IS THIS THE WORLD'S LARGEST YAGI? Page 5.

CQ

February 1969
75¢

CQ REVIEWS THE GALAXY R-530 RECEIVER

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- POWER INPUT vs. POWER OUTPUT
- THE TEETER TOTTER TUNERS

The Radio Amateur's Journal

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February, 1969 VOL. 25, No. 2

CQ

The Radio Amateur's Journal

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THE EQUALIZER

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ZERO BIAS

REALIZE it or not, we're in the midst of one of the most exciting technological eras to come upon the radio world since Lee DeForest put a grid into a diode over fifty years ago. This revolution, unlike DeForest's, is a quiet one and perhaps not yet making itself known to the large numbers of amateurs who enjoy their operating rather than technical pursuits. But quiet as they may have seemed, the last three or four years have literally launched the amateur radio world into areas previously unimagined.

We've come to take in stride shoe-box-sized equipment with performance figures mocking those of only a few years back. Frequency stabilities and readouts, which ten years ago were expected only in precise measuring equipment, are now expected and delivered in amateur equipment selling for under $300. Receiver sensitivity and selectivity specs approach textbook figures, and we take them for granted. Mechanical filters abound and noise blankers are becoming commonplace. The table-top kilowatt linear is nearly as common as the multiband yagi. But you haven't seen anything yet!

For instance, the field-effect transistor (FET) —the pride of the transistor world—as great an advance as it is in large-signal handling capability for transistor receivers, has still not been used in a single commercial design for the amateur. And even so, the signal-handling capability of bi-polar transistor front-ends in the current commercial receivers rivals the best vacuum tube sets.

Voltage variable capacitors and inductors, silicon controlled rectifiers, tunnel diodes, diode switches, diode multipliers, integrated circuits and a hundred other terms are only now becoming a part of the amateurs' vocabulary. The equipment manufacturers have barely scratched the surface of the unending reservoir of possible applications for the new "tools," and although the past few years have seen "revolutionary" new designs of equipment, the next few years are going to make the gear of the early 1960's look like Model-T's.

This "quiet revolution" has made possible — and conversely has largely been made possible by—the space race. Surely without the development of highly efficient and extremely small electronic circuits and devices, the state of space technology would not have reached its current level of sophistication. Without the stringent requirements of space technology, it seems unlikely that the applications men in radio and electronics would have at their disposal all the marvelous little building blocks with which they now play. All of which brings us to conclude that the future technological development of amateur radio is going to be closely related to the U.S. space program, and we'd better start paying a little more attention to the electronics end of what's going on at the space centers.

Looking over a few articles scheduled for next month's *CQ*, the frightening realization suddenly swept over us that the electronics world is fast rushing past amateur radio and has been for about fifteen years. Here we sit in our wood-paneled shacks gabbing into equipment which, by space-age standards, was obsolete ten years ago, on 20-meters, a band which, technically, was tapped-out 30 years ago! That's right—anything you can do with your current equipment on 20-meters was being done in the 1930's.

What has all the new type, greatly-improved equipment brough to the h.f. bands? Status quo, that's what! It seems that each and every technical "advance" has been accompanied by a corresponding "retreat" in desire to seek new horizons in amateur radio. Instead of utilizing the great ingenuity and imagination inherent to amateur radio to move ahead into new fields, to conquer new worlds, to do the things the pro's say can't be done, the vast majority of amateur talent has been turned inward to relieve congestion on the h.f. bands, thereby inviting still further congestion.

Every so often, some small group of amateurs possessing vision beyond 20-meters strikes out at a new challenge. The OSCAR group is one. K2QBW's Satellite Scatter study group was another. The u.h.f. moon-bounce efforts we're so pleased to report every so often are by others of that élite group of visionaries, as are the rapidly gelling efforts of NASTAR and its Project MOONRAY.

We all applaud these efforts, when they succeed, but nearly all of us sink immediately back into the lethargy of "conventional" h.f. operation. What a tragedy! We live in a swiftly moving, excitingly technical world, and we're too apathetic to take a part in it. We're scared stiff to do battle with a new challenge we're not sure we can win, and therefore shun the challenge in favor of the "sure thing." As we sit here able to view amateur radio as a whole, being exposed daily to every conceivable aspect of the hobby, we wonder how much longer amateurs will be content with driving "Model-T's" on their archaic h.f. "highways." We sincerely hope that it won't take another "200-meters-and-down" decree to dislodge us from our apathy.

On The Cover

No, that's not a new six-meter Long-John you saw on the cover. It happens to be what we believe is the world's largest amateur beam antenna: a 12-element 20-meter yagi 152′ long! The monster beam was used by the gang at WA6ZZK during the phone portion of the 1968 *CQ* W.W. DX Contest. If *this* isn't the world's largest, we'd sure like to know what is!

73, Dick, K2MGA

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OUR READERS SAY

Amateur Construction

Editor, *CQ:*

As a fairly active amateur I feel obliged to answer G8GI's letter which appeared in your November's issue. Mr. Raithbury's comments on the decline of amateur radio, to which he linked single sideband as a major cause, were totally unfair and incorrect.

His claim of suppressed construction and repairing of our own rigs is untrue. I know many amateurs who have built their own equipment and repair their own. And they are the majority, not the minority either. Those who do not, and unfortunately they do exist, have no interest or desire in the technical aspect of this wonderful hobby. To each his own. Chances are if they were on a.m. they would still avoid building their own so I don't see how anything can be placed on Mr. Raithbury's statement.

As for the cost factor—anyone who claims s.s.b. costs more than a.m. hasn't looked into the matter at all. Sideband gear today is produced in a highly competative market. You can buy a transceiver today which will outperform anything available ten years ago for less than $300. A medium priced a.m. station would set you back at least $500. In fact one can get on sideband with all accessories for less than $200!

The reason many of us don't build our own s.s.b. gear is that it is not economically feasible. My low band station is totally commercial; however, my s.s.b. v.h.f. transverters, transmitters v.h.f. linears are of my own design and construction because there were no comparable commercial units available that economically or technically meet my needs.

S.s.b. offers much inspiration Anyone who has ever done any s.s.b. work on six or two meters will attest to this. The ease of working the lower frequencies cannot be denied; nor the need for amateurs to at least keep within a decade of our present technology. The thrill of working DX is the same, no matter if it is done on s.s.b., a.m. or c.w.

To sum it all up, s.s.b. is no cause for a decline in building. The availability of high-quality low-priced equipment leaves a serious experimenter free to build in other areas such as v.h.f. and u.h.f., teletype and antenna work; areas where one can technically advance; and build cheaper than he can buy.

Again you can get on s s.b. for less than $200 with new gear, even less if you are willing to buy used gear. Anyone who doubts this just has to send me a s.a.s.e. and I will gladly point out several manufacturers who have low priced high quality transceivers on the market.

Sideband does not detract from the challenge or enjoyment of our hobby. In our crowded bands it has probably done more to save it than anything else.

Peter J. Bertini, K1ZJH
Windsor Locks, Conn.

Youth Defended

Editor, *CQ:*

I have just read with disbelief the letter from Paul Ninken, W2WDH, in December's issue. I'm going to try to defend the youth of America that Mr. Ninken has so sweepingly condemned.

I am seventeen years old and I've been a ham since I was twelve. I'm president of the Shaker Heights High School Amateur Radio Club, and I do not have a silver spoon in my mouth. I worked to raise the money to buy my rig. Many of my friends are hams, and I know for a fact that most know more electronic theory and better operating technique than many of the older hams I've met, who you so readily defend.

I have never smoked pot; I know my friends haven't, and our hair is no longer than what is average in today's fashions. I am still amazed by the miracle of communications, and I expect I always will be. And believe it or not, Mr. Ninken, I don't have a sports car as you implied in your letter.

Instead of making sweeping generalities about a subject upon which you are obviously uninformed, you might get to know youth a little better. I don't believe in the theory that one bad apple spoils the barrel; while there may be a few teenagers who act as you suggest they represent youth no better than the handful of poor operators represent ham radio as a whole

Why not go out of your way to meet the people who will be America for the next 25 years; you may even get to like them.

Kenneth M. Riff, WA8SMG
Shaker Heights, Ohio

Editor, *CQ:*

In the December issue of *CQ*, Paul Ninken W2WDH, said that "our youth is more interested in long hair, smoking pot and in Suga Easy Xray," as he put it. I would like to know where he gets all his information. I am a membe of today's youth and I know of none of my friends who fit that description.

Furthermore, he says we have been brough up with silver spoons in our months. I, for one bought my receiver with money that I personall earned. No "big daddy" gave it to me. I am als building my own transmitter. That wasn' dropped in my lap, either.

I think that Mr. Ninken ought to do a littl more investigating before he accuses someon else. Sure, you read all the time about bad teen agers, but not about good teens. Why? Sinc most of the teens are not on drugs or avoidin the draft, they aren't making the headlines. Th kids who are freaking out are making th headlines.

Jay Ayers, WN2HJY
Endwell, N.Y.

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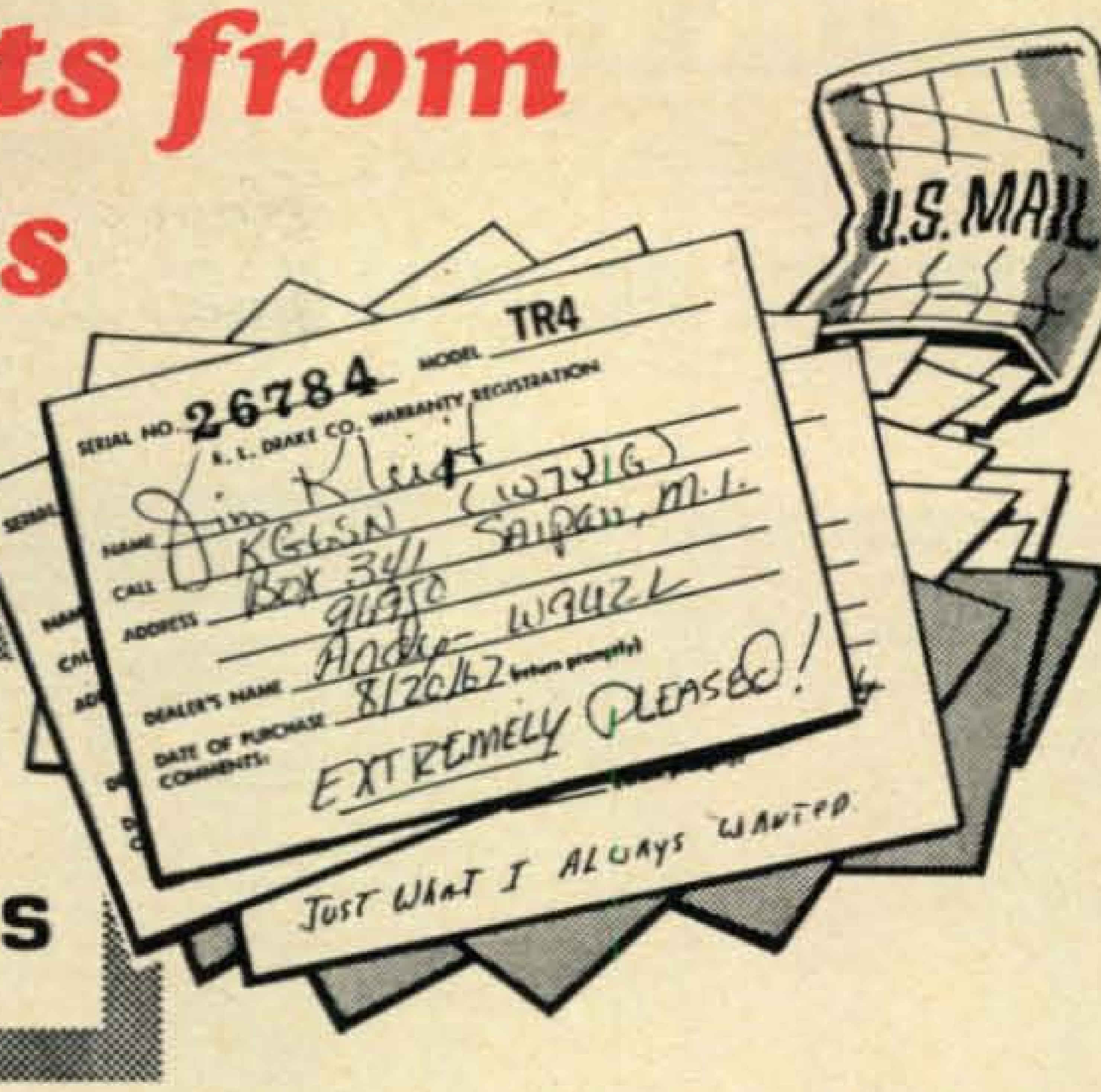
Some comments from warranty cards by owners of



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Joe Braz Ribeiro, PY4UK
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Thomas F. Totten, Jr. WB2GZR
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Rev. James Mohn, W3CKD
Lititz, Pa.

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Guy N. Woods, WA4KCN
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. . . or write for details . . .

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SCRATCHI

Feenix, Ariz.

Deer Hon. Ed:

Boy oh boy am I a mess! Are having so many bandages on I looking like a Hon. Marshmellow. Only part of me that not bandaged are my feets, and they tucked under covers of bed. Hon. Ed., I not even having use of my hands.

Only reason that I can riting you is that Hon. Brother Itchi giving my electric tiperiter for Xmas. So, here I sit, tiperiter on lap, hitting keys one by one with pencil held in teeth. Each stroke sounds like clap of thunder to my poor aching body, and when carriage is returned, the hole room shakes and every pore of me hurts.

What's happening? Well, it all starting when I dropping into Joe's Triple-Dip Hunky-Dory Ice Cream and Used Magazine Parlor cupple weeks ago. I picking up magazine to reed while eating one of Joe's speshuls —a Desert Rainbow. That a delishus concockshun with forteen diffrent flavors of ice creem covered with orange and coffee syrup and topped with pint of whipped creem.

Well, anyways, this magazine having artickle in it about this famous clairvoyant from England what making some predickshuns about what will be happening to Hon. Yewnited States. He saying that pretty soon-like we having series of earthquakes on West Coast and California plus Arizona going under water — kerplop — right into Pacific Ocean. He predickting earthquake in Alaska in 1964, and sure enuf—there was one.

This getting me so upset I leeving two kinds ice creem uneaten in Desert Rainbow. In fackly, I so upset, I buying Hon. Magazine and driving home to ranch. Looking up this feller in ensighclopedia, and surely to goodness, he making lots of predickshuns what coming true.

Well, you don't have a State fall out from

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under Scratchi before he getting idea. No indeedy. I sitting rite down and making list of things I having to do and things I wanting to save. On acct. not knowing when all this going to happen, are going to have to build a boat to save things in.

When list are getting cupple hundred items long I looking at it and desiding I want to reely saving everything on ranch, including my ham shack and equipment. So, if going to bild a boat, it going to have to be a Arizona Ranch Conserver. I making note to go to library to see if can getting books on how to bilding Hon. A. R. C.

Meanwhile, before can designing Hon. A. R. C. I need to knowing how big it needing to be. This means I gotta deside on what all will be in it. You know, like two tarantulas, two black widow spiders, two peccaries, two coyotes—things like that. Only taking two of each as aren't going to be room for all of everything.

All this hard brane work taking several days. Making lists, desiding where I putting ham shack, trying to find info on antennas for boats, etc. When finely having a good idea of what I'm going to do, I letting Hon. Brother Itchi in on hole deel. He giving me big horsey-laff and telling me I wasting my time.

Howsumever, after few minutes more talking, he saying maybe I rite, but he not sure I can doing everything on the list. Like take, for example, where I listing "two mounten lions." He saying he not thinking I can catching even one mounten lion.

Well, Hon. Ed., that making Scratchi plum angry. Anybuddy can catching mounten lion if he wanting to. I desiding I showing that brother of mine.

So, next day I getting old pickup truck we having on ranch and bilding cage on it. Nice strong cage, with speshul door on back that springing up and closing when pulling on speshul trip wire I fixing up.

Following morning I geting up early, tell Hon. Itchi where I going, getting nice big chunk of meat from freezer, and hedding for mountens on back of ranch. In hour or so are about where wanting to be. So, parking truck, then cutting down some trees and fixing up truck with branches and leeves so it camoflaged to not looking like truck.

Then letting down ramp and opening reer door of cage and going inside, carrying

[*Continued on page 94*]

Good Soldering

Editor, *CQ:*

Jesse L. Meredith's (W7CCG) article "The In's and Out's of Good Soldering" was great. It is one thing to be told to do something and quite another to be told why. I have made the article required reading for the other two ET's and the RM who do repair work on the site. They also agree that Mr. Meredith's work is the most comprehensive article on soldering that they have seen. As you can guess by our location and the nature of our work, reliability is important to us and those who use the equipment. A well done to Mr. Meredith and *CQ*.

ETN2 David C. Bunting, WA1JRA/3W8
APO San Francisco, Calif.

In response to numerous reader inquiries, *CQ* will publish a booklet written by Mr. Meredith, based on his recent article on soldering techniques. The booklet will include expanded discussion of specialized techniques as used in military and printed circuit work, and will be available later this Spring from the *CQ* Circulation Department.—*Ed.*

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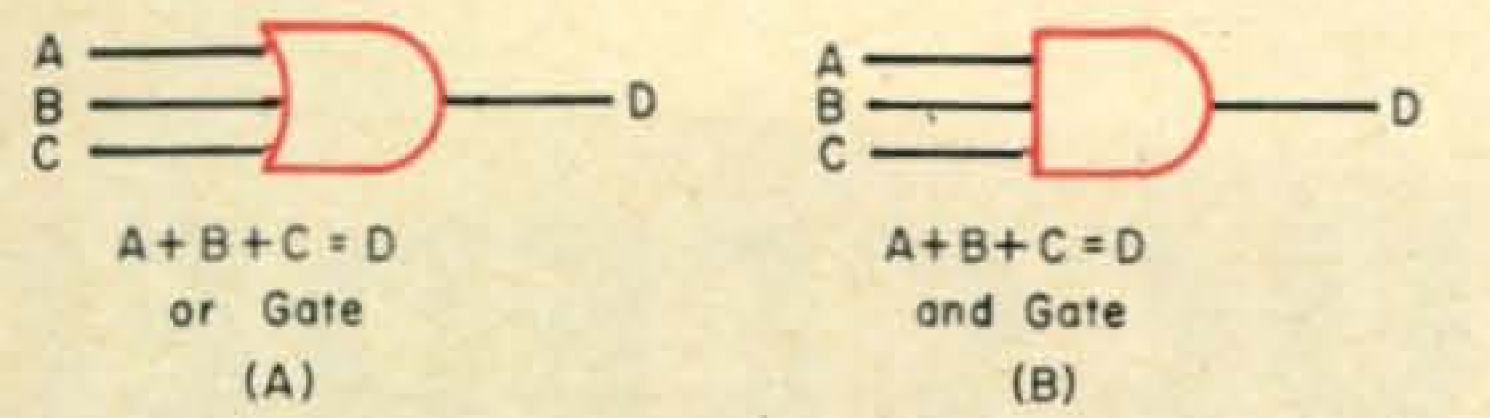

Fig. 1(A)—Symbol and Boolean algebra expression for a 3 input OR gate. (B) Symbol and Boolean algebra expression for a 3 input AND gate.

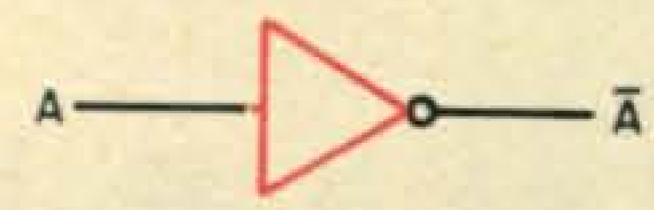

Fig. 3—Symbol of an inverter stage. It generally consists of one (or an odd number) common emitter amplifier stage that introduces a 180° phase shift.

Introduction to IC Binary Logic

BY F. B. McWILLIAMS*

Only a handful of amateurs can boast even the barest familiarity with computer-type logic. The following article is an attempt to rectify the situation by describing the circuit elements which are the building blocks of binary logic. The author also describes a Logic Pulser and a Sine to Square wave converter circuit, two novel construction projects.

OVER the years, the amateur who has kept abreast of "the state of the art" has been the person who has advanced the technical standards and capabilities of amateur radio. Two relatively new areas to which the amateur is being exposed are integrated circuits (IC's) and computer binary logic. IC's are already affecting amateur radio, but applications of binary logic circuits are rare—mostly in automatic keyers—probably because of a lack of information. Below, the author introduces the reader to some basics of binary logic and describes a pulse generator and logic pulser made up from integrated circuits.

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Logic Fundamentals

There is really only one basic element in binary logic circuits; a two-stage gate. An on-off toggle switch is an example of such a two state device; it is either on or off. The two binary logic states are designated as a logic one ("1") and a logic zero ("0").

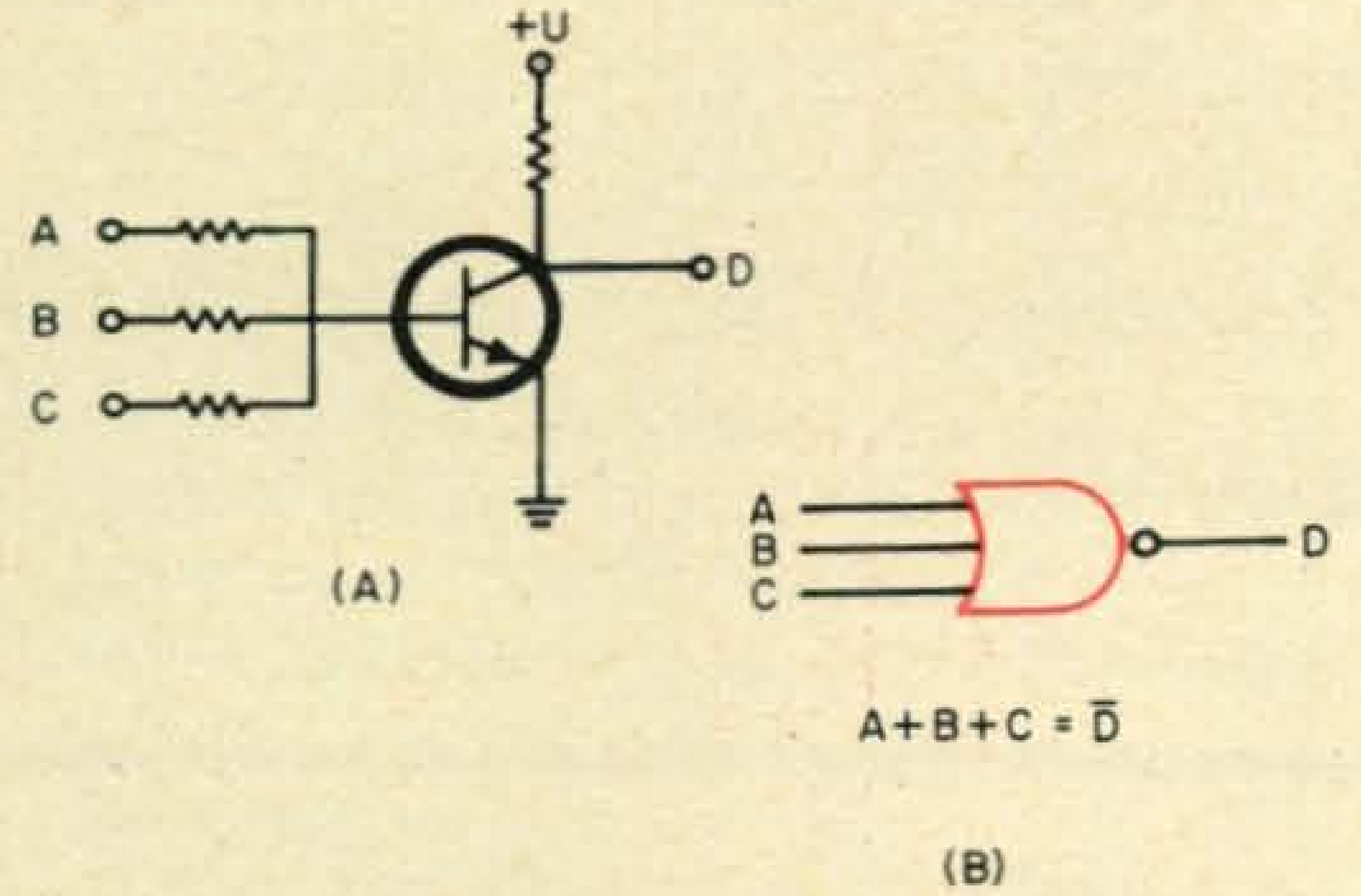

Fig. 2(A)—Schematic of a NOR gate and (B) the symbol and Boolean expression for the NOR gate. The difference between the OR and NOR gate symbols is the circle on the output terminal of the NOR gate.

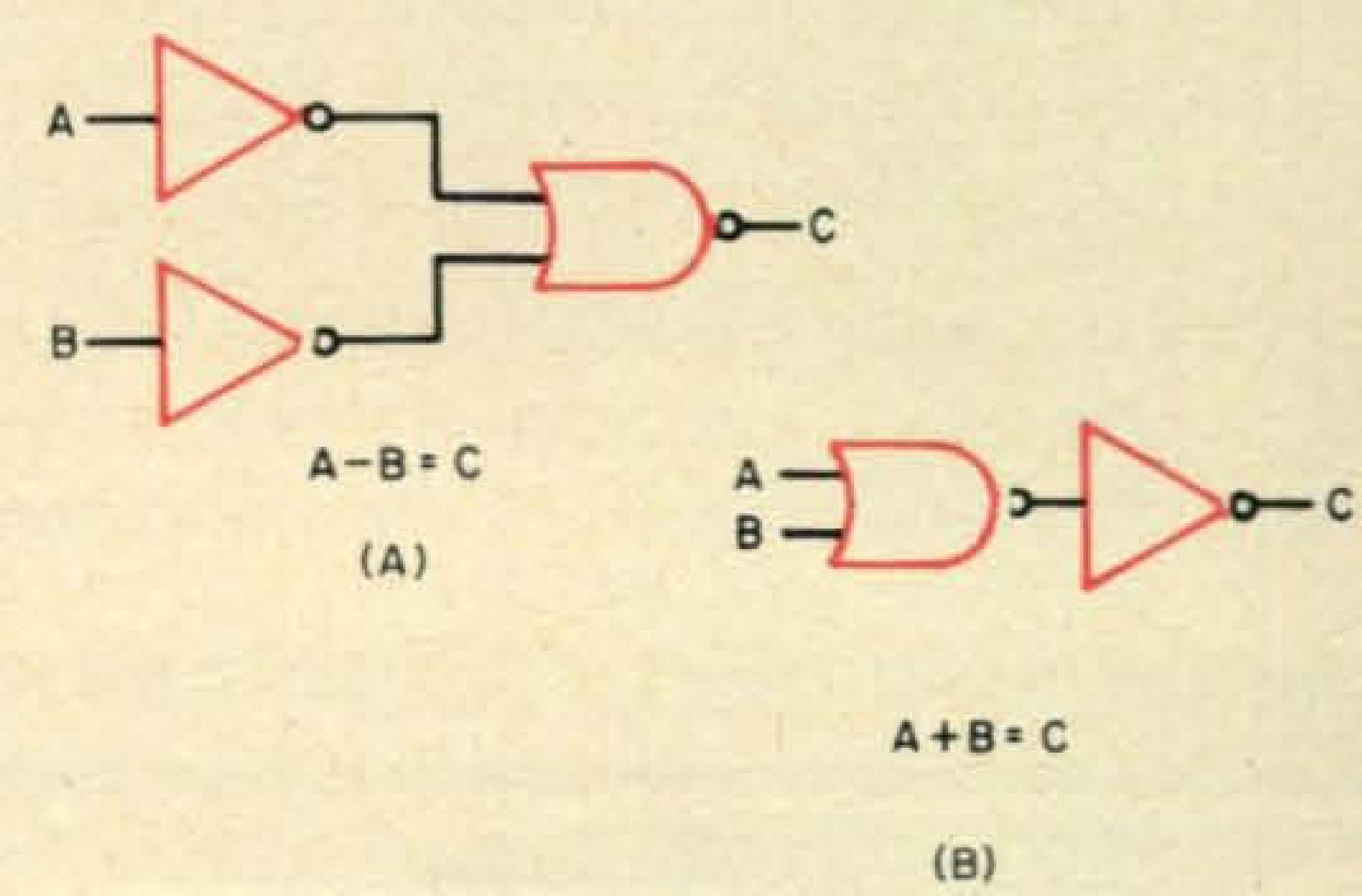

Fig. 4(A)—Combination of two inverters and a NOR gate provide the AND function. (B) The use of one inverter and the NOR gate provides an OR function.

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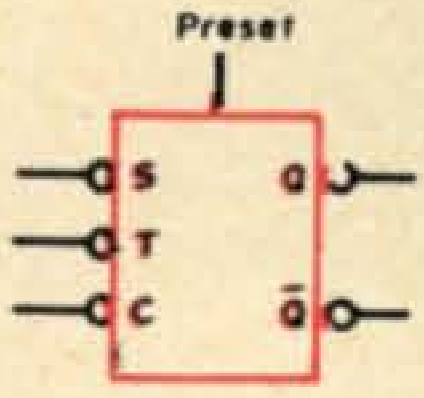
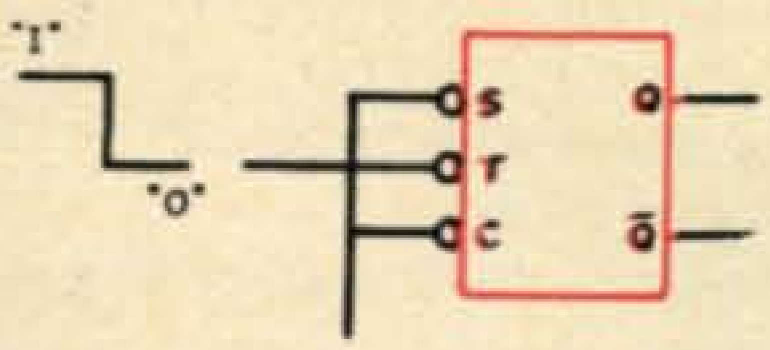


S	C	Q, After Toggle
1	0	1
0	1	0
0	0	*
1	1	* *

(A)



Before Toggle		After Toggle	
Q	Q̄	Q	Q̄
1	0	0	1
0	1	1	0

(B)

Fig. 5(A)—Symbol for the J-K flip flop. The table shows the states of the Set and Clear terminals and the condition of the output Q after a toggle pulse. The single asterisk indicates the inversion of the output before the toggle and the double asterisk indicates that a "1" input on both S and C is not allowed. (B) Circuit arrangement for reversing output states with a toggle pulse.

A logic gate is a device whose output takes on one of two voltage levels in response to its input or inputs. Either of these two voltage levels may be designated a logic "1" or "0." If we have a device whose two possible output voltages are zero volts and 4 volts, and we assign logic "0" to zero volts and logic "1" to 4 volts, we are using positive logic since the higher voltage corresponds to the logic "1." Conversly, negative logic assigns logic "0" to the higher voltage level and logic "1" to the lower voltage level. To avoid confusion, we will consider positive logic only, but the only difference between the positive and negative logic conventions is the definition of the voltage levels.

The symbols for two common logic gates are shown in fig. 1. The OR function is described in Boolean algebra by the expression $A + B + C = D$ where the + sign is read as OR; in other words, a logic "1" at input A *or* input B *or* input C gives a "1" at output D. The AND function is given by $A \cdot B \cdot C = D$ where the $\cdot$ sign is read as AND; a logic "1" at input A and input B and input C gives a "1" at output D. In the case of the AND gate,

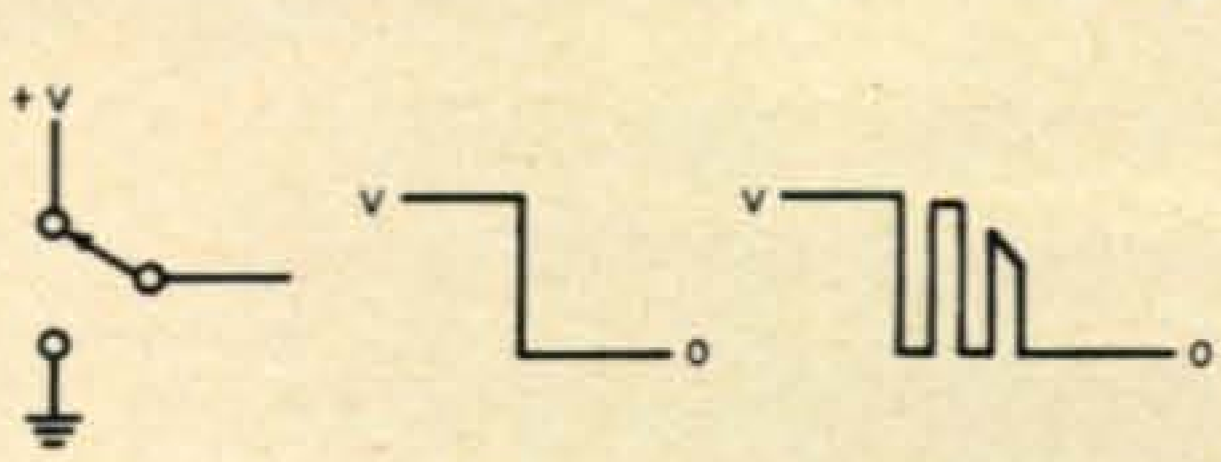


Fig. 6(A)—Switch symbol and circuit. (B) Desired ideal transition from *V*max to *V*zero. (C) Actual transition as might be seen on an oscilloscope.

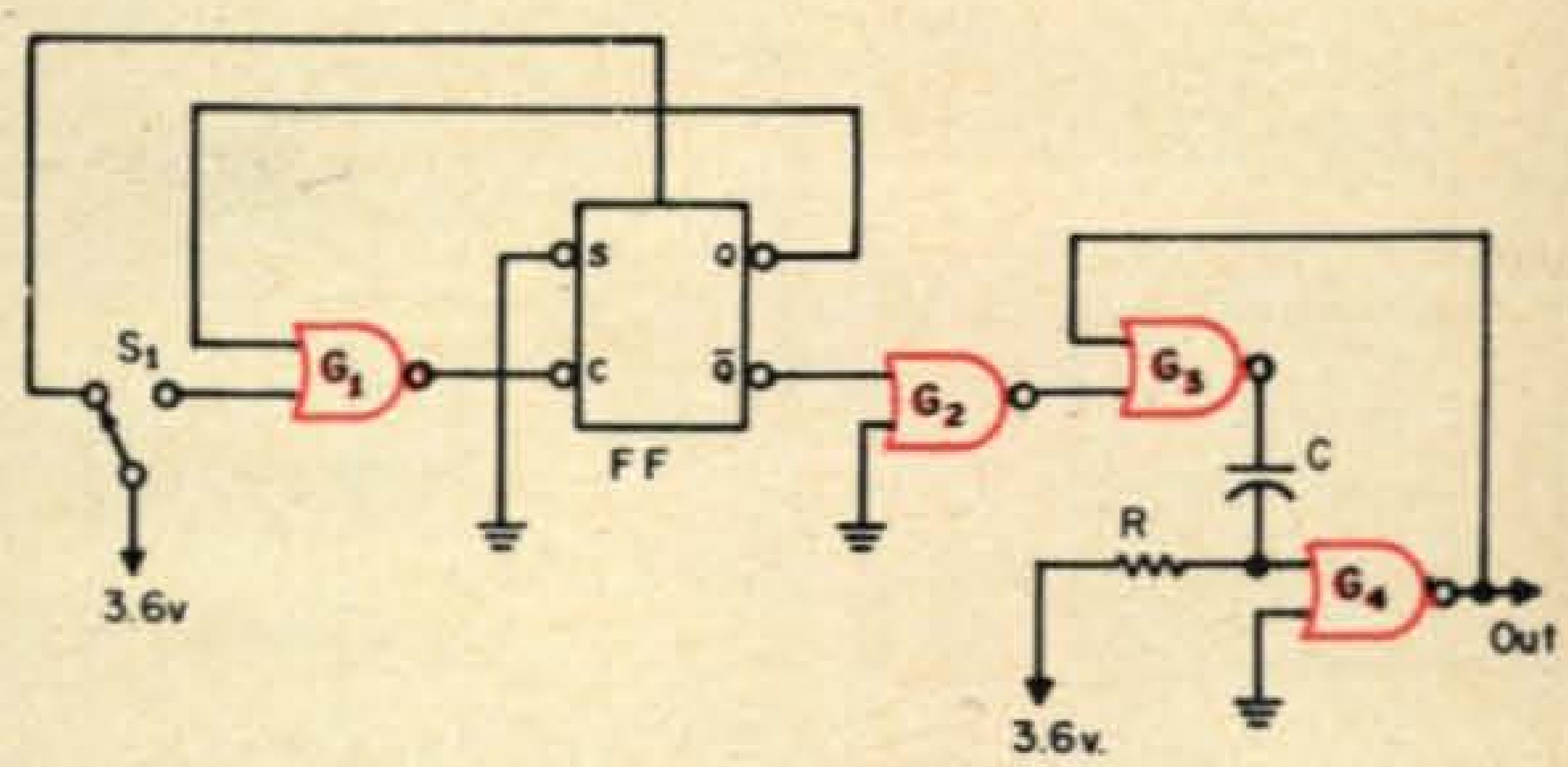
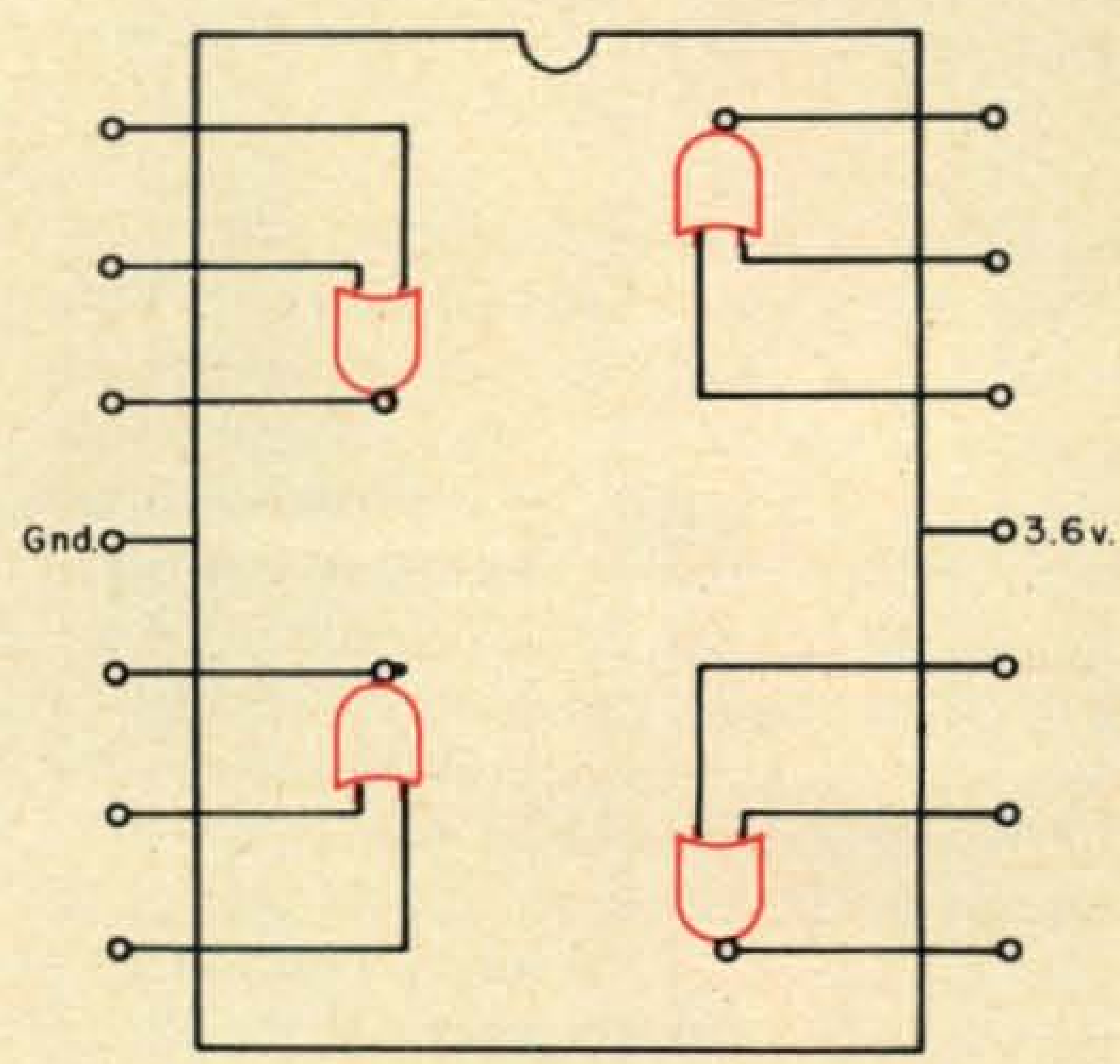
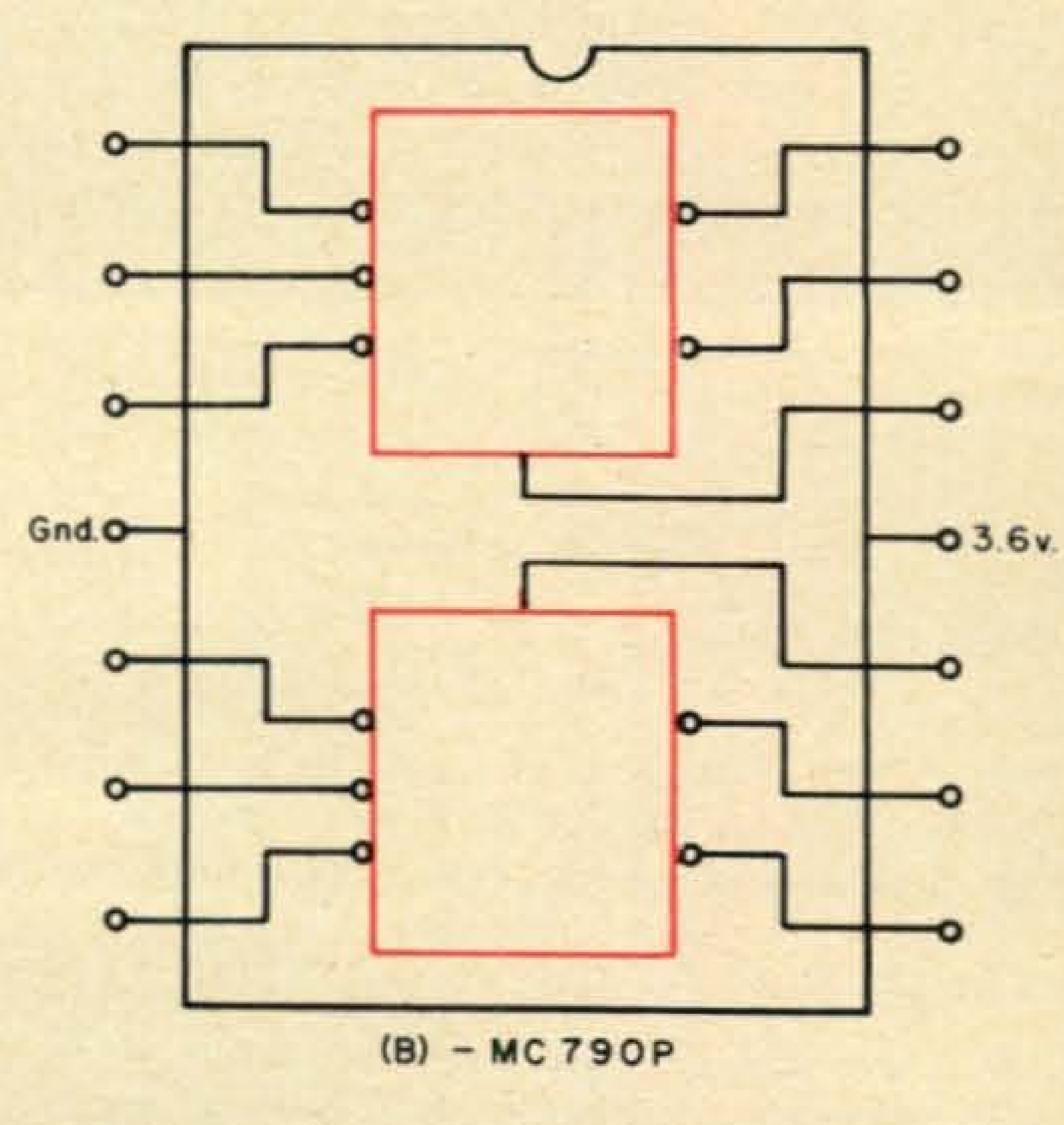


Fig. 7—A logic pulser made from integrated circuits to insure a single short pulse needed to toggle a J-K flip flop or any other logic circuit.

all inputs must be at logic "1" to give a "1" output; otherwise the output is "0." For the OR gate any one or more of the inputs at logic "1" will give a "1" output and the output will



(A) - MC724P



(B) - MC 790P

Fig. 8—Top views of connections and layouts of the Motorola Dual-In-Line IC's used to construct the IC Logic Pulser.

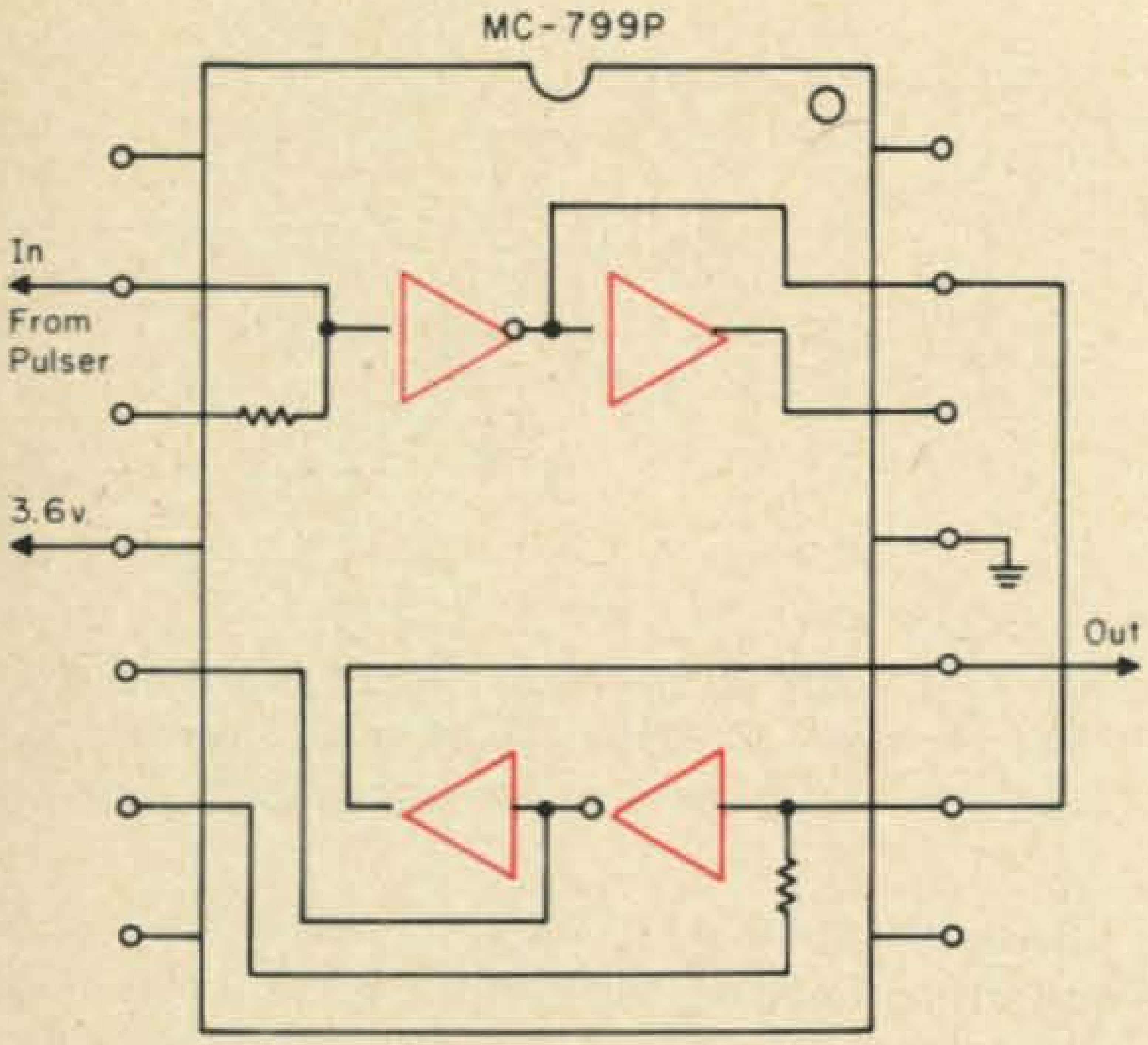


Fig. 9—Connections and circuit arrangement to use the Motorola MC799P to provide enough pulse output to drive more than one gate or flip flop.

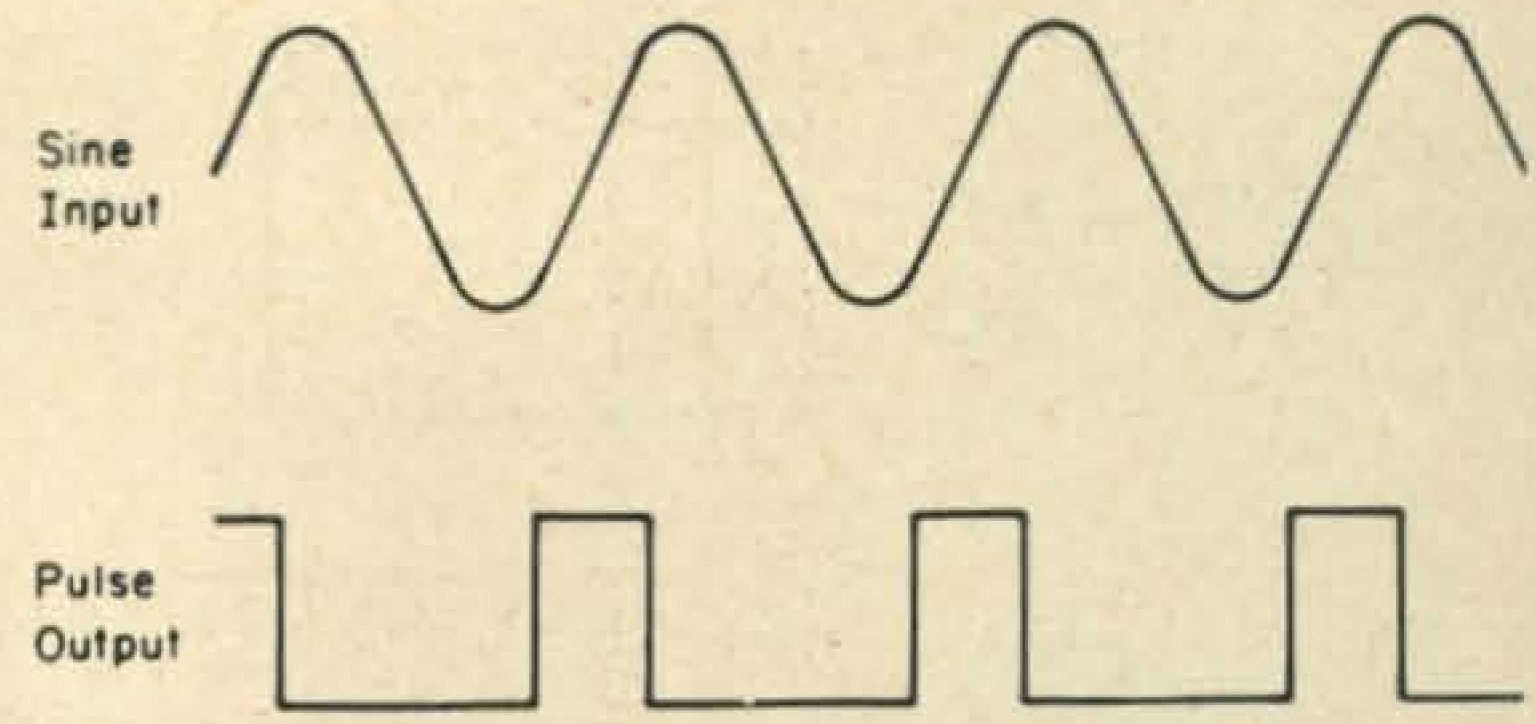


Fig. 11—Input and output waveforms of the sine wave to pulse converter. The width of the output pulse is determined by the value of *R* and C in fig. 10(A).

be "0" only if all of the inputs are "0."

A typical gate is shown in fig. 2. You will note that in this circuit, if any one of the inputs is at a logic "1" (high voltage level), the output will be zero (180° phase inversion of the common emitter circuit). When all of the inputs are at logic "0" (zero volts), the output will be at a high voltage level corresponding to a logic "1". This circuit functions similarly to the OR gate described above; however, the output is "0" when we would expect the OR gate to have a "1" and *vice versa.* This function which is an inversion of the OR gate is called a NOR gate.

The Boolean algebra expression describing the NOR gate is $A + B + C = D$. The bar over the output D indicates that the output is inverted; that is, a logic "1" at input A or input B or input C gives a "0" at output D, and a logic "0" at all three inputs gives a "1" at the output.

Another logic element used here is an inverter shown in fig. 3. This circuit is similar to that shown in fig. 2 but has only one input. The function of the inverter is simply to change a logic "1" to a logic "0" and *vice versa.*

Using the NOR gate and inverter we can assemble the logic AND or OR functions shown in fig. 4.

A concise discussion of binary logic and the use of Boolean algebra is presented in the *GE Transistor Manual* for those who might wish to consider this subject any further.

The Flip Flop

The memory elements most often used in called flip-flops. The name originally referred to the Eccles-Jordan multivibrator circuit and is now the accepted label for all computer circuits which perform the function of high speed memory elements.

[*Continued on page 98*]

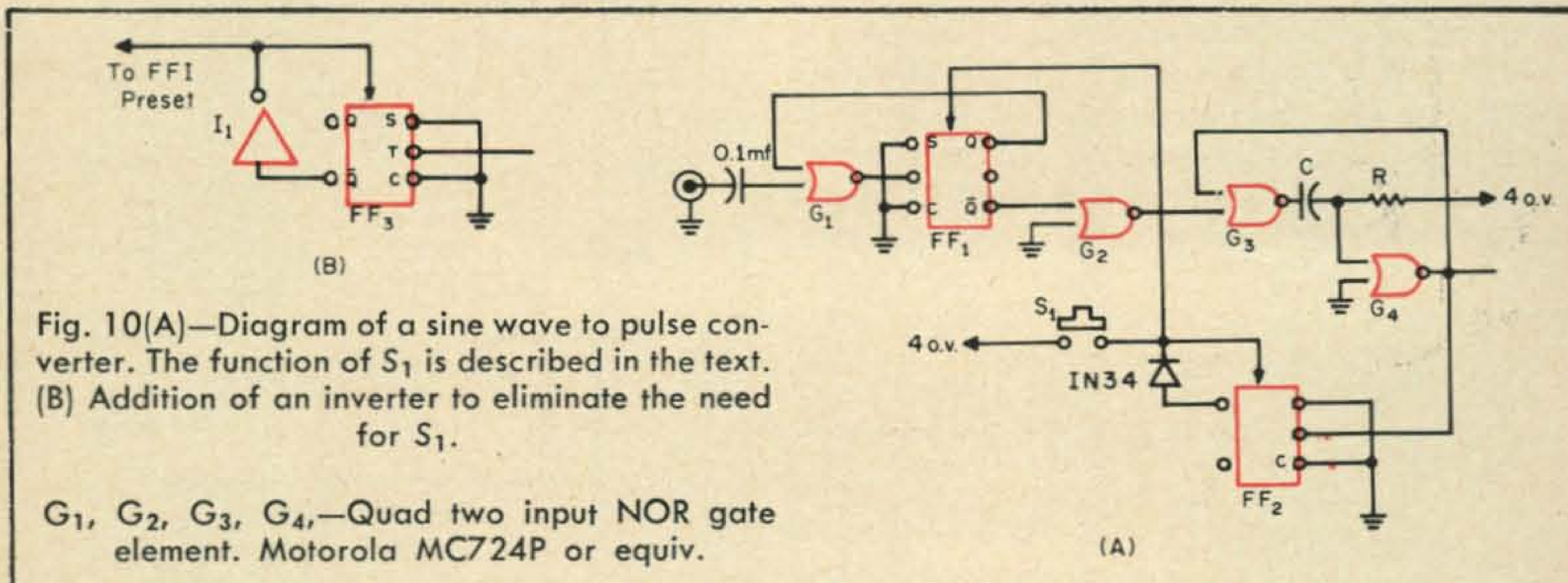


Fig. 10(A)—Diagram of a sine wave to pulse converter. The function of S_1 is described in the text. (B) Addition of an inverter to eliminate the need for S_1.

G_1, G_2, G_3, G_4,—Quad two input NOR gate element. Motorola MC724P or equiv.

FF_1, FF_2, FF_3—Dual JK flip flop (2 req.) Motorola MC790P or equiv.

I_1—Dual buffer element, Motorola MC799P or Hex inverter, Motorola MC789P or equiv.

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VARIABLE FREQUENCY TUNER FOR THE VISIBLE LIGHT BAND

BY JAMES A. GUPTON, JR., *W4AML

Part II

Part II of this two part series describes the construction, calibration, and operation of the monochrometer that can be used to tune across the light frequencies.

In Part I we contructed one of the several detectors described so that it could be used to align the monochrometer. With this done we can now proceed to homebrew the monochrometer.

Monochrometer Construction

Figure 13 illustrates the basic configuration of a monochrometer. A diffuser is employed to spread pin-points of light and attenuate intensity for the lens to collect and concentrate the light within the slit area. The image of the slit appears on the diffraction grating where finely ruled lines break up the light into the individual frequencies contained therein. The reflected spectrum is then captured by the concave mirror and focused into the exit slit and onto the photo-sensitive surface of the detector. The corrector lens adjusts the focal length of the mirror to coincide with the slit distance. The purpose of the entrance and exit slits is to aid in passing

* 4120 Camelot Drive, Raleigh, North Carolina 27609.

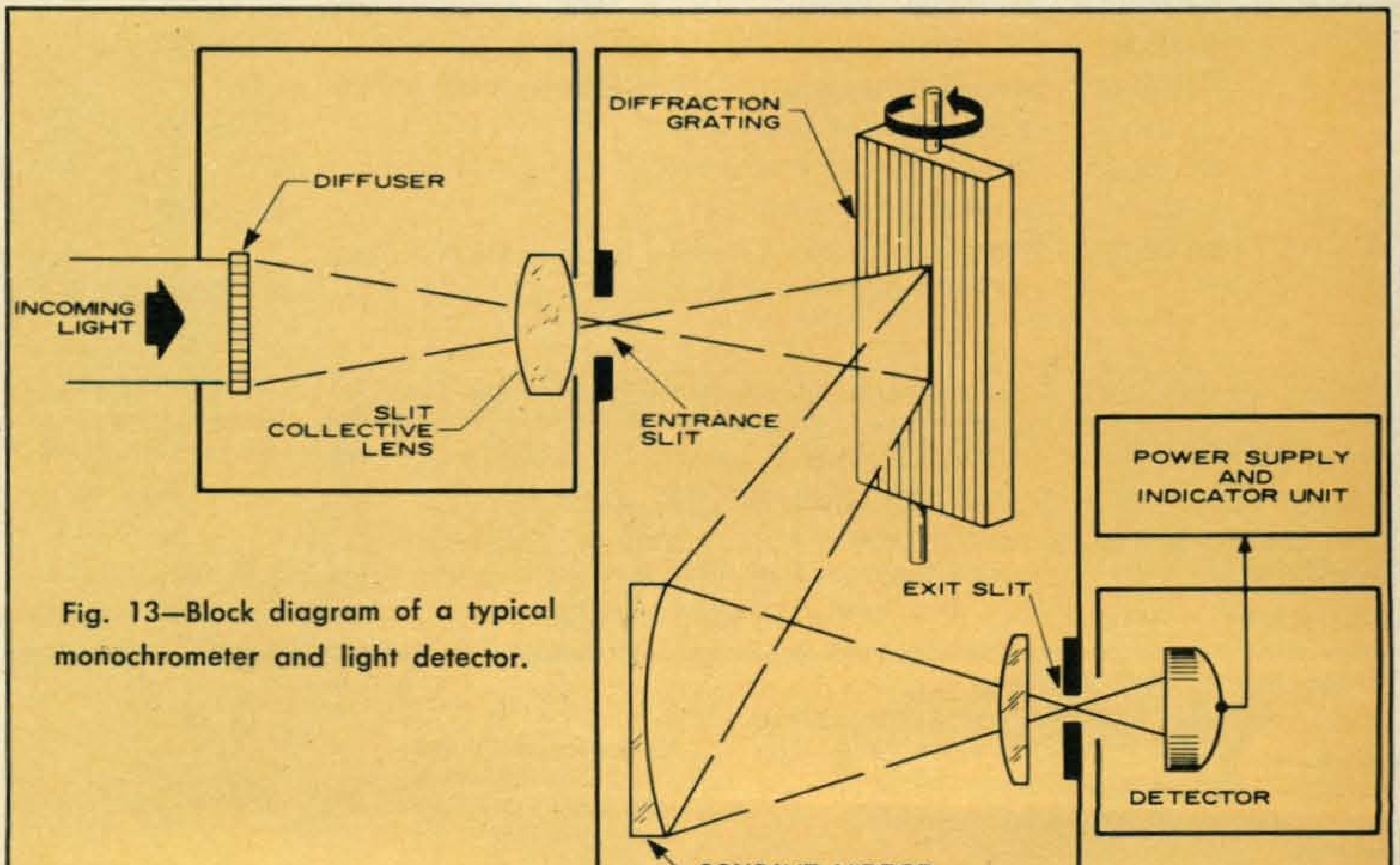

Fig. 13—Block diagram of a typical monochrometer and light detector.

