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73 magazine

for radio amateurs

FEATURES:

- ANTENNAS
- *ANTENNAS*
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- SSTV
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73 magazine

for radio amateurs

#141 JUNE 1972

FEATURES

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Here are a few messages:
Don't forget the 73 Tour in September. . .send money now for a reservation. Turn to the last page and mark reader's service you want literature from (or send list on your QSL card). Buy a gift subscription for yourself, a friend or even an enemy and get a book per our ridiculously generous subscription offer. Try FM. Try SSTV. Have fun. . .that's what it's all about. It is forbidden to let a friend borrow this issue of 73. . .let him buy his own.

Amateur Radio

JUNE MCMLXXII Monthly Han

HAMS HELP IN TORNADO CRISIS

Louis R. Huber W7UU

A classic demonstration of a monitoring service's capability in an emergency occurred April 5, 1972, when a tornado struck Vancouver, Washington. Six people were killed outright, with hundreds suffering injuries. $6.2 million dollars damage was done by demolition of a school, a supermarket, a bowling alley and portions of other buildings.

The tornado struck at 12:49 P.M., PST. NAMS (Northwest Amateur Monitoring Service) received the first news of the disaster when K7SUX mobile checked in with Monitor Control (W7DFL Tacoma) as 2:18 P.M. "I'm on my way to Red Cross headquarters," he said. That is also the meeting place for the Clark County Amateur Radio Club. K7SUX contemplated putting the club station on the air; however, it was out of order and he continued to do what he could as a mobile. Later the club station (W7AIA) did get on the air with a transceiver brought down by WA7MQC.

With the first raw news of the disaster from K7SUX, NAMS' cogwheels jumped a bit – wonderment at first, than casting about as to what best to do. WA7NVF and W7ZF in Portland, Oregon (across the Columbia River from Vancouver) were well aware of the vicious wind because of torn-off shingles and other debris flying about. They were on the air along with W7UU, Seattle, and Monitor Control W7DFL.

A local control station was set up on 3960 kHz, with NAMS keeping on as usual on 3970.

About this time WA7KKC, Vancouver, was driving in the tornado-struck area. He had to detour around the devastated area to reach his home and so he knew almost precisely the limits of the devastation. "I'll take it and go down to 3960,' said WA7KKC, as soon as he got on the air. This was at 2:40 P.M., less than two hours after the "killer wind" struck. Bill Tuominen WA7KKC, has been a licensed amateur only a little over two years. His performance in this instance, and for the next three days, leaves no doubt as to his proficiency – it was tops!

WA7KCC's son, Monty, was home on vacation from college. He spread out a map of the city and circled the devastated area. "Give us addresses," said WA7KKC, for health and welfare inquiries were already coming in, "and we'll see if they're in the disaster area. That's the best we can do right now."

Bill estimates that somewhere around 1,000 inquiries were handled that same day over his station and others in Vancouver. Something less than that during the next day, plus a few stragglers on the third and fourth days after the disaster. There were probably 2,000 or more such calls. Telephone service was destroyed in the devastated area and remained out locally until mid-afternoon Friday, although some telephones got into operation slightly before then. Incoming long-distance calls were met by a recorded announcement during this period so amateur radio was the only way relatives had for finding out how their kin had fared.

WA7KKC was on the air continuously until 6:30 P.M., a stretch of four jampacked hours. He then drove over to the Red Cross headquarters. By this time W7AIA, the Clark County Amateur Radio Club station, was on the air by means of WA7MQC's transceiver. Bill manned the city map at the club station, checking out addresses one by one as they came in.

Mid-evening brought some phonepatch activity through other Vancouver ham stations; W7EEA, who is totally blind, handled a number of them with great efficiency on 3950 kHz. WA7OAS, Sally, an XYL, with other Vancouver hams had two-meter gear in operation for Vancouver area operation – especially with mobiles. The latter included K7SUX, W7SNY, K7SUQ and others.

The mobiles were used for various chores, checking out details and providing communication where needed by the Red Cross crews.

Although NAMS ceases operation at 5:45 P.M. daily, the 3960 kHz NAMS emergency operation kept right on throughout the night and into the next morning until about 2:00 A.M. Two nets, Columbia Basin and Northwest Eyebank, which normally use 3960 kHz, graciously moved to other frequencies so NAMS could continue its work uninterrupted.

From other points in the Pacific Northwest and West, health and welfare inquiries originated through a large number of ham stations who got in touch with their local Red Cross offices, where such inquiries are placed.

The cooperation of all NAMS members and non-members proves the reliability of this kind of service and the efficiency with which hams can mobilize to perform emergency communications.

HAM OPERATORS AID TANKER

Two ham radio operators who established communications with the Military Sealift Command's *USNS Cossatot* after the ship's system failed have been commended by Marine Transport Lines, Inc., operators of the tanker. John Previtera WB2BAR, Bronx, N.Y., and William Taylor WA3HRO Thorton, Pa., answered *Cossatot* Captain Finn Bjorney's call for assistance, and established a connection with the company's home office in New York City. The tanker was directed to Trinidad for repairs. *Reprinted from the Military Sealift Command Newsletter.*

News Pages

BY NOAA $1K RADIOTELESCOPE

Scientists of the Commerce Department's National Oceanic and Atmospheric Administration have developed a radio telescope array which observes radio stars and upper atmosphere discontinuities simultaneously.

Moreover, the instrument is so economical, with a hardware cost of approximately $1000, that it should bring important new radio astronomical and ionospheric studies within the reach of universities and private researchers, large and small.

The present NOAA array consists of 16 small zigzag antennas with a signal-combiner. Conceived for the purpose of studying small-scale irregularities of the ionosphere, it was designed and developed by Dr. Clifford L. Rufenach, Dr. Willard M. Cronyn and Kerry Neal, of NOAA's Space Environmental Laboratory, Boulder, Colorado.

"Radio astronomical observations at frequencies less than 100 MHz normally require huge antenna arrays," Rufenach said. "The prototype telescope array which we built allows us to examine the ionosphere at many different radio frequencies simultaneously."

The new NOAA radio telescope design represents an advance in observational flexibility. Each element is triangular in shape with a wire zigzagging from the narrow top to the broad base. A radio wave coming down over the triangle is picked up by an appropriate length of the zigzag wire whose active portion is about one-third of the radio wavelength. Different wavelengths may be picked up by different lengths of wire simultaneously. The present array can receive radio wavelengths between 3 and 12 meters.

Absorbed radio energy travels up the zigzag wire of the element into a line that carries it along with the signals from the other 15 elements, into a central signal combiner that amplifies the output of the array.

Large-scale disturbances occurring in the ionosphere have long been interesting to scientists because they affect the quality and, at times, the feasibility of radio communications on earth. Such ionospheric disturbances can cause short-wave fadeout and signal distortions. A fairly regular fluctuation in the ionosphere's electron density results from atmospheric tides produced by the sun and the moon. Erratic ionospheric disturbances can be caused by meteors, solar flares, and magnetic storms.

Small-scale ionospheric irregularites are often related to the larger-scale upheavals, but the exact relationship is not always clear. These small-scale fluctuations in electron density affect trans-ionospheric radio communications from satellites to earth. This is particularly significant in the equatorial and polar regions where scintillation at super-high frequencies (1.5 to 6 GHz) are sometimes harmful to communication channels.

Defining "small-scale" as any irregularity less than about 2 kilometers in size, Rufenach says: "We wanted to look simultaneously at the various dimensions involved in small-scale irregularities. We first set out to design a small scale prototype radio telescope. Our initial observations with this 16-element array have been very promising."

The prototype radio telescope is located in the mountains behind the front range of the Colorado Rockies to avoid radio and television interference.

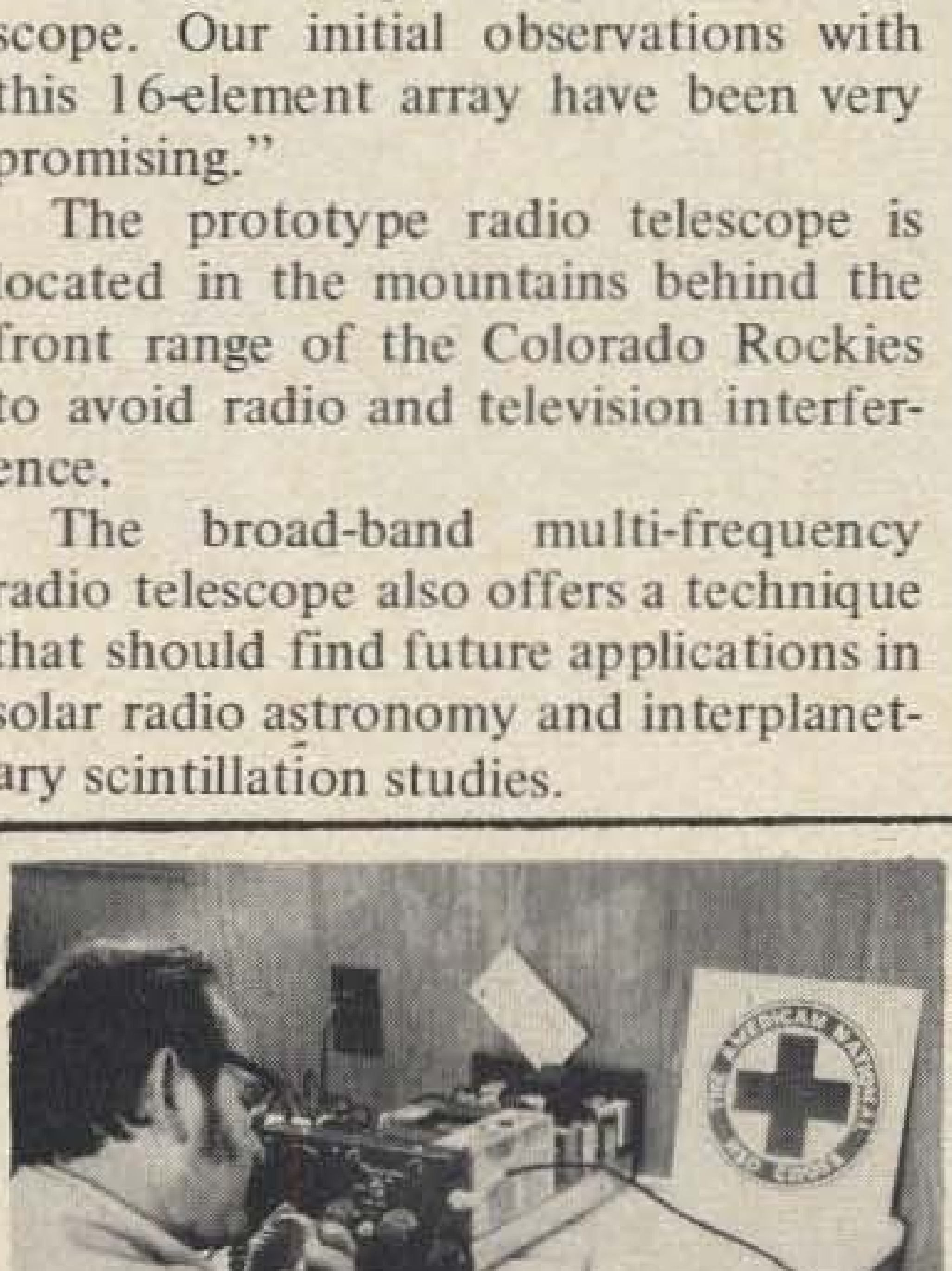
The broad-band multi-frequency radio telescope also offers a technique that should find future applications in solar radio astronomy and interplanetary scintillation studies.

73 HILTON?

Lee Wilkinson WA4QXC, was the first guest at the new motel in Tennessee. Each room has independent beam antennas, a full kilowatt on each band, and long-term guests can use FM hand held units while visiting. Stop by for a visit but keep your cameras ready; we move fast.

RED CROSS TEST

The Elkhart Red Cross ARC held an emergency test of its communication facilities on March 26. Making use of the K9HDH club repeater, several mobiles were directed to special assignments while base stations were on handy call via 94 direct to relay messages to hf nets. The emergency center was a specially prepared trailer that the club set up for Field Day, 1971. W9FJA and WA9WYY coordinated the projects. Participants were mobiles K9SRI, K9ADF, WB9BFU, WA8CEN, K9FUP; bases WA9RNT, K9FAP; headquarters K9IXB.



WA9WYY in communications trailer during emergency test.

W9FJA keeping track of mobile's location during emergency test.

GOOD NEIGHBOR HAMS

Here are the hams who founded the SIRA (Sociedad Internacional de Radio Aficionados) on Dec. 4, 1971, in Miami, Florida. They also elected a provisional Board in order to elaborate the Articles and By-laws. Seated left to right are: WN4VQH Orlando Martin, Treasurer; HK3CJD German Ordonez, Delegate; HK3CAB Hernan Melo, Secretary; WA4ZZG Rafael M. Estevez, President; WB4TED Tony Urbizu, Delegate; and HC2IP Hector Patino, Delegate. Standing left to right: CO2AB Genaro Rguez., WN4PXA Marta Estevez, CO2VE Publio Maldonado, WB4SNC Alberto Coya, SWL Edgar Bueno, YN1AEO Adrian Espinosa, CO5TM Tomas Munoz, WB4JSS Mike Caruncho, CO3JR Raul Fdez., WN4VSX Eduardo Glez., WN4UIL Jorge Quintero, K4CAG Carlos Hdez. and TG9MP Rene Alvarez. Picture taken by HP1FH Fernando Henrique. The SIRA welcomes any radio amateur who wishes to join their Society. Mailing address is SIRA, P.O. Box 71, Miami International Airport, Miami FL 33148.

Here is a partial group of Latin and American hams who attended the Annual Luncheon. They usually meet and lunch the last Sunday of the year since 1968. There were 64 persons at the last one. Hams from VE3, CO2-3, 8, YV5, HI8, HC2, HK3, TI2, W3, W4, KP4, YN1, LU3 and TG9 were at the luncheon. Picture was taken by WB4SNC. Release by Rafael M. Estevez WA4ZZG. P.O. Box 2442, Hialeah FL 33012.

STANDARD COMMUNICATIONS IS OKAY!

The instruction booklet that comes with the new SR-C146 transceivers is the first that we have seen which recommends the use of 146.52 for simplex operation . . . hooray! It did not cool our enthusiasm to see 73 and several 73 books given as prime refer ences on using FM.

73 AGAIN

Readers will no doubt be whelmed to hear that a "quiet" snowmobile engine has been announced by the Outboard Marine Corp. This dandy has a sound output of "only" 73 dB at 50 feet distance when running full throttle. Isn't that somewhere in the range of sound that can cause permanent damage to the ear? *(Thanks to K9MGX)*

2ND WORLDWIDE SSTV CONTEST RESULTS

Sponsored by *cq elletronica Magazine*, 5–13 February 1972.

	A	B	C	D
W9NTP	80	40	63	7.560
PAØLAM	75	60	50	6.750
VE3GMT	85	40	51	6.375
I6CGE	80	50	38	4.940
W4MS	60	30	53	4.770
G5ZT	75	40	41	4.715
F6AXT	65	40	39	4.095
W5PPP	50	50	40	4.000
I2KBW	80	50	30	3.900
K9BTU	40	30	45	3.150
F9XY	45	30	24	1.800
I5BNT	45	30	24	1.800
I5CW	50	30	19	1.520
SMØBUO	45	40	17	1.445
I1ROL	55	30	16	1.360
W1JKF	25	20	27	1.215
EA4DT	40	20	20	1.200
W5QKR	30	10	28	1.120
SV1CG	35	20	15	825
WB2MEX	25	30	15	825
K4TWJ	25	20	18	810
VK5MF	40	40	10	800
W7FEN	15	10	30	750
I5CG	45	20	11	715
WB6OMF	15	10	25	625
W1FUQ	30	30	9	540
W5GQV	15	10	17	425
EA4KJ	20	20	10	400
FO8DO	20	20	8	320
K6IV	15	10	12	300
WB6ZYE	10	10	15	300
G3ZGO	15	10	11	275
OD5BV	20	10	8	240
OZ6PH	15	10	9	225
F9AC	5	10	2	30
I1LCF	75	50	18	–
EA8CI				
		S.W.L.		
I1BAY	90	40	46	5.200
ON4BX	75	30	33	3.465
WDX4IKZ	35	30	31	2.015
I1RAR	40	30	10	700

A – Country
B – Continent
C – Contacts
D – Score

WARNING!

