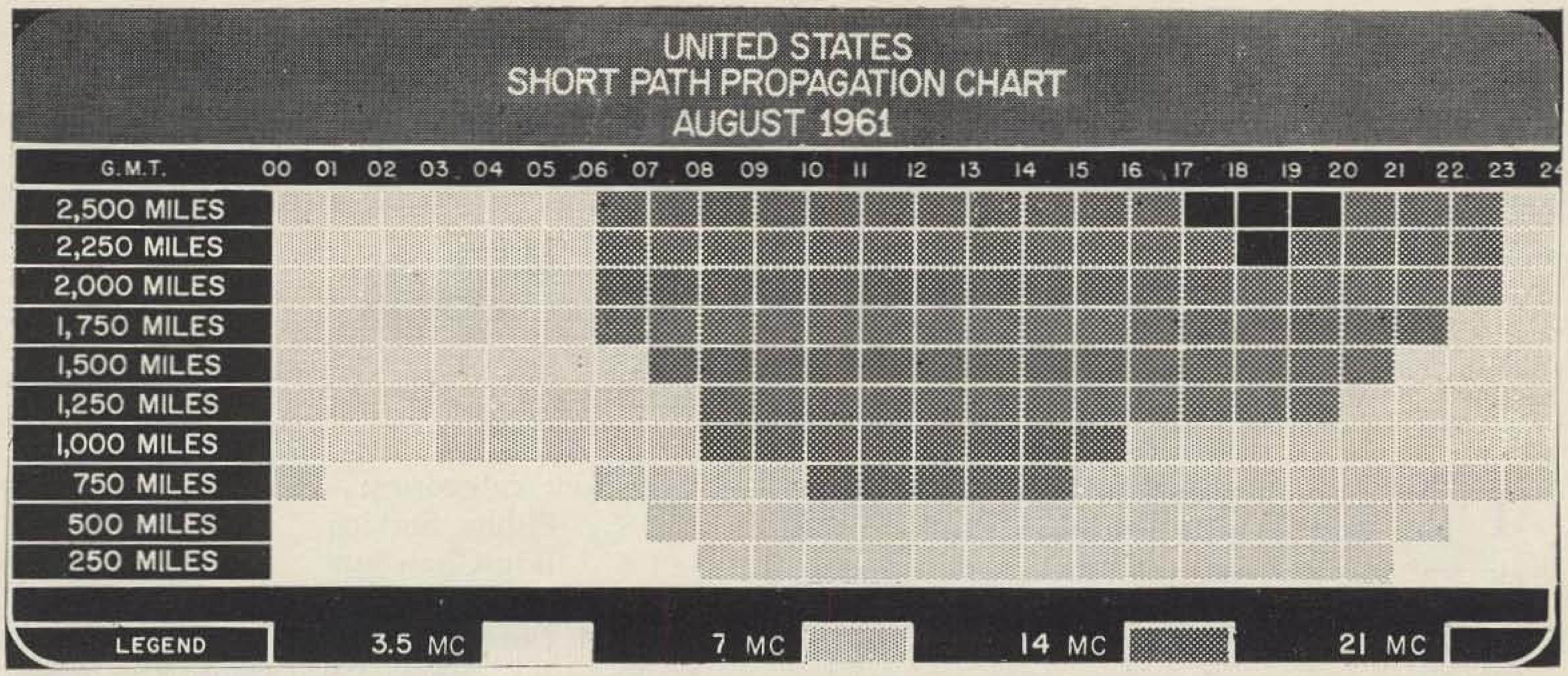
My subsequent withdrawal was a blessing in disguise, to coin a phrase. In disguise opinion—that's the phrase. Anyway, sir, I found an ideal outlet for today's neurotic—writing to the editor. Any editor. They're pretty much the same, aren't they? Nice guys, but . . . well, who else uses gold color typewriter ribbon? Or hangs a homey embroidered sampler over the desk: "He-men Don't Cry; They Keep Their Mascara Dry." Of course it's true that you're the only editor I've written to but obviously you are a conformist and represent the pattern. For proof note the characteristic device employed with subscriptions. A two-year stretch of 73 costs five bucks, but one for me and one for my mother costs six. Surely the extra reader brought in on a gift subscription is worth the trouble of the extra stencil. Why penalize the good-hearted? Another minority group abused.

Oh yes, speaking of minority groups, that's what I was getting around to: I'd like to vote a few times

(Continued on page 69)

# PROPAGATION CHART






# Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

**Advanced Forecast: August 1961**

Good 1-11, 13-14, 16-28

Fair 12, 15, 29

Bad 30-31

The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earths curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same

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Jim Kyle K5JKX/6
1851 Stanford Ave.
Santa Susana, Calif.

# Four Kinds of Ham

THESE days, it seems to be fashionable to sling mud at one's neighbors. Both on the air and in print, we see Novices denouncing Generals, Generals denouncing Novices, Technicians denouncing both, rag-chewers loosing blasts at contest enthusiasts, DX-ers complaining about foreign BC stations, etc., etc., etc.

In line with 73's Number One policy—We Are Not Mad At Anybody—and in the interests of unity within our ranks, let's take a few random slices through the ham world and see just how bad the situation is (or isn't, as the case may be).

One of the first things to examine is this question: Just what is a ham, anyhow?

International law and Government regulations give us a pat answer to that one: An amateur radio operator is a person who is interested in radio and is licensed to operate an amateur radio station because of his love of the art, without hope of any pecuniary reward.

There's just one thing wrong with that definition, for our purposes. It's too broad. After all, it fits each and every one of the "offenders" mentioned earlier (except the illegally operating BC stations, at whom we *are* mad). We are going to have to find some definitions which are more suitable to the case at hand.

We can try the FCC classifications: Extra Class, Advanced, General, Conditional, Technician, and Novice. However, while these may tell quite a bit about the skill, knowledge, and experience of their holders they won't tell us a thing about the essential characteristics of the typical ham's personality—if there is such a person as "the typical ham."

So at this point it appears that, in order to bring some order and unity into the situation, we're going to have to introduce some classifications of our own. The labels themselves aren't new, but some of the interpretation of the labels may be.

Without too much difficulty, we can divide every trace of amateur radio activity into one of these four categories:

* Public Service
* Rag Chewing
* Experimentation
* Contest Activity

At this point, someone is undoubtedly howling. "You forgot the DX men!" They weren't forgotten. After all, what is the DX chase if it's not a contest—the biggest and most liberal contest of all ham radio history, with no time limit or entry restrictions? With that point out of the way, let's examine these categories in some detail and see what we can deduce about them.

Public Service heads the list because it's by far the most spectacular part of hamming. If you doubt this, check the clipping files maintained at League headquarters— or ask any newsman who's acquainted with our hobby. The part of ham radio which most frequently makes news is that which provides communication to ice-, snow-, or flood-bound areas; which aids in dramatic rescues; and which is connected with disasters. And all this can be listed under no other heading than Public Service.

In addition, this classification most obviously serves the Public Interest, Convenience, and Necessity—the FCC's PICON rule for justifying any radio service. So it appears that we must all gree that Public Service is essential to the survival of ham radio in any form.

Included in Public Service activities, by the way, in addition to the glamorous items listed earlier, are the long hours spent handling traffic by hundreds of hams who inhabit the lower end of 80. They're quiet, for the most part, but they're there and we're all better off for their existence.

How about the Rag Chewer? If we were to conduct a random-sampling survey of all bands for several weeks, we would undoubtedly find that something like 90 percent of all on-the-air activity falls into this category. No definition is really necessary—if we're not rag-chewers ourselves, we all know several.

There's no question that the rag-chewer has fun for himself—possibly more than any other kind of ham—but how does he benefit the hobby?

It may sound strange at first hearing, but we believe that he also serves the Public Interest, and serves it well. Here's the reasoning:

While a few rag-chewers only talk to fellow hams in the same area, most have a regular circle of chatters scattered across the nation. More than a few extend their rag-chewing to an international level.

One of the major characteristics of the rag-chewer is that he not only talks, he listens. Some observers have termed this branch of our hobby "the last refuge of the fine art of conversation." One of the distinguishing aspects which differentiate "conversation" from plain "talk" is that both participants learn from a conversation.

What is this leading up to? Simply that most rag-chewers are better-informed about opinion and activities around the nation and the world than are their less-voluble brethren. An informed citizen, to paraphrase Jefferson, is a useful citizen. For this reason, and no other, we believe that the rag-chewer is a top-level servant of the Public Interest.

Then there's the Experimenter. He's the chap who likes to try out new ideas. You might call him the "Good Amateur" of John Campbell's article in our initial issue—he doesn't know that something can't be done, so he goes ahead and does it. An excellent pair of examples are W6NLZ, John Chambers, and KH6UK, Tommy Thomas. Their exploits in the VHF and UHF region between California and Hawaii are legendary. For a list of additional "Experimenters," see the table of contents on any issue of this magazine—or check the subscription list.

With the exception of the few who come up with a fantastic advance in the state-of-the-art (such as Chambers and Thomas, or more recently the Moonbounce experiments spark-plugged by Sam Harris) you don't hear very much from or about the experimenter. His main interest is in the equipment itself, and frequently the only time you'll find him on the air is when he's testing his latest gadget. The rest of the time, he's lost in the workshop, soldering iron in hand . . .

Like the Public Service man, the Experimenter's place in our firmament is almost universally acknowledged. While he doesn't quite fit into the "Convenience" part of the FCC

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formula, there's no question that he serves the Public Interest and Necessity—without him, much of the territory above 200 meters would never have been explored.

This leaves until last the Contest enthusiast, including DX-ers. No slight is intended by this positioning. The fact of the matter is that whether you like him or hate him, he's one of the most necessary of all hams.

Here's the reasoning behind that statement: The Public Servant is a quiet, behind-the-scenes type in most cases. He uses his station as a tool to help people; many stations manned by this variety of operators have undergone little change in the last 10 years, because the equipment installed then is still doing its job adequately. The Rag Chewer lives in front of the scenic backdrop, to continue the metaphor, but his concern for equipment is at about the same level. The experimenter, for the most part, builds his own gear. But the Contest man? What about him?

By our definition, he's primarily interested in winning a contest; this contest may be simply to gather more DX QSLs than anyone else in the world, or it may be an annual event with organized rules and time limits. In either case, he's not primarily interested in equipment—only results.

But in the big leagues of Contest Activity, results can be expressed as a function of three variables: operator skill, equipment excellence, and luck. At the top level, operator skill is about equally distributed. Luck, also, is equally generous (or foul, as the case may be) to all. But equipment excellence is a variable which can be controlled.

Since the Contest man's prime interest is in results, and the equipment itself is only a tool, the chances are great that he will purchase the equipment rather than building his own.

This trend has been noticed by many, and is evident in some of the published complaints that ham radio is in danger of becoming "a millionaire's hobby." However, the trend isn't necessarily a danger.

Without the Contest Man and his avid desire to have the best of everything with which to pursue his own star, where would the industry which supplies us all be? Odds are that the answer to that question is, "Nowhere."