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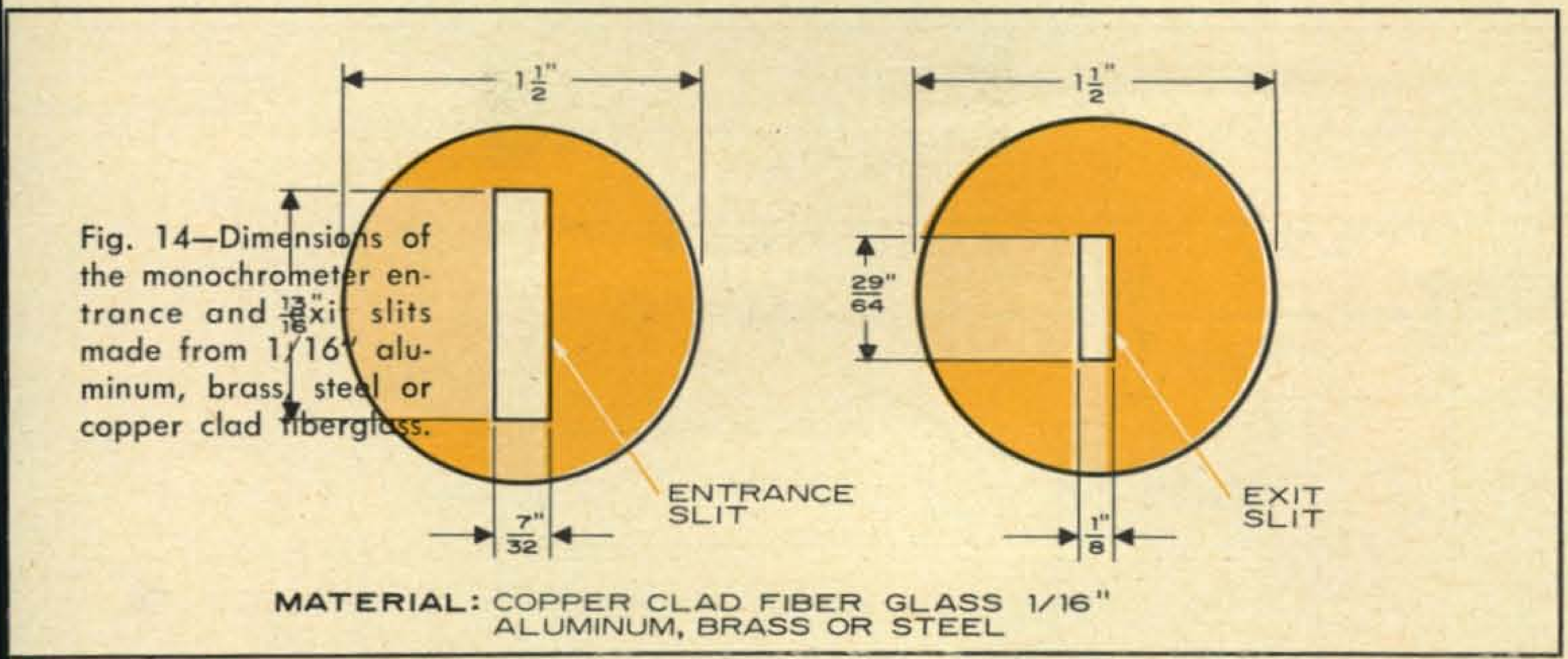

Fig. 14—Dimensions of the monochrometer entrance and exit slits made from 1/16" aluminum, brass, steel or copper clad fiberglass.

only a very narrow part of the spectum and to restrict the angle of light onto the diffraction grating.

Figure 14 provides the dimensions and configuration of the entrance and exit slits. These are readily cut from copper clad fiberglass printboard and finished black to reduce reflections and glare.

The diffuser can be made by grinding two pieces of flat glass with a cleansing compound serving as the grinding agent.

Diffraction Grating

The diffraction grating is the heart of the monochrometer. It consists of a number of lines ruled into plastic and mounted upon a glass substrate. Figure 15 illustrates the basic principle whereby white light is both reflected and diffracted from a finely ruled surface. The finer the ruled lines, the greater the angular separation of the diffracted light.

Edmund Scientific Co., of Barrington, N.J.,[2] offers a variety of diffraction gratings in sheet plastic or in instrument quality glass. The plastic sheet grating contains rulings of 13,400 lines per inch and is available in either transmitting or reflecting form. The 13,400 line ruling provides a 24 degree angular dispersion of diffracted light making it suitable for use in the monochrometer provided it is made rigid by mounting on a flat metal or glass substrate. Extreme care should be exercised in handling a diffraction grating as it can be ruined if fingerprints get on it.

The instrument quality diffraction gratings are somewhat expensive yet the higher number of rulings per inch justify the increase in cost. Containing 15,000 to 30,000 lines per inch, the instrument quality diffraction gratings offer greater angular dispersion of light and higher reflectance of light for improved performance at low light power levels.

[2] 101 Gloucester Pike, Barrington, N.J. 08007.

Monochrometer Layout

Figure 16 illustrates the general layout and typical measurements for the monochrometer housing. The idea is to "Homebrew" the monochrometer therefore it must be assumed that many of the available lenses will vary in focal length instead of a specific ideal focal length. To simplify any confusion, the dimensions have been purposely made variable to accommodate different lenses. Figure 17 illustrates trial spacing of the input optical elements. The components are attached, with Scotch tape, to cardboard or plastic mockup partitions which are then positioned to obtain maximum light directed into the entrance slit. The final position of most lenses will be very close to the entrance slit and approximately equal to the lens focal length from the diffusion glass.

Diffraction Grating

The positioning of the diffraction grating requires that the grating center be on the

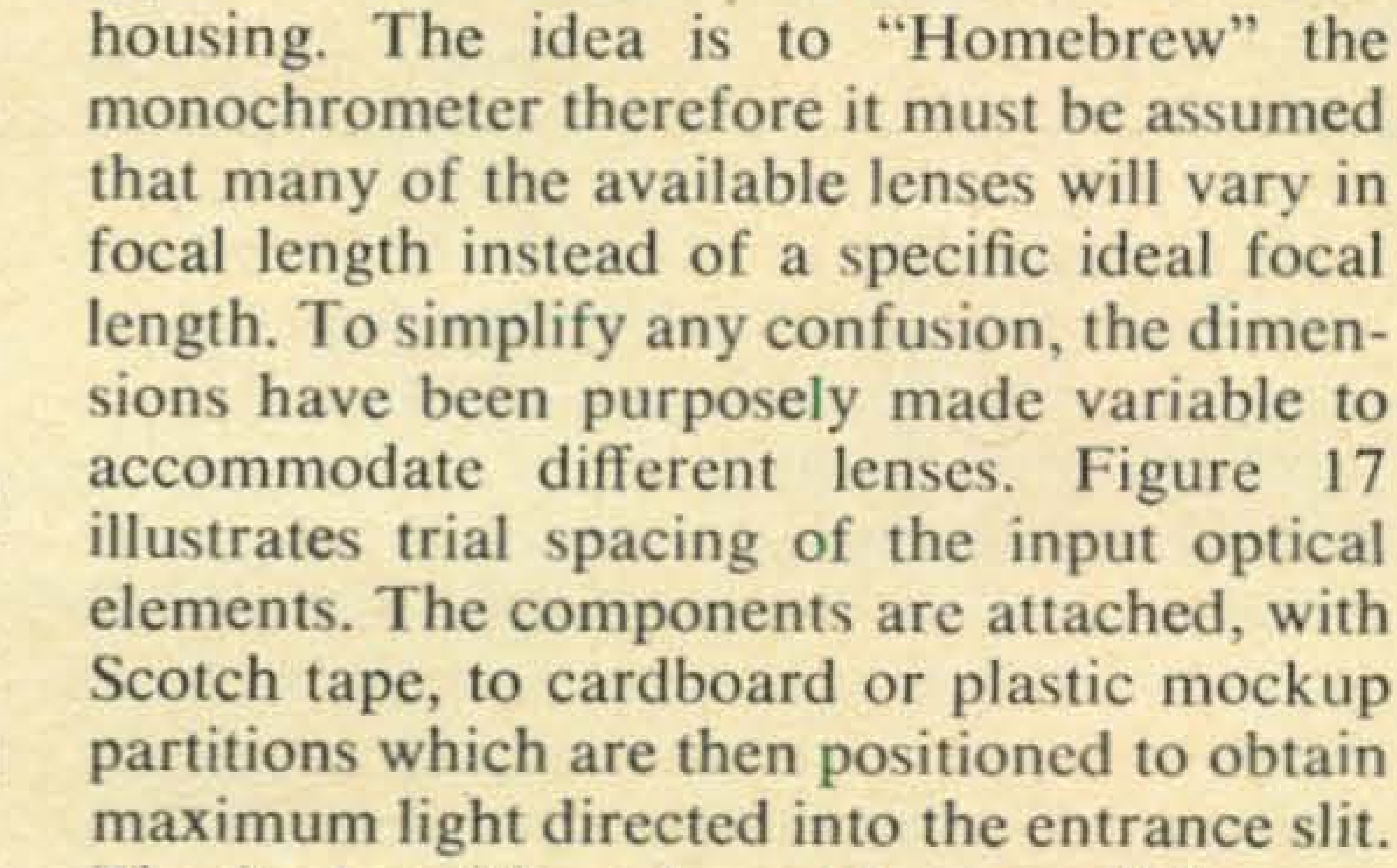

Fig. 15—Diffraction grating principle and light diffraction pattern.

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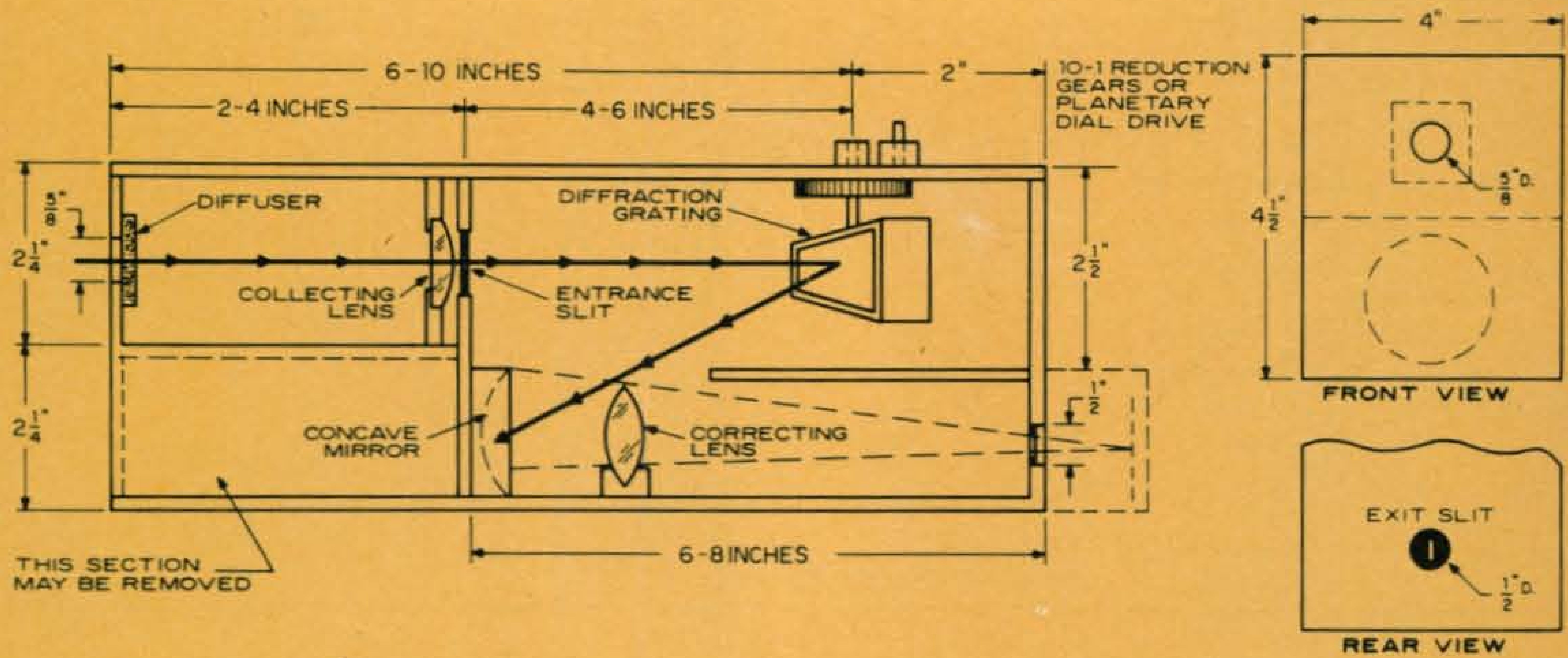

Fig. 16—Monochrometer housing construction diagram. The optical system components may be purchased from the Edmund Scientific Co.[2] The part numbers listed below are from catalog #681.

Diffuser—1⅜" × 2" × ⅛" .... #30456
Collector Lens—Acromat, dia. 29mm, f.l. 55mm .... #6307
Correcting Lens—Acromat, dia. 29 mm, f.l. 136 mm .... #625
Concave Mirror—Front surface dia. 51 mm, f.l. 22mm .... #4088
Diffraction Grating—Plastic Sheet, reflecting. Instrument quality: ½ × 1"—15,000 lines #41021, 30,000 lines #41048.

optical center-line of the collecting lens and approximately equal to the lens focal length away from the lens. Figure 17 illustrates the trial and error positioning. In positioning the optical components you should illuminate the diffuser glass with a small light source such as a small flashlight and work in subdued light.

Figure 17 also illustrates the details of the diffraction grating's reduction gears as well as the grating's holder. A planetary dial drive from the "junkbox" will work as well as reduction gears.

The entrance slit should be mounted with the slit in a vertical position thus illuminating the diffraction grating with a thin vertical line The correct positioning of the diffractio grating is governed in the direction of th ruled lines and should produce a horizonta spectral pattern with the colors of the spec trum blue on the left and red on the right.

The concave mirror is positioned one foca length or less from the mirror's center to th diffraction grating's surface. Again you ca arrive at the correct position by trial an error. The effect you need to achieve is t magnify the image of the spectral colors a great as possible. The greater the magnifi cation, the easier it will be to separate th individual frequencies through the exit sl

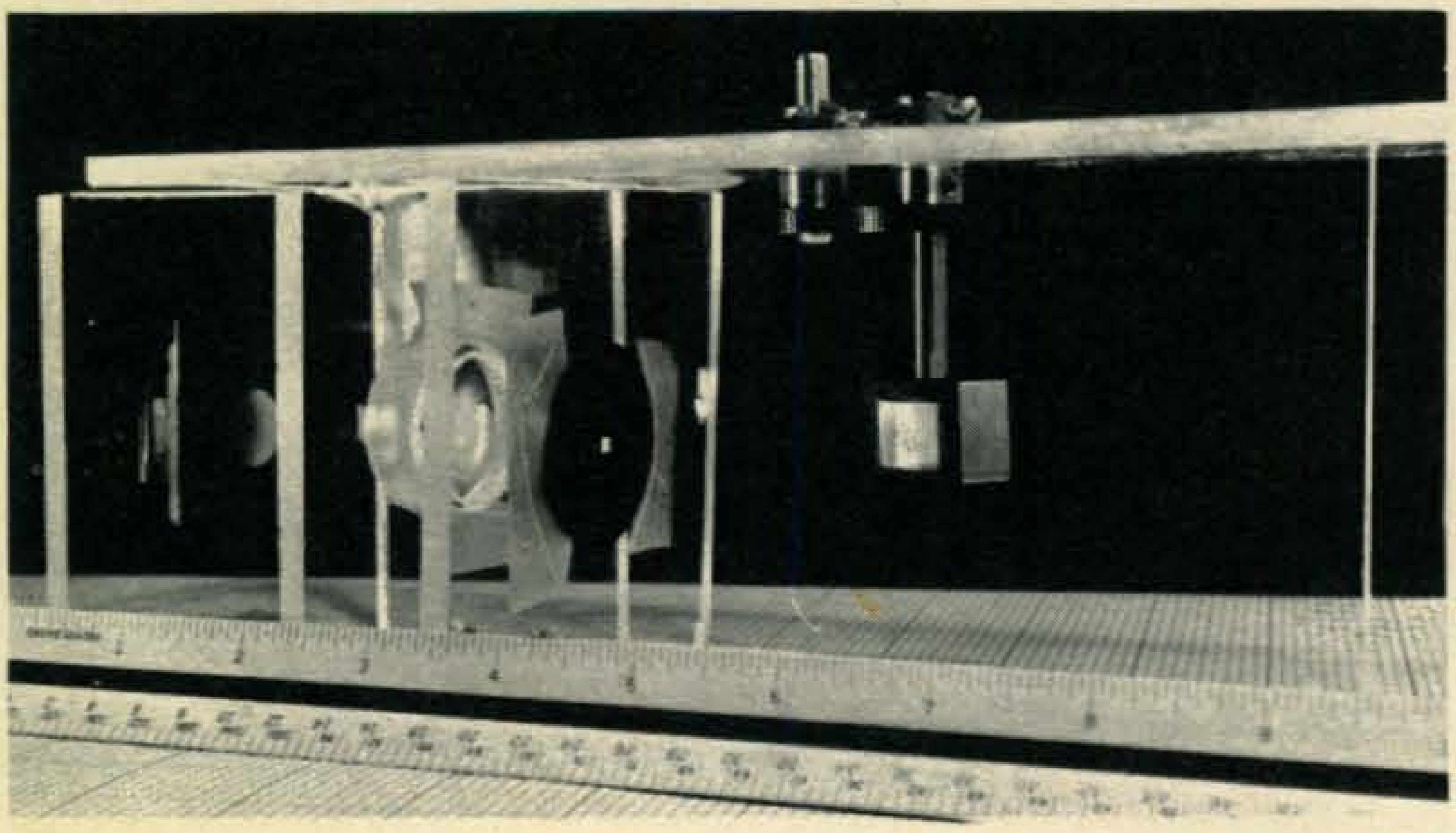

Fig. 17—Arrangement f trial positioning of the i put optical elements. No the gear arrangement f positioning the diffractio grating. This can be r placed by a planeta drive type dial.

See page 110 for New Reader Servi

onto the detectors photo-sensitive surface. The position of the corrector lens will produce a sharp clear image at the exit slit instead of a blurry splotch of color. The focal length of the corrector lens should be greater than that of the concave mirror.

Final Housing

Having completed the trial positioning of the optical components and noting the exact measurements for each position, the final housing can then be constructed. Most any material can be used just so long as it is rigid and light tight. For the easy way out, I could suggest an aluminum chassis and bottom cover using wood partitions attached by epoxy or screws. The partitions and interior of the housing should be painted with a flat black paint before mounting the optical components. Epoxy or rubber base cements are excellent for the attachment of glass to either metal or wood. Be sure to maintain an optical center-line in mounting the optical components.

Calibration

With the completion of the monochrometer, the final step is the calibration. Preliminary calibration is accomplished visually. Using Scotch tape, secure a piece of paper next to the diffraction drive shaft and affix a pointer knob. Position a 100 watt, 120 volt lamp 6 inches from the input diffusion opening. Rotate the diffraction grating until the color Blue appears in the exit slit. Mark the scale paper Blue. Now rotate the diffraction grating until Red appears in the exit slit and again mark the scale paper. Repeat the process for yellow, green and violet. From fig. 18 indicate the frequencies of the colors marked on the scale.

Now affix the photo-detector and record the meter readings at each of the marked frequencies. Your results should approximate the readings indicated in fig. 19. All calibrating data was made on a commercial monochrometer and is accurate within ±3%. Greater accuracy in your calibration can be made by ruling your scale in linear increments and measuring the color of a known frequency glass filter. The detector's meter will rise to a peak at the filter's frequency and fall off as you pass through the peak.

Figure 20 illustrates the spectral response curves of three types of photo detector devices commonly used in conjunction with the monochrometer. Each curve has a peak response of 100% at a specific frequency therefore it will be necessary to compensate all measurements accordingly. A simple compensation formula is as follows:

Actual response =

$$\frac{\textit{Meter reading per millimicron}}{\textit{Det. response in \% per millimicron}} \times 100$$

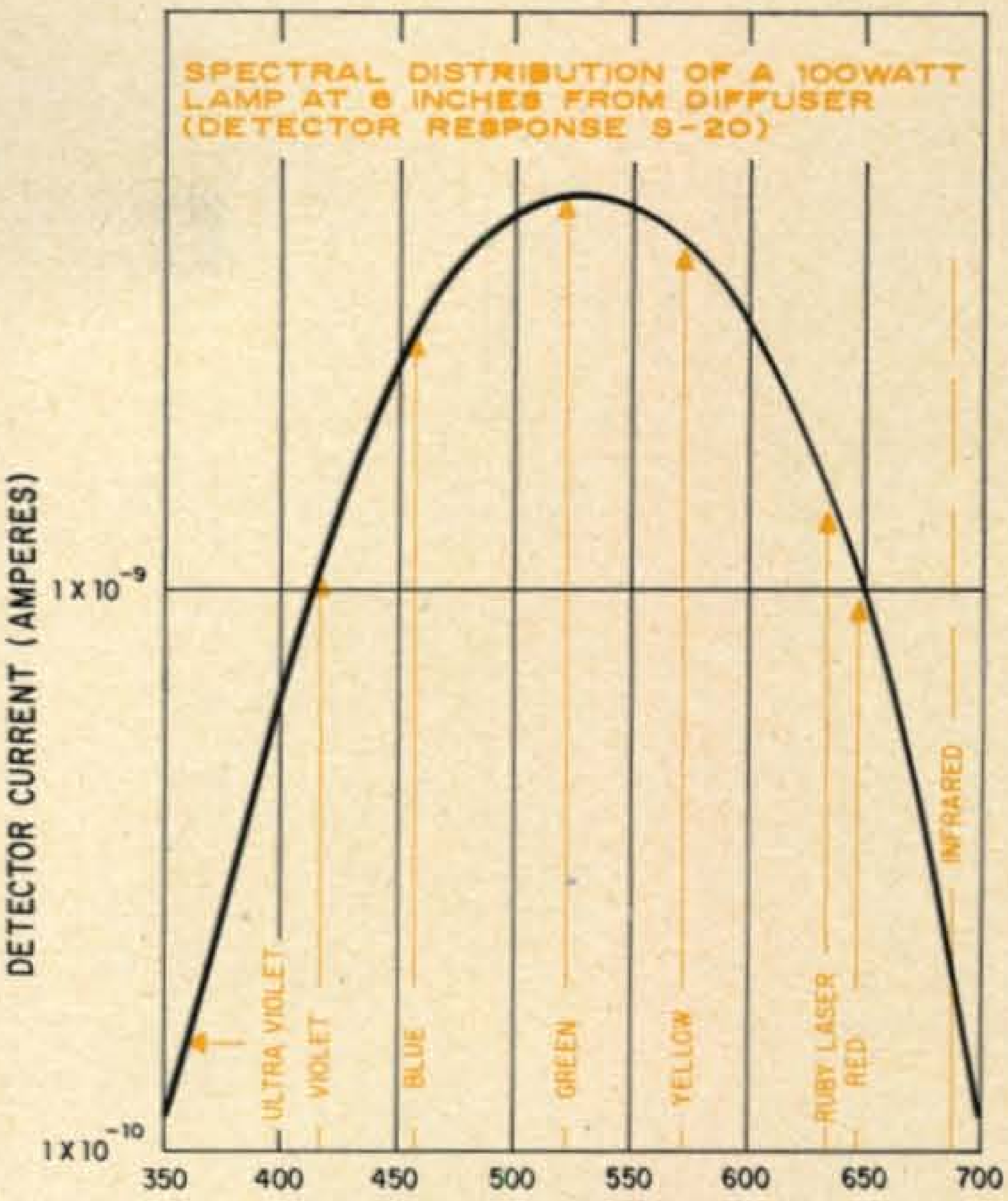

Fig. 18—Spectral distribution of a 100 watt lamp six inches from the diffuser as measured by a detector with an S-20 response.

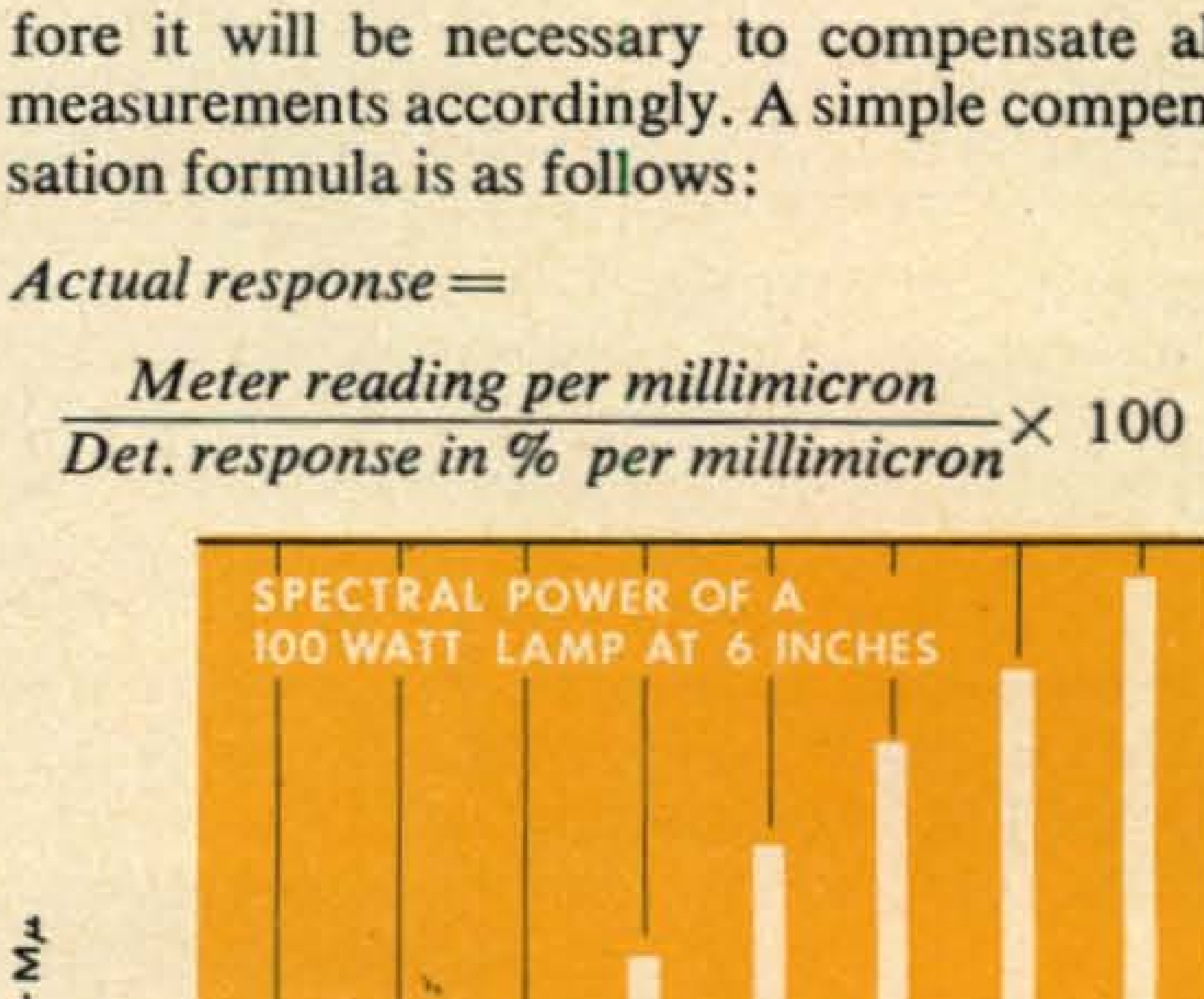

Fig. 19—Spectral power of a 100 watt lamp at six inches based on *P=detector output in amperes/ luminated area in square centimeters.*

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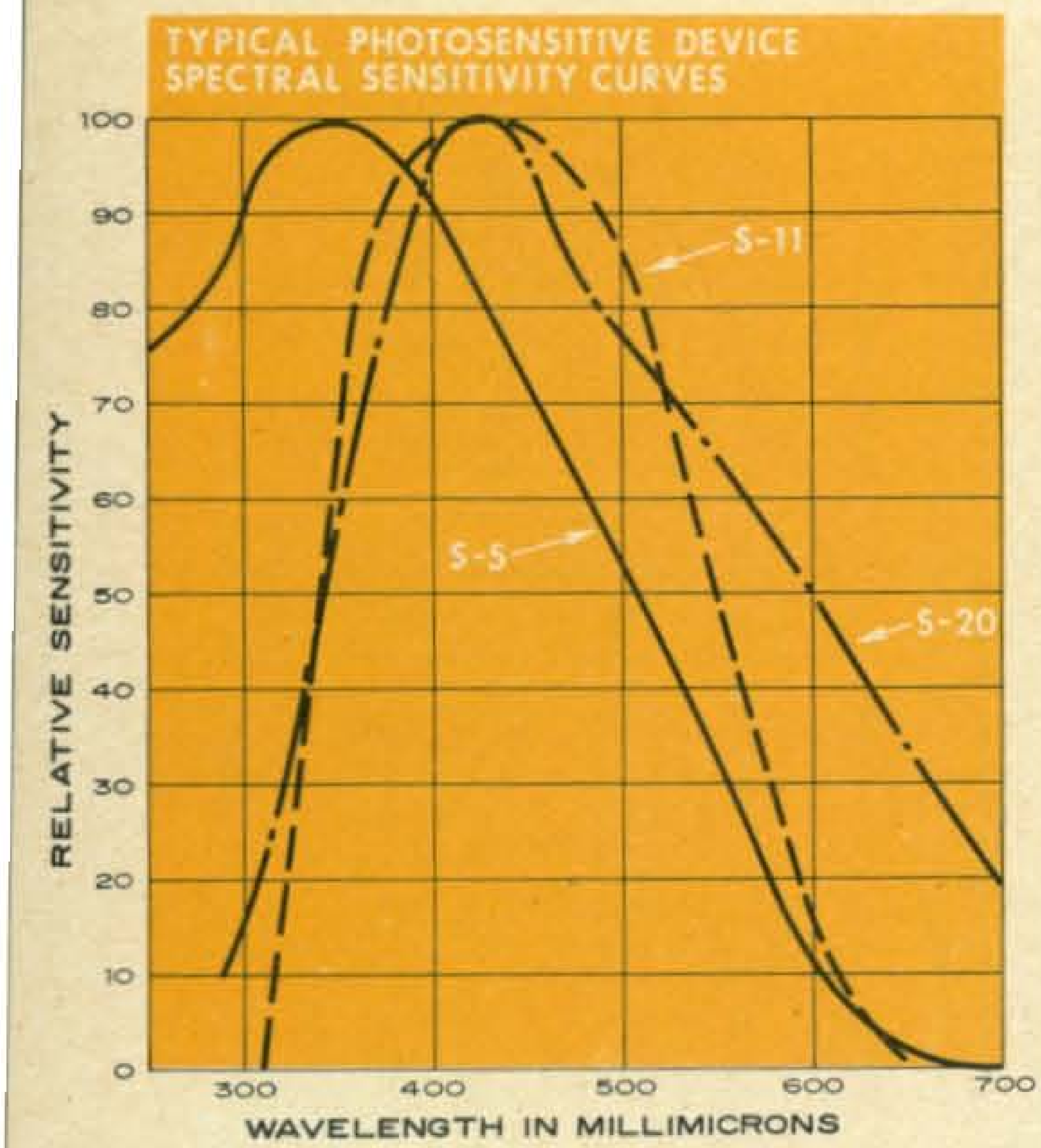

Fig. 20—Typical spectral sensitivity curves. The S designation indicates the spectral response of the photo detector to various wavelengths.

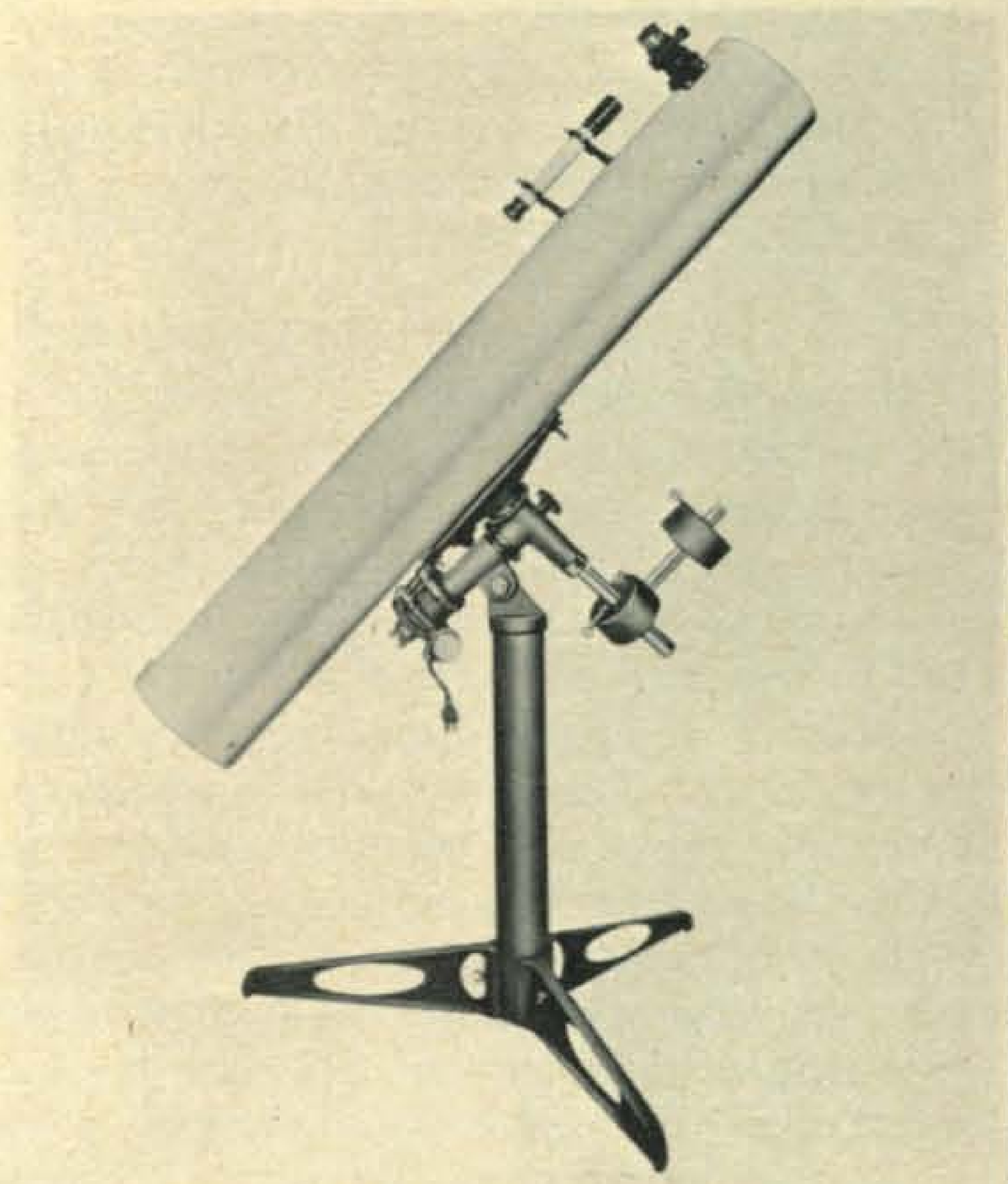

Fig. 21—Typical reflecting telescope for light communication. *Photo courtesy Edmund Scientific Co.*

Figures 18 and 19 provide frequency measurements both in amperes and in power. These graphs should enable you to compare your detector current reading with a commercial monochrometer measurement and to determine power by comparison. Variations in detector area of photo-sensitivity will produce variations in your readings unless you compensate by using the photo-sensitive area as measured in square centimeters as a compensation factor. Figure 19 is power in watts per centimeter squared thus, if your detector has 10 square centimeters of photo-sensitive area, your readings will be 10 times higher.

Another method of determining power is to measure lumens per centimeter squared. One lumen equals 0.001471 watts of monochromatic light at 555 millimicrons. The calibrating lamp at 6 inches produces 500 lumens of chromatic light. Again referring to fig. 18, you can determine the total light of any frequency in lumens by integrating the values of each frequency with the response of the curve.

Adapting the monochrometer to a telescope for communication experiments, I would suggest the use of a reflecting type telescope such as the Edmund Scientific Model 85086 6" telescope shown in fig. 21. The reflecting type telescope has the ability to collect more light into the eyepiece than any other type. The 6 inch dimension refers to the diameter of the collecting and focusing mirror. The larger the mirror's diameter, the greater the collection of light and the higher intensity available for measurement. ■

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Put Your Beam Up To Stay

BY ED MARRINER,* W6BLZ

AMATEURS driving past my station stop their car and inquire what kind of "Black Maria" is on top of the tower. If you saw the beam, you would also wonder why it is all black. The answer is simple; the four element, 15 meter Cush Craft beam and boom was wrapped with Scotch Electrical tape to protect it from the elements, as an experiment. The idea was a success, and the tape apparently had no adverse effect on the operation of the beam. Wrapping the beam is recommended.

After the first look of amazement, the question asked is how many rolls of tape did it take? This 15 meter beam took about nine rolls of tape, including the boom. If you live near the ocean the extra expense is well worth the trouble. Here the beams go to pieces very fast if they are not protected because of the salt air.

Down through the years various methods of protection have been tried on numerous beams at this station. Each new preparation protected except the "U" bolts and nuts which were rusted beyond description.

The last beam to go up was better protected by painting the bolts with De-Rusto paint, wrapping them with Scotch tape wherever possible and then smearing on RTV-102 GE Silicone Rubber. The results, after months of peppering with salt air, now seem to be holding in the hardware department much better than other applications tried.

The Tower

To pursue the matter further, here are some tips on keeping the tower in good condition. By all means, if possible, buy a galavanized tower; it will out last any other protection. A plastic coated tower here lasted eight years in salt air, and it was scraped and painted every six mouths. The part above the garage, where it was exposed, was in terrible condition and had to be replaced; pitting and rusting was very bad in the seaward direction. If the beam motor is on top

was gleefully smeared on with high expectations and bad results. First came formvar varnish, boat paint, chrome paint, De-Rusto, fibre-glass, epoxy and various types of metal paint—you name it and it's been tried.

Aluminum elements seem to have a special problem, and regardless of most protective applications they eventually turn to aluminum oxide or a white powder like substance. This may be caused by electrolysis, but whatever the cause, the white powder pushes up under the protective coating applications and it flakes off. Fibre-Glass and epoxy crack after being in the sun, water gets into the crack and it flakes off and corroded beam elements result.

For some reason Scotch Electrical tape has been the best thing applied to the beam. After seven years the tape did not harden, and when it was unwrapped the aluminum was shiny as the day it was put up. All was

of the tower, wind blowing can twist the tower and the rusted rungs will break at the weld joints. As a result of this information the motor was moved to the base of the tower and a pipe run up to turn the beam. Now the torque was taken up by the pipe an not by the tower.

If you do have a plastic coated tower, it is suggested that you wrap it with Scotch electrical tape. If the top of the tower is rusted and the bottom 20 foot section is good, it can still be used. Obtain a two inch thick piece of oak, boil it in parafin and lag screw it at the top. Have a hole bored in the middle to accept a thrust bearing made of brass.

Turn the beam with electrical conduit with the motor at the base. The electrical conduit can be connected together with conduit connectors. After the lock nut is wrenched on, put a drift pin through the works so that the pipe will not twist. Give the pipe a coat of De-Rusto ánd it will last many many years. ■

*528 Colima Street, La Jolla, California 92037.

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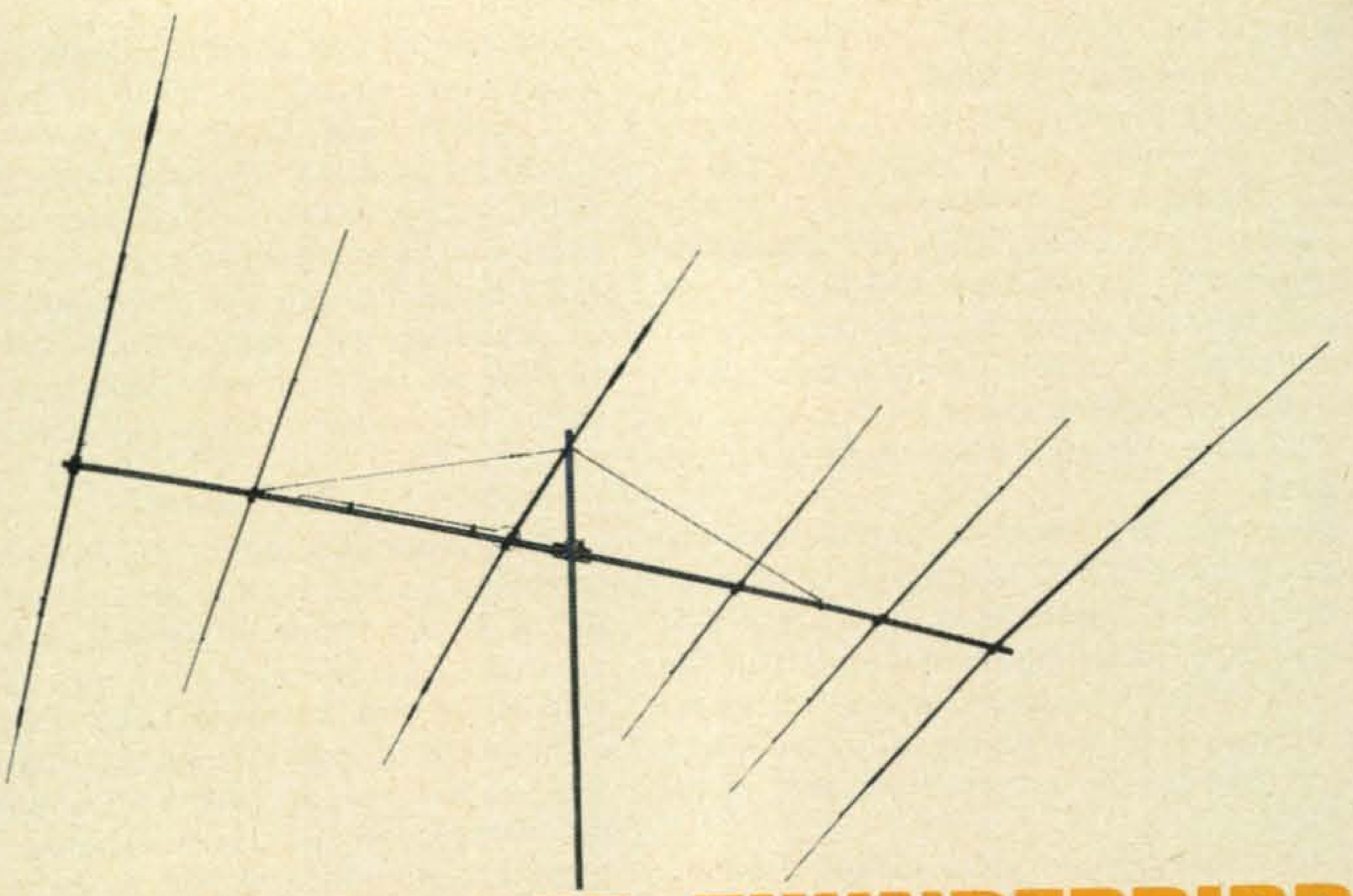

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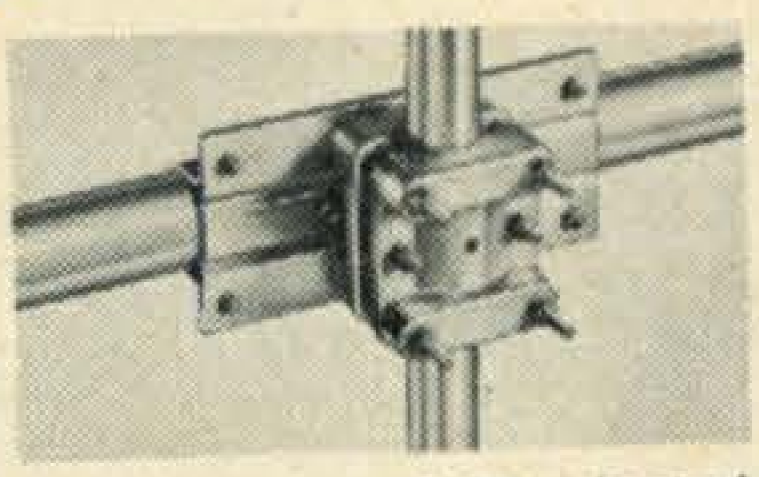

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The W8NWU Teeter Totter Tuners

BY JOHN J. SCHULTZ,* W2EEY/1

The authors article on T networks in the CQ issue of May, 1968,[1] resulted in correspondence with various amateurs who developed T network designs. One of the most interesting variations on the theme of T networks was W8NWU's series of tuners.

THE original article on T networks mainly emphasized their low-loss possibilities and their application in matching relatively short antennas on the low frequency bands.

W8NWU found a much wider application possible for this handy network, including usage at v.h.f. frequencies where the components for other networks may become trickier to adjust. He also found various inexpensive sources for the components that could be used in a variety of the lower frequency versions of a T network.

The Basic Teeter Totter

Figure 1 shows the basic T network which was named the Teeter Totter. If both the input and output impedances are the same, the value of both capacitors will be the same at resonance. When the output impedance is greater than the input impedance, the value of the capacitor in the output leg will decrease to match the higher impedance at the output while the value of the capacitor in the input leg must increase in order to keep the combination of the two capacitors and the coil in resonance. When the output impedance is lower than the input impedance, the opposite setting of relative capacitor values is necessary. This seesaw action of the capacitor values resulted in the Teeter Totter name.

The circuit was tried on 80 through 2 meters. The range of impedances that can be matched depends upon the tuning range of the components used but it will cover at least 4 to 1. That is, with a 50 ohm input reactive impedances from at least 12 to 200 ohms can be accommodated. A typical circuit for use on 80 meters was constructed using a 20 μh coil and two 140 mmf variable capacitors. The unit was constructed in a small aluminum enclosure using the components that were available from a surplus BC-375 tuning unit. Although no power tests were

* 40 Rossie Street, Mystic, Conn. 06355.

1 Shultz, J. J., "Using A T Network," *CQ*, May 1968, p. 78.

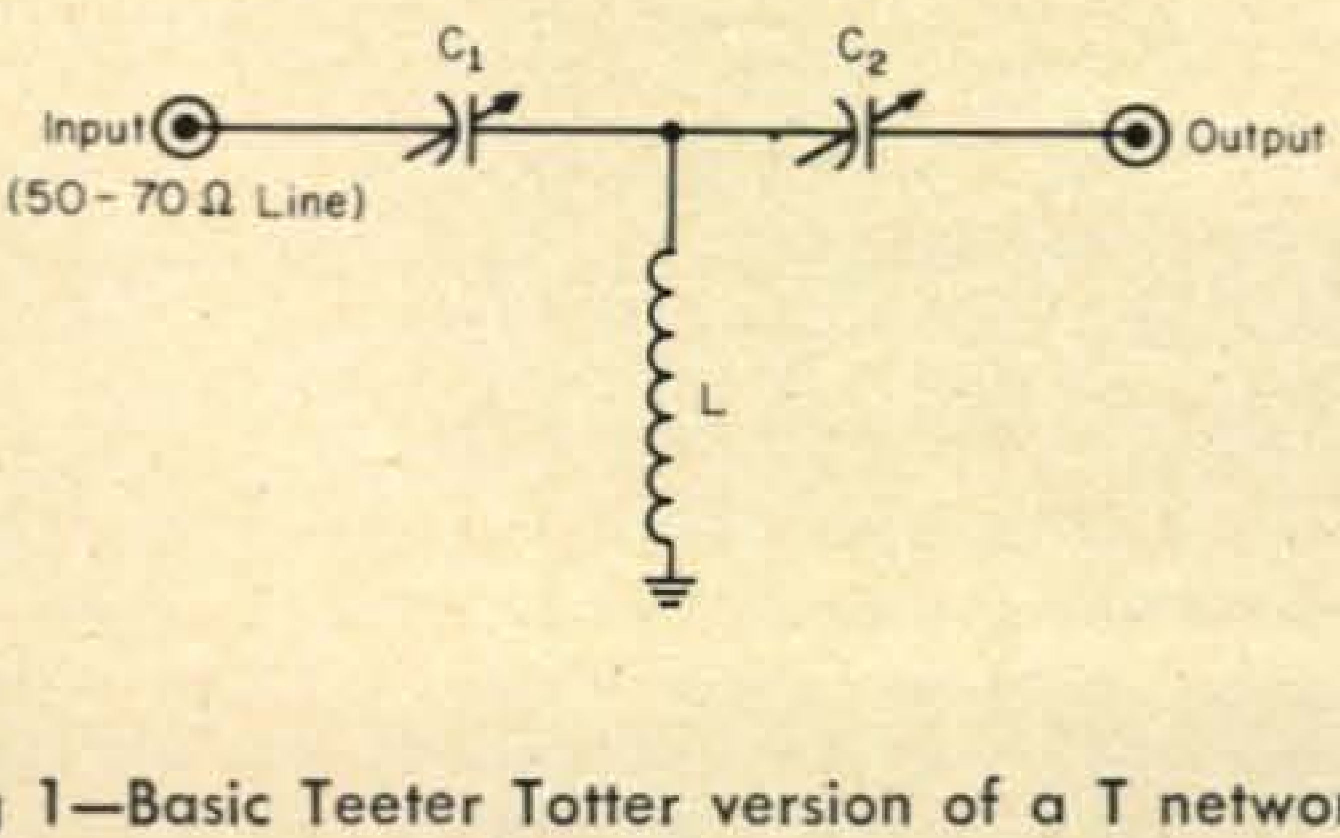

Fig 1—Basic Teeter Totter version of a T network.

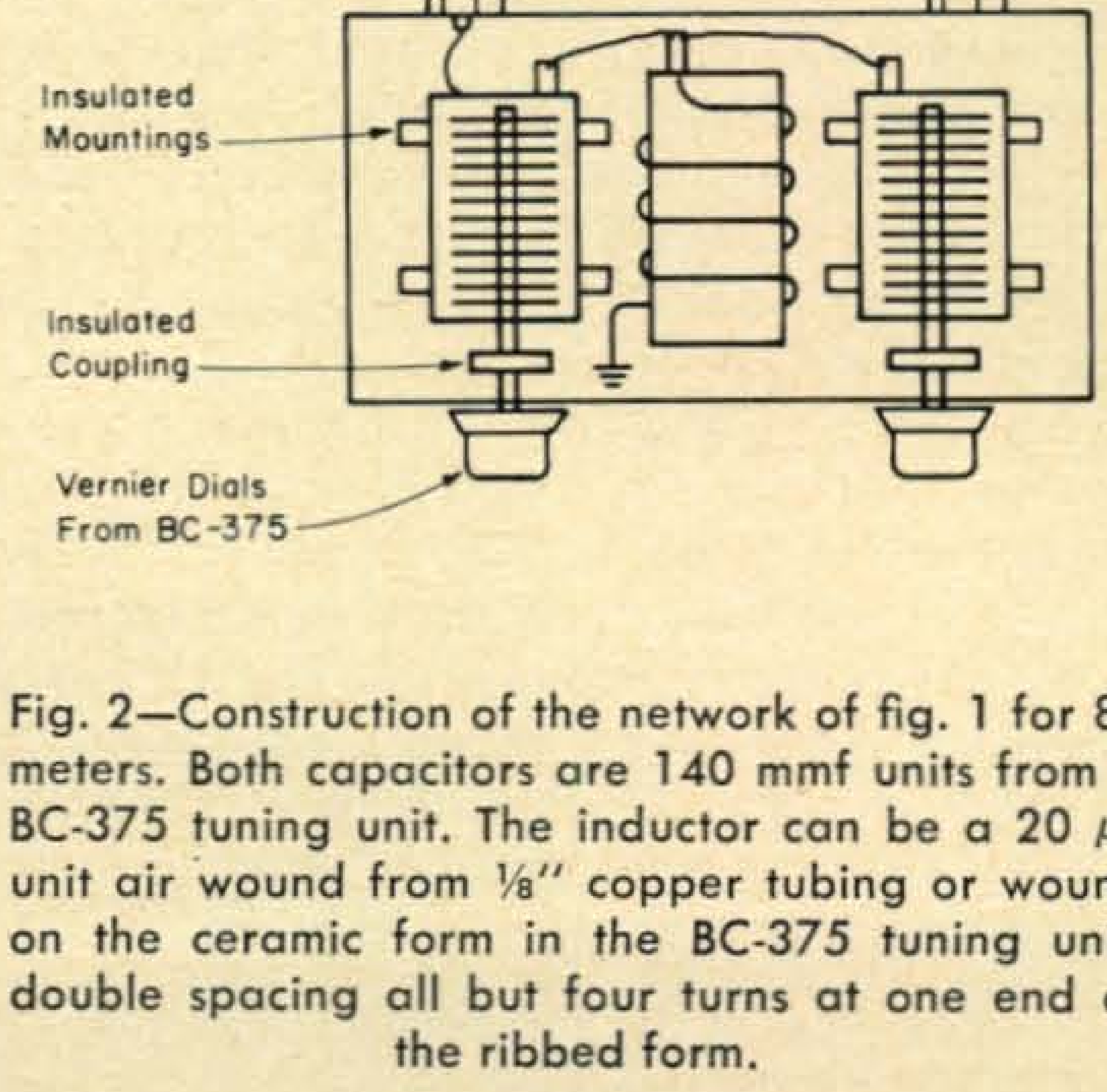

Fig. 2—Construction of the network of fig. 1 for 80 meters. Both capacitors are 140 mmf units from a BC-375 tuning unit. The inductor can be a 20 μh unit air wound from 1/8" copper tubing or wound on the ceramic form in the BC-375 tuning unit, double spacing all but four turns at one end of the ribbed form.

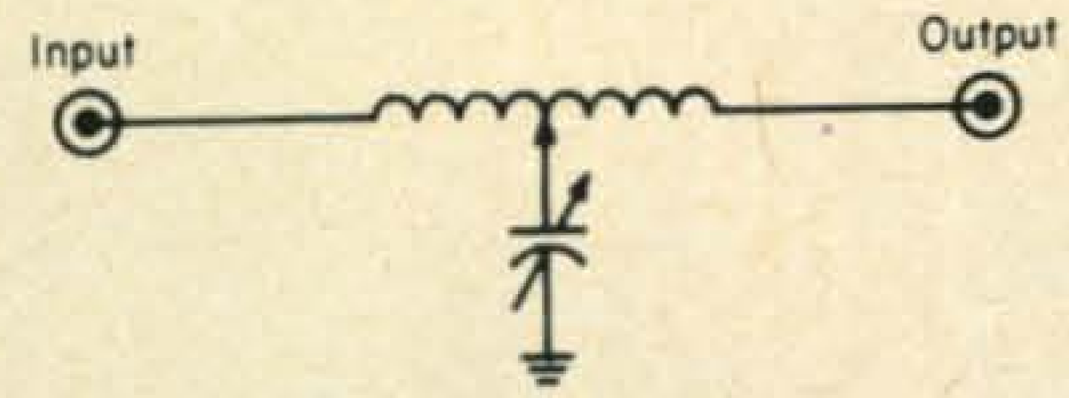

Fig. 3—A variation of the basic network which allows use of a capacitor with a grounded rotor.

tried, it would seem that the spacing of these capacitors and the heavy coil would allow operation with even a kw rig. Figure 2 shows the construction used.

Circuit Variations

In order to eliminate the need for having to insulate the two variable capacitors from ground, the circuit of fig. 3 was developed. Basically it works the same as the circuit of fig. 1 except that it is a half-wave instead of a quarter-wave circuit. The proportionate amount of inductance in each leg varies according to the impedance ratio being matched while the impedance at the point where the variable capacitor is connected remains infinite. The range of impedances which can be matched is again at least 4:1.

A simple procedure is possible to initially determine the coil and capacitor values. Both ends of the coil instead of being connected to any external circuit are grounded, each through a 50 ohm resistor (for use in a 50 ohm coaxial line at the input). The capacitor is placed at the center of the coil. Then a grid-dip oscillator is loosely coupled to the coil and tuned to the band of interest. The coil is symmetrically dimensioned and the capacitor value adjusted for resonance. The resistor representing the output load can be replaced by different values and the resistive range which the circuit can match determined as the components are resonated again for each different load value.[2]

Figure 4 shows the construction of such a tuner for use on 80 meters. The contact on the roller inductor must be modified to permit a separate lead to the variable capacitor. By removing the two TV doorknob capacitors, which are in series, from their parallel connection to the variable capacitor, the same component values will work on 40 meters.

Low power versions of the circuit, particularly for use on 10 meters, have been constructed using XR-50 coil forms and 25-50 mmf receiver type variable capacitors. Such a circuit constructed in a Minibox would be

[2] You may use a low power exciter and s.w.r. meter to the network's input.

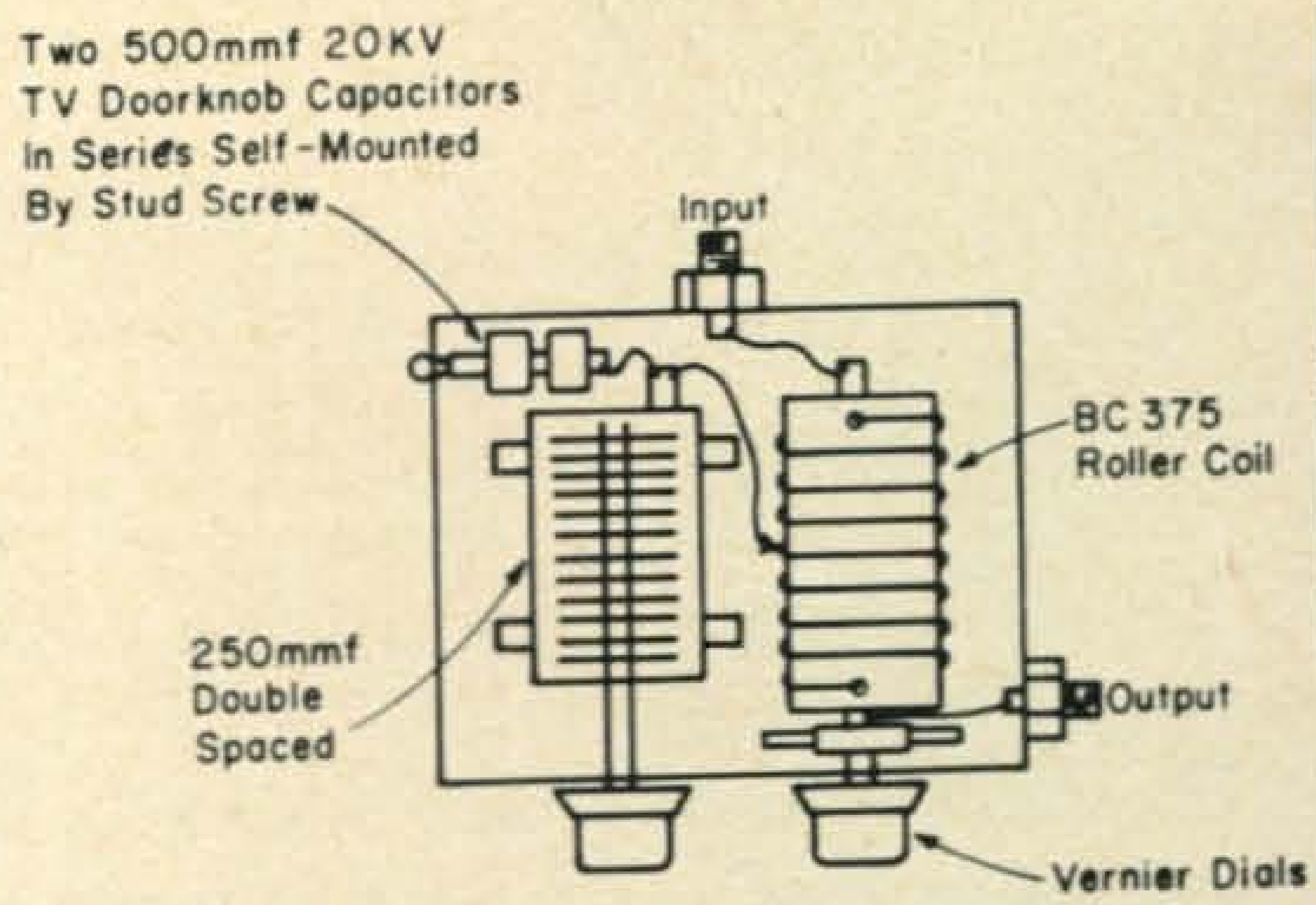

Fig. 4—Construction of network of fig. 3 for 80 or 40 meters utilizing mainly BC-375 components.

particularly useful, for example, at the base of a fixed station or mobile vertical antenna which didn't present an exact match to the type of coaxial line that was available. When the impedance transformation was not too great, as it would be when going from a 30-36 ohm whip base impedance to a 52 or 70 ohm coaxial line, no retuning of the circuit is necessary over any major segment of a band. Instead of a variable capacitor being used, the slugs in the coil form could also be used for tuning and a fixed 47 mmf mica capacitor used.

Multiband Versions

Multiband versions of either form of the network can be constructed as shown in figs. 5 (A) and 5 (B). Which circuit is best is a moot question and the choice must be left

[*Continued on page 102*]

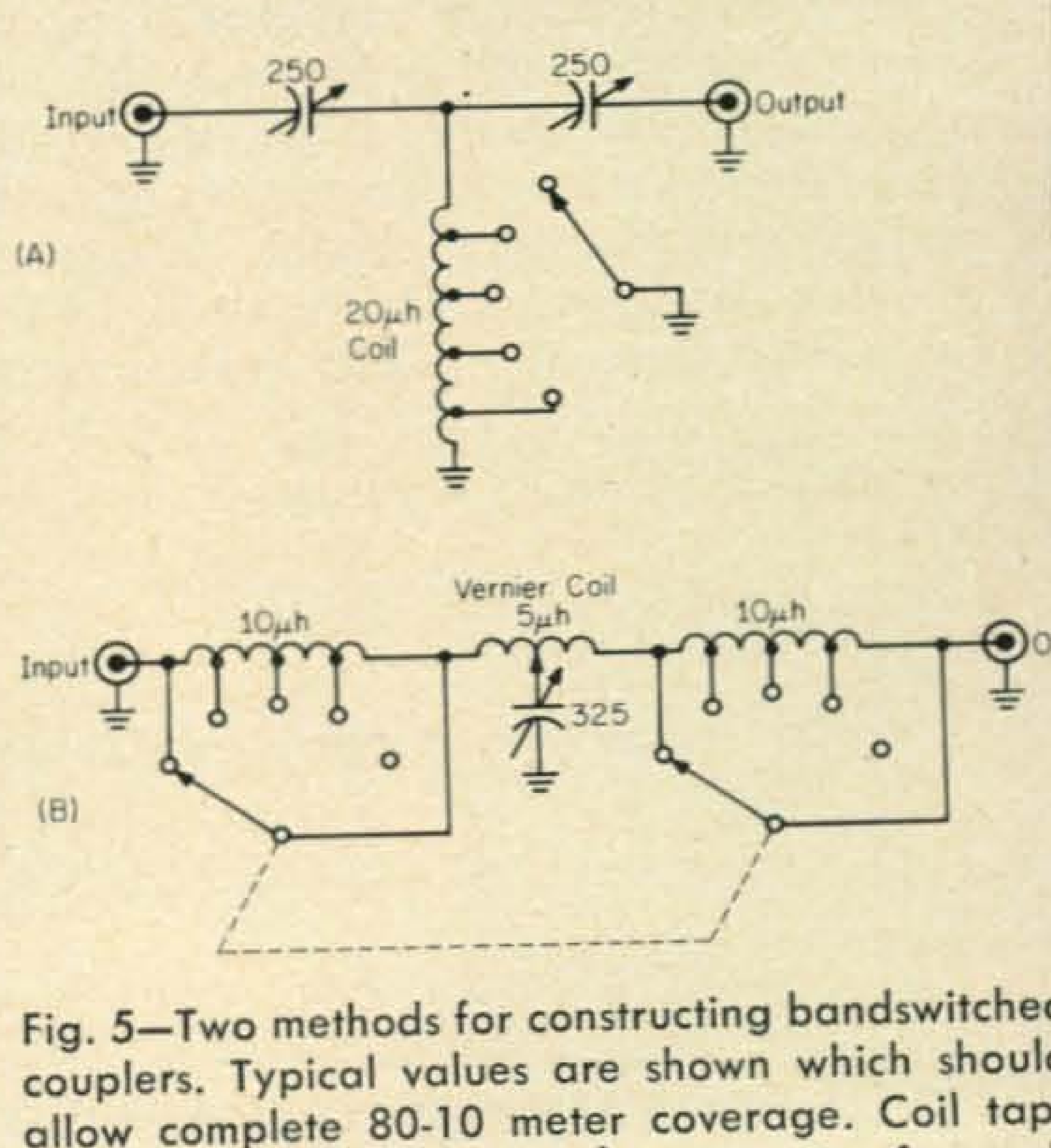

Fig. 5—Two methods for constructing bandswitched couplers. Typical values are shown which should allow complete 80-10 meter coverage. Coil taps must be determined by experimentation for each band.