Word comes in, certain unscrupulous antique dealers are pawning off fake radios to the public.

The new wave of interest in old battery sets generated by erroneous publicity in various publications has prompted these characters to doctor up old junkers with anything handy: rheostats replacing holes where once was mounted a variable condenser, dials and hardware from other brands, modern tube sockets for UV, unseasoned wooden breadboards and cabinets, steamed off stickers re-glued, replaced nameplates and other amateurish attempts to sell a "rare" old battery set!

Reprinted from the Old Timer's Bulletin.

TVI ESCALATION

Reprinted from the Pack Rat's Cheese Bits

The following is extracted from a complaint filed in Common Pleas Court of Philadelphia against one of our club members.

For a period in excess of three years, defendants have systematically harassed and persecuted plaintiffs without reasonable cause or justification as follows:

Since 1966 defendant has operated a wireless radio set at his residence which interfered with the picture and voice on plaintiff's television set. Plaintiff's complaints over this interference with their quiet enjoyment of the television set in their home has caused defendants to engage in a course of conduct, vilification and harassment, intended to cause plaintiffs to move from their residence.

Since 1966 defendant has engaged in the unlicensed and unauthorized sale and repair of wireless radio receivers and television sets at his residence, thereby causing the common driveway to be filled with automobiles so that plaintiffs were denied the right of entrance and departure.

In the summer of 1966, attempted to enter plaintiff's residence and claims to have authority under F.C.C. regulations to search their residence to remove the thermostat from plaintiff's refrigerator and air conditio ner because they interfered with the reception of his wireless radio sets.

Defendant often takes pictures of plaintiffs with a camera to confuse, intimidate and harass them. Since this time defendants have cursed plaintiffs on many occasions and addressed loud and abusive language and threats at them.

Since 1966, defendants have constantly and repeatedly banged on the party wall of their home, slammed the door, as well as banged on piano keys, thereby interfering with plaintiff's quiet enjoyment of their home.

Since 1968, defendants have called plaintiffs foul and vile names on many occasions.

In the fall of 1966, defendant attempted to strike plaintiff Josephine — with a motor vehicle on several occasions. Defendant attempted to push a baby coach into a collision with a motor vehicle being operated by plaintiff John —

Every summer since 1966, defendants repeatedly and constantly hosed the common pavement from the front doors to the street with great and excessive amounts of water causing plaintiffs to get their shoes wet in order to leave or return to their home.

Since 1966, whenever defendants dumped the water from their portable swimming pool, they would cause the water to flood plaintiff's lawn.

Defendants teased and harassed plaintiff's father (now deceased) whenever he was outside tending to the lawn or shrubbery by siccing their dog on him and by calling him names.

Since 1966, defendants constantly honk the horn of their car to harass plaintiffs. They operate their car at great speed and screech to a halt in front of plaintiff's home and blow the horn loudly and repeatedly. They follow plaintiffs in their auto whenever plaintiffs leave their home.

On Sunday, July 6, 1969, defendants had a lawn party wherein defendants and their guests amused themselves by throwing firecrackers at and against plaintiff's residence, thereby interfering with plaintiff's quiet enjoyment of their home and causing them to become fearful and apprehensive. On this occasion, the defendants said "I wish this was a bomb." One of the defendant's guests said "I wish they would come out. I could take care of them and make it look like an accident."

Defendants have often expressed their intention and desire to frame plaintiffs and have them arrested. In July 1969 defendants falsely accused plaintiffs of having stolen their cat and caused a policeman to search their home and garage for the cat.

Defendants operate an electric gasoline generator in their garage which emits noxious fumes which seep into plaintiff's home.

All of the above specified actions of the defendants have caused plaintiffs to become nervous, upset and ill, to lose sleep and peace of mind, to spend substantial sums of money for counsel fees, all without reasonable and probable cause.

Wherefore, plaintiffs bring this action in the nature of a Bill of Peace and pray the Court to:

a. Enjoin defendants from further harassment or persecution of the plaintiffs, from trespassing upon or damaging plaintiff's property and from threatening or assaulting plaintiffs.

b. Direct that defendants pay the costs of this suit.

c. Grant such other relief as may appear proper to the Court under the circumstances.

You see what a TVI complaint can lead to. After you finish laughing about the charges, consider several things:

1. An attorney will have to be retained to defend the suit (approximately $1500).

2. It could have been you.

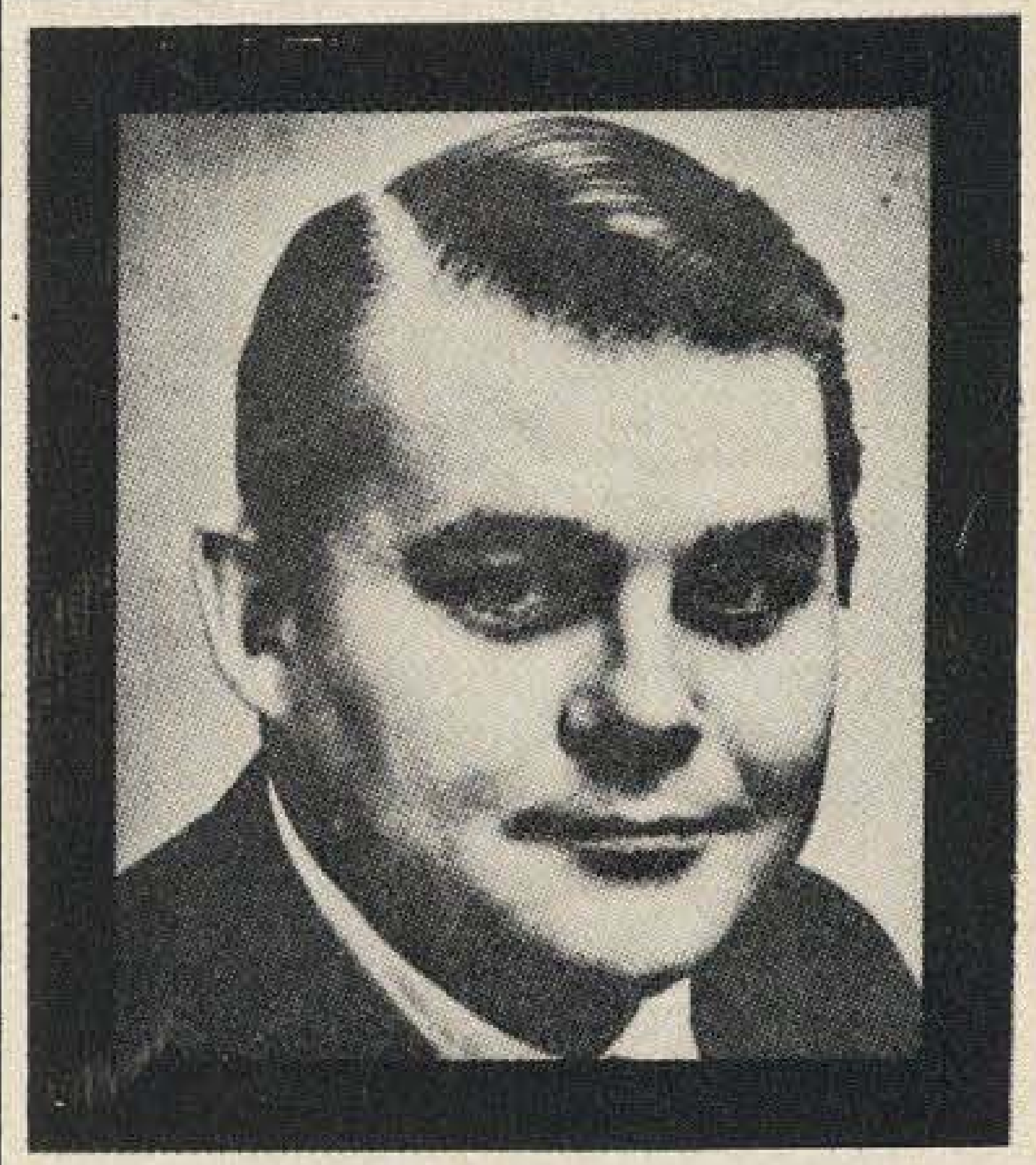
K3JJZ

TECHNICAL AID GROUP

The Technical Aid Group is a band of volunteers who offer their services to those who are befuddled with troubles. When making a request, please use an SASE. For more members with their speciality areas and information on joining the TAG, see March '72 *73*.

Allen Hochstetler, WA4HNX, 1524 Valencia St., Clearwater FL 33516. Allen is able to help anyone with HF transmitter and receiver problems, solid state matters, and ICs. Allen is also able to locate needed parts.

Please do not forget to include an SASE when writing to TAG members, as they are strictly volunteers and it is not fair to make them spend lots of postage money when they answer lots of questions.



In Memorium — James R. Lightfoot, WA1KRN

Word was received on ECARS March 20th of the sudden passing of one of the founders of ECARS, Jim Lightfoot. Jim had a massive coronary attack at the age of 35. He will be missed greatly by all his friends. Jim, along with the late K1LTO and WA3GAL, was one of the original triumvirate that got ECARS started one wintry day a few years back.

The press of his job as general manager of WBZ in Boston became too great to continue editing and publishing the ECARS Monitor as well as maintaining all the ECARS membership records. He did continue printing and mailing the Monitor. It was only when WA1KRN became President of Firestone Communications and moved to the New York City area that he had to sever fully his working connections with the service, but he continued to be as active as possible on the air and to support the service in every way possible.

Jim just recently moved to San Diego to take over a broadcast station there, and it was in California that he passed away.

REPEATER UPDATE

LISTENING
94 76 88 73 70 64 82. . .

CA	WA6ZQD	Monterey	37–97
	(formerly K6LY)		
CO	KØPHF (Delete)		
CT	WA1OHR	Ellington	04–64
CT	K1IIC	Avon	28–88
			221.02–224.02
CT	K1TBA	Hartford	221.86–224.86
CT	WA1JTB	Bridgeport	.295–.895
CT	K1IGF	Groton	07–67
GA	K4SEX	Newnan	19–79
IL	WA9EAE	Oaklawn TB	46–88
IN	WA9HRK (Delete)		
IN	K9LEH	Indianapolis	16–76
	Soon to be K9LPW		
LA		Shreveport	31–91
LA		Shreveport	22–82
MA	WA1LEM	Waltham	49–709
NJ	K2TYV/2	Denville	146.385–146.985
NM	W5SRW	Las Cruces	145.30–146.94
NY	K2AVP	Valhalla	145.68–147.06
			221.50–224.50
NY	W2FWG	NYC	07–67
NY	WA2UWS	Rome	28–88
NY	WB2SEQ/2	Yonkers	221.74–224.74
NY	WA2KEC	NYC	40–995
OH	WA2NVT	Whiteface Mt.	221.86–224.86
OH	K8ALB	Toledo	10–85
OH		Toledo	20–80
OH		Toledo	UHF
PA	WA3KUV (Delete)		
PA	W3ZLO	Erie	34–94
			19–94
TN	WA4JSX	Nashville	145.75–449.65
TN	WB4QFW	Nashville	16–88
TN	WB4QES	Nashville	28–76
			52.920–52.525
			449.45–448.45
TN	W4RFR	Nashville	34–94
TN	WA4YND	Nashville	146.70–147.70
TN	WA4TOA	Nashville	10–64
	(formerly W4AY)		
TN	WB4EKI	Nashville PL 114.8 Hz	40–700
TN	WB4QEY	Gallatin	146.04–147.18
TX	W5NEC (Delete)		
TX	WA5YTO	Austin (Delete UHF) Add	34–94
TX	WA5YZD	Austin	449.1–444.1
WI	W9AIQ	Sturgeon Bay T 1.95	16–76
CANADA			
Nova Scotia			
	VE1JB	New Glasgow	46–94

Thanks to W3ZLO, K9DKW, WA1OJX, NERA, VE1SH, WA8ZID, K2IXN, W5ZBC, K4IKV, WN6LQQ, W9RSV, WB4EKI, WA2ROJ, W2LOY, WBØDMQ, W9HTK, W5EZM.

CALIFORNIA FM SCENE

Bob Greenberg WB6INR/6

The FM scene in Los Angeles has gained a certain degree of infamy, due to the rapid, unorganized growth of FM in the last few years. It is well known that the Southern California area has had numerous problems with desensitization, simultaneous frequency use by different modes, intermodulation, etc.

According to a survey done in November, 1971, by Jack WA6JXG, there are at present the following repeaters in L.A.: 4 open FM, 3 closed FM, 2 AM, 1 RTTY, plus an additional 8 others proposed (plus innumerable remote base stations). There are also 10 open FM repeaters and 3 proposed within a 150 mile radius of L.A.

Of the 20 operating repeaters in Southern California, only two are on standard 600 kHz spacing and standard channels. All the others are on channel pairs that most likely are unique to this area.

There are rumors of a Repeater Owner's Council of some sort being formed, but at present, no such organization exists. It should be pointed out that if we don't organize soon, there will be at least eleven other repeaters to consider in the near future.

Interesting activities have been occurring on WB6ZDI, the Palisades Amateur Radio Club's Repeater. The PARC Repeater operates on 146.61 in, 147.33 out, and has approximately 300 hams populating it. Apparently this concentration of hams attracted the FCC to monitor ZDI since in the past few weeks there have been several citations handed out for improper identification (not signing the call, area, i.e. 76) and out of band operation. The latter was the secondary violation in both cases so far, with Technician class licensees being repeated out of their band segment. At present, the FCC has not replied to the cited amateurs' letters. Each one simply stated they were only transmitting in their assigned band, on 146.61 MHz. Has anything similar happened in other parts of the country? More on this next time.

Information about the rest of the West Coast has been non-existent so far, and contributions would be welcomed. Please mail them to Bob Greenberg, 16705 Dalton Ave., Gardena, CA 90247.

SOCIAL EVENTS and CONTESTS

FM WEST, the First Annual Western Amateur FM Conference, will be held in conjunction with the California Amateur Relay Council meeting on June 2–3. Friday night's champagne party and the Saturday technical talks and exhibits guarantee an excellent program. Saturday's banquet, a scrumptious affair, will be followed by door prize announcements and individual repeater movies and talks. The conference will be held at the Tropicana Lodge, 4061 N. Blackstone, Fresno. Motel reservations must be made before May 20, and specify you are attending FM West. Contact WB6OSH for more information.

Circle June 10th and 11th on your calendar. The Atlanta Amateur Radio Club will hold its annual hamfest on the Mall at the Lenox Square Shopping Center. A banquet will be held Saturday night, June 10th. Main prizes include your choice of a Drake TR-4 transceiver with AC Supply or a RCA Home Stereo Center. A Regency HR-2A will also be given along with other fine prizes. Experts on Teletype, FM, DX and many other subjects will be present. For further information contact W4JM, James Gundry, 2498 Echo Drive, N.E., Atlanta, Georgia, 30345.