All the top ham manufacturers have large military contracts. With almost all of them, ham radio is now just a sideline. The moment it stops being a lucrative market, they'll be forced by economic necessity to reduce their lines. For that reason, if no other, the Contest Man with his relatively-open pocketbook is a necessity to the continued existence of our hobby. And this is not the only justification for the Contest Activity.

No less an authority than J. P. Costas, writing in the Proceedings of the I. R. E. several months ago, compared average amateur radio activity with the situation facing any military communications outfit during combat—interference, difficulty in confirmation of messages, and all the rest. Over the years, many others have lauded ham radio as one of the best training grounds for skilled radio operators—and this part of the field falls into the "Contest Activity" domain.

So in one point of view, at least, all four of these four kinds of ham are essential to the hobby. A couple more points to be considered are these:

Any individual ham is not limited to just one of these four types. You, yourself, may be one part Contest Man, one part Public Service, three parts Experimenter, and the rest Rag Chewer—or any other combination of part or all of the types. The major point intended by the classification was that *all* ham activity can be described within the limits of these four categories.

The second point is this: While you may not like one or more of these types of activity, it's really sort of pointless to knock it either. Granted, it's disgusting to find a Rag-Chewer parked on your only crystal frequency when the long-hop skip is in and you hear an AC4 calling. It's also more than irritating, while chewing the rag, to be "invited off" the frequency by a too-ardent DX-er. And Experimenters have been known to clobber an entire band when something went wrong during an on-the-air test . . .

However, as we've tried to show, all four are necessary to ham radio. Doing away with any one class would irreparably harm the remaining three. And restrictive legislation or regulations which limit their activities will do no good for anyone.

Let's face facts, fellows. While ham radio *can* be divided into four parts, any one of the four requires the other three for support. In plainer words, first attributed to Ben Franklin (an early Experimenter without benefits of ticket), "We must all hang together or all hang separately." How about it? Can we see the other fellow's point of view for a few minutes at least? OK? Now, then, about those illegal BC stations in the 40-meter band. . . .

73

## Lifer Number 1

Lamon Whiddon K4MYH, the discouragingly healthy-looking chap above, backed the editor up against a wall during the Miami Convention and forced him to reveal the secret rate for lifetime subscriptions to 73. So, the news is out. The rate is $30 for life. This rate has been set up particularly for hams with sons who are QCWA members, fellows with heart conditions who like to climb towers, heavy smokers, etc. We will accept marginal cases of chaps with a history of cancer in the family or who are seriously overweight. We are not particularly anxious to sign up any more such robust specimens as Lifer Number 1.

## Letter

**Editor of 73 Magazine:**

Say, where in the Hell do you get that QRM! Do you know that broadcast and TV stations get their license for free?

They make thousands and thousands of dollars from their stations and in most cases have a monopoly at that.

Why the hell should hams have to pay for a license? It's about the only thing that is free any more. Let it stay that way.

As long as the USA pours money down rat holes all over the world in the name of defense and relief (trying to buy friends) why shouldn't they give the hams a license. It's the hams that furnish the radio men come a war.

Oh yes, while we are about it—Our old 11 meter band is now CB. It's free too and they don't furnish any radio men for the country, either.

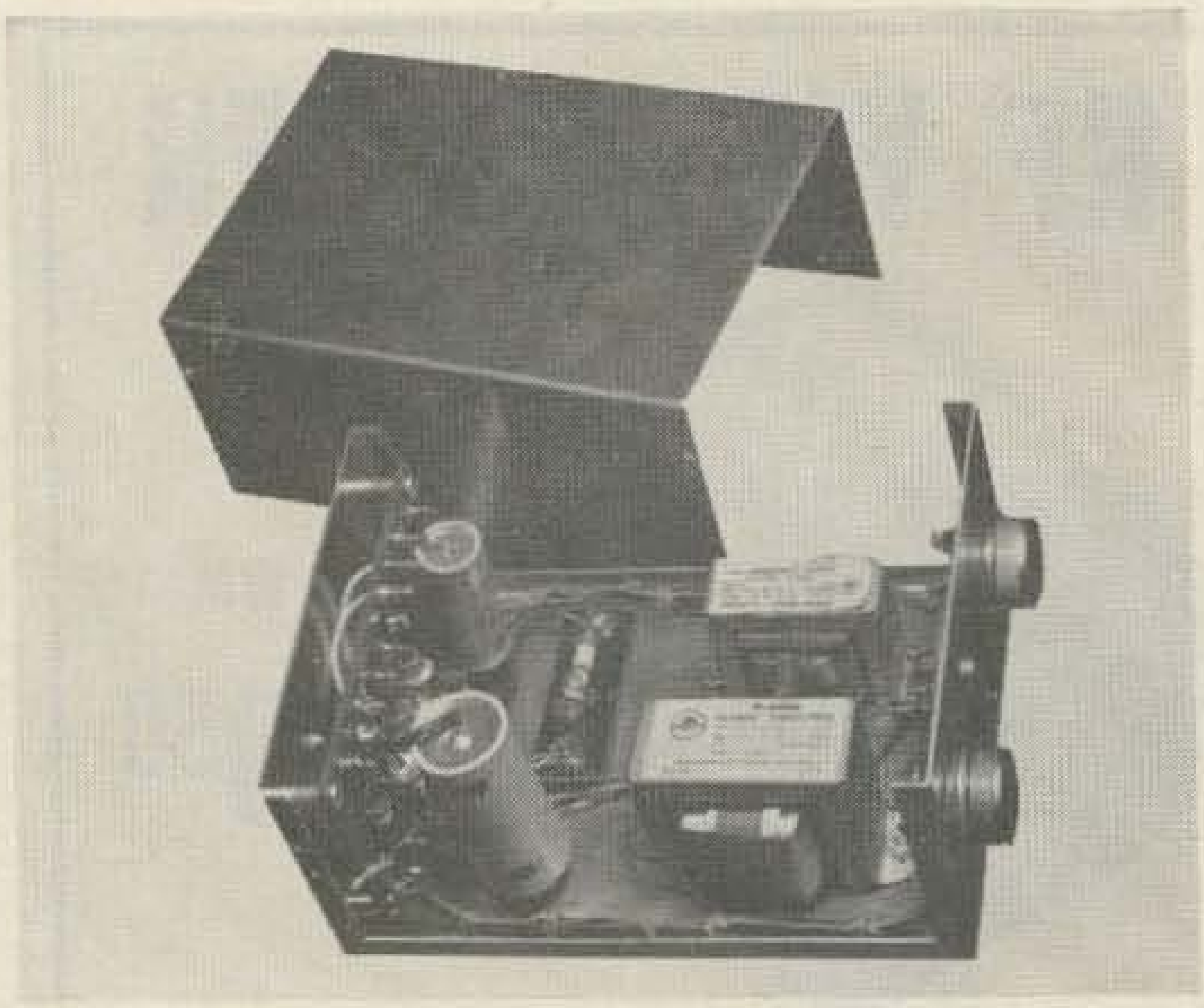
Also, all other services get their license free.

Again, why should the ham pay?

I hear the boys in Canada do—you and any other hams who want to shell out can move up there.

**Clyde Rubottom W9OKX**

*Too cold.*



Austin C. Farrell W2BXE
27 Heath Road
Fishkill, New York

# Mobile Power Converter

THE transistor power converter is the latest development in a long line of power supplies for mobile operation. The vibrator supply, long used, is often in need of a new vibrator. The dynamotor is a bulky supply and expensive, unless bought surplus. The transistor converter eliminates moving parts, is more efficient, and much smaller than any previous type supply. One thing has made it lack full acceptance by the amateur—that is cost. This supply is an answer to that problem by its use of easy to obtain filament transformers.

The circuit (Fig. 1) is not the design of the author but has been used by many hams in the Poughkeepsie, N. Y. area. Two 6.3 volt filament transformers are used; one as a power transformer and one as the feedback transformer. The basic circuit is a multivibrator. One transistor is cut off while the other is conducting. The collector current of the conducting transistor passes through half of the 6.3 volt winding of the transformer T-1 similar to the operation of the standard vibrator circuit. The primary of this transformer steps the voltage up to a large value. This induced voltage is rectified by the solid-state diode-bridge circuit and filtered by condenser C2.

The feedback transformer (T2) steps the high voltage ac down to a low level for drive to the bases of the transistors. Q-1 is driven to cut off when Q2 is driven to saturation and vice-versa. Resistors R1 and R2 sets the operating bias.

The transformers used are not ideal for the job as the normal operating frequency is about 400 cycles and the core material should be square loop material. However, the circuit as described is quite practical. It may be worth while to experiment with 400 cycle transformers if you have some available.

A 1.2 ampere filament transformer was used for the feedback transformer (T2) because it was readily available. Any size, smaller or larger will do. Nothing is gained using a larger one as little power is required. The step-up transformer (T1) is a 6.3 volt, 3 ampere filament transformer. A higher current transformer can be used, giving slightly higher voltage and more power. You are cautioned, however, to use good heat sinks on the transistors and check for excess temperature. There is little impedance in the low voltage windings to limit collector current to a safe value. Some experimenting was done with other transformers, but the 3 ampere