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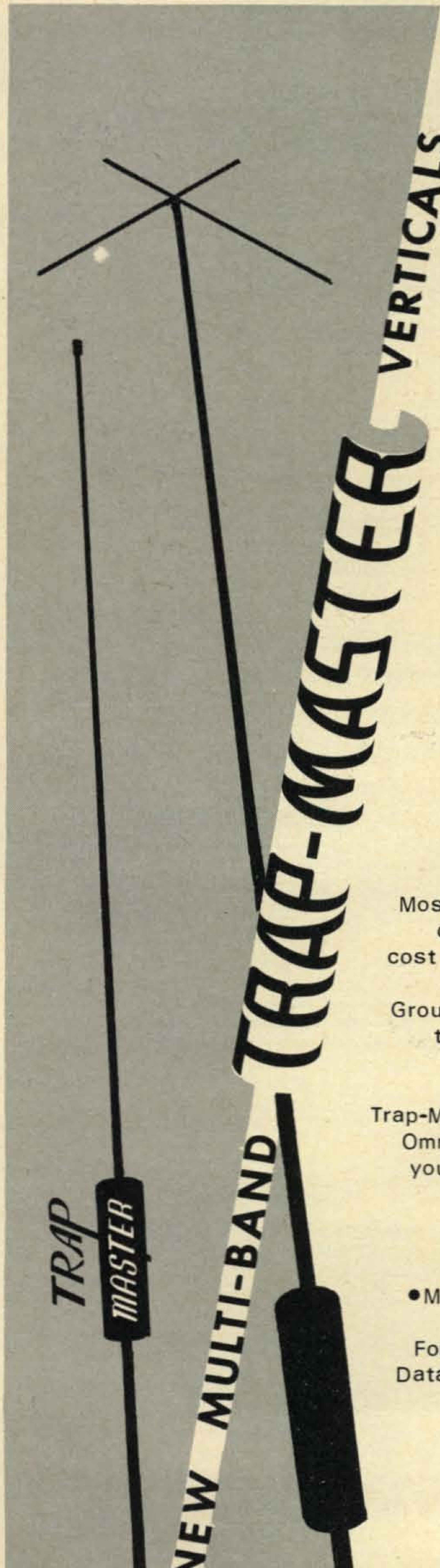
NEW MULTI-BAND TRAP-MASTER VERTICALS
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Measuring Power Input and R.F. Power Output

BY DAVID P. SMITH *

As modulation waveforms become more complex, perhaps someday including digital forms, one's view of power measurements requires a more generalized approach in order to avoid confusion.

ONE can still measure the power input to a c.w. transmitter by holding the key down and multiplying the d.c. plate current to the final stage by the d.c. plate voltage. Power output could be determined by I_2R using the direct reading on an r.f. ammeter and having a correctly matched load. A c.w. transmission is the only type of transmission where this type of simple measurement can be made and, even then, it is deceptive because it really defines the power conditions under non-keyed conditions only.

* P.O. Box 188, N. Stonington Village, Conn.

There are at least three types of power measurement which can be used to distinguish the power level in various unmodulated and modulated waveforms: carrier power, average (heating) power and peak power. Each is important not only to comply with transmission regulations but also in making the proper choice of the rating for transmitter and transmission line components. The relationship between the various power measurements is often not a simple ratio and watt-meters as well as other instruments, may indicate only one power measurement directly. By realizing the characteristics of the

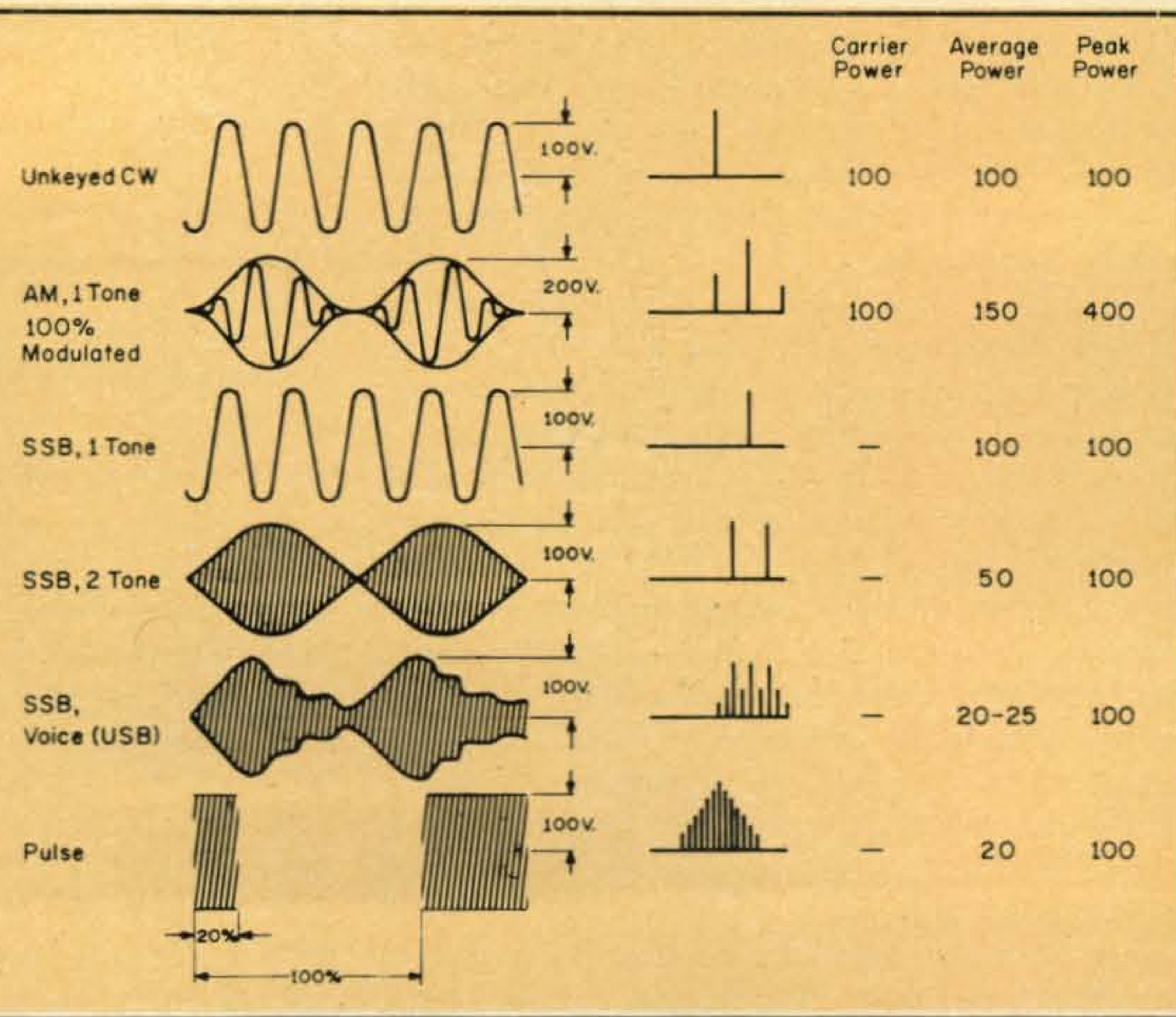

Fig. 1—Power levels for various unmodulated and modulated waveforms. The power levels are calculated for the waveform amplitudes shown across a 50 ohm load.

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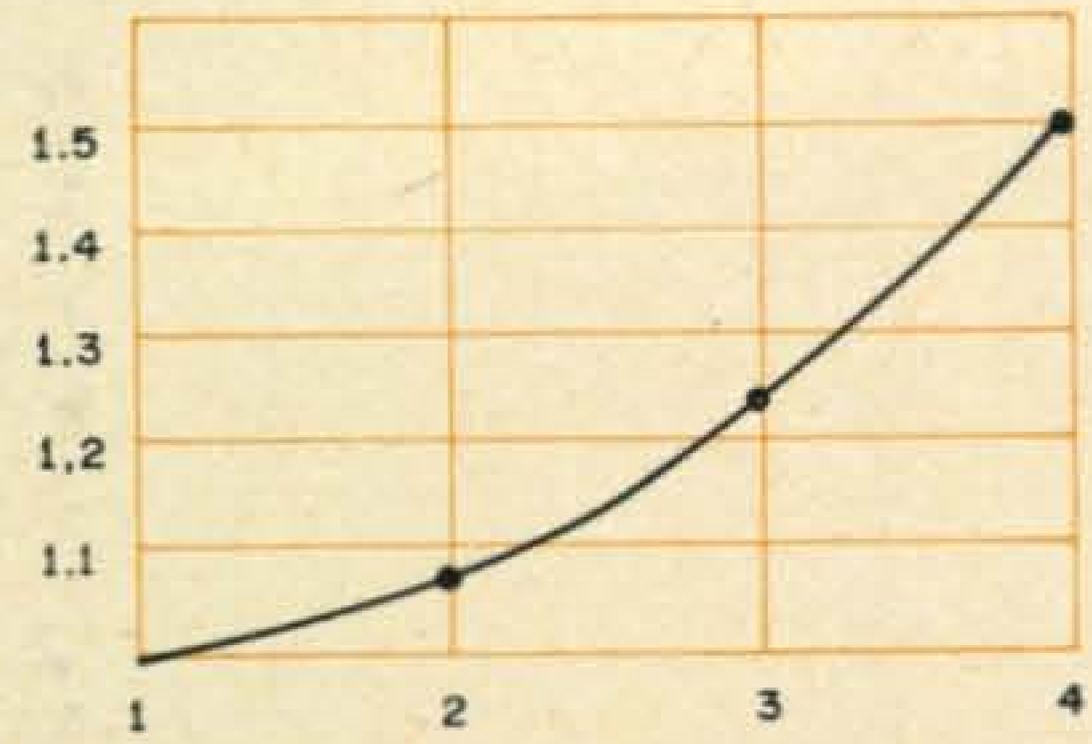

Fig. 2—Graph used to relate various power levels for an amplitude modulated carrier. It is not applicable to s.s.b. transmission.

waveform that one is concerned with, however, it is possible to derive the relationships between the various types of power terms and to correctly interpret the indication which a meter, used to measure either power input or output, indirectly produces.

To clarify the various power terms, the waveforms produced by common modulating techniques are first discussed. Then, the reaction of various meter indicating devices to the power levels contained within these waveforms is examined as a basis for practical methods of measuring r.f. power input and output levels.

Transmission Waveforms

Not all amateurs have the equipment necessary to view actual transmission waveforms and must rely upon meter indications for transmitter adjustments. However, one can easily become too dependent upon meters and not realize the actual content of a transmission waveshape. As one uses meters, therefore, it should be realized that, in general, they indicate only indirectly and partially what is really happening.

Figure 1 shows the envelope waveforms, spectrum presentation and a tabulation of power measurements for various types of unmodulated, modulated and keyed waveforms. It is assumed that the waveforms are produced across a 50 ohm load and the voltage levels shown are such as could be measured on a calibrated oscilloscope display. The unkeyed c.w. waveform results in carrier, average and peak envelope powers of all the same value. Intuitively, one can see that the average and carrier powers should be the same since the signal is the carrier and it doesn't vary. However, the value of the 100 watts p.e.p. may not seem to correlate immediately with the 100 volt peak voltage shown on the waveform. The reason is that for a power figure, r.m.s. voltage must be used. The r.m.s. value of the peak voltage is 100 × 0.707 and the peak envelope power is:

$$\text{p.e.p.} = \frac{V_{r.m.s.}^2}{Z} = \frac{(100 \times 0.707)^2}{50} = 100 \text{ watts}$$

Peak envelope power is *not* simply peak voltage squared divided by the impedance as many amateurs believe. If one used such a relationship and worked "backwards" to determine, for instance, the peak voltages that various components should withstand for a transmitter of a given p.e.p. output, it would result in using under rated components. For 100 watts p.e.p., for example, components would be chosen for a 70 volt peak rating whereas a 100 volt peak rating is necessary.

A.M. Waveforms

The single tone modulated a.m. waveform presents peak, carrier and average powers which all differ. Since it is assumed that the waveform represents a 100 watt output transmitter which is modulated 100% by a single tone, the carrier power must remain 100 watts since, by the definition of amplitude modulation, it does not vary. The peak power is calculated the same as in the c.w. case, using the 200 volt peak of the modulated waveform. The average power can be calculated by an analysis of the waveform but, for simplicity, the relationship is shown in the form of the graph of fig. 2. From this graph, since the peak power is four times the carrier power, the average power is 150 watts. This average or heating power would be the dissipation a dummy load used with the transmitter would have to handle but transmission line insulation, *etc.*, would have to be calculated on the basis of the peak power.

S.S.B. Waveforms

The single tone modulated s.s.b. waveform is exactly the same as the unkeyed c.w. waveform and all the same power levels apply. One can get involved in semantics as to whether the carrier power should be zero or 100 watts. Compared to the c.w. case, it can be regarded as 100 watts. Compared to the a.m. case, it should be regarded as zero.

The two tone modulated s.s.b. signal presents a different set of power levels. The peak

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power is calculated from the peak voltage of the waveform. The average power can be calculated by assuming a carrier power that corresponds to the single tone a.m. modulated waveform as a rough approximation, but the single-sideband and a.m. waveforms are *not* the same. The approximation would produce an average power of about 40 watts while the actual average power for the 2 tone s.s.b. signal is 50 watts. Tests are rarely made on a s.s.b. transmitter with more than 2 tones (where the 2/1 peak to average power ratio applies) but a graphical relationship could be presented which would show the peak/average power ration decreasing to 3/1 with 3 tones and then slowly leveling out. (See fig. 3.)

The relationship of the average to peak power in a voice modulated s.s.b. system depends a great deal upon voice characteristics and equipment characteristics. Usually, the average is taken as 20-25% of the peak value.

Pulse Waveforms

The peak power of the pulse or digital waveform is calculated the same as for the other waveforms. The average power is simply calculated from the percentage of time that the pulse is transmitted. In the example shown, the pulse is present 20% of the time and so the average value is 1/5 of the peak value. Usual keyed c.w. is about 50%.

The usefulness of the various power level measurements depends upon what components are being chosen. Output circuit and antenna components must be rated to withstand the peak voltages encountered with any modulation system for a given peak power level. Tube dissipation, cooling requirements, power transformers, *etc.*, must be chosen on the basis of a sustained average power for their minimum requirements.

Meter Measurements

The usual D'Arsonval movement used in meters for measuring plate current, plate voltage, relative r.f. output, *etc.*, is essentially an average reading device. This factor is important because it is often used to measure waveforms which are not formed to present equal average and peak value.

The plate meter in an a.m. high-level modulated transmitter does not indicate any change during modulation, except for transient flickers, because it averages out to zero the symmetrical change in the current caused

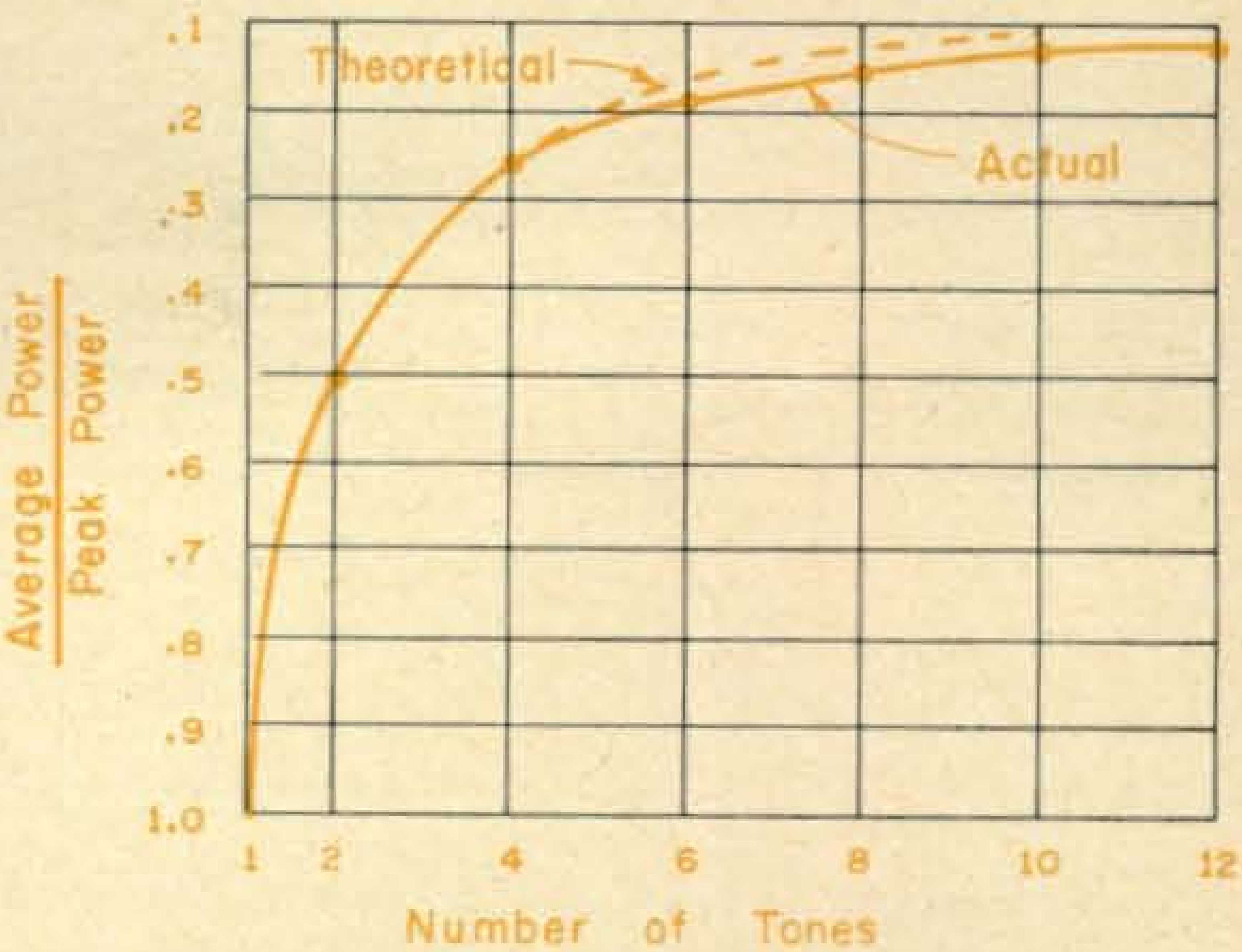

Fig. 3—Use of two equal amplitude test tones produces s.s.b. average/peak ratio of 1/2, four tones a ratio of 1/4, *etc.* For a high number of tones the actual ratio is slightly different than expected because statistically for brief instants the tone amplitudes will combine in such a manner that the rated peak power is exceeded.

by the modulation process. It continues to read carrier power level although the modulator output has raised both the average and peak power output levels. Special peak reading meters can be used across the output to indicate the actual peak output but usually an r.f. thermal type ammeter is used in the transmission line to register the increase in average power output. Knowing the average power and the carrier power (the latter by an unmodulated c.w. test), the peak power can be found from fig. 2. The peak and average power levels are directly related to the percentage of modulation, of course. The percentage of modulation can be calculated from the formula:

$$\text{Mod. }\% = \frac{\sqrt{P_{\text{peak}}} - \sqrt{P_{\text{carrier}}}}{\sqrt{P_{\text{carrier}}}}$$

In the case of an s.s.b. transmitter which is being modulated by a 2 tone test signal, the plate current meter is being driven by a series of half sine waves if the final stage operates Class B so that current flows during 180 degrees of the input r.f. signal to the stage. The average value of such a wave is 0.636 of its peak value. Thus, the peak power input to the final stage is the usual plate voltage times indicated plate current reading but then divided by the 0.636 factor. If an average reading r.f. power output meter is used on such a transmitter, its reading will also be in error. The meter in such an instrument is also driven by a series of half sine waves but

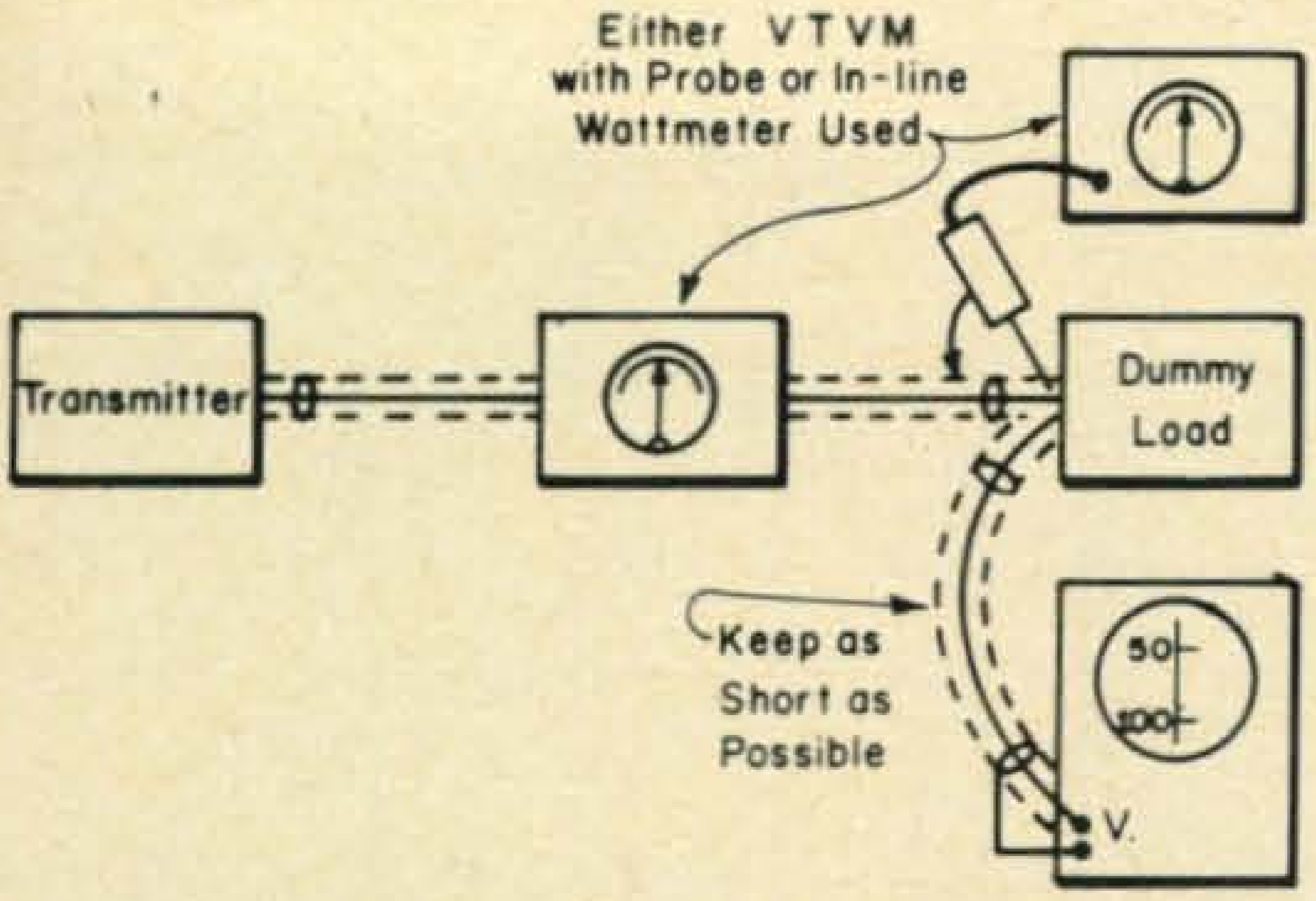

Fig. 4—Vertical scale on oscilloscope is calibrated in watts using c.w. mode. It will then directly indicate p.e.p. during s.s.b. modulation.

the meter scale is usually calibrated on the basis of symmetrical waveform using the V^2/R relationship in watts. Thus the meter scale will be in error by a factor of 0.636^2 or 0.405. The scale reading on such an average reading wattmeter must be divided by 0.405 to obtain p.e.p. during a 2 tone s.s.b. transmitter output test.

A thermal type r.f. ammeter, if it were placed in series with the transmitter output and a suitable correctly matched load, would indicate the true average current and its reading could be taken directly for an I^2R calculation of average power.

Some readers are bound to have noticed by now that the chart of fig. 1 shows a 50 watt average power for a 100 watt p.e.p. level on s.s.b. during a two tone test and yet it was just mentioned that the peak power input to the transmitter is found by multiplying plate voltage times plate current and then dividing by 0.636. This apparent inconsistency in the relationship between average and peak power when considering the d.c. power input and r.f. power output has caused a great deal of confusion. The confusion arises because most of us are used to thinking of the efficiency of an amplifier as a constant (60-70%, for instance). The efficiency, however, is not constant and changes during portions of the plate current flow cycle, being greatest when the current is at a maximum. This changing efficiency accounts for the small difference in the average/peak ratio between the input and output.

In the case of a keyed or pulsed transmission with essentially a rectangular waveform, the peak reading is directly related to the average value as a function of the pulse time duration, as shown in fig. 1. The time characteristics of the waveform must be determined by means of an oscilloscope display having a calibrated time base. Actually, exactly rectangular waveforms are not usually used because of high power transmitter design difficulties with such waveforms and because of the unnecessary interference created when the pulse rate is high. With an odd shaped waveform the only real way to measure the peak or average power input is to calculate an individual correction factor for the meter readings based on an oscilloscope display and an analysis of the waveform. The thermal method remains again, however, a valid means of measuring the average power output.

Practical Measurements

For the modulation methods commonly used today by most amateurs, measuring the d.c. plate power input to the final stage of a transmitter is still most easily done by means of d.c. plate voltage and plate current meters. One must be sure that the correct modulation is applied to the transmitter, especially in the case of s.s.b., and the meter readings are corrected for peak value. In the s.s.b. case, the audio tones used for the two-tone test must be of exactly equal amplitude and the transmitter should be checked for linear operation.

The average power output of any transmitter can be measured by means of a thermal-type r.f. ammeter which is used in series with a matching dummy load for the transmitter.

Measuring peak output power levels can be done in one of several ways. If a calibrated average wattmeter is available, it can be used on s.s.b. using the 0.405 correction factor just discussed. This correction factor is only good for a two-tone test signal, however. Another method would be to operate the transmitter into a dummy load and measure the r.f. voltage across the dummy load. One has to be careful that the voltmeter used is calibrated and that it will operate properly at r.f. frequencies. If a meter is used which is so-called peak reading but has a scale calibrated in r.m.s. values, the values read from the scale can be used directly in the V^2/R formula to calculate the peak power.

Another method that avoids some of the instrument problems of the last method is to use a calibrated oscilloscope display (fig. 4). Use c.w. transmissions first and find the power output either by an average reading wattmeter (which for c.w. requires no scale

[*Continued on page 102*]

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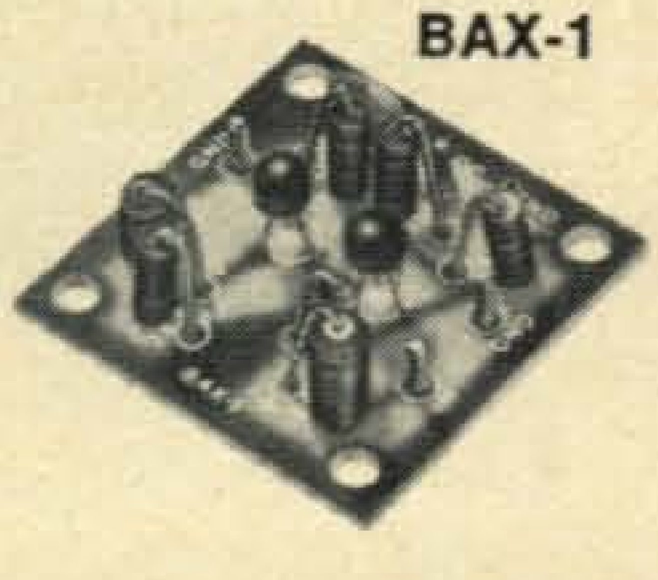

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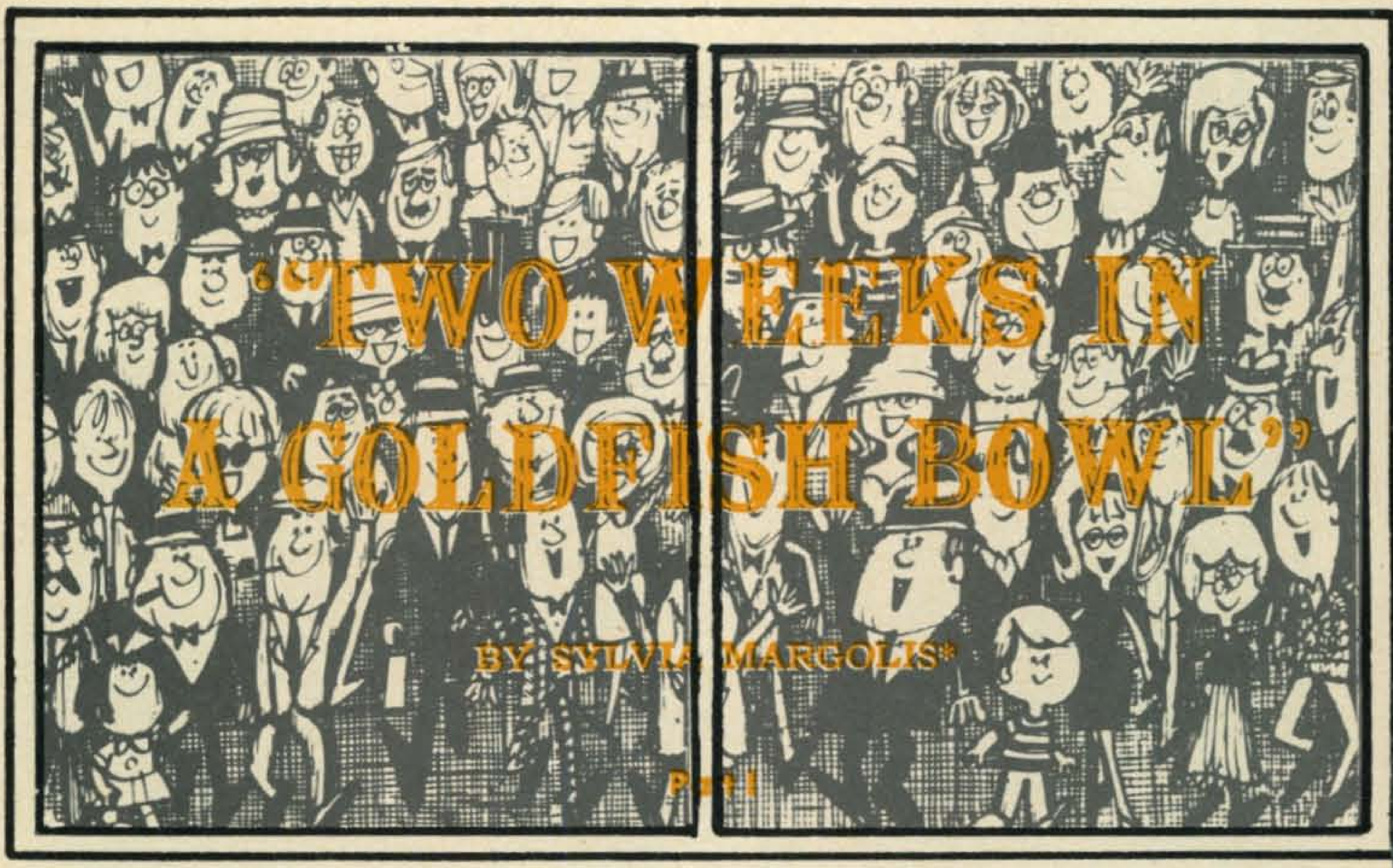

"TWO WEEKS IN A GOLDFISH BOWL"

BY SYLVIA MARGOLIS*

Part I

WILLIAM Shakespeare (or it may have been Grace Metallious) said: *"... some men are born great, some achieve greatness and some have greatness thrust upon them..."* forgetting that some people there are who blunder into success. Without genius, without much inspiration, without talent, even, it's possible to wander, wide-eyed, out into the limelight, have 'em rolling in the aisles, take a dozen curtain calls, leave 'em yelling for more.

*95 Collinwood Gardens Clayhall, Ilford, Essex, England.

The Goldfish Bowl, with the *Daily Mirror* building behind.

Not that the Radio Society of Great Britain lacks genius, inspiration and talent. As the first amateur radio organization in the world to appoint a public relations officer, they must be credited with breadth of vision. But R.S.G.B. couldn't be expected to guess, when that same P.R.O. came up with another o her scatty publicity ideas, just what she was going to involve them in. It was a traumatic experience for the Society, one they wil never forget, that left them bruised and gasp ing. That, with their P.R.O.'s brain child they scooped the biggest publicity promotion ever achieved for amateur radio hardly com pensated for the Englishman's dislike of any thing that might hint at the ostentatious o over-stated.

Which came first, the callsign GB2LO o the idea of GB2LO? Did we think of a call sign, then find a project to fit it? Nobod knows for sure now, now that all the excite ment and tension and praise are over. Whe GB2LO was merely the gleam in the eye o R.S.G.B.'s Public Relations Officer, most o the Society's Council were cautious, cynica and unconstructive over the baby's gestatio and birth. When GB2LO was delivered t them, a bouncing, lusty and very beautifu

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bundle of joy, R.S.G.B. acknowledged the compliments on its virility and sagacity with the aplomb and pride of any proud papa on his first stint in the O.B. Department.

Against all prophesies of the Jeremiahs, the sad sacks, the nit-pickers, GB2LO was a sensational success. It owed its impact to two things—its callsign and London.

Once London was the greatest city in the world. Tokyo and Los Angeles challenge that supremacy now, although thèir case remains to be proved to Londoners. But the heart of London is a tiny area, slightly east of center, built on for more than 2,000 years, the most expensive real estate in the world. This is the CITY OF LONDON, only 1.03 square miles of it.

It was fought over frequently, destroyed by fire in 1666, battered by Hitler's bombs in 1940. It still has nearly forty ancient churches. St. Paul's is its cathedral, dwarfed now by towering new buildings, yet still incomparable.

The "City" is tremendously wealthy, vital, wielding influence all over the world. Here are the Stock Exchange, Lloyd's of London, the Bank of England. Toothsome bits of the City are exported, now and again, for toothsome dollars. The church of St. Mary Aldermanbury is in Fulton, Missouri. London Bridge is on its way over to Lake Havasu City, Arizona.

City policemen wear special helmets, must be minimum 6 ft. tall and are the finest in the world. The Sovereign, when entering the City on a formal occasion, must ask the formal permission of London's First Citizen, the Lord Mayor, who takes precedence over the monarch within the City. Frequently, in 2,000 years of history, monarch and burgers of London have clashed, usually over the money which the burgers possessed in impressive quantities and which the king wanted to fight a war somewhere. The City preserves its independence and individuality. Ostensibly government of the British Commonwealth emanates from Westminster, a mile up the River Thames. The fashionable stores, hotels and theaters lie to the west, in Mayfair, Soho, Belgravia and Kensington. Yet the tiny City, with its narrow alleys and quaint buildings, controls much of Britain's —and the world's—destiny.

Once the City was thickly populated, wealthy merchant's homes neighboring slum rookeries. Now the residents number less than 5,000. Into the City each day commute sev-

Engraved glass commemorative plaque presented by R.S.G.B. to the *Daily Mirror*. John Graham, G3TR, R.S.G.B. President, left with Mr. D. W. Atkins, Director of the *Daily Mirror*.

eral hundred thousand office workers. Home they go each night and weekend, leaving the City in the possession of that migrating, camera-clicking, blessed species, the tourists. For them the City of London Fetival, 1968, was to promote concerts, exhibitions, fireworks, processions, pageants, theater, dancing and general happiness. Why not, I thought, have an amateur radio station as part of the City of London Festival?

One of my P.R.O. functions is to present amateur radio to the public, at its most attractive. This can best be achieved with efficient exhibition stations. What connection is there between an arts festival and amateur radio, you might ask, and I would reply that man's first art was communication. It was his desire to communicate and his ability to devise the means to communicate that caused him to swing down from the trees, stand upright and invent Coca Cola and the H-bomb! Any further questions?

I remember hearing my daddy tell of a magic sound in the early 1920's:

"2LO calling from London . . . !"

You crouched over your set and probed a piece of quartz crystal with a cat's whisker. With skill and luck you would hear the crackly, precise voices. 2LO was the callsign of one of the world's earliest wireless stations. Why not, then, revive 2LO for the City Festival? The G.P.O. confirmed that the callsign "GB2LO" was available. The GB prefix denotes an exhibition station.

I called Roy Stevens, G2BVN, of the R.S.G.B. Council. "I've had the most marvellous idea . . ."

"Will it cost money?"

The author's son, G3UML, with the GB2LO equipment.

This is the opening line of many of our most promising QSO's.

With G3BID, Edgar Wagner, Roy and I approached the City Festival authorities in the 900-year-old Guildhall.

"Will it cost money?" they asked.

That's what they said to Columbus, Pasteur and Einstein. Who was I to be offended?

Once we convinced them that GB2LO would cost them nothing and that we weren't planning a pirate radio station, it was go-go-go!

All that remained was to find a QTH. The qualifications were few. We must have a prominent place with lots of tourists and passersby. No use an esoteric nook where only invited guests and radio amateurs, the "converted," would find us. Yet there must be no chance that the resultant crowds would cause an obstruction and arouse the ire of the police. We must be able to mount an antenna very high, above the City's tall buildings, high and secure. The public must have access, yet it must be controlled access. There must be total security for the equipment, night and day. The operators must be free to come and go as they liked. And technically we must be able to operate an h.f. s.s.b. station that would obtain clear, 5/9 signals in the middle of the most complex business and industrial complex in the world —all this within the 1.03 sq. miles of the City of London, where space is more precious than money.

Each specification seemed insurmountable.

"This time you've bitten off more than you can chew!" they said. Yet it was such a marvellous idea, so simple, logical, exciting. And such a darned shame to shelve it.

Then occurred one of the regular punch-ups I have with the Press regarding the image of amateur radio. A TVI case had so escalated[1] that it had attracted the unwelcome attentions of the national papers, who made of it the usual picnic. The result, in the popular *Daily Mirror*, was so misconstrued that I went to see the Editor, to straighten out his conception of the science of amateur radio. I didn't get far with the TVI case, but I did find a home for GB2LO.

Of course the Editor wasn't there for our appointment. Editors are rarely there when the R.S.G.B.'s P.R.O. comes at them, lance tilted. They are ill or their grandmothers have just died or they have an assignment on the moon. Maybe my best friend didn't tell me.

The Editor's Deputy-Deputy-Deputy did the honors and we never did get onto the same frequency, until I mentioned GB2LO as part of our public relations program, poor, homeless GB2LO.

"Why not approach our Publicity Department?" suggested that darling Deputy-Deputy-Deputy, may he soon make Deputy-Deputy!

So I did. And the *Daily Mirror* said yes! GB2LO was in business.

I'm sorry to say this to U.S. readers, especally those in Texas, but the British *Daily Mirror* has, without doubt, the largest circulation of any daily paper in the western world 5½ million copies a day. Only *Pravda* and one Japanese newspaper top this record. Texas must be slipping.

If we were to be adopted by a publishing organization as massive and influential as the *Daily Mirror*, with its associated *Sunday Mirror* and a group of over 200 periodicals, we must rise to their level and Think Big.

I thought big by sending a Press Information Release, with a photo of the *Daily Mirror* building, air-mail no less, to the U.S. amateur radio magazines. 5 dollars it cost R.S.G.B. I run the P.R. program on the slimmest of shoestrings. Whenever I can I use surface mail. I'd float letters across the Atlantic in a bottle, except some bottles cost money. This unseemly extravagance paid off. Every magazine published the story and picture.

The only day the antenna could be raised was a wild, wet and windy Sunday, the kind of day we normally get in June. The gales were only at about 70 m.p.h., which is quite the nicest speed to mount a cubical quad 200 ft. up in the air.

A labor problem had arisen. In a voluntary

[1]Margolis, S., "The Corston Affair," *CQ*, Oct. 1968, p. 55.

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organization like R.S.G.B., it's easy to have ideas, but ideas usually resolve themselves into man hours and man power. All the R.S.G.B. man power I approached were ill or their grandmothers had just died or they had to keep skeds with the moon. I could put pressure effectively only on G3NMR, to whom I am married. At first he said he had a sked with the moon. He knew he couldn't pull the grandmother or illness bits. He argued a little, but I made him see things my way. How could he have a sked with the moon when the only man capable of DX-peditioning to the moon is practising medicine in Wisconsin.

He drafted a group of his friends to help, by promising them, I think, that when Don does go to the moon, I would use my influence to get them QSL's.

The antenna mounting party had little to do, in fact, for the *Daily Mirror* had a highly skilled (and highly paid, on a Sunday,) squad to do the actual hoisting. The R.S.G.B. group need only direct the operation. Trouble about GB2LO is that it must spoil us for any future large-scale exercise. Where else would you clap your hands and have a ready-made expert-made expert labor force at your disposal, on a Sunday, too?

Indeed, would any amateur radio organization be so spoilt, so cossetted, as lucky R.S.G.B. with GB2LO? From the start it was like sinking into a warm bath of scented water, a shedding of responsibility. We had the distinct and far from unpleasant feeling of being taken over by a vast, omniscient paternalism. The *Daily Mirror* did us proud.

On the sidewalk outside their building, they erected a glasswalled studio, a goldfish bowl, with wall-to-wall carpet, furniture, double glazing to keep out the noise, air conditioning, a direct telephone line, blinds to lower at night. They hired a policeman to control the crowds by day and two monolithic security men to guard the station at night. They provided all the display material, the graphics, publicity handouts and 2,000 elaborate QSL's. They concocted a magnetic world map on which we could move arrows to show the current contact. And presented it to us afterwards. And they let all R.S.G.B. personnel have the 24-hour use of their heavily subsidised staff canteen. All this and heaven too!

The fibreglass cubicle quad went up on top of the 180 ft. *Daily Mirror* building, mounted sweet as you could wish on a sturdy 20 ft. pole. Once it was up everybody agreed that London's skyline had been significantly altered—and for the good. The rotor cable, 100 yards long, was of too small a gauge at first. The rotor, which worked on low voltage, wouldn't turn, because the 4 volt drop along the cable made the working voltage too low. Connecting another cable in parallel with the original solved the problem. This was one of the few technical obstacles we encountered.

The first QSO between GB2LO and W2LEC. Operating is R.S.G.B. President, G3TR, Logging is the author in an unusual guise, as a uniformed member of the British Red Cross Society. (picture permission, *Daily Mirror Newspaper*)

We decided, in the face of some opposition, to use commercially manufactured equipment. G's are a generation behind Americans in the home-brew-vs-commercial controversy and I had to defend our choice to antagonistic die-hards who, I presume, must still be going so far as to wind their own coils, as well as build their own gear, so prejudiced were they against commercial equipment!

Again and again I tried to explain our motives. Simply - reliablity. The *Daily Mirror* was going to enormous trouble and expense

Part of the Opening Day crowds. That City of London policeman was hired by the *Daily Mirror*. Bet he's saying "You can't miss it!"

WA6ZIQ/G5AAM, Bob Lane, operating GB2LO.

to give us the best publicity platform ever enjoyed by amateur radio anywhere. We were part of a serious and top-level arts festival. Yehudi Menuhin, for instance, was playing in one Festival concert. Therefore we were morally obliged to put on a fool-proof show for the public, in exchange for the remarkable goodies we were enjoying.

No matter how efficient, how ingenious a home brew rig might be, fuses blow, capacitors collapse, resistors burn out. Only the builder himself could trace and remedy the fault. If he were not on hand, what should we do? Close down for the day? Radio amateurs would understand and sympathise. These things happen in the best of installations. But how would we explain to the public and to the *Daily Mirror?* No matter what commercial gear we used, if anything should go wrong, a substitute rig could be obtained and installed within minutes. At the wails that this wasn't a typical amateur station, we countered the GB2LO was to demonstrate not the radio amateur's ability to build communications equipment, but the radio amateur's unique privilege, that he has worked hard to earn, to communicate with the rest of the world, in the cause of international friendship. The critics remained adamant. Is there anybody more obstinate than a radio amateur? But we did please some of the people all of the time!

One thing everybody approved, though, was that the equipment was almost entirely British made. In July London is full as an egg with overseas tourists and since when did Britain miss out on a chance to sell British? We chose the KW-2000A transceiver, with the KW-1000 linear, manufactured by KW Electronics Ltd., the premier European manufacturer of amateur gear.

In selection of operators we had to be very firm indeed. On one thing you can bet. Every radio amateur you meet is the most skilled operator *he* knows. Sooner query an amateur's credit rating than his operating! So by restricting the GB2LO operators to the regrettable few who came up to GB2LO standards, we succeeded in infuriating hundreds of others, who could have run the show much better than I did, no doubt, except that I got there first!

What is required of a top exhibition operator? Operating skill at Don Miller / Gus Browning level goes without saying. Nothing less would suffice. Then appearance and articulation—kinks, kooks, eccentrics, beatniks, dodderers were OUT! This level of exhibition work is Show Biz and the operators are on stage as surely as any vaudeville act. They must put the story over to the listening public, to interpret the situation into popular terms, to enable the public to identify themselves with the station, to convey to Joe Soap the wonder of amateur radio. Some of our operators were so good they had the audience laughing *with them* during QSO's, hanging breathless on every word.

Next the exhibition operator with an unusual callsign like GB2LO must be able to handle a wolf pack of prefix hunters; to sort out the good, clear signals, the ones that would entertain and inform the public, to avoid the too technical QSO, to avoid, like it was radio-active, meaningless jargon and archaic idiocies, like *aitch-eye* and *ex-why-el.* Radio amateurs use jargon without knowing. The public often asked, at GB2LO:

"Who is this CQ you keep calling?"

So absorbed into our culture is the phrase *CQ*, that it never occurs to us that not everybody understands it!

One qualification an exhibition operator needs is diametrically opposed to the talents possessed by the experienced DXer. Faced with a choice between VR6, 5/4, and a W, 5/9, the DXer will opt for the VR6. But the public in Europe are much better entertained with a day-long diet of clear, informative, articulate W's or ZS6's than with all the exotic DX.

To help with the GB2LO tests we needed an operator with all these qualities and, moreover, somebody who could be freed of all business responsibility for several days. I knew of such a man. I had a quiet word with a high-ranking friend in the U.S. Air Force/ Europe and we had officially assigned to GB2LO, on temporary Air Force duty,

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M/Sgt. Robert Lane, WA6ZIQ-G5AAM. This is known, in public relations jargon, as "knowing the right people" and your success in the racket depends on how many of the right people you are lucky enough to know!

Bob had been connected with the GB2CC operations and he knew exactly what was required at GB2LO. He helped set up the station, saw it through its teething troubles, then stayed with it until it was out of diapers. An all-American boy down to his sergeant's stripes, and sparing with praise for anything Limey, Bob was impressed despite himself with the GB2LO set-up. The most magnificent exhibition station ever promoted, he admitted.

We began the tests. In theory, nothing would work. QRM would swamp us. The center of a huge conurbation is notoriously the worst place for good 5/9 both ways QSO's and lots of them. For the tests we used my husband's callsign, G3NMR/A. The /A is the British suffix equivalent to "fixed portable." Out went the first CQ.

"What kind of a signal is that?" asked I1DFD, "It's paralysing!"

"What are you using there?" queried a W9, "The B.B.C.'s TX?"

"The loudest signal I've ever heard out of Europe!" said W2LEC.

It looked as if we'd got ourselves a humdinger of a station.

"How about getting up real early on Monday morning, so that you can be the first station to work GB2LO?" we asked W2LEC.

[2]Margolis, S., "By Permission Of Her Majesty Queen Elizabeth II," *CQ*, Aug. 1968, p. 32.

The old and the new meet in the City of London. Statue of Prince Albert, Queen Victoria's husband, raises his hat to the new *Daily Mirror* skyscraper.

At precisely 1100 GMT on July 8, John Graham, G3TR, President of the Radio Society of Great Britain, put out the first, nostalgic, sensational CQ, the CQ that turned back the clock nearly 50 years, to the old 2LO, yet brought it, WHAM, up to date, very 1968, with an immaculate, 5/9-plus, SSB amateur signal:

"THIS IS LONDON CALLING, GB2LO, EXHIBITION STATION OF THE CITY OF LONDON FESTIVAL, GB2LO, CALLING CQ . . .!"

And back, almost as if we'd planned it, the public heard:

"GB2LO, GB2LO, THIS IS W2LEC, NEW JERSEY, U.S.A. . . ."

Within minutes all hell broke loose . . . !

(to be contiued)

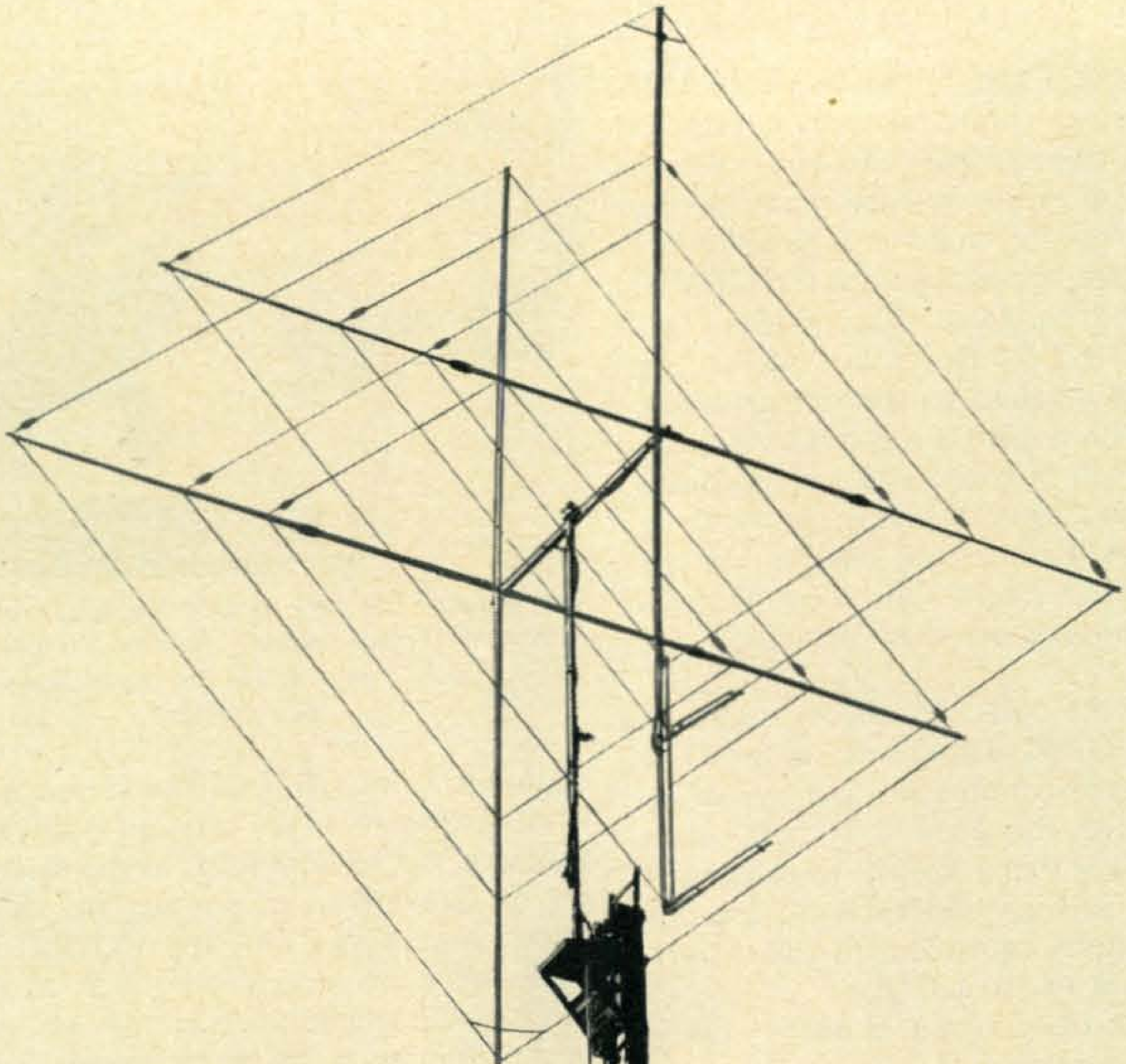
"CQ YL" PAGES AVAILABLE

AT the 5th International Convention of the Young Ladies Radio League held at Denver, Colo. June 13-16, 1968, the YLs present requested W5RZJ/s book, *CQ YL*, be brought up to date and, at the suggestion of WA6AOE, within minutes had donated enough money to pay for printing several more pages.

These supplemental pages are now available and, since the printing has already been paid for by the YLs attending, and by The Colorado YLs, the pages are *free* for the asking to anyone who has a copy of *CQ YL*. The pages are 36-G & H, bringing current through 1969 information on officers of YLRL, and Chapter Six-C, a full report on the Denver Convention.

To obtain the pages, just send your name and address to W5RZJ, Louisa Sando, 4417-11th Street, N. W., Albuquerque, N. M., 87107. Enclose a 6¢ stamp to cover mailing (the pages will be mailed flat in a large envelope). The pages are perforated for easy insertion into the book's spiral binding at the proper place.

Copies of *CQ YL*, the one and only book about the YLs, may be had from W5RZJ for $3 each, postpaid. As noted above, the book is now up to date through the 1969 YLRL officers and the 1968 YLRL Convention. ■



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Coaxial Cables: S.W.R. READINGS, TESTING AND INSTALLATION

BY JOHN J. SCHULTZ, *W2EEY/1

The s.w.r. indicator at the transmitter never indicates the exact s.w.r. between the transmission line and antenna. Most often, however, the reading is close enough to be useful. This article explores what can cause erroneous s.w.r. readings on coaxial lines and how such lines can be tested and installed to prevent problems with them.

MANY amateurs erect a dipole or other antenna with a coaxial transmission line, place an s.w.r. indicator at the transmitter and then proceed to operate confident that everything is in order, as long as the s.w.r. indicator reading is low. If contacts are made easily, the s.w.r. indicator is just watched occasionally for any change which would indicate a deterioration in the antenna system performance. However, if contacts are not made and still the s.w.r. reading is low and the transmitter loads properly, the tendency is to blame either the antenna and proceed to try another type or to blame the QTH. To reach such a conclusion on the basis of a low s.w.r. reading may be false. In spite of the s.w.r. reading, it is possible that the coaxial transmission line is defective and that a great deal of the power which the transmitter is putting into the line never reaches the antenna.

Many amateurs find it a difficult idea to grasp that an s.w.r. indicator located at the transmitter can indicate very satisfactory line matching conditions and yet the antenna or line may not be working properly. The basic reason such a situation can occur is that although a perfectly lossless line will accurately reflect back the effects of changes in its termination (antenna), a practical line has losses which increase with frequency and such a line does not reflect back all the effects of changes in its termination.

*40 Rossie Street, Mystic, Connecticut 06355.

Conditions for Erroneous S.W.R. Readings

Although line attenuation is the basic cause of false s.w.r. readings, exactly what indication is noted depends upon a number of factors such as frequency, type of line, line condition and installation methods. It

Band	*RG-58*	*RG-58/A*	*RG-59*	*RG-8*
2	6.3	7.5	4.8	2.5
6	3.4	4.4	2.8	1.4
10	2.7	3.0	2.0	1.0
15	2.2	2.5	1.7	0.8
20	1.7	2.0	1.3	0.7
40	1.2	1.3	0.9	0.5
80	0.8	0.9	0.7	0.3

Fig. 1—Db attenuation/100 feet for common coaxial cables.

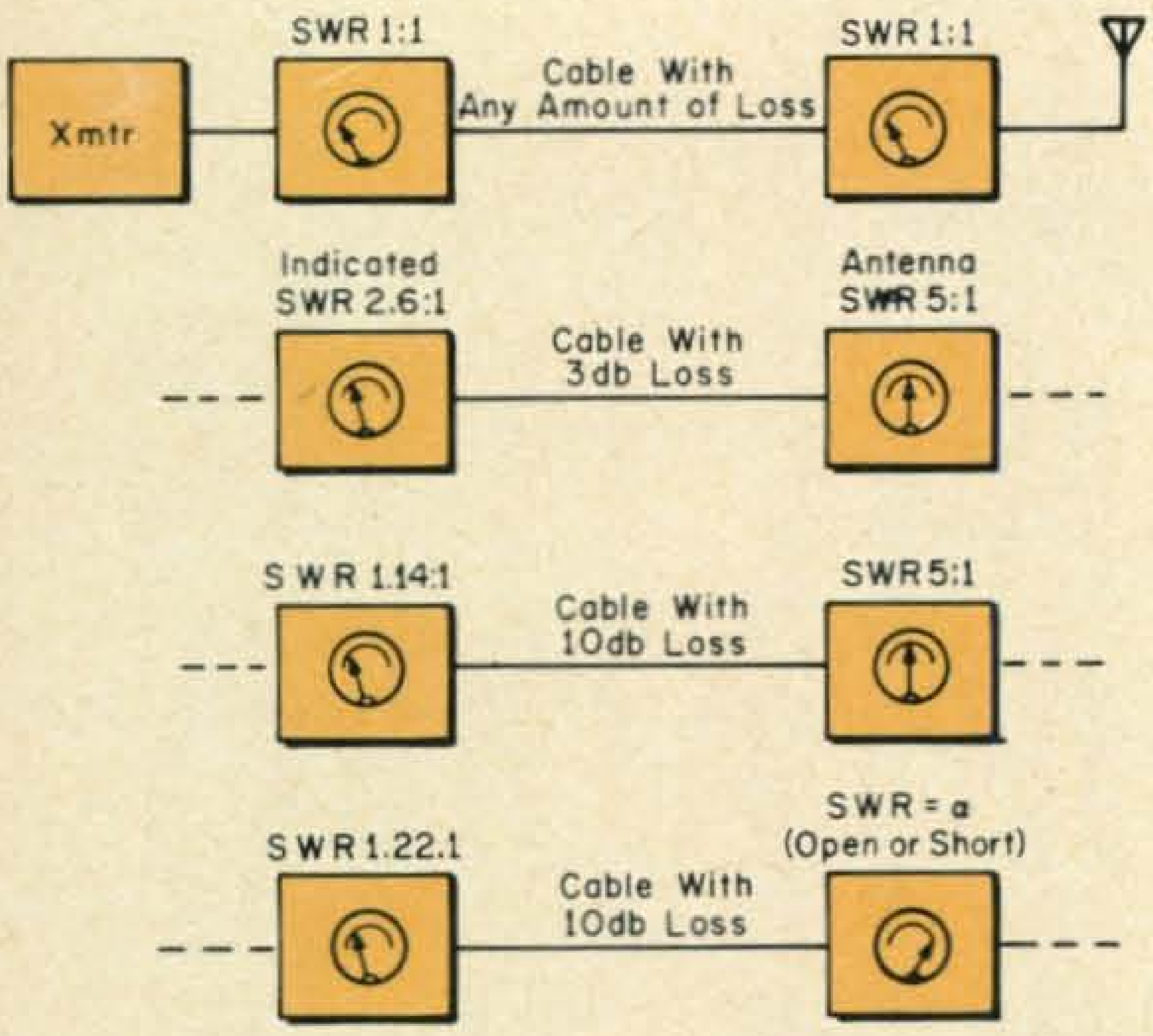

Fig. 2—S.w.r. indicated at transmitter may not be the same as actual antenna s.w.r., depending on cable loss. Loss may be due to faulty cable or long run of small cable on high frequency.

doesn't take very much attenuation, however, to produce s.w.r. readings with quite a bit of error. For example, a fairly long run (several wavelengths) of the commonly used RG-58/U cable, even in reasonably good condition, will show a relatively small change on the s.w.r. indicator at a transmitter when its far end termination goes from a direct short to an open circuit when operating on 10 meters. The high attenuation of the line simply washes out the effect of the termination, the transmitter sees 50 ohms (the cable impedance), the s.w.r. is low and conditions appear proper although the antenna may actually have *broken off* from transmission line. Of course, with a shorter length of line, a line in excellent condition or a line having less inherent loss (RG-8, for example, as shown in fig. 1) such a drastic event as the antenna becoming disconnected will be noticed on the s.w.r. indicator although it may still not accurately indicate the real value of the s.w.r. existing between the antenna and the transmission line.

The obvious point to the foregoing statements is that the readings on an s.w.r. indicator installed at the transmitter only have meaning if one knows how these readings react to changes in the antenna system in which the indicator is installed or used with. The s.w.r. indicator is a very useful instrument but not an absolute indicator of antenna system performance. The ideal situation, although in practice rarely possible, would be to use two s.w.r. indicators, one at the transmitter and one at the junction of the transmission line and antenna. Changes in antenna tuning or transmission line condition will then be readily apparent. See fig. 2.

Calculating Effect of Attenuation on S.W.R.

It is not difficult to calculate how attenuation will effect s.w.r. readings. One can make the calculation for any given installation although, unfortunately, it is necessary to do so for each band since coaxial transmission line loss is frequency dependent.

The following examples assume the use of 100 feet of RG-58/U on 10 meters and a 100 watt transmitter. Taking into account the normal line loss for new cable and about ½ db allowance for connectors and other minor discontinuities, the overall loss for the 100 feet of line is 3 db. This will cause a power loss of 50%. If the antenna is perfectly matched to the line and the line to the transmitter, there will be a 1:1 s.w.r. shown on an s.w.r. indicator at each end of the line.

Example 1—The s.w.r. at the antenna goes up to 5:1 either because of a fault developing at the antenna or because the transmitter frequency is shifted to a point where the antenna presents a poor match to the transmission line.

The power delivered to the antenna is:

$$\begin{aligned} P_{\text{ant.}} &= P_{\text{out}} \times \text{Line losses} \\ &= 100 \times 1/2 \\ &= 50 \textit{ watts} \end{aligned}$$

The power reflected at the antenna is equal to:

$$\begin{aligned} P_{\text{refl.}} &= P_{\text{ant.}} \left(\frac{s.w.r. - 1}{s.w.r. + 1}\right)^2 \\ &= 50 \left(\frac{4}{6}\right)^2 \\ &= 22.2 \textit{ watts} \end{aligned}$$

The reflected power measured at the transmitter can be calculated by:

$$\begin{aligned} P_{\text{refl. at Tx}} &= P_{\text{refl. at ant.}} \times \text{Line loss} \\ &= 22.2 \times 1/2 \\ &= 11.1 \textit{ watts} \end{aligned}$$

The s.w.r. at the transmitter can be calculated from:

$$s.w.r.\ at\ Tx = \frac{\sqrt{P_{\text{Tx}}} + \sqrt{P_{\text{refl. at Tx}}}}{\sqrt{P_{\text{Tx}}} - \sqrt{P_{\text{refl. at Tx}}}}$$

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$$= \frac{\sqrt{100}+\sqrt{11.1}}{\sqrt{100}-\sqrt{11.1}}$$
$$= 2.6{:}1$$

The s.w.r. indicator at the transmitter indicates about half of the actual s.w.r. existing at the antenna. The s.w.r. meter at the transmitter would certainly be useful to indicate that matching conditions have changed but the operator may also have a false sense of the performance being adequate at frequencies near the band-edge when, in fact, it is twice as poor as indicated on the s.w.r. meter. The same false sense of performance may occur when experimenting with different forms of antennas and taking s.w.r. readings across a band. An antenna that seems to be "broadband" may not be so after all.