* * *

The Tri-State Amateur Radio Association will have its 10th annual hamfest at Camden Park, Huntington, West Virginia, June 4, 1972 from 11 A.M. to 4 P.M. Activities: CW Contest, QSL bulletin board, flea market, prizes for the oldest ham, the youngest ham, and the "fartherest-away" ham. Drawings for the major prizes will be at 4 P.M. featuring Drake TR4 and Drake TR22. You do not have to be present to win major prizes. Tickets are $1.25 each or 5 for $5.00, available from Tri-State Amateur Radio Association, P.O. Box 1295, Huntington, West Virginia 25715.

* * *

The 1972 Jackson Amateur Radio Club hamfest will be held July 29 and 30, 1972. All events will be held inside the Heidelburg Hotel in downtown Jackson MS. The banquet begins at 7:30 P.M. on Sunday, July 29. The price will be $6 per person. The hamfest begins at 8:30 A.M. Sunday, July 30, in the Victory Room. A TEMPO I with ac supply is the first prize. Write to Charles Rogers WA6FII, P.O. Box 8371, Jackson MS 39204 for more information.

* * *

MASSACHUSETTS AMATEUR RADIO WEEK

Operating times are from 0001 GMT June 11 to 2400 GMT on June 17. Massachusetts amateurs must work 16 other Mass. amateurs. The rest of New England State amateurs must work 8 Mass. amateurs. All other amateurs in the U.S. must work 5 Mass. amateurs. DX, including KL & KH must work 2 Mass. amateurs. Any band and mode mav be used. All stations participating will exchange signal report, County, and State. Logs must show date, time, and frequency of contact. Applicants must include a No. 10 size (business size) self--addressed stamped envelope (DX enclose one IRC) with application which must be received no later than July 31, 1972. Submit applications to William Holliday, WA1EZA, 22 Trudy Terrace, Canton MA 02021.

The Music City Hamfest will be presented by the Nashville (TN) ARC June 18 (Father's Day) at Lock Two Park, two miles north of Opryland USA. Flea market, refreshments and more. Prize drawing will be held at 1:30 P.M. Talk-in call is K4CPO on 75m and FM 146.94. For more information write Music City Hamfest, P.O. Box 8085, Nashville TN 37207.

* * *

The Ninth Annual Penn - Central Hamfest will be held by the Milton and Williamsport clubs on Sunday, June 4th, starting at 12:00 noon at the Union Township Volunteer Fire Grounds on Route 15 in Winfield PA. Bring your own lunch or use the snack bar. There are indoor and outdoor facilities for auction, contest, and swapping. Gate registration is $2.50 (XYL and children free) and parking is free. Talk-in frequencies: 3940, 50.4, 146.940 2 meter FM. For more information, write to Paul Mitch W3LXN, RD 2, Milton PA 17847.

* * *

AKRON, OHIO – The Goodyear Amateur Radio Club will hold its 5th Annual Hamfest Picnic on June 18 at Goodyear Wingfoot Lake Park east of Akron, 1 mile west of Suffield, Ohio on County Rd 87 near Ohio Rte 43 Entertainment, swap-and-shop, prize awards, and good fellowship. Refreshments, displays, huge flea market. Hours: 10 A.M. to 6 P.M. Family admission $2 prepaid, $2.50 at gate. For details, tickets and map write Eugene J. Cooke K8ORL, 3079 Rosebay Blvd., Norton OH 44203.

* * *

The Kansas Nebraska Radio Club will hold its annual hamfest on August 6 at the Moose Club at Concordia, Kansas. Registration will start at 0900. All amateurs are welcome.

WITH THE FCC

The following FCC Bulletin appeared in Florida Skip.

Federal Communications Commission
Field Engineering Bureau
Bulletin

"Manufacturers of audio devices for home use do not design such equipment to operate in the presence of strong radio signals from nearby radio or shortwave stations. Strong radio signals which cause interference to audio devices require that special treatment be given to the audio device receiving the interference. The Commission cannot give any protection to audio devices from interfering signals. The only 'cure' is by treatment of the audio device receiving the interference.

"You should, therefore, contact the dealer or manufacturer of your audio device (or telephone company for telephone interference) for assistance. The state of the electronics art is such that it is possible to manufacture 'custom built' audio devices; that is, to install in the complete shielding and special circuits to reject nearly all types of unwanted signals. Cost of such special design and circuitry would necessitate an increase in the price of the devices.

"Perhaps less than one percent of the total number audio devices in operation todaywill ever be located near enough to any kind of radio station so that the device would respond to undesired radio signals, which it is not designed to receive when in the strong field of a nearby station. If it does, it needs additional filtering or shielding, or both. Manufacturers believe it unfair to burden an entire population with the additional cost of special circuits and design inasmuch as the number of devices affected is small. Therefore, in the less than one percent of the instances where interference is caused by insufficient rejection of strong unwanted signals by the devices, many manufacturers, dealers and servicemen have worked out procedures and processes for interference elimination in such specific cases. The statement of a salesman or dealer that he sells a good quality device, is not enough. Persons receiving interference must fully recognize the situation involved. The audio device may be an excellent one in performing the task it was designed to do. Regardless of the quality of the device, special treatment of it for rejection of strong unwanted signals is essential in some localities.

"RF interference to transistorized audio amplifiers can be eliminated in most cases by connecting capacitors or both capacitors and RF chokes directly from base to ground of the input transistor. If the audio amplifier is part of a stereo system, then this has to be done on both channels. In interference cases of this nature the volume control is in the input circuit, consequently, it has no effect on the RF interference."

ERRATUM

Mr. A Prose Walker has advised us that several of the figures in his speech (reported last month on pages 85 through 89) were incorrect. On page 86, the path losses should have been approximately 176 dB at 435 MHz and 166 dB at 146 MHz. Thus the system in the example would have less capacity and/or signal to noise ratio than indicated. However, various combinations of ground to satellite equipment characteristics can be assumed, each giving different capabilities for an overall system design. Needless to say, the example used was not intended to be used in a hardware proposal for a system.

HOT GEAR

Collins 62S1 transverter, S/N 10728, stolen from the Michigan State University ARC on March 22. Contact Electrical Engineering Dept., MSU, East Lansing, MI, or MSU Dept. of Public Safety (517-355-2221).

WRL Duo-Bander 84 S/N 6010AT302 stolen from parked car in Portland OR on Feb. 15, 1972. Gerald Dimmitt WA6FCY–WA7MMD, 710 East Ave. K*8, Lancaster CA 93534.

List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli, SR46A, No.446100	WA1EMU	9/71
Reg., HR-2, No.04-03505	WA5BNM	11/71
Sonar, FM3601, No.1003	WB2ARM	11/71
Coll., 75A4, No.804	WØMGI	12/71
GE, Portable, No.1041218	K2AOQ	1/72
Coll., 75SE-B, No.15640	Col.St.U.	1/72
Coll, 21S3, No.12000	Col.St.U.	1/72
Coll., 516F1,No.1649	Col.St.U.	1/72
Simp. Mod-A, No.35457	W2PWG	1/72
SBE SB-33 No.103906	WA5JGU	2/72
Heath HW22A No.907-1835	W1BDX	2/72
Nat'l HR050 No.280019	WA5DQF	2/72
Halli., SR160 No.416000-108039	K9YVA	2/72
Drake TR3 No.3858	WA9EYL	2/72
Coll., KWM2A No 13815	ARRL HQ	2/72
	M. Godwin	
Coll., 312B4 No.59920		
Coll., 30L1 No. 40084		
Coll. MPL No. 44507		
Coll. MM1 (mob. mike)		
Misco minispkr.	Sgt. Hopkins Wilm. DE Police	2/72
Swan SW174 No. 416-5	WØAXT	2/72
Reg. HR2A No.04-05896	K4GBL	2/72
HR2A, No.04-6208	W8FXX/5	3/72
Heath SB102,No.132-128107	W.Singer Woodbridge VA 703,491-2257	3/72
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72
Standard SRC-806M No. 009210	K1TLP	5/72
Aerotone 6M 355LT, No. 685064	RR Police Grd.Ctrl.Trml. NYC	5/72
Standard SRC-806M, No. 102703	C. Mathias	5/72
Lafayette HA-410 No. 009210	WA2KDG	5/72

EDITORIAL BY WAYNE GREEN

DAYTON!

The Hamvention is hands down the biggest ham event of the year. The only real criticism I can make of it is that it should run for two or three days instead of one single day. There is just too much to do.

If you have any interest in building or buying equipment then you can't pass up the flea market. I would estimate that there were a couple of hundred "booths" set up in the parking lot with enormous piles of ham gear . . . from the most sophisticated slow scan and FM gear right on back to World War I military surplus. Tons upon tons of parts . . . equipment . . . stuff. They had more there than the Allied catalog. I spent an hour browsing through the place and wished I had several more hours and a pickup truck . . . plus unlimited cash.

The manufacturers' exhibits were lavish. There was no way to see them in less than a couple of hours . . . and to do that you would have to skip a lot of interesting things. Many new items were being shown there for the first time. Tom Litty K6RAD had a TPL Communications booth and showed his new 220 MHz transceiver which should be out in July in quantity, selling for about $220. He also had his superb line of solid state amplifiers for 146 MHz, 220 MHz and 450 MHz. These items are being merchandised by Henry Radio under the name of Tempo and are built in California.

Ed Clegg was there with his new 220 transceiver, also due out in July in production runs. FMers also looked longingly at the 27A Clegg unit on display. Drake surprised everyone with their new 220 transceiver, made by the same folks who make the Marker Luxury 2m rig.

There were so many new things that there is no way to remember all of them. J&R Electronics were showing their new slow scan monitor . . . should be a winner. Robot was wowing them with their slow scan gear and showing what can be done. Slow scan was really big at Dayton . . . it looked like about 500 active slow scanners at the forum to me . . . and the orders for our upcoming slow scan book poured in.

The forums ran all day long and I wanted to see and hear every one of them . . . but had to miss virtually all since I had to stop by the 73 booth now and then . . . see the other exhibits . . . try and sell a few ads (almost impossible in the hubbub) . . . and put in a few words for several of the forums when I managed to get to them at an appropriate time. I tried to make the Midcars forum, but got there early and late . . . I wanted to try and let them know that I intended to convince repeater groups to set up a down link to 7255 kHz for emergencies so the two meter repeaters could work 7255 simplex when wider area emergency coverage is needed. I just got one of the little Justin sideband transceivers and hope to have a chance to set it up with our repeater (WA1KGO) for this service, operated by a 2300 Hz tone burst to make the down link tie in.

I had my slides of Jordan along, but didn't see myself on the program so I wasn't sure when to drop in on the DX forum . . . they seemed busy when I went by . . . and I missed showing them. Oh well, I'll have a new set of slides of Jordan in a few weeks My others are two years old now. Time flies.

Some of the companies that didn't turn up as exhibitors were interesting for their absence. There has been some mystery about whether Rpt magazine was still in business or not. The last issue I've seen or heard about was February. They didn't show at Dayton . . . but a good friend of mine did show there sporting a disk jockey magazine just being started by the erstwhile publisher of Rpt . . . and he said that Rpt was on ice. I think I mentioned that special interest ham magazines have a way of never making it.

There was no Dycomm exhibit either! When you consider that this was the biggest FM event in the country this seems very significant. Incidentally, 73 will no longer accept advertising from Dycomm.

Judging from the number of Motorola HT-220's I saw at Dayton, the Motorola company must have added at least one more assembly line. It looked like thousands of the little beasties, though it probably wasn't any more than 500 or so. They were in pockets and hanging from belts everywhere. The Standard 146 is beginning to show now too . . . I did see dozens of them. They're just getting started. Oh, by the way, watch out for the Standard 145 . . . this is the Japanese model and is startlingly different from the 146 . . . different transmitter in particular. It uses 12 MHz crystals, in case anyone tries to fool you. The 146 uses 8 MHz crystals, like the 826. We had a 145 here at 73 for a few days and were unable to tweak it on channel because the rig had so many outputs that the counter couldn't decide which was the one to count. I don't see any way that unit can meet FCC specifications. I guess they don't care about spurious output that is almost as strong as the intended output in Japan. We care. Beware.

MIDWEST FM SYMPOSIUM

On the evening before the Dayton Hamvention a special FM Symposium was held at the Imperial Motel. Though there was little time to pass the word about the meeting, representatives of 46 midwestern repeaters were present, along with about 300 FMers.

The main topic for the evening was the plans for organizing a serious effort to save the 220 MHz band from the EIA and a handful of greedy manufacturers. The main approach to holding the band is to use it . . . "USE IT OR LOSE IT."

This Symposium was a follow-up on the one in Shrewbury (Mass.) in February where representatives of over 50 eastern repeater associations agreed to set up 220 MHz repeaters as soon as practically possible. Within days of that meeting the first 220 repeaters were set up and operating, coordinated by F2BO/W1, K4GGI/1 and WA1KEC the committee for eastern U.S. coordination.

The repeater representatives at Dayton also agreed 100% to get on 220 as soon as possible. This leaves only the southwestern and western parts of the country still not committed to going 220 immediately. Hopefully the repeater groups in these areas will get together at Fresno in June and put their repeaters on the line to back the project to save 220. California needs 220 more than any other part of the country, so perhaps this will be an added inducement.

Considerable equipment is coming along for 220. Ed Clegg showed his new 220 transceiver at the Symposium. This unit has a great many interesting features and should be in production by July and sell for under $300.

Bob Booth W3PS, counsel for the ARRL, was present and spoke about the need for cooperation between all groups if the band is to be saved. Both ARRL and 73 are working for the same goals and working in the same directions . . . now if only CQ and Ham Radio would lend a hand!

The Midwestern Symposium was certainly fun . . . and a success.

73 PROTECTS YOU

Some of the FM units that we have checked out have not been written up in 73 . . . and this is no accident. They just don't pass muster. When we run into rigs that are not up to snuff we not only refuse to run articles on them, but we generally refuse to accept ads for them, unless the problems are marginal. You may be sure that when we do write about a rig that we have checked it and we like it.

A reader recently wrote in regarding one of the transceivers that 73 has NOT advertised. *"Have had much trouble. The receiver desensed 100% by nearby low power transmitter. Factory installed trap cured that problem. Intermod tremendous. Local taxi and sheriff's repeater cause full scale deflection of signal strength meter, local 2m repeater desenses receiver. Sensitivity changes with vibration. Squelch much too touchy; meter impossible to read at night in the car; insufficient audio for mobile operation; channel numbers difficult to read; cover screws strip easily; etc."* This chap has a Sonar 2301 that he likes and a Standard 146 he thinks is "great." From all those desensing problems you might expect this chap to be in New York City . . . he is in Nevada.

WHOM TO WRITE

If you are uptight over the idea of turning our desperately needed 220 MHz band into a screaming mess of CBers . . . if I may put the case to you factually and unemotionally . . . then why not drop a line giving your thoughts to one or two of the members of the Electronics Industries Association Executive Commitee?

You might write to the Chairman of the Executive Committee, Richard Horner, E. F. Johnson Company, Waseca MN 56093. Or you might get in touch with Andy Andros, the president of Hy-Gain Electronics. Lincoln NB68501. If they can't stop the drive to take away this band, at least they can pull their company out of the EIA and stop furnishing the money which is being used to lobby for it in Washington.

CONTROVERSIAL FM'ER

The other day Carl Lindeman W1MLM, NBC's VP of sports, was flying across the country, TR-22 in hand, talking through various repeaters. With him was controversial sportswriter Howard Cosell. Howard's interest in the proceedings quickly rose to where he spent most of the trip arguing heatedly with amateur radio sports fans as they passed over them.