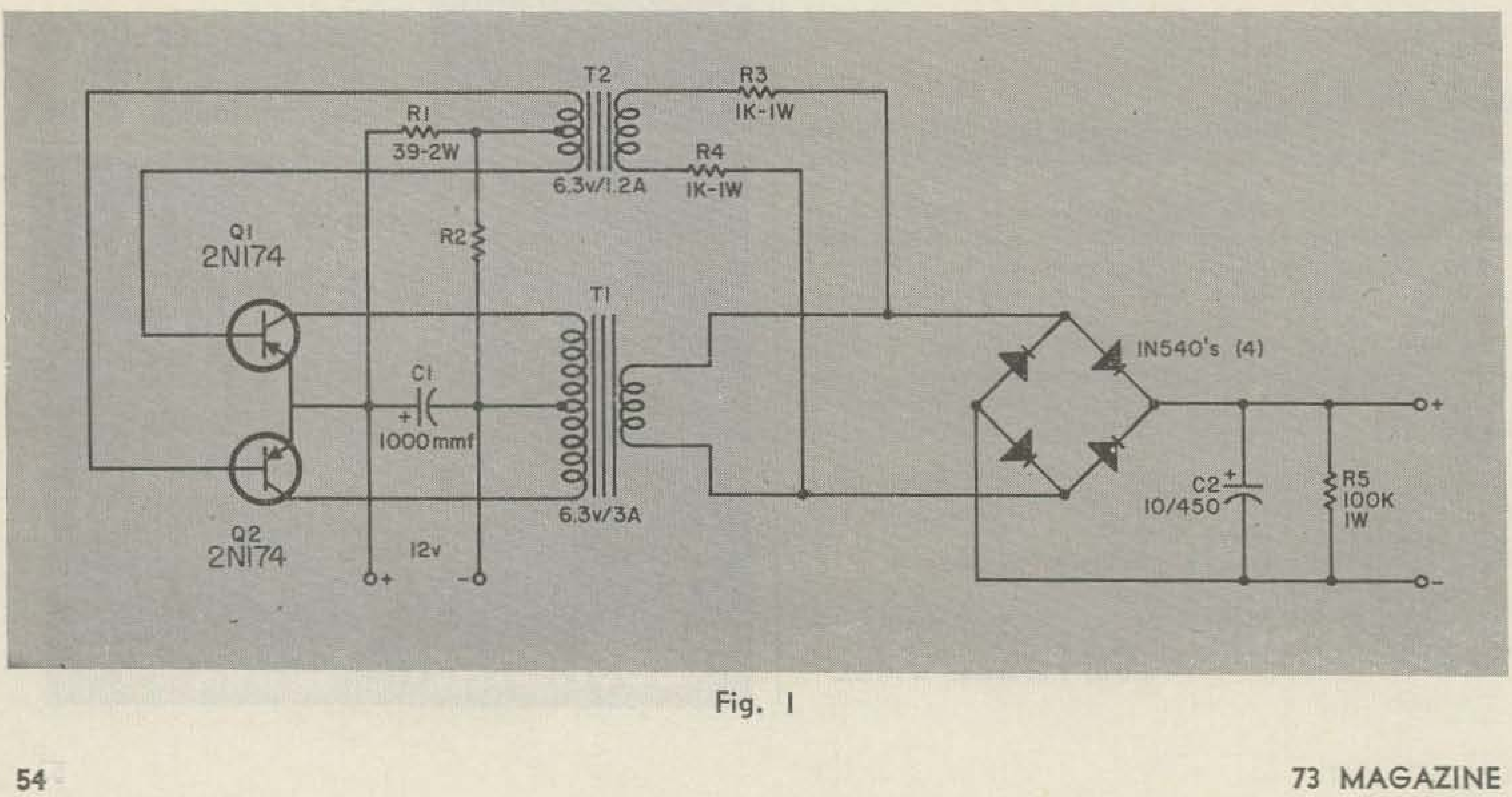



Fig. 1

transformer seemed to be a safer design. It will run warm in normal operation. A 5 volt filament transformer will give higher output voltage but current available will be less to keep within the power ratings.

The waveform of the high voltage ac and the waveform at the transistors (collector-to-collector) should be a square wave. There should be no spike on the leading edge of the square wave as this could cause breakdown of the transistor. The purpose of the large filter condenser across the 12 volt supply is to eliminate this spike and to filter out line noise.

Theoretically, the supply should not operate unless the feedback winding to the transistor bases are of the proper phase, but I found that it would work with the wrong phasing at much reduced output. Efficiency is much lower and collector current is high. Also the waveform is closer to a sine wave than a square wave. This condition causes the transistors to remain in the linear portion of their curves for a longer period during each cycle, causing them to overheat. Do not allow this condition to exist. To reverse the phase of the feedback transformer reverse the two primary leads of T2.

The purpose of the resistors in series with the primary of the feedback transformer is to limit the base current into the transistors. Also, if the output of the supply is accidently short-circuited, the feedback current drops to a very low value, causing the circuit to cease oscillation. This provides some protection for the transistors, however the circuit is fused as an additional precaution.

The output of the transformer is rectified by a silicon diode bridge. This eliminates heater current and gives a higher output voltage as there is less drop in the silicon diodes than in tubes.

The circuit is designed for 12 volt operation, however, output starts at a low value of input voltage. The same circuit can be used for six volts input supplying 150 volts at about 100 ma. The chart shows the output voltage versus load for 12 volts input using the components shown in Fig. 1.

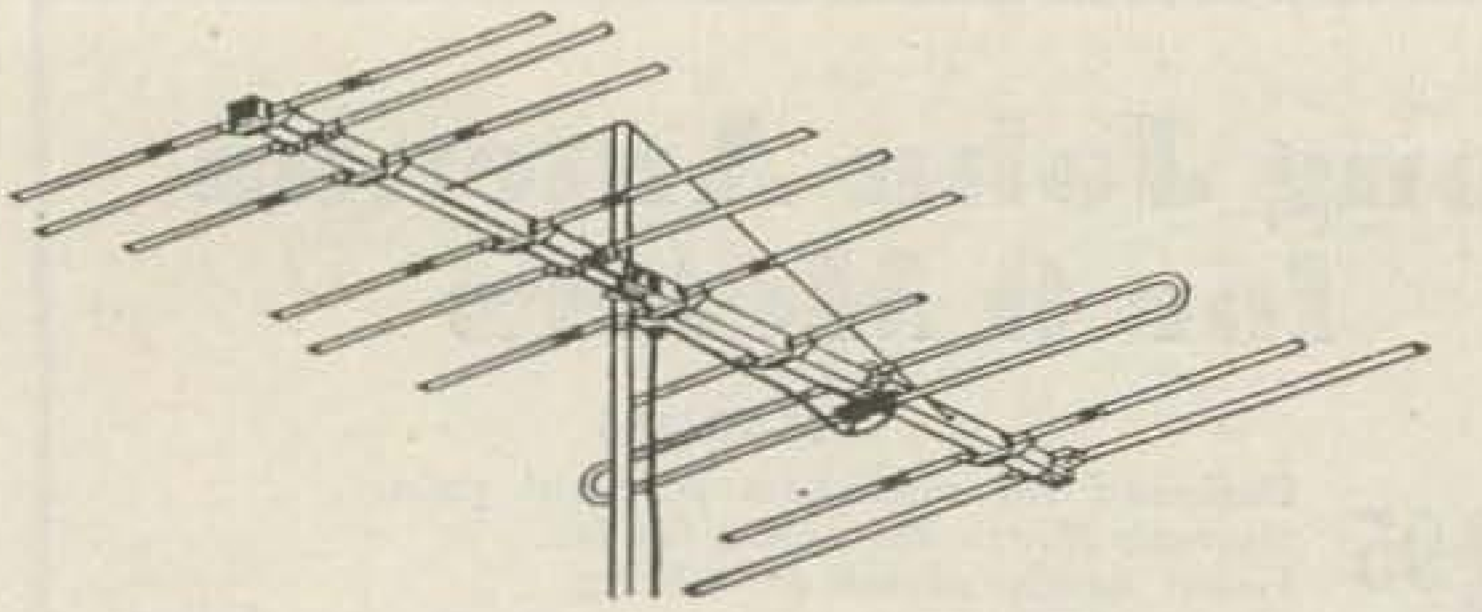
## Construction

The supply is built in a 3″ x 5″ x 7″ minibox with all components mounted on the cover. All parts are inside except the transistors.

The case of the transistors is the collector terminal and must be insulated from the chassis. A fiber shoulder washer was used under the mounting nut. Sheet mylar was used between the transistor case and the chassis, but mica or other insulating material with good heat transfer may be used. If there is danger of shorting the case of the transistors to ground where the supply is mounted in the car, a perforated cover could be used to protect them and still allow free air circulation. Use an ohmmeter to check each terminal of the transistors for shorts to the chassis before connecting wires to the terminals. By keeping all transistor circuitry above ground it is possible to use the same supply for either a negative or positive grounded battery by grounding the proper terminal.

. . . W2BXE

| Input Current at 12 volts | Output Voltage | Output Current | Efficiency |
|---|---|---|---|
| 2.4a | 400 VDC | 26 ma. | 34.9% |
| 4.4a | 350 VDC | 97 ma. | 64.2% |
| 5.8a | 300 VDC | 160 ma. | 69.0% |



# 73 Tests the Finney 6 and 2 Meter Beam

Donald A. Smith W3UZN
Associate Editor

WHEN I heard about Finney's new combination 6 & 2 meter High Gain Yagi beam, I was skeptical. When I found out that it had a *common* (single) feedline for both bands I really developed an "I'm from Missouri attitude"! Previous experience with combination beams had not been the best, though I had to admit that it's a lot easier to mount one combination beam on a tower than two separate ones. Then too, at only $33.00 for the beam, I decided to find out just what it had to offer.

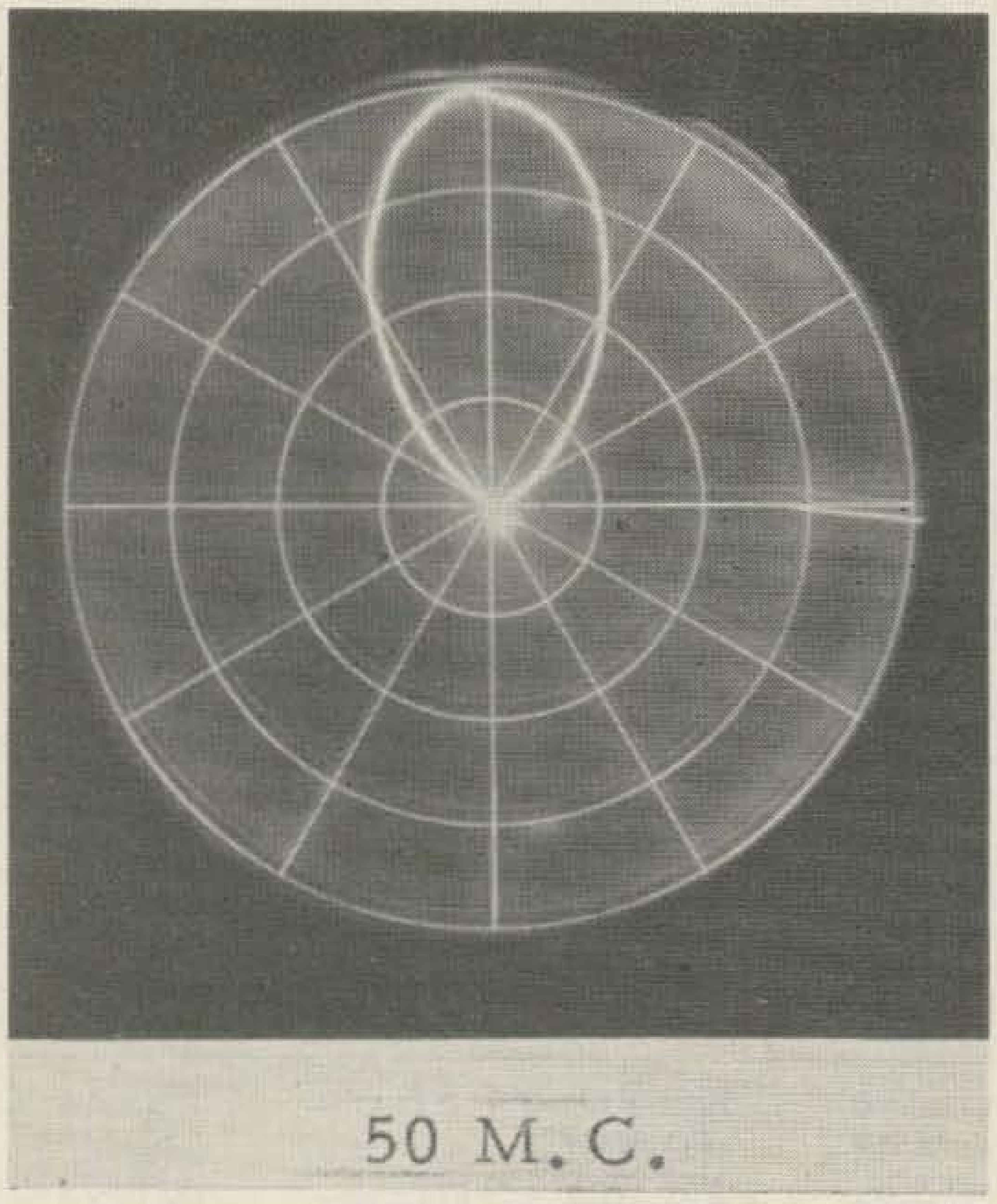



Fig. 1

Manufacturers use various methods to test and rate their beams, so the first step was to find out Finney's method for rating theirs. As far as I know, they have an exclusive, rather unique way of doing this. The usual method is to make pattern measurements at every 10° or so around the beam. Then a curve is plotted showing the major lobes present. Some minor lobes may not show up in these tests. Finney does it in an entirely different manner.