Example 2. The antenna s.w.r. rises to 5:1 as before but something happens to the transmission line and instead of its normal 3 db loss, it develops 10 db loss. This will result in a loss of 9/10 of the power with only 1/10 delivered to the load.

$$P_{\text{ant.}} = P_{\text{Tx}} \times \text{Line loss}$$
$$= 100 \times 1/10$$
$$= 10 \text{ } watts$$

$$P_{\text{refl. at ant.}} = P_{\text{ant.}} \left(\frac{s.w.r. - 1}{s.w.r. + 1}\right)^2$$
$$= 10\left(\frac{4}{6}\right)^2$$
$$= 4.44 \text{ } watts$$

$$P_{\text{refl. at Tx}} = P_{\text{refl. at ant.}} \times \text{Line loss}$$
$$= 4.44 \times 1/10$$
$$= 0.444 \text{ } watts$$

$$S.w.r. \text{ } at \text{ } Tx = \frac{\sqrt{P_{\text{Tx}}} + \sqrt{P_{\text{refl. at Tx}}}}{\sqrt{P_{\text{Tx}}} - \sqrt{P_{\text{refl. at Tx}}}}$$
$$= \frac{\sqrt{100}+\sqrt{0.444}}{\sqrt{100}-\sqrt{0.444}}$$
$$= 1.14{:}1$$

Not only has the actual power delivered to the antenna dwindled to practically nothing but about 90 watts are being wasted to heat up the transmission line. Yet the s.w.r. meter at the transmitter indicates everything being perfectly OK and the transmitter still loads properly, all because the line attenuation has gone up significantly.

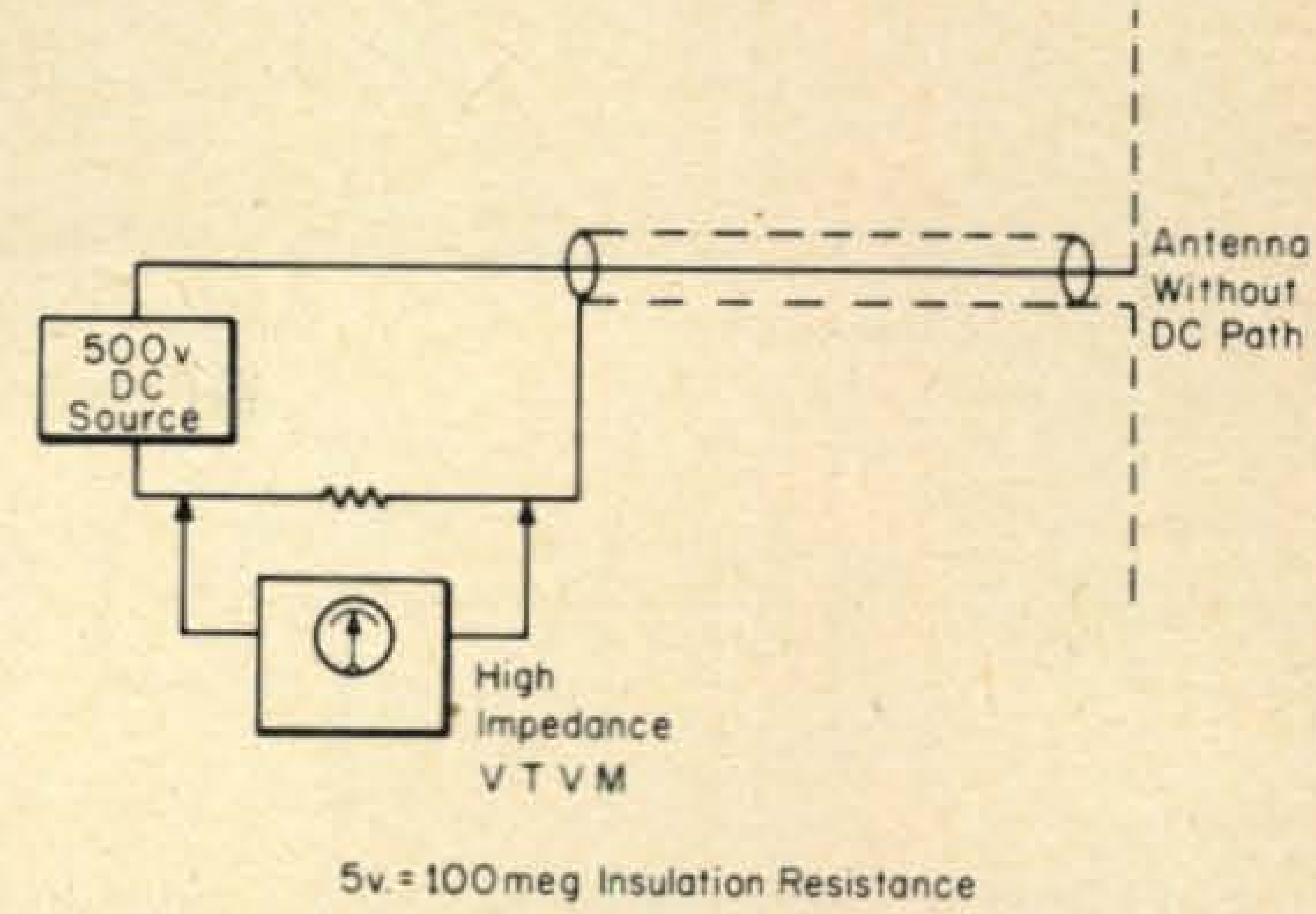

Fig. 3—Insulation resistance measurement is one simple means to obtain a quick check of cable condition. Some more expensive VTVM's have a special 1000 megohm range which can be directly employed.

When making the above calculations, the attenuation involved can either be measured or estimated. Attenuation figures for coaxial cables are available in many publications. An extra allowance must also be made for connectors, switches, filters and other devices placed in the line which contribute attenuation.

Testing Coaxial Transmission Lines

If one checks the effect of load changes at the antenna end of a line on the s.w.r. indicator at the transmitter end of the line, at least some idea is gained of the s.w.r. reading accuracy. This can be done by simulating different loads with composition resistors (100 ohms for 2:1 s.w.r. on 50 ohm line, 150 ohms for 3:1 s.w.r., *etc.*). A change in s.w.r. reading will not tell, once the line is in use, whether the antenna or line is at fault should an abnormal reading occur. The rechecking of the line by using dummy loading is also rarely possible with ease once the line is in use.

An ohmmeter can be used to determine drastic antenna faults such as opens or shorts but aside from these faults, it is pretty useless for antenna system checks. Various methods are available for checking deterioration in a transmission line. Many depend, however, upon elaborate equipment or having an accurate termination at the far end of the line while testing. One very interesting method is the use of a time domain reflectometer where a step voltage is impressed on the line and returning reflections versus time are displayed on an oscilloscope. Both the general type or fault and its location can be determined. However, about the simplest method to use, which can also be done with the antenna connected as long as the latter does not present a direct d.c. path, is the

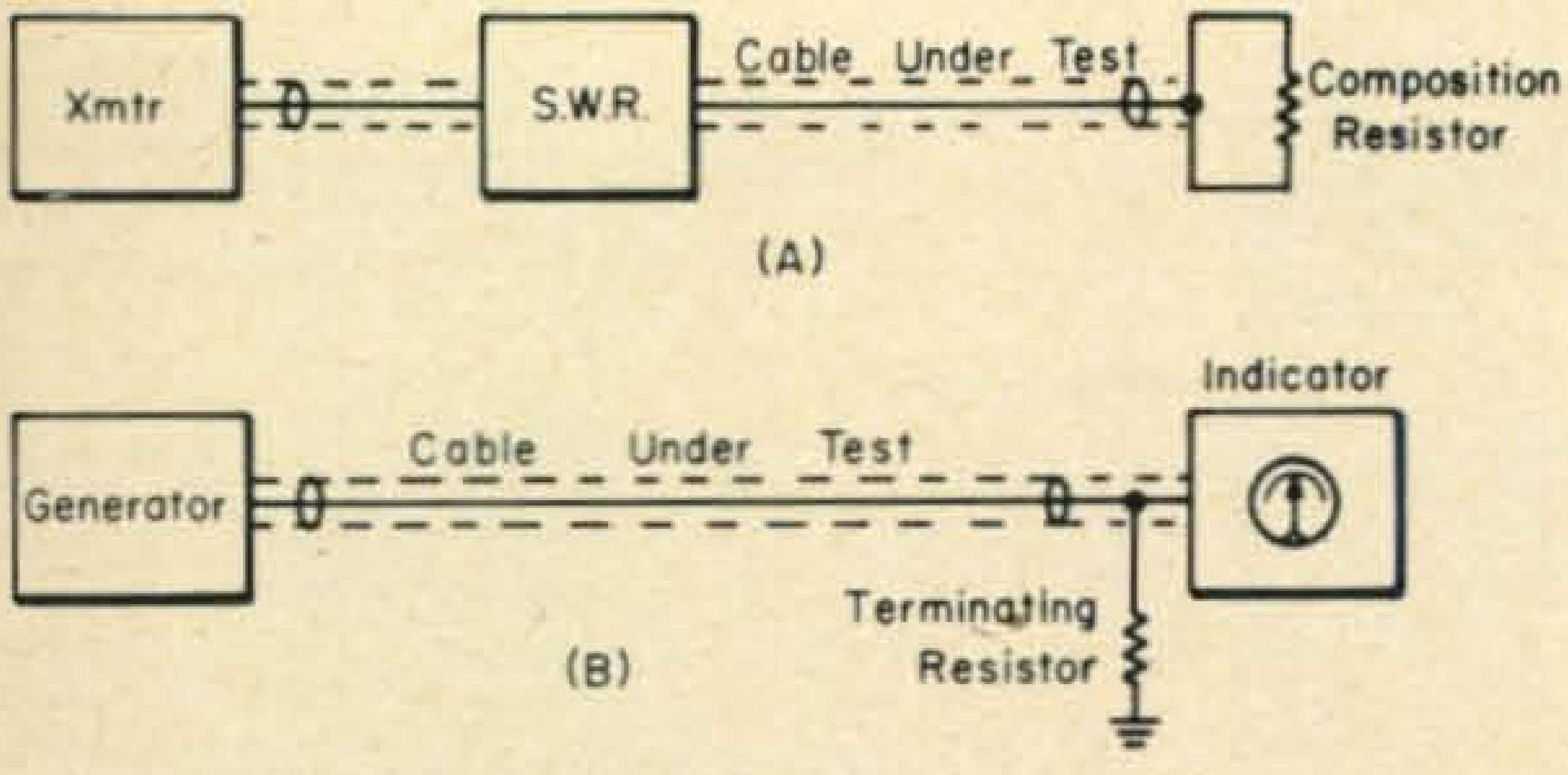

Fig. 4—Generalized methods to measure attenuation. Method (A) creates an artificial s.w.r. and cable loss is calculated from formulas given in text. Method (B) compares output of cable being tested to output available from direct connection between generator and indicator.

measurement of insulation resistance. The method is used widely in commercial and military installations to periodically check the general condition of coaxial lines for the h.f. bands.

Measuring Insulation Resistance

A megohmmeter is commonly used to measure insulation resistance. It is a form of ohmmeter designed to measure high resistances from 20 to 1,000 megohms. Those amateurs with experience in the electrical power field are probably well acquainted with this instrument. A regular ohmmeter is not useful to measure the insulation resistance between the shield and inner conductor of a coaxial cable since their maximum resistance range is 1 to 10 megohms. The insulation resistance of a coaxial line should normally run from 100 to 200 megohms. When it falls below 100 megohms, it is usually a good indication that moisture has entered the cable, the dielectric is damaged or some other difficulty exists.

The megohmmeter consists essentially of a 500 volt hand-crank generator and a special construction microammeter that requires no "zeroing". However, with care one can use the instruments normally available around the shack to perform the same measurement. A power supply delivering a few hundred volts and a microammeter are necessary. The circuit must be protected against a short by a series protective resistor of sufficient value to protect the power supply and meter. As long as the voltage and current readings across the coaxial line are properly taken, the resistance is easily calculated. (See figure 3.)

This simple measurement will hardly detect some of the complicated chemical changes that could occur in a cable but assuming the cable is in good condition when purchased, it will normally give warning of any drastic change in cable characteristics.

Attenuation Measurements

If cable is used which was not purchased fresh or if cable is being reused from another installation, a check of its attenuation characteristics may be in order. Again, such a measurement can be made with complicated instruments to a high degree of accuracy or with simpler instruments to obtain approximate values. One simple method of measurement is the reverse of the procedure described before to determine cable effect on s.w.r. readings. One calculates what the s.w.r. reading is at the transmitter end of the line from a known, artificially created s.w.r. at the load end of the line. Normalized to attenuation per 100 feet, one can then compare the attenuation of the cable under test to that value given for the cable in a manual. This arrangement is shown in fig. 4(A).

A signal generator can be used in several ways to measure attenuation. The line can be terminated in its characteristic impedance and, with a v.t.v.m., the actual input/output powers calculated. The signal generator must, of course, be carefully matched to the cable. If the generator has a well calibrated output, the amount of increase in db output necessary for the generator to work directly into a load is compared to going through the cable under test to the load will be the attenuation. This assumes the same level across the load as checked by a receiver "S" meter or v.t.v.m. A less accurate but still useful method is to use the receiver "S" meter as a db indicator. The drop in reading is noted as the cable is connected between generator and receiver as compared to a direct connection between generator and receiver as shown in fig. 4(B).

Coaxial Cable Installation

Most faults that occur because of installation methods have to do with poor connections, moisture entering the cable and use of sharp bends. Connections are best made in accordance with the method suggested by the connector manufacturer. These methods are detailed in various manuals and also available in free literature available from most manufacturers. Manufacturers certainly are interested in having their connectors put into service as quickly as possible while still performing properly and there rarely should be reason to deviate from their instructions. In

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spite of this, the use of connectors is often seen with mechanical stress capabilities exceeded and with unduly long discontinuities on the constant impedance coaxial path. Splices in cables should definitely be avoided unless the economics of the situation allow no other choice.

Moisture can do a great deal of damage to a cable. The shield corrodes, the wires become insulated from each other and the efficiency of the shielding is ruined. If the cable is flexed, the shield may open up altogether. Moisture cannot enter a cable along its run unless nicks in the jacket are present. Even small nicks or cuts can allow a great deal of damage to occur and should be sealed with tape or heat shrinkable tubing. Moisture can enter the ends of the cable if they are not sealed off or some cement compound used to waterproof the ends. Most connectors in common use are *not* waterproof types and, again, tape or heat shrinkable tubing should be placed over them.

Coaxial cables were never meant to be bent like hookup wire. If a cable has a very sharp bend in it, the dielectric is strained and it will tend to crack inside the cable as the cable gets older. If the cable is subject to temperature and moisture extremes, such as in outdoor service, the cracking progress is considerably accelerated. In general, a cable should never be bent in a radius less than 10 times the cable diameter (fig. 5). In service where the cable is continually flexed, such as a rotatable beam installation, the minimum radius should be two to three times greater. Coaxial cable was also never meant to be self-supporting

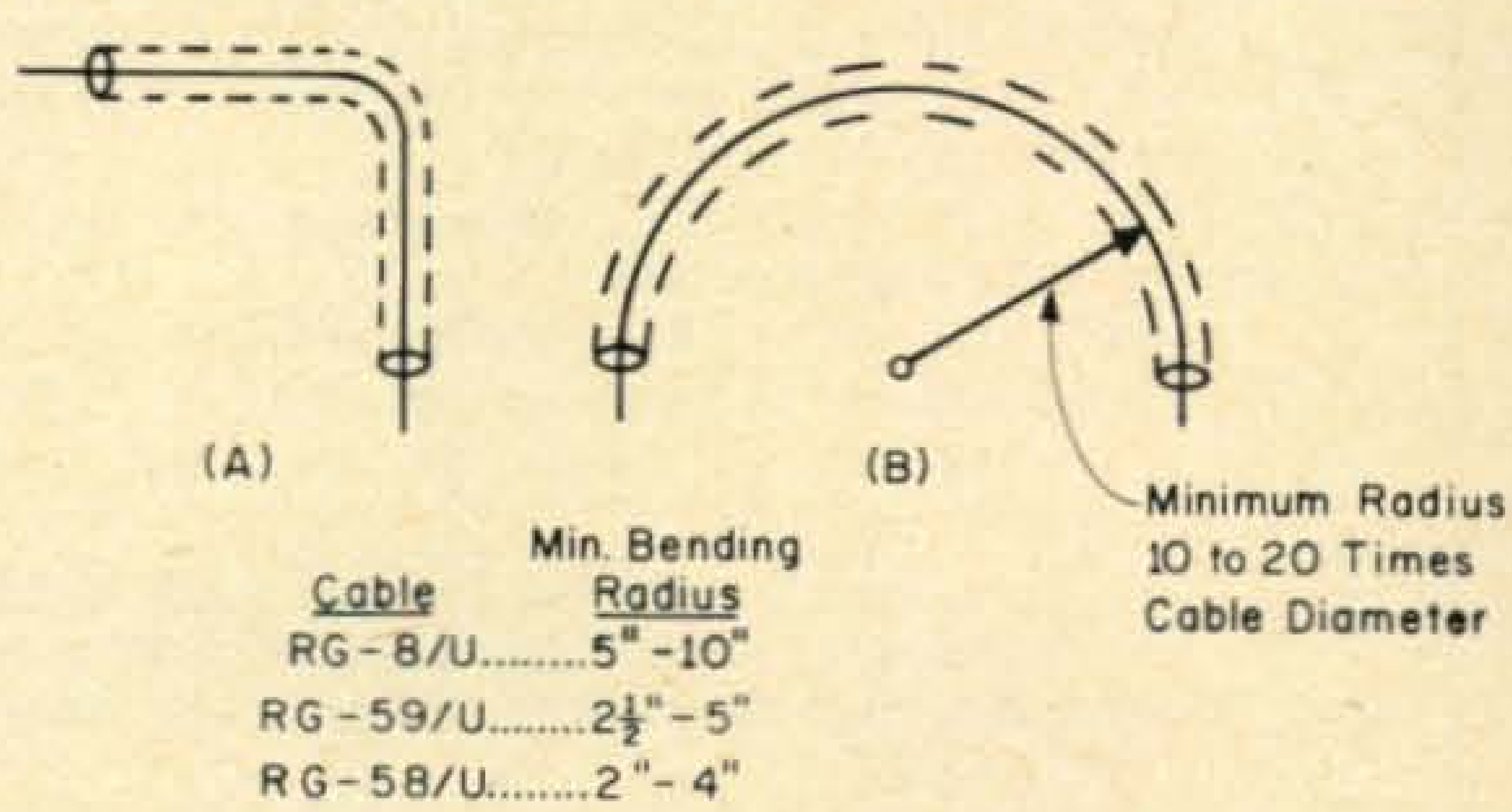
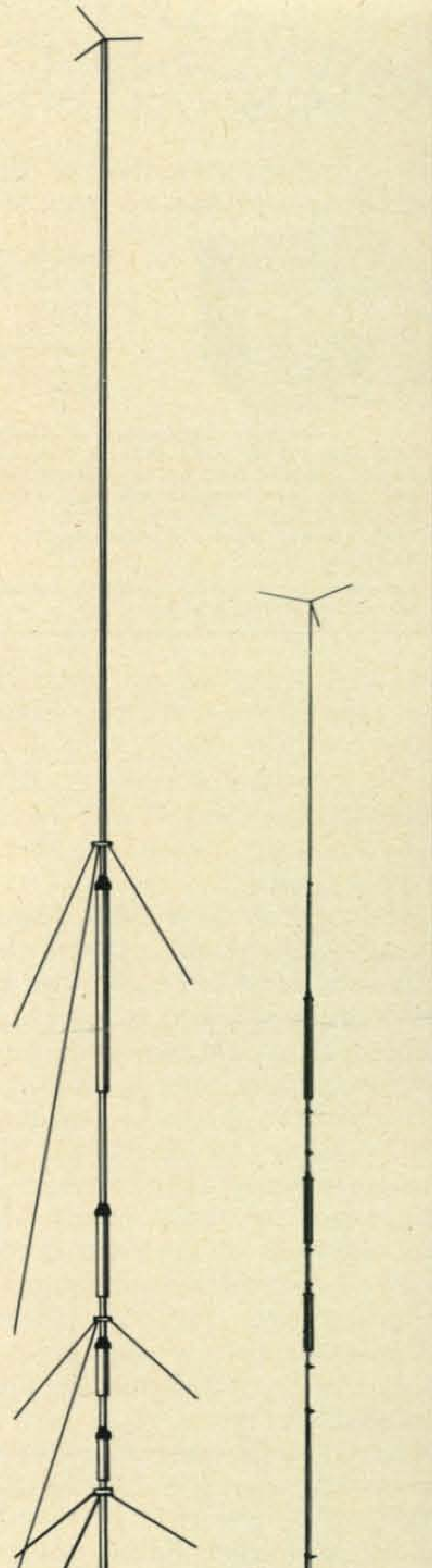


Fig. 5—One common installation fault: sharp bends (A). Cable should be bent gradually (B) to prevent eventual damage to dielectric.

for any great lengths. The distortion in form produced by draping long lengths of cable can effect its performance. The cable manufacturers recommendations should be secured before using any long run of unsupported cable. The use of a hanger wire will often insure a more maintenance free installation.

Summary

This article has tried to present some basic precautions to be observed when reading s.w.r. on a coaxial cable and basic testing and installation methods. Although a careful installation will probably pay most dividends when used for transmitting, receiving conditions will also benefit, especially if proper shielding is useful in preventing local noise pickup. Proper interpretation of s.w.r. meter readings and proper cable installation is not difficult. Certainly, there is no reason to nullify the benefit of having a good radiator by a haphazard transmission line installation. ■



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Grumbles

by Sam

I don't think that *CQ*, amongst its many sins, does book reviews. This month is an exception—however, a few words of caution. If you're one of those nasty little kids who picked up your General ticket last month at the age of 6, pass this page by or give it to your old man.

The book in question isn't what you think—*Playboy;* it's not even the latest bit of technical twaddle from the slide-rules of Rider, Sams, Tab, Cowan, or the Grolier Society. As a matter of fact it is the newest edition of the book which probably got most people over the age of 30 started in radio in the first place. Right now, I can see all of the peacocks up in Newington puffing out their chests, fanning their feathers—they think that I mean their beginners' book—but, no; this is the one book which hooks you *before* you've even heard of the League! I'm talking about the Johnson Smith Company catalog, that last outpost of neckties that light up in the dark and say, "Oh you kid;" the one place you can still see the "throw your voice" ad showing the little bearded guy with the boxes under his arms which shout, "Help! Take me out! Loafer!"

Anyway, that book started me off in radio when I was a kid. I had lost track of the outfit; never even thought about it for about 20 years. But only last week one showed up on my desk mysteriously. Was I still on their mailing list? Heaven knows, but that book sure brought back memories. Would you believe that it hasn't changed in all of these years? I've worn thin around the edges, but their new edition still has the strange aura which started me on the road to fame and riches in ham radio.

Flipping through the book—past the secret code maker, the luminous western jeweled belt, the book on occult powers, the Hercules wrist band, the awful tasting beer—I came upon the treasures of my youth! The electronics section—and, guess what! It's just as it was when we were kids.

They still have this fantastic ancient-looking desk mike which can let you "Talk—Sing—Play Through Your Radio." Little did I then know that this can usually be unavoidably accomplished by anybody running more than 10 watts on 6 meters. Nevertheless, that's what was one of the things which pulled me into radio. I guess it was the illustration next to the mike which shows the entire family seated in the parlor around this big Midwest 33-tube console superheterodyne. The ad promised that I could imitate Bob Hope or Bing Crosby.

The next building block in my career was their "Book Of Radio Plans," which (in the ad) shows a grotesque woodcut of a guy with a headset trying to electrocute himself by putting his mitt into the gizzards of a breadboard type receiver built with large glass tubes. I'd almost wager that if you sent away for that book today it would still be the very same edition with the circuits calling for 2A7's, 80's, and maybe a 6K7 or two. And look—on the very next page! Plans for building radio controlled models. The picture shows a large wireless tower, an ocean liner, and

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a plane which looks like the prototype of The Spirit of St. Louis. Each of these is radiating out large lightning bolts and sparks. And, right on the very same page; a Philmore crystal detector, cat whiskers, a 65¢ crystal radio, radio aerial wire, and even an ICA lightning arrestor There's more, too.

I wouldn't want to make any claims of a spiritual or medical nature for the Johnson Smith catalog, but I will tell you that by reading a few of its pages each day I've been able to kick the *Serutan* habit. Look, if you're from the paunch generation, why not send them 10¢ (to 16535 E. Warren Avenue, Detroit, Mich. 48224—the Zip code seems to be the major change in their catalog) and get one of these as your own personal guide to happiness.

Integrated circuits? Semiconductors? Collins? Fooey!!! I'm going to be the first one on 80 meters with the Johnson Smith "Super Tone Crystal Radio, plays indefinitely, no interference; no tubes, no noise." They must know where it's at, Baby! ■

". . . Glad to know I'm beautiful copy . . ."

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AN AUDIO LIMITER CIRCUIT

BY JAMES V. MOTSINGER,* WB4CVF

Described below is a distortion free limiter circuit capable of handling a wide dynamic range. Originally intended for RTTY use, the addition of a preamplifier has made it suitable for low level inputs.

THIS article describes an audio limiter circuit which produces a 3.0 volt r.m.s. output with inputs which can fluctuate from 0.01 volts to 2.0 volts r.m.s. By proper component selection, the response time can be as low as 0.1 second. Because this wide dynamic range is accomplished without introducing distortion, the limiter has a multitude of uses. The original limiter was designed as a senior project at Virginia Polytechnic Institute and was intended for use as a limiter in an RTTY converter. Since then the limiter has been used as a compressor amplifier for a transmitter and to provide constant input for tape recording group conversations. Both of these uses require a preamplifier (Q_1) which is shown as part of the complete schematic (fig. 5).

Most limiters previously used in converters either sharply clipped or otherwise distorted the waveform. Any limiter used must be placed before the tone filters to avoid broadening the filter curve, and a clipping limiter may produce harmonics which are within the bandpass of the filters, and which blanket the desired signal. Also, if the desired signal is significantly lower in amplitude than other signals present, the information may be stripped off when the signal is clipped. If a saturating limiter which does not sharply clip is used, the output may vary over a three-to-one range. None of these types produce ideal limiting. The ideal limiter is one which would give a constant, undistorted output, with a widely varying input.

To the author's knowledge, the only previous work on such a limiter is that done by

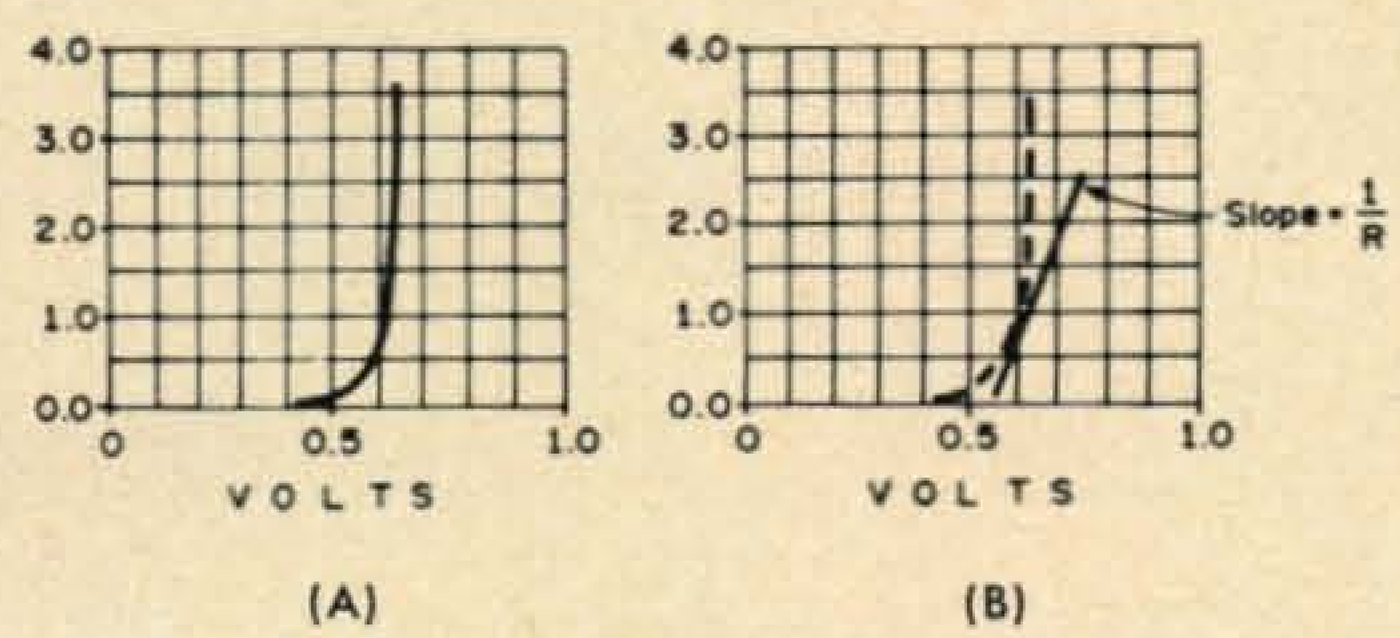

Fig. 1 (A)—Non-linear voltage—current characteristics of a typical silicon diode. (B)—Same curve as that of fig. 1A but presented as if it were composed of short straight lines.

*1501 Rigsbee Drive, Plano, Texas.

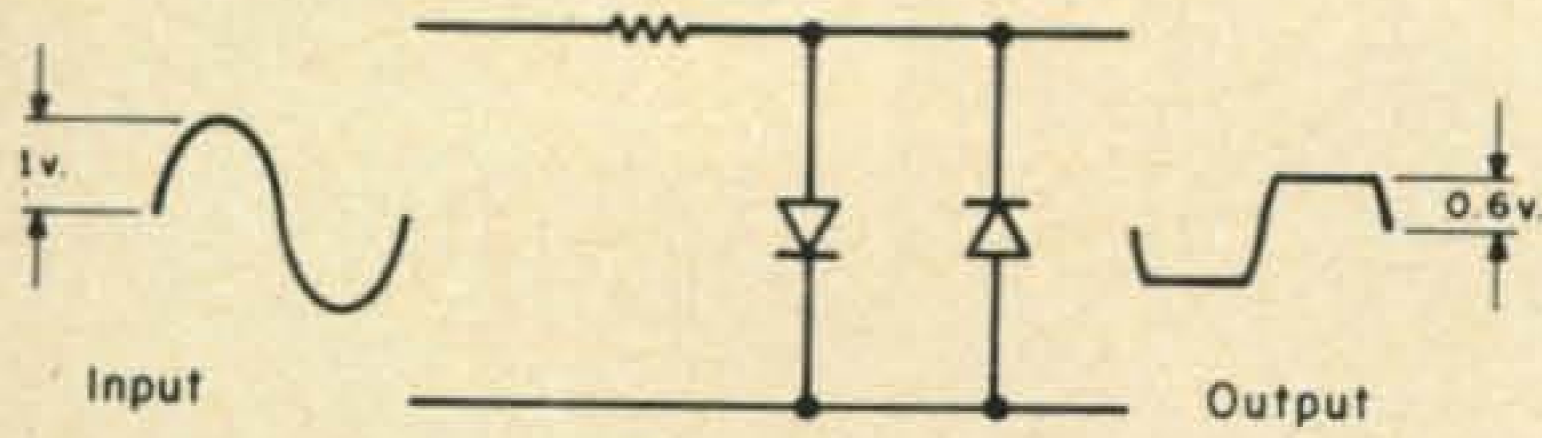

Fig. 2—When a diode with the characteristic shown in fig. 1(A) is placed in the circuit above, the output is limited to 0.6 volts peak, producing severe distortion.

Buttschardt and Olson,[1] in which a light-controlled photo diode is used to control the input level. Light-controlled limiters maintain constant output only as long as the input changes slowly; however, the inherent response time of the light filament is on the order of several seconds. The ideal limiter circuit would consist of a fast-acting, current- or voltage-controlled audio attenuator.

Circuit Description

The circuit described uses the small signal (less than 2 mv), a.c. resistance of a diode. Most previous circuits have used the large signal (greater than 600 mv), switching characteristics. Consider the nonlinear voltage-current curve of a typical silicon diode given in fig. 1(A).

It can be seen from this curve that the current through the diode can increase very rapidly as the voltage across the diode approaches 0.6 volts. If a diode with this characteristic is placed in series with a resistor, the voltage across the diode will then be limited to about 0.6 volts. (See fig. 2.) While this circuit acts as a limiter, the non-linear characteristics produces severe distortion.

[1] Buttschardt and Olsen, "A RTTY Terminal Unit of Wide Dynamic Range," *QST*, May 1968, p. 22.

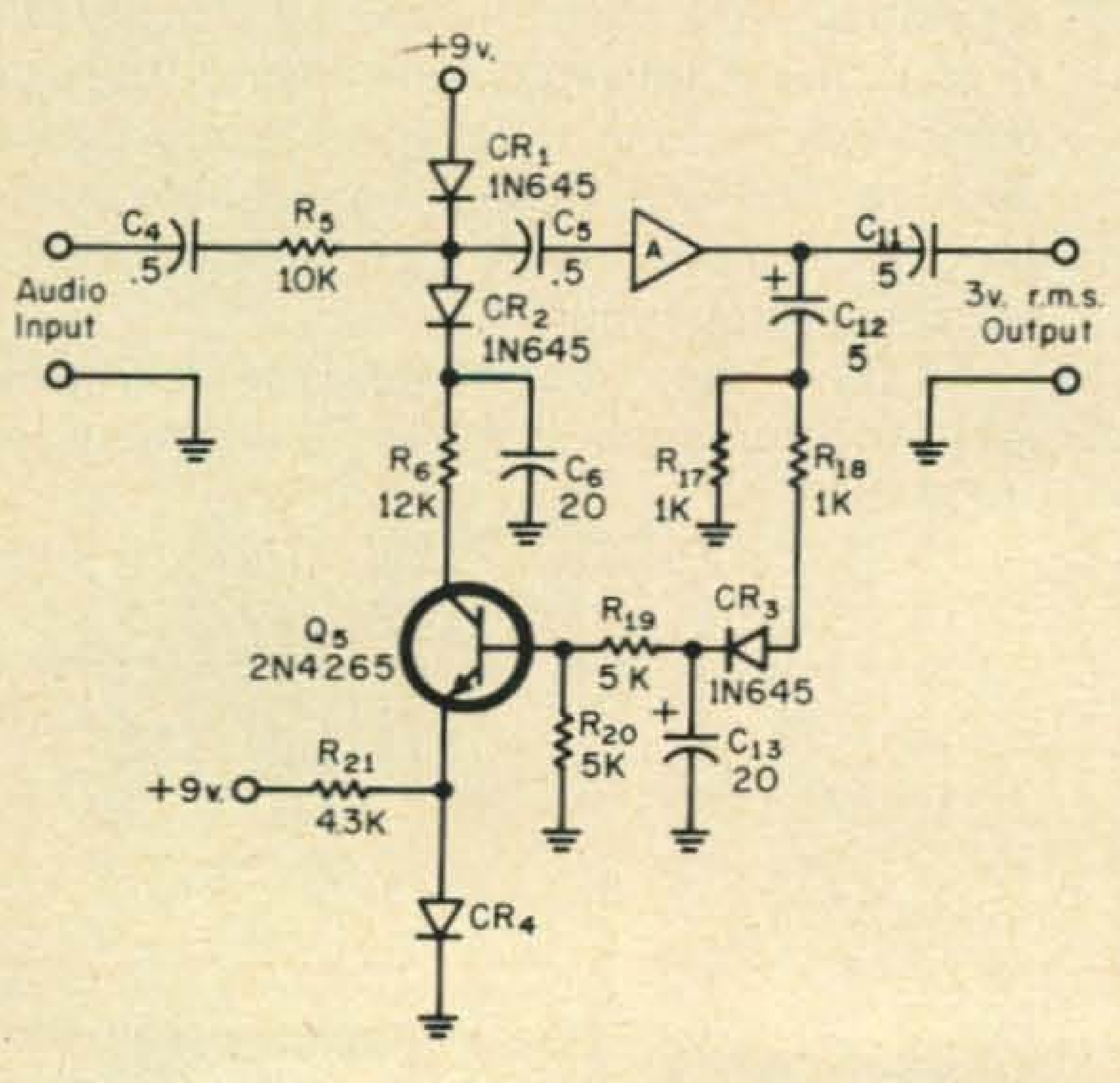

Fig. 3—Circuit of the distortion free limiter. Amplifier block A is discussed in the text.

We can, however, imagine the same curve as composed of very short straight lines (fig. I(B). Provided the voltage or current variation is small, there will be a linear relationship between the voltage or current and therefore no distortion. Also we note from the curve that at different points on the curve the slope, and thus the resistance, changes. Therefore, by keeping the a.c. signal small and varying the d.c. bias current through the diode we can obtain a variable resistance. The practical resistance of such a diode can vary from about 10 ohms to several hundred thousand ohms.

The basic limiter circuit is shown in fig. 3. Diode CR_3 and capacitor, C_{13}, provide a d.c. voltage proportional to the amplifier output. This voltage is dropped across a voltage divider consisting of resistors R_{19} and R_{20}, and coupled to the base of transistor Q_5. Any tendency for the output to increase causes an increase in the voltage on the base of transistor Q_5. This causes a corresponding increase in the collector current and the current through diodes CR_1 and CR_2. This decreases the a.c. resistance of these diodes. When this occurs, a greater portion of the input signal is allowed to pass through diodes CR_1 and CR_2 to a.c. ground, thereby reducing the output. In addition to providing an a.c. ground point, capacitor C_6 reduces ripple in the feedback circuit, and reduces distortion.

The voltage at the base of transistor Q_5 is determined by its V_{BE} and the voltage drop across the forward-biased diode, CR_4. Resistor R_{21} provides a forward bias current of approximately 2 ma through diode CR_4. Since diode CR_4 and transistor Q_5 are both silicon, the voltage at the base of transistor Q_5 is approximately 1.2V. Resistor R_6 was selected to limit the collector current of transistor Q_5 to about 1.5 ma.

Amplifier A is shown in detail in figure 5. Any high gain audio amplifier could be used provided it has the same terminal characteristics. Briefly these characteristics are: gain above 1500, input impedance greater than 25K, output impedance less than 1K and output voltage greater than 3 volts r.m.s. without distortion.

Substitutions And Alterations

All parts used are standard electronic items. The transistors and a blank printed circuit board can be obtained from Poly Pacs, Inc. of Lynnfield, Mass., for $4.00. To aid in using junk box components, however, the following comments are offered.

Diodes CR_1 and CR_2 should have low reverse current (I_0) to provide sharp knee action so that a small current change can change the diodes a.c. resistance from maximum to minimum. Diode CR_4 and transistor Q_5 should be silicon to provide a turn on point of about 1.2 v.d.c. Changing the value of C_6 and C_{13} changes the response time. These may be selected to give the fastest response time without introducing distortion.

Transistors Q_2 and Q_3 both have betas (current gain) of over 300. If transistors with a lower beta are used, more audio stages may be required. Of course, one obvious change would be to replace the whole amplifier with an I-C amplifier.

If even wider dynamic range is desired the limiter shown in fig. 4 can be used. This will require a higher gain amplifier however.

The amplifier as shown has a low frequency roll-off of about 1000 c.p.s. for use in an RTTY converter. For speech, C_7 and C_{10} can be increased to improve low frequency response. To further accent the signal for RTTY use, a bandpass filter of 2000 to 3000 c.p.s. can be added within the amplifier.

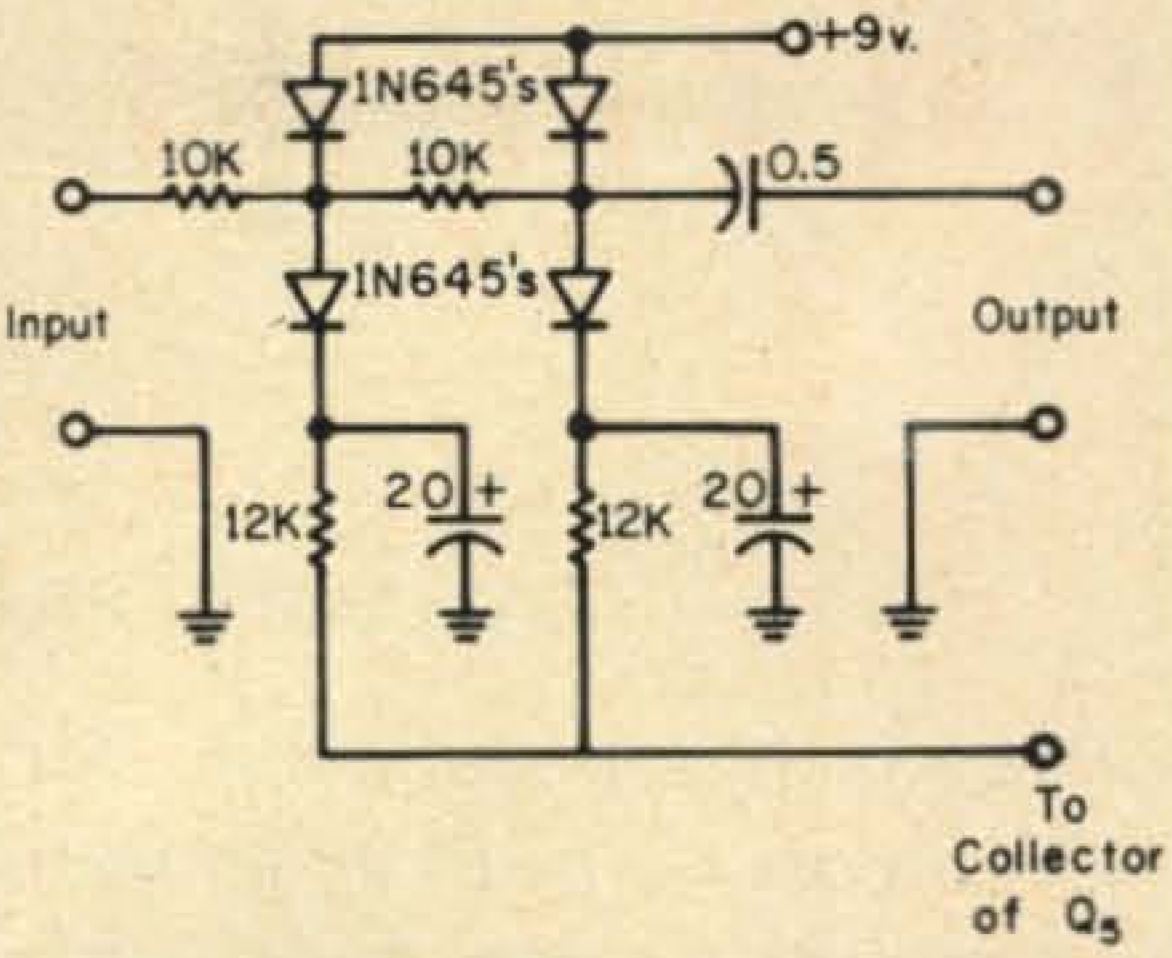

Fig. 4—The two stage limiter shown above can be used to increase the dynamic range.

Conclusion

The author has tried to suggest several uses and modifications of the basic limiter circuit. However, the reader must realize that the actual uses can be as varied as his own imagination. Any time a constant level audio signal is required, think of this wide range non-distorting limiter. ■

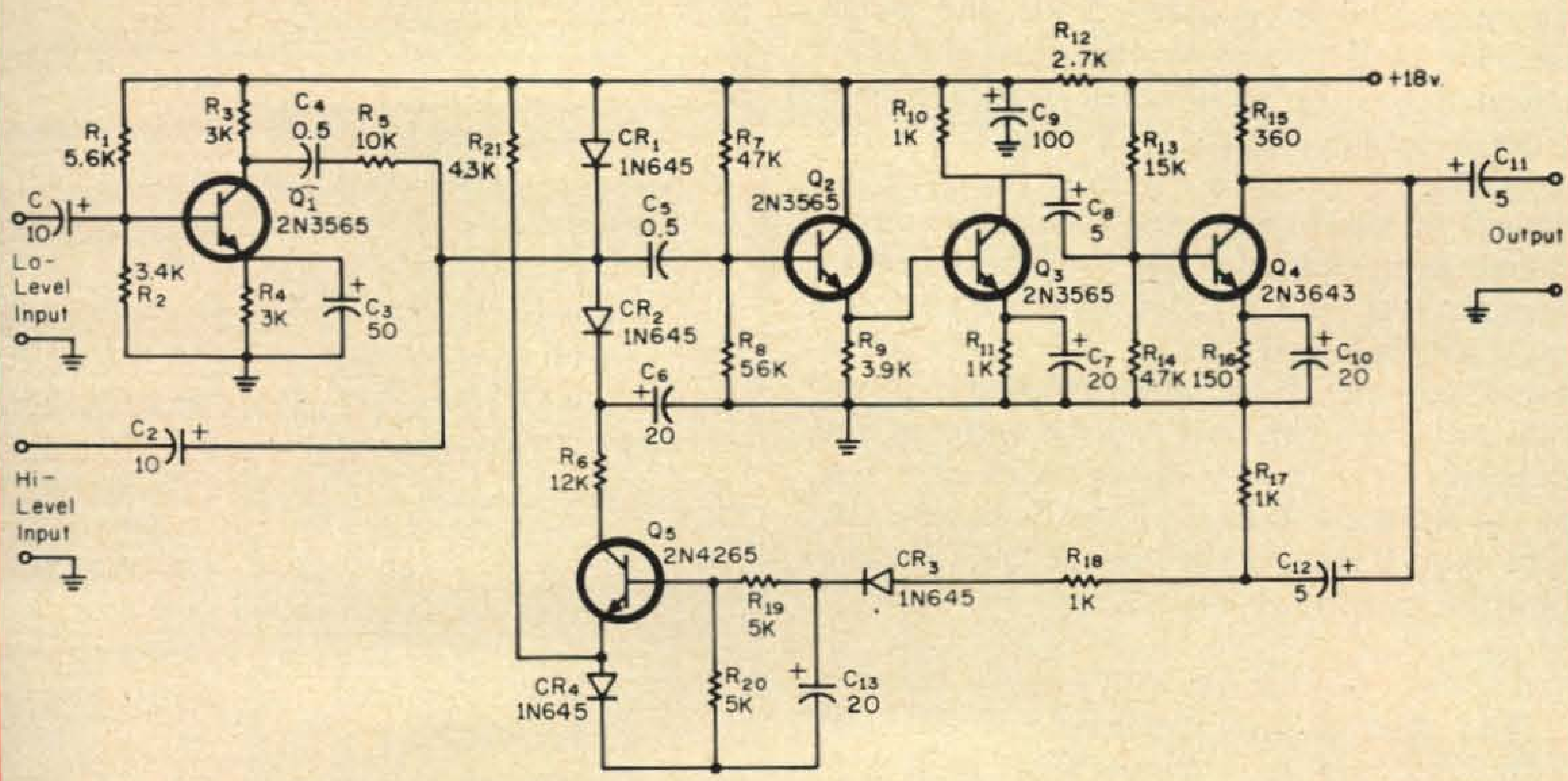

Fig. 5—Circuit of the complete limiter including a preamplifier circuit (Q^1) for low level inputs. All resistances are 1/2 watt and all capacitances are in mf.

VERTICAL ANTENNAS

Part IX

BY CAPT. PAUL H. LEE,* W3JM

The author, in this installment, Part IX, discusses a very simple directional array which can be built in an equilateral triangle configuration. Using any two elements at a time world wide coverage can be obtained at a gain of 5.2 db.

As previously stated in Part IV[70], the maximum gain obtainable with two vertical elements in any configuration is 5.2 db. This occurs with an element spacing of 210°, and with equal in-phase currents. Readers should refer to references 39, 40 and 41 of Part IV for details of this and other directional configurations, and gains obtainable. I should also reiterate here that when talking about gain of an array of equal height elements, the reference is the non-directional field which would be radiated from one single element of the same height when the total power fed to the array is fed to it. The field from a single element radiating 500 watts would be 138 mv/m at one mile, for example. This field, minus any losses due to the directional array's phasing and branching system (usually less than 2% for a two element array), will be equal to the r.m.s. of the directional pattern. Thus, when plotting a directional pattern, we can use the ratio of the pattern's field in any direction to its r.m.s. as the pattern's voltage gain in that particular direction. Knowing the voltage gain, we can find the gain in db easily.

Equlateral Triangle

The case of two elements spaced 210° with equal in-phase currents lends itself very nicely to an equilateral triangle configuration, with the elements fed two at a time by means of a switching arrangement. This case is also a very easy one to compute. Inasmuch as the currents in the equal height elements are equal and in phase, the elements' operating impedances will be equal, they will be fed equal amounts of power, and their antenna tuning units will be identical. This makes the switching arrangement very simple, for the triangular configuration.

First, let's run through the pattern computation for this one, as done in Part VIII[71]

*5209 Bangor Drive, Kensington, Md. 20795.

[70]Lee, P. H., "Vertical Antennas–Part IV", *CQ*, Sept. 1968.

[71]Lee, P. H., "Vertical Antennas–Part VIII", *CQ*, Jan. 1969.

A	B	C	D	E	F	G	H	J
φ	Cos A	S x B	C + ψ	Cos D	1+E	√F	K x G	1.29xG
0°	1.000	210.0	210.0	-.866	.134	.366	65.1	.472
10°	.985	206.7	206.7	-.894	.106	.326	48.2	.421
20°	.940	197.3	197.3	-.954	.046	.214	38.1	.276
30°	.866	182.0	182.0	-.999	.001	.031	5.5	.040
40°	.766	160.9	160.9	-.945	.055	.234	41.7	.302
50°	.643	135.0	135.0	-.707	.293	.542	96.4	.699
60°	.500	105.0	105.0	-.259	.741	.861	153.2	1.110
70°	.342	71.8	71.8	+.313	1.313	1.143	203.5	1.474
80°	.174	36.5	36.5	+.804	1.804	1.342	239.0	1.731
90°	0	0	0	1.000	2.000	1.414	252.0	1.825
100°	-.174	-36.5	-36.5	+.804	1.804	1.342	239.0	1.731
110°	-.342	-71.8	-71.8	+.313	1.313	1.143	203.5	1.474
120°	-.500	-105.0	-105.0	-.259	.741	.861	153.2	1.110
130°	-.643	-135.0	-135.0	-.707	.293	.542	96.4	.699
140°	-.766	-160.9	-160.9	-.945	.055	.234	41.7	.302
150°	-.866	-182.0	-182.0	-.999	.001	.031	5.5	.040
160°	-.940	-197.3	-197.3	-.954	.046	.214	38.1	.276
170°	-.985	-206.7	-206.7	-.894	.106	.326	48.2	.421
180°	-1.000	-210.0	-210.0	-.866	.134	.366	65.1	.472

Table III — Data for the computation of the antenna radiation pattern shown in fig. 83.

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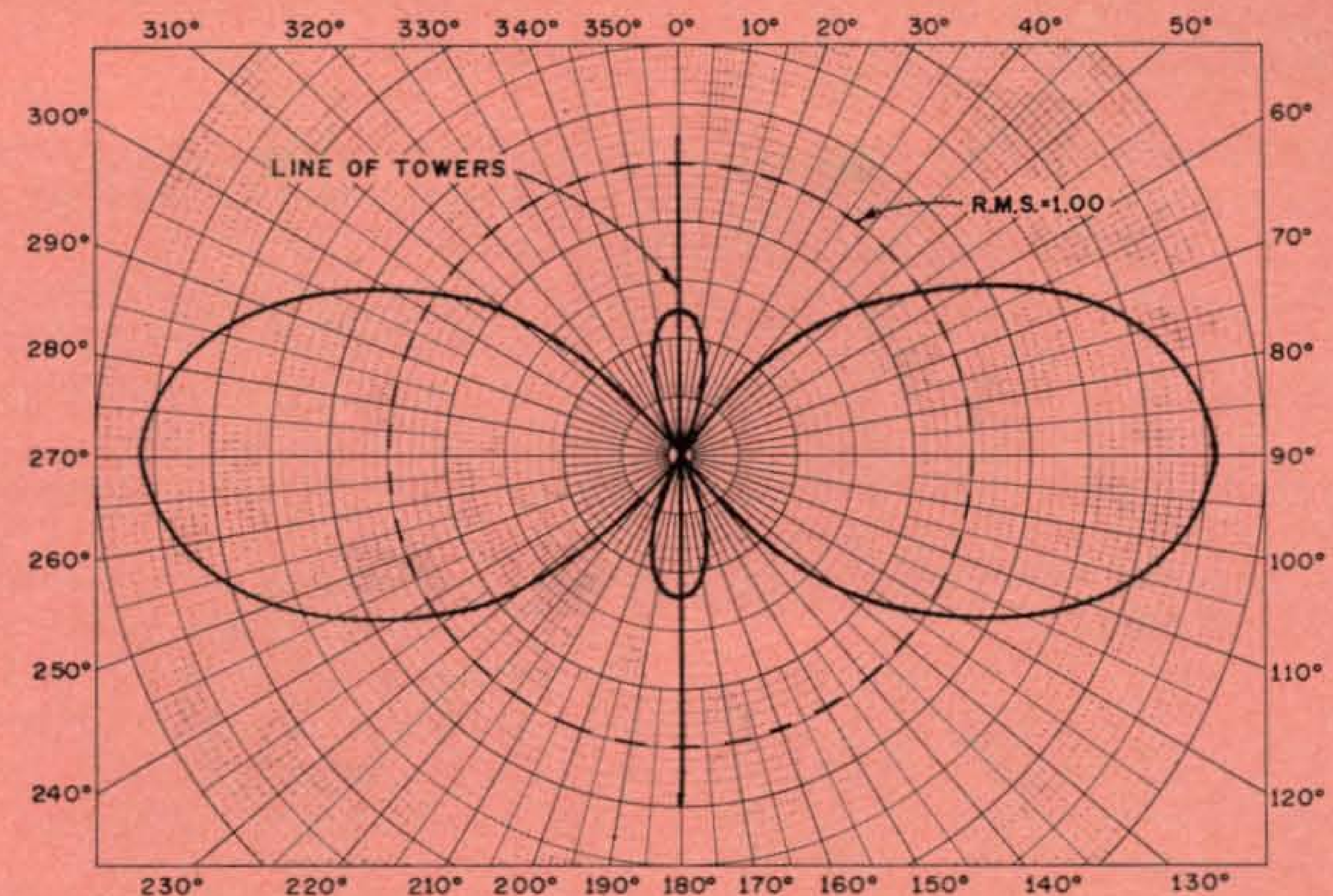


Fig. 83—Antenna radiation pattern, plotted from Column J of Table III for the two elements 210° apart with equal, in phase, currents.

for the case of 90° spacing and 90° phasing. For ground wave pattern computation, and where the two tower currents are equal, the equation used is:

$$E = K\sqrt{1 + \cos\,(S\cos\phi + \psi)}$$

where S = spacing in degrees
ϕ = azimuth angle
ψ = phase angle
K = constant depending on r.m.s. of the pattern's mathematical plot.

For the array being discussed here, S is 210°, ψ is 0°, and ϕ is taken every 10° from 0° through 180°. The tabulation of computations is shown in Table III. Each column is given a capital letter designation for simplicity in labelling the columns in the heading of the table. The computation follows through very logically, step by step, column by column.

The pattern will be symetrical about the line of towers, so it is necessary to compute only from 0° through 180° the values for columns A through G. The r.m.s. of the pattern is determined by adding column F, multiplying it by 2 (to get the whole pattern from 0° through 350°, then subtracting one set of values for 0° and 180° (so that they are not included twice in the summation), dividing by 36, then taking the square root of what remains:

Sum of column F = 10.986
× 2
21.972
−.134
21.838
−.134
21.704

$$\frac{21.704}{36} = 0.603$$

$$\sqrt{0.63} = 0.776 \text{ r.m.s.}$$

$$K = \frac{138}{0.776} = 178$$

Column H shows the value of the radiated field at the various values of ϕ, in mv/m at one mile. Column J shows the pattern normalized to a value of 1.00 for its r.m.s., for purposes of determining voltage gain. The values in column J are plotted in fig. 83. The gain in the direction of the maximum lobes (broadside to line of towers) is 1.825, which is a power gain of 3.33 or 5.23 db. There are two minor lobes, with two pairs of nulls at 31°, 149°, 211°, and 329°. I might state here that if the spacing were 180° instead of 210°, with equal in-phase currents, the two minor lobes would not be present. There would be only two nulls, at 0° and 180°, but the gain at 90° and 270° would be reduced to 4.56 db. Any reader who wishes to run through the pattern computation for this latter case is welcome to do so, and find out this answer for himself.

If one wishes to compute the vertical pattern in the case of this 210° spacing, 0° phasing array, it may be done by use of the expanded formula:

$$E = K f(\theta) \sqrt{1 + \cos (S \cos \phi \cos \theta + \psi)}$$

Factor $f(\theta)$ was discussed in Part IV, and it depends on the tower height G in degrees. θ is the vertical angle for which the value of radiation is to be computed.

Feed Design

With the array parameters decided, we must now determine how to feed it. The first step is the determination of the self-impedance of each tower. Assuming a design frequency of 3.9 mc, a tower height of 60 feet is about right for a quarter wavelength. Assuming an effective diameter of 7 inches, the L/D of the tower would be about 100. Referring back to Part II[72] it will be found that K_a for this value of L/D is 599. Or K_a can be computed from the equation:

$$K_a = 120 \log \frac{L}{D} - 120.$$

From fig. 13 of Part II, for a tower height of a quarter wave and a K_a of 600, $R = 34$ ohms and $X = +j25$ ohms. Next comes the computation of the effects of mutual impedance between the towers, and the actual operating impedance of each tower. Again referring to Part IV, fig. 32, we see that the mutual impedance between the towers spaced 210° is $-9 -j11$ ohms. Yes, -9 ohms! Don't let the minus sign in front of the R term frighten you. It is perfectly "legal."

The equations for finding the actual operating impedances of each tower are:

$$Z_1 = Z_{11} + \frac{I_2}{I_1} Z_{21} \textit{ and,}$$

$$Z_2 = Z_{22} + \frac{I_1}{I_2} Z_{12}.$$

where Z_{11} is the self-impedance of tower 1 by itself,

Z_{22} is the self-impedance of tower 2 by itself,

I_1 is the base current (loop current) of tower 1,

I_2 is the base current (loop current) of tower 2,

Z_1 is the actual operating impedance of tower 1 in the array, and

Z_2 is the actual operating impedance of tower 2 in the array.

This is the same set of equations used in Part VIII.

Having found Z_{11} and Z_{22} from fig. 13 of Part II, we know them to be $34 + j25$ ohms. The mutual impedances Z_{21} and Z_{12} equal $-9 -j11$ ohms. We do not know the magnitude of I_1 and I_2 yet, but they are equal and in phase, and can be represented as $I_1 = I_2 = 1.0 \underline{/0°}$.

Solving for Z_1:

$$Z_1 = (34 + j25) + \left(\frac{1.0 \underline{/0°}}{1.0 \underline{/0°}}\right)(-9 -j11)$$
$$Z_1 = (34 + j25) + (1)(-9 -j11)$$
$$Z_1 = 25 + j14 \textit{ ohms}$$

Solving for Z_2:

$$Z_2 = (34 + j25) + \left(\frac{1.0 \underline{/0°}}{1.0 \underline{/0°}}\right)(-9 -j11)$$
$$Z_2 = (34 + j25) + (1)(-9 -j11)$$
$$Z_2 = 25 + j14 \textit{ ohms}$$

Note that we get the same result. This means that the operating impedances of the two towers are identical. Note, however, how different they are from the tower self-impedances. The effect of the mutual impedance and the currents flowing is quite pronounced.

Tower Currents

Now that we know the actual operating impedances we can find the tower currents:

$$P_1 = I_1^2 R_1$$
$$P_2 = I_2^2 R_2 \textit{ and}$$
$$P_1 + P_2 = 500 \textit{ watts}$$

$$I_1 = I_2 \textit{ and, in this case,}$$
$$R_1 = R_2$$

Therefor:

$$2 (I_1^2 R_1) = 500$$
$$2 (I_1^2 25) = 500$$

[72]Lee, P. H., "Vertical Antennas—Part II", *CQ*, July 1968.

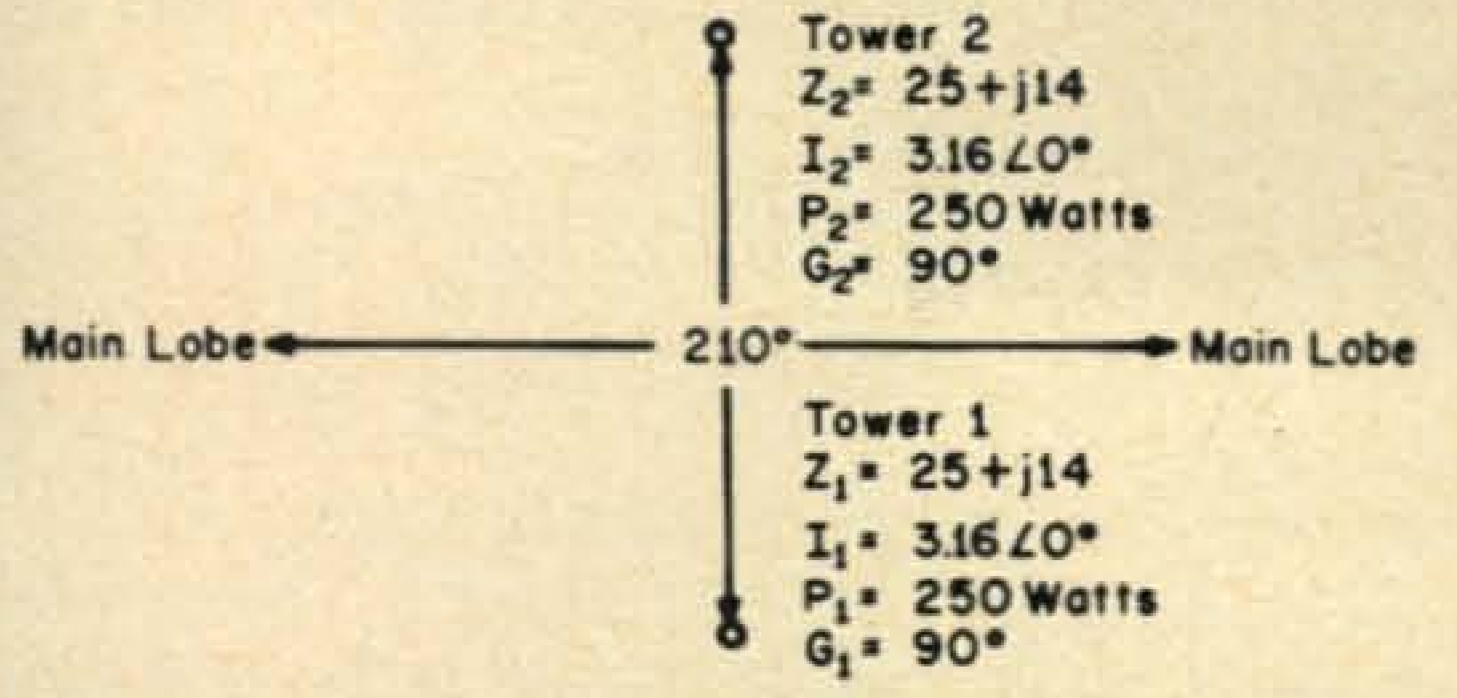


Fig. 84—Array configuration discussed in text.

$$I_1{}^2 = 10$$
$$I_1 = 3.16 \text{ amps} = I_2$$

As a check:

$$P_1 = (3.16)^2\, 25 = 250$$
$$P_2 = (3.16)^2\, 25 = 250$$
$$P_T = 250 + 250 = 500 \text{ watts}$$

The array configuration is shown in fig. 84.