I can just see a dozen or so amateurs across the country rushing into the kitchen and telling their wives . . . "Hey, I just talked with Howard Cosell!" And I know what the wives said, too. "Who's he?" Fellows, I know just how it feels. A few weeks ago King Hussein called me on 20m and we talked for a while. After I signed I was busting to tell someone about it and at that particular time the baby sitter arrived so I casually mentioned to her that I had just finished talking with King Hussein. She had never heard of him . . . or Jordan. I'm not sure she has ever heard of Israel.

K2ORS NOMINATED!

Jean Sheperd K2ORS, frequently heard through the repeaters around New York . . . particularly WA2SUR . . . via his Tempo FMP transceiver, and heard nightly through WOR, has been nominated for an Emmy award this year. Jean Shepherd and Jane Fonda were the nominees for the Most Interesting New Performer on television for 1971. If you have any friends whose vote counts toward the Emmy, nudge them re Shep.

Shep was the feature speaker at the FM Symposium in Shrewsbury in February. The array of walkie talkies there got to him, and he has been an active FMer ever since, usually talking from his office high up in the WOR building on Broadway.

MORE TWO METER FM CHANNELS

The FCC does not have any intention of giving us the green light for repeating Techs above 147 MHz. Though their rules are quite explicit and it would be exceedingly difficult to interpret them as prohibiting a repeater from retransmitting Techs above 147, it is obviously easier to avoid a fight than to go after one . . . so most repeaters have been avoiding the 147 MHz range.

The 146–147 segment is FULL in many parts of the country and the pressure is mounting for more FM repeater channels. Where to go? Once gear is available in quantity for 220 MHz that is the obvious band for further repeater expansion . . . but it will be quite a while before the manufacturers are able to supply us with enough 220 gear to make that band really useful for everyone. In the meantime we must have more FM channels . . . and they must be on two meters. The answer is obvious . . . they will have to come out of the 145–146 MHz segment.

But won't we get into a big fight with the AM ops down there? We started in above 146 MHz because the AMers didn't use that part of the band. If we start moving down aren't we liable to get a big war started? I doubt it.

I've been tuning the lower two MHz of the band for some months now and I have so far heard exactly one (1) AM station on the 2m band from up around the New Hampshire area. One weekend I tuned the band in New York and all I heard there was one (1) AM station all weekend! Either I managed to listen at all the wrong times and missed hearing all the AM activity or else all those chaps have moved up into the FM band. I suspect the latter. Who would stick with AM on 2m when FM is so very much better?

If my survey is correct, then we do have some channels available for FM which will not inconvenience any other ops. I suggest that instead of using those confounded splinter channels in the 146 range that we start using standard channels in the 145 segment.

If we start easily, opening up about six FM repeater channels, there should be a minimum of bloodshed. I suggest that the repeater input be high and the output low, with the following channels used.

145.71 - 145.11	145.80 - 145.20
145.74 - 145.14	145.83 - 145.23
145.77 - 145.17	145.86 - 145.26

This system will leave the bottom 100 kHz of the band open for AM operation . . . sideband, whatever. It will also leave the surplus crystal channel of 145.35 open . . . as well as the 145.9–146.0 for satellite input.

I realize that this is probably impractical in Los Angeles, but perhaps it will work elsewhere. Any comments? Any takers?

600 kHz Uber Alles

The universal change in the eastern part of the country to 600 kHz repeater spacing was not accomplished without some difficulties. The wonder of it was that the battles were so few and far between.

Some of the skirmishes have recently been settled. For instance there was the little matter of WA1KFX on Mt. Snow on 31–91. This repeater, operated by Gordon Pugh W2GHR, had been on 31–88 for some years and then suddenly appeared on 31–91 early this spring . . . not long after the Mt. Greylock repeater shifted from 04–91 to 31–91. Thus there were two closely spaced and far-reaching repeaters both on 31–91. The result was an incredible mess and the hardest of hard feelings.

Many repeater people have been severely critical of Pugh for jamming

(continued on page 10)

the Greylock repeater and have been openly hostile to the attempts of Pugh to form a repeater organization in view of his lack of cooperation on 31–91. Pugh was the instigator of the North East Repeater Association and became its first president.

Apparently the pressures grew to where something had to give . . . and Pugh gave. WA1KFX would go off 31–91 and would move to some other open channel, possibly 01–61, since that seemed open for that area.

It should be pointed out that WA1KFX, though it has been on the air for several years, is remotely enough located in Vermont so it has seen little use. It has been off the air entirely for the last few months, so the sudden appearance on 31–91 was quite a shock to the K1FFK groups, which number close to 200.

KFX is reachable in April only on skis and the first reports are that Pugh did follow through with his agreement to turn off the repeater, but that he broke a leg on his way back down the mountain. The Greylock group wishes him a speedy recovery.

Another hassle was over 146.76 around the Long Island–Connecticut area, with WA2UZE on 16–76 and Bridgeport WA1KGK on 22–76. Power and feelings had escalated about evenly and the grievances were many and strong . . . UZE was there first by about ten years . . . KGK had more users and a wider range . . . and so it went. The solution came when the two principles finally sat down at the bargaining table and worked it out. UZE would stay on 76 . . . KGK would move to 10–70 . . . the UZE crew would guarantee to move heaven and earth to get the RTTY ops on Long Island to change from 70 to 146.55 as an RTTY simplex channel . . . and this is not simple because it means coming up against Byron Kretzman W2JTP and occupying his "private" channel. The Staten Island group agreed to move WA2YZZ off 70 RTTY to make room for KGK . . . and so it went. K1ABR in Rhode Island will probably move from 10–70 to 01–61, thus giving KGK more elbow room.

One other sore point was solved too, with the WA3BKO Philadelphia group agreeing to get the higher powered base stations to stop using 28 and use the 16–76 Philly machine, thus permitting WA2YYQ on Staten Island to move from 25–88 to 28–88.

Things are really falling into place for universal eastern 600 kHz spacing.

. . . *Wayne*

Military Affiliate Radio System

New Chief MARS Army, A3ZLH, is off from the starting gate faster than a speeding bullet! Innovations already announced are plans for updating the weekly WAR Broadcasts, a new SIG 439-2 Communications Manual and new carpets for the office! Chee! Southern New England has a new RATT net on 4035 kHz at 1901Z Sundays. A3NFS won the First Army Commander's Annual MARS Trophy. A1VFB is new Maine Army Mars Director. MARS Director. A very well-attended Spring meeting was held at Natick, Mass. As most such meetings, it included a "happy hour." Fifth Army MARS called it by a different name at their four-state convention in Fort Leavenworth, Kansas – "Attitude Adjustment Hour!"

Delaware MARS held their semi-annual meeting in Dover, complete with Crab Imperial, Crepes Suzette and a Swap-Shop. Their first two meter repeater should be in operation soon (in 148.01, out 143.99– as are most MARS Army installations). A *"did you know"* item: Office of Civil Defense has hired Systems Development Corp. to make a study of RACES. Wonder whom they will ask for opinions? Armed Forces Day cross-band operation was greater than ever, with NSS, NPG, AIR and WAR reporting hundreds of contacts with hams throughout the world. Your QSL cards and certificates will be mailed soon.

Air Force MARS is undergoing a geographical reorganization. Details have not been officially announced, but a reliable source informs us that there will be three major divisions, each being divided into several smaller groups of states. The new Air Force MARS manual is being distributed and one important change is noted: AF stations are now allowed to cross state lines with VHF repeaters as long as operation is within the same region.

Third Army's Fifteenth Annual MARS Conference was attended by more than 700 members and guests! They too had an "Attitude Adjustment Hour," a portion of the activities which can only increase in popularity as time progresses. Congratulations to Director Hal Mulkey for the finest conference ever. Assistant Chief MARS Army Joe Ziglinski was a welcome guest. Congratulations to AD4DQQ, honored at the Conference as Third Army's Operator of the month. In passing, Third Army's oldest VHF repeater, on Brasstown Bald is now in its *13th year!* This repeater was utilized to bring immediate help during a recent tragic occurrence. A camper-trailer went through a guard rail into Lake Hartwell in South Carolina. A4AZT, witnessing the accident, called through the repeater into Atlanta reaching AA4YBT, who alerted the South Carolina Highway Patrol. Although help arrived within a matter of minutes, it was too late.

Fifth Army Director Roland Belk has been on the road for months attending State meetings throughout the area. One of the largest was the Texas meeting at San Antonio. Still upcoming: Iowa, 3–4 June, Minnesota 8–9 July and Illinois on 31 July–1 August. ADØNIC was named Fifth Army Operator of the month, and AA5WHN is new Training Officer of Fifth Army. New Manual REG. 105-4, is being distributed to members.

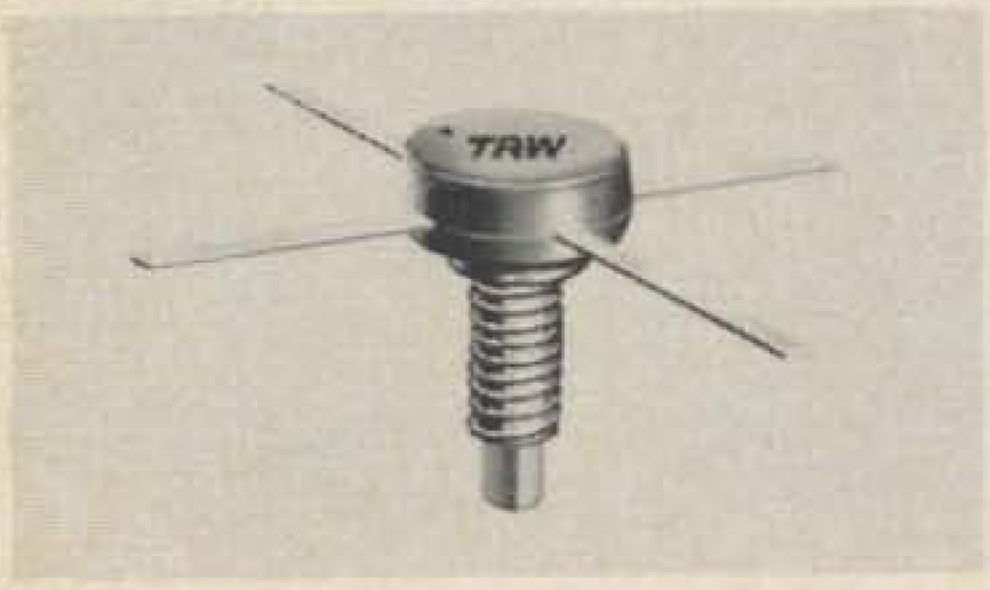
The Texas RATT Net has gone to 170 Hz shift – a growing national trend. If you have been using WBR/70, Miami WX, to adjust your printer, etc., don't be surprised when they go to 100 wpm on 1 July. Louisiana has a new VHF emergency communication plan, under which the 2 and 6 meter MARS repeaters are tied together to cover a large part of their area. Meetings in that state were held in Shreveport and Alexandria. Missouri State MARS meeting is being held in Lebanon, with VHF repeaters high on the agenda. A new Missouri repeater is in operation in the Cape Giradeau area – your editor accesses it often, but perhaps they don't answer AR's.

AA6TOV has been appointed Director of Research & Development, Southern California Army MARS. That group's very fine Monthly Signal, edited by AA6GJY, has just finished a fine series on the Apollo program, and is now featuring a first-person account of the sinking of the USS Milwaukee in 1917, a story told by AA6LJ. In addition to the usual 148.01–143.99 repeaters, the Southern California group has repeaters on 143.415 in, 148.650 out. Also, while we are fooling around with those 2 meter frequencies, they already have nets going on 432 and 1296 MHz! The Arizona MARS meeting will be held in Tucson in conjunction with the Old Pueblo Radio Club Hamfest.

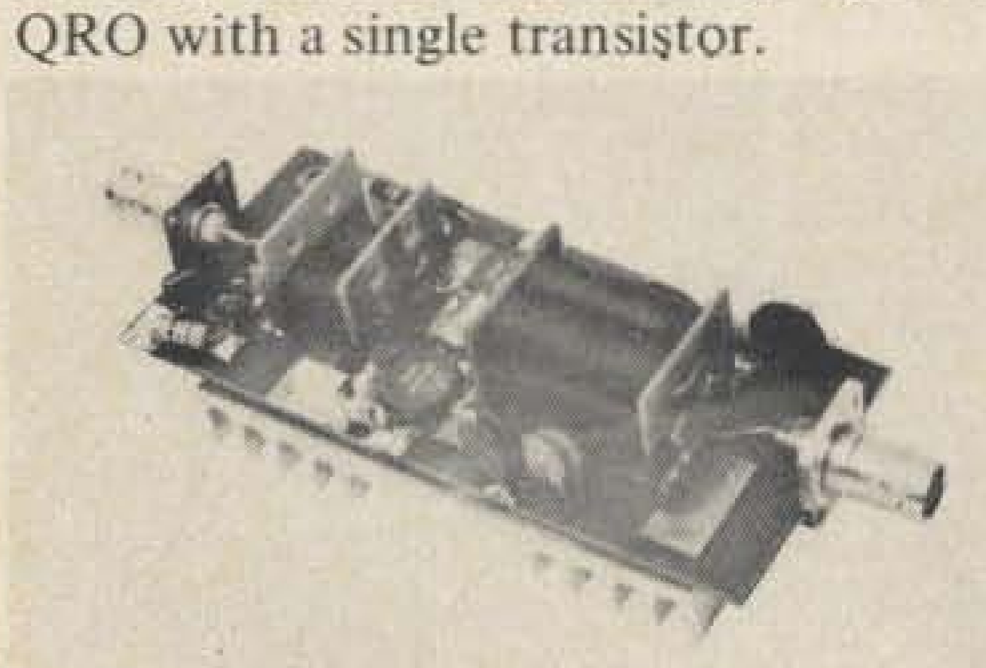
This column is designed to keep you informed of matters MARS. If you have information that should be included, or if you would like to become a member of one of the three MARS programs, contact Harry Simpson, A4SCF, P.O. Box 27015, Memphis TN 38127. ZKJ – which is MARS-ese for QRT.

NEW PRODUCTS

NEW LINEAR TRANSISTOR

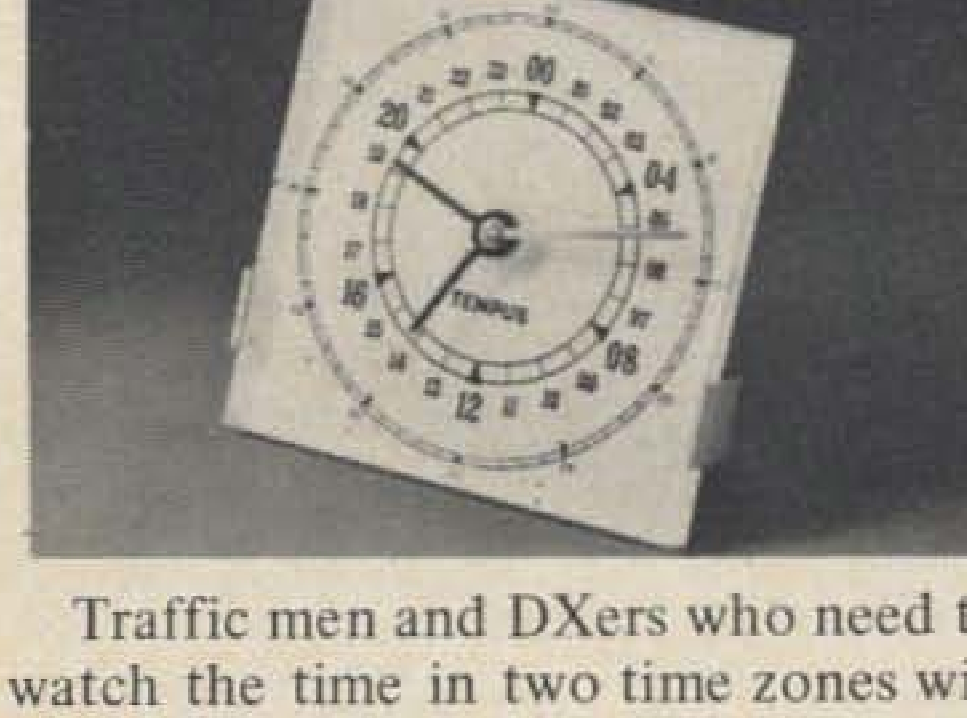


TRW Semiconductors has developed a new transistor that will have wide-reaching effect upon us all. Their PT5740 series can be driven with less than a watt for outputs of over twenty watts at twelve volts. This is significant for transistor power amplifiers that can be used in your car with flea power drivers. Four of them can be driven to over 100 watts output which is perfect for driving most tube kilowatt amplifiers currently on the market. QRPPers can easily go QRP or QRO with a single transistor.