Finney spins the beam under test at 30 revolutions per minute and develops the pattern of the spinning beam on an oscilloscope! They photograph the face of the scope and retain the photo for their files. Photos are made with the beam operating on at least three frequencies in the band for which the antenna is designed. In addition to the photographed frequencies, many other frequencies in the band are checked, though they are not recorded. One of the actual patterns on 6 meters (at 50 mc) is shown in Fig. 1. One of the patterns for the beam operating on 2 meters (at 144 mc) is shown in Fig. 2. These are the actual photos made when checking out the new A-62 combination 6 & 2 meter beam.

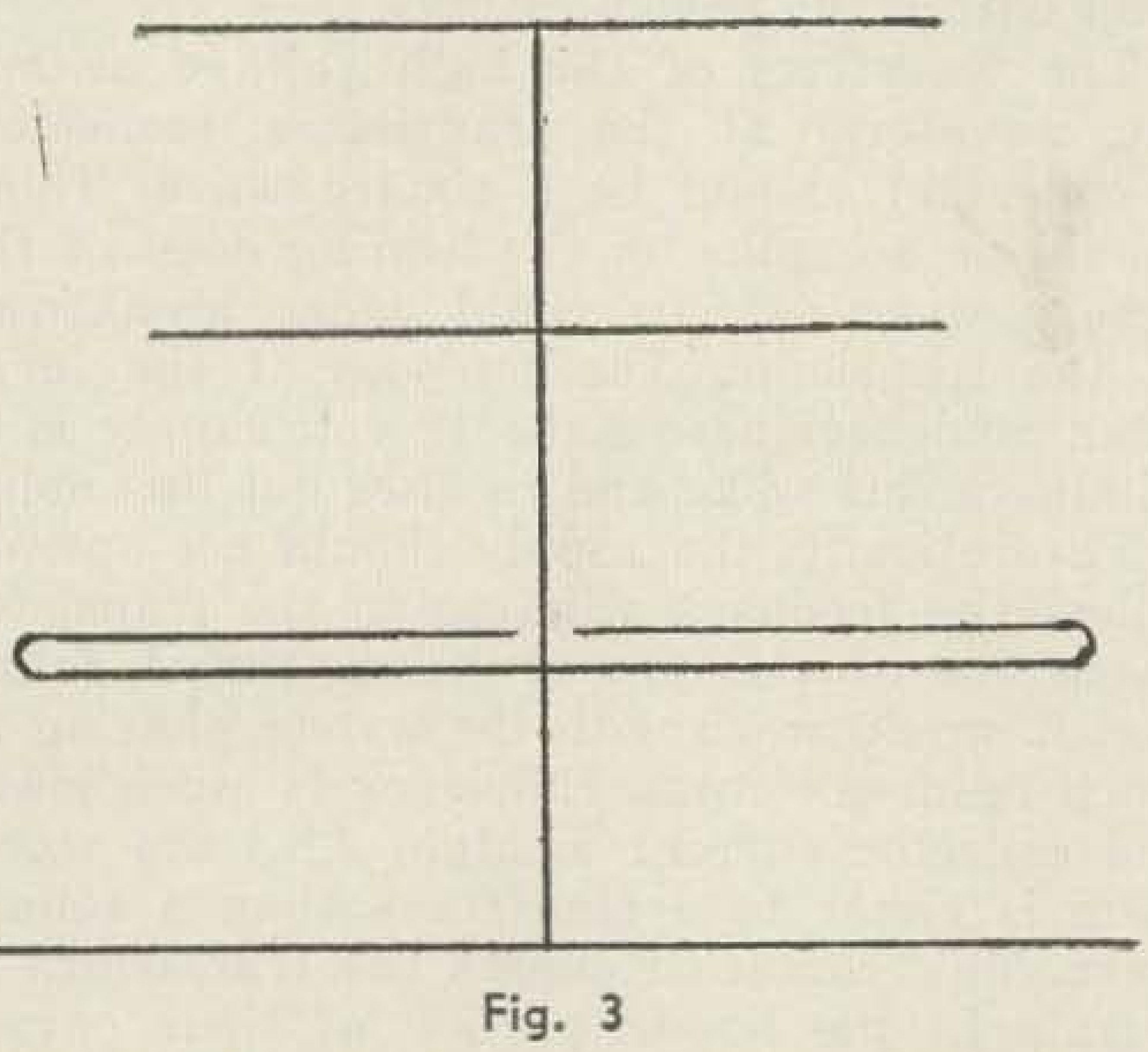


Fig. 3

In regard to gain, the beam when used on 6 meters has a gain of slightly over 8 db when operating on the lower two mc of the band. On 2 meters the beam has even more gain than Finney's own 10 element 2 meter beam! The gain on 2 (at 144 mc), is 14.2 db and increases to 14.9 db or better at 146.6 mc. Front-to-back ratio on six meters is 17 db and 20.5 db on two. Real fine specs all the way around. Believe it or not, the patterns shown, the gain and f/b measurements were made using *one common* feedline for both bands!

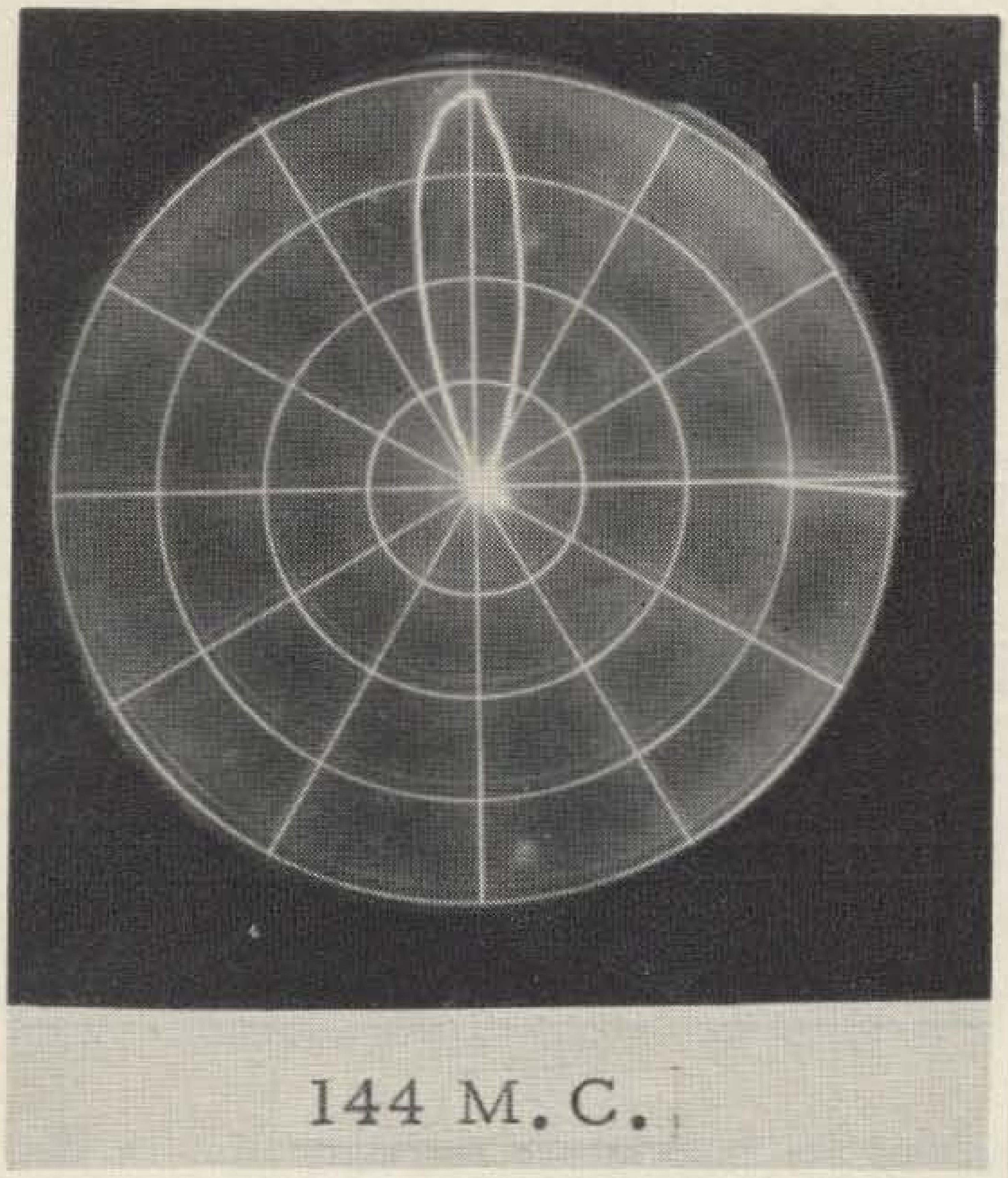



Fig. 2

The theory behind the antenna is very interesting. To begin with, the antenna acts very differently on 6 meters than it does on 2. Take six meter operation for example (follow the sketches). The spacing and arrangement of the elements of the beam result (Fig. 3) in a normal 4 element Yagi, consisting of the driven folded dipole, one reflector and two directors.