ATU's

Now that we know the tower operating mpedances, it is possible to design the power lividing circuit and the antenna tuning units. t would be possible to do without any tuning inits and simply connect 50 ohm line to the owers, and parallel the two equal length lines at the feed point. However, quite a large s.w.r. will result, and this is undesirable. The circuit of fig. 85 is recommended. An Ohm's Law network is used to give exact control over power division. Since the array is to work on 3.9 mc, 10 microhenry power divider coils are assumed. Each of these has a reactance of $+j260$ ohms at 3.9 mc. The taps are at equal distances above ground, and are placed at the $+j188$ ohm points, to make the computation simple. This leaves $+j72$ ohms above each tap. Considering each feedline to be pure 50 ohms resistance load, the parallel combination of 50 and $+j188$ is computed:

$$\frac{(50 \,\underline{/\,0°})\,(188\,\underline{/\,90°})}{50 + j188} = \frac{9400\,\underline{/\,90°}}{195\,\underline{/\,75°}} =$$

$$48.2\,\underline{/15°} = 46.6 + j12.5$$

Adding the upper portion of the coil to this, the total impedance of each tower's feed which is presented to the common branching point is:

$$46.6 + j12.5 + j72 = 46.6 + j87.5$$

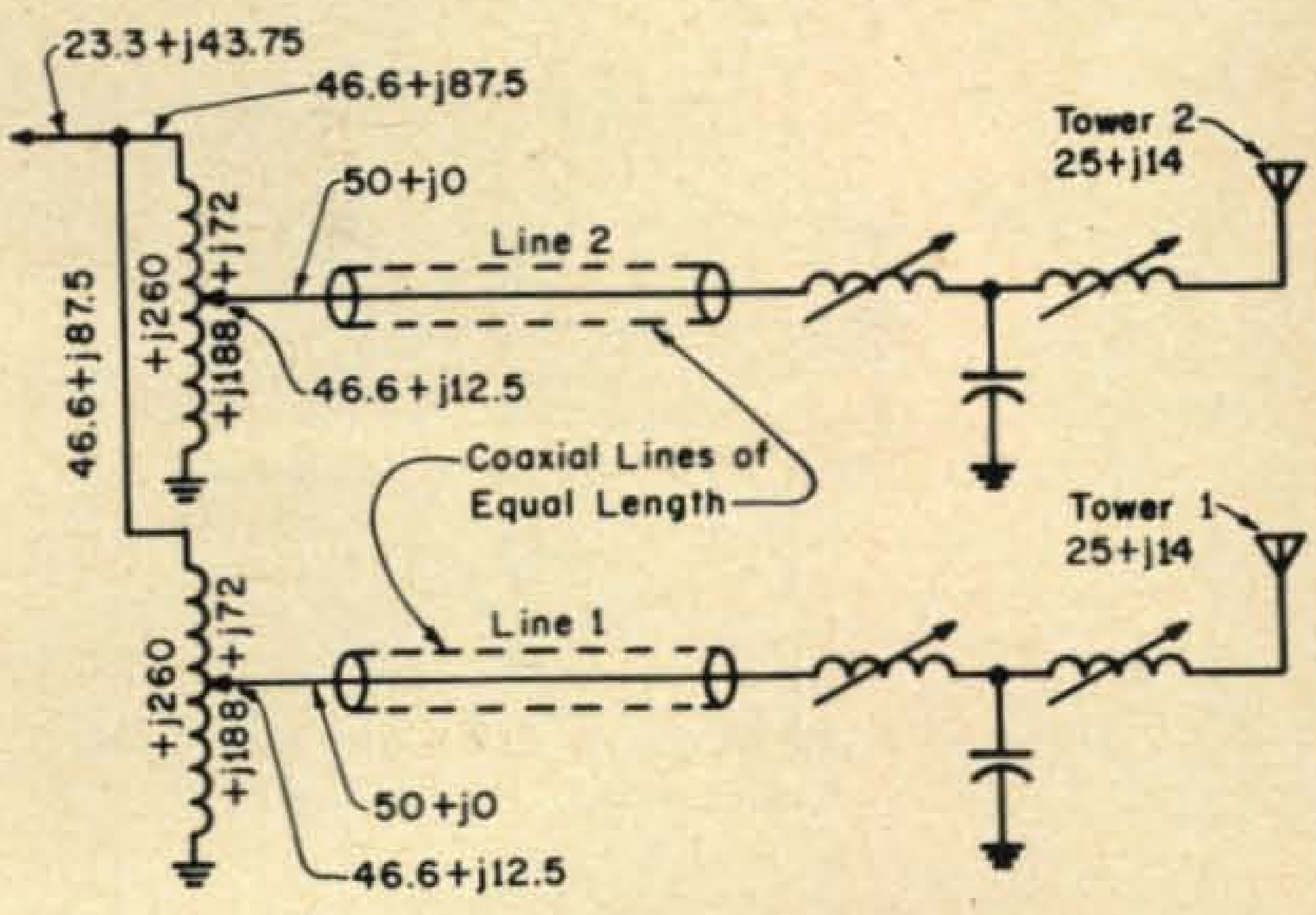


Fig. 85—Branching circuit and the various impedances and reactances.

Inasmuch as the two tower feeds are equal, adding them in parallel can be accomplished by dividing one of them by 2:

$$\frac{46.6 + j87.5}{2} = 23.3 + j43.75$$

These several impedances and reactances are shown at appropriate places in fig. 85.

A matching network will be required to transform this value of $23.6 + j43.75$ to $50 + j0$ ohms. Again, as in Part VIII, we use our old friend the 90° network, so easy to compute. It is shown in fig. 86. The values of X_C and X_L are easily computed from the equation:

$$x = \sqrt{R_1\, R_2}$$

In this case:

$$x = \sqrt{23.3 \times 50}$$
$$= 35.8$$
$$x_C = -j35.8 \quad \text{or} \quad 1120 \text{ mmf at } 3.9 \text{ mc.}$$
$$x_L = +j35.8 \quad \text{or} \quad 1.45\ \mu\text{h at } 3.9 \text{ mc.}$$

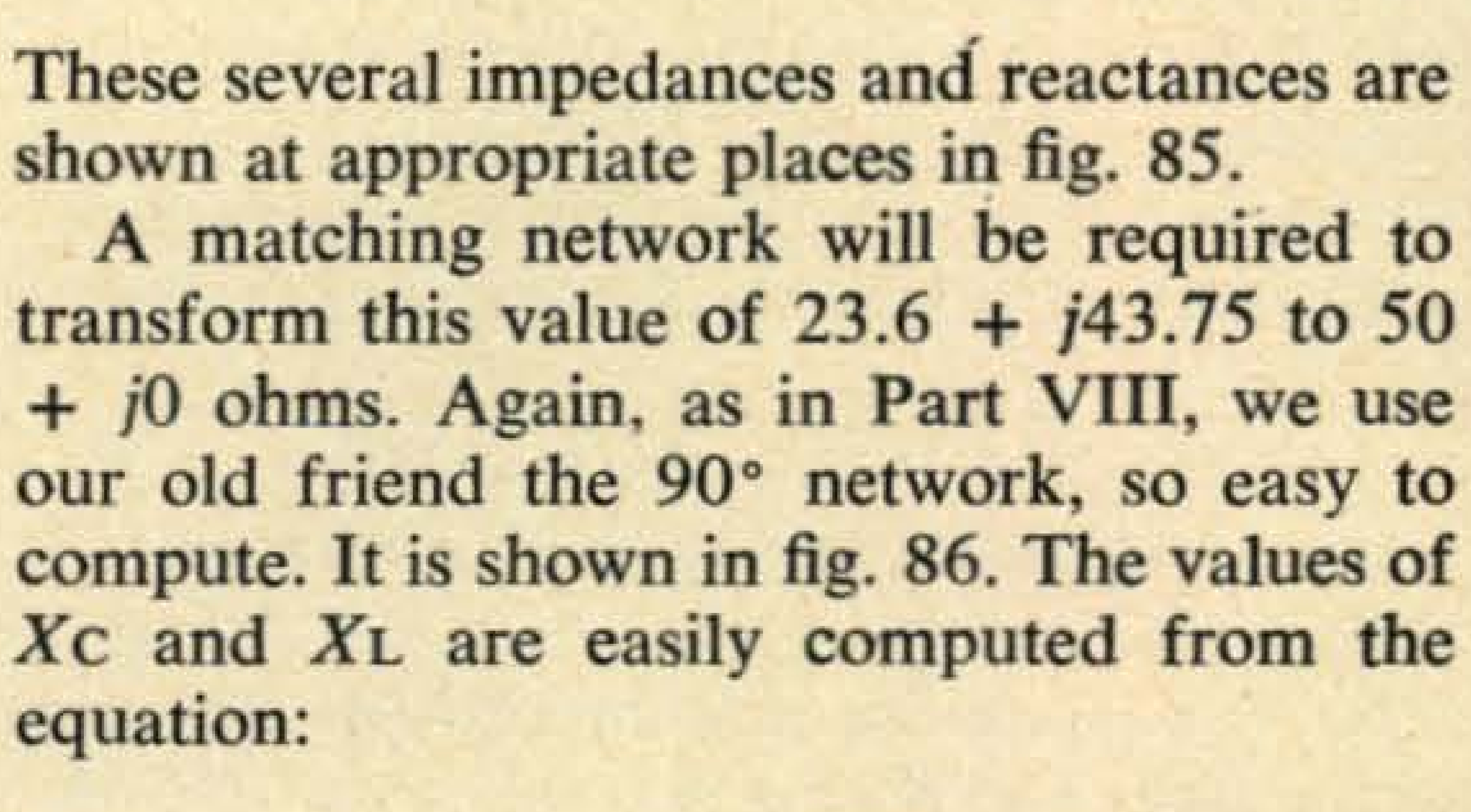


Fig. 86—Input T network, a 90° network that is easy to compute, is used to match branching network to transmitter.

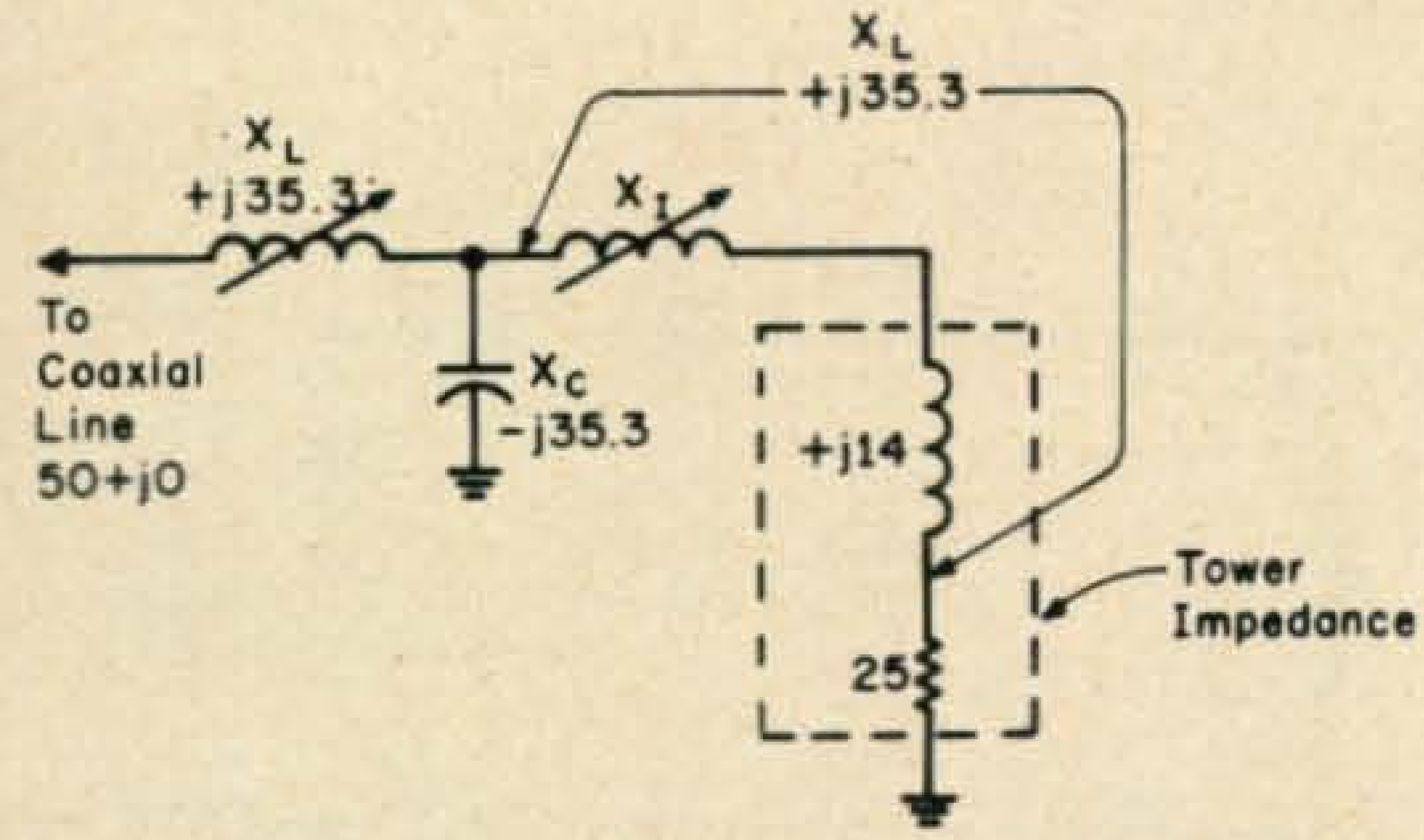


Fig. 87 — ATU employs a 90° network for matching.

Inasmuch as X_L is less than the reactance of the input to the branching network, it is most expedient to insert some negative reactance X_2 in series and to cancel some of it out with an adjustable positive X_1. Why not simply insert a negative reactance equal to the difference between $+j43.75$ and $+j35.8$ ohms? This would be equal to about $-j8$ ohms, which would be 5000 mmf at 3.9 mc. It would be a bit impractical to make this variable. It is much easier to make the inductance variable. In this case a 1000 mmf fixed capacitor is chosen for X_2, with a reactance of $-j41$ ohms. Thus X_1 can be found as follows:

$$x_1 = +j35.8 - (+j43.75 - j41)$$
$$x_1 = +j33.05 \quad \text{or} \quad 1.35\ \mu\text{h at 3.9 mc.}$$

Now, turning our attention to the antenna tuning units and noting that the tower operating impedances are identical, the ATUs will be identical. (Figs. 85 and 87.) Again using our old friend the 90° T network, so easy to handle,

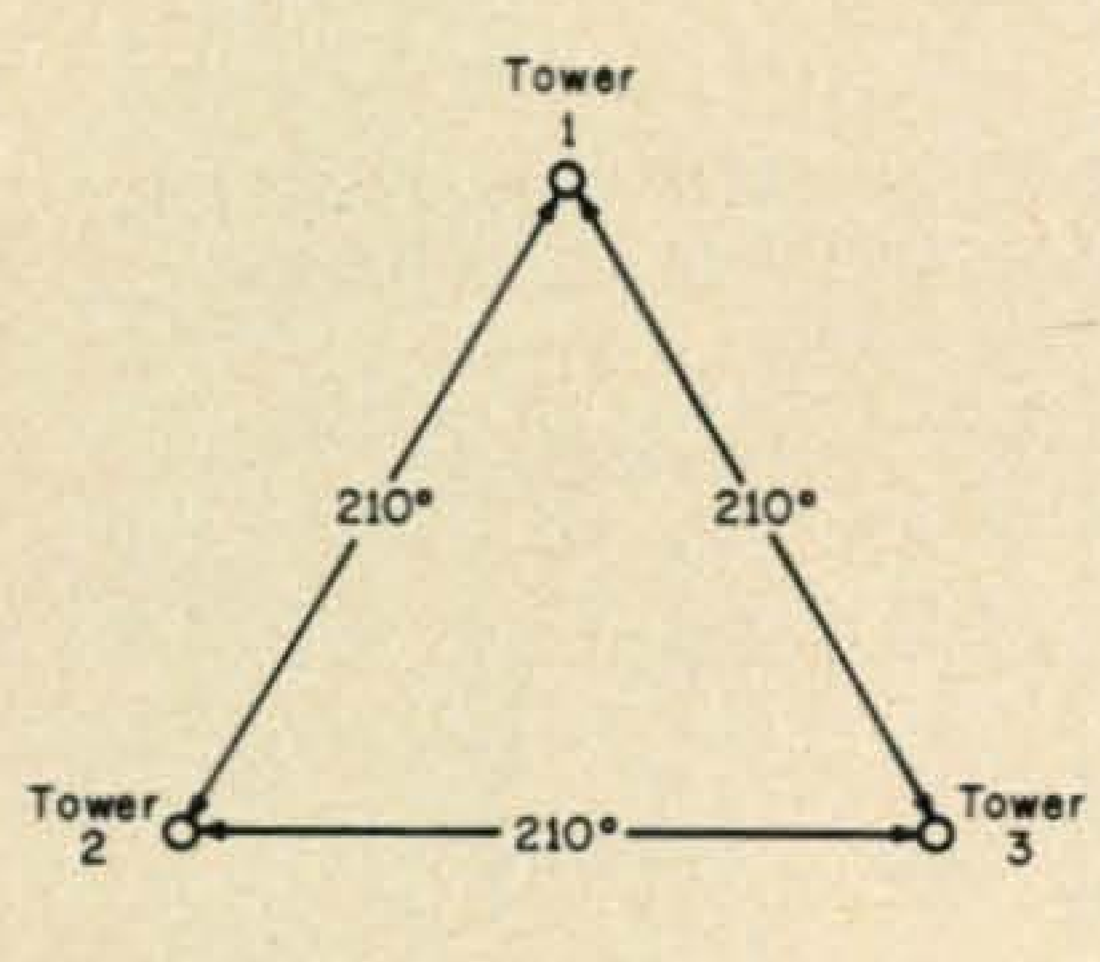
$$x = \sqrt{25 \times 50}$$
$$= 35.3$$

$$x_C = -j35.3 \quad \text{or} \quad 1106 \text{ mmf at 3.9 mc.}$$
$$x_L = +j35.3 \quad \text{or} \quad 1.47\ \mu\text{h at 3.9 mc.}$$
$$x_1 = +j21.3 \quad \text{or} \quad 0.886\ \mu\text{h at 3.9 mc.}$$

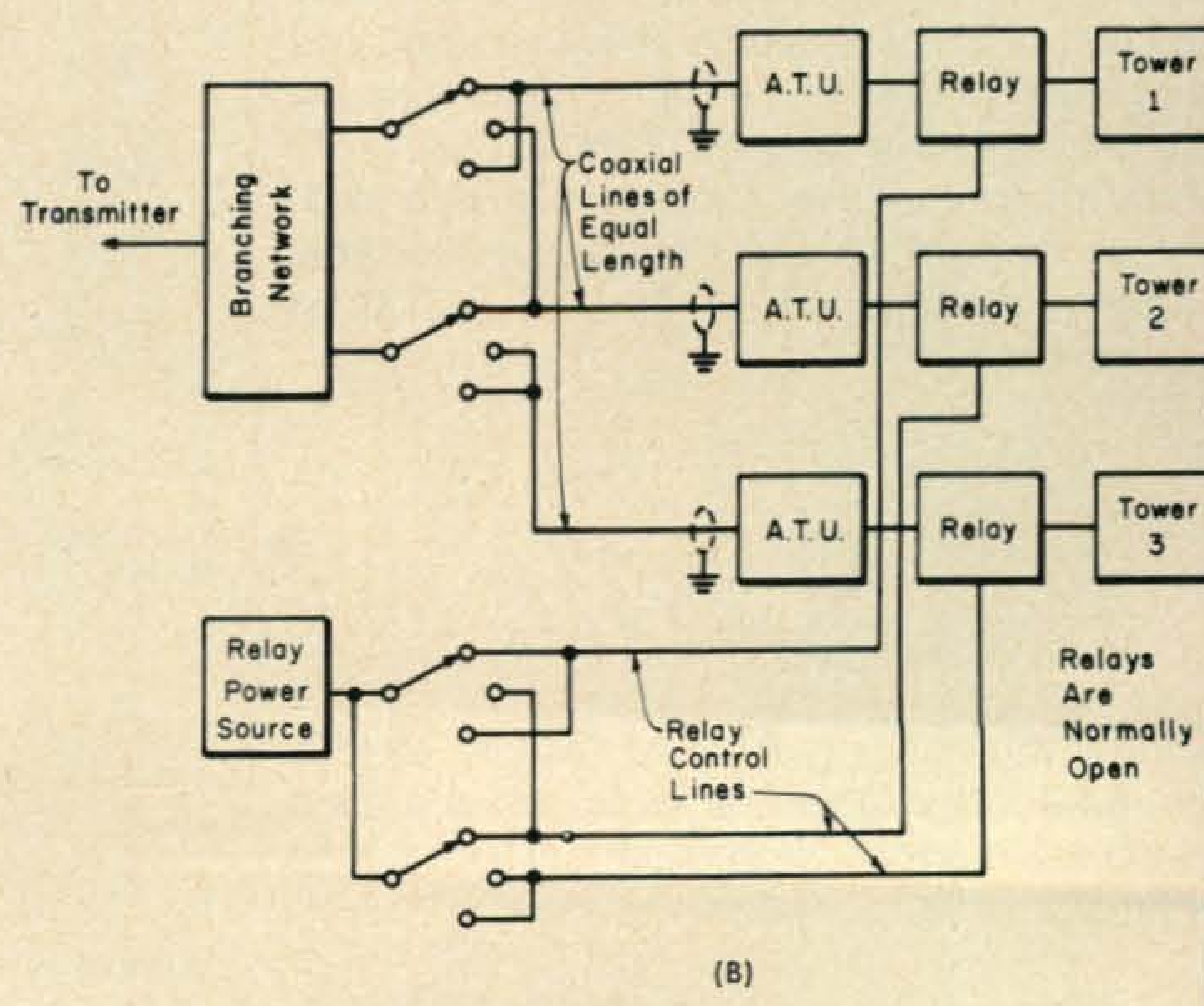
It must be emphasized that this is the *computed* design. In actual field practice the professional engineer will measure the tower self-impedances and the mutual impedance with his r.f. bridge, and will then run through the phasing and branching network calculations again using the actual *measured* values. The results should be fairly close to the computed values. In actual practice, the equipment designer will make all reactances with a 50% increase in tolerance to allow for the differences which may occur between computed and measured values. To obtain odd values of $-jX_C$, it is standard practice to use a fixed capacitor in series with a variable coil.

Three Element Array

Now that we have the array and feed system designed, it is quite simple to use it in an equilateral triangle configuration, with three elements, driving any pair of them at a time. Such a system is shown in schematic form in fig. 88. A three position rotary switch is needed, with provision for open-circuiting



(A)



(B)

Fig. 88(A)—Configuration of the towers. (B) Switching arrangement for triangular configuration.

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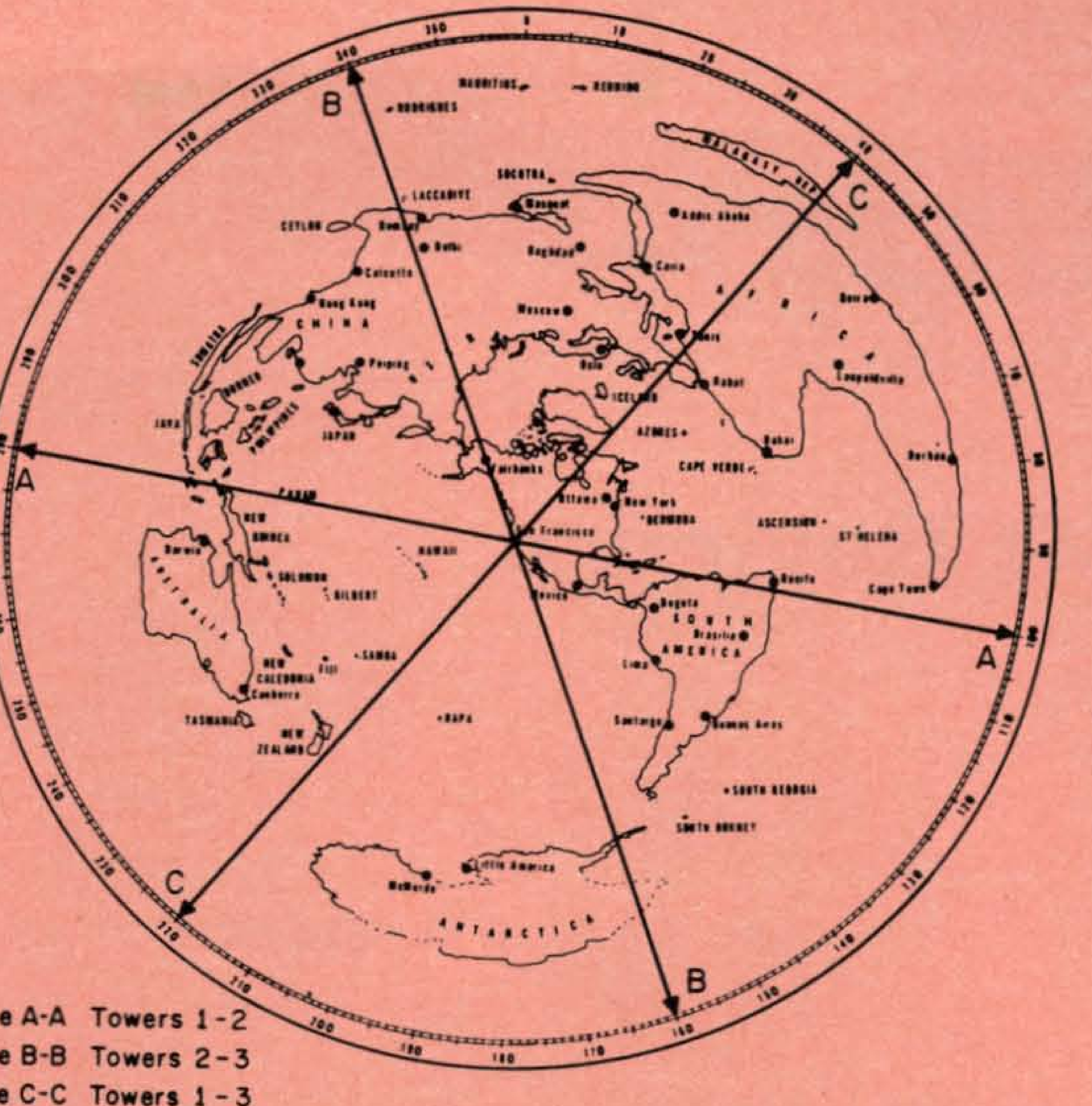

Fig. 89—Directions of the main lobes as shown on an azimuthal projection centered on Los Angeles Line A-A is the direction of the main lobes from towers 1 and 2, B-B from towers 2 and 3 and C-C from towers 1 and 3. The tower orientation for this pattern is discussed in the text.

the unused tower in each position. This is most easily done by means of a relay in each tower.

The triangle can be oriented so that the bidirectional beam from each pair of elements falls on a desired azimuth, for global coverage, as shown in fig. 89. This is an example of the directions which can be obtained from a west coast site. A similar map can be used for any other site in the United States. Azimuthal maps such as this often appear in the front pages of the *Radio Amateur Call Book*, and they may be obtained also from the U. S. Navy Hydrographic Office, Washington, D. C., and the U. S. Coast and Geodetic Survey, Washington, D. C.

In fig. 89, Line *A-A* is the direction of the main lobes from towers 1 and 2, Line *B-B* is the direction of the main lobes from towers 2 and 3, and Line *C-C* is the direction of the main lobes from towers 1 and 3. To produce the main lobes oriented on the azimuths shown, the triangular configuration of towers shown in fig. 88(A) is oriented as follows:

Line of towers 2 and 1—bearing 10°
Line of towers 2 and 3—bearing 70°
Line of towers 1 and 3—bearing 130°

The next Part of this series will cover the theory and design of the folded unipole antenna. There have been several requests for more information on this type.

[To Be Continued]

Back issues of *CQ* containing earlier installments of "Vertical Antennas" by Capt. Paul H. Lee, W3JM, are available from the *CQ* Circulation Department, 14 Vanderventer Ave., Port Washington, N.Y. 11050. Price per copy is $1.00, with the exception of January 1969, which is 75¢. The entire series is planned to run twelve consecutive installments.

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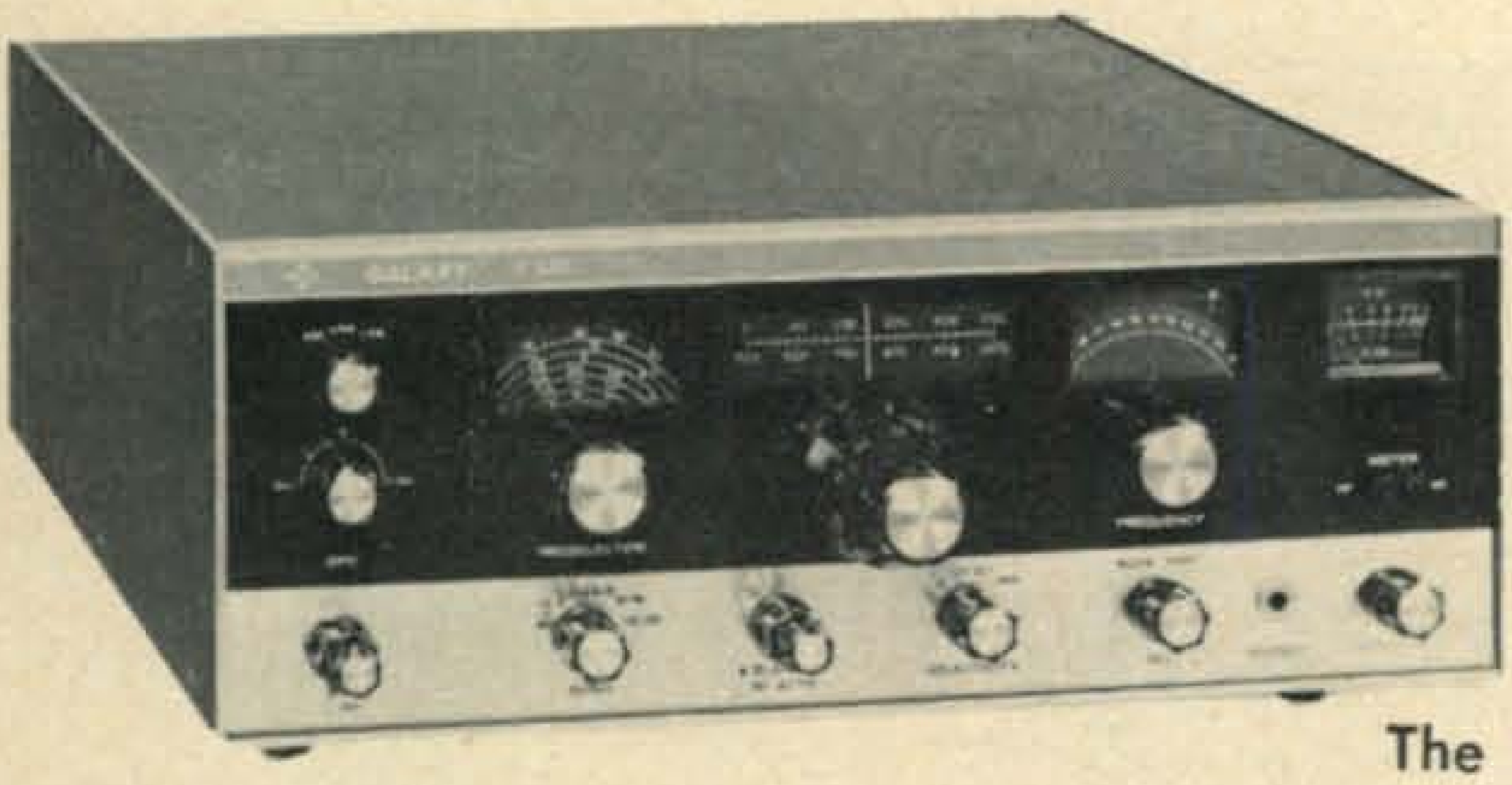

The Galaxy R-530 Solid-State 0.5-30 mc Continuous-Coverage Receiver.

CQ Reviews:

The Galaxy R-530 Solid-State Receiver

BY WILFRED M. SCHERER,* W2AEF

THE Galaxy R-530 is an all solid-state receiver with *continuous* frequency coverage from 500 kc to 30 mc. Unlike the run-of-the-mill general-coverage receivers, the R-530 provides an accurate calibration in 1 kc steps throughout its entire range which consists of 59 separate 500 kc segments each with the same linear tuning rate. Exceptional stability is achieved by means of a comparatively low-frequency v.f.o. and a phase-locked frequency synthesizer.

Since the benefits of such a setup, along with the following features, should be quite obvious, a further discussion in this respect has been set aside in favor of devoting our alloted space to looking over the interesting details regarding this receiver.

Other features of the R-530 include: high sensitivity; high-Q preselector tuning; four choices of selectivity with crystal-lattice filters of 0.5, 1.5, 2.1 and 6 kc for optimizing operation with c.w., RTTY, s.s.b. (l.s.b. or u.s.b.) and a.m.; envelope and product detectors; fast and slow a.g.c., r.f. and a.f. gain controls plus r.f.-input attenuator; tunable crystal-controlled b.f.o.; noise blanker; 50 kc crystal calibrator; meter for r.f.-input or a.f.-output signal levels; two-speed tuning control; adjustable hairline fiducial for precise indexing; 8- and 500-ohm a.f. outputs; modular construction; operation from 120/240 v.a.c. 50/60 c.p.s. or 18 v.d.c.

*Technical Director, *CQ*

Basic Lineup

Referring to the block diagram at fig. 1, the R-530 is a dual-conversion job with a 1st i.f. of 41.625-42.125 mc and a 2nd i.f. of 9 mc. The h.f. heterodyning-oscillator signals are obtained from the phase-locked frequency synthesizer and are in increments of 500 kc between 42.625 and 71.625 mc as needed to produce the 1st i.f. with incoming signals on the particular band segment.

The 9 mc 2nd i.f. is obtained by mixing the 1st i.f. signals with variable heterodyning signals of 32.625-33.125 mc obtained by "pre-mixing" the output of a 4975-5475 kc permeability-tuned v.f.o. with a 38.1 mc crystal-controlled signal.

Use of the 42 mc 1st i.f. ensures high image rejection and along with the related need for 42-71 mc heterodyning signals which are above the receiver range, eliminates spurious oscillator responses. Oscillator pre-mixing for the second conversion and the

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relatively low-frequency v.f.o. provides excellent stability at these injection frequencies and further minimizes spurious responses.

The basic lineup is otherwise quite convention and thus needs no further explanation.

Circuit Details

Bi-polar transistors are used in the R-530. As far as the r.f. front-end of a receiver goes when solid-state devices are engaged, precautions must be taken to minimize the possibility of overload and cross modulation in the presence of strong signals. To cope with the situation, the r.f. stage consists of two transistors which function as an emitter-coupled amplifier that is analogous to the cathode-coupled vacuum tube amplifier which has high signal-handling capabilities. The arrangement is shown at fig. 2. An r.f.-input attenuator, which is simply a 5 K poteniometer, also is included for use under severe conditions.

The r.f. stage input and output circuits are adjusted to frequency by permeability tuning of the associated inductors. High-Q circuits for good selectivity are thus maintained along with relatively uniform gain over the entire range.

To further enhance the front-end characteristics, the 1st mixer is one of the latest type devices which is the coming trend in sophisticated equipment. This is the balanced-converter or -mixer using four diodes, a particular feature of which is the minimization of both signal and oscillator voltages at the output, greatly reducing the possibility of spurious responses.

This mixer is an individual unit encased in a package similar to that used for crystal-lattice filters. Included in it is a low-pass filter to enhance the rejection of unwanted signals. The setup also is shown at fig. 2.

The 2nd mixer is in a completely shielded module which also includes the noise blanker. This mixer employs a grounded-emitter circuit with both the i.f. signal and the variable-oscillator signal applied to the base. The input circuit is a double-tuned affair and provides a second bandpass setup to further attenuate undesired signal responses.

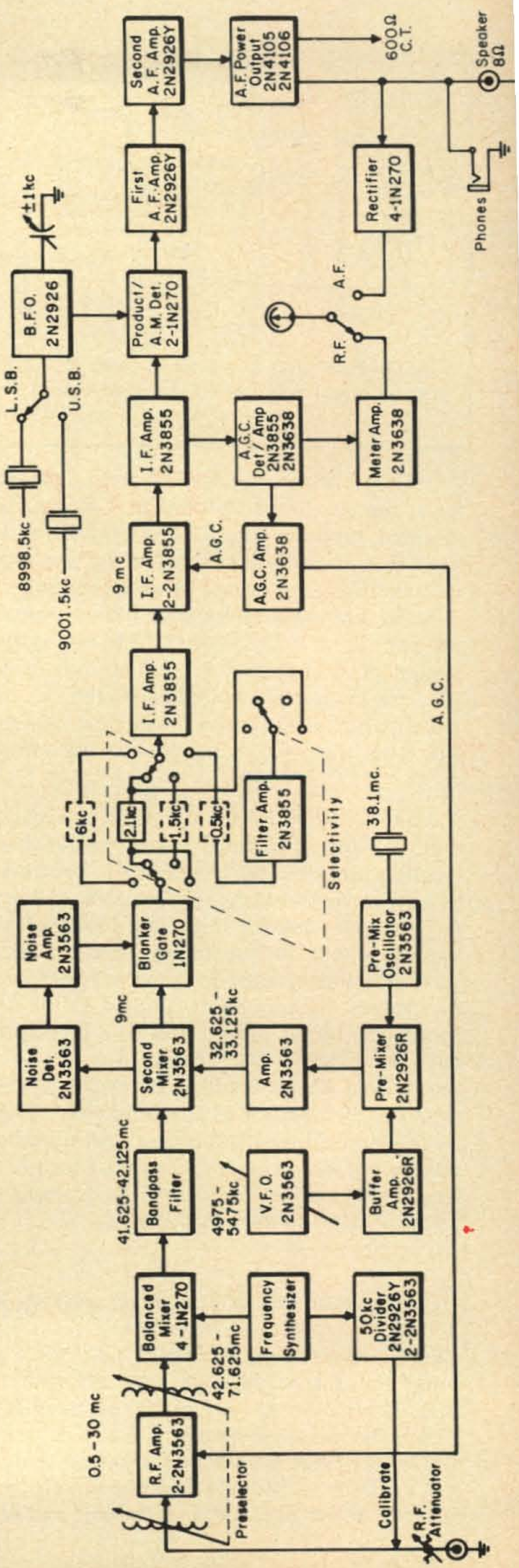

Fig. 1—Block diagram of the setup used in the R-530. Details are given in the text.

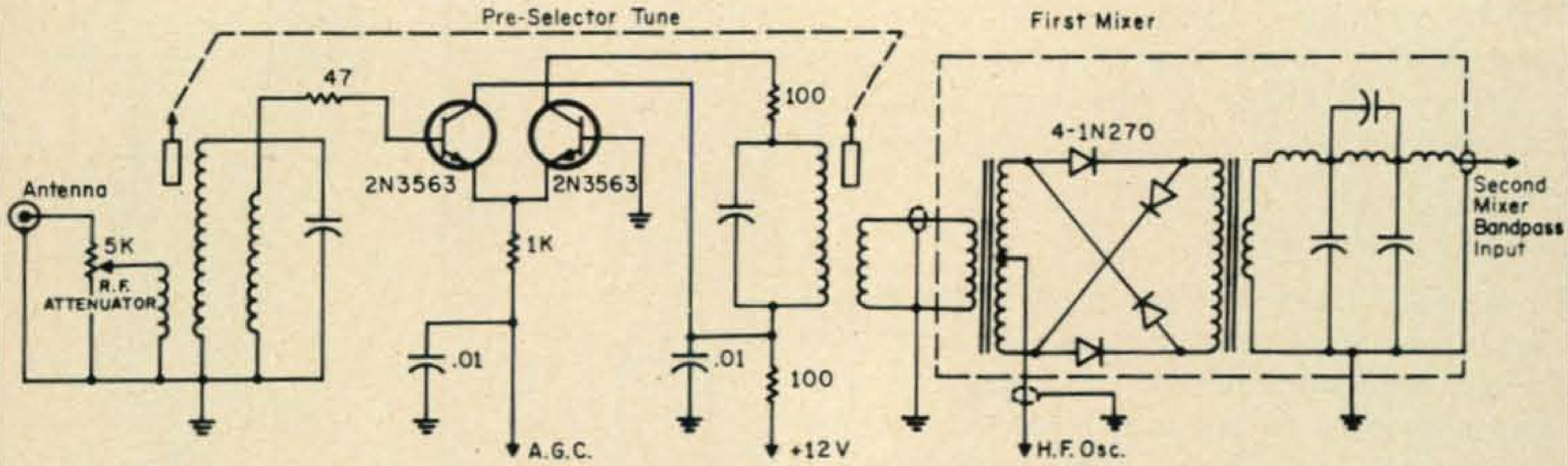

Fig. 2—Front-end basic setup used in the R-530. The r.f. stage is an emitter-coupled amplifier with permeability-tuned input and output circuits. Th mixer is a balanced affair using 4 diodes and includes a low-pass filter.

The oscillator-injection signals are fed from the oscillator "pre-mixer," in another shielded module, and is a common-emitter type that is followed by a buffer amplifier with bandpass input-and output-coupling circuits to attenuate undesired mixing products outside of the 32.625-33.125 mc output range. Also included in the module is the 38.1 mc crystal controlled oscillator, the output of which is fed to the mixer base. The output from the v.f.o. is injected at the emitter.

V.F.O.

The 4975-5475 kc v.f.o. is in a separate module and functions in a series-tuned Colpitts circuit. The frequency is controlled by permeability-tuning the inductive element. A grounded-emitter amplifier follows the v.f.o. Its output passes through a three-section low-pass filter designed to reject v.f.o. harmonics. Besides being applied to the pre-mixer, the buffer output goes to a rear-apron jack for external use. There also is a v.f.o. input jack which enables an external v.f.o. signal to be applied to the pre-mixer. These facilities thus make transceive operation possible using the receiver v.f.o. for also controlling a transmitter, or using the transmitter v.f.o. to also control the receiver.

I.F. Circuits

The output of the 2nd mixer goes to the crystal-lattice filters for which a 4-position switch allows the selection of any one filter (only the 2.1 kc filter is supplied with the set), regardless of the mode of operation. When the switch is set for 0.5 kc selectivity, the 0.5 kc filter is switched in series with the 2.1 kc filter to provide additional selectivity further down the skirts. A buffer amplifier between the two filters makes up insertion losses and provides proper matching.

The filter output goes to the 9 mc i.f. module which, besides the three i.f. stages, includes the product and envelope detector, the b.f.o. and the a.g.c. detector/amplifier. The 1st and 2nd i.f.'s are grounded-emitter stages. The 2nd i.f. uses two transistors in an emitter-coupled affair like that of the r.f. input amplifier shown at fig. 2.

The product detector is a dual-diode "balanced Modulator" type and is similar in principle to one described some time ago in *CQ*[1] where one diode can be switched out, leaving the other one to serve as an envelope detector for a.m. The circuit is shown at fig. 3.

B.F.O.

The b.f.o. is crystal-controlled, but can be varied ±1 kc using a unique arrangement, as shown at fig. 3, whereby a panel control "rubbers" either sideband crystal. Another feature is that when sidebands are switched by changing the b.f.o. crystals, a diode switch simultaneously cuts an inductor in or out of the 38.1 mc pre-mixer crystal circuit. This then alters the 2nd mixer oscillator-injection signal by the same amount by which the b.f.o. has been shifted. This eliminates the need for likewise compensating the v.f.o. frequency as is usually done to avoid the need for retuning when sidebands are switched. It also ensures perfect tracking of the v.f.o. when either sideband is in use.

A.F. System

The a.f. chain is an individual unit built on an open printed-circuit board. There are

[1]Brown, "Tubeless Product Detector," *CQ*, March 1965, p. 41.

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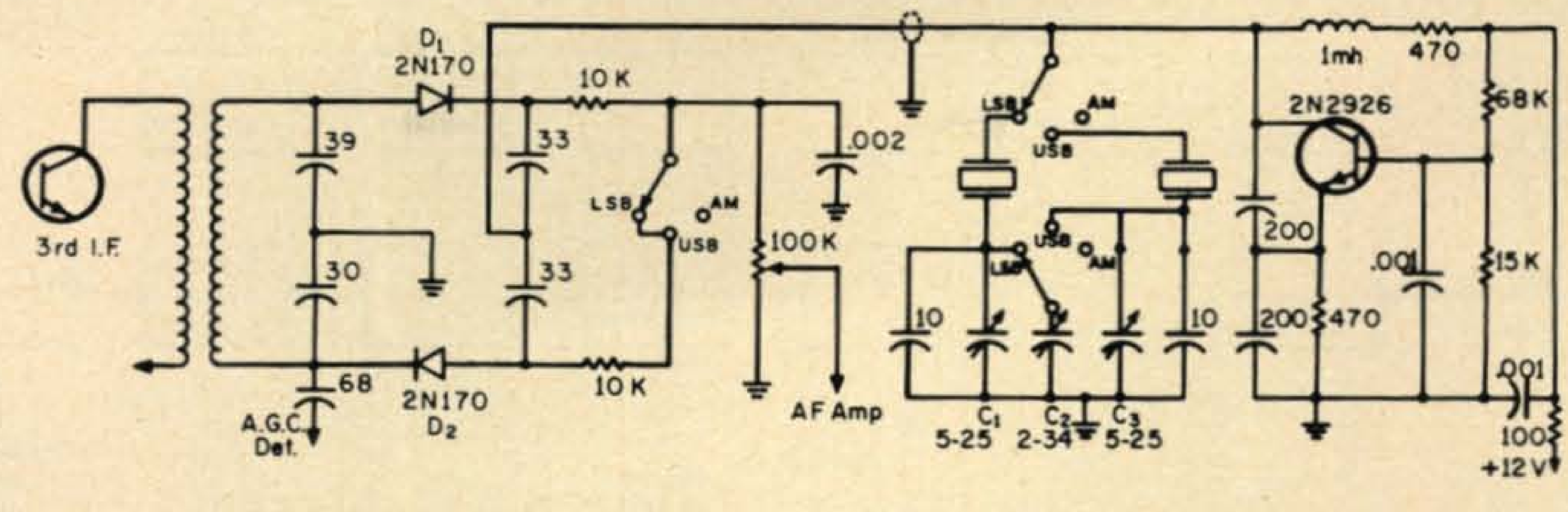


Fig. 3—Product detector used in the R-530. Envelope detection for a.m. is obtained with D1 when D2 is switched out and the b.f.o. is off. Also shown is the tuning setup for the crystal-controlled b.f.o. C2 is a panel control that is switched to either sideband crystal to rubber the frequency 1 kc. To avoid the neea for retuning when sidebands are switched, C1 and C3 are initially adjusted so that when C2 is at mid-capacitance, Y_1 and Y_2 frequencies are properly correlated with the 2nd-mixer variable-oscillator signal.

two stages of amplification with special filtering to tailor the a.f. response. The 2nd stage is d.c. coupled to a driver which in turn is d.c. coupled to two power-output transistors which are connected in a complimentary NPN/PNP push-pull type circuit with the output applied directly to the loudspeaker jack from the low impedance common emitter circuit. There is no output transformer needed for the speaker. On the other hand, there is a transformer that steps up the low-impedance output from the amplifier to provide a 600-ohm c.t. feed for other uses. In addition, the amplifier output goes to a bridge rectifier that can be switched to the panel meter for indicating relative a.f. output levels and as such, provides monitoring as might be needed when feeding a radio line, p.a. system or recording gear.

A.G.C.

The a.g.c. detector / amplifier is d.c. coupled to a 2nd amplifier (on a separate circuit board) the output voltage from which is applied to the return for the common-emitter resistor of the r.f. stage and the 2nd i.f. A separate d.c. amplifier, bridged across the 2nd a.g.c. amplifier input, functions as an amplifier for the signal-level meter which is calibrated in steps of 10 db above 1 μv r.f. input signal.

The r.f. gain alters the bias on the a.g.c. amplifier. Slow or fast a.g.c. is selected by switching a 100 mf capacitor in or out of the a.g.c. circuit. The a.g.c. voltage also is fed to a jack for external use. Another jack is tied in with the a.g.c. feed to the controlled stages for muting purposes. There also are two spare jacks and one for the output of the detectors.

The a.c. power supply employs a silicon-diode bridge rectifier and it provides two output voltages, one plus 12 v., the other minus 12 v. Each source is individually electronically regulated using two transistors. These voltages are also available at rear-apron terminals for external use. The power plug is a Jones type at which jumpers may be connected to provide operation from 120 or 240 v.a.c. or from two 18-volt batteries connected in series.

Noise Blanker

The noise blanker samples the output of the 2nd mixer, any noise pulses from which are detected and amplified to provide a gating signal of the proper amplitude and shape to momentarily make the diode gate go into non-conduction and thus interrupt the circuit to the i.f. filter during each noise pulse.

Phase-Locked Frequency Synthesizer

Except for the frequencies involved, the phase-locked oscillator or frequency synthesizer setup is similar as found in other gear.

A block diagram of the system is shown at fig. 4. The h.f. oscillator provides heterodyning frequencies spaced 500 kc apart between 42.625 and 71.625 mc. This oscillator is a self-excited affair and might ordinarily drift or be detuned from the exact required frequency, but this possibility is forestalled by phase-locking the oscillator to harmonics of a 500 kc signal derived from the 2:1 fre-

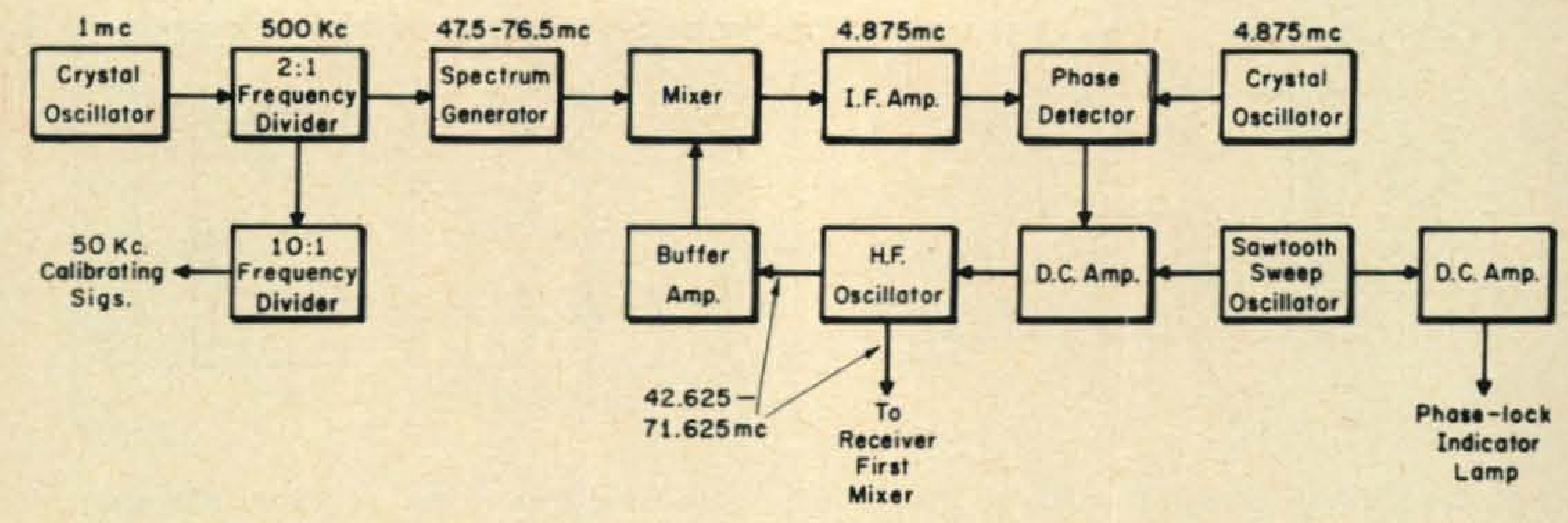


Fig. 4—Block diagram of phase-locked frequency synthesizer used in the R-530. See text for details.

quency divider driven by the 1 mc crystal-controlled oscillator.

The frequency divider drives the spectrum generator [2] where the harmonics are exaggerated and where the correct one is selected [3] for producing a 4.875 mc i.f. at the output of the mixer when the desired h.f. oscillator frequency is also applied to the mixer. This signal is amplified and fed to a phase detector to which a crystal-controlled reference signal of 4.875 mc also is applied.

If the i.f. signal is not exactly the same as that of the 4.875 mc oscillator, an a.c. voltage beat will appear at the output of the detector. This a.c. component is increased by a d.c. coupled amplifier and is applied to a varactor (voltage-controlled variable-capacitor diode) in the self-excited h.f. oscillator. The varactor

[2]The 2:1 frequency divider also drives a 10:1 dividing system to provide the 50 kc calibrating signals.

[3]The spectrum-generator and h.f.-oscillator tuning are ganged together.

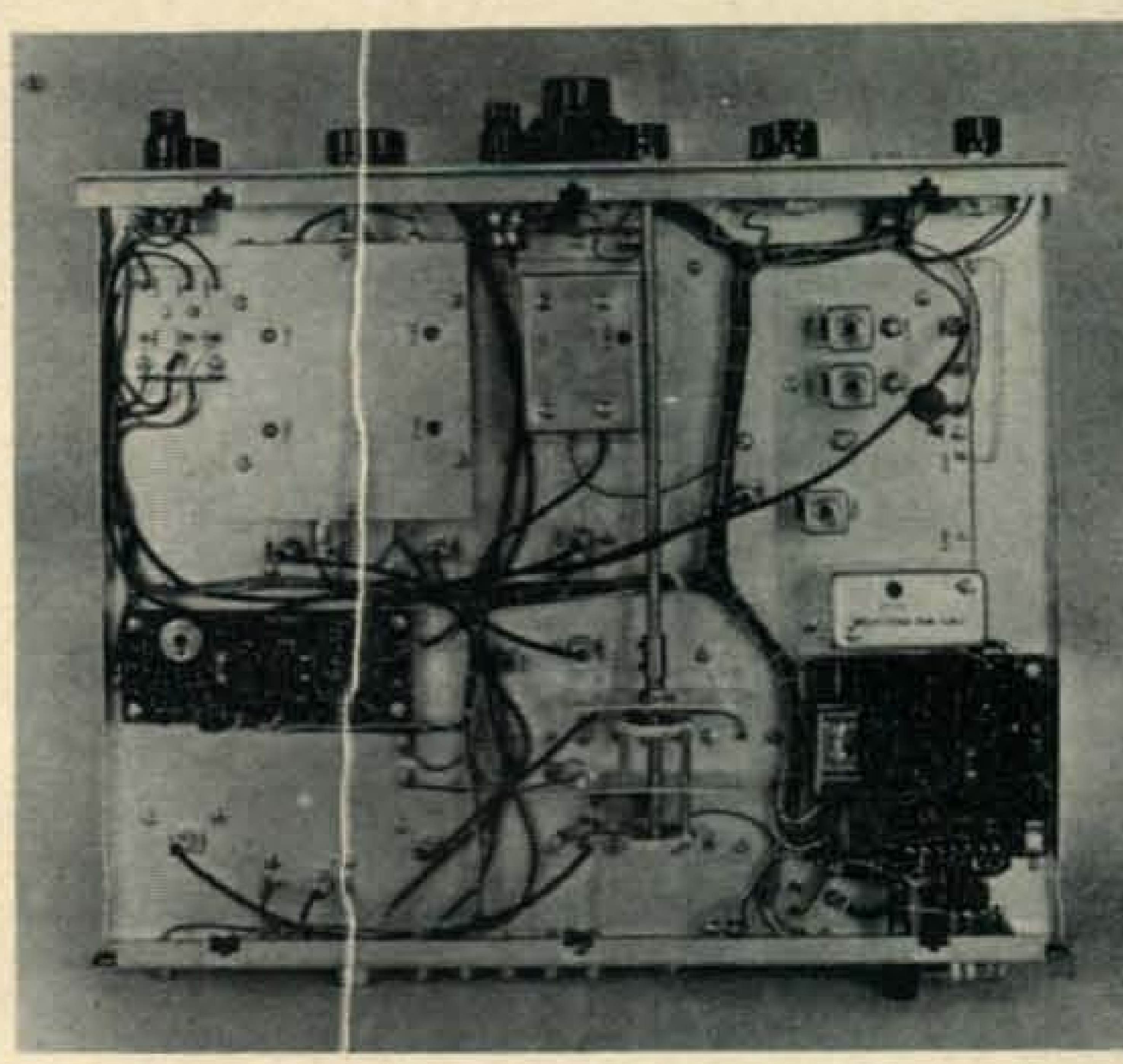
Bottom view of the R-530. A neat layout is made with shielded cables and phono connections for the r.f. circuits between the various modules. Each connector is identified by numerals, as are the tie points for various other power leads. The two circuit boards contain the a.g.c. and a.f. sections.

capacitance will vary at an a.c. rate and thus will sweep the oscillator frequency; however, as soon as the oscillator frequency becomes identical to that of the crystal reference oscillator (usually before one a.c. cycle is completed) there will be no a.c. output from the detector to further sweep the oscillator.

On the other hand, there will be a d.c. output component of an amplitude and polarity (according to the phase-angle difference between the two signals applied to the phase detector) that holds the varactor capacitance at the required value just obtained.

If the h.f. oscillator tends to drift, the phase angle will change and a different d.c. voltage of the correct polarity will alter the varactor capacitance to bring the oscillator back on exact frequency, thus cancelling the initial drift.

The amount of sweep obtainable from the a.c. output of the detector is limited. Thus, if phase-lock control is lost, the h.f. oscillator



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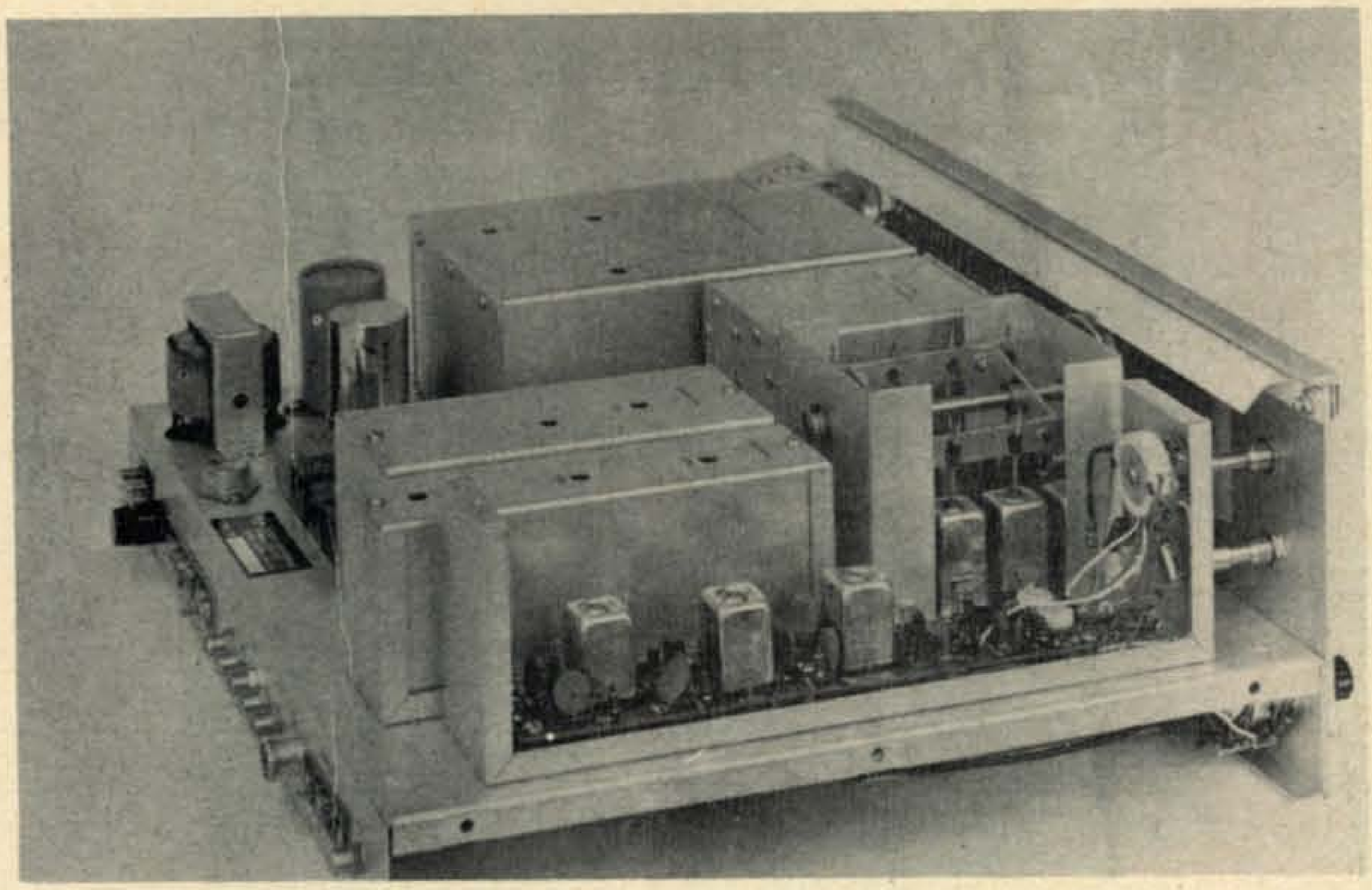

A top view of the R-530 showing the modular type of construction. Several of the modules are built in minibox type cases turned upside down with a printed-circuit board for the components. It is mounted on standoffs at the bottom as shown at the 9 mc i.f. module in the foreground from which the cover has been removed.
Behind it at the right is the mechanism for operating the slugs in the permeability-tuned preselector. A cradle on the control shaft moves the slugs up or down in opposite directions on each side, resulting in reverse frequency tuning on adjacent bands.

frequency may be too far removed from that required to phase-lock with the particularly needed harmonic from the spectrum generator. A sawtooth sweep generator then is automatically engaged to vary the varactor control voltage by a large amount, thereby providing a wide frequency scan of the h.f. oscillator until a 4.875 mc i.f. signal is again produced to cause phase locking.

During periods when the oscillator is being swept, the output of the sawtooth generator is also detected and amplified as a d.c. voltage to light an indicator lamp. When the sweep generator stops, the lamp extinguishes, indicating that the h.f. oscillator is phase locked on the frequency required for the band segment to which the oscillator dial is set.

Construction and Panel Controls

The v.f.o. is tuned by means of a two-speed affair with an inner knob that provides fast tuning with 5 revolutions required to cover the full 500 kc range for each band segment. Slow tuning is accomplished with the outer knob which covers 15 kc with one revolution. A slide-rule type dial is calibrated in 20 kc steps with numerals at the 100 kc points on two scales for 0-500 and 500-1000 kc. The slow-speed knob has a 0-100 kc scale on it calibrated in 1 kc steps spaced about 1/16" apart. A slip ring behind the inner knob has the reference hairline inscribed on it and may be rotated slightly to the left or right to provide precise calibration.

The band-selector dial, marked "Frequency," is calibrated in 0.5 mc steps which identify the low-frequency end of each band segment in megacycles. The frequency readout of the receiver is obtained by adding the sum of the slide-rule scale setting and the 0.100 kc vernier-dial reading to the megacycles indicated by the *frequency* dial.

The preselector is tuned separately with calibrations read on its dial that are related to the position of an r.f. bandswitch. The r.f. and a.f. gain controls are concentric affairs, as are the r.f. attenuator and the noise-blanker level.

Operation and Performance

As may be gathered from the foregoing, changing bands required an adjustment of the *frequency*-range selector, setting the r.f. bandswitch, tuning the preselector and the v.f.o. It was found that the frequency synthesizer quickly and positively phase locks when the dial is rotated to the band-segment calibration. As this dial is moved between calibration markers, the indicator lamp lights and at the same time the sawtooth oscillator can be heard, both features indicating that the oscillator is not phase-locked and the dial not correctly positioned.

The slow-tuning v.f.o. control operates easily and smoothly; however, the fast tuning requires a fair amount of energy for hand manipulation which, along with its rather small size, makes large band excursions somewhat tedious. Also, when this knob is operated, care must be taken not to accidentally knock the hairline ring out of position.