There are simple circuits that can be duplicated to make broadband power amplifiers that will amplify a one watt signal to over a hundred watts output at 14 MHz, all from a 12.5V dc source, not 28 volts as is required on several other similar circuits. As the amplifier is broadband, no tuning is necessary from 80 through 10 meters with a 50Ω load. TRW has the transistors available, and their application notes give all the information needed to make the power amplifiers. Write to *TRW Semiconductors, 14520 Aviation Blvd., Lawndale CA 90260* and ask for CT-122-71 and CT-113–71.

CORDLESS 24 HOUR CLOCK



Traffic men and DXers who need to watch the time in two time zones will want to buy this 24 hour clock with a second hour hand for keeping time in local time, Greenwich time, EST, EDT, or any other time. The beauty of this clock is that it will run for almost two years on a standard C-size flashlight battery. This handsome clock will look beautiful in your shack and it will help you meet your nets and skeds. It is only $29.50 from *Tempus Instruments, Villa Italia Center Suite 594, 7200 W. Alameda Ave., Denver CO 80226.*

NOVICE

Alaska is a rare state for most people, not just Novices. In fact there are only about 1,200 hams in Alaska, which is about 0.4% of the total number of hams in the entire U.S. Although it looks hopeless for the Novice to find an Alaskan ham, much less an Alaskan Novice ham, there is a way. On most week nights at about 0700 GMT, there is a Novice Net that is based in Alaska on 21.225 MHz. Active stations in the net include WL7HH), WL7HET, and WL7HJR. Although it may seem unlikely that you might get in to Alaska at that hour, keep listening. This is the kind of activity for which many top DXers look. Tune the frequency at the time that the station is normally on, and keep doing this until the moment comes that you work the rare one. He may be booming in due to freak conditions or he may be very weak in the noise. But keep trying. He's in there waiting for you.

NEW SSB/CW XCVR

Hallicrafters has a new sideband transceiver that deserves investigation if you're looking for a new or second rig. The FPM-300 features all solid-state construction with only two tubes and modular construction throughout. The rig runs a cool 250 watts PEP or 180 watts CW. You will sound much stronger on sideband, however, because there is an IC speech compressor for emphasizing audio punch. Full coverage of all bands and built-in ac and dc power supplies complement the rig for a great fixed or mobile signal. *Hallicrafters Co., 600 Hicks Rd., Rolling Meadows IL 60008.*

AMSAT ACTIVITIES

Mike Frye WB8LBP
640 Dauville Dr.
Dayton OH 45429

The Radio Amateur Satellite Corporation (AMSAT) was formed in 1969 to provide amateur satellites and space experiments for the amateur service. Membership currently numbers 460, including over 40 member societies, and is worldwide with amateurs from some thirty countries represented.

AMSAT is currently active in preparing for the launch of AMSAT-OSCAR-C (A-O-C), scheduled to go up in July, 1972. A-O-C will feature a 24 channel Morse code telemetry system developed by W5CAY; the 432–146 MHz ten watt linear translator developed by DJ4ZC and DJ5KQ in Marburg, Germany; the two-ten meter linear translator built by W4RUD, WA4DGU, and K3JTE, the 35 function command system provided by WAI-Project Australis, and the instrumentation converter provided by W3GEY, A-O-C project manager. CODESTORE, a Morse message storage unit was developed for storing emergency messages, operational information on the satellite and orbital information for repeated transmission to the ground over the satellite's telemetry systems.

When A-O-C is ready for launching it will ride piggyback on NASA's ITO S-D meteorological satellite into a planned 1500 km polar orbit.

AMSAT has also submitted a proposal to NASA to provide for amateur experiments aboard the ATS-G Applications Technology Satellite scheduled for 1975. The space would be put to good use with a SYNCART (*SYNC*hronous *A*mateur *R*adio *T*ranslator) experiment. AMSAT will provide NASA with a 146–435 MHz 20 watt linear translator for integration into the ATS-G package. The satellite will be placed in a geostationary (synchronous) orbit. It will contain a 30 foot parabolic reflector which is available for the SYNCART experiment. This will enable amateurs for the first time to use a synchronous satellite on a more or less regular basis with modest amateur equipment.

The SYNCART package is designed for emergency communcations, educational training and experiments with small terminal multiple-access communications.

AMSAT members at the NASA Goddard Space flight center and many other manned flight centers have been assisting with these projects. Dr. Owen Garriott, one of the astronauts in training for SKYLAB, has indicated his support. Dr. Garriott happens to be W5LFL and a member of AMSAT.

The 50 MHz Band

As of this writing there has been no further word on the VP5RS DXpedition planned by W4GDS, but knowing Bob's ability to get things done it would be safe to assume that everything will come off as scheduled.

Webster defines a hobby as "a pursuit outside one's regular occupation enjoyed for relaxation." Public service aspects aside, amateur radio is supposed to be fun. It therefore behooves each of us to avoid doing things which deprive others of their pleasure. Do you call a rare or DX station every time he stops transmitting? Do you inquire if the frequency is in use before calling CQ or tuning up? Do you own and USE a dummy load, even on VHF? Do you make transmissions so long the band folds before you complete one schange? Do you call CQ so long the prospective contact gets tired of waiting and looks elsewhere? We have all experienced signals 20, 30 or 40 kHz wide obliterating a goodly segment of the band. A malfunction can happen to anyone, but all too often the cause is Fred talking to Harvey down the block with his Band Burner VI (or the matching linear) cranked into saturation . . . just like the last time the band was open. QRM from other stations in QSO and tuning up, etc., has become as common as on the lower bands. But it need not be so. Rarely, even during the widest openings, does one hear activity above 50.2. With 4 MHz available, doesn't it seem a bit ridiculous to congregate in the first 50 kHz? Would it not be reasonable to assume that all would profit if we were to make better use of the band during openings?

A report has been received to the effect that WA5HNK worked CE4CP on March 25th. This to my knowledge is the first Chilean contact since Urly, CE3QG, was active several years ago. XE1PY remains active with several stations reporting contacts during the past month. Bob WAØTXV, is looking for scatter and/or groundwave contacts on Sunday mornings from 0500 to 0800 CST.

The comment in the March issue relative to the lack of activity in Kentucky really stirred up a hornets' nest. Tony WA4JQS, informs us that he and Ken WB4UQC, are active from Somerset. Both are working on linears with 3–500Zs. This industrious pair will be operating from a fire tower at 1590 ft above sea level during the VHF contest and will be happy to make schedules on 3960 kHz. Also add Hamp WB4SBU and Don WA4VIR of Jeff Town and Fort Campbell to the list of active stations in Kentucky.

Those suffering TVI would do well to try the bandpass filter design by WA5SWD/6 described in the January 1970 issue of 73. Several of these are in use in this area and are doing a good job of reducing TVI on the local channel 2, the callsign of which is a very appropriate KTVI.

Doc WA7FLB, reports a very quiet winter, which is probably just as well. Doc has had antenna difficulties but promises to be back in full operation shortly. K9SDF is recovering from double hip surgery and expects to be out of the hospital and on hand for all of the spring openings. Very good planning, Gabe! Larry Phant WØRVF, works the nightshift on 6 meters, seldom getting on before midnight. You late night types would do well to turn your beams in the general direction of St. Louis in the early morning hours.

It seems that not many 6 meter hams are aware that many TV manufacturers will supply high pass filters at no charge or for a small handling charge. I would be pleased to send a copy of a list of manufacturers' addresses collected over a period of years to anyone sending an SASE to my home address. This list is not complete in that many "house" and imported brands are not included, but it does cover a good cross-section of the more popular brands. Perhaps I am leaving myself open for more than I can handle, but I will also offer assistance to anyone who needs help in getting on the air, curing TVI, or any other problem, as long as it pertains to 50 MHz operation. I can't guarantee anything other than a sincere effort. See you on 6.

Bill Turner WAØABI
5 Chestnut Court
St. Peters MO 63376

SSTV SCENE

Slow scan activity has started to pick up on ten meters with most of the activity centered on 28.680 MHz Saturday mornings and Sunday afternoon. A fair amount of activity from Europe and Africa there also.

A few months ago I noticed Denson Electronics' large ad in 73. So I checked into them and found a real gold mine of fast and slow scan TV goodies. Zoom lens, turrents, projection TV systems and much more. The video tape recorders really caught my eye. Some were under $400! What possibilities! Video tape those ATV QSO's, or make up programs to feed when you're not using the camera. Coupled with an on-off timer and TV, you could work up a system to tape favorite TV programs for later viewing. Our day of dreams is rapidly approaching.

I have a very interesting picture for the column this month. This was recorded by W7ABW, and photographed (and described to me) by WB8BQT about two years ago. Notice first the skewed lines running from the bottom left to the top right of the picture. Here the playback recorder was running slightly faster than the recording tape recorder, thus the lines "lean" toward the right. If the playback recorder had been slower than the recording recorder, the lines would be skewed from the top right to the bottom left. If the two tape recorders were running at the same speed the lines would be vertical, and not noticeable, except for four very slight "humps" at the very top of the picture. It is those four "humps" (60 cycles divided by four) that makes the skewed lines. The picture starts erratically on the right top. A perfect SSTV picture starts the first line two thirds of the way across the top. (The blank period is the vertical re-trace.) Notice the texture of the hair, and the white of the collar – this is evidence of a high quality gray scale. There is a slight light reflection in the center of the left eye, showing the definition a 120 line slow scan picture is capable of producing. Now remember, a certain amount of quality is lost each time a picture is reproduced, thus the original image on the screen was better than the photo and the photo better than the magazine picture. So the magazine picture is third rate to the original viewed on the screen.

Robot Research is busy these days. Their SSTV directory is in the works and should be available very soon. If you haven't sent them a post card yet telling of your SSTV activity better do so right away or you may get left out. They are also publishing a short SSTV newsletter which is usually available from authorized distributors. It is refreshing to see a company interested in just more than selling their product, and Robot is as gung-ho on slow scan as we are.

That fellow with the high country total on SSTV is Gene W8YEK, who has 44 countries confirmed. Close behind him is Eddie W4MS, with 40, and WAC/SSTV. W8UUS and a couple

Microwaves

Those amateurs working at the higher microwave frequencies will be glad to know that the National Bureau of Standards (Boulder CO) can now measure frequencies on the order of 85 terahertz (or 85,000 GHz) to an accuracy of about ±10 parts per billion. The apparatus used as a mixer for these measurements uses a microscopic version of the cat-whisker diode. Shades of 1923!

AT&T has proposed that the land mobile telephone service be moved from 50, 150 and 450 MHz to 850 MHz so that more channels may be accommodated. The FCC has responded by opening a new band from 806 to 881 MHz, to be used exclusively for mobile communications. If this plan is implemented, there is going to be quite a haul of VHF surplus FM gear on the market from people evacuating to the new band. Watch this column for more info, or see March 72 *Microwaves*.

An added note: Motorola objects to the AT&T plan, and instead asked for another band at 900 MHz; no FCC action on this proposal is known of at this time.

New Microwave Products

Microwave Semiconductor Corp. (MSC) has scooped the bipolar industry again by announcing a 5 watt (output power) device at 4.0 GHz. At $400 apiece, I sincerely doubt you or I will put one on the ham bands soon, but don't forget that the 2N3866 was over $100 just ten or so years ago. Base and emitter linewidths of one micron allow minimal parasitic reactance while still providing maximum power gain at 4 GHz for the MSC 4005.

Last month's mention of arsenic transistors has led some amateurs to comment that 15 GHz is a pretty high frequency to be fooling around with transistors. While I must admit that 15 GHz is the state-of-the-art as far as bipolar transistors are concerned, I feel I must mention that there are commercially available FET's that have cutoff frequencies (F_T) of 40 GHz. Now, that's really *moving!*

Jim Weir WB6BHI
P.O. Box 23233
San Diego CA 92123

of others have WAC on SSTV also, and Bill XW8AX has left Laos and returned to the U.S. But alas . . . there are some 4X4's on SSTV hanging around 14.230. . . .

Well, summer is here, and may all your hamfests give Robot gear as prizes.

Dave Ingram K4TWJ
Rte. 11, Box 499, Eastwood Vil. 50N, Birmingham AL 35210

LETTERS

KIND WORDS

With so much computer talk now interesting hams – and your interest in various usages of "73," have you ever noticed how evenly this comes out as a binary number: 1001001?

Alexander Stewart W1TD
Camden ME

Haven't noticed.

I have been in the ARRL for the last year but QST just doesn't cut it for me. Not enough articles that are really for a beginner like me, so I've had to go out and buy 73 off the stand. Your "General Class License Study" is a help for my next step which I'm sure is going to come out on the passing side. Keep up the good work. Guys like me need a mag like 73.

Earl Bach WNØAVU
Minneapolis MN

You keep up the good work, Earl. Ham radio needs guys like you.

Please accept my congratulations for your consistent production of a publication that contains useful, authoritative articles. These articles are written so they are easily understood without regard to the complexity of their subject matter.

F. W. Harland
Abington PA

I have enjoyed your magazine for some time now. I find it more interesting than QST. I am interested in your IC applications articles. How about a feature article on SSTV which summarizes the developments to date for someone who knows very little about SSTV.

David A. Bollmann
Bethlehem PA

Coming.

. . .AND A RASBERRY!

Cripes! Just shelled out one buck for your April issue! It's a catalogue not a magazine! You lost a long-standing reader!! WHEN you eliminated the jokes, W1YSD, and W2NSD/1 funny comments and went all FM it was Baaaaa!!! But turning 73 into a catalogue, phooey! I can get *free* catalogues and brochures.

No Block + No Manning + No interest = No ME!!!

Cal Emerson

If you want humor, read CQ. Their April Fool survey article was a laugh and a half.

EUROPEAN TOUR

"Three solid weeks with Wayne Green?" All I can say is *YUK*!!!

D. M. Casselman WAØGSY
Conway Springs KS

Three solid weeks with D. M. Casselman? Double YUK!!!

PLATE PLIGHT

There is so much to say about the April issue I'll try to keep myself down to a few choice words so as not to take too much of your time. This issue was so great that a few of us got together just to sit and praise it last evening! You really hit the top with this issue!

Watch for some fire from Nebraska in the next year or so about license plates: seems the legislature here said anyone who wanted special plates could pay a $50 fee and many people did. Then they saw amateurs with call plates and learned that the hams paid only about $2. People got mad and wrote their congressmen. Now we wait! I like Alaska's system for amateur plates if rumors are correct: $1.00 total cost if vehicle has mobile equipment regularly installed in it. This could encourage some growth in the ranks if nothing else will.