On 2 meters, quite a different beam results! The best way to understand its operation is to consider the current distribution on the driven

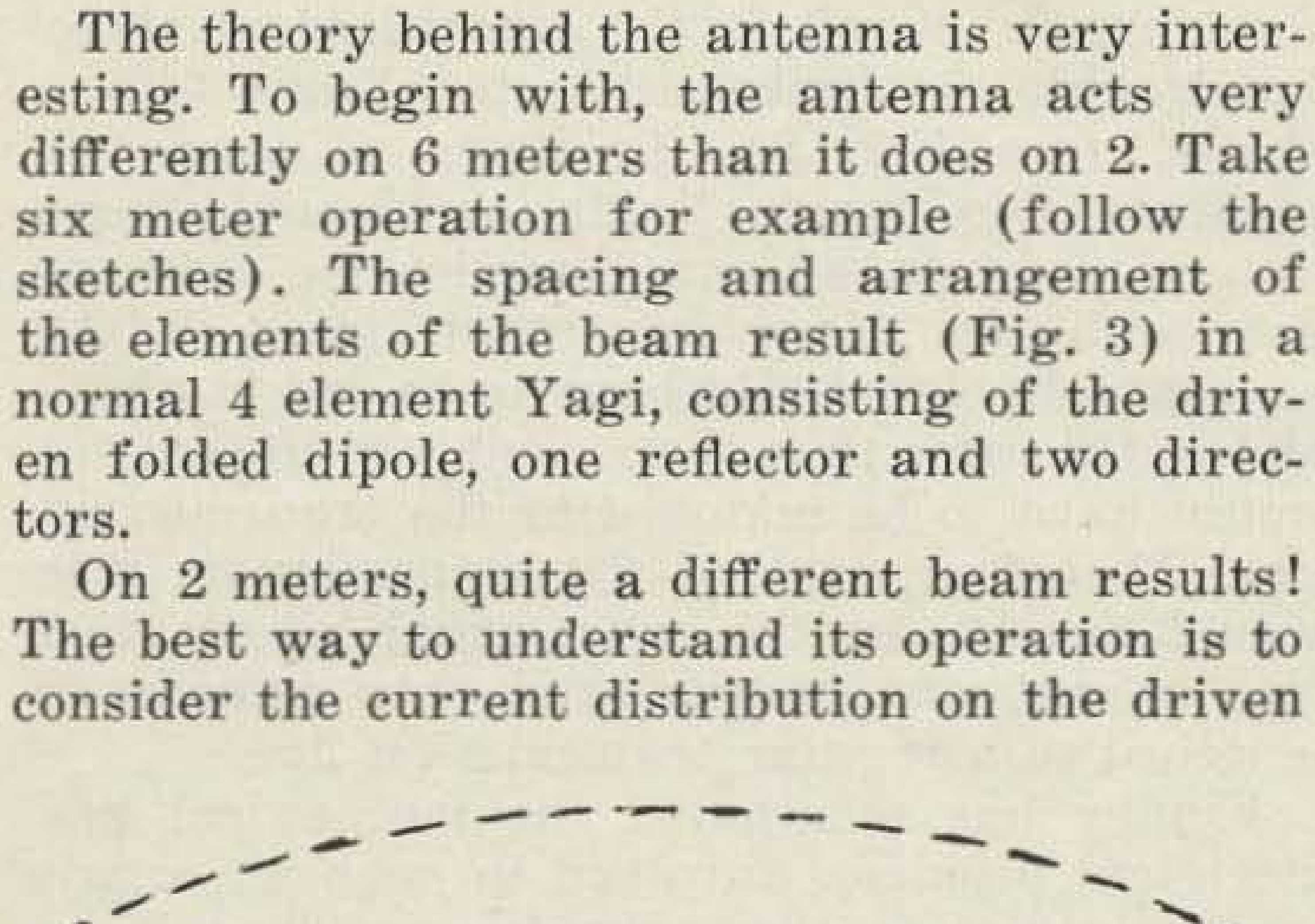



Fig. 4—a, b, c

element (folded dipole), when the beam is used on 6 meters (see Fig. 4a). This is the normal current distribution you would expect. On two meters the current distribution would look like the diagram shown in Fig. 4b. This distribution is not at all desirable, as two positive and one negative loop result, giving an out-of-phase condition and producing a polar directivity pattern with almost equal lobes at right angles in four directions, as shown in Fig. 5.

By adding Finney's patented "Fidelity hPasing Stub," cut to the proper length and spaced properly in front of the driven element, the

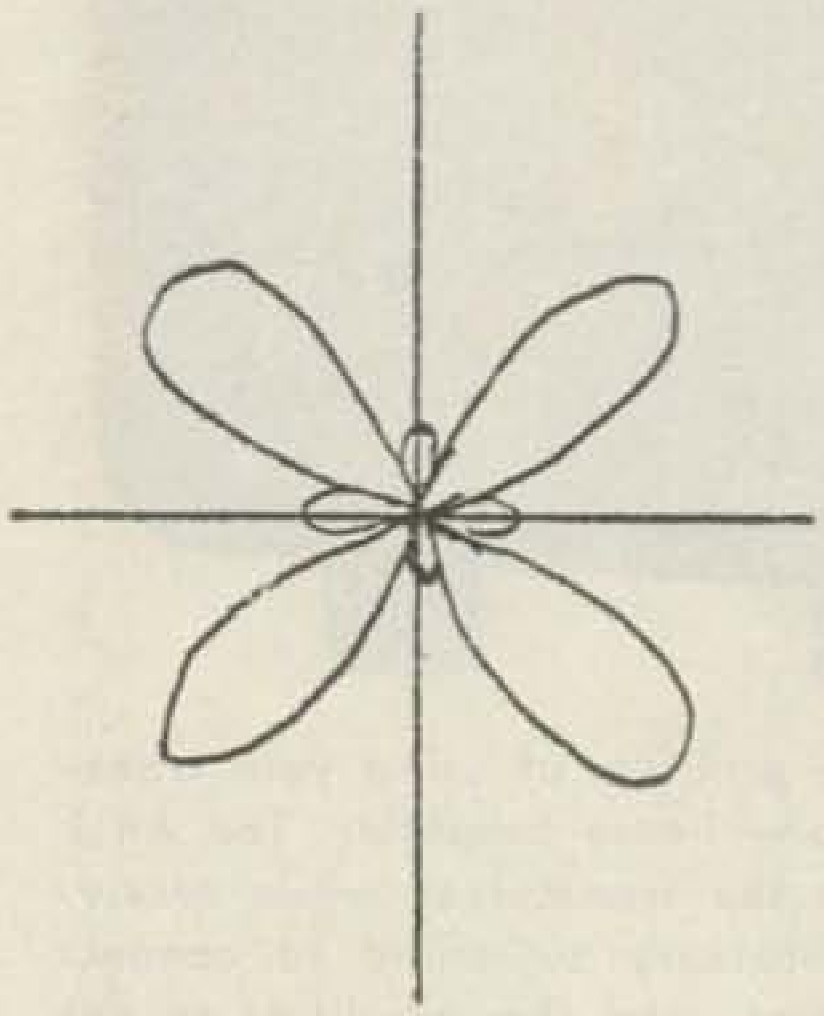


Fig. 5

negative current loop is "phased" and becomes a positive loop, so that the current distribution on the dipole, with the stub, now appears as shown in Fig. 4c. The directivity or polar pattern now looks like that shown in Fig. 6, as the driven element is now an in-phase, 3 element colinear. This is due to the fact that the dipole is three half-wave lengths in the 2 meter band long with the Fidelity Phasing Stub present. (Note that the stub has no effect on 6 meter operation, due to the spacing and length of the stub.)

Spacers (fibre glass insulators), are placed in the elements of the antenna (except for the driven element), as shown in Fig. 7. On 6