Vernier tuning at the preselector control functions smoothly. Identification of which scale to follow is a bit confusing in that some ranges go in reverse order, and duplicate numerals are shown at the start of each of any two successive ranges. Alphabetical letters at each scale with correlated letters at the bandswitch would make identification much easier.

As for reception of signals, the overall performance was excellent. The a.f. quality with s.s.b. was exceptionally clean with fine sideband suppression and a relatively flat a.g.c. characteristic.

The sensitivity was more than adequate for the frequency spectrum concerned and measured within the specifications of 0.1 μv for 6 db S + N/N for s.s.b. with 2.1 kc filter, .05 μv for c.w. with 0.5 kc filter and 0.5 for a.m. with 6 kc filter. For the standard S + N/N ratio of 10 db, sensitivity for above respective conditions averaged within 0.15, .09 and 0.6 μv. Exceptions were found below 2 mc where sensitivity gradually dropped to 0.5 μv (s.s.b.) at 1250 kc and to 8 μv (a.m.) at 750 kc.

The band-to-band gain, checked on all segments, was within ±2 db at 2-26 mc (referred to 14 mc) with a 4 db drop-off at 28.5 mc and minus 12 and 22 db at 1250 and 750 kc respectively.

Primary-image rejection (signal frequency + 84 mc) was at least 50 db. A secondary image (signal frequency + 21 mc) was 60 db down on all ranges. Operationally, some problems were experienced in these respects with local TV signals or others in the v.h.f. region. For these cases a 30 mc low-pass filter at the antenna input should eliminate such difficulties. I.f. signal rejection was 60 db at 42 mc and over 100 db at 9 mc.

Unwanted-sideband suppression with the 2.1 kc filter was 45 db at 500 c.p.s. and over 50 db at 1 kc or higher (either sideband position). The 0.5 kc filter was closer to 750 c.p.s. at 6 db with a shape factor of near 4:1. The other filters were close to the specified bandpass and with a shape factor near 2:1.

A 1 μv internal spurious was found near 9 mc due to the b.f.o. oscillator. Other spurious were equivalent to only 0.1 μv and appeared near 9708 and 26812 kc. Also, a 0.1 μv equivalent was at the 260 and the 760 kc points on all band segments. With on-the-air operation, such responses are ordinarily obscured by picked-up background noise and will go un-noticed.

Frequency stability was about the best we've run across. Starting cold at 68° F ambient, the frequency on any band held to within 60 c.p.s. during the first hour, drifted 80 c.p.s. the next hour and then stayed within 10 c.p.s. thereafter. When the frequency-synthesizer dial was rotated from band to band, the frequency for each band segment fell right on the nose. With ±20% line-voltage variations, no detectable change in frequency was observed. Slight microphonics were found when the cabinet is tapped.

The frequency readout could be made to within about 500 c.p.s. The calibration linearity also was within 500 c.p.s. with dial indexed at nearest 100 kc point. No backlash was detectable.

Desensitization of a desired signal by an undesired one was on a par with that found with other solid-state gear we've checked.

Cross modulation, measured in terms of r.f. intermodulation products which are closely related to the former, was about equal to that of a number of vacuum tube jobs, but not as good as some of the more sophisticated ones. In actual on-the-air performance these effects were not experienced, except where a number of signals were encountered at levels near 1000 μv or more, such as may be found at times on some of the short-wave broadcast bands. In these cases we were able to aurally detect 3rd and 5th order I.M. products appearing as cross modulation. Under these conditions, bringing the r.f. input attenuator into play, eliminates such effects.

All in all, the Galaxy R-530 Solid-State Receiver is a good unit, for the job at hand and one we wouldn't mind having on our own desk. It is priced at $695 with 2.1 kc filter. Other filters are optional accessories. The manufacturer is Galaxy Electronics, 10 South 34th Street, Council Bluffs, Iowa 51501.

—W2AEF

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DX

BY JOHN A. ATTAWAY,* K4IIF

A FUNNY thing happened on the way to writing a column this month. A note came in from Louise, W8HDB, our S.S.B. DX Award Manager, who seemed to be laughing so hard she couldn't type. According to our present policy, she said that she would have to reject K4IIF/KV4 QSL's which were submitted by award applicant's wishing to claim KV4 credit. It seemed that this horrible K4IIF character tried to pull a fast one, but the ever-vigilant minions of the ARRL Award's Committee rode up on their white horses in time to cut him off from the pass a year later. Who knows, he may have been in the British Virgin Islands or Anguilla and only pretended to be KV4.

Unfortunate, this isn't funny to the surprising number of people to whom we represented the only KV4 station they have confirmed. Even WPX Manager K4DSN has received inquirys as to what the heck is going on. Naturally this necessitates a revision in *CQ*'s policy. We have always used the ARRL countries list as a convenience to DXers, and recognized only DXpeditions sanctioned by the League's award's committee as a courtesy to ARRL. However, *CQ* can hardly be expected to endorse a policy which rejects the QSL cards from a perfectly legitimate operation by it's own DX editor. We will continue to use the same countries list because that is what the DXers want. However, courtesy is a two-way street, and until our employees at Newington (I'm an ARRL member) learn this fact of life we certainly aren't bound to their rulings on legitimacy.

The ARRL award's committee policy is supposedly designed to cut down on cheating by heavily financed DXpeditions who have offended by their "commercialism." However, these operations normally take place in uninhabited "countries" where there are no hotels or scheduled carriers to give receipts. Transportation is usually via a privately-owned boat whose movements may be quite random and impossible to document. We have never heard of anyone operating from the Sheraton Serrana Bank or the Malpelo Hilton with transportation furnished by Baja Nuevo International Airlines.

The WAZ Program

The following new WAZ certificates were authorized this month:

WAZ S.S.B.: WB6CAB – 620, W6ISQ – 621, W9ZTD – 622, W9ARV – 623, TI4JP – 624, OZ6MI–625 and WA8OJI–626.

WAZ C.W.–Phone: K6KQN–2538, GM3CSM –2539, DK4SK–2540, W9LKI–2541, W9HDR –2542, ZP5JB–2543, W9EXE–2544, DL7MQ–2545, DL6KG–2546, DL1TV–2547, K4MOJ–2548, K1KDP–2549, 4S7DA–2550, GC2LU–2551, K3EUR–2552, and YU1YG–2553.

WAZ–Phone: PY7YS–399, PY4KL–400, and VK2AGO–401.

The WPX Program

The following new WPX certificates were authorized this month:

WPX C. W.: JA1IFP – 895, CR7BN – 896, 4S7DA–897, and UB5KDS–898.

WPX S.S.B.: DJ9AL – 370, WA6AHF – 371, KA9MF–372, WA8VFK–373, WØGYM–374, 9X5PB – 375, W1DTY – 376, UA1DJ – 377, W3TBF/8–378, JA4WI–379, OX5AR–380, and DL-4PX–381.

WPX MIXED: JA4XW–183, WA2FQG–184, and K3CHP–185.

WPX Phone: W4AXE–161.

The following endorsement stickers were issued:

CONTINENT-EUROPE: UB5KDS & W8FPM. AFRICA: W6CHY. SO. AMERICA: W6CHY. OCEANIA: SM5BPJ.

BAND–*14 mc:* JA1IFP & UB5KDS. *3.5 mc:* UB5KDS.

MODE-*Mixed:* VK3AHQ – 700, WA6GLD – 550, KØHUU–500, JA4WX–450, and WA2-FQG–450.

S.S.B.: WA5LOB–550, SM7CSN–450, WØ-GYM – 450, WA2CCF – 300, KA9MF – 250,

S.S.B. DX Honor Roll

W2TP	317	K6YRA	305	K1IXG	288	G3WW	269
VK3AHO	315	W8DE	305	K2LV	286	K8ONV	269
WA2RAU	315	WA8AJI	304	W6EUF	286	MP4BBW	267
W9ILW	315	W6YMV	303	K8RTW	286	G2PL	265
T12HP	313	W0QVZ	303	F2MO	283	G2BVN	264
W3NKM	313	W2BXA	302	W3KT	281	W2MJ	261
WA2IZS	312	G3AWZ	301	W1LLF	280	DL3RK	259
G3FKM	310	G6TA	301	W6UOU	280	G3DO	259
KP4CL	310	W3DJZ	301	W4RLS	279	W6WNE	259
DL9OH	309	XE1AE	298	K4OEI	279	PJ2AA	258
W2RGV	309	5Z4ERR	298	K4HYL	276	K1SHN	257
W4OPM	309	W/K2DX	297	DL1IN	276	WA2EOQ	256
G8KS	307	W4QCW	297	W7DLR	276	W6BAF	254
W5KUC	307	W4SSU	297	K9EAB	273	K6CAZ	254
K6LGF	307	W4UF	295	K9LUI	273	PA0SNG	252
I1AMU	305	W4PAA	294	W6RKP	272	W1AOL	250
W2ZX	305	W8EVZ	293	PZ1AX	271		
K6CYG	305	W2FXN	292	G3NUG	270		

*P.O. Box 205, Winter Haven, Florida 33880

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Wolfgang Renner, YA5RG, of P.O. Box 279 Kabul, Afghanistan. Wolf recently qualified for WAZ.

and WA6AHF–250.
C.W.: OK2QR–650, WØAUB–650, W9ZTD –450, DL7MQ–400, UB5KDS–400, JA1IFP –350, K4CK–350, and OK2BLG–350.

The S.S.B. DX Award Program

The following new S.S.B. DX Award certificates were authorized:

100 Countries: WA8TFJ–533, G3UOL–534, YV1EC–535, WA4DWR–536, W1DNZ–537, and W4WSF–538.

200 Countries: WA6GLD–159 and F2MO–160.

300 Countries: K6LGF–38 and K6YRA–39.

DXpeditions

Gus–At our mid-December deadline Gus has advised us where he plans to kick-off his new worldwide DXpedition, but as license negotiations are still in progress he requested that this information remain confidential. However, by the time you read this it may be history.

After the first stop is behind him Gus hopes to fly to Dakar, and then journey leisurely across Africa to the Indian Ocean conducting 6 band operations from all stops. He will operate split frequency most of the time with 14025 a favorite spot. For the low power operators a special hint. Gus like to

Left to right, Bob, OE1ZRC, and Karl, OE1ZNC, of Vienna. Both brothers are quite active on the air. Bob is a student while Karl works as an Industrial Engineer. Photo courtesy WB2GQK.

work around the edge of the pileups so rather than slug it out with the kilowatt boys just slip off to the side and be amazed at the results you will get. He will use both c.w. and s.s.b. in proportion to the demand.

This expedition will last until there are no more countries to visit or the money runs out, whichever comes first. He hopes it will run for 5 years. Anyone interested in helping out should contact Ack, W4ECI.

The Calgary Pacific DXpedition–At last word the boys are becoming experts on catching fish and trapping lobsters. This is a real, pure DXpedition as they indicated it would be when they left. More power to them and lots of success. We hope to have photos of them in a later issue.

FW8 Trip–About Feb. 1, KH6GLU will be starting a 10 day operation from Wallis on 80 through 10 meters. He will handle the QSL's himself. The equipment will be a Yaesu FTDX-100 and a 3-element quad.

VP2, Grenada -- W4YBH will commence operation on Jan. 22, 1969 at VP2GRN. He will be there for 4-5 weeks. QSL to P.O. Box 1909, Hendersonville, N.C. 28739.

VK9, Norfolk–A February operation is said to be in the planning stage by W4WS and W6BPO. No further info at press time.

De Extra

Back in November, 1968 De Extra commented briefly on the new licensing requirements. Nothing in recent years, not even the Don Miller-Awards Committee squabble, has affected DX as much as this regrettable action. As might be expected these comments brought forth a storm-tide of mail. Over 60% agreed with De Extra's views, but there were many who disagreed violently. Our ancestry was questioned by some and others used language which can only be described as sick. These were relegated to file 13 without an answer.

After recovering from the viciousness of these attacks it dawned on us that not one dissenting letter had substantiated anything with facts. This was quite remarkable, and consequently we decided to present some more of the facts ourselves. We wrote to the Amateur and Citizens Division of the FCC to obtain the latest statistics regarding the numbers of amateurs holding each class of license. The figures they sent us in early December were not completely up to date but they did give us a good comparison of the number of amateurs holding each class

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f license in 1965 and in the latter part of 968, 10 months after the new licensing hanges were announced. The following table hows this breakdown converted to a percentage basis:

lass of icense	Percentage of Total Licensed Amateurs Holding this Class of License 1965	1968	Change
ovice	6.2	5.6	−0.6%
echnician	22.4	21.8	−0.6%
onditional	15.4	13.6	−1.8%
eneral	39.5	40.5	+1.0%
dvanced	15.0	15.8	+0.8%
mateur Extra	1.6	2.6	+1.0%

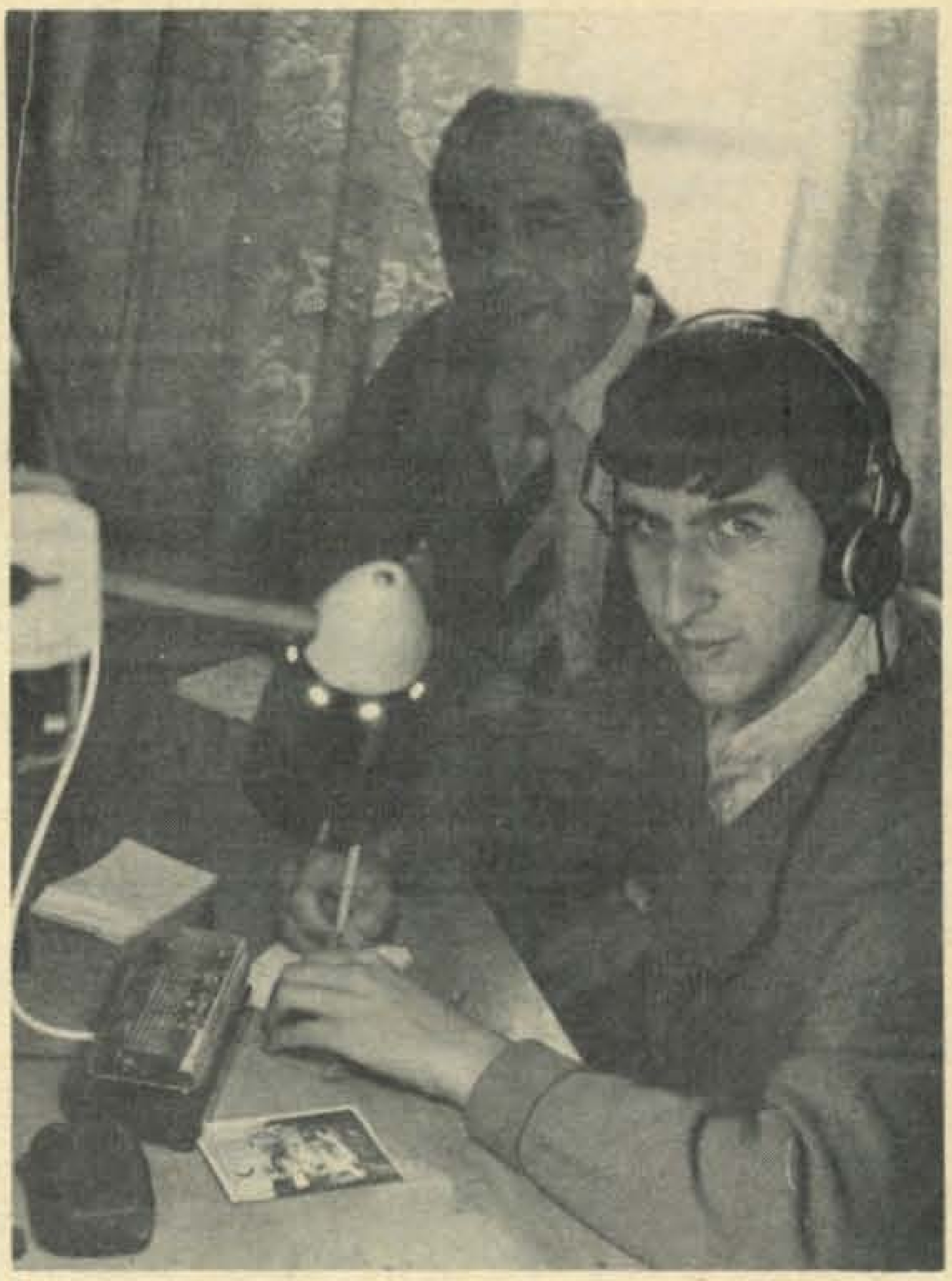
It is obvious that there has not been any ush to obtain either the Extra class or the dvanced class ticket. Increases of 1% and .8% respectively can hardly be considered landslide. In fact, just as many new generals ere licensed. If this trend does not accelerate, the choice c.w. frequencies will end up irtually unpopulated. By the end of this year /2 of the 20 meter c.w. band will be in the ands of the amateur Extra class only. (As Xers we know that 14100-14200 is not a w. area.) Likewise the only portion of the 0 meter c.w. band which is suitable for Xing, namely 7.000-7.050, will only be vailable to the very, very tiny minority who old the Extra class ticket. Either the hams re at fault or the licensing system is at fault, aybe both. Maybe nobody wants to operate w. anymore. A crying shame if so because w. is the most efficient mode for DX comunication.

In conclusion, we recall a statement made the *QST* editorial on page 9 of the July, 963 issue in answer to a member who ought that a poll of the membership on ncentive" licensing was in order: "The oard (ARRL) has found in the past that rmal polls of opinion were not much help." o be it, but in a day when Gallup can forest the national election to within 1% of 2,000,000 votes even the crudest of polls ould have distinguished between a majority favor and less than 10% in favor. This of ourse presupposes a desire to follow the will f the majority, but then that's what demoacy is all about, isn't it.

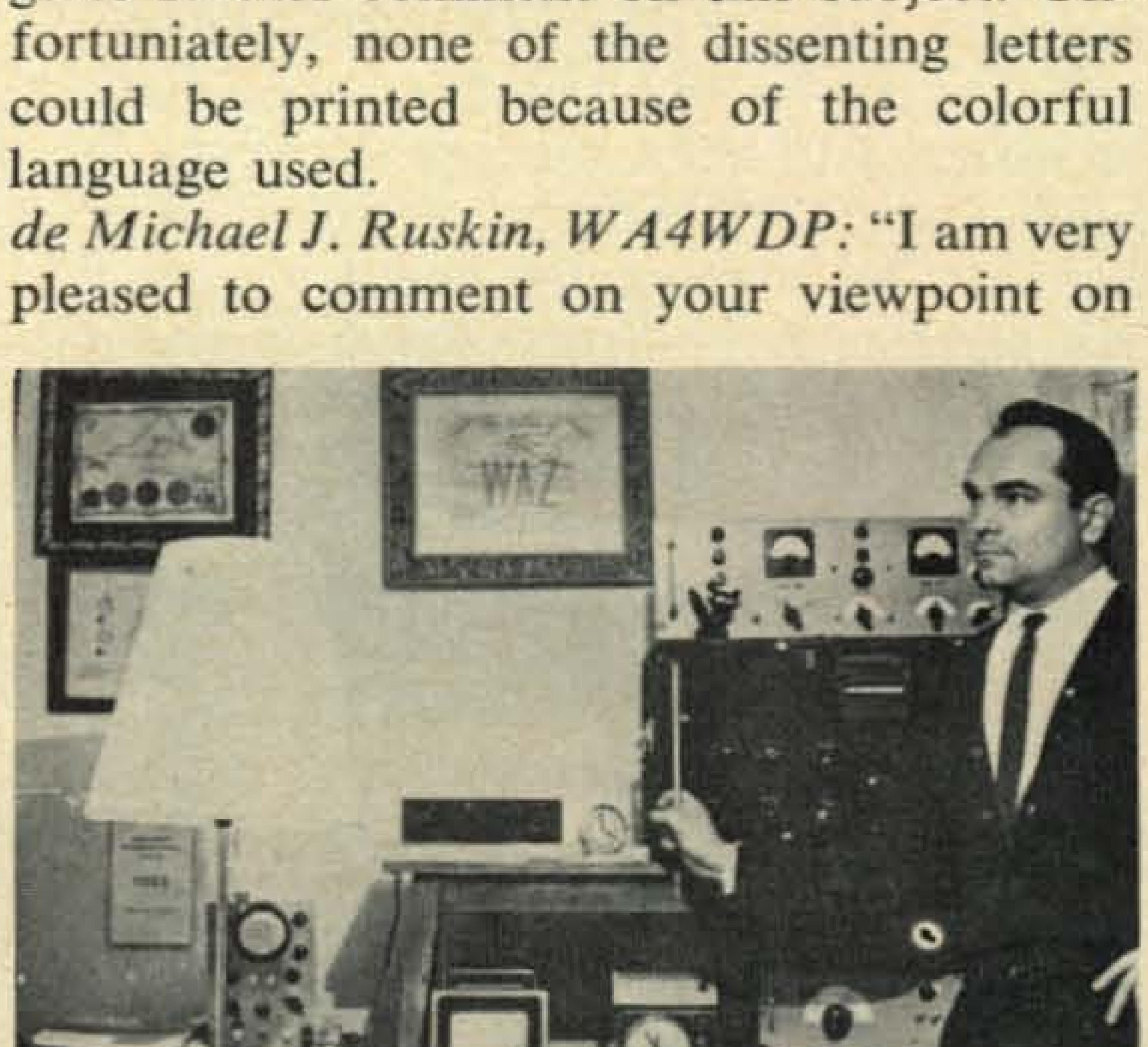
From the Mailbag

The following is an example of a letter greeing with our comments on the new licensing restrictions made in De Extra for November, 1968. This months De Extra gives further comment on this subject. Unfortuniately, none of the dissenting letters could be printed because of the colorful language used.

de Michael J. Ruskin, WA4WDP: "I am very pleased to comment on your viewpoint on



Cliff Davidson, WAØKXJ, logging in an AP5 during his recent trip to Ireland. EI9AR, owner of the rig, looks on. Cliff operated from England, Wales, Scotland and Ireland under the reciprocal agreements.



Val Antonov, UT5EH, one of the leading Ukranian DXers. Val is 34 and has been on the air since 1952. He has made almost 26,000 QSO's and earned 193 certificates including WAZ. He is also a CQ subscriber. Outside of radio Val likes music, particularly classical and classic jazz. No commercial jazz please.

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The Marin County DX group, publishers of the West Coast DX Bulletin. Shown at the Greater Bay Area Hamfest are: Hugh Cassidy, WA6AUD, Bus Burton, W6CYO, Bill Hansen, W6PTS and Wes Loudon, WB6UJO.

incentive licensing in November's issue of *CQ*. May I say 'well done.' I am 68 years of age—my ticket (Commercial) was issued June 1918—saw years of shipboard operating but didn't become an amateur until 1960. I love and enjoy the hobby, and at my age am content to sit back and enjoy the fruits of my labor when young. Unlike you I dropped my league membership. That was the only way I could protest. I salute you for your stand."

Official CQ Prefix List

In response to popular demand, WPX Manager Howard Kelley, K4DSN, has prepared a master list of all prefixes which have been assigned to hams through the years. It contains over 1400 different prefixes, all of which can be counted for credit toward a WPX certificate. Prefixes marked in italics are considered to be inactive and do not count for WPX Honor Roll standing. All other prefixes are either on the air today or could conceivably be issued by the appropriate governments. In each case we prefer to have the maximum number of foreseeable possibilities on this basic list. New prefixes will be added annually, although they will count immediately for WPX purposes. Special issue prefixes such as 3C, OF, 4A, etc., will cease being "current" five years after the last issuance and prefix and will then be deducted from Honor Roll credits.

Left, Fred Powell, 5U7AL, and right, Larry Loper, W4WHF, in the front yard of Larry's QTH at 255 Suntan Avenue, Sarasota, Florida. Fred visited Larry, his QSL manager, while on vacation from his job in the Niger Republic.
Photo by W4WHR

A A2, *AA7*, AC1, AC2, AC3, AC4, AC5, AC6, AC7, AC8, AC9, ACØ, *AG2*, *AG6*, *AIØ* (AIR), *AL2*, AP2, AP5, *AP8*, *AR1*, *AR8*

B *BM7*, BV1, BV2, *BV3*, BY1, BY2, BY3, BY4, BY5, BY6, BY7, BY8, BY9, BYØ

C *C1*, *C2*, *C3*, *C5*, *C7*, *C8*, *C9*, CE1, CE2, CE3, CE4, CE5, CE6, CE7, CE8, CE9, CEØ, CM1, CM2, CM3, *CM4*, CM5, CM6, CM7, CM8, *CM9*, CN2, CN8, CN9, CO1, CO2, CO3, *CO4*, CO5, CO6, CO7, CO8, CP1, CP2, CP3, CP4, CP5, CP6, CP7, CP8, CP9, CPØ, *CR1*, CR3, CR4, CR5, CR6, CR7, CR8, CR9, *CR1Ø*, *CS3*, CT1, CT2, CT3, CX1, CX2, CX3, CX4, CX5, CX6, CX7, CX8, CX9, CXØ

D *D1*, *D2*, *D3*, *D4*, *D5*, *D6*, *D7*, *D8*, *D9*, *DA3*, *DA5*, DC6, DC7, DI2, *DI9*, DJ1, DJ2, DJ3, DJ4, DJ5, DJ6, DJ7, DJ8, DJ9, DJØ, DK1, DK2, DK3, DK4, DK5, DK6, DK7, DK8, DK9, DKØ, DL1, DL2, DL3, DL4, DL5, DL6, DL7, DL8, DL9, DLØ, DM1, DM2, DM3, DM4, DM5, DM6, DM7, DM8, DM9, DMØ, DU1, DU2, DU3, DU4, DU5, DU6, DU7, DU8, DU9, DUØ

E *E3*, EA1, EA2, EA3, EA4, EA5, EA6, EA7, EA8, EA9, EAØ, EI2, EI3, EI4, EI5, EI6, EI7, EI8, EI9, EIØ, *EK1*, *EK3*, EL1, EL2, EL3, EL4, EL5, EL6, EL7, EL8, EL9, ELØ, *EL12*, EP1, EP2, EP3, *EP5*, *EQ2*, *EQ3*, *EQ5*, *ET2*, ET3, ETØ *(ETE3)*

F F1, F2, F3, F5, F6, *F7*, F8, F9, FØ, *FA2*, *FA3*, *FA8*, *FA9*, FB8, FC1, FC2, FC3, FC5, FC6, FC7, FC8, FC9, FCØ (F9RYØFC, etc.), *FD1*, *FD3*, *FD4*, *FD8*, *FE8*, *FF3*, *FF4*, *FF7*, *FF8*, FG7, FH8, *FI8*, FK8, *FL1*, *FL5*, FL8, *FL9*, FM7, *FM8*, *FN8*, FO8, FP8, *FQ8*, FR7, FS7, *FT4*, *FT5*, *FU8*, FW8, FY7

G G2, G3, G4, G5, G6, G8, GB2, GB3, GB4, GB5, GB6, GB8, GC2, GC3, GC4, GC5, GC6, GC8, GD2, GD3, GD4, GD5, GD6, GD8, GI2, GI3, GI4, GI5, GI6, GI8, GM2, GM3, GM4, GM5, GM6, GM8, GW2, GW3, GW4, GW5, GW6, GW8

H HA1, HA2, HA3, HA4, HA5, HA6, HA7,

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HA8, HA9, HAØ, *HB1, HB3,* HB4, *HB7, HB8,* HB9, HBØ, HC1, HC2, HC3, HC4, HC5, HC6, HC7, HC8, HC9, HCØ, *HE1, HE2, HE3, HE4, HE5, HE6, HE7, HE8, HE9,* HG1, HG2, HG3, HG4, HG5, HG6, HG7, HG8, HG9, HGØ, HH9, HHØ, HI3, HI4, HI5, HI6, HI7, HI8, HI9, HIØ, HK1, HK2, HK3, HK4, HK5, HK6, HK7, HK8, HK9, HKØ, *HL1, HL2, HL5, HL8,* HL9, HM1, HM2, HM3, HM4, HM5, HM6, HM7, HM8, HM9, HMØ, *HN3, HNØ (HND5A),* HP1, HP2, HP3, HP4, HP5, HP6, HP7, HP8, HP9, HPØ, HQ2, HQ3, HR1, HR2, HR3, HR4, HR5, HR6, *HR7, HR8, HR9,* HRØ, HS1, HS2, HS3, HS4, HS5, HS6, HS7, HS8, HS9, HSØ, HV1, HV2, HV3, HV4, HV5, HV6, HV7, HV8, HV9, HVØ, HZ1, HZ2, HZ3, HZ4, HZ5, HZ6, HZ7, HZ8, HZ9, HZØ

I I1, I2, I3, I4, I5, I6, I7, I8, I9, IØ, IC1, ID1, IE1, II1, *IL1, IM1,* IP1, IPØ, IR1, IS1, IS2, IS3, IS4, IS5, IS6, IS7, IS8, IS9, ISØ, IT1, IT2, IT3, IT4, IT5, IT6, IT7, IT8, IT9, ITØ, IU1, IV1, IZ6

J *J2, J3, J4, J5, J6, J7,* J8, *J9,* JA1, JA2, JA3, JA4, JA5, JA6, JA7, JA8, JA9, JAØ, *JB8,* JH1, JH2, JH3, JH4, JH5, JH6, JH7, JH8, JH9, JHØ, JT1, JT2, *JT4,* JW1, JW2, JW3, JW4, JW5, JW6, JW7, JW8, JW9, JWØ, JX1, JX2, JX3, JX4, JX5, JX6, JX7, JX8, JX9, JXØ, JY1, JY2, *JY3, JY4, JY5,* JY6, *JY7, JY8, JY9, JY , JY74, JZ*

K K1, K2, K3, K4, K5, K6, K7, K8, K9, KØ, KA1, KA2, *KA3, KA4,* KA5, *KA6,* KA7, KA8, KA9, *KAØ,* KB6, KC4, KC6, *KF3,* KG1, KG4, KG6, KH6, KJ6, KL7, KM6, *KN1, KN2, KN3, KN4, KN5, KN6, KN7, KN8, KN9, KNØ,* KP4, KP6, KR6, KR8, KS4, KS6, *KT1,* KV4, KW6, KX6 KZ5

L LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9, LAØ (LAA), *LB1, LB4, LB8,* LF2, LF3, LG5, LH2, *LH4,* LI2, LJ2, LJ3, *LP2, LP3, LP4, LP5, LP6, LP8,* LU1, LU2, LU3, LU4, LU5, LU6, LU7, LU8, LU9, LUØ, LX1, LX2, LX3, LX4, LX5, LX9, LXØ, LZ1, LZ2, LZ9, LZØ

M M1, *MB9, MD1, MD2, MD3, MD4, MD5, MD7, MF2, MI3, MI6,* MP4, *MS4*

N NPØ (NPG), NSØ (NSS), *NY4*

O OA1, OA2, OA3, OA4, OA5, OA6, OA7, OA8, OA9, OAØ, OD5, OE1, OE2, OE3, OE4, OE5, OE6, OE7 OE8, OE9, OEϕ, *OE13,* OF1, OF2, OF3, OF4, OF5, OF6, OF7, OF8, OF9, OFØ, OH1, OH2, OH3, OH4, OH5, OH6, OH7, OH8, OH9, OHØ, *OI2,* OK1, OK2, OK3, OK4, OK5, OK6, OK7, OK8, OL1, OL2, OL3, OL4, OL5, OL6, OL7, OL8, OL9, OLØ, OM1, OM2, OM3, OM4, OM5, OM6, OM7, OM8, ON4, ON5, ON6, ON8, ON9, ONØ, *OQ5, OQØ,* OR4, OR5, OX3, OX4, OX5, OY1, OY2, OY3, OY4, OY5, OY6, OY7, OY8, OY9, OYØ, OZ1, OZ2, OZ3, OZ4, OZ5, OZ6, OZ7, OZ8, OZ9, OZØ

P PA1, PA6, PA9, PAØ, PE1, PE2, PI1, PJ2, PJ3, PJ4, PJ5, PJØ, PK1, *PK2,*
PJ2, PJ3, PJ4, PJ5, *PJϕ,* PK1, *PK2,*
PK3, PK4, PK5, PK6, PK7, PK8, PX1, PX2, PX3, PX4, PY1, PY2, PY3, PY4, PY5, PY6, PY7, PY8, PY9, PYØ, PZ1, PZØ

R RA1, RA2, RA3, RA4, RA6, RA9, RAØ (RAEM), RB5, RC2, RD6, RH8, RI8, RJ8, RL7, RM8, RN1, RO5, RP2, RQ2, RR2

S SK1, SK2, SK3, SK4, SK5, SK6, SK7, SKØ, SL1, SL2, SL3, SL4, SL5, SL6, SL7, *SL8,* SLØ, SM1, SM2, SM3, SM4, SM5, SM6, SM7, *SM8,* SMØ, SP1, SP2, SP3, SP4, SP5, SP6, SP7, SP8, SP9, SPØ, ST2, SU1, SU3, SU7, SV1, *SV5, SV9,* SVØ

T TA1, TA2, TA3, *TA4, TA5,* TAØ, *TC3, TD8,* TF2, TF3, TF4, TF5, TF6, TG4, TG5, TG6, TG7, TG8, TG9, TGØ, T12, T13, T14, T15, T16, T17, T18, T19, TIØ, TJ1, TJ8, TL8, TN8, TR8, TT8, TU2, TY2, TY3, TY4, TY5, TY6, TZ1, *TZ2, TZ5,* TZØ

U U3, U5, U21, UA1, UA2, UA3, UA4, UA6, UA9, UAØ, UB5, UC2, UD6, UF6, UG6, UH8, UI8, UJ8, UL7, UM8, UN1, UO5, UP2, UPØ (UPOL), UQ2, UR2, UT5, UV3, UV4, UV9, UWØ, UW1, UW4, UW6, UW9, UWØ, UY5, UZ9, UZØ

V VE1, VE2, VE3, VE4, VE5, VE6, VE7, VE8, *VE9,* VEØ, VK1, VK2, VK3, VK4, VK5, VK6, VK7, VK8, VK9, VKØ, VO1, VO2, *VO4, VO6,* VP1, VP2, *VP3,* VP4, VP5, *VP6,* VP7, VP8, VP9, *VPØ,* VQ1, *VQ2, VQ3, VQ4, VQ5, VQ6, VQ7,* VQ8, VQ9, VR1, VR2, VR3, VR4, VR5, VR6, *VS1, VS2, VS4,* VS5, VS6, *VS7,* VS9, *VT1,* VU2, *VU4, VU5, VU7*

W W1, W2, W3, W4, W5, W6, W7, W8, W9, WØ, WA1, WA2, WA3, WA4, WA5, WA6, WA7, WA8, WA9, WAØ (WAR), WB1, WB2, WB3, WB4, WB5, WB6, WB7, WB8, WB9, WBØ, WC4, WC6, WFØ, WG1, WG4, WG6, WH6, WJ6, WL7, WM6, WN1, WN2, WN3, WN4, WN5, WN6, WN7, WN8, WN9, WNØ, WP4, WP6, WR6, WR8, WS4, WS6, *WV2,* WV4, *WV6,* WW6, WX6, *WZ5*

X XAØ (XARC), XE1, XE2, XE3, XE4, XE5, XE6, XEØ, *XF1,* XF4, XF5, XP1, *XQ8, XS5,* XT1, XT2, XTØ, XU2, *XU6, XU8,* XV5, XW8, XZ2

Y YA1, YA2, YA3, YA4, YA5, YA6, YA7, YA8, YA9, YAØ, YB1, YB2, YB3, YBØ,

Rubin and Ferne Hughes, the dynamic WA6AHF QSL Managing team who are QSL Manager of the Month. Photo taken September 1968.

YC1, YC2, YC3, YCØ, YD1, YD2, YD3, YDØ, YI2, *YI3*, YJ1, YJ8, YK1, YN1, YN2, YN3, YN4, YN5, YN6, YN7, YN8, YN9, YNØ, YO2, YO3, YO4, YO5, YO6, YO7, YO8, YO9, YOØ, *YR5*, YS1, YS2, YS3, YSØ, YU1, YU2, YU3, YU4, YU5, YU6, YU7, YU8, YU9, YUØ, YV1, YV2, YV3, YV4, YV5, YV6, YV7, YV8, YV9, YVØ, *YZ3*

Z ZA1, ZA2, ZA3, ZA7, ZAØ, *ZB1*, ZB2, *ZC1*, *ZC3*, ZC4, *ZC5*, *ZC6*, *ZC8*, *ZD1*, *ZD2*, ZD3, *ZD4*, ZD5, *ZD6*, ZD7, ZD8, ZD9, ZE1, ZE2, ZE3, ZE4, ZE5, ZE6, ZE7, ZE8, ZF1, ZK1, ZK2, ZL1, ZL2, ZL3, ZL4, ZL5, *ZM6*, ZM7, *ZO8*, ZP1, ZP2, ZP3, ZP4, ZP5, ZP6, ZP7, ZP8, ZP9, ZPØ, ZS1, ZS2, ZS3, ZS4, ZS5, ZS6, *ZS7*, *ZS8*, ZS9

1 1A6, 1B9, 1G5, 1M4, 1S9

3 3A2, 3AØ, 3B1, 3B2, 3C1, 3C2, 3C3, 3C4, 3C5, 3C6, 3C7, 3C8, 3CØ, 3V8, 3W8, 3Y1, 3YØ

4 4A1, 4A2, 4A3, 4A4, 4A5, 4A6, 4AØ, 4J2, 4J7, 4L1, 4L3, 4L7, 4M4, 4M5, 4M7, 4MØ, 4S7, 4U1, *4U2*, *4U3*, *4U4*, *4U5*, *4U6*, *4U7*, *4U8*, *4U9*, 4UØ, 4W1, 4W2, 4X1, 4X4, 4X5, 4X6, 4X7, 4X8, 4X9, 4XØ, 4Z4

5 5A1, 5A2, 5A3, 5A4, 5A5, 5B4, 5H3, 5J3, 5J4, 5J5, 5L1, 5L2, 5L3, 5L4, 5L5, 5L6, 5L7, 5L8, 5L9, 5LØ (5LA), 5N2, 5R8, 5T5, *5T7*, 5U7, 5V1, 5V4, 5V8, 5VØ (5VZRQ, etc.), 5W1, 5X5, 5Z4

6 *6N5*, 601, 602, 603, 604, 605, 606, 6W8, 6Y5, 6YØ

7 7G1, 7P8, 7Q7, *7QØ* (7QD1), 7X1, 7X2, 7X3, 7XØ, 7Z1, 7Z2, 7Z3

8 8F1, 8F2, 8F3, 8F4, 8F5, 8F6, 8J1, 8J2, 8J3, 8J4, 8J5, 8J6, 8J7, 8J8, 8J9, 8JØ, 8P6, 8R1, 8R2, 8R3, *8X1*, 8Z4, 8Z5

9 9A1, 9E3, 9F3, 9G1, 9H1, *9I1*, *9I2*, *9I3*, 9J2, 9J6, 9J7, 9J8, 9K2, 9K3, 9L1, 9L2, 9M2, *9M4*, 9M6, 9M8, 9N1, 9Q5, *9S4*, 9U5, 9V1, 9X5, 9Y4

QSL Manager of the Month

The QSL Manager slot is occupied this month by Rubin Hughes, WA6AHF, a gentleman who has been biled as the "west coast answer to W2CTN." Of course anybody has a long way to go to catch up with Jack, but it makes a nice tribute to the integrity of Rubin's operation.

Rubin writes that his interest in QSL managing came about as a result of an accident incurred by his XYL Ferne, who actually handles the cards, in which she suffered a broken back. In the aftermath Ferne was in and out of the hospital many times and had several operations. She is now able to take short walks with the aid of a cane, but after being very active all of her life she needed a useful pursuit which she could manage at home.

It all started with Ferne filling out Rubin's own cards. Then KW6EO asked if they would handle his cards. KW6GA was close behind and the list has now expanded to include HKØBKZ, PZ1DC, VQ9DM, ZD8GA, and ZD9BL. Rubin emphasizes that contributions certainly aren't necessary in order to get cards from any of these stations. However, an s.a.s.e. is a must if you want a direct reply. Otherwise the cards will go via the bureau. As Ferne is an avid stamp collector she appreciate receiving unusual stamps on the envelopes bringing the cards. The correct address is 18494 Via Alamitos, San Lorenzo, California 94580.

Rubin works for Sierra Electronic's Division of Philco and holds an Advanced license. He is a member of the Northern California DX Club.

QSL Information

CR5SP—Via W2GHK
CT2AO—To CT1IW
EA8CB—c/o WB4ITQ
EL2BE—To WB8ABN, P.O. Box 62, Rochester, Mich. 48063
VK9TB—c/o WA8DXA
VK9WD—Via W2CTN
VP2AW—To W9FIU
VP2GBR—c/o WA5IEV

[*Continued on page 100*]

See page 110 for New Reader Service

Propagation

BY GEORGE JACOBS,* W3ASK

DURING the *daylight* hours of February, ptimum DX propagation conditions are exected on 15 meters, with 10 meters a close unner-up. The 15 meter band is expected to pen to all areas of the world sometime beveen sunrise and sundown, often with exeptionally strong signal levels and little ading or noise. Excellent 10 meter openings re forecast to most areas of the world durg much of the daylight period. Excellent X propagation is also forecast for 20 meters uring the sunrise period and again during e late afternoon hours, with fair-to-good onditions to most areas of the world during e other daylight hours.

During the early hours of *darkness*, both 5 and 20 meters are expected to share onors for optimum DX propagation condions. Fifteen meters should have a slight lge for openings from the west, 20 meters r openings from the east, with conditions n both bands almost equal for openings to e north and south. Later in the evening, 20 eters is expected to stand out by itself as e optimum band, with excellent openings recast to almost every area of the world. uring the late evening and early morning ours, good DX propagation conditions are so expected on 40 meters, with solid opengs predicted to many areas of the world. ome fairly good 80 meter DX openings are recast during the hours of darkness, and ome 160 meter openings are likely to occur uring the same period.

Beginning during early February and connuing through March and early April, a oticeable seasonal improvement usually kes place in high frequency propagation onditions between the northern and souern hemispheres. This should result in omewhat better openings during February etween the USA and South America, Africa, ustralasia, Oceania, parts of Asia and the Antarctic than were observed during the earlier winter months. This improvement is expected to be noticeable on all h.f. bands between 10 and 160 meters.

1307 Clara Street, Silver Spring, Md. 20902.

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for Feb. 1 through March 15, 1969

Days	*Forecast Rating & Quality* (4)	(3)	(2)	(1)
Above Normal: 2, 7-8, 14, 3, 7, 15	A	A-B	B-C	C
Normal: 1, 3, 5-6, 9-10, 12-13, 15-17, 22, 24-25, 27, 1-2, 4-6, 9-10, 12-14	A-B	B-C	C-D	D-E
Below Normal: 4, 11, 18, 21, 23, 26, 28, 8, 11	C	D	D	E
Disturbed: 19-20, None?,	D	E	E	E

HOW TO USE THESE CHARTS

The following is an explanation of the symbols shown above, and instructions for the use of the *CQ* propagation predictions:

1—Enter Propagation Charts on following pages under appropriate band and distance or geographical area columns. Read predicted times of band openings at intersection of both columns.

2—Following each predicted time of band opening is a forecast rating which indicates the relative number of days the band is expected to open during each month of the forecast period. The higher the rating, the more frequent the opening, as follows: (4) band open more than 22 days each month; (3) between 14 and 22 days; (2) between 8 and 13 days; (1) less than 7 days.

On the "Short-Skip" Chart, where two numerals are shown within a single set of parenthesis, the first applies to the shorter distance for which the forecast is made, and the second to the greater distance. Note the forecast rating for later use.

3—With the forecast rating noted above, start with the numbers in parenthese at the top of the "Last Minute Forecast" appearing above. Read down the table for a day-to-day forecast of propagation conditions in terms of Above Normal (WWV rating higher than 6); Normal (WWV rating 5-6); Below Normal (WWV rating 4); Disturbed (WWV rating less than 4). The letter symbols (A-E) describe reception conditions (signal quality, noise and fading levels) expected for each day of the month and have the following meanings: (A—excellent opening with strong, steady signals; B—good opening, moderately strong signals, little fading and noise; C—fair opening, signals fluctuating between moderately strong and weak; D—poor opening, signals generally weak and considerable fading and noise; E—poor opening, or none at all.

4—This month's DX Propogation Charts are based upon a transmitter power of 250 watts c.w.; 500 watts s.s.b., or 1000 watts d.s.b., into a dipole antenna a quarter-wave above ground on 160 and 80 meters, a half-wave above ground on 40 and 20 meters, and a wave-length above ground on 15 and 10 meters. For each 10 db gain above these reference levels, reception quality shown in the "Last Minute Forecast" will improve by one level; for each 10 db loss, reception will become poorer by one level.

5—Local Standard Time for these predictions is based on the 24-hour system.

6—The Eastern USA Chart can be used in the 1, 2, 3, 4, 8, KP4, KG4 and KV4 amateur call areas; The Central USA Chart in the 5, 9, and 0 areas, and the Western USA Chart in the 6 and 7 areas. The Charts are valid from Feb. 15, 1968, through April 15, 1968, and are prepared from basic propagation data published monthly by the Institute For Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado.

Sunspot Cycle

A monthly mean sunspot number of 88

was reported for November, 1968 by the Swiss Federal Solar Observatory, the world's official keeper of sunspot records. This results in a running smoothed sunspot number of 108 centered on May, 1968. A smoothed sunspot number of 109 is forecast for February, 1969.

V.H.F. Ionospheric Openings

A seasonal increase in the occurrence of auroral displays often takes place during February and the early spring months. During such displays, there is a strong tendency for ionospheric disturbances or radio storms to take place. While DX conditions on the high frequency bands may become erratic or blackout entirely during such storms, unusual short-skip openings for distances up to approximately 1300 miles may be possible on the v.h.f. bands. These openings occur by way of reflection from the ionized area produced by an auroral display. Auroral-type openings are often characterized by flutter fading and multi-path echos. To take maximum advantage of such openings, rotatable antennas should be beamed towards the auroral display if it is visible, or in a northerly direction. Check the "Last Minute Forecast" at the beginning of this column for those days that are predicted to be "disturbed" or "below normal", since these are the most likely times for v.h.f. auroral openings to occur during February.

While solar activity is not high enough to produce the large number of 6 meter DX openings that took place during February 1958 and 1959, an occasional opening between the USA and points in the southern hemisphere may be possible during the month. The best time to check for regular F- layer 6 meter openings are during the noon and post noon hours, while trans-equatorial (T.E.) openings are likely to occur during the evening hours, between approximately 8 and 11 p.m. local time.

No significant meteor showers are expected during February, and few, if any meteor-type v.h.f. ionospheric openings are likely to occur during the month.

Sporadic-E ionization reaches a seasonal low during February, an few short-skip openings from this type of propagation are expected during the month.

This month's *Propagation Charts* contain band opening predictions for major DX paths for the period February 15-April 15, 1969. A short-skip propagation forecast for February appeared in last month's column. Instructions for the proper use of the *Propagation Charts* appear directly below the "Last Minute Forecast" at the beginning of this column.

FEBRUARY 15-APRIL 15, 1969

Time Zone: EST (24-Hour Time)

Eastern USA To:

Western & Central North Africa	08-09 (1) 09-10 (2) 10-12 (3) 12-13 (2) 13-14 (1)	06-07 (1) 07-08 (2) 08-10 (3) 10-14 (4) 14-15 (3) 15-16 (2) 16-18 (1)	22-03 (1) 03-06 (2) 06-09 (3) 09-11 (2) 11-13 (3) 13-16 (4) 16-20 (3) 20-22 (2)	17-18 (1) 18-19 (2) 19-22 (3) 22-01 (4) 01-02 (3) 02-03 (2) 03-04 (1) 19-21 (1)* 21-00 (2)* 00-02 (1)*
Northern Europe & European USSR	08-09 (1) 09-11 (2) 11-12 (1)	07-08 (1) 08-09 (2) 09-12 (3) 12-13 (2) 13-14 (1)	00-02 (3) 02-03 (2) 03-05 (1) 05-07 (2) 07-09 (3) 14-18 (3) 18-21 (2) 21-00 (1)	17-19 (1) 19-02 (2) 02-03 (1) 20-01 (1)*
Eastern Mediterranean & Middle East	08-09 (1) 09-12 (2) 12-13 (1)	07-08 (1) 08-09 (2) 09-10 (3) 10-12 (4) 12-14 (2) 14-15 (1)	05-07 (2) 07-12 (1) 12-14 (2) 14-15 (3) 15-17 (4) 17-20 (3) 20-22 (2) 22-00 (3) 00-02 (2) 02-05 (1)	18-20 (1) 20-23 (2) 23-00 (1) 20-23 (1)*
West & Central Africa	07-09 (1) 09-10 (2) 10-11 (3) 11-14 (4) 14-16 (3) 16-18 (2) 18-19 (1)	06-08 (1) 08-10 (2) 10-13 (3) 13-16 (4) 16-18 (3) 18-19 (2) 19-21 (1)	00-06 (2) 06-13 (1) 13-15 (2) 15-17 (3) 17-22 (4) 22-00 (3)	18-21 (1) 21-01 (2) 01-03 (1) 22-02 (1)*
South Africa	07-08 (1) 08-10 (2) 10-11 (3) 11-13 (4) 13-14 (2) 14-15 (1)	06-10 (1) 10-12 (2) 12-14 (3) 14-16 (4) 16-17 (2) 17-18 (1)	05-07 (2) 07-14 (1) 14-15 (2) 15-17 (3) 17-19 (4) 19-21 (2) 21-23 (1) 23-02 (3) 02-03 (2) 03-05 (1)	18-20 (1) 20-23 (2) 23-00 (1) 21-23 (1)*
East Africa	09-11 (1) 11-13 (2) 13-15 (3) 15-17 (2) 17-18 (1)	07-09 (1) 09-11 (2) 11-13 (3) 13-16 (4) 16-18 (3) 18-19 (2) 19-20 (1)	12-14 (1) 14-16 (2) 16-18 (3) 18-22 (4) 22-01 (3) 01-03 (2) 03-05 (1)	19-23 (1) 23-01 (2) 01-02 (1)
Central & South Asia	08-11 (1) 19-21 (1)	07-08 (1) 08-10 (2) 10-12 (1) 20-22 (1)	06-07 (1) 07-09 (2) 09-11 (1) 17-19 (1) 19-21 (2) 21-23 (1)	19-22 (1) 04-06 (1)
South-east Asia	10-13 (1) 18-20 (1)	07-08 (1) 08-10 (2) 10-12 (1) 12-14 (2) 14-18 (1) 18-20 (2) 20-21 (1)	05-07 (1) 07-09 (2) 09-11 (1) 14-17 (1) 19-20 (1) 20-23 (2) 23-01 (1)	05-07 (1)

*Predicted times of 80 meter openings. Openings o[n] 160 meters are also likely to occur during those time[s] when 80 meter openings are shown with a forecas[t] rating of (2), or higher.

See page 110 for New Reader Servic[e]

Far East	09-11 (1) 18-20 (1)	07-08 (1) 08-10 (2) 10-12 (1) 15-16 (1) 16-17 (2) 17-19 (3) 19-20 (2) 20-21 (1)	06-07 (1) 07-09 (3) 09-11 (2) 11-13 (1) 17-19 (1) 19-22 (2) 22-00 (3) 00-02 (2) 02-03 (1)	05-08 (1)
South Pacific & New Zealand	08-14 (1) 14-16 (2) 16-18 (3) 18-19 (2) 19-21 (1)	07-08 (1) 08-10 (2) 10-13 (1) 13-16 (2) 16-20 (3) 20-21 (2) 21-22 (1)	11-19 (1) 19-21 (2) 21-23 (3) 23-01 (4) 01-03 (3) 03-07 (2) 07-09 (3) 09-11 (2)	00-01 (1) 01-02 (2) 02-05 (3) 05-07 (2) 07-08 (1) 03-07 (1)*
Austral-asia	09-11 (1) 15-16 (1) 16-17 (2) 17-18 (3) 18-19 (2) 19-20 (1)	08-09 (1) 09-12 (2) 12-16 (1) 16-18 (2) 18-20 (1) 20-21 (2) 21-22 (1)	06-08 (2) 08-10 (3) 10-12 (2) 12-15 (1) 15-17 (2) 17-21 (1) 21-23 (2) 23-02 (3) 02-03 (2) 03-06 (1)	02-04 (1) 04-06 (2) 06-08 (1) 04-06 (1)*
Northern & Central South America	07-08 (1) 08-09 (2) 09-15 (4) 15-18 (3) 18-19 (2) 19-20 (1)	05-06 (1) 06-07 (2) 07-10 (4) 10-12 (3) 12-17 (4) 17-20 (3) 20-21 (2) 21-23 (1)	02-05 (2) 05-06 (3) 06-09 (4) 09-10 (3) 10-14 (2) 14-16 (3) 16-22 (4) 22-02 (3)	18-19 (1) 19-20 (2) 20-03 (4) 03-05 (3) 05-06 (2) 06-07 (1) 20-22 (1)* 22-03 (2)* 03-05 (1)*
Brazil, Argentina, Chile & Uruguay	07-08 (1) 08-10 (3) 10-13 (2) 13-15 (3) 15-17 (4) 17-18 (2) 18-19 (1)	06-07 (1) 07-10 (2) 10-13 (1) 13-15 (2) 15-16 (3) 16-19 (4) 19-21 (3) 21-22 (2) 22-00 (1)	15-16 (1) 16-17 (2) 17-18 (3) 18-00 (4) 00-02 (3) 02-04 (2) 04-05 (1) 05-07 (2) 07-09 (1)	19-21 (1) 21-03 (2) 03-06 (1) 21-05 (1)*
McMurdo Sound, Ant-arctica	16-18 (1)	12-16 (1) 16-18 (2) 18-21 (3) 21-22 (1) 22-23 (1)	15-17 (1) 17-21 (2) 21-00 (3) 00-05 (2) 05-07 (1) 07-09 (2) 09-10 (1)	22-00 (1) 00-04 (2) 04-06 (1)

Time Zones: CST & MST (24-Hour Time)

Central USA To:

Western & Central Europe & North Africa	08-10 (1) 10-12 (2) 12-13 (1)	07-08 (1) 08-09 (2) 09-13 (3) 13-14 (2) 14-15 (1)	00-06 (1) 06-09 (2) 09-11 (1) 11-13 (2) 13-17 (3) 17-19 (2) 19-22 (1) 22-00 (2)	17-19 (1) 19-22 (2) 22-00 (3) 00-01 (2) 01-02 (1) 20-22 (1)* 22-00 (2)* 00-01 (1)*
Northern Europe & European USSR	09-12 (1)	07-08 (1) 08-12 (2) 12-13 (1)	07-10 (2) 10-13 (1) 13-15 (2) 15-17 (3) 17-19 (2) 19-23 (1) 23-02 (2) 02-07 (1)	19-22 (1) 22-00 (2) 00-02 (1) 22-01 (1)*
Eastern Mediter-ranean & Middle East	09-12 (1)	07-08 (1) 08-09 (2) 09-11 (3) 11-12 (2) 12-14 (1)	05-06 (1) 06-08 (2) 08-12 (1) 12-14 (2) 14-18 (3) 18-20 (2) 20-23 (3) 23-01 (2) 01-02 (1)	19-22 (1) 20-22 (1)*
West & Central Africa	08-10 (1) 10-11 (2) 11-12 (3) 12-14 (4) 14-16 (3) 16-17 (2) 17-18 (1)	06-08 (1) 08-10 (2) 10-13 (3) 13-16 (4) 16-17 (3) 17-19 (2) 19-20 (1)	04-06 (2) 06-12 (1) 12-15 (2) 15-17 (3) 17-20 (4) 20-22 (3) 22-02 (2)	18-20 (1) 20-23 (2) 23-01 (1) 21-00 (1)*
South Africa	08-09 (1) 09-10 (2) 10-12 (3) 12-13 (1)	07-09 (1) 09-11 (2) 11-12 (3) 12-14 (4) 14-15 (3) 15-16 (2) 16-17 (1)	05-07 (2) 07-13 (1) 13-15 (2) 15-16 (3) 16-18 (4) 18-20 (3) 20-22 (2) 22-00 (3) 00-02 (2) 02-05 (1)	19-22 (1) 20-21 (1)*
East Africa	11-13 (1) 13-15 (2) 15-16 (1)	08-09 (1) 09-12 (2) 12-16 (3) 16-18 (2) 18-20 (1)	12-14 (1) 14-16 (2) 16-20 (3) 20-22 (2) 22-00 (1)	19-22 (1)
Central & South Asia	07-09 (1) 18-20 (1)	07-08 (1) 08-10 (2) 10-11 (1) 18-19 (1) 19-21 (2) 21-22 (1)	06-07 (1) 07-09 (2) 09-11 (1) 16-18 (1) 18-22 (2) 22-02 (1)	05-07 (1) 18-20 (1)
South-east Asia	09-10 (1) 10-12 (2) 12-14 (1) 16-17 (1) 17-19 (2) 19-20 (1)	08-09 (1) 09-10 (2) 10-12 (3) 12-13 (2) 13-17 (1) 17-20 (2) 20-22 (1)	06-07 (1) 07-08 (2) 08-10 (3) 10-12 (2) 12-18 (1) 18-21 (2) 21-23 (1)	04-07 (1)
Far East	15-17 (1) 17-19 (2) 19-20 (1)	09-11 (1) 14-16 (1) 16-17 (2) 17-20 (3) 20-21 (2) 21-22 (1)	06-07 (1) 07-08 (2) 08-10 (3) 10-12 (2) 12-16 (1) 16-20 (2) 20-22 (1) 22-01 (2) 01-03 (1)	02-04 (1) 04-06 (2) 06-08 (1) 05-07 (1)*
South Pacific & New Zealand	10-12 (1) 12-14 (2) 14-16 (3) 16-18 (4) 18-19 (2) 19-20 (1)	08-12 (1) 12-14 (2) 14-16 (1) 16-18 (2) 18-19 (3) 19-21 (4) 21-22 (2) 22-00 (1)	17-19 (1) 19-21 (2) 21-23 (3) 23-03 (4) 03-05 (3) 05-07 (2) 07-10 (3) 10-11 (2) 11-12 (1)	22-00 (1) 00-01 (2) 01-06 (3) 06-07 (2) 07-08 (1) 00-02 (1)* 02-05 (2)* 05-07 (1)*
Austral-	09-11 (1) 14-15 (1) 15-16 (2) 16-18 (4) 18-19 (3) 19-20 (2) 20-21 (1)	07-08 (1) 08-11 (2) 11-14 (1) 14-16 (2) 16-18 (1) 18-19 (2) 19-21 (3) 21-22 (2) 22-00 (1)	05-07 (2) 07-08 (3) 08-10 (4) 10-12 (2) 12-14 (1) 14-16 (2) 16-21 (1) 21-23 (2) 23-01 (3) 01-03 (4) 03-05 (3)	02-04 (1) 04-06 (3) 06-07 (2) 07-08 (1) 04-05 (1)* 05-06 (2)* 06-07 (1)*
Northern & Central South America	07-08 (1) 08-09 (2) 09-11 (3) 11-15 (4) 15-17 (3) 17-18 (2) 18-19 (1)	06-07 (1) 07-08 (2) 08-10 (4) 10-14 (3) 14-17 (4) 17-19 (3) 19-21 (2) 21-23 (1)	06-09 (4) 09-11 (3) 11-15 (2) 15-17 (3) 17-21 (4) 21-01 (3) 01-05 (2) 05-06 (3)	18-19 (1) 19-20 (2) 20-00 (3) 00-02 (4) 02-03 (3) 03-04 (2) 04-06 (1) 19-21 (1)* 21-03 (2)* 03-05 (1)*
Brazil, Argentina, Chile & Uruguay	07-08 (1) 08-10 (3) 10-12 (2) 12-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	06-07 (1) 07-10 (2) 10-13 (1) 13-14 (2) 14-15 (3) 15-18 (4) 18-20 (3) 20-22 (2) 22-00 (1)	13-15 (1) 15-16 (2) 16-18 (3) 18-23 (4) 23-02 (3) 02-06 (2) 06-08 (1)	19-20 (1) 20-22 (2) 02-05 (1) 21-03 (1)*
McMurdo Sound, Antarctica	15-20 (1)	13-16 (1) 16-18 (2) 18-21 (3) 21-22 (2) 22-23 (1)	16-19 (1) 19-20 (2) 20-02 (3) 02-05 (2) 05-07 (1) 07-08 (2) 08-10 (1)	22-02 (1) 02-04 (2) 04-06 (1)

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Western USA To:

Western Europe & North Africa	08-11 (1)	07-08 (1) 08-10 (2) 10-12 (3) 12-13 (2) 13-14 (1) 19-21 (1)	00-06 (1) 06-09 (2) 09-11 (1) 11-13 (2) 13-15 (3) 15-18 (2) 18-22 (1) 22-00 (2)	19-20 (1) 20-22 (2) 22-00 (1) 20-22 (1)*
Central & Northern Europe & European USSR	08-10 (1)	07-08 (1) 08-10 (2) 10-12 (1) 19-21 (1)	05-06 (1) 06-09 (2) 09-12 (1) 12-14 (2) 14-16 (3) 16-17 (2) 17-18 (1)	19-21 (1) 21-23 (2) 23-00 (1) 21-23 (1)*
Eastern Mediter-ranean & Middle East	08-10 (1)	07-08 (1) 08-10 (2) 10-11 (1) 20-22 (1)	05-06 (1) 06-09 (2) 09-12 (1) 12-16 (2) 16-18 (1) 18-22 (2) 22-02 (1)	18-21 (1)
West & Central Africa	09-11 (1) 11-14 (2) 14-16 (1)	07-10 (1) 10-12 (2) 12-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	04-06 (1) 06-08 (2) 08-12 (1) 12-14 (2) 14-15 (3) 15-19 (4) 19-22 (3) 22-23 (2) 23-01 (1)	18-22 (1)
East Africa	10-12 (1) 12-14 (2) 14-16 (1)	08-11 (1) 11-14 (2) 14-16 (3) 16-18 (2) 18-19 (1)	06-08 (1) 12-14 (1) 14-16 (2) 16-18 (3) 18-20 (2) 20-22 (1)	18-20 (1)
South	08-09 (1) 09-11 (3) 11-12 (1)	06-09 (1) 09-11 (2) 11-13 (3) 13-14 (2) 14-15 (1)	04-06 (1) 06-08 (2) 08-13 (1) 13-15 (2) 15-18 (3) 18-19 (2) 19-21 (1) 21-23 (3) 23-00 (2) 00-02 (1)	18-21 (1)
Central & South Asia	07-09 (1) 17-18 (1) 18-19 (2) 19-20 (1)	07-08 (1) 08-10 (2) 10-11 (1) 16-17 (1) 17-19 (2) 19-21 (1)	16-18 (1) 18-21 (2) 21-23 (1) 02-03 (1) 03-05 (2) 05-07 (1) 07-10 (2) 10-12 (1)	05-07 (1) 18-20 (1)
South-east Asia	08-09 (1) 09-11 (2) 11-12 (1) 14-15 (1) 15-16 (2) 16-18 (3) 18-19 (1)	07-08 (1) 08-10 (3) 10-12 (2) 12-17 (1) 17-20 (2) 20-00 (1)	23-01 (1) 01-02 (2) 02-04 (3) 04-06 (2) 06-08 (3) 08-11 (2) 11-14 (1)	00-02 (1) 02-05 (2) 05-07 (1)
Far East	14-15 (1) 15-16 (2) 16-18 (3) 18-19 (2) 19-20 (1)	08-10 (2) 13-14 (1) 14-15 (2) 15-17 (3) 17-19 (4) 19-20 (3) 20-21 (2) 21-22 (1)	06-07 (2) 07-09 (4) 16-183 09-12 (3) 12-14 (2) 14-19 (1) 19-21 (2) 21-23 (3) 23-04 (2) 04-06 (1)	00-02 (1) 02-07 (2) 3(07-08 (1) 02-06 (1)*
South Pacific & New Zealand	09-10 (1) 10-12 (2) 12-14 (3) 14-18 (4) 18-19 (3) 19-20 (2) 20-21 (1)	07-08 (1) 08-10 (2) 10-12 (3) 12-16 (2) 16-18 (3) 18-20 (4) 20-22 (3) 22-00 (2) 00-01 (1)	06-07 (3) 07-09 (4) 09-10 (3) 10-11 (2) 11-17 (1) 17-19 (2) 19-20 (3) 20-00 (4) 00-03 (3) 03-06 (2)	19-21 (1) 21-22 (2) 22-23 (3) 23-05 (4) 05-06 (3) 06-07 (2) 07-08 (1) 22-01 (1)* 01-05 (2)* 05-06 (1)*
Austral-	11-13 (1) 13-15 (2) 15-16 (3) 16-18 (4) 18-19 (3) 19-20 (1)	06-07 (1) 07-09 (3) 09-11 (2) 11-13 (1) 13-15 (2) 15-17 (1) 17-18 (2) 18-20 (4) 20-21 (2) 21-22 (1)	12-20 (1) 20-22 (2) 22-00 (3) 00-03 (4) 03-07 (3) 07-09 (4) 09-10 (3) 10-12 (2)	00-01 (1) 01-02 (2) 02-05 (3) 05-06 (2) 06-08 (1) 02-04 (1)* 04-06 (2)* 06-07 (1)*
Northern & Central South America	07-08 (1) 08-09 (2) 09-11 (3) 09-11 (3) 11-15 (4) 15-16 (3) 16-17 (2) 17-18 (1)	05-06 (1) 06-07 (2) 07-09 (4) 07-09 (4) 09-14 (3) 14-16 (4) 16-18 (3) 18-20 (2)	05-07 (4) 07-09 (3) 09-14 (2) 09-14 (2) 14-16 (3) 16-21 (4) 21-00 (3) 00-03 (2)	18-20 (1) 20-01 (3) 01-03 (2) 01-03 (2) 03-06 (1) 19-21 (1)* 21-02 (2)* 02-04 (1)*
Brazil, Argentina, Chile & Uruguay	07-08 (1) 08-09 (3) 09-11 (2) 11-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	06-07 (1) 07-09 (2) 09-12 (1) 12-14 (2) 14-15 (3) 15-19 (4) 19-20 (3) 20-21 (2) 21-23 (1)	12-14 (1) 14-16 (2) 16-18 (3) 18-23 (4) 23-02 (3) 02-06 (2) 06-08 (1)	16-20 (1) 20-01 (2) 01-03 (1) 22-02 (1)*
McMurdo Sound, Antarctica	15-18 (1)	14-16 (1) 16-17 (2) 17-20 (3) 20-21 (2) 21-23 (1)	16-18 (1) 18-19 (2) 19-21 (3) 21-00 (4) 00-02 (3) 02-04 (2) 04-08 (1)	22-02 (1) 02-04 (2) 04-06 (1)

NATIONAL RARE BLOOD CLUB

WB2SSM has recently accepted the chairmanship of the Amateur Radio Division of the National Rare Blood Club. His job is to try to contact the 300,000 hams in this country to try to locate the 25% of the group that might have rare blood, put them on record with central headquarters, and set up an amateur central frequency for hams to check into, in case there is a call for rare blood anywhere in the country.