G. Wayne Heck WB9HJM/Ø –NØTUB
7401 South 33 St.
Omaha NB 68147

I want to tell you about a bum deal we are about to get from the Michigan legislature. Michigan amateurs were able to get their call letters on their auto plates for $2.00 over the regular cost of plates. This isn't anything new but what is new is that some group has pushed a bill through the Senate (March 16, 1972) boosting the fee to $25. The bill is Substitute Senate Bill 240, I believe. By chance, one ham (W8AQA Saginaw) found it out and the result is angry muttering all over Michigan. If it can happen here it can happen in other states. We know CB'ers have been stumping for their

(continued overleaf)

call letter plates for some time. This may the the state's way of shutting them up and at the same time stopping complaints of favoring certain groups, but I think it still is a bum deal.

R. Dring K8YQC
1100 E. Hill Rd.
Flint MI 48507

It seems like the license plate issue is up again in different parts of the nation. How have other groups worked to repeal this form of discrimination against hams? Please send information to either/or both of the gentlemen above and send a copy to 73.

Amateurs all over the world must have a quiet chuckle to themselves as they watch the goggle-box and anything to do with radio crops up – for the TV-men ALWAYS goof it! Here in England we get all your "Cops and Robbers" films and I was rather idly watching one recently when the strong arm of the law burst open the door of the baddies' hideout. The local police-inspector looked puzzled at what he saw inside the room, but the know-all FBI agent explained rather airly, "Aha, yes, that's a very high powered marine wireless transmitter."

No wonder the inspector looked puzzled, for the camera zoomed in on a typical Novice setup, complete with DX-40.

When will the film producers learn to consult an amateur?

Douglas Byrne G3KPO
Spalding, England

At our FM Symposium in Shrewsbury, Massachusetts, one ham walked around talking into a Minox camera with toothpick antenna.

DYCOMM DISSECTED

After seeing your "Dycomm Demand" story in the April issue,I thought I would share with you an experience I have had with the good folks at Dycomm.

December 21, 1971, I wrote Jim Penny at Dycomm and indicated our CD group was in the process of installing a repeater and I wanted information on the Dycomm repeater. We had been considering a Motorola unit. Two months passed, we had our money in our hands, but no word from Dycomm.

I called Dycomm the latter part of January, talked to the secretary who answered the phone, explained to her the situation, and she said that Penny was in a conference with everybody else and couldn't be disturbed. She acknowledged receipt of my letter and said that she would have him either call me back or get a letter out to me in the next day's mail. Two weeks later, nothing.

A friend who is the owner of a nearby repeater saw me a week later and I told him of my unsuccessful attempt to buy a repeater from Dycomm (he had ordered a Dycomm machine earlier but had not received it) and he said he would be talking to Penny in a few days and would mention my plight, which he did. He told me that Penny was sorry as hell and had misplaced my letter and would I please by so kind as to drop him another letter, which I did. I sent him a Xerox of the first letter to him with a note at the bottom telling him that I had also called him. *To this date I have not heard from Dycomm.* We have since bought a solid state GE repeater ($700).

I thought you would be interested in how one of your advertisers responds to requests for information. Also I guess you are not the only one who has trouble getting them to read their mail.

Name withheld

No further ads will be accepted from Dycomm for the Repeater Bulletin, 73 Magazine, or any other 73 publications.

ANOTHER CHANCE! OH, WOW!

You are probably wondering why i took so long to renew so I'll tell you. I was considering dropping you because I did not like your sideways format and the fine print was too much strain on my farsighted eyes, and also you did not put your yearly index in the Dec. 1971 issue. What I do like is your construction articles and also you keep me posted on what the other mags do wrong. I get them all.

Please push for more activity on 220 MHz even if it is FM repeaters so we don't lose it. I am a 2 meter AM operator and also some 6 meter SSB. I have also operated on 220 but there wasn't much activity so I shelved it temporarily. I decided to give you another chance so don't disappoint me with any more cockeyed formats.

Joe Murphy WA2FEK

CB'ER INTO HAM?

Reading your January issue, there is a letter from Ed Brooks Jr. W3GAB. Well I agree with him him 100% about the EIA proposal to allocate 146–148 MHz to CB hobby operations. Why get another mess started. If you give them another one of our bands, they may at a later date want more. As the saying goes, you give them an inch and they will take a mile. I know several CBers who are running against every regulation the FCC has put forth. I have converted a few of them to amateur radio. I showed them how easy it was to get a Novice ticket. I believe that if everyone who is a ham would get together with the CBers and show them how easy it is to become a ham operator, there wouldn't be a need for the EIA proposal at all.

William D Steen WA6HBM

This is where the local ham club plays a role in building PR. With another few hundred thousand hams our voice would be much louder.

EUROPE REVISITED

Top Tour and Swissair vacation plan as described in CQ for March may indeed appeal to some amateurs and be a good undertaking. But, one should carefully check what one is getting and total *all* the costs involved against other available plans. The Swissair ad in CQ makes reference to "1st Class Hotels." Some of those described under the plan are first class but some are definitely not. For instance, the "hotel" in Germany does not fall under any of the officially established categories of hotels of the first, second, third or fourth class. It is a so-called "Gasthaus" or inn. The hotel in Zweisimmen, Switzerland is officially listed as a hotel of the second to fourth class (depending on the room). The postal authorities in the countries mentioned who control the issuance of amateur licenses, are usually very friendly people, but the idea of obtaining your "own specialized personalized callsign," as the ad states, when native amateurs cannot generally obtain such service is stretching things. Your personalized call sign will usually be your W call followed by the normal country prefix, such as W8XXX/DL. There are other points one could mention such as: what does one see of Europe staying in insolated spots? Ever drive around in Europe during the tourist peak? Those 1–2 hour "theoretical" drives to sights of interest become 6–8 hour grinds. What is so DX'y about signing W8XXX/DL? There will be no pileups waiting to work you.

Name withheld

Visiting Europe during the summer months can be a terrible grind. My own preference is in May or in the fall – September and October, when the hotels have rooms, there are seats in the restaurants, and weather is just a bit cool, but not cold. I like the smaller hotels better than the first class Hilton type sanitized and plastic American type hotels. And who wants to sit in a hotel room watching a German-dubbed rerun of December Bride?

I'm on a 3-month business trip to Key West. Driving across country I worked into many FM repeaters and dutifully used your "FCC Official" log book that I got from the 73 booth at Las Vegas.

On the way down the Florida Keys my car with lots of antennas and the "FCC OFFICIAL" was spotted by a Citizen Bander at a service station. He passed the word down the Keys that the FCC was coming. There was a mad scramble to disconnect linears and lower antennas by the local CB'ers.

This info was passed on to me after I was here a couple of weeks.

Tom ORR W6EIF/4
Key West, Florida

These log books are available from 73 4/$1. They are designed to be used as FM mobile logs. The cover was designed to help keep fuzz off the car, the idea being to casually leave the log book on the dashboard with the "FCC OFFICIAL" facing upwards. The CB reaction is a side benefit, but one certainly worth pursuing.

CHAPIN REBUTTED

I would like to comment on your guest editorial in Jan. 72 issue of 73, which incidentally was a great way to begin the new year. An excellent edition (slim or otherwise!).

Admittedly, Mr. Chapin is well informed on the inner workings of the former IRE and AIEE, now IEEE and his arguments offer much for thought with regard to the ARRL and its obvious problems in the area of finances, membership & P.R., but to structure the ARRL in the manner he suggests is pure folly. I will agree that every organization goes through a cycle, beginning with its embryonic stage to its final plea for recognition, and ironically enough, that is where the similarity in our thin-ing also dies.

Forming a new organization by the act of merging does not guarantee continuity of the old organization, it is merely a way of saving face, in most cases, it is the final plea for recognition as mentioned earlier. Once the merger is complete the old organization is gone forever. I would like to know how Mr. Chapin is able to draw a parallel between the IRE & AIEE vs. ARRL & WHOM? *The ARRL simply has no competition.* How can you draw a parallel between the ARRL & CW & RC & TFC & Non/TFC & DX & etc.? Any rank SWL realizes that the real problem stems from the fact that *ARRL simply has no competition!* I know I repeated it, maybe by now it has sunk in somewhere between the head phones. Show me an organization or company with sole rights and distributorship of a product or service and I will show you an inferior product or service!

You know it, I know it, and Mr. Chapin knows it along with 200,000 other amateurs in the U.S. We live in a country whose economy is based and founded on competition, yet we sit on our tails for 50 years and let ourselves be led around and dictated to by an organization that claims 27% of our lot. C'mon fellows and YL's, wake up, we can do better than this!

For my part, since all the dissension began 3 years ago, and new organizations have cropped up (one of which is doing very well) and I'm proud to be a member of Nu Sigma Alpha, amateur radio has never been more exciting. Let's face it, competition is food for the soul, we all must have it, win or lose, we do the best we can for our colors. I can think of nothing more boring than to boast that I belong to the one and only major ham radio organization in the country. We've had 50 years of this drudgery, and another 5 or 10 years would parallel the Chinese water torture. So let's let ARRL continue the way they wish, let's develop one or two more organizations and with it develop some friendly competition for a change. It may uncover a few dusty old rigs, solidify the present membership of ARRL and bring back some of the competitive spirit into an area where it has been heretofore virtually non-existent.

Bob Linker WA9VIR
Chicago IL

I cannot agree with you more. It is only with competition that products improve and progress is made. Any company or organization that has a monopoly stands only to protect its monopoly and great efforts are often made to crush any smaller organization that threatens to upset the status quo. About a decade ago, a small group organized the Institute of Amateur Radio. This organization promised to make many resounding changes in our hobby; but this proved to be such an earth-shaker that the well established organization took great efforts to stop the competition.

What can be done now? Well, for a start, a new organization is needed to offer services, produce some sort of information disseminating system, and present ideas to its membership. The resultant competition need not be vicious nor cruel, but may be done with a keen eye to the other to see what is being done so that it may improve upon the latest offerings. The consumer has the ability to vote for the system he approves of most, and that vote he casts is in the form of the dollar. Obviously the organization that offers the most will win. That which offers nothing will stagnate.

The following letter was received by Peter Lovelock W6AJZ, for his role in saving two Navy aircraft from disaster.

I wish to thank you for the excellent assistance which you, as an amateur radio operator, gave the United States antarctic program on February 28, 1972. At that time two United States Navy LC-130 aircraft had been forced by headwinds to turn back on a flight from Christchurch, New Zealand, to McMurdo Station. Although the planes had been able to inform McMurdo of their change in plan, due to high latitude communication interruptions neither they nor McMurdo were able at that time to notify New Zealand or to request the needed lighting at the airports there.

By working an amateur circuit with Palmer Station you were perhaps the only person in the United States in radio communication with Antarctica at that time. By relay through Palmer, and thence through you to the Office of Polar Programs, McMurdo Station was able to report this operational emergency. We were then able to telephone New Zealand authorities to verify that the situation was known to them and that the airports were ready to receive the flights. Both planes landed safely.

Your prompt and capable assistance provided a reassuring backup communication capability for which all concerned are grateful.

Joseph O. Fletcher
Head, National Science Foundation
Washington DC

MARKETING MAGIC?

Reference the "thin 73" item at p.10 of the December 1971 issue. Was one of the Massachusetts bandits, by any chance, my favorite anathema, Herb Gordon of Woodchuck Hill? As your files will disclose I wrote you on Oct. 2, 1970, concerning my efforts to induce that individual to either ship merchandise ordered or refund my payment for it.

Ultimately I turned the matter over to my attorney and all normal legal steps of a preliminary nature were taken. Gordon blithely ignored all correspondence (including mine), so we decided it would be ridiculous to spend a couple of hundred dollars in court to recover $99.95, the amount of the check I had sent Gordon. I publicized his performance via a couple of OT organizations to which I belong. I wonder if he is still in business?

In any event, I'm minus the $99.95 – and the wattmeter.

Further concerning material in recent issues. You have indicated an interest in the possibility of introducing things of a new nature which might have departmental aspects. So how would you like to bankrupt the organization via a thing that might be entitled "Marketing Magic?" It would be concerned with the type of reaming I took from Gordon. It would report complaints from amateurs who, in fact or in fancy, have been victimized by suppliers. It would be based upon letters sent to 73 by victims such as W1GAA. It would contain nothing libelous, but would rather constitute a factual and objective record that would, hopefully, differentiate between the suppliers who deal above the table and those who don't.

Allowing for my undoubted bias, I think something of this nature would

(continued overleaf)

Caveat Emptor?

Price – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor . . .

FOR SALE. Ross & White 1972 model FM transceiver with twelve channels and three frequency tone burst built in by the factory. Loudspeaker on front panel for best audio results. S-meter, hot front end, protected rf transistors, all crystals easily changed and trimmed, 0.1, 1.0 and 10 watt output, mechanical filter for selectivity, six IC's in one of the most modern circuits yet produced This transceiver sold for $405 with the 1800, 1950 and 2100 Hz tone burst. The first check for $200 will get this unit, brand new, used only for tests at 73 HQ. 73 Magazine, Peterborough NH 03458.

FET VOM's. CD IGNITION SYSTEMS. Nationally advertised. Good discount. All equipment guaranteed. Must see specs to appreciate. Rodgers & Son (73). Box 3583, Anaheim CA.

LETTERS CONT.

be a real service to all hams. But of course it might take 73 out of the picture – or, like the various consumer's magazines, it might start a boom for you.

I'd be delighted to edit such a column. What do you think?

Al Smith W1GAA/K3ZMS
Temple NH

There are a few cases where a warning to the reader is in order, but a good percentage of the complaints that have been received at 73 have been exaggerated. The 73 policy has been to refuse further advertising to firms which generate legitimate complaints from customers. A good percentage of the 73 advertisers are involved with mail orders so we try to do everything we can to make sure that everything is on the up-and-up. 73 is also suing Mr. Gordon, though not with any remarkable success.

WARREN, OHIO ARA'S Family Hamfest, Aug. 20. Giant fleamart, swimming, picnicking, all free. Displays, mobile check-in. Camping Available. Yankee Lake, Rt. 7 near I-80. Details: QSL W8VTD.

A5 MAGAZINE: The all new ATV publication covering all modes of ham TV. Subscription $2.50 per year. Bimonthly. P.O. Box 6512-B, Philadelphia, Penna. 19138.

WILL TRADE a General Radio primary frequency standard model 1100-A for a Hewlett Packard signal generator model 608-D/E. The GR 1100-A will measure frequencies from 100 kHz to 50 MHz to 1 part 10^9 for short term stability. Complete with all manuals and cabinets and precision master oscillator, clock, comparator scope and transfer oscillators. Tech Editor, 73 Magazine.

GREATER INDIANAPOLIS HAMFEST Sunday Sept. 17, 1972. Gas Co. Park, on Thompson Rd. Between Franklin Rd. & Five Points Rd. Admission $1.00. Vendors Free Hourly Prizes, Refreshments. For info Write Bill Evans, P.O. Box 19449, Indianapolis, Ind. 46219.

FIGHT TVI with the R.S.O. Low Pass Filter. See p115, March 1972, 73. Write for brochure. Taylor Communications Manufacturing Company, Box 126, Agincourt, Ontario, Canada.

Be The First!

Are you going to let the EIA steal one of our most promising ham bands without a fight? Are you going to sit still while this piracy takes place? Or are you going to fight back? Are you going to get on 220? Are you going to help get a repeater on 220? Are you going to let the manufacturers know that they can't buy our ham band by lavishing dollars in Washington?

To help you get the spirit started with your club 73 is offering these shirts – 220 – USE IT OR LOSE IT – you may be the first in your club and make everyone eat their heart out. Wear these to hamfests and conventions – let's get the word out.

These 220 shirts are $2.50 each postpaid – state size desired – small, medium or large – state color desired as long as it is blue. USA only.