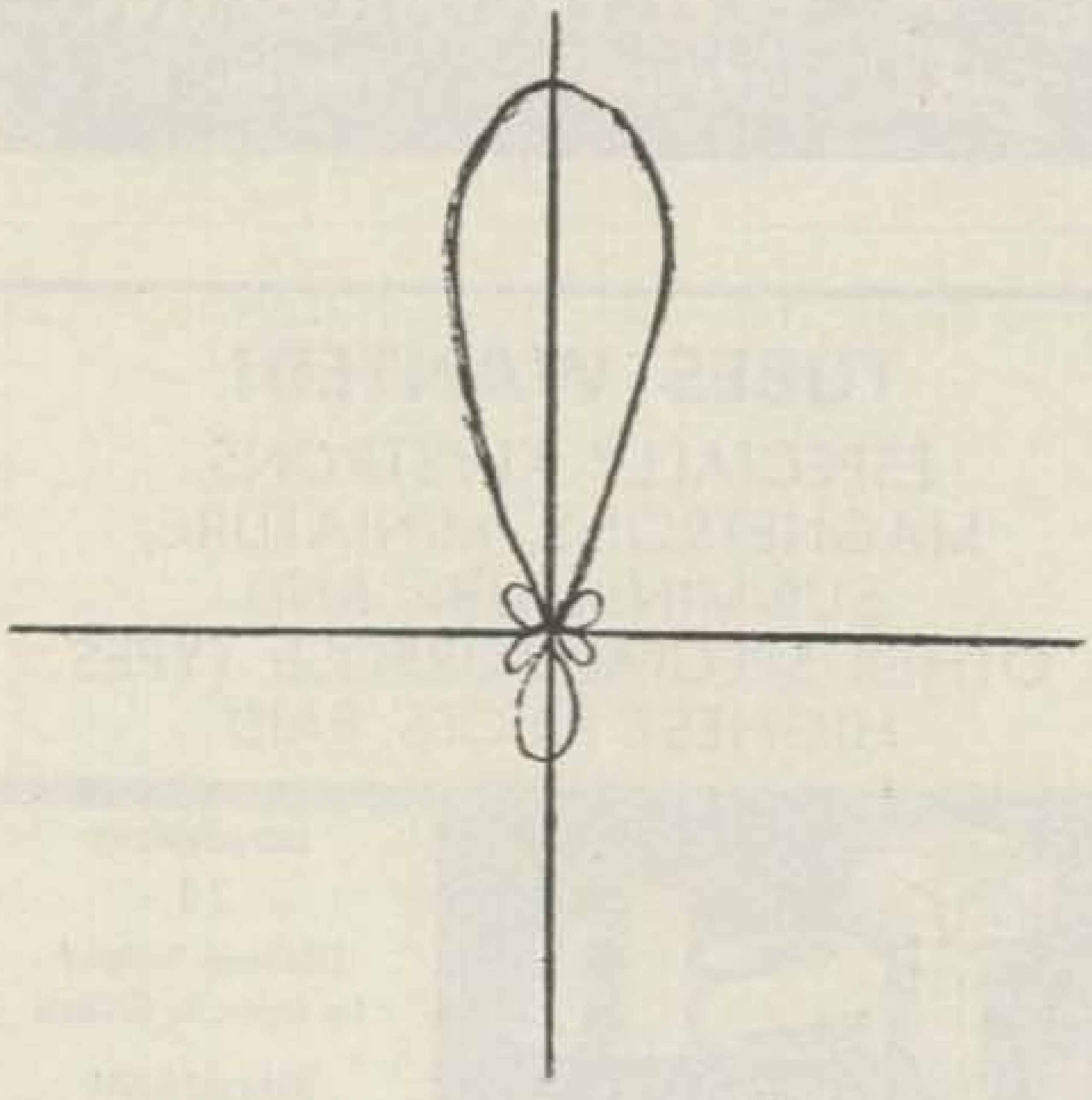


Fig. 6

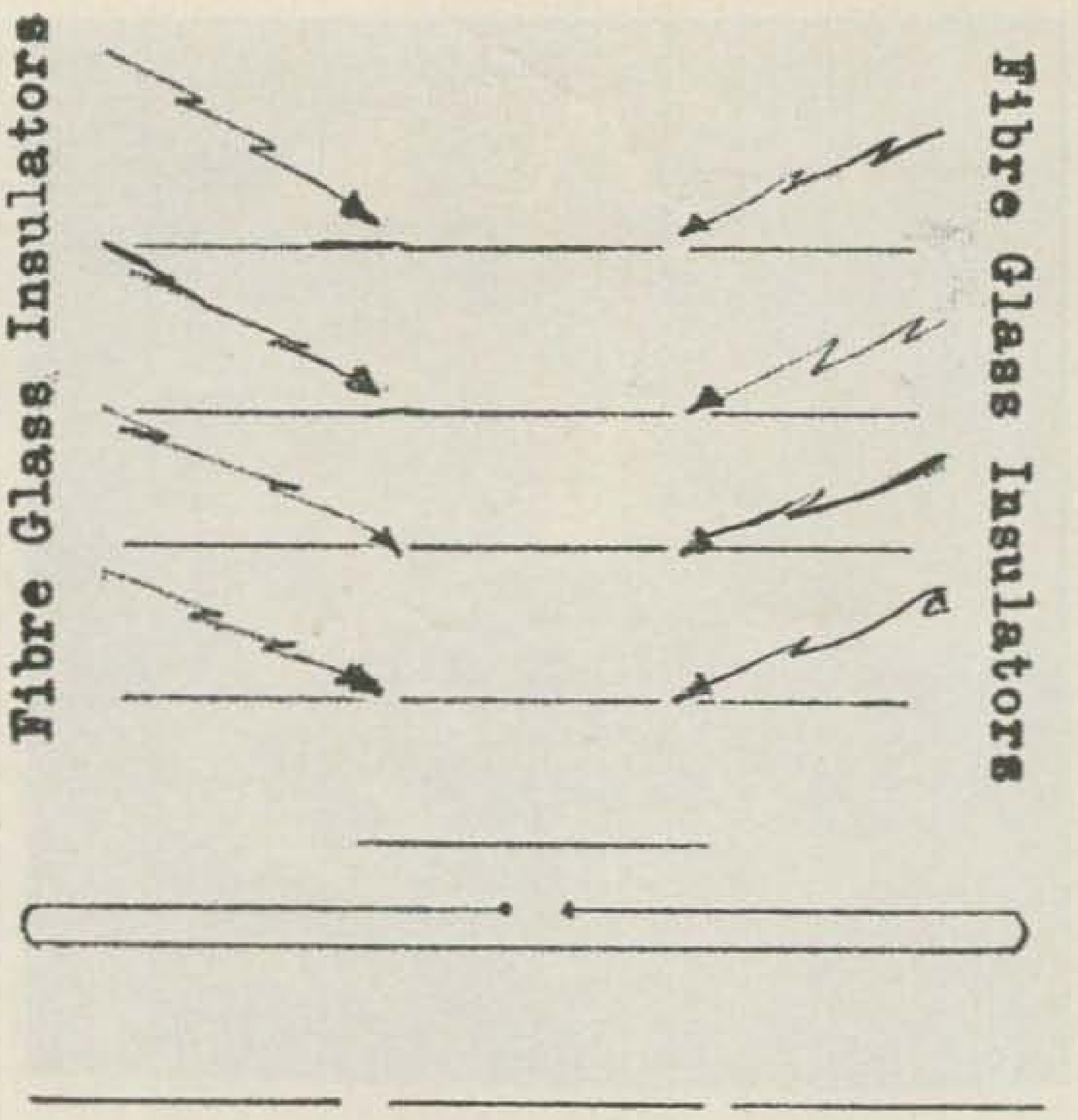



Fig. 7

meters the spacers are not significant as the beam reacts as if these elements were not broken up into three sections. On 2 meters however, the result is the equivalent of three side-by-side, 6 element, 2 meter Yagis fed in phase! (see Fig. 8). To have an array of separate side-by-side Yagis, each would have to have a separate boom, complicating mechanical problems. More important, each of the separate dipoles would have to be fed in-phase and at the same time their combined impedance would have to be matched to the transmission line. Therefore, each of the transmission lines would have to be the exact equal length, tied into a common junction and then impedance matched to a regular transmission line.

Finney has eliminated the mechanical and electrical problems involved in such an array, while retaining the advantages. They have done this by the use of the phasing stub and insulators in the directors and reflector. The operation is exactly the same as the three separate, side-by-side, 6 element Yagis, fed in phase. Actually, this discussion is a little over simplified, as other complications did arise when the beam was being designed. The directors for six meters had a detrimental effect on the 2 meter band. They eliminated this problem by co-ordinating the elements on 6 and 2, so that one of the systems did not interfere with the other. This required precise spacing of all the directors involved.

The result of all this theory is that they are able to obtain, in one antenna with one driven element and thus one transmission line, a high gain 4 element yagi on 6 meters, with the equivalent of three 6 element, 2 meter yagis, side-by-side, fed in phase on 2 meters. You will notice that the gain on two meters is somewhat higher than on 6. This is to be expected, due to the increase in efficiency at higher frequencies (in antenna design), and to the antenna behaving as a 6 element colinear on the higher band, while the antenna is only a 4 element yagi on 6.

As mentioned previously, the driven element is a folded dipole, so the antenna impedance is 300 ohms. Twin lead or open line can be used (which the manufacturer recommends, due to the high losses in coax at high frequencies), or a balun can be used to match the antenna to coax. The balun would be cut for ½ wave length on 6 meters. This will be a 3/2 wave balun on 2 meters, which will of course be a proper match on both bands. It must be mentioned here that the placement of the antenna, particularly in the height above ground and other objects will to some extent affect the gain and impedance characteristics of the beam on both bands.

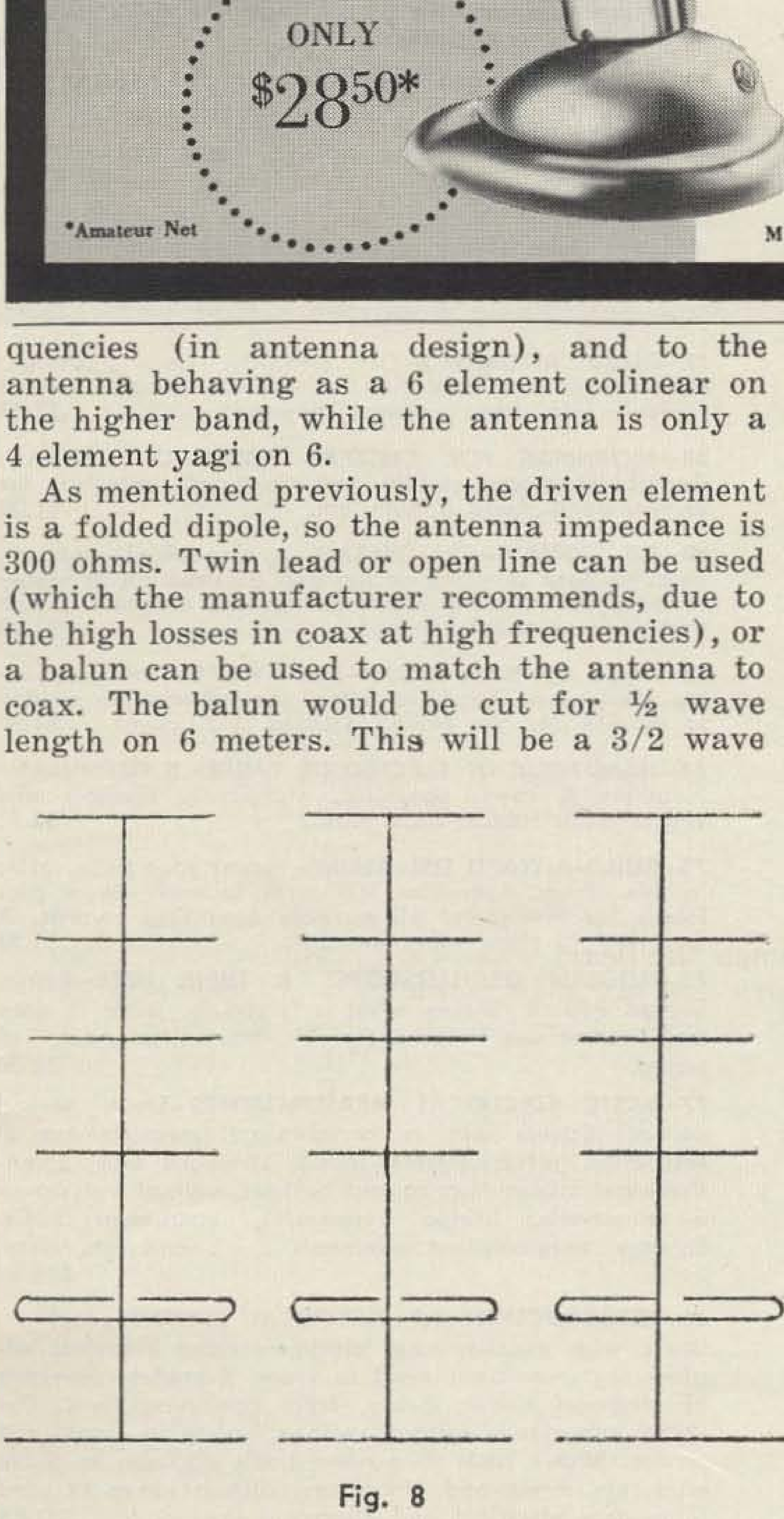


Fig. 8

In my own particular case, I ran RG-11/U, using the balun cut for a ½ wave on 6 meters. My s.w.r. on 6 (using a Heath reflected power and s.w.r. bridge), was 1.5 to 1. On 2 meters the s.w.r. was 2.1 to 1. This was with the antenna considerably lower than would be desired. The antenna was only 10 feet above the roof of the house. Results with the beam on both 2 and 6 have been much more than satisfactory! On 2 meters it is normal to hear stations in Washington, D.C. and down in Virginia over 100 miles away! Ground wave even brings in stations down in Southern Maryland, at distances up to 175 miles away. These are stations I have never heard before! The beam is very directional on 2, due to the high gain, colinear characteristics, and you have got to zero right in on them or they just won't be there. (Check that antenna direction indicator, fellows!) Next time someone mentions a beam for use on more than one band, I'll be a lot more interested, after this experience. I have learned that it can be done, by proper engineering and careful design plus careful, quality production.

. . . W3UZN

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# A New Look At Old Ideas About ANTENNAS

Jim Kyle, K5JKX/6

LIKE weather, everybody talks about antennas but nobody (well, hardly anybody) ever does anything about them.