Rare blood donors are not paid, nor does the recipient of rare blood pay for the blood he receives. Being a member of the club is a two way street: not only does a donor help another human being but he also helps himself by insuring against the time of his own emergency.

In the past ten years NRBC members have performed nobly in coming to the rescue of patients all over the country in dire need of rare blood, and making themselves available at all times and sometimes under difficult conditions. These men and women have sup-

[*Continued on page 94*]

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Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

February	1-2	ARRL DX Phone Contest
February	7-9	QCWA QSO Party
February	8-10	Vermont QSO Party
February	8-10	Arizona QSO Party
February	15	RTTY Flash Contest
February	15-16	ARRL DX CW Contest
February	22-23	YL/OM Phone Contest
February	22-23	French Phone Contest
February	22-23	Operation's Day
February	22	RTTY Flash Contest
March	1-2	ARRL DX Phone Contest
March	1-16	IARC Propagation Contest
March	8-9	YL/OM CW Contest
March	8-9	RSGB BERU Contest
March	15-16	ARRL DX CW Contest
March 29 -	Apr. 13	IARC Phone Contest
April	5-6	SP DX CW Contest
April	**12-13**	**CQ WW WPX SSB Contest**
April	19-20	Helvetia 22 Contest
April	26-27	PACC CW/Phone Contest
April	26-27	One Land QSO Party
May	24-25	YL International SSB
July	19-29	Minnesota QSO Party

ARRL DX Contest

Phone: February 1-2 and March 1-2
C.W.: February 15-16 and March 15-16
Starts: 0001 GMT Saturday
Ends: 2359 GMT Sunday

This is the 35th running of this marathon in which the W/Ks and VEs try to work as many DX stations as possible, and with four week-ends at their disposal they should be able to show an impressive total.

Our fellows will send a signal report and their state or province. The DX gang will send the signal report plus 3 figures indicating their power input.

All the details and sample log forms appeared in the December issue of *QST*.

New log, summary and a fine DX check-off sheet are available from ARRL.

Mailing deadline for the finished product is April 12th, and they go to: ARRL Communication Dept., 225 Main Street, Newington, Conn. 06111.

QCWA QSO Party

Starts: 2200 GMT Friday, February 7
Ends: 2200 GMT Sunday, February 9

This year's party is sponsored by the Joliet Chapter of QCWA. Only members are eligible for the QCWA Certificate and Plaque, and only contacts with other members will count toward the awards.

Mailing deadline for your logs is March 8th and they go to: R. H. Woolsey, W9AQP, 1511 Burry Street, Joliet, Ill. 60435.

Vermont QSO Party

Starts: 2300 GMT Saturday, February 8
Ends: 0300 GMT Monday, February 10

The Central Vermont ARC is running this one. It's one of the few state parties that credit the counties worked on *each* band for their multiplier. (max. of 14 per band)

Mailing deadline March 31 to: CVARC c/o E. Reg. Murray, K1MPN, 3 Hillcrest Drive, Montpelier, Vermont 05602.

Arizona QSO Party

Starts: 1400 GMT Saturday, February 8
Ends: 0200 GMT Monday, February 10

The boys of the Saguaro High School ARS are behind this one.

Logs go to: Brian Wood, WA7FIK, 6707 N. 60th Street, Scottsdale, Ariz. 85251. Mailing deadline is March 15th, include a s.a.s.e. if a copy of the results are desired.

French Contest

Starts: 1400 GMT Saturday, February 22
Ends: 2200 GMT Sunday, February 23

This is the phone section, the c.w. weekend was last month.

Logs go to: REF Contest Committee, B. P. 42-01, Paris R.P., France.

Operation's Day

From 1300 GMT Feb. 22 to 0100 Feb. 23

Work station WA2DNR and get the special QSL card that has been printed for the occasion.

Send yours to: Colonie Central High School Radio Club, 100 Hackett Ave., Albany, New York 12205.

Complete rules and suggested frequencies for the preceding five events appearing in the January CALENDAR.

*14 Sherwood Road, Stamford, Conn. 06905

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Claimed Scores
1968 CQ WW DX C.W. Contest

Single Operator All Band	
ZD8J	1,709,955
YV5ANT	1,437,588
W9LKJ	1,136,163
W2PCJ	1,260,480
LA0AD	1,035,188
W3GBF	1,024,125
9J2MX	994,224
G3HDA	969,612
W6ANN	968,000
W6WX/6	806,520
VK2BKM	703,296
VK6RU	667,212
XW8CS	563,445
W6KG	537,958
K4II	531,434
K8HZU	500,956
28 mc	
W9ZTD	87,792
WB4EPJ	58,638
SM6AFH	30,108
DL1TA	16,377
21 mc	
CX2CO	805,090
W1MDO	171,796
W4TXE	153,387
WA6IVN	150.176
DU1CE	138.776
CE3OE	117,432
JA0CUV	59,521
14 mc	
K4PHY/YV5	296,429
TG9UZ	192,065
W4HM	133,632
W4SNU	104,333
W4ZCY	101,898
W7RQN	100,225
9G1HM	86,870
SM5BNX	60,306
7 mc	
W3FU	89,094
W1WAI	81,116
W4BYB	75,576
OH1VA	48,314
SM0CCE	34,515
3.5 mc	
G3VMK	35,316
W2MEL	29,445
1.8 mc	
W2EQS	646
Multi-Operator Single Trans.	
K1DIR	1,736,736
W8UM	932,719
W4ZXI	829,380
HL9US	566,004
Multi-Operator Multi Trans.	
PJ0CC	8,258,787
W6GP	2,180,864
W3TV	2,002,296
W7SFA	1,280,485
W6SR/6	550,830

YL/OM Contest

Phone: Feb. 22-23 **C.W.:** Mar. 8-9
Starts: 1800 GMT Saturday
Ends: 1800 GMT Sunday

Its the YL's working the OM's in this one. Complete rules appeared on page 12 of last month's issue.

Mailing deadline is March 24th and they go to: Ebba Kristjansson, VE5DZ, Box 71, Colonsay, Saskatchewan, Canada.

RTTY Flash Contest

Two Periods:
0200-1000 GMT February 15
0200-1000 GMT February 22

This is the first "flash" RTTY contest organized by *CQ Electronica* magazine of Bologna, and so called because of the short operating periods.

All bands, 3.5 thru 28 mc, may be used. The ARRL country list and the CPR zone boundries are the standards.

Exchange: Signal report and zone number.

PACC Winners

W2ZV	– 1,053	W9LKI –	504
W3BYX –	930	W4WHK –	378
W1FZ –	567	W4JUK –	27

Points: Contacts with stations in one's own zone 3 points. Contacts with stations in other zones, score points as listed in Exchange Point Table. The same station may be worked once on each band for QSO and Multiplier credit.

Multiplier: One for each country worked on each band. (Own country does not count)

Final Score: Total QSO points times the total multiplier.

Awards: Gold medals and subscriptions to *CQ Electronica* to leading scorers, low power less than 100 w. and s.w.l's.

Use a separate log for each band. Indicate time in GMT, call, number sent/received, country and exchange points.

Logs must be received by March 20th by: *CQ Electronica*, via C. Boldrini 22, 40121 Bologna, Italy.

IARC Propagation Contest

CW/RTTY:
0001 GMT Mar. 1 to 2400 Mar. 16
Phone: 0001 GMT Mar 29 to 2400 Apr. 13

The IARC calls this the "contest with a purpose." The objective being to work as many stations in as many different CPR Zones as possible during the above periods. Countries do not figure in the scoring. (Note: CPR Zones are *not* the same as CQ Zones. A s.a.s.e. to IARC or *CQ* will get you a zone map.)

Categories: Single operator, single and all band; multi-operator, all band; radioteletype, all band; mobile, all band; all events, total from all modes and bands.

Exchange: RS/RST report plus your CPR Zone.

Scoring: 1 point for each QSO. And a multiplier of 1 for each Zone on each band. Final score, total QSO points multiplied by total Zones from all bands. (Own Zone may be worked for multiplier credit *only.)*

Awards: Certificates to the top scorers in each category in each Zone. All entries with 100 or more valid QSO's will receive a CPR Certificate.

All bands may be used, 1.8 thru 28 mc and times must be in GMT. You may work the same station as often and for as long as you wish. When a contact exceeds 6 minutes make a new log entry for each additional 6 minutes.

Log and summary sheets may be obtained from IARC, Box 6, 1211 Geneva 20, Switzerland or from the Contest Chairman.

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Mailing deadline for logs is June 1st. They go to: L. M. Rundlett, IARC Contest Committee, 2001 Eye Street, N.W., Washington, D.C. 20006.

CQ World Wide WPX SSB Contest

Starts: 0000 GMT Saturday, April 12
Ends: 2400 GMT Sunday, April 13

Following is a brief rundown of the rules for the benefit of our overseas friends. They are the same as last year, and for all practical purposes the same as our well established phone contest in October, with two exceptions. The limited operating time for single operator stations, and the use of Prefixes instead of Zone and Countries for the multiplier, with the multiplier counting only *once* instead of once on each band.

The limted operating time has been very favorably received. However not so with the multiplier. Many think we should count it on each band but we feel that the scores for all band operation would reach astronomical figures if this was allowed.

Operation is limited to s.s.b. only, and only 30 out of the 48 hour contest period are allowed for single operator stations. The 18 hours of non-operating may be taken in up to 5 periods during the contest. (Multi-operator stations can operate the full 48 hours.)

QSO point value is same as our October contest, 3 for stations on different continents, 1 if on the same continent, and zero points between stations in the same country but permitted for multiplier purposes. Exception: Contacts between stations within the North American boundries count 2 points.

And as stated above, a prefix may be counted only *once* during the contest. Therefore the final score in all cases will be the total QSO points multiplied by the number of different prefixes.

Rules in details including a list of Trophies will appear in next month's issue.

Editor's Notes

Once again let me remind you that the list of claimed c.w. scores is only a small cross-section of some of the early received logs.

Conditions for the c.w. week-end did not seem as good as the phone a month earlier. Or it may have been a lower activity caused by the restrictions on the lower 25 kc of most of the c.w. bands. However there seemed to be plenty of DX up in the higher portion of the bands. It will be interesting to see what the returns show.

At this writing I have not heard from the Radio Society of Bermuda so do not know if anyone will get to spend a week in Bermuda as their guest this year. Their contest is usually held during February.

73 for now, Frank, W1WY

IARC Winners

Single Opr. Single Band
CW–UA9BZ–17,520
Phone–SM7CSN–35,664

Single Opr. All Band
CW–OK2RZ–87,550
Phone–XW8AX–238,100

Multi-Operator
PE2EVO–94,714

Mobile
ZL2AQV–1,900

RTTY
PE2EVO–1,134

THE awards PROGRAM

BY ED HOPPER,* W2GT

THE February "Story Of The Month" is about:

Phillip Carlson, WAØEVO

"Phil" first saw the light of day in 1935 at Cherokee, Iowa. The family soon moved to a farm near Le Mars, where he went to school.

His Air Force service covered from 1954 until the fall of 1957—but the **BIG** event was in 1956 when he married "Kay."

After leaving the Air Force, Phil attended a technical school in Chicago, then returned to Cherokee and worked as a TV repairman.

For the past eight years, the Mental Health Institute in Cherokee has kept Phil very busy with their TV, radio and electrical maintenance.

The family now includes, Kay (XYL and keeper of the logs); Corrine 11 and Gary 10.

His first license was received in January 1963, then a conditional in July and in February 1968 an Advanced Class Licens was received.

An interest in County Hunting was ig nited one evening on 75 meters when h heard a bunch of the fellows exchangin signal reports and county identification It sure sounded like a challenge, so Ph joined the group, many needed Cheroke and Phil was happy to comply.

The equipment at WAØEVO includes Swan 350 (for fixed and mobile use), H Gain TH-3 Jr. at 48 feet and dipoles fo 40 and 80. Phil has another station at th hospital, WAØVCC, using a Swan 24 home brew linear (4-811As) and dipol for 80, 40 and 20.

The family had a wonderful vacation i Montana and Phil gave out some ra counties, many that he also needs. So som how, he will have to make a ham out another member of the family, to be ab to work them for himself on the ne trip.

Our USA-CA Records show: USA-C 500 Award #605 issued December 196 #119 USA-CA-1000 Award dated Octob 1967; #74 USA-CA-1500 Award and #4 USA-CA-2000 Award both dated Mar 1968 and #32 USA-CA-2500 Award we to Phil in July 1968.

* 103 Whittman St., Rochelle Park, N. J. 07662

Phil Carlson, WAØEVO.

Letters

Cliff, WAØKXJ, writes: "Just returne from another county expedition, this w for the Minnesota QSO Party. Ja WAØPKE, and Dan, WNØTGK (wh also operated from Nebraska QSO Part accompanied me to the village of Shak pee, Minnesota, right on the county li between Carver and Scott counties. W rented a motel room about half a mi

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from the county line and stretched a long wire along the highway until it reached into the adjacent county. Over 200 OSOs were made from this QTH. The rigs were the ole SR-160 and dipoles for me, Viking xmtr and portable vertical for Jay, and Dan used a Globe xmtr, 90 watts with a dipole."

"This will be my last story for a while as I will be in college shortly. John Hansen, WAØPTV and I took a trip to Indiana and operated /9 in the Indiana QSO Party. The QTH was Newton county, which has no active hams. The only two hams in the entire county, one Technician and one General, are both inactive.

We attempted to make the trip bigger than previous trips by taking a jet to Chicago and doing a half-day of sightseeing there before proceeding to Indiana. The timing worked out perfectly, and by leaving Des Moines at dawn Saturday we arrived in Kentland, Indiana in mid-afternoon.

Unfortunately, previous problems in the town with TVI, especially from police transmitters, had created an anti-radio feeling in Kentland, and John and I were unable to get a motel room in any of the 4 or 5 motels in town. However, we were invited to set up our rigs in the porch of the town's only ham, Kenny, WA9DHZ. He was very helpful, and he, his son, and his son's fiancee helped with antenna stringing.

Although we did not begin operating until 8:30 P.M., 2½ hours after the contest had started, we managed a total of 300 QSOs by 6 P.M. Sunday. I bought a Galaxy V before the trip, and John used my old SR-160. The antennas were dipoles.

In the past two years I have gone on 18 trips covering 144 counties from which there was operation as portable/mobile.

During the seven main trips, the following hams participated on at least one of the seven trips: WAØNYK, WAØNVM, WAØHYS, WAØTGK, WAØPKE, WAØPTV and WAØKXJ. Total QSOs amounted to 1740, of which over 1500 were made with regular County Hunters in QSO Parties. Special QSLs were printed for each trip.

The other 11 trips were mainly mobile/portable operation on family vacations. Some 2,025 QSOs were made from 23 states and 6 DX countries. Many of the

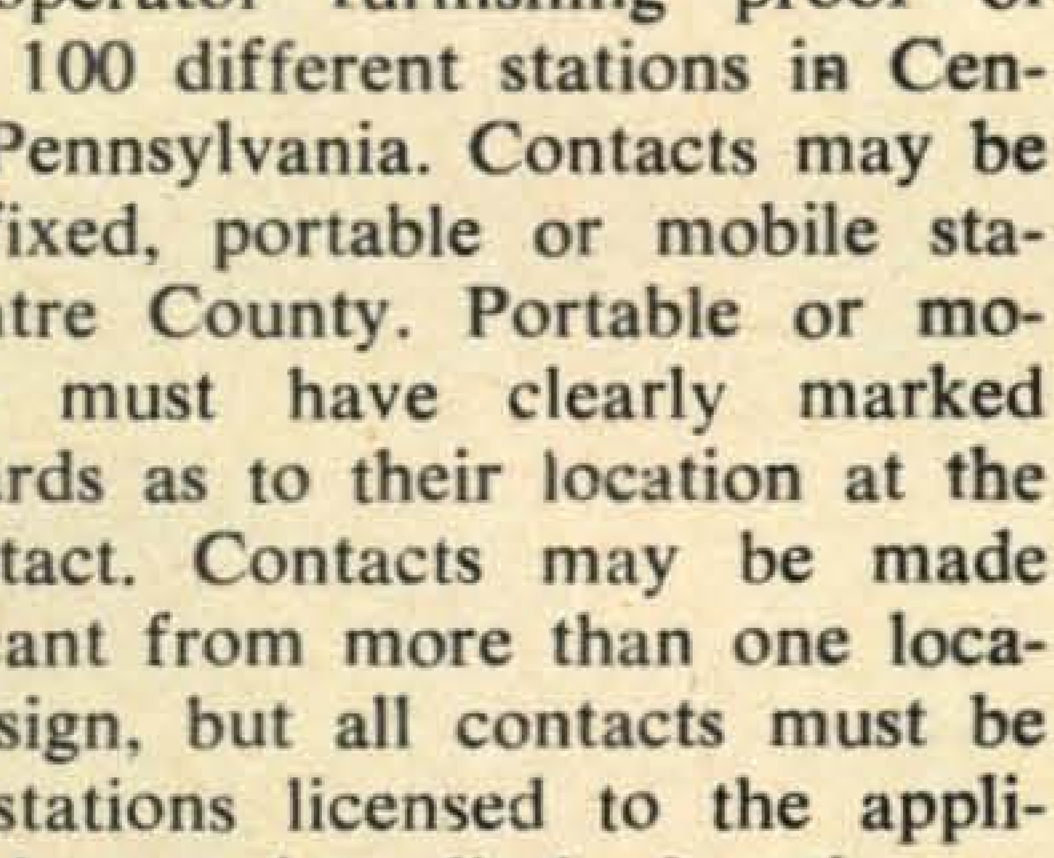
Century Of Progress Award.

QSO's were made with an SR-160 and Hustler mobile antenna on our family station wagon. The calls used were WAØKXJ/M-P, VP7NA, G5AKQ and EI2VAE. U.S. operations included all call districts except W6."

Awards

Alaska-Canada-Nebraska Century of Progress Award: Sponsored by the New Jersey State CHC Chapter 28. Work a city or town starting with each letter, repeat, each letter of Alaska-Canada-Nebraska, each to be in a different county in the U.S., **plus** any 5 New Jersey counties. No date limit. DX/KH/KL work any two of the named, plus 3 New Jersey counties. AOMB/M. s.w.ls. Free to B/P. Send GCR list and $1 or 10 IRCs to Clarence W. Tinsman, WA2QPC, 12 De Kalb Ave., Plainfield, N.J. 07063.

The Centre County Century Club Award: Membership in the Centre County Century Club (CCCC) will be awarded to any amateur radio operator furnishing proof of contact with 100 different stations in Centre County, Pennsylvania. Contacts may be made with fixed, portable or mobile stations in Centre County. Portable or mobile stations must have clearly marked their QSL cards as to their location at the time of contact. Contacts may be made by the applicant from more than one location or call sign, but all contacts must be made from stations licensed to the applicant. There is no time limit for the re-



CCCC, Pa. Award.

WCCNY Award.

quired contacts. Special endorsements will be available as follows: All one Band; All one mode; Additional contacts above the original 100 (endorsed in increments of ten). Applications should include the 100 QSL cards in alphabetical order, an alphabetical listing of the QSL cards, and request for any special endorsements. Application for additional endorsements should include the original award and the required QSL cards. There will be no charge or fee for the CCCC award. Submit application to: Awards Committee, Brasspounders Amateur Radio Fraternity, P.O. Box 17, Oak Hall Station, Pennsylvania 16862. (There are over 220 resident hams in Centre County, plus a student population of about 100 more at any given time—Penn State University is in Centre County).

Worked Chenango County, New York: The Chenango Valley Amateur Radio Association has recently made available this WCCNY Award for successfully contacting any three (3) stations located in Chenango, N.Y. on any band and using any mode. Chenango county is one of the more rare counties in N.Y. and it is hoped that this AWARD will stir up more activity. Send log data (QSLs not necessary) and 50¢ to: Ron Faulkner, K2IQH, 8 Union St., Sherburne, N.Y. 13460.

The Wheat City Award: This award is sponsored by the Brandon Amateur Radio Club of Brandon, Manitoba, Canada. It will be issued for having the required QSOs with stations in the City of Brandon beginning 1st January, 1967 on any band and any mode. Stations on the continent of

Wheat City Award.

North America (Canada, USA & Mexi work 5 stations. All the rest of the wo (Including Central America and Haw work 3 stations located in the province Manitoba. Send log data (QSLs not requir and return postage (1 IRC for N. Am ica, 2 IRCs for DX) to: Doug Bow VE4QZ, 1104 First Street, Brandon, Ma toba, Canada. Active stations in the city Brandon are: VE4AO, AU, CI, CT, D EL, GV, JF, OD, OM, QD (Club Statio QZ, RW, SR, UP, XN, and YC.

Results of 1968 CW County Hunter Contest

Courtesy of Rick, K2VGR and Dick, K2UFT

UNITED STATES SCORES

Conn.	**K1GUD**	26	25	65
Me.	**W1UOT**	145	98	14,21
	W1PJ/	74	55	4,07
Mass.	**W1AQE**	286	159	45,47
	K1PRB	94	69	6,48
	W1PLJ	16	16	25
R.I.	**K1QFD**	223	143	31,88
V.T.	**W1MRW**	35	33	1,15
N.J.	**WA2IRN**	134	103	13,80
	WA2BZV	136	90	12,24
	WA2BLB	112	76	8,51
	W2GT	89	72	6,40
	WB2UVB	73	59	4,30
	WB2NSV	68	52	3,53
N.Y.	**WA2UWA**	151	109	16,45
	WB2KVH	152	104	15,80
	W2ZV	140	98	13,72
	W2CUE	81	67	5,42
	K2UFT	76	63	4,78
	K2VGR	54	45	2,43
	W2ECY	24	23	55
	W2NCG	Check log.		
Del.	**K3ZMI**	322	179	57,63
Md.	**W3OFU**	155	101	15,65
	WA3GUI	68	54	3,67
	W3QCB	33	29	95
	W3RYV	3	1	
Pa.	**WA3EYL**	149	110	16,39
	WA3BGN	72	59	4,24
	WA3JGQ	8	5	4
Fla.	**K4WVX**	110	85	9,35
Ga.	**K4TBN/4**	131	94	12,31
N.C.	**WB4IOJ**	308	176	54,20
	WA4FFW	328	160	52,48
	W4OMW	250	143	35,75
S.C.	**W4WHE**	110	79	8,69

[*continued on page 102*]

See page 110 for New Reader Servi

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Q AND A

BY WILFRED M. SCHERER,*
W2AEF

SB-200 Linear Amplifier with Heath HW-16 C.W. Transceiver

QUESTION: I have a Heath SB-200 Linear Amplifier and am wondering if it would be possible to use the HW-16 Transceiver as an exciter for it. I know, of course, that it will not drive the amplifier to full output. Also, that there would have to be some method of activating the relay in the SB-200. This would not be any great problem, but would there be too much feedback into the receiver section of the HW-16?

ANSWER: You should not have any feedback problems with the above setup. The receiver would be cutoff in the normal manner. Also, you won't have to worry about damaging the T-R diode since it is confronted only with the normal output from the HW-16, because the transceiver output is connected only to the linear *input* when the amplifier is in use.

As you have already indicated, an external switch will have to be rigged up to activate the linear-amplifier relay, etc.

As checked in the *CQ* Lab, the HW-16 will drive the SB-200 to almost 500 watts output on 40 and 80 meters. On 15 meters the output will be about 400 watts.

Articles on BC-348 Receivers

QUESTION: Can you refer me to articles on the BC-348 receivers?

*Technical Director, *CQ*.

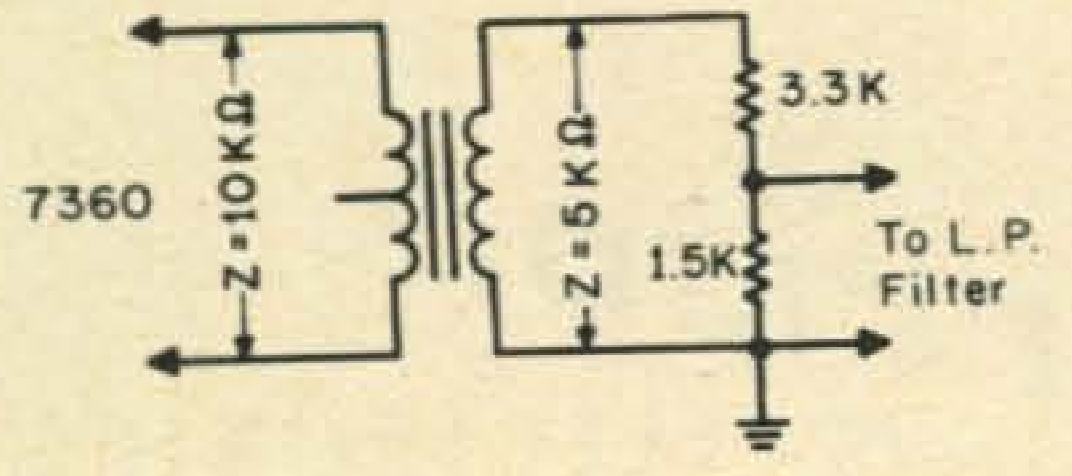

Fig. 1—Method of matching 1500-ohm l.p. filter input to 5000-ohm source.

ANSWER: The following articles on the B 348 receivers have appeared in *CQ:*

"New Life for the BC-348," *CQ*, May '5 p. 47. (S-meter, crystal phasing).

"Surplus Column," *CQ*, Feb. '59, p. 7 (Power supply, a.f. amplifier, schemati

"Surplus Column,"*CQ*, March '59, p. 6 (Power supply, T.N.S. noise limiter, a amplifier, schematic).

"So I Bought A BC-348Q," *CQ*, April '4 p. 25. (General Modifications).

"Bandspread on 14-21 mc with BC-348," *C* Dec. '48, p. 39.

Back copies of the above issues are av able at $1.00 each from *CQ* Circulati Dept. The April and Dec. '48 articles available only as Xeroxed copies.

Termination for Low-Pass Filter to b Used with Inverted-Audio System

QUESTION: I am constructing the low-p filter described in the April '64 *CQ*, page It is stated there that the filter must work of a low impedance. Please advise m exactly on this impedance or can you s gest a transformer type to be used betw the 7360 tube and the filter input using setup shown in the "Inverted Audio" art in Feb. '64 *CQ?* It is clear that the filter c put must be terminated in 1500 ohms.

ANSWER: The terminations for the af mentioned filter theoretically should be same at the filter input and output; that 1500 ohms. It is especially important the *output* be properly terminated, in or to obtain a flat passband. The input sou impedance is not as critical, so may v between 1000 and 2000 ohms.

You can use the Triad M1-X transfor as specified in the Audio Inverter article, it might be well to provide an impro impedance match by using the scheme sh at fig. 1. A small loss in signal level result. On the other hand, the resistors be eliminated if you use a transformer a 10,000-ohm center-tapped primary an 1000-2000 ohm secondary.

Antenna Balun Data

QUESTION: I am hoping to broadband dipole on 80 meters with a toroid balu have a 2" diameter (o.d.) core, but nee know the winding data and how the con tions are made to the dipole. Can you h I should have first asked if this would re broadband the dipole.

ANSWER: The balun itself will not necess

See page 110 for New Reader Se

road-band the antenna. Your impression as o this stems from the fact that the balun self can be a broadband device; that is, it is seful over a wide band of frequencies for btaining a suitable balance when an otherwise unbalanced transmission line is emloyed. This should result in a minimization f feedline radiation, a more uniform radiatng pattern and a minimization of TVI in ome cases.

A fine informative article on the subject as been written by L. G. McCoy, W1ICP. t appears in the December '68 *QST* under e title "Is A Balun Required?"

Winding data for the balun is as follows: 0-12 turns of #16 enamel wire trifilar wound ith connections made as shown at fig. 2. his is for a 1:1 balun.

NS Noise Limiter Installation in HA-460

UESTION: How should the TNS Noise imiter/Squelch be installed in the Lafayette A-460 6-meter Transceiver?

NSWER: Figure 3 indicates the method of onnecting the TNS in between the detector nd a.f.-amplifier input of the HA-460. To ake it easier to follow, the drawing is shown s it is basically laid out in the original chematic for the HA-460. R_F and C_F are ew components. The original noise limiter or the set has been deleted.

The method of installation should also be pplicable to the 10-meter version of this ansceiver.

V.H.F. Voltmeter

UESTION: I should like to build a v.h.f. r.f. oltmeter to read 0-5, 0-50 and 0-500 μv. an a 1N21B diode be used with a d.c. amplier and a 0-500 μa meter with shunts for arious ranges? How may it then be calirated. I wish to use this in conjunction with lignment of 2-meter f.m. receivers.

NSWER: When you're asking for a v.h.f. oltmeter – for measurements in microvolts, s quite a tall order. Although very highriced commercial instruments may be available for such measurements, do-it-yourself onstruction is pretty much out of the realm f the amateur.

A crystal-diode detector is okay, but there re problems involved. The linearity of the iode is very poor and varies considerably elow about 0.1 volts. This would make alibration difficult and different for each ange.

The diode would have to be followed by a d.c. amplifier with a gain of at least 100 db. It would require several stages of extremely high stability. Also, the amplifier would have to feed another voltmeter, such as a v.t.v.m., with about a 1.5-volt range.

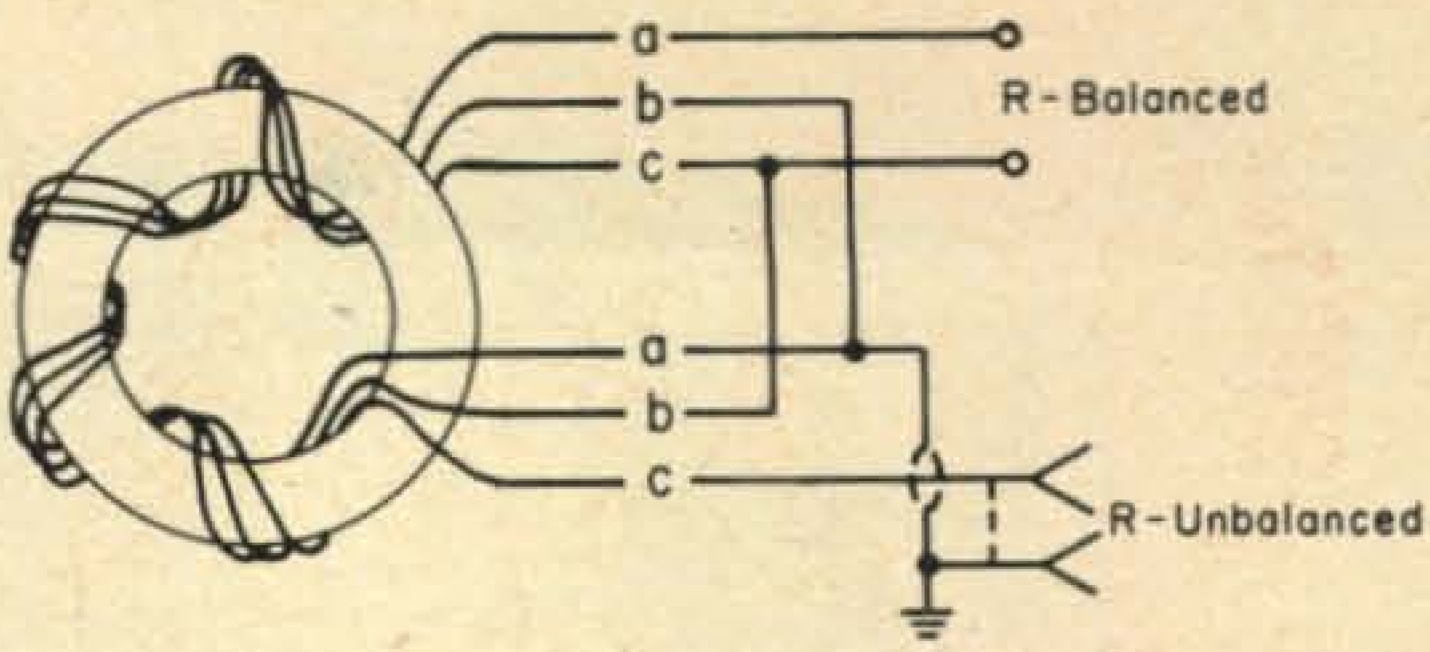

Fig. 2 — Connections and winding scheme for toroidal 1:1 balun.

In any event, calibration would be best made using a 0.1-volt r.f. signal source and an accurate step attenuator with a total attenuation of 100 db. Each 20-db of attenuation will decrease the signal level by a factor of ten.

Your best bet, for use with f.m. receiver alignment, would be a signal generator with known output voltages.

51J-3 Mixer Modification

QUESTION: I want to improve my Collins 51J-3 receiver as outlined in April 1968 *CQ*, page 68, but am puzzled as to where and what happens to the connections to S_{106} for the mixer changes. Also, is the connection to S_{105} removed from C_{116}?

ANSWER: In respect to the modifications given in the reference article, the mixer output goes to S_{106}. S_{105} should be connected to the junction of C_{116} and *R*s.

[*Continued on page 95*]

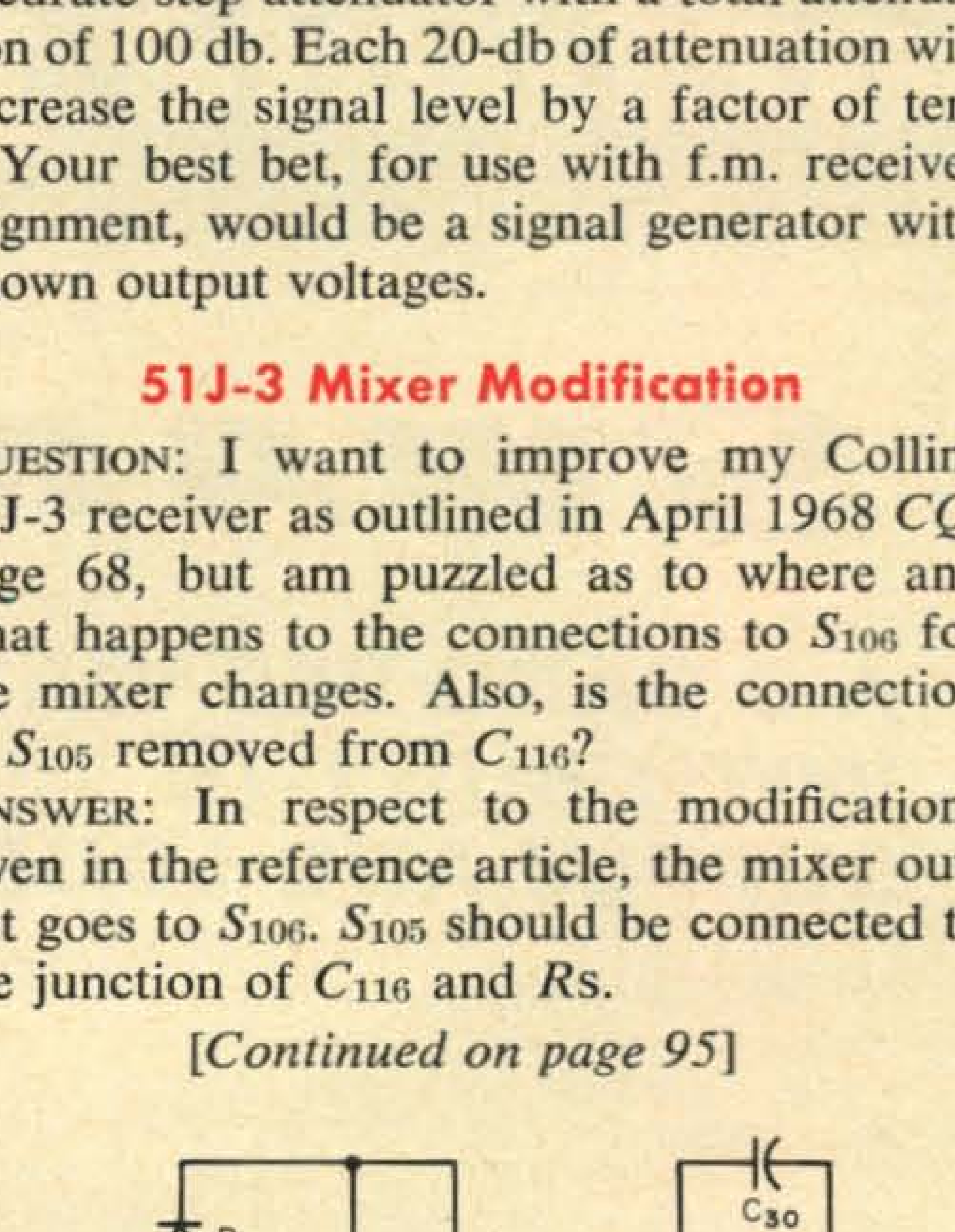

Fig. 3—Connections for installation of the TNS in the HA-460. The original noise limiter is disconnected as indicated by its absence here. The TNS ground should be connected at the same physical point used for the ground of the detector diode, D_1, C_{27} and Cf.

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The new Cygnet is designed to provide efficient, high quality communications in the 5 most commonly used amateur bands. Its low cost is a tribute to Swan's well known techniques in value analysis, and simple, direct circuit design. Above all, these techniques lead to a high degree of reliability and foolproof performance. Dimensions are: 13″ wide, 5½″ high, and 11″ deep. Weight is 24 lbs.

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SURPLUS sidelights

BY GORDON ELIOT WHITE

THREE years ago I started this column with a treatment of the AN/ARC-58 transceiver, an airborne unit capable of a kw in the h.f. bands with extreme stability and digital tuning. Though that Collins set has been widely used in USAF B-52 and C-135 jets, it proved a bit complex for most hams, and only a few have shown up in surplus.

Now I can report that another quite stable airborne set, the AN/ARC-21 and a single-sideband version, AN/ARC-65 (fig. 1) is coming into surplus channels in decent numbers, and can be converted to amateur or s.w.l. use rather readily.

The a.m. AN/ARC-21, built by RCA, covers 2 to 24 megacycles. Its transmitter is capable of 100 watts output. Specification stability for the ARC-21 is .0015 percent in airborne use. The set may be adapted for frequency-shift reception or transmission. The AN/ARC-65 is virtually identical, but has some modifications in the receiver-transmitter area to adapt it for s.s.b. operation.

Either set will tune 44,000 available channels in 500 kc steps, though control head C-451 is capable of handling only 20 pre-set selections at a time.

The appearance of the AN/ARC-65 is so odd that many potential purchasers have thrown up their hands and passed it by as some exotic radar set, but despite its bomb-like shape, this is a well-constructed, medium-power s.s.b. or a.m. transceiver. If you can hide the chassis away out of sight and mount the control head at a convenient operating position, you can have yourselt a fine transceiver at a fraction of the cost of either a commercial amateur or general coverage system, or even far below the surplus price of the classic R-390-A receiver.

Unlike the AN/ARC-58, the ARC-21/65 uses no 400-cycle power in the receiver-transmitter itself. It may be powered by a built-up power supply, or through dynamotor set DY-50/ARC-21.

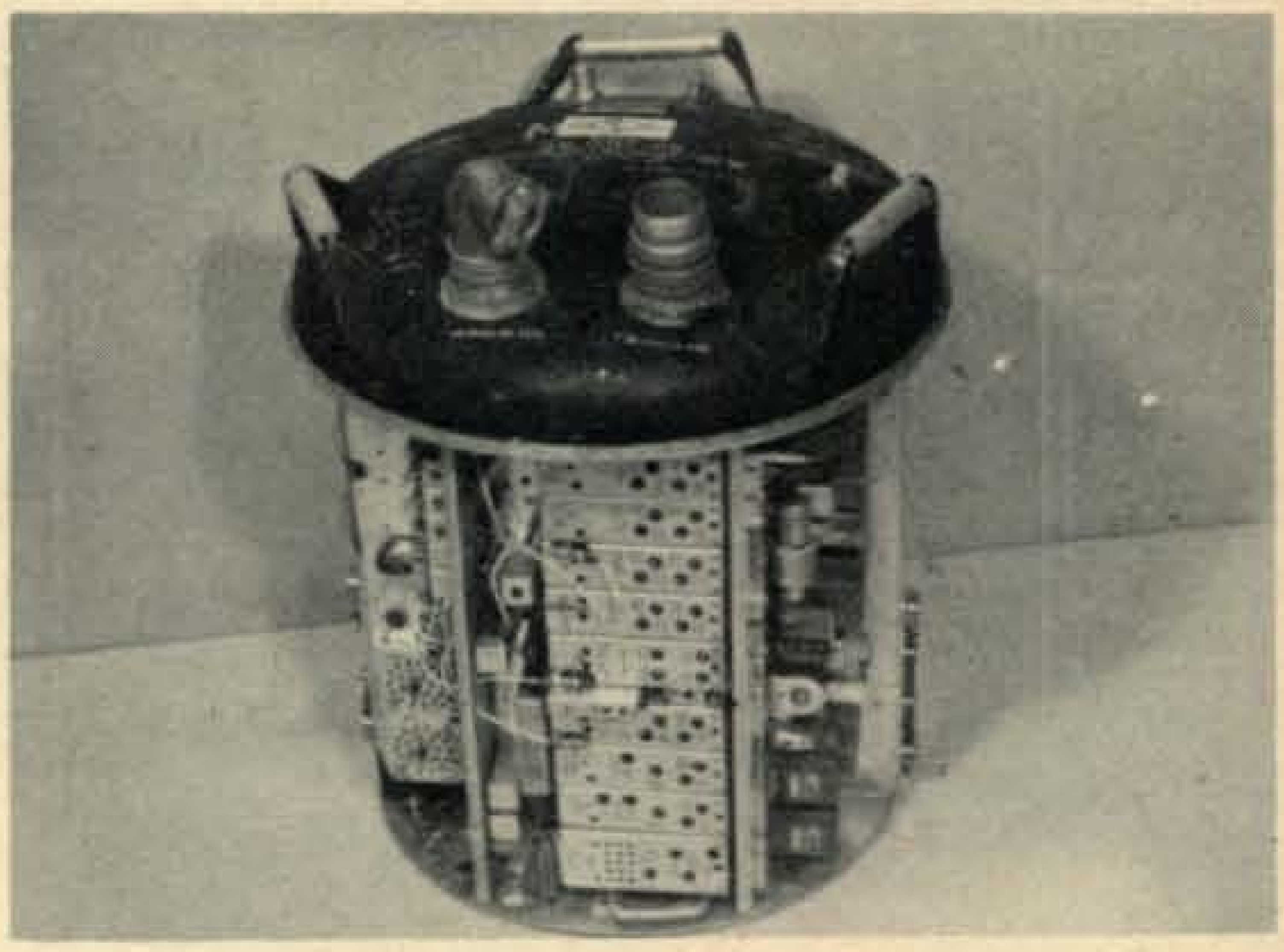

Fig. 1—The RT-400/ARC-65 transmitter-receiver unit. This pressurized container holds most of the transceive system, allowing it to operate without arc-over, even at altitudes of 70,000 feet. The ARC-21 set is virtually identical.

There is available a non-mechanical surplus power supply, PP-298/ARC-21, which is designed to use 400-cycle power from an aircraft generator. I have this unit, and do not have the DY-50, so I had to have a means of providing both 400-cycle and the 28-volt d.c. power required. (The dynamotor set of course runs solely on 28-volt d.c. power.)

For my 28-volt power supply I picked up in surplus a very heavy telephone battery supply containing a transformer, rectifiers and voltage-regulator circuits. The DY-50 draws from 25 Amperes in receive mode to 59 Amps while tuning the trans-

Fig. 2—Surplus aircraft inverter runs on 28 volts d.c. and puts out 400 cycle a.c. power. The large unit is a surplus Telphone Company rectifier to provide the d.c. current. Alongside is the PP-298 power supply for the ARC-65 set.

*5716 N. King's Highway, Alexandria, Virginia 22303.

See page 110 for New Reader Service

CONNECTORS

Unit	JAN connector number
RT-400/ARC-65	3108B-28-425S
	3108B-32-409P
	3106-16-9S
PP-298	3106A-24-11P
	3108B-28-425P
C-415	3106-22-14S
	3106-20-27S
C-455	3106-22-14S

Fig. 3—The above list indicates the connectors required to make up the AN/ARC-65 or AN/ARC-21 system.

mitter. The PP-298 requires between 17 and 37 Amps. d.c. and between 2 and 8 Amps of 400-cycle a.c. power.

If you want to build up a power supply, voltages required are shown on the schematics in the manual, Air Force T.O. 12R2-2ARC-21-2, and in the ARC-65 addendum, IB-39847-1. I can furnish the voltages, but not the current requirements, to any reader who sends me a self-addressed, stamped envelope.

But I am using the PP-298, providing the d.c. power through my surplus rectifier set, and driving its 400-cycle input with a surplus aircraft inverter. These are usually available cheaply, operate on 28-volt d.c. input, and make it simpler to get the set operating than actually putting together a rather complex power supply from scratch. Other alternatives include rewinding the power transformers in the PP-298 for 60 c.p.s. input, or construction of a stiff solid-state 400-cycle supply. With more than 900 watts of power involved, the latter approach seems impractical. Fig. 2 shows my inverter and rectifier unit, along with the PP-298.

Plugs for the ARC-21/65 are exotic, but most of them are available from suppliers such as Bill Slep, box 178, Ellenton, Florida, Wilgreen Industries, New York, or Radio Ham Shack, in Miami, among others. Fig. 3 is a list of the necessary connectors.

Unlike the AN/ARC-58, which was tuned with 400-cycle servo motors, the automatic tuning in the ARC-21/65 uses ordinary d.c. motors. This makes things much simpler.

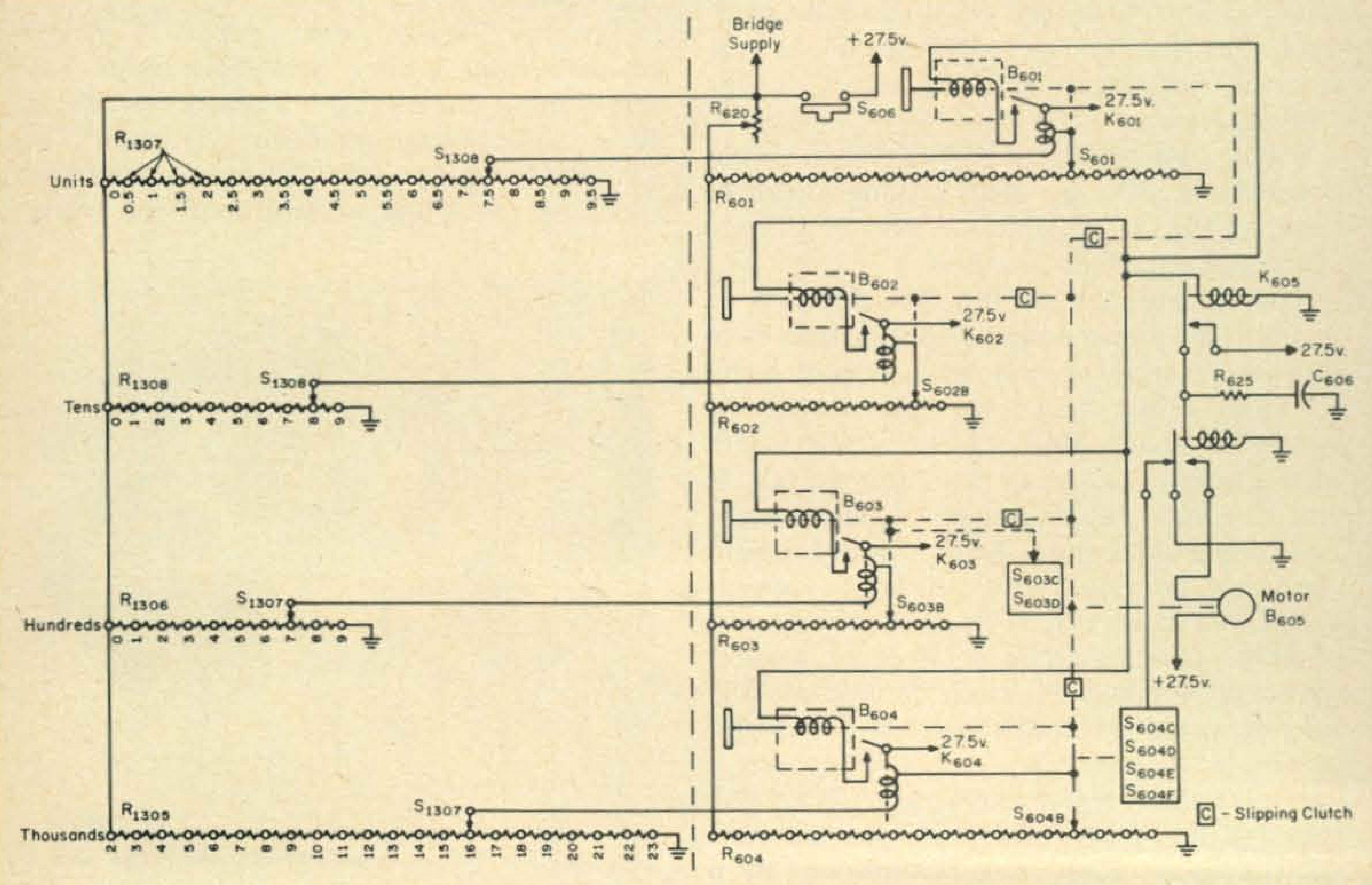

Fig. 4—Simplified tuning circuit of the AN/ARC-65 set.

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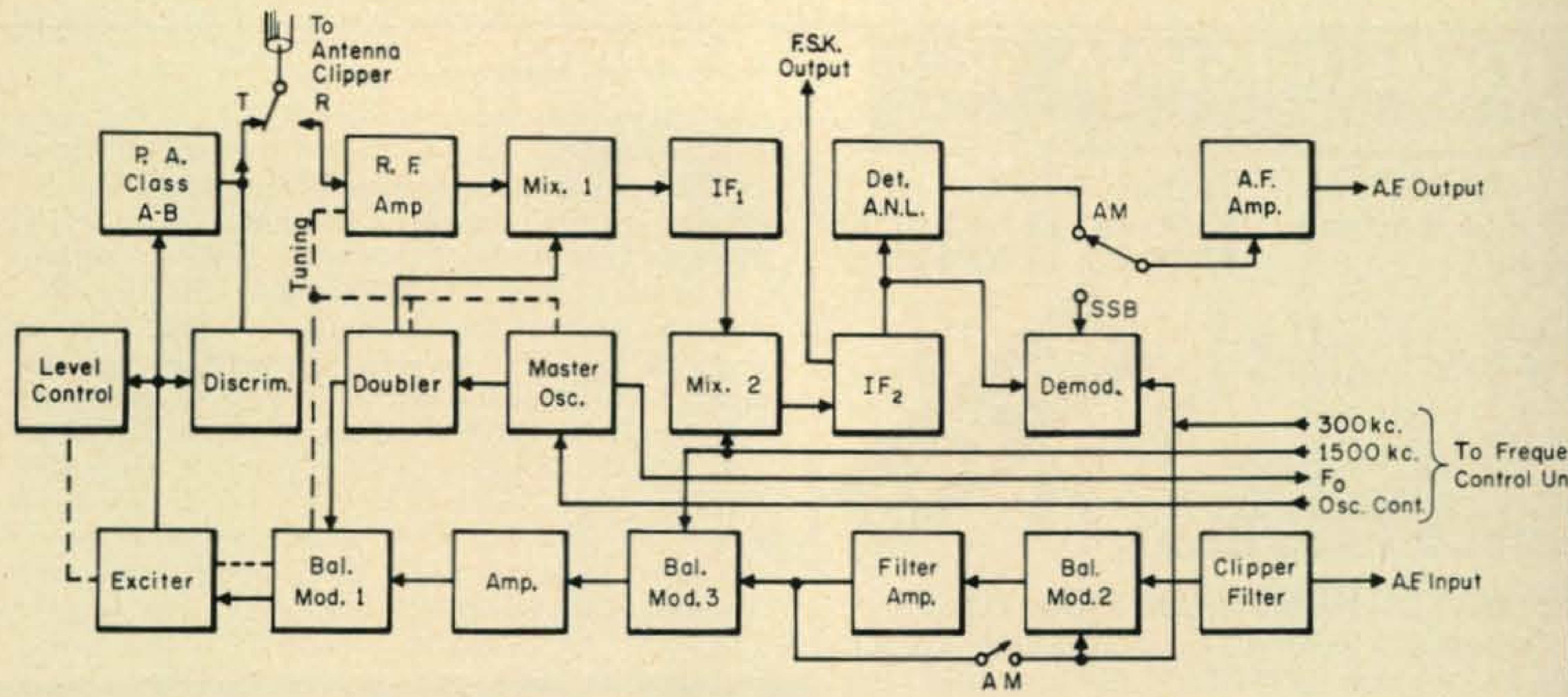

Fig. 5—Block diagram of the AN/ARC-65 transceiver.

From a conversion point of view, 400 cycles is a nuisance, particularly if you have the dynamotor unit, and need to bother with only 28 volts d.c. The Collins ARC-58 had motors which used 400-cycle power, and the servo system was so complex that even the Collins engineers would have had a hard time converting it. You were forced to use it as-was or not at all. My ARC-58 was perfect. I plugged it into a test bench at Andrews Air Force Base, dialled up WWV, and was on zero beat. But I didn't have the control box, a $1,2[illegible] mass of precision parts, and in the end [illegible] swapped the airborne set for a more p[illegible] destrian R-390-A receiver.

Incidentally, I bought the ARC-58 fro[illegible] the Navy at an open sale for $15, so t[illegible] day of the surplus bargain is not yet dea[illegible] It cost the U.S. government a cool $20,00[illegible] The ANARC-21/65 cost about $18,000, and is selling now for around a penny [illegible] the dollar, or less, among the surplus dea[illegible] ers. Some are showing up in MARS.

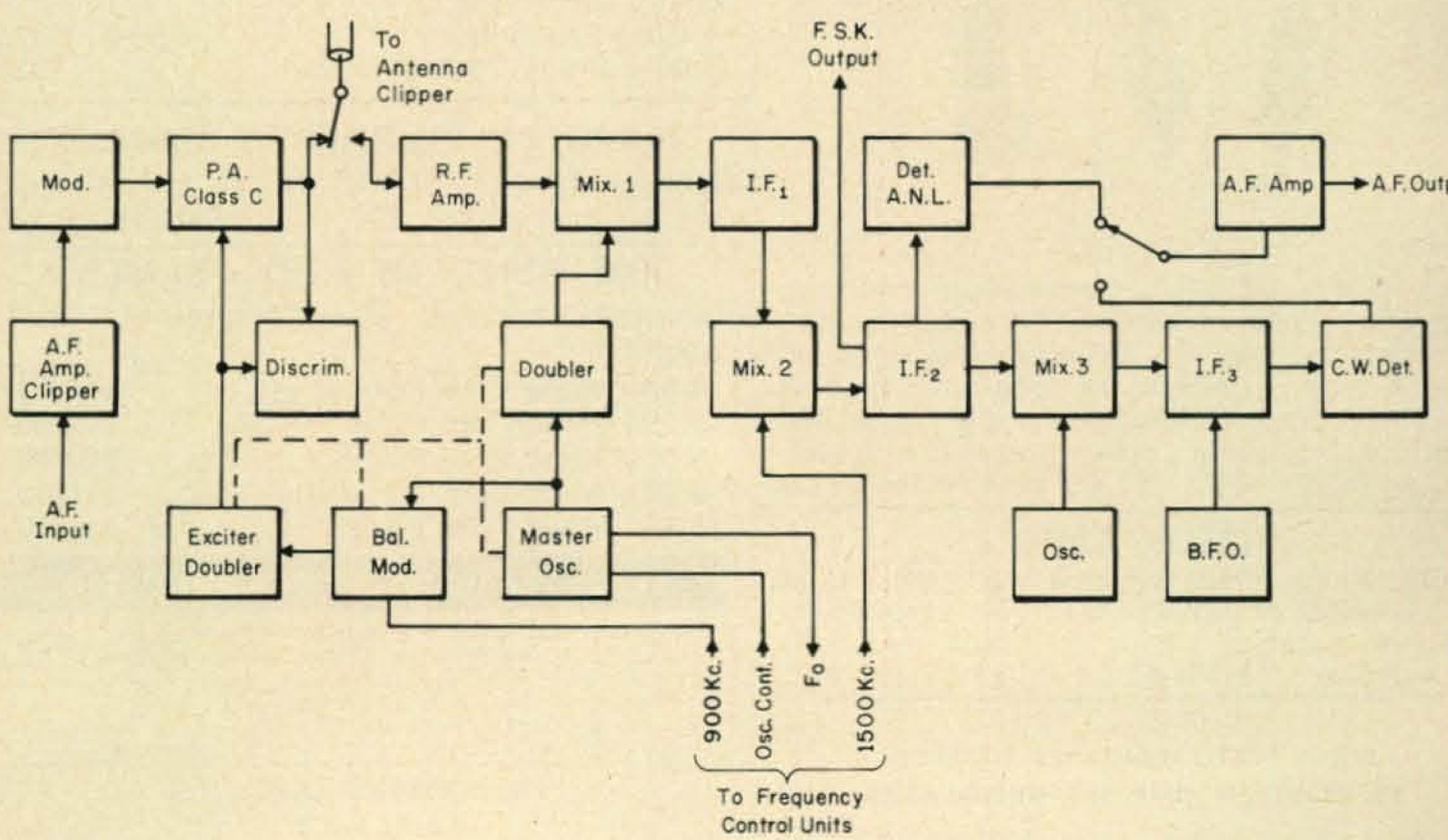

Fig. 6—Block diagram of the AN/ARC-21 transceiver.

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See page 110 for New Reader Service

But even if you lack the C-451 control for the ARC-21, take heart. The set is tuned by a bridge circuit. Precision resistors in the control head are switched in to upset the bridge balance, and the d.c. tuning motors operate to re-balance the circuit. It is relatively simple to provide calibrated potentiometers, or to wire up rotary switches, to control the tuning circuits. Fig. 4 shows the tuning circuit in simplified form.

There is an auxiliary tuning head for the system, C-455, but it must be operated through the C-451, thus is relatively useless alone, and does not contain the bridge circuit components.

Incidentally, in addition to offering s.s.b. mode and suppressed-carrier a.m., the ARC-65 equipment increased the power output to 230 watts and the stability was narrowed to 22 c.p.s. at 20 mc. Sensitivity of the improved set is rated at 1.5 microvolts for 10 db signal plus noise to noise. Selectivity is 4 kc at 6 db down; 8 kc at 60 db.

The transmitter may be tuned over the entire range, automatically, with the antenna properly loaded at 52 ohms, through coupler CU-145.

The AN/ARC-65 is incredibly complex, by the standards of most surplus material. The diagrams and schematics would take up this entire issue of *CQ* to reprint, but the manuals are still around, so anyone who picks up this gem should try to get himself the book, too. Fortunately these sets are fairly durable, so they should, hopefully, work when fired up. If they don't, my best suggestion is to cultivate the friendship of the sergeant in charge of radio work at your nearest Air Force Base, and give him a bottle or a steak in exchange for some checkout time.

The block diagram (fig. 5) itself is pretty awesome, but in brief, the system has two r.f. stages followed by an 1,800 kc first i.f., a second mixer, and a 300 k.c. second i.f. detector, a.g.c. (A third, 105 kc i.f. stage is introduced for c.w. reception in the ARC-21) and audio amplifier. Fairly straightforward, aside from the tuning system, which involves the bridge circuit mentioned above, several d.c. motors, electrical clutches, a 50 kc reference oscillator, reactance tube, etc. The final two i.f. strips (300 and 105 kc) contain good mechanical filters for passband shaping. In the ARC-65 the 300 kc filter has been improved and the 105 kc i.f. section deleted.

I will have more on this set in succeeding months, and welcome suggestions and comments from readers who have had experience with the AN/ARC-21/65 sets.

As I noted above, the provision of 400-cycle a.c. power is a bit of a problem. If you need only a few watts, there is a kit now being offered by B & F Enterprises, Box 44, Hathorne, Massachusetts, which will provide about 350 ma of 400 c.p.s. square wave power. Input is 6 or 12 volts. d.c., to a transistorized a.c. oscillator.

The kit is a very handy item, but of course is not going to drive your AN/ARC-65. You'd need about 24 such units in parallel, to power a set of that size. It ought to do the trick, though, where lower power consumption is involved.