73 Magazine, Peterborough NH 03458

SALE OR TRADE: AN/URC-4 manual, 90 pages; AN/ART13,A,B manual, 400 pages, binder. WANT: Hanson Gorrill Bryan 100R phase-sensitive Voltmeter manual; Instrument Electronics 247 VTVM manual; 0–400V regulated power supply.

IRCC PICNIC/HAMFEST. Interstate all the way; 2 hours Chicago; 2 hours Cincinnati; 2 hours Louisville. July 9, FAIRGROUNDS, LAFAYETTE, INDIANA. Indiana Radio Club Council.

SALE – like new with original instruction book (3) Art 13 Autotune Aircraft Transmitters with all tubes, $50.00 each. Also: (3) new Panadapters, BC 1031 with spare tubes and power cord and original tech. manual. $70.00 each. Shipping costs collect. W3RYJ, R.D. 4, Box 368, Reading, PA. 19606.

FOR SALE Drake TR-6- with AC-4, MS4 RV6, AM filter. "Mint" $600.00. Will trade. Swan-TV2-B – $200.00. Jim – W1VYB, 53 Lothrop St., Beverly, Mass. 01915.

FIFTH ANNUAL RADIO SOCIETY OF ONTARIO Convention – Kitchener, November 3 and 4, 1972. Canada's Biggest – excellent forums for OM's and XYL's. Write R.S.O. Convention, Kitchener-Waterloo Amateur Radio Club, Box 812, Waterloo, Ontario, Canada.

TECH MANUALS for Govt surplus gear only $6.50 each: R-388/URR, R-389/URR, R-390/URR, R-390A/URR, R-220/URR, R-274/FRR, CV-591A/URR, TS-497B/URR, URM-25D. W3IHD, 4905 Roanne Drive, Washington, DC 20021.

CLEANING OUT SHACK, garage and attic. Six new surplus 6C21 triodes, misc xmfrs, chokes, caps & xtals. List available. WA7OTN, 185 East 550 North, Bountiful, Utah 84010.

BUYING? SELLING? TRADING? Don't make a move until you've seen our new publication. Free sample copy! Six issues $1. HAM ADS, P.O. BOX 46-653R, L.A., Cal. 90046.

FIELD DAY masts: 9½' x 3" o.d. aluminum alloy; extremely rigid; 20 lbs. each. $8.25 each. Kleinschmidt teletypewriter (KSR), very good condition, $49. Model 14 reperf, good condition, $15. Unused: 4CX250K, $38; 4CX300A, $26; 4X150A, $17. Aircraft emergency horn, 28v@5.5A (loud!), $35. New 28LPR reperf in ognl sealed carton, $79. RCA4500 vidicon for SSTV, unused, (New: $480), $99. K3MNJ, 8361 Langdon St., Phila. Pa. 19152. Tel: 215-725-2373.

Peter R. Jennings VE3GEJ
600 Peach Avenue
Niagara Falls, Ontario

SIX ELEMENTS ON TWENTY METERS

Literally hundreds of articles have been written over the past few years describing antenna arrays ranging from dipole simplicity to full-size 40m quads. Still, it seems that most hams do not have as good an antenna system as they would like to have. There are two major reasons for this: They don't have the room or they don't have the money. Well, here is a high-gain antenna which was built in a 55 x 35 ft back yard at a total expense of about $5 for antenna wire plus some leftover hardware from a 75m dipole.

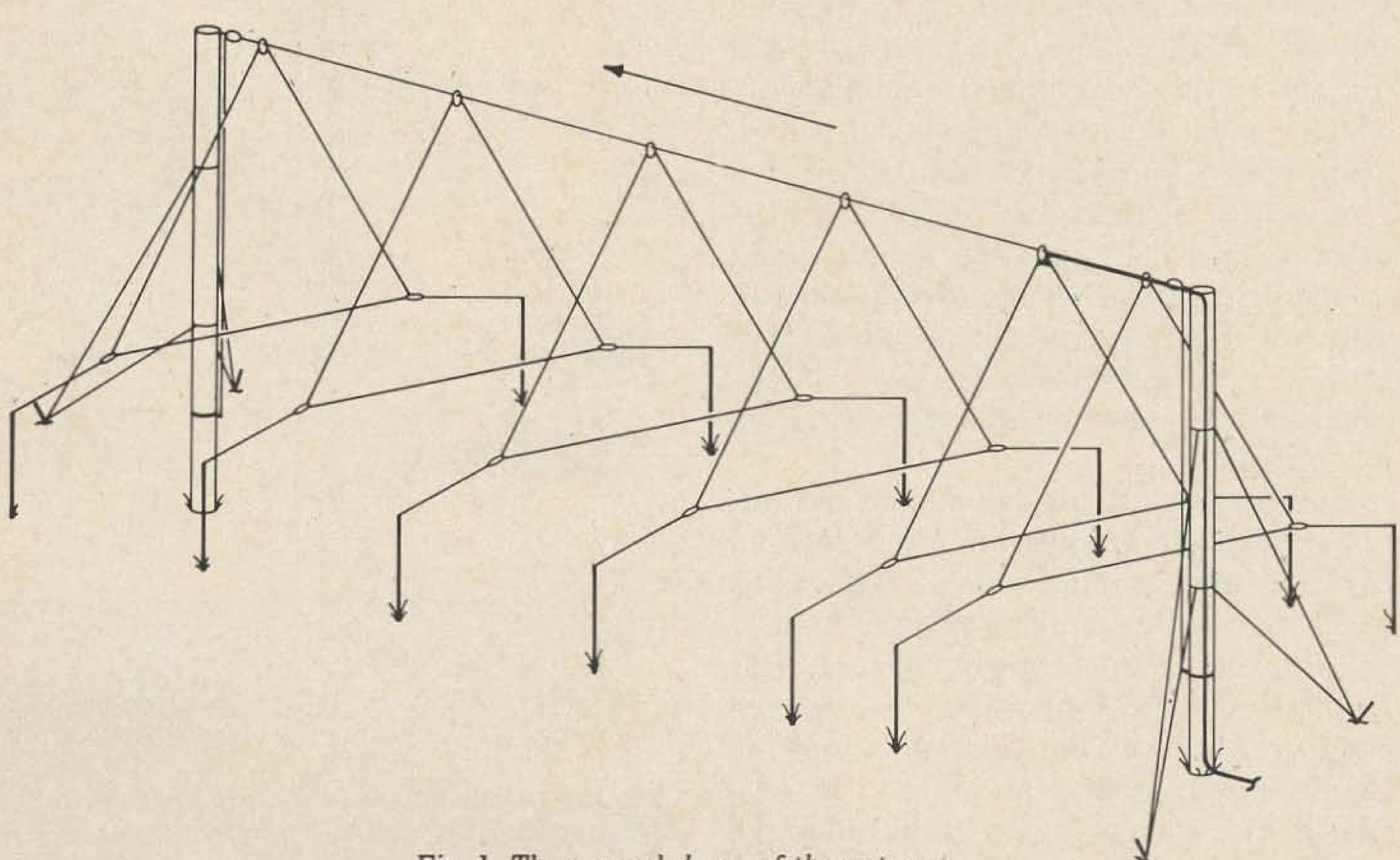


Fig. 1. The general shape of the antenna.

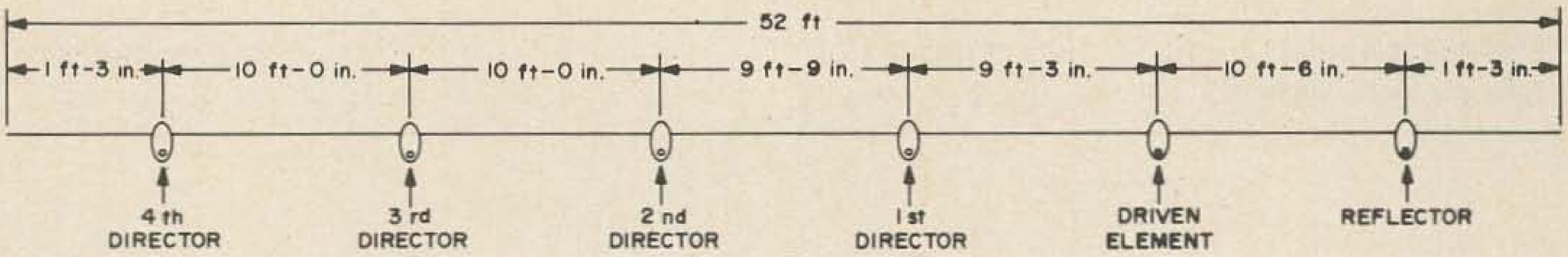


Fig. 2. Spacing of the elements on the support wire.

Checking back over the past two years of 20m operation I discovered that 62% of all contacts were with stations in Europe. The remainder were mostly contacts in Canada, South America, and a small country to the south known as the U.S. Although I was working a fair number of stations, the reports were usually, "You have a good signal here, but there is plenty of QRM on the frequency, 73 and hope to see you when the band is quieter." Of course, the band has not yet quietened down. Since I enjoy ragchewing much more than the quick "report exchange" contact, I decided to take stock of what I had in my junkbox and build the best unidirectional antenna I could devise in the space available.

My search complete, I came up with two 33 ft TV masts, a few hundred feet of guy wire, and a box of egg type strain insulators. After purchasing 450 ft of antenna wire, a roll of nylon clothesline, and two small pulleys, I had all the parts for my superbeam. Several months ago I had the idea of suspending a quad from a wire boom. Closer examination of this idea showed that if the square element configuration was to be used, two booms would be required, if the diamond configuration were to be used it would be difficult to form the square shape necessary and the elements themselves would almost touch the ground.

Suddenly while playing about with different element configurations, I realized that the most compact shape with a 1λ perimeter would be a triangle. So I came up with the antenna shown in Fig. 1. This requires only one supporting wire, and the element shape can be adjusted so that the height above ground is about 7 ft. Although this sounds low, it turns out to be just high enough to mow the lawn, yet low enough to reach easily for pruning. With the guys which hold the elements in shape attached to a fence at the edge of the yard, the forces are directed to the side instead of downwards, thus putting less stress on the supporting wire.

Although I will explain the method of construction in considerable detail here, the mechanical structure is not very critical and is only presented for the use of those who wish to duplicate my antenna exactly.

First, measure off a 52 ft length of guy wire, which will be the supporting cable. Slide six of the strain insulators onto the wire and space them according to the

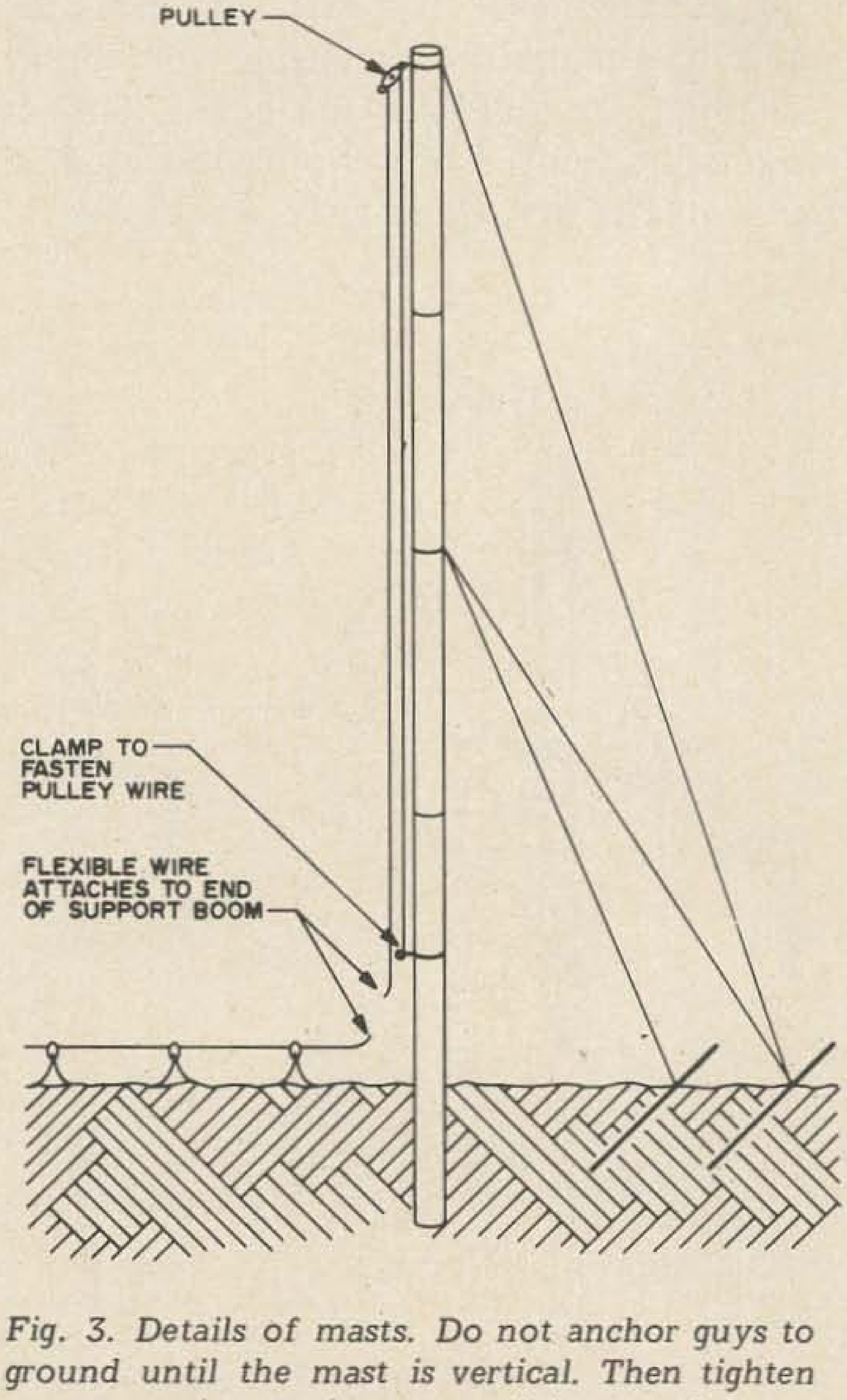


Fig. 3. Details of masts. Do not anchor guys to ground until the mast is vertical. Then tighten guys as tension on the antenna is increased.

spacing shown in Fig. 2. The insulators I used have the two holes drilled perpendicular to each other, which makes them excellent for supporting the elements of this antenna. Electrical tape was used to hold them in position.

Second, set up the masts according to the details of Fig. 3. The poles I used are TV masts made to a length of about 33 ft each by adding three 10 ft sections with swaged ends and a 4 ft scrap of tubing to be buried in the ground. A pulley is attached to the top of the mast and 50 ft of flexible guy wire is pulled through it. This will be used to lift the antenna into position after the masts have been erected and lower it for changes or servicing. Two guys attached adjacent to the pulley are used to balance the tension on the supporting wire. In addition, two more guys are attached halfway up the masts to hold them straight. The entire assembly is light enough to be walked up into the vertical position and dropped into a 3–5 ft hole. The earth can then be filled in around the mast and the guys temporarily anchored.

Next, measure the wire for the elements according to the table in Fig. 4 and insert the wire in the insulators as shown in Fig. 5. Make sure you do not mix up the elements at this point. Add two more insulators to each element and spread the wire out on each side of the boom so that it will not tangle when the antenna is being lifted into place. The feedline should be attached to the driven element and taped along the support wire to the end nearest the shack. Any 50Ω coax will work well (depending on the power you are running). Incidentally, the loss in RG-8 is 0.7 dB/100 ft. The loss in RG-58 is 1.7 dB/100 ft. In watts that means that 100W output from the transmitter at the end of 100 ft of RG-58 is only 68W at the antenna. But with RG-8, 100W at the transmitter means 83W at the antenna.