The result, as you and every other literate ham know, has been an uncountable outpouring of words on the subject. Various authors exhort you to raise your antenna higher, lower it, bury it underground, turn it on end, tune it, not tune it, match it, forget about matching it, and so forth into the hazy distance.

If you're looking for more material along those lines, turn the page and find some other article. This piece has to do with skywires, some new ideas, and some old ones, but one thing it has nothing to do with is exhortations to you to make changes in your antenna if it's working the way you want it to.

Of course, if your trusty length of baling wire draped across the backyard landscape isn't quite doing all you desire, you may feel tempted to make some changes after reading this. But if you do, never claim this article told you to do it. This is information, not detailed direction.

To most newcomers—and not a few old-timers too!—the subject of antenna theory is draped in mystery. The multiplicity of conflicting information already in the literature is largely to blame for this. Back in the ancient days of spark-gap wireless, antennas had no mystery.

Then, you simply put up all the wire you could beg, borrow, or moonlight-requisition, and coupled the rig into it until your lamp-bulb current indicator threatened to burn out.

Primitive? Crude? Inaccurate? Mebbeso, but a fellow name of Marconi spanned a couple of thousand miles of Atlantic Ocean with that technique nearly 60 years back—and that's something a lot of hams frequently find difficult, especially on the lower frequencies where arconi was working.

To a present-day technically-minded ham, who studies Dr. Kraus for a beginning in antenna theory and moves from there to the exotic mathematics of log-periodic calculations, or for that matter even to the average rag-chewer who gets all he needs from the ARRL antenna book, some of the definitions and techniques found in early-day manuals seem laughable.

For instance, they readily admitted that any antenna had a resonant frequency. They explained it like this: Every piece of wire has inductance distributed throughout its length. In addition, an "aerial" (they didn't like that new-fangled term antenna) strung out over the earth had capacity from the wire to ground.

Ground, you must realize, was the other side of the aerial circuit. Nobody even considered working one half of an aerial against the other half, although a few unfortunate souls who couldn't get decent soil under their stations were forced to erect counterpoises.

But to get back to the resonant frequency, that turned out to be the frequency at which the inductance of the wire cancelled out the capacity to ground, in the familiar fashion of a tank circuit.

They had elaborate tables showing how the height of the aerial above ground affected its resonant frequency, and extended calculations to determine the effect of lead-in wires on the system's resonance.

They didn't bother with the little electron bouncing out to the end of the wire, finding nothing there, turning around, and starting back to the transmitter, as we explain electrical resonance in terms of too-long or too-short wires.

And as for standing waves, which possibly have cost more hams more gray hair than any other item (with the possible exception of parasitic oscillations, which have nothing to do with this subject), the old-timers didn't worry. Most of the operators in that day and age wouldn't have known a standing wave if it walked in and sat down. Sure, they had RF in the shack, but that was just a part of this strange thing called radio.

The whole approach sounds a bit archaic in the light of modern theory and training, but did you ever stop to think what you're doing when you add a loading coil or a top-hat to a mobile antenna?

Your main result in either case is the addition of enough reactance, either inductive or capacitive as needed, to make the antenna system resonate in tank-circuit fashion at your operating frequency. And how far removed is that from the old-timer's definition of electrical resonance in aerials?

The idea isn't confined to mobile installations, either. If you hate standing waves and vertical antennas (some people do, you know) and still don't have room in your yard to sling an 80-meter half-wave, you might try adding capacitance by doubling the wire back.

Modern theory tells us that a linear antenna should be strung in a straight line, but the theory is strangely silent about results if you bend and twist the radiator. Modern theory is silent, that is—the older version says quite directly that you have added capacity and hence have lowered the system's resonant frequency, which is exactly what you set out to do.

If you try this, be sure to keep the wires separated at least a foot or so. This ensures that the RF sees the wire as one long piece and not as a shorter, fatter conductor.

Of course, if you can't keep them separated, try it anyway. A short, fat conductor has greater capacity than a long, thin one, and greater operating bandwidth to boot.

A while back we mentioned standing waves. Most articles these days tell you how to minimize standing waves through perfect matching of the transmission line to the antenna.

In practice, of course, this matching mania can be carried much too far. Several articles in the past two years have pointed out that, once the VSWR is lower than 2:1, you get little more improvement by more careful matching. Yet many hams still worry themselves sick if the meter shows a ratio greater than 1.01:1. They forget that any measurements made at the transmitter end of the line are inaccurate anyway, due to attenuation in the transmission line, and end up devoting much energy to a more-or-less-lost cause.

As a matter of cold, calculated fact, if you ever manage to get rid of every standing wave in the system you'll have a dickens of a time being heard five blocks away—even if you run a California kilowatt.

The reasoning behind this is simple: most antennas radiate because of the large standing wave which exists there at all times. Take away the standing wave, and you take away the antenna's effectiveness.

Exceptions to this rule are the rhombic and similar terminated antennas. However, relatively few hams maintain a farm of terminated rhombics in the backyard.

If you're going to be a perfectionist about matching, how about going one step farther and matching the antenna to free space?

In case you're interested, free space has an impedance of 377 ohms. Applying the basic principles of impedance matching will tell you that an open-circuited 300-ohms line should show little mismatch. Now measure such a line and see what happens. Something's wrong somewhere!

Rather than raise and lower the antenna a thousand times, the simple way to accomplish the same result (of an effective signal) is to tune the line. Pruning accomplishes the same result, but coax is expensive. This will enable the transmitter to operate into a non-reactive load, while conserving energy on the part of the operator. An additional benefit is added reduction of TVI-causing harmonics, because of the extra tuned circuits.

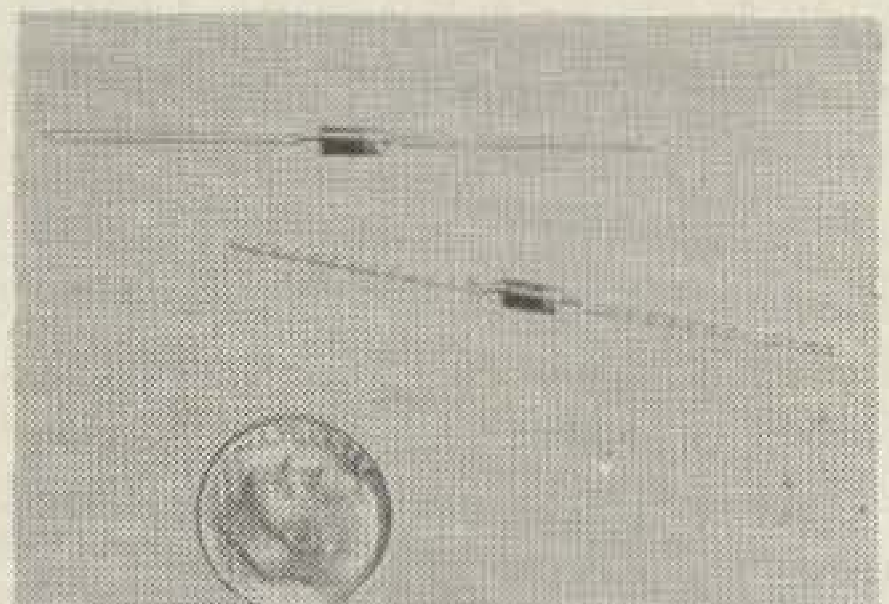
Of course, if the VSWR is too high you still have a possible danger of arcing through the dielectric. In this case, the ancient but reliable 600-ohm open wire line will give good results. It also beats the cost problem, since Sears, Roebuck, will sell you a half-mile of copperclad steel electric fence wire for the price of 100 feet of coax. TVI problems attributed to open-wire line usually result from other causes, and noise pickup is virtually eliminated when an antenna tuner is properly employed. The only disadvantage is esthetic—and who ever claimed a backyard full of antenna wire looked pretty (to a non-ham XYL, anyway) with coax dangling from the midpoint of each strand?

In this brief discourse we've only touched on a couple of points the old-timers know well and modern theorists seems to have overlooked. These are not the only such points; a few hours spent in study of ancient texts can prove rewarding for any ham who holds a three-letter call (and some who hold two). Most public libraries have a good stock of pre-1934 radio books, and many have treatises dating as far back as World War I. Browse through them — you'll be surprised at how much solid operating information was in existence before the days of store-bought stations! . . . K5JKX/6

## Antenna Relays

For most applications, it is not necessary to invest the money for a coaxial relay to use as an antenna change-over relay. Almost any relay having SPDT contacts with decent insulation will work. Although it is claimed that this will cause a mis-match, waste power, etc. the mis-match is hardly measurable in most cases and the same goes for the power that is supposedly wasted. The only place where a coaxial relay is desirable is on 2 meters, and only because the capacity between the contacts is lower (so is the inductance). In spite of this, I have no problems with a surplus AC relay on 2 meters. If the only objection to an ordinary relay is mis-match, consider the fact that UHF type connectors are not a perfect impedance match by any means, and the coaxial construction of the relay probably isn't either. In some cases, there is more of a mismatch from 2 coax connectors (UHF type) than from a good relay that is not of the coaxial type. . . . WA2INM

## New Products



**Dear Wayne,**

Here are some little gems I would really like to rave about. I was naturally a little bug-eyed when I saw the size and efficiency of the KW mobile power supplies the boys at Jennings were building to run their miniature water-cooled KW mobile rigs. These are the diodes used in the inverters, and they are tickled pink with their performance. When I learned what they could do, I was a little flap-jawed myself. It seems that one of these, the size of a ¼-watt resistor, can handle **three-quarters of an amp** at peak inverse voltages of 200, 400, 600, 800, or 1000 volts (the size stays the same, only the price increases with voltage)—with a voltage drop at full current of about one volt, which means ¾ watt **maximum** of heat needs to be dissipated by the diode. Due to a unique construction feature which incidentally produces high stability, mechanical ruggedness, and miniature size, these diodes will take a square wave beautifuly at frequencies up to 10 kc—which is a real test if you are familiar with diodes—that square wave front can really shake them up. With sine wave, full output can be obtained with inputs as high as 100 kc. Units will operate at anywhere from freezing to boiling. Leads are pure silver. Price is competitive, very much so, even disregarding the added performance features.

Needless to say (but I will) they lend themselves beautifully not only to "big" power supplies, but to relay supplies, bias supplies, meter protection, and semiconductor-capacitor applications (varying from 1 mmf with back bias of —100 v to 15 mmfd at —1 v.); and good old audio clipping, in this case neatly nipping the tops off waves as far out as 500 kc. Made by Diodes Incorporated, 7303 Canoga Ave., Canoga Park, Calif. And they will sell them to hams by direct order. I asked.

**Jim WA6EXU**

**Eddie Tor,**

Russ Farnsworth, W6TTB, is kind of a genius on teaching code. Thru many years of teaching the code to groups Russ developed the "word method" and a step by step method of learning the code quickly and somewhat painlessly. Since he is gifted with a very professional-sounding voice, Russ has finally recorded the course on 6 sides of 12" LP's (3 records) in an album selling for $9.95.