I have a couple of reader requests which I have been unable to solve. Can anyone identify units of the FRN-12 and TDA-8 systems, or offer advice on conversion of the ALA-2 to 14 mc input, for KØVRA, in Marcus, Iowa? Or can someone suggest a source of parts for the ID-60/APA10, for E. A. Sjulander, of 119 7th St. W., Ashland, Wisconsin?

As always, I am eager to get more information on the availability of technical manuals, and reader John Lenkerd, of Morristown, New Jersey, has labored in the New York Public Library, and has come up with a compilation of the military manuals that are available there. The list may be obtained by writing to me at my Virginia address, include 25¢ to cover the Xerox copy, plus a s.a.s.e.

John has also dug into the National Archives for listings of military manuals. Though only record copies are kept, it is possible to obtain reproductions of books, or individual pages, of virtually any manual. Cost is five cents a page for microfilm, twenty cents for photocopy. This isn't cheap, but it is a last resort. Incidentally, you do not need to order an entire manual. You can select individual pages to be copied.

The gentleman in charge of the military manual section at the Archives is Thomas H. Hohmann. His phone is 202-963-6565 in Washington, and his address is National Archives and Records Center, Washington, D.C. 20408. Manuals from 1917 through 1954 should be available through him. Later books, 1954-66, may be found through the Reference Service Branch, Washington National Records Center, Washington 20409, which is physically located in Suitland, Maryland, 4205 Suitland Road, about ten miles from downtown Washington.

These sources have most Army manuals. Mr. Perry Schwartz, also at National Archives (202-963-6887), can assist with Navy books. Information on U.S. Coast Guard manuals may possibly be obtained through the archivist at 202-963-3171. Most U.S.A.F. Technical Orders must be sought through the Air Material Center at Tinker Air Force Base, Oklahoma City, though Mr. Hohmann may be able to get leads on Air Force books. Pre-1940 Air Corps sources may be on file in Washington, for those interested in really old gear.

That about wraps it up for this month, as we start the fourth year of Surplus Sidelights. In the next few issues I will deal with more detail of 400-cycle a.c. power sources, with the mobile and handy-talky f.m. gear now coming out in large quantities, and with Western Union facsimile sets, now in the hands of many surplus dealers. ■

Scratchi *[from page 11]*

twenny pound hunk of beef. Are tying meat to front of cage with hevvy wire. You see, Scratchi are going to let mounten lion smell meat, come inside cage, and when that happens Scratchi, who are outside, are pulling trip wire and – kerflam – cage are closing. Pretty slicky, you think not, Hon. Ed? What can go wrong?

Only one thing can go wrong. The one thing that went wrong. Scratchi are supposed to be outside of cage when mounten lion are inside cage–not vice versa.

Because–when I finished tying meat to front of cage, and turning around, there are 240 pounds of mounten lion on the ramp of truck, looking at twenny pounds of meat with reel affeckshun.

If I could just have made that mounten lion understand that he could have the meat! But no, I think he thought I was as hungry as he was, and I wanted the meat too.

Suddenly there was all this ackshun in the cage. One was Scratchi trying to get out and the other was the mounten lion trying to get in. Did I menshun that the cage wasn't very big? Hon. Ed., Scratchi and a 240 pound mounten lion just can't pass each other in a small cage. It all very misty rite now–all I recalling is that in leeving cage I tripping over trip wire and – kerblam – cage are closing.

I'll say one thing for Hon. Brother Itchi. He very understanding. He saying that he making deel with zoo to buying mounten lion and price we getting will pay for doctor's bills, nurse bills and bandages–and still have cupple bux left over. Which–if I forgetting about Hon. A. R. C.–I can having to buy some new ham geer.

I agreeing–what else could I do. Howsumever, Hon. Ed., if you heering about any earthquake reports, please calling me posthasty on landline. I'd like to have some warning as can't swim worth a darn with all these bandages on.

Respectively yours,
Hashafisti Scratchi

Rare Blood Club *[from page 76]*

plied almost 3000 units of rare blood yearly since 1958, a fact that can hardly be over emphasized since rare blood patients are recipients who never pay a cent for any amount of blood needed.

In cases where fresh, rare blood is required, such as in heart surgery, club mem-

See page 110 for New Reader Service

bers go directly in the hospitals to give blood at a time specified by the surgeon.

There are six basic rare blood types in the population, making up one-fourth of all blood types. You fall into this category if you have one of the following types:

B Rh Positive	8.5% of the U.S. Pop.
O Rh Negative	6.75% of the U.S. Pop.
A Rh Negative	6.15% of the U.S. Pop.
AB Rh Positive	3.4% of the U.S Pop.
B Rh Negative	1.5% of the U.S. Pop.
AB Rh Negative	.6% of the U.S. Pop.

If you have rare blood, we invite you to join the National Rare Blood Club. As a member, you donate blood only when called upon and only if you are physically able and between 18 and 59 years old.

Employee groups, social groups, fraternities, and in fact, any individuals with a rare type of blood are invited to join. There are no dues. The Club is financed mainly through the Associated Health Foundation, Inc., an association of lodges within the Fraternal Order, Knights of Pythias, New York State.

So far the club has answered every appeal from a hospital or surgeon, regardless of whether the patient is a member of the NRBC, and hopes to continue this generous policy, but needs many more than its present 6000 members to be able to do so. Although NRBC cannot guarantee to provide blood when needed, it can and will, through the amateur radio operators guarantee that every effort will be made to provide this service.

Will you help save a life today? Tomorrow it may be yours.

Contact

Lou Goldberg, WB2SSM
566 Conway Road
Elmont, N.Y. 11003

Q & A [*from page 85*]

Corrections

At fig. 5A in the Q & A Column on page 85 of the Jan. '69 *CQ*, the .01 mf output-coupling capacitor should have been shown connected to the tube cathode, instead of to the grid.

In the Millen Transmatch Review in Jan. '69 *CQ*, on page 62 the last sentence in the last paragraph under "Adjustment", should read "used between the *Transmatch* and the load. Also, the interior photo was shown upside-down and thus does not completely fit the caption.

Plate Choke for Eldico SSB-1000 Amplifier

QUESTION: Can you furnish wire size and information useful for rewinding burned out cathode r.f. choke in Eldico SSB-1000MIL Amplifier using original ceramic form? If not, how about a suitable substitute?

ANSWER: The cathode choke for the Eldico SSB-1000 is a 3 mh job with a current-carrying capacity of 500 ma peak. The original one was a surplus job made up of several Pi sections; however, any type, such as a solenoid one, will do as long as it does not exhibit self-resonances at the operating frequencies for which the amplifier is used. You can use a standard solenoid type high-power plate choke such as found in present-day linear amplifiers. Many of these are commercially available.

You also can wind your own choke, helpful information for which is given in an excellent article on the subject: "R. F. Chokes for High-Power Parallel Feed," V. Chambers, *QST*, May 1954, p. 30.

Any size wire larger than #24 should handle the current okay. ■

You say your taxes were raised?

You missed three payments on your Jaguar XK-E?

You had to turn in your Playboy Club Key?

Your salary was cut?

You say the F.C.C. has expressed interest in your four different calls?

You say food is so expensive it's cheaper to eat money?

You say you invited your boss to dinner and during the soup course the finance company repossessed your furniture?

You say your XYL backed the family car out of the garage after you backed it in the night before, and now you can't get to the Newsstand to get your monthly copy of CQ?

HOLD IT!!

While we are in no position to alter the tax structure, give you a raise, or sway the F.C.C., We can save you a pile of cash on CQ! So drop that anchor, pick up a pen and dash off a CQ subscription right away!

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2 yrs....... I PAY ONLY $11.00 .... a savings of $ 7.00
3 yrs....... I PAY ONLY $15.00 .... a savings of $12.00

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 See page 110 for New Reader Service

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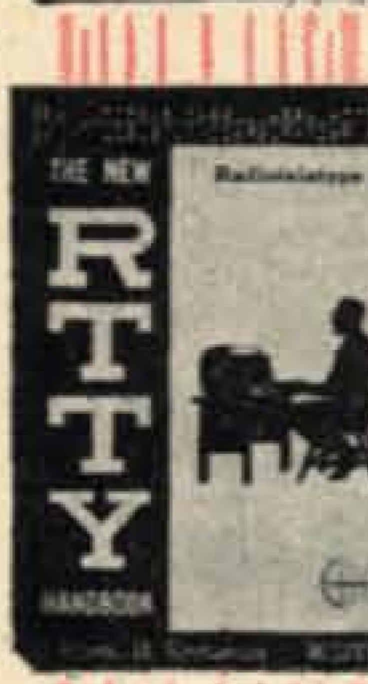

THE NEW RTTY HANDBOOK

Cat. #116. A treasury of vital and "hard to get" information. Loaded with equipment schematics, adjustment procedures, etc. A valuable asset to both the beginning and the experienced RTTY'er. Special section on getting started, written by Byron Kretzman, a well known authority in the field.

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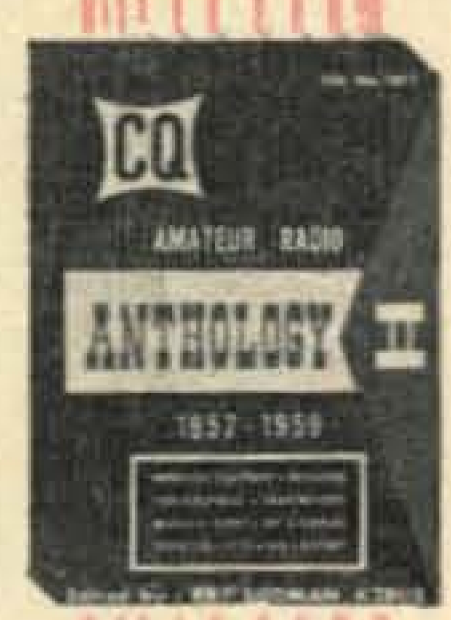

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IC Logic [*from page 16*]
speed memory elements.

There are several different types of flip-flops; the one we are interested in is called the J-K flip-flop. In the J-K flip-flop the letters J and K were arbitrarily assigned years ago and don't stand for anything. You will note that there are outputs available on this device shown in fig. 5(A), *Q* and *Q*; *Q* is simply the inversion of *Q*. The flip flop will remain in the same output state, regardless of its inputs, until a negative going (*i.e.,* +4 volts to 0 volts) pulse is applied to the toggle (or trigger) input, *T*. If the set input, *S*, is at "1" and the clear input, *C*, at "0", the output at *Q* will be "1" after the toggle pulse. If the set input is at "0" and the clear input at "1", the output at *Q* will be "0" after the toggle pulse.

The flip flop may also be connected so that each toggle pulse flips the outputs around (*i.e.,* the output after the toggle pulse is the inversion of the output that existed before the toggle). This is accomplished by tying both the *S* and *C* inputs to ground (logic "0") as shown in fig. 5(B).

Another terminal available is the Prese terminal which sets the Q output to "0" and the Q to "1" when +4 volts is applied. There is no need for a toggle pulse as the flip flop goes to its preset state immediately upon application of the +4 volts.)

The IC Logic Pulser

In experimenting with the J-K flip flops it is often desireable to be able to toggle the circuits slowly and observe the outputs after each transition. The first solution which would certainly come to mind is to use a pushbutton switch connected to the Toggle input. This scheme is illustrated in fig. 6 along with a typical output of such a switch as seen on an oscilloscope. Dirt on the switch contacts, and uneven pressure on the button will cause the output to jump on and off for very short periods of time. This problem of "contact bounce" is even more pronounced in snap action and spring loaded switches. In many switch applications this is no problem for the switch rapidly reaches steady-state either on or off. With these integrated circuits however, the circuits are able to respond as rapidly as the switch bounce; in the case of the flip flop, it will toggle back and forth a number of times when only one toggle was actually desired.

The purpose of the IC Logic Pulser, the circuit of which is shown in fig. 7, is to gi

See page 110 for New Reader Servi

R	Pulse Width (μs)
33K	240
22K	180
15K	110
10K	70
6.8K	50
4.7K	30
3.3K	22
2.2K	13
1.5K	10
1.0K	6

able I—Pulse widths in microseconds for varous values of R with a capacitor value, C, of 0.01 mf.

ne and only one toggle pulse when desired. Vhenever switch S is closed, a single short ulse with a sharp fall is produced at the utput of the circuit, and another pulse canot occur until the switch is returned to its nitial position and switched again.

As shown in fig. 7, when the switch is noved to the right, gate G_1 output goes from 1" to "0" which toggles the flip flop (*FF*). Almost immediately the *FF* output at Q becomes "1," and since this is coupled back to ate G_1, the output at G_1 will stay at "0" egardless of whether the switch stays on or ounces around.

Thence, the output at Q of the flip flop is a ingle pulse which goes from "1" to "0." Gate G_2 is used as a buffer and inverter so that here is a positive going pulse into G_3.

Gates G_3 and G_4 are connected in a standrd monostable multivibrator configuration. The positive pulse into G_3 causes its output to o to "0" and both inputs to G_4 will be at 0" until the capacitor has time to charge up hrough the resistor connected to the 3.6 volts us.

While the capacitor is charging, the output f G_4 will be at "1"; the duration (the width) f the output pulse is determined by the time onstant of the *RC* network. Pulse widths for arious resistance values are tabulated in Table I.

Finally, when the switch is returned to its eft hand position, 3.6 volts are applied to the ip flop's Preset terminal. This forces the ip flop output Q back to "0" so that gate G_1 is no longer held in its "0" state and is eady for the next application of a "1" (3.6 v.) rom the switch.

[*Continued on page 108*]

DX [from page 72]

ET3FMA—Via W7WLL
ET3USA—To VE3IG
FC5RV—c/o F5RV
F08BV—Via WB6TFP
FY7YQ—c/o WA4GQM, 392 Byron Drive, Memphis, Tenn. 38109
GB3IIF—To G3MAD
GB3RAG—c/o G3UJU
HC8FN—Via WA2WUV
HL9KA—To W2CTN
HKØBDG—c/o Box 354, San Andres Island, Columbia
HKØBIS—Via Box 411, San Andres Island, Columbia
HKØBKX—To WA6AHF
HRZAFK—P.O. Box 254, San Pedro Svla, Republic de Honduras
HR2GK—Via VEIASJ
HV3SJ—c/o WB2ETL
JA4AS—"Mas" Takata, K6PIH, 721 N. 20 St., San Jose, California
JX10M—Via Norwegian Embassy, Reykjavik, Iceland
KC5USN—To K1TWK
KR6MB—c/o W7VRD
LA2MA/MM—To WB8ABN, Box 62, Rochester, Mich. 48063
OX3UD—Via W2CTN
PJ5MJ—To W2BBK
PJØMM—c/o W2GHK, Box 7388, Newark, N.J.
TA3AB—R. E. Stone, WSFBO, P.O. Box 1416, Anna, TX 75003
TA3AR—Via WA7GQA
TA3X—To WA7GQA
TJ1QQ—c/o W4DQS
TL8DL—Via WA3CGE
UAØKIP—To UW3FD

VP2GSM—Via W7YSM
VP2KW—To WOC
VP2MU—c/o VE4Y
VP2VO—Via VE3ACD
VP5CB—To K3NA
VP7NA—c/o K9GZ
VP7NF—Via Box 6004, Nassau, Bahamas
VP8FL, VP8JG, VP8JH, VP8JI—Eri R. Chilvers, 1 Grov Rd., Lydney, Glos., England
VP7NP—c/o WB65JS
VQ9JW—To G3ON
VQ9TC—c/o W4HU
VS9MB—Via W2CT
VU2KV—To W6BC
VU2LN—c/o W20D
XEØGJR—Via J. B. Hendrix, Box 154, Tehuacan Puebla, Mexico
XW8CAL—To VE6AO
YA3TNC—c/o W3TNC
YJ8BW—Via W4NJF
YN1GLB—To W4SYL
ZD5V—c/o 4A2YP
ZD7KH—Via K2HV
ZD9BJ—To GB2SM
5R8AS—c/o W6ZP
5V4AP—Via Box 33 Atakpame, Togo
5W1AS—c/o WB6KBK
5W1AT—To W4ZX
601GB—c/o W1YR
6W8DY—Via VE4S
7P8AR—To W4BR
7Q7AM—c/o Dr. A Mittleholzer, Box 215, Lilongwe, Malawi
7XØAH—Via VE3DLC
8R1G—To WA4UO
9I3AB—c/o W6BA
9N1MM—Via W3KVQ
9X5AA—To W1YR
9X5MF/EAØ—c/o HB9MQ
9X5SP—Via K9KC

73 John, K41

See page 110 for New Reader Servi

See page 110 for New Reader Service

USA-CA [*from page 82*]

Va.	**W4OWE**	223	144	32,112
	W4UM/4	127	100	12,700
	W4JUJ	33	33	1,089
Miss.	**K4RIN/5**	286	145	41,470
	K5AEU	242	137	33,154
	WA50YU	105	77	8,085
N.Mex.	**W5QNY/5**	75	60	4,500
Tex.	**W5OIB**	131	90	11,790
	W5NFJ	101	84	8,484
Calif.	**W6CLM**	148	108	15.984
	WA6JDT	80	59	4,720
	W6CLZ	68	59	4,012
	W6BVB	12	12	144
Mont.	**K7LTV**	33	28	924
Nev.	**WA7CWM**	196	124	24,304
Utah	**K7SQD**	72	68	4,896
Wash.	**WA7JCB**	102	72	7,344
Mich.	**WA8MCQ**	62	47	2,914
Ohio	**WA8E0H**	168	115	19,320
	WA8TGX	153	108	16,524
	WA8WGJ	33	29	957
W.Va.	**WA8HSB/8**	108	87	9,396
	WA8CNN	98	81	7,938
Ill.	**WA9OQE**	145	91	13,195
	W9GFF	50	41	2.050
	W9WR	39	38	1,482
Wisc.	**W9CHD**	103	75	7,725
	WA9TCR	2	2	4
Colo.	**WØLRW**	221	133	29,393
Iowa	**WAØKXJ**	190	118	22,420
	KØWNV/O	170	104	17,680
Kans.	**WAØJVS**	254	150	38,100
	KØPFV	35	32	1,120
Nebr.	WØLGE	109	76	8,284
	Multi-Operator Stations			
Mich.	**K8UDJ**	345	185	63,825
N.Y.	WA2WEA/2	240	149	35.760
	DX Scores			
Canada	**VE3BMR**	143	110	15,730
	VE1AE	112	103	11,536
	VE6ABV	36	35	1,260
Denmark	**OZ4H**	14	13	182
England	**G5GH**	14	14	196
ITU	**4U1ITU**	166	116	19,256
Korea	**HL9KQ**	35	25	875
Mexico	**XEØGJR**	65	56	3,640
	XE1KD	25	25	625
P.R.	**K5FKTKP/4**	64	57	3,648
Sweden	**SMØBDS**	9	9	81

TOP THREE: K3ZMI, WB4IOJ, WA-4FFW.
TOP DX: 4U1ITU.

Notes

Although I have not had the pleasure of any recent QSO with Hong Kong, I did have a visit by the Hong Kong Flu which knocked me flat on my back in bed for 8 days (so far).

Speaking of more pleasant things, I did enjoy a nice visit (during the Thanksgiving holidays) by Cliff, WAØKXJ and another County Hunter, Tom, WB6KIL. They are both attending Carnegie-Mellon University in Pittsburgh.

I have had the pleasure of checking into the Independent County Hunter Net—14336 — quite a few times recently *(Bertha, WA4BMC got after me-Hi . . .)* and I really enjoyed myself. They are a grand bunch and the Net Controls do a good job, and you are sure to run across a mobile going to some of the counties *YOU* need.

No more time nor space, so try to find time to write and tell me—How was your month? 73, Ed., W2GT. ■

Measuring Power [*from page 34*]

correction) or by measuring the voltage across a dummy load with a v.t.v.m. and r.f. probe (following the v.t.v.m. instructions to determine the a.c. r.m.s. voltage values) and simply using the V^2/R formula. The oscilloscope scale is marked for various power levels. The transmitter is then switched to s.s.b. transmission and the vertical scale deflection on the oscilloscope will give a direct and instantaneous indication of the p.e.p. output level under tone or voice modulated conditions. The same scheme can be used to check the peak output level using any other modulation method as well. ■

W8NWU Tuners [*from page 28*]

to the individual builder. Each circuit has various constructional advantages and disadvantages. The circuit of fig. 5 (A) requires 2 insulated capacitor mountings but the dissipative losses in the capacitors may be less than in the inductors of fig. 5 (B). The arm of the inductor bandswitch can be grounded thus lowering its insulation requirements. The single capacitor of fig. 5 (B) is certainly easier to mount on a chassis. However, the insulation requirements of the inductor bandswitch, if it is mounted on a metal panel, may be rather high when a high impedance is being matched at the output. ■

See page 110 for New Reader Service

1969 CQ READER SURVEY

CUT HERE

YOUR CALL AREA

Reader surveys have become fantastically popular with magazine publishers nd readers alike, because they give the reader a perfect chance to tell the nagazine's staff what they think and want. The survey questionnaire below is ntended to help us learn more about you so we can give you more of the hings you want in a ham magazine. Fill out and mail your survey answers today o: CQ Reader Survey, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.

-Personal

. (a) Your age? (b) Class of License? (c) Years Licensed?
. Have you upgraded your license in the past year?
. If not, do you intend to do so in 1969?
. Are you employed in the electronics industry?
. If yes, what is your job function: Engineer, Technician, Sales, Communications Specialist, Executive, Other.
. If yes, which best describes your place of employment: Manufacturer, Distributor, Retail Dealer, Manufacturer's Rep, Military, Industrial Communications, Research & Development, Other.
. If you don't work in electronics, what is your occupation?

—Investment

. Approximately how much money have you invested in amateur radio?
. Approximately how much money did you spend on your hobby in 1968?
. Approximately how much do you expect to spend during 1969?
. Will most of your purchases be through local distributors or through mail-order?

—Equipment

. Please list all major pieces of commercially manufactured equipment in your station (receivers, transmitters, transceivers, linear amplifier, antennas). Next to each category, please list the manufacturer's name, the model number or model name and the approximate retail price. Please underline all items purchased in 1968 or 1969.
2. Please check any items of test equipment you own and enter the manufacturer's name in the space provided.

VOM ....
VTVM ....
Oscilloscope ....
Grid Dip Meter ....
SWR Bridge ....
Impedance Bridge ....
Wattmeter ....

3. Approximately how many dollars have you spent in the past 12 months for vacuum tubes of any sort?
4. Approximately how many dollars have you spent in the past 12 months for solid-state devices?

/—Operating Habits

1. Are you more or less active on the air than you were a year ago?
2. Have your operating habits been forced to change as a result of Incentive Licensing? How?
3. Have you constructed any equipment or accessory which employs semiconductor devices?

—Reading Habits

1. Do you subscribe to CQ or buy on a newsstand?
2. Are you a member of ARRL?
3. If not, have you ever been a member of ARRL?
4. If you are not an ARRL member, how many issues of *QST* have you bought and read in the past year?
5. Do you subscribe to *73*?
6. If not, have you ever subscribed?
7. If you don't subscribe to *73*, how many issues have you bought and read in the past 12 months?
8. Do you subscribe to *Ham Radio*?
9. If not, how many issues have you bought and read in the past year?

I—Personal
1. ______
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______

II—Investment
1. ______
2. ______
3. ______
4. ______

III—Equipment
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IV—Operating
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V—Reading
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Ham Shop

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Direct All Correspondence & Copy to: **CQ Ham Shop, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.**

FOR SALE: Heath SB-301 Receiver, with 3 filters, $250.00. K2EEK, CQ Magazine, 14 Vanderventer Ave., Port Washington, L.I., N.Y., 11050.

WANTED: Berkeley FR67U digital frequency counter manual; Collins 75A-4, 500 cycle mechanical filter. D. Shongut, 25 Cameron Place, New Rochelle, N.Y. 10804.

FOR SALE: I have two fine transceivers, will sell only one. Mint condition NCX-5 with NCX-A AC power unused, both $755. Plus shipping. M. Edison, W5AMK, Temple, Texas 76501.

FM MOBILE & Base Radios, Power supplies, Meters, Parts, etc. Latest list 10¢. N. F. Doney, Box 1416, Winter Haven, Fla. 33880.

RCA Employees Net meets Monday nights, 8:30 PM EST, 3885 ±2 kc. K. K. Miller, W2KF, Net Secy.

CAN ANYONE supply me with the technical manual for the 268 Radar set (British?) G. Kapsokavadis, 13 Kolokotroni St., Corfu, Greece.

FOR SALE: Utica 650 with VFO, book, mount brackets & mike. 6 meter transceiver, excellent condition. $80. Postpaid, Ralph W. Wilson, Falmouth, Ky. 41040.

VAN WERT RADIO CLUB has TG-34A keyer, no tapes! Can anyone help us out? If so, contact, K8LMN, Jim Feldwisch, RR #1, Mendon, Ohio 45862.

FOR SALE: Clean HT-37 and SX-101A orig. purchaser. First, for $300. Will ship f.o.b. El Campo. R. P. Lampley, WA5CBR, Box 326, El Campo, Texas 77437.

WANTED: 75A-2 or 75A-3 receiver. K. C. Stormer, Roseville RD 4, Brookville, Pa. 15825.

FOR SALE: Drake R4 $270., Monitoradio M-160, $75. Mite KSR, $550., Unimat, $85. Tom Perera, K2DCY, 410 Riverside Dr., N.Y.C., N.Y. 10025.

FOR SALE: Heath HW-12 $85. Lafayette HE-45A 6M xcver., P & H Linear 800W. P.E.P. $100. B. Erdely, Jr., Gaines Trailer Ct. Lot 13, Blacksburg, Va. 24060.

NOVICES: Sell Heath HR-10, $50. DX-20, $20., 5 xtals, $5., all for $60. FOB. Dave Naatz, c/o ILC, West Grover Rd., Eau Claire, Wis. 54701.

FOR SALE: Pair unused 4CX250B's $20., pair unused 4X150 A's $14. PL-172 new $80. Want 2B. Samkofsky, 201 Eastern Pkwy., Brooklyn, N.Y. 11238.

FOR SALE: Eico 753, a.c./d.c. supplies, HQ-145 with cal., Hustler mobile ant. SASE for details. L. B. Cebik, 245 Morning View Drive, Athens, Ga. 30601.

TRADE (2) 6336A for anything wanted: Manual & schematics for Dumont 256F scope. Also manual for RCA WV-77 V.T.V.M. F. Harmon, P.O. Box 203, Owasso, Ok. 74055.

FOR SALE: HQ 170-A-VHF $285., HW-32, 32 with mobile power supply and Hustler antenna, $135. Valiant I $85., Clegg 99'er $75. Bob WA2KAB, Box 927, Shoreham, L.I., N.Y. Tel: 516-744-3519.

HAMVENTION, April 26, 1969, Dayton Amateur Radio Assn., Dayton, Ohio 45405, Dept. C, Box 44.

FANTASTIC—1969 New England ARRL Convention May 24 & 25, Swapscott, Massachusetts. Save Money! Early bird registration $10. including Saturday dinner, dance and night club entertainment. Be a winner! Every major manufacturer will exhibit plus top speakers from science & industry. Tickets: John McCormick, Berkeley Street, Taunton, Massachusetts.

FOR SALE or swap, make offer, Popular Electronics Magazines, All issues—Oct. 54 to present. J. E. Probst, 5783 Oakridge Rd., Hamilton, Ohio 45011.

FOR SALE: TS-382, $145. TS-497. TS-658 Rtty test set $19. Cm-22 comparator $24. PL-9027 Hi-pwr variables $7. H. T. Brown, 110 Adams Dr., Crestview, Fla. 32536.

SPRING CLEANING! Gobs of VHF/UHF/Microwave & Bird gear to trade or sell. List for stamp. Spitz, 1420 S. Randolph, Arlington, Va. 22204.

FOR SALE: Heath Marauder $160., Hallicrafters SX-101, Mk 2 with R-46B, $195., both for $340. Heath HO-10 Scope $25. or all for $360. Van, K1YYM, 7 Princeton St., Peabody, Mass. 01960.

FORT WORTH-DALLAS hams. Selling out ham gear and parts I no longer need. Call CE 2-1506 or send stamp for list. L. B. Hoops, 1604 Glenn Dr., Ft. Worth, Tex. 76131.

WANTED: Power transformer for AN/USM-24C Oscilloscope, Ed McCormick, P.O. Box 36, Wynne, Ark. 72396.

FOR SALE: Hombrew keyer-prototype for article in Aug. 68 CQ $30. University PP2T, Bullhorn, 14w Cost $100, sell $40. R. Lumachi, 73 Bay 26th Street, Bklyn., N.Y. 11214.

HELP: Need GE Progress Line f.m. gear. Rx and Tx strips, T-power supplies, what have you? Low, high and 450 band wanted. State price with first letter. Travis R. Jarman, WB4IES, Box 17316, Tampa, Florida 33612.

FOR SALE: Collins 75A-3 with F455C-31 filter—$275. Johnson Viking 2 with v.f.o. and low pass filter—$100. Johnson Match Box (275)—$35. Jones micro match—$25. Vibroplex—$15. Guaranteed A1 condition. W2TN, Old Forge, New York 13420.

FOR SALE: Collins 51-J4 w/3 kc filter, excellent condition—$700; KW-1 transmitter, excellent condition but needs bias transformer available from Collins for $53,—$700. Shipping paid. Paul Reid, 405 4th Place, Merritt Island, Florida 32952.

FOR SALE: 3 plastic holders will frame and protect 60 cards—$1.00. 10 holders—$3.00. Prepaid and guaranteed. Patent 3309805. Tepabco, Box 198Q, Gallatin, Tennessee 37066.

FOR SALE: National HRO-50T, top condx, very clean in and out, w/coils A, B, C, D, E, G, H, and AC. 100-400 kc, and 900 kc—30 mc plus all ham bandspread ranges. Also with select-o-ject unit, N.B.F.M. adaptor, 100/1000 kc xtal calib, matching spkr and manuals for RX and acc.—$150. Shipping paid, insured. Ronald Keuler, 331 Saratoga, Chilton, Wisc. 53014.

FOR SALE: Panadaptor, PR-1 scope. For use with 455 kc if RX. Up to 200 kc video/audio scan. Six months old, excellent condx, no scratches. With manual—$55. shipping PPD, insured. Ronald Keuler, 331 Saratoga, Chilton, Wisc. 53104.

LONG RANGE TV reception easy! Booklet outlines methods to receive distant TV stations using inexpensive materials. $1.50 postpaid. Practical Plans, Box 56-F, Killeen, Texas 76541.

See page 110 for New Reader Service

L's: 100—$1.25 and up, postpaid. Samples—10¢. lland, R 3, Box 649, Duluth, Minn. 55803.

RTHERN CALIFORNIA HAMS: Best deals—new and conditioned equipment. Write or stop for free estite. The Wireless Shop, 1305 Tennessee, Vallejo, lif. 94590.

TY gear for sale. List issued monthly, 88 or 44 Mhy oids, uncased, five for $2.00 postpaid. Elliott chanan and Asociates, Inc., 1067 Mandana Blvd., kland, Calif. 94610.

NTED: Lampkin type 205A FM modulation meter. Copenhauer, 1617 Daisy St., Clearfield, Pa. 16830.

OTECT your transceiver. Self adhesive warning els—3 for $1.00. Bob King, 735 East 239 Street, w York, N.Y. 10466.

TY, AT&T Surplus Telegraph Station Test Set A1 with booklet. Trade for anything of equal ue. Want Millen or other grid dipper. L. Biese, 70 rt, Plymouth, Mass. 02360.

L's used gear has trial-guarantee-terms! HW-22—.95; Swan 350—$279.95; Galaxy 300—$139.95,V—9.95, Vmk 2—$299.95; HX-500—$269.95; HT-37—9.95; NCL-2000—$449.95; SB 300—$229.95; NC —$119.95; RME 6900—$149.95; Collins 312B5—9.95; hundreds more. Free "blue-book" list. WRL, 919, Council Bluffs, Iowa 51501.

ST EQUIPMENT WANTED: Any equipment made by wlett-Packard, Tektronix, General Radio, Stoddart, asurements, Boonton. Also military types with M—( ), USM—( ), TS—( ), SG—( ) and similar nenclatures.Waveguide and coaxial components needed. Please send accurate description of t you have to sell and its condition to Tucker ctronics Company, Box 1050, Garland, Texas 40.

R SALE: HQ-170 with speaker, perfect—$165. Philip rgulies, 133 North Wood Avenue, Linden, New sey.

NTED: An opportunity to quote your ham needs. years a ham gear dealer. Collins, Drake, Swan and others. Also $20,000.00 inventory used gear. ck, W8UCG, Electronic Distributors, 1960 Peck, skegon, Michigan 49441.

ADE COUNTER KITS—$13.95. Professional qualiy dout. Free information. Display Electronics, Box 4, Littleton, Colorado 80120.

NTED: Courier 50 FM transceiver or its equivalent. ph J. Cramer, RD 2, Huntingdon, Penna. 16652.

R SALE: 6 meter Hallicrafters a.m. SR-46 transver w/HA-26 VFO and mobile kit. Mint condition. 0. Joel Eschmann, K9MLD, 2036 Erie St., Racine, c. 53402.

GREAT CIRCLE Bearings, return bearings, disces, time differences, computerized to your QTH. 00. Samples—25¢. Bearings, 122 Lockhart, Unisity, Princeton, N.J. 08540.

EAR BUILDERS: 100 mfd @ 3000 VDC capacitors 0 each. Basil J. Weaver, 1821-B Ave., M., Lubbock, as.

R SALE: Heath HW-16 c.w. transceiver, never used, ertly wired, aligned—$90. FOB 218 W. Montgom- Creston, Iowa 50801. Dr. Jack Robinson.

K ISSUES CQ: Complete run 1948 to 1959, except 6 issues. Excellent condition. Best offer. G. Flynn, MHV, 5504 Kansas, Omaha, Nebr. 68104.

SALE: T-60 transmitter—$25. Wanted: 150-250 a.m. transmitter. L. D. Olmstead, Route 1, rhead, Minnesota 56560.

SALE: Complete station. SX-99 receiver with th "Q" multiplier and 500 kc crystal calibrator, th DX-40 transmitter with VF-1 v.f.o., all manuals, as—$150. package deal, local pickup. Collins h. filters F500F-60—$15 each. Cadre C-75 1.5 cb walkie-talkie made USA with Ni-Cad batteries charger—$50. Charles Strauch, WA2MKY, 742 dfield Rd., West Hempstead, New York 11552.

FOR SALE: Tr-44 rotator, factory rebuilt, $50. postpaid in continental USA. Al Brogdon, Rd 1, Box 390A, State College, Pa. 16801.

FOR SALE: Gonset Communicator IV for 2 meters. Good condx. Will ship postpaid for $200. C. Simmons, 5024-A Idaho Ave., Plattsburgh, New York 12903.

FOR SALE: HW-16, factory checked, speaker, great shape. $90. Kirt Fanning, 6021 Edgewood, Lagrange, Ill.

SCOPE: Brand new sencore oscilloscope/vectorscope model PS-148. Never used, in sealed box. Cost $220. Make offer. Write: R. Simon, 1694 Linden Place, No. Merrick, N.Y. 11566. Call (516) 538-3250.

BEGINNERS: Globe HG-303 75W TX, relay, filter, xtals, $55. Lafayette, HA-225 Rcvr with speaker, $65. EICO 772 VFO $30., 31 Eaton, Syosset, N.Y. 11791 (516) 931-2966.

WANTED: DX-40 Trans. under $50. Must be in fair condx. M. Evans, 4622 E. Mexico, Denver, Colorado 80222.

WANTED: Transceiver—Cash waiting for right deal—Ludwig, 600 Hylan Blvd., N.Y., N.Y. 10305 Eves. 212-981-2094.

TRADE: Johnson-Viking 2 KW P.E.P. with desk and Ranger for high S.N. Collins KWM-2 and power supply. G. Richie, W4JGO, 643 Diamond Road, Salem, Va. 24153.

JOIN SPAM—Society for promotion Advanced Modulation—Go DSBRC for greater talk power. SPAM is a non-profit group. No dues. W4CJL—202 Baker Dr., Florence, Ala. 35630.

SWAN 250, HB Power supply, mike and stand, VOX, $300. W. Heverly, Box 131, Turbotville, Pa. 1772.

WANTED linear for sale Eico 720 $45; Ameco CN144, 2mtr conv $25. V. E. Gildersleeve, 5046 Wycliff Dr., San Antonio, Tex. 78220.

FOR SALE: NC-400 National general coverage, all mode receiver with calib and manual, A-1 condition, best offer. Wm. Sakal, 62 Bacon Hill Rd., Pleasantville, N.Y. 10570.

FOR SALE: 20A Central Electronics SSB exciter with manual, 458 v.f.o. and separate pwr for v.f.o.—$75. W9SRO, 418 W. McDonald Rd., Prospect Heights, Illinois.

FOR SALE: NC-98, DX-100, Drake 2-B atr rectifier power supply, 3 el tri-band beam, prop pitch motor. Make offer. K3RDT, 1832 Jennings St., Bethlehem, Pa. 18017.

FOR SALE: New Hallicrafters CB20 transceiver—$75. Already converted to 10 meters—$90. Also crystals 28.6 to 28.9 mc—$3 each. W5QNQ, 2025 O'Donnell, Las Cruces, New Mexico 88001.

G3IDG WANTS R/9 Nos. 40-49, will swap English ham mags. Also seek old certificates and QSL collections for preservation. A. Herridge, 96 George St., Basingstoke, Hants., England.

FOR SALE: Gonset Comm. II, 6 mtrs—$85. P&H 6-150 transmitting conv., 6 mtr, s.s.b., a.m., c.w.—$100. Heath GW-12 CB two units, 1 d.c. supply, all—$50. 4D32 tubes, surplus—$10. E. F. Lankford, 511 Purnell Dr., Nashville. Tenn. 37211.

JOIN THE OOTC: If you have been licensed for 40 years, you are eligible. Send a QSL card to Chas. W. Boegel, Jr., WOCVU, 1500 Center Point Rd., NE., Cedar Rapids, Iowa.

COLLECTORS—Will swap copy Volume I ARRL handbook for latest edition same publication. W7FZW, 10433 Salem Dr., Sun City, Ariz. 85351.

FOR SALE: General Radio Piezo oscillator type 675P, frequency standard—$30. Pick up. W2MPP, 8 Winding Way, Denville, N.J. 07834.

FOR SALE: Mobile rcvrs and xmtrs—$20-$35. All in good condx and operating, with manuals. Write W. E. Thurston, 216 Cottage Rd., South Portland, Me. 04106.

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FOR SALE: DX-100B Heath transmitter and HQ-170C receiver in good condition. R. Dorough, W5DPN, 117 Pecan St., Terrell, Texas 75160.

VHF, TV, FM & DX: Old established club now with new exciting format. International column, picture page and DX reports every month. Dues—$3.50 U.S. funds, or samples 30¢. Worldwide TV-FM DX Assn., Box 5001, Dept. Q, Milwaukee, Wisc. 53204.

FOR SALE: SX-100 Hallicrafters, very clean—$139; HA-1 Hallicrafters, new—$59; KG-221A Knight f.m. receiver, New—$40. G. E. Scott. 2015 Beverly Blvd., North Platte, Nebr. 69101.

CLEANING OUT: Too much gear, clearing and cleaning out, send for list. v.t.v.m., scope, rotors, mikes, tubes, GSB-101, Heath transceivers, v.h.f. parts, antennas. Send sase. D. Etheredge, 12040 Redbank St., Sun Valley, Calif. 91352.

FOR SALE: Heath IM-13 "service bench" v.t.v.m. for sale, a.c. and d.c. volts, ohms, 21 scales on 200 μA 6" meter, like new with book—$25. Cal Enix, W8EN, Box 474, White Pigeon, Mich. 49099.

WANTED: Diagram and/or manual for Johnson Adventurer. Will Xerox and return immediately. A. M. Fox, Box 895, Greeley, Colo. 80631.

FOR SALE: Eico Model 460 oscilloscope—$50. J. C. Taft, 603 Gailwood Lane, Nashville, Tenn. 37214.

WANTED: Kit projects that didn't work out. Will finish or buy. Kits also built. Will repair all types of amateur gear. Donate any old radio magazines, parts, etc. Address all correspondence to North Springs Amateur Radio Club, c/o Carey Coggins, WB4JFV, 7125 Hunters Branch Drive, Atlanta, Georgia. (This is a non-profit organization.)

FOR SALE: DX-100B, excellent condition—$75 plus shipping. A. Barry, 135 N.W. Drive, PAFB, Fla. 32925.

WANTED: 3 speed gear shift box for Model 28KSR. Give condition and price. Also Model 28TD and RCA Radiola 17. R. Mendelson, 27 Somerset Place, Murray Hill, N.J. 07971.

FOR SALE: Mint Collins KW-1, 1000 w. trans.—$750. Ideal for a.m., c.w., RTTY. Cont. rating, 160-10 m. WB4BLK, Box 3005, Duke Hosp., Durham, N.C. 27706.

FOR SALE: Cellar full of gear and parts, surplus, home brew, etc. Send sase for list or come and look. WB2OBO, 1533 Lowell Ave., New Hyde Park, L.I., N.Y. 11040.

POLICE AUTO ALARM—Patented police alarm protects your car—bumper to bumper, doors, wheels, trunk, ignition—everything in it too. Simple installation. Compact, rust proof steel unit measures 6" x 2" x 3", weight—1¾ lbs. Send $9.95 ppd to B. Schneider, 2662 Hewlett Lane, Bellmore, L.I., New York 11710.

SELL OR TRADE: Poly-Comm 62B xceiver, 6 & 2 meters, clean and perfect working condition, complete w/mike, all access. including mobile—$150. K9EGD, 5963 N. Nina, Chicago, Illinois 60631.

URGENTLY NEEDED: Source of parts for AN/APA-10 Panadapter. E. A. Sjolander, Jr., 119 7th St., W., Ashland, Wisc. 54806.

FOR SALE: Ampro tape rec., $25; Garrard RC88 rec. changer, base, "45" spindle, stereo cartridge, $35; Zenith "Royal 300" transistor radio, as is $10. V. R. Hein, 418 Gregory, Rockford, Illinois 61108.

WANTED: Louden boomer rotator and control box in good condition. W2GQN, 114 Phylis Ct., Elmont, N.Y. 11003.

WANTED: Early Atwater Kent and RCA radios & parts, by former employee, now collector. (Crystal & battery sets only). Frank Atlee, 92-31st Ave., St. Petersburg Beach, Fla. 33706.

FOR SALE: H. V. Ins: Xfmrs, 6.3 v., 6 amps—$2.50; 5V-7A—$3; 2.5V-15A—$3; 10V-12A—$3.50; Chokes—12H, 200 m—$4; 12H-300m—$5. All new. E. Tischler, 58 Care Yave, Wilkes-Barre, Pa. 18702.

FOR SALE: LM Freq. meter, mint, Navy power suppl cables, spare plugs, tubes, maint., manual, calib book, spl. shock mtd. case—$65. firm. C. A. Stevens Box 909, Darien, Conn. 06820.

WANTED: VF-1 or HG-10 v.f.o. in good condx. Tor Ginkel, WA0AHV, 820 Center St., New Ulm, Minne sota 56073.

WANTED: Master Mobile #331 variable 40 thru 1 mobile loading coil. Instructograph complete wit tapes. Heinlein, 107 Wyoming, Boulder City, Nevad 89005.

WANTED: RTTY Journal & RTTY Bulletin back issue wanted. Buy, swap or duplicate. Have some spares What have you? J. Sheetz, K2AGI, 5 Hansell Rd Murray Hill, N.J. 07974.

WANTED: Vacuum variable cap. type UCSL-1000 2000, 3000 or similar. Surplus ok. State lowest pric Jim Garland, W0ZKE/2, 102 Holmes Hall, Ithaca, N.Y 14850.

FOR SALE: Heath HP-13 d.c. power supply in perfe condition—$45. Have 2 Telrex 6 element, 6 mete beams with stacking harness. Will separate or se all for $50. Equipment located in the Chicago are Write to Craig Pitcher, WA9HRN, 829 South 20th St Terre Haute, Indiana 47803.

WANTED: Source of parts and manual for SX-28. E. A Sjolander, Jr., 119 7th St., W., Ashland, Wisc. 5480

GALAXY OWNERS: Modify Galaxy III, V and MK-II t higher power of MK-III. Sase for info. J. Kreska, 281 Lakewood Dr., Garland, Tex. 75040.

FOR SALE OR TRADE: Heath Tower; HX-20; Hali HA- HT-41; BC-221; mobile Transcon 10. Sase pleas K4LIE, 1742 Petersburg Rd., Burlington, Ky. 4100

W1JJ IS RETIRED. Moving. Sase for list 50 yrs. loot. Meters: 2½" rd. 3v dc or 15v ac—$1.50 ne Trites, 165 Parkway, Melrose, Mass. 02176.

WANTED: 800 cycle Collins mechanical filter f 75A3. All replies answered. Harold Cagle, Route Jonesboro, Tenn. 37659.

WANTED: Hickok 288X or later signal generato other good test equip. State condition, price, fir letter. M. C. McCombs, 505 Cedar Rock Rd., Easle S.C. 29640.

COLLECTORS: Make offer. 1920 "Amateur Wireless handbook; 1935 ARRL HB; 1936 Jones Radio H Smith, 915 Lovera, San Antonio, Texas 78201.

WANTED: QST before 1930; Sell—QST after 1930. Guimares, 17 West End Ave., Middleboro, Mas 02346.

FOR SALE: 6 meter HE-45A with HE-61 v.f.o., work good—$40; Hallicrafters transceiver SSB, on air S 150 with HB ac supply—$200; SX-117 receiver—lik new, used 2 months—$175. Russ O. Amsted, 15 N.W. 15 Ave., Ft. Lauderdale, Fla. 33311.

FOR SALE: Gonset 3012 (152-162 mc) and 3011 (4 50 mc) tuners. Police, fire, mobile telephone, hig way patrol, etc. Cost $89, sell $25. F.O.B. Richard Jacobs, WA0AIY, 4941 Tracy Ave., Kansas City, Mi souri 64110.

FOR SALE: Eico 723 c.w. xmtr/xtal, excellent cond tion—$35; Collins 75A-1 rx perfect mint condx—$15 Want triband beam, rotator, rx preamp. B. Gross, Gerhard Rd., Plainview, N.Y. 11803.

FOR SALE: Old handbooks, call books, early rad magazines, books, etc. Send stamp for list. Rasmussen, W6YPM, 164 Lowell St., Redwood Cit Calif. 94062.

WANTED: Heath SB-610, 620, tunnel dipper. For sa SX-101A with speaker — $150; HQ-110 — $110, pl shipping. Tom Dornback, 19 West 167 21st, Lombar Illinois.

CANADIANS: Complete amateur equipment servi by licensed radio technician (and amateur). B Fransen, Box 197, Sherwood Park, Alta., Canada.

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FOR SALE: TS-175/U; Northern VMO; BC-453; 375 rotor-inductor. Make offer. G. Smith, 915 Lovera, San Antonio, Texas 78201.

WANTED: Good used Lampkin 105B freq. meter and Lampkin modified PPM xtal calib. Model 111. W0RXD, 8908 W. 72nd St., Merriam. Kansas 66204.

WANTED: Old battery operated radios of early 1920's. Also want early wireless equipment. Need not be in working condition. State your price. K0SVJ. David McKenzie, 1200 W. Euclid, Indianola, Iowa.

FOR SALE: Ranger in very good condition—$95; Hammarlund HQ-110 A with 24 hour clock in very good condition—$145. WB8BLH, Marlington H.S. A.R.C., 10450 Moulin Rd., Alliance, Ohio 44601.

FOR SALE: Two code machines. TG-10-F with McElroy (10) tapes. Instructograph with 14 tapes. F. M. Cotton, R 1, Box 122K, Omak, Washington 98841.

FOR SALE: Ameco convs. CN-50 and CN-144—$27 each. Also have PV-144—$5. Bob Coburn, R.F.D. 2, Londonderry, New Hampshire 03053.

FOR SALE: Mosley TA-33, TA4OKR, all new factory sealed cartons, plus 125 ft. new cable—$249. G. S. Morris, WA9YKM, RR1, Peru, Ind. 46970.

FOR SALE OR TRADE: Best offer, 5 inch Precision Model ES-500A oscilloscope. WA8LTJ, 131 Pepperidge Lane, Battle Creek, Mich. 49015.

FOR SALE: Marconi CRD 150/20A triple diversity receiver. S.s.b., a.m., c.w. 1.5 to 30 mc. Sel. .1 to 5 kc, sen. 1.5 to 3 μV. for S/N of 10 db. VE2BGI, 5688 De Lorimier Ave., Montreal, Que., 331, Canada.

TRADE: Hallicrafter SX-100 in good working condition on all bands. In fact, plenty of ham gear. For 35 mm through lens camera or what can use. Meade Johnston, 2625 University Blvd., Tuscaloosa, Ala. 35401.

FOR SALE: Polar relay test set, I-193C. Like new in wood chest. Built-in power, relays and all access. $20. You pick up. Frank, K9EGD, 5963 N. Nina Ave., Chicago, Ill. 60631.

FOR SALE: Boards with xistors, sinks, studs, zeners, tant. caps.—1% res.—trimpots. $2.50 each, 10 (all diff.) for $20. PPD. SASE for details. Ken Morey, 803 W. 6th, Pittsburg, Kansas 66762.

FOR SALE: Marion HM2-ET running time meter, new —$3; set pipe taps 1/8 thru 1 inch—$5. Robert Ireland, Pleasant Valley, New York 12569.

FOR SALE: Knight rcvrs: R-55—$30; R-100, spkr, s-mtr, calib.—$55; Knight T-150 xmtr—$45. Capt. Tanaka, KH6BTH, 5315 E. Cassino Ave., Fresno, Calif. 93727.

WANTED: Heath HA-14 linear amplifier and/or HP-24 a.c. power supply. Working or damaged condition acceptable. Mike Ludkiewicz, 143 Richard Road, Ludlow, Mass. 01056.

TRADE: Antique converter, Sparton model 60, with manuals. 1.5 to 25.5 mc. Swap for Ameco R-5 or Heath Mohican. J. A. Dixon, Wheatland, Manitoba, Canada.

SELLING OUT: Clegg Zeus 331 transmitter w/p and intercepter rec—mint condition. First $350. takes both. R. P. Lampley, Box 326, El Campo, Texas 77437.

WANTED: Antique radio tubes. Made prior to 1923. Also, UV203. W9LGH, R. W. Schnedorf, 610 Monroe Ave., River Forest, Illinois 60305.

WANTED: Collins filters for 75A4, 500 cy (F-455J-05) and 6 kc (F-455J-60) R.D. Sever, P.O. Box 120, Div. 23, USNAVCOM Sta., Guam, FPO, San Franciscc, Calif. 96630.

SELL OR TRADE: Wheatstone perforator and Boehme keying head for high speed cw. Have extras, manuals. Gene Hubbell, W7DI, 6633 E. Palo Verde Lane, Scottsdale, Arizona 85251.

WANTED: 2 meter skeds from A.R.S. of St. Peter's College. Contact—Thomas Zalewski, WB2LEB, 411 Grove St., Jersey City, N.J. 07302.

FOR SALE: HQ-170c, B&W—51006. Make offer—separate or combined. W8JGJ, 238 Sunset Drive, Charleston, W. Va. 25301.

FOR SALE: Collins 75S1—$289; Drake T4X, AC3, MS4 —$379; New Eimac 4-1000A—$49. Cash and carry. Bud, 2963 Hannan Dr., Pleasant Hill, Calif. 94523.

SELL OR TRADE: HQ-170C and Viking Valiant xmtr with Dow-Key. Mint condition—$250. Henry Wroblewski, 3747 S. Harvey Ave., Berwyn, Illinois 60402.

ANYONE INTERESTED in forming a 6 meter net in the Western Penna. Ohio, W. Va., and New York areas? Contact R. Hajdak, 4 Homer St., Greenville, Pa. 16125 for information and forms.

WANTED: Schematics and manuals for TC47/APR; Navy TDN/VFO; SG-15/PCM: DB meter BE-22PCM. T. A. Herrmann, 2327 S.E. 72nd Ave., Portland, Oreg. 97215.

FOR SALE: Swan-350 pwr/spkr, VOX & cal. Like new —$300. You pay shipping. Chas. Browning, Rt. 4, 3959 Beach Rd., Medina, Ohio 44256.

FOR SALE: 6 m xcvr, excellent cond—$170. T-175 Knight, 6/10 m linear, new—$70. Vandegrift, 4350 Heidelberg, St. Louis, Mo. 63123.

FOR SALE: New Johnson S auto key mod. 114-501. Weston multi-mtr, very good cond. New 11-pc. small socket set. All for $30. A. R. Bergeron, 616 N. 11th St., Carlsbad, N.M. 88220.

WANTED: Taylor tubes. T55, T200, 822, 866JR, etc. State price and condition, W7JI, 235 E. 15th St., Tempe, Ariz. 85281.

WANTED: W8FYO paddle for electronic keyer. K2PXX, Gene Meyle, 527 Palmer Ave., Maywood, N.J. 07607.

FOR SALE OR TRADE: Heath Apache xmtr, SB-620 scanalyzer, Heath Mohican rcvr, Johnson low-pass filter. Want SB-630 station monitor. L. Litwin, WA6ZFF, 9033 Wilshire Blvd., Beverly Hills, Calif. 90211.

WANTED: State Directors to promote SPAM—Society for Promotion of AM. Should be active running 500 watts or more. Write SPAM, 202 Baker Dr., Florence, Ala. 35630.

FOR SALE: Eddystone dial #893—$15; tube 4-65—$8; 2-3 mc ARC 5 receiver with pwr sup—$20; Novice transmitter, 7 mcs—$30. E. Marriner, 528 Colima St., La Jolla, Calif. 92037.

FOR SALE: Receiver, BC to 35 mcs, S-meter, noise limiter, b.f.o., electrical bandspread, mahogany cabinet—$25. FOB, K4JK, 2804 Broadview Dr., Huntsville, Ala. 35810.

FOR SALE: Lo-pass filter Johnson 250-20—$5; Twinlead, Amphenol 214-023, KW 75Z, 100'—$3; Weston frec. mtr. 50-70C ps 115v ac—$5. Trustee WB6CPE, Loyola H.S. Radio Club, 1901 Venice Blvd., Los Angeles, Calif. 90006.

FOR SALE: 6v to 110v rotary converter. 85 watts continuous. Make offer. H. B. Smith, W8VVD, Box 452, Birmingham, Mich. 48012.

FOR SALE: Heath 10-21 scope. Excellent condition. Extras. $40. William Karl, 24 Mill St., Cooperstown, N.Y. 13326.

FOR SALE: General Radio 650-A impedance bridge (CRL). Like new condition with manual. $135. Glen Richie, W4JGO, RFD 2, Box 149, Salem, Virginia 24153.

WANTED: Copy of schematic for early Heathkit sweep generator Model TS-2. WA5CXT, 6323 Newquay, Houston, Texas 77045.

WANTED: Late model matching Perma Power receiver and transmitter for garage door operator. Don't need operator. For cash or will swap RTTY equip. J. Thomsen, W9YVP, 8280 S. Tennessee, Claredon Hills, Illinois 60514.

FOR SALE: Two 4-400's, sockets, filament transformer—$40. Also three 4-125's, sockets, filament trans.— $20. FOB Paul Rich, Box 4, Morton, Ill. 61550.

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IC Logic *[from page 99]*

The parts and wiring of this circuit are not critical. The flip flop and gates are available from Motorola, Texas Instruments, Fairchild, *etc.* Using the Motorola IC's shown in fig. 8, the complete circuit can be built using only two dual-in-line integrated circuits for a cost of about four dollars including the external resistor, capacitor and switch. The switch used should be of the break before make type; most of the inexpensive push-button switches are of this type.

If this pulser is used to drive a number of gates or flip flops in parallel, it is necessary to connect up two inverters in series at the output to increase the available output. A Motorola MC799P dual buffer may be used as illustrated in fig. 9.

Sine Wave to Pulse Converter

Very few changes are required to use the pulser described above as a periodic pulse generator driven by a sine wave generator. If a sine wave is fed into the circuit in place of the switch in fig. 7, when the sine wave goes positive for the first time, the circuit will generate a pulse whose width is determined by R and C as described earlier. To generate a string of pulses which occur each time the periodic sinewave goes positive, the circuit must be reset at the end of each pulse generated by applying a 3.6 volt level to the flip flop's Preset terminal. A circuit which accomplishes this is shown in fig. 10; here FF_2 will flip on the training edge of the output pulse. The output which goes positive from FF_2 is connected to FF_1 and FF_2 Preset terminals to reset the flip flops and make them ready for the next period of the sine wave which goes positive. This relationship is shown in fig. 11.

The push button switch, S_1, shown in fig. 10(A) is necessary to start the circuit working if FF_2 becomes locked into the state which applies a "1" to FF_1, for as long as there is a high level ("1" on FF_1's Preset, the flip flop will not change states with the applied sine wave input. This locked condition occurs when the timing resistor R is changed to obtain different pulse widths, or when the circuit is first turned on. An inverter/buffer connected between the Q terminal of FF_2 and the Preset of FF_1 and FF_2, (fig. 10B) will cure this locking problem if it seems objectionable to have to push a switch occasionally. The diode is any small signal diode such as a 1N34 or 1N91. ■

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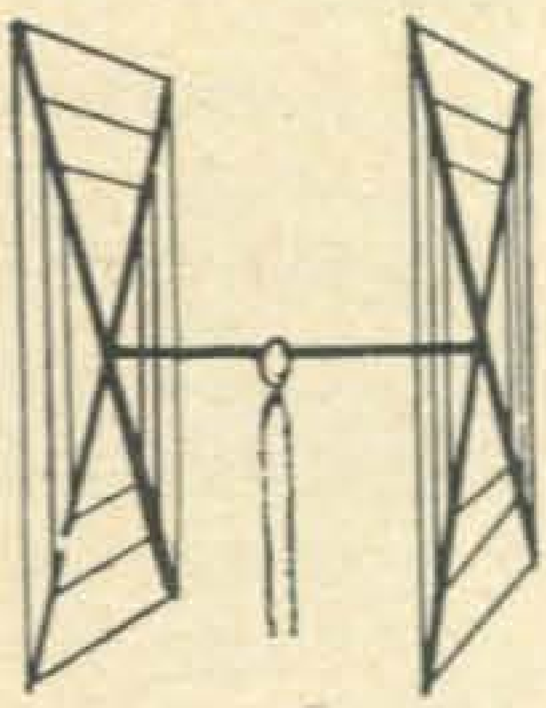
CUBICAL QUAD ANTENNAS — these two element beams have a full wavelength driven element and a reflector; the gain is equal to that of a three element beam and the directivity appears to us to be exceptional! ALL METAL (except the insulators) — absolutely no bamboo. Complete with boom, aluminum alloy spreaders; sturdy, universal-type beam mount: uses single 52 ohm coaxial feed; no stubs or matching devices needed; full instruction for the simple one-man assembly and installation are included; this is a fool-proof beam that always works with exceptional results. The cubical quad is the antenna used by the DX champs, and it will do a wonderful job for you!



10/15/20 CUBICAL QUAD SPECIFICATIONS

Antenna Designation: 10/15/20 Quad
Number of Elements: Two. A full wavelength driven element and reflector for each band.
Freq. Covered: 14-14.4 Mc. 21-21.45 Mc. 28-29.7 Mc.
Shipping Weight: 28 lbs. Net Weight: 25 lbs.
Dimensions: About 16' square.
Power Rating: 5 KW.
Operation Mode: All
SWR: 1.05:1 at resonance
Gain: 8.1 db. over isotropic
F/B Ratio: A minimum of 17 db. F/B
Boom: 10' long x 1¼" O.D.; 18 gauge steel; double plated; gold color
Beam Mount: Square aluminum alloy plate incorporating four steel U-bolt assemblies. Will easily support 100 lbs. Universal polarization.

Radiating Elements: Steel wire, tempered and plated, .064" diameter.

X Frameworks: Each framework consists of two 12' sections of 1" OD aluminum 'hi-strength' (Revere) tubing, with telescoping ⅞" tubing and short section of dowel. Plated hose clamps tighten down on telescoping sections.

Radiator Terminals: Cinch-Jones two-terminal fittings

Feedline (not furnished); 52 ohm coaxial cable

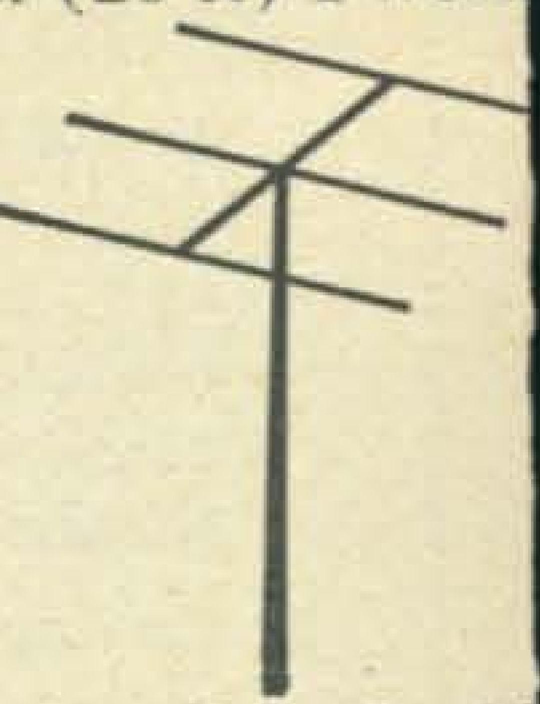
Now check these startling prices—note that they are *much lower* than even the bamboo-type:

10-15-20 CUBICAL QUAD	$35.00
10-15 CUBICAL QUAD	30.00
15-20 CUBICAL QUAD	32.00
TWENTY METER CUBICAL QUAD	25.00
FIFTEEN METER CUBICAL QUAD	24.00
TEN METER CUBICAL QUAD	23.00

(all use single coax feedline)

BEAMS

The first morning I put up my 3 e ment Gotham beam (20 ft) I work YO4CT, ON5LW, SP9-ADQ, and 4U1ITU. THAT ANTENNA WORKS! WN4DYN Compare the performance, value, and price of the following beams and you will see that this offer is unprecedented in radio history!



Each beam is brand new; full size (36' of tubi for *each* 20 meter element, for instance); solutely complete including a boom and all ha ware; uses a single 52 or 72 ohm coaxial fe line; the SWR is 1:1; easily handles 5 KW; ⅞ and 1" alumnium alloy tubing is employed maximum strength and low wind loading; beams are adjustable to any frequency in t band.

2 EL 20	**$19**	**4 EL 10**	**$18**
3 EL 20	**25**	**7 EL 10**	**32**
4 EL 20	**32***	**4 EL 6**	**18**
2 EL 15	**15**	**8 EL 6**	**28**
3 EL 15	**19**	**12 EL 2**	**25**
4 EL 15	**25***		***20' boom**
5 EL 15	**28***		

ALL-BAND VERTICALS

"All band vertical!" asked one skept "Twenty meters is murder these days. Let's s you make a contact on twenty meter phone w low power!" So K4KXR switched to twent using a V80 antenna and 35 watts AM. Here a small portion of the stations he worke VE3FAZ, T12FGS, W5KYJ, W1WOZ, W ODH, WA3DJT, WB2FCB, W2YHH, VE FOB, WA8CZE, K1SYB, K2RDJ, K1MV K8HGY, K3UTL, W8QJC, WA2LVE, YS MAM, WA8ATS, K2PGS, W2QJP, W4JW K2PSK, WA8CGA, WB2KWY, W2IWJ, VE KT, Moral: It's the antenna that counts!

FLASH! Switched to 15 c.w. and worked KZ IKN, KZ5OWN, HC1LC, PY5ASN, FG7X XE2I, KP4AQL, SM5BGK, G2AOB, YV CLK, OZ4H, and over a thousand other station

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