During the past year or so the records have become increasingly popular with groups and individuals struggling to master the elusive 13 wpm. Sightless Russ has done a good job of shedding light on the path of code-learners.

**Jim WA6EXU**

*I have one of his albums here Jim and my hat is off to anyone who can fail to learn the code using his method. . . . wayne.*

# Hiss, Sputter,

Jim Kyle K5JKX/6

SAID one of Lewis Carrol's immortal characters, "When I use a word, it means exactly what I want it to mean—no more and no less!"

This esteemed gentleman wasn't talking about noise in ham radio receivers, but he might as well have been. Because most writings which mention "noise" use the word to mean "exactly what I want it to mean"—and the result is total confusion about this most important receiver problem.

One of the first paradoxes raised by the many meanings of "noise" in receivers is the well known fact that a noise limiter will do nothing at all about noise of the atmospheric sort.

After this opens the door to bedlam, all discussions of noise prevention, elimination, and cure eventually lead to a withdrawal into the corner, muttering beardwise.

So before we get much deeper into the morass ourselves, this looks like a good place to explore the title of this article, the many meanings of "noise," and what we can do about *all* the effects which we dislike.

When we're trying to find out what a word means, one of the most logical places to start is with a good dictionary. Let's see what one has to offer in this case:

"NOISE: 1. A sound that is not musical or pleasant. 2. A sound. 3. Din of voices and movements; loud shouting; outcry; clamor."

Granted, all three definitions given satisfy the general meaning of "noise"—but none of them are directly applicable to any meaning of the word as it's used in radio. Let's look at the physicist's definition of "electrical noise":

"NOISE: An electrical signal having random distribution of both frequency components and of amplitude; evenly distributed throughout the electromagnetic spectrum from zero frequency to infinite frequency."

That's closer. Translated out of the exotic verbiage, this is a precise definition of the kind of noise developed in a high-gain amplifier—the hissing or frying sound which provides an absolute limit to useful gain.

But it doesn't even begin to mention the effect of passing hot-rods. To pick up that definition, we have to go to information theory and the writings of Messrs. Hartley, Shannon, et al:

"NOISE: Any interference with the desired communication during transmission of a mes-

*Being a Brief Dissertation on Noise and Such*

# and Crash

sage; this interference may be from any source, and tends to obliterate a part of the message."

At first glance, you might say that this definition really wraps up the entire problem, since it includes the physicist's "noise" as well as ignition pops, lightning static, and QRM from the kilowatt down the block.

Actually, that's what's wrong with this definition for our uses; it's too broad. When we're trying to find out how to prevent, eliminate, or cure "noise" in a receiver, we want to know what kind of "noise" a given treatment will be effective on. And the information-theory definition is too broad to give us that bit of detail.

Thereby hangs our title: "Hiss, Sputter, and Crash." These three words describe the three kinds of "noise" most prevalent in radio receivers, and by using them instead of the too-general term "noise" we can straighten out most of the confusion.

Hiss, naturally, is the physicist's kind of noise: random voltages which come out as a hiss or frying sound. If you've ever turned a high-gain audio amplifier all the way up with no signal input, you've heard hiss.

Sputter is meant to describe ignition noise, electric-motor interference, and similar annoyances. In a strictly engineering sense, these things are really signals rather than noise, but from the standpoint of communication (where information theory applies) they are just so much noise. Since most of them have a sputtering sound, we picked this name.

The final category, crash, is meant to describe thunderstorm effects and similar happenings. Electrically, these are similar to sputter, but while sputter is reasonably regular (ignition pops show up on every revolution of the engine, etc.) crashes occur only in isolated instances and frequently persist longer.

With the category of effects usually termed "noise" broken down this way, we're now ready to go into them in some detail and discuss elimination, prevention, and cures for all three.

Hiss is inescapable in any high-gain amplifier; that's a fact which must be faced. Any time you increase gain enough, you'll hear it. The reason for this lies in the cause of hiss: it's actually (not just figuratively) the result of the random motion of electrons in each atom of the circuit. The only time it ceases is at absolute zero—and nobody has ever gotten anything that cold.

(Continued on page 68)

(Hiss, etc. from page 67)

However, hiss can be minimized by proper circuit design. The "low-noise" circuits you read about for both rf and hi-fi uses are actually "low-hiss" circuits.

Naturally, the less hiss present the more amplification you can use. However, this fact only becomes important at frequencies above about 50 mc, since at lower frequencies sputter and crash are much more prevalent and mask out any hiss which the receiver may contribute.

For a complete discussion of "low-hiss" rf circuitry, see the technical article "Up Front" in the March, 1961, issue. And remember, wherever the original article says "noise," read it as if it said "hiss."

As we said a couple of paragraphs back, at frequencies below about 50 mc sputter and crash become important. Much effort has gone into circuitry to minimize their effects, and a lot of it has paid off well. Automatic "Noise" Limiters (read it as really being "Automatic Sputter Eliminators") are standard equipment on most receivers these days, and improvements on the standard ANL (ASL) circuits are continually being made.

Naturally, a sputter-eliminating circuit can't do a thing in the world about hiss. The reasons for this lie in the basic differences between the waveforms

The waveform associated with hiss is almost indescribable; since hiss has no specific frequency or amplitude, it's sort of a Heinz mixture of all waveforms. n a scope, it shows up as a rather ragged line. The British term for it is most descriptive of the scope picture; they call it "grass."

On the other hand, sputter has a most definite characteristic waveform. It's sharply spiked, and usually narrow. Most pulses of sputter range in width from one to ten microseconds, which correspond in time to a single cycle of a 2 mc or 200 kc signal, respectively. This, as you can imagine, isn't very long. Crash has a waveform which is something like sputter, but isn't so sharply defined. Like sputter, the wavefront is extremely steep and the peak amplitude extremely high.

Virtually all ANL circuits operate on the magnitude of the signal. An exception is the rate-of-change limiter developed by British TV designers, which is triggered by the steep wavefront.

Both the high amplitude and the steep wavefront are completely missing from hiss. For this reason, no conventional noise-limiter will have any effect on hiss, efficient though the circuit may be with sputter and crash.

By similar reasoning, you can see that the measures taken to reduce hiss will have no effect at all on sputter or crash—except maybe to make them more clearly audible!

In addition to front-end changes to reduce hiss, though, you do have one additional weapon. It's the series-gate trough limiter described in "Stop That Noise!," the technical article for November, 1960, which also included a number of circuits aimed at reducing sputter and crash.

To sum up, then, we must first reemphasize the fact that "noise" isn't always "noise." To deal adequately with the various types of "noise" present in receivers, we've divided them into three categories: hiss, sputter, and crash. Hiss can be prevented by receiver front-end design, or eliminated by a trough limiter. Sputter can be controlled by a good ANL but can be eliminated only at the source, which usually isn't under your control. Crash we must live with, since man can't yet control the atmosphere and crash is so powerful that most ANL circuits can't handle it either.

Not mentioned are various receiver faults which can result in hiss or sputter. Here are a few of them (full descriptions must wait for another article):

HISS:

Can be caused by an oscillating tube in rf, mixer, or *if* stages. Sometimes caused by defective volume control.

SPUTTER:

Can be caused by a stage oscillating far from normal operating frequency (parasitics, in other words). Occasionally caused by arcs in power supply or defective rectifiers.

. . . K5JKX/6

(Letter from page 47)

ıgainst that sick-humor suggestion of yours that Extra Class licensees be granted the privilege, if that's what t is, of picking out calls like W2SKIDDOO, etc. Goodıess, Wayne, don't drag the flag, dive with the hatch ›pen, trade for a pot of message—what am I trying to hink of? No sir, let's hold out for something good, like ›lack Homburgs, or rehabilitation at public expense. Extra Class has been a big zero for nearly a decade; vhat have we got to lose? Thing bug—I mean big.

Ken, W7IDF

P.S. Otherwise the idea of a fee for licenses is fine. Ve use the F.C.C. and we can pay for the service. The armers can pay for the Weather Bureau and the boatuts for the Coast Guard. After all, the Postmaster ›eneral wants to run his show this way, and why not? 'ay for what you get, and no more taxes for what you on't use. Is that what you mean by Goldwater Republicanism? I'm with you.

*Mother and son subscriptions special this month, two for* 5.00.

(Propagation from page 49)

t each end of the circuit. B.) To work the ›ath New York to San Francisco (2,600 ıiles), the local time centered on the mid-point f the path will be 1½ hours later than at ›an Francisco and 1½ hours earlier than in Jew York (the time difference between New 'ork and San Francisco is 3 hours). Looking p the HBF's next to the 2,500 mile listings vill give the HBF to use. In San Francisco ubtract 1½ hours from the time periods listed or local time and in New York add 1½ hours › the time periods listed for local time.

These charts are to be used as a guide to Iam Band openngs for the Month of August, 961. I am interested in hearing of your reılts using these charts and will consider any equests you might make for the inclusion of ifferent areas in the DX chart.

(W2NSD from page 41)

ntenna. Too bad it is too big a deal for six ıeters.

The panadaptor article came in second. It 'as close enough so that I had some nervous ıoments thinking about my policy of paying alf the original price to the winner each ıonth. Abe got 1891 votes to 1779 for Panaaptors, which is close. The staff article on ›ower supplies came in a healthy third, again ›stifying that we're on the right track in preınting technical articles that are written for ıe regular amateur instead of the engineer. he article on capacity measurement by John ›einartz K6BJ was fourth. It sure is nice to ave John with us, his articles are always of igh interest.

## VOX POPS

Here are some of the comments received in

(Turn to page 71)

# Advertisers

(W2NSD from page 69)

answer to the "Articles I would like to see" blank in the June issue of 73. This should answer the question posed by many writers: "What should I write about?"

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Hundreds of cards asked for more VHF articles, dozens for RTTY. Antennas are very high in interest, both HF and VHF. I have articles on hand, bought and paid for, covering many of the requests, but as you can see from the sample above, the demand is unlimited. You convert it, we'll print it. You build it, we'll print it. You explain it, we'll print it.

## W4BPD

A letter just came in the other day from Ack, W4ECI of Birmingham, telling of the new DXpedition planned by Gus Browning W4BPD. Gus made quite a trip last year, as those of you who chase DX well konw, and found out how to go about getting licenses for operation in many of the rare countries.

After hearing Gus tell about the trip in rather good detail at the Miami Convention in January I made him promise to write an article on his methods for brainwashing the local officialdom of these countries. Gus came through in good fashion and we will be printing this in our October First Anniversary. We've Made It For A Whole Year Issue. Gus used a different approach and it certainly was effective. After reading his article I think most of us will be able to go into just about any of the smaller countries and get a license.

. . . de W2NSD

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4.5 Mc. Intercarrier, .01%........ **$2.95 Net**

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To determine band edge. To keep the VFO and receiver properly calibrated.

100 Kc. .. **$6.95 Net**


Z-6A

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