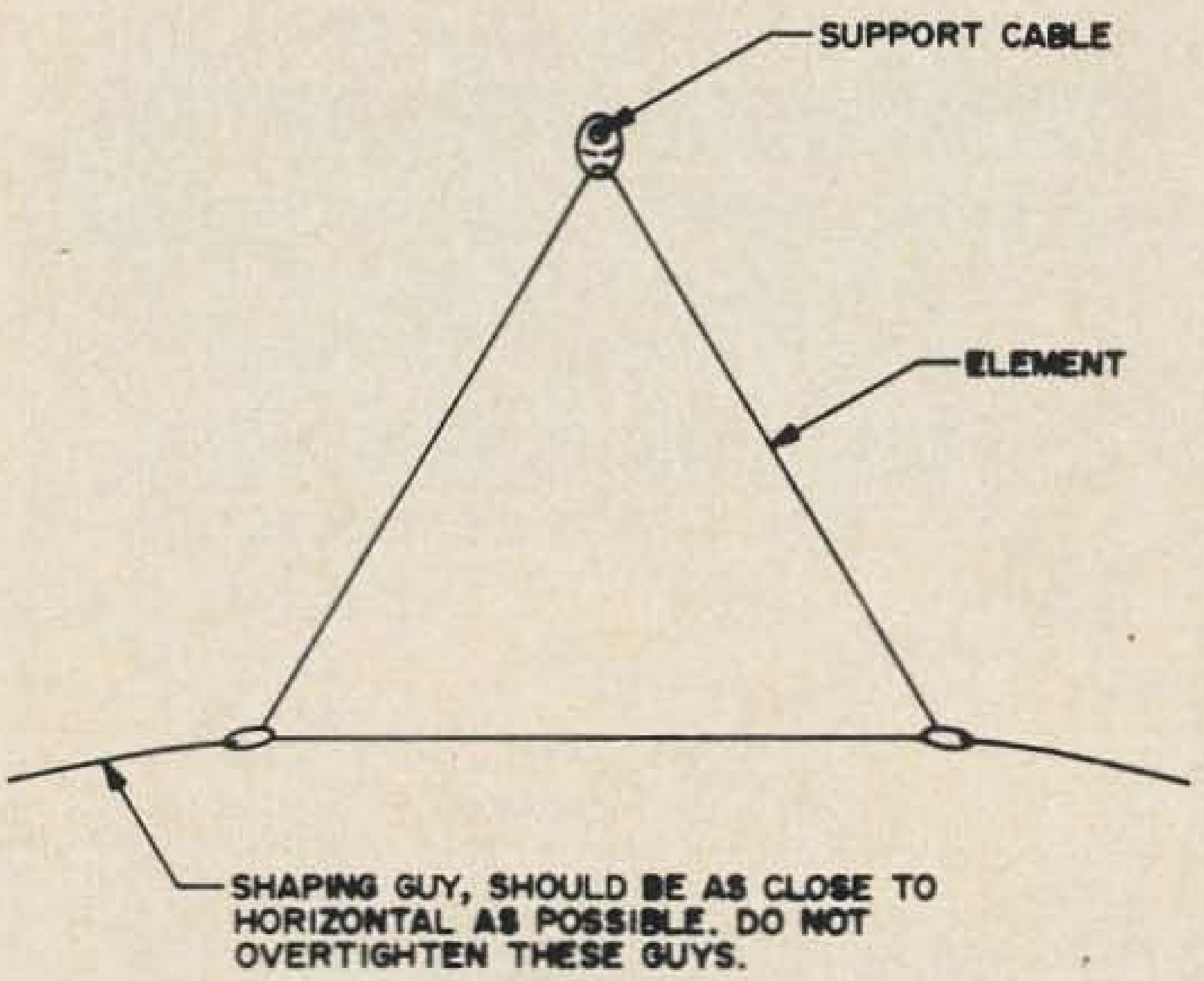


Fig. 5. Details of the element mounting.

Next, attach the support wire ends to the wire on pulleys of the masts and hoist the antenna into the air. Attach nylon clothesline or heavy string to the insulators and pull the elements into a triangular shape. These guys should be attached as far from the antenna as possible or even better as high from the ground as possible. This is to prevent the strain of the guys from pulling the support wire out of shape.

Now you are ready to prune the elements. This can be done by setting a field strength meter in front of the antenna and trimming the elements for a maximum reading. If this is not possible, a reasonably good approximation can be made by resonating the elements to the frequencies shown in Fig. 4 with a grid dip meter. To be sure that the calibration of the grid

Element	Length of Wire Needed	Resonant Frequency
Reflector	71'9"	13.8 MHz
Driven Element	70'0"	14.17 MHz
First Director	68'3"	14.60 MHz
Second Director	66'6"	14.90 MHz
Third Director	64'9"	15.40 MHz
Fourth Director	63'0"	15.90 MHz

Lengths are given for a resonant frequency of 14.170 MHz. If the frequency is higher, they should be shortened accordingly. IMPORTANT: These lengths are rough estimates and should not be used without pruning with the antenna in the air.

Fig. 4.

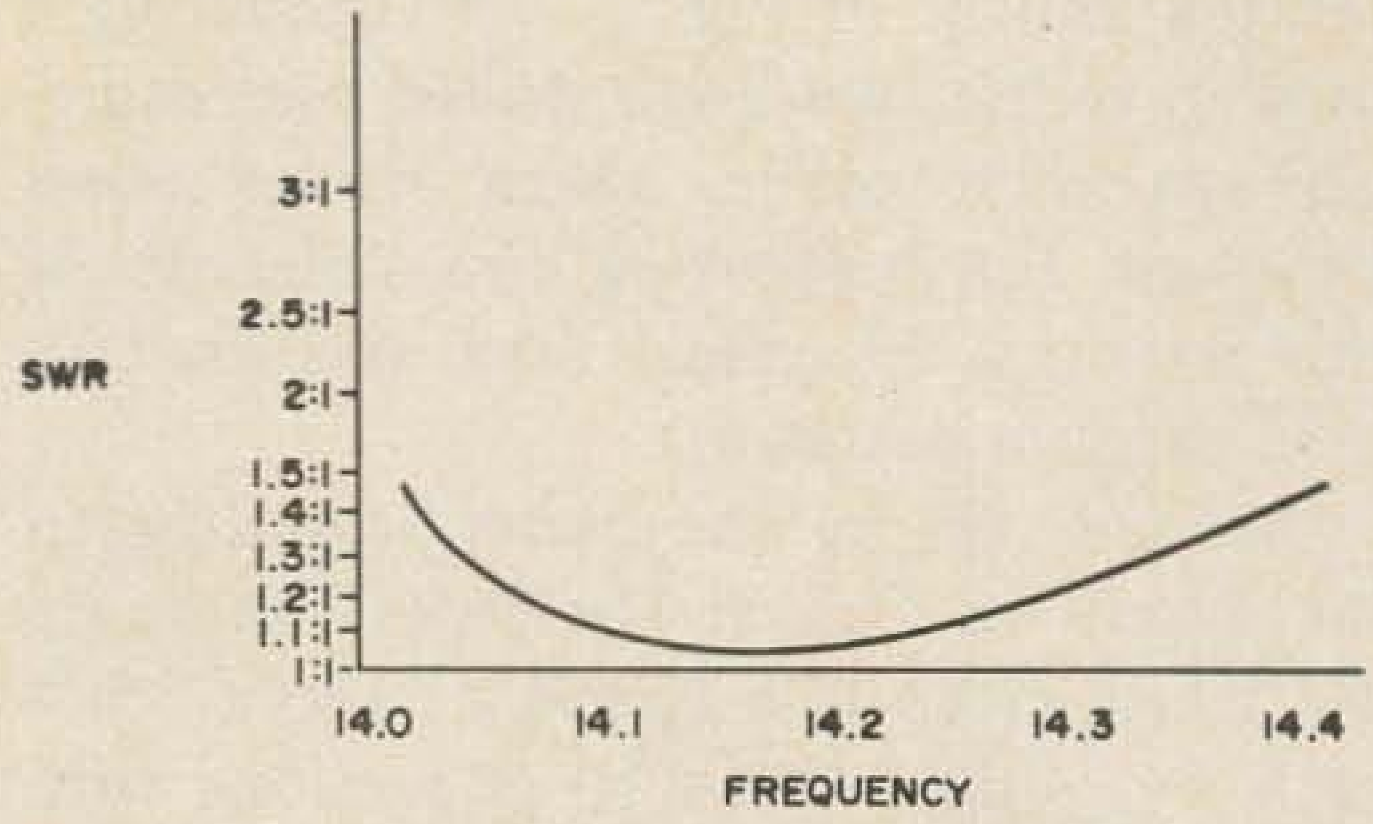


Fig. 6. A plot of swr vs frequency shows that the antenna is quite flat across the entire band. In fact the swr does not exceed 1.5:1 on any frequency.

dipper is not being pulled by the antenna element, a communications receiver can be connected to the antenna which will pick up the signal and assure accurate calibration. Last, trim the driven element for a minimum swr.

The first time I plugged the antenna into the transmitter I thought something had gone wrong with my swr meter. No matter how far I advanced the sensitivity I could not get a reading in the reflected position. The swr was a flat 1:1. The final resonance swr is shown in the graph of Fig. 6.

The first station I worked was OZ7KB, who reported my signals to be S9, and one of the few VEs coming through at that time. Receiving, his signals were also S9. A few more contacts with more S9 reports using 150W PEP confirmed that the antenna was working well.

Comparison reports with a vertical show a consistent 10 to 15 dB gain on both receive and transmit. The antenna has the added bonus of cutting out the QRM I used to get from the South American kilowatts.

Since I am no antenna engineer, I cannot give any rigid theories as to how or why this antenna works. I do not even know what the polarization is. All I can say with certainty is that it works for me and I am quite pleased with its performance. Incidentally, I do not see why the antenna can't be extended to more elements if the room is available. Like, how about a cheap 12-element 20m beam?

. . .VE3GEJ■

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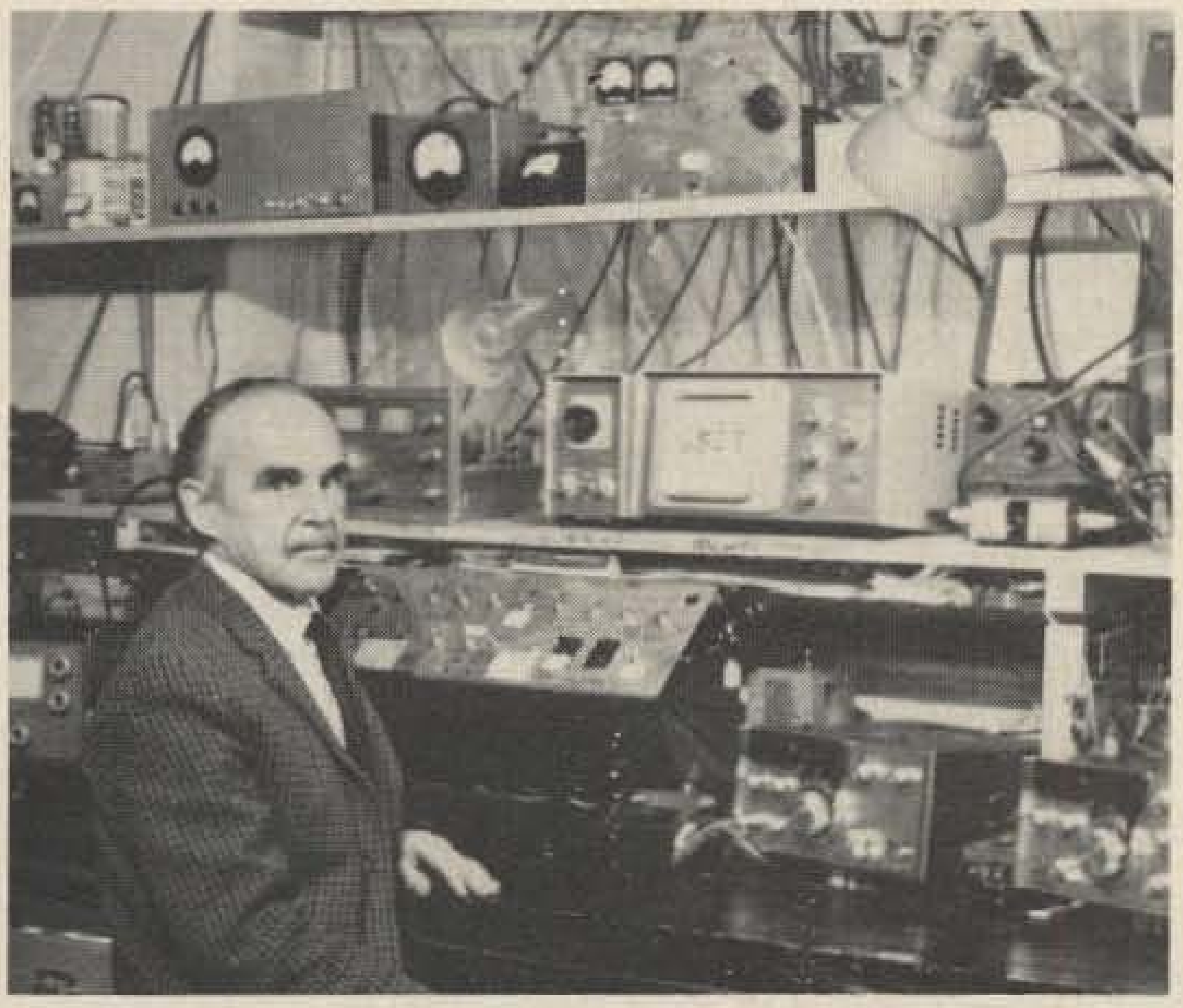
SLOW-SCAN TELEVISION

"Slow Scan? What is that, OM?"

Yes, believe it or not, that is the question I am asked time and time again when I have transmitted amateur television Slow Scan pictures on 14230 kHz and announced the fact on SSB, only to find some DL, OK, SM, and even W/K station responding as if I had only transmitted a phone CW call. When I reply that I am ready for Slow Scan transmissions and ask, "Have you that facility?", they appear puzzled: "Slow Scan? What is that, OM" When I explain that I have been sending Slow Scan amateur television pictures, they invariably say something like this: "Sorry, OM, I did not know that sound was Slow Scan. I have often heard it but thought it was some commercial RTTY or high speed Morse – I deliberately used the frequency for testing and tuning-up purposes. Television on these DX bands would be most interesting . . . please explain all about it and tell me how I can get equipment going and where I can get the equipment or circuits."



G5ZT at his station.

Hence this article to explain in simple terms what SSTV means and what equipment is required. Much has been written about this subject but it seems to me that it has been too technical for many amatuers. They have just given the article a cursory glance and then forgotten all about it.

SSTV is a means whereby amateurs can transmit and receive television pictures world-wide using the normal narrow band wavelengths in the amateur bands of 80, 40, 20, 15 and 10 meters.

All amateurs will understand the principles of commercial broadcast television.

SSTV DX! Transmitted by W4LAS, the picture is of his niece.

This must be transmitted and received on VHF or UHF because of the wide bandwith – anything from 2 MHz to 6 MHz depending on the country. To use a minimum of 2 MHz bandwidth for amateur televison means that hams have to use the 432 MHz or even higher frequency bands, which they do, but activity is comparatively low and communication is normally only a few miles, seldom out of the amateur's own country.

By using SSTV, television pictures can be transmitted using a bandwidth of no more than 2.5 kHz so that transmission is perfectly possible in the 80 to 10 meter bands where world-wide communication is quite normal. Not only is this possible, but, because of the narrow bandwidth used, it easily complies with international regulations, covering no wider a channel than SSB does and even less than that of AM or FM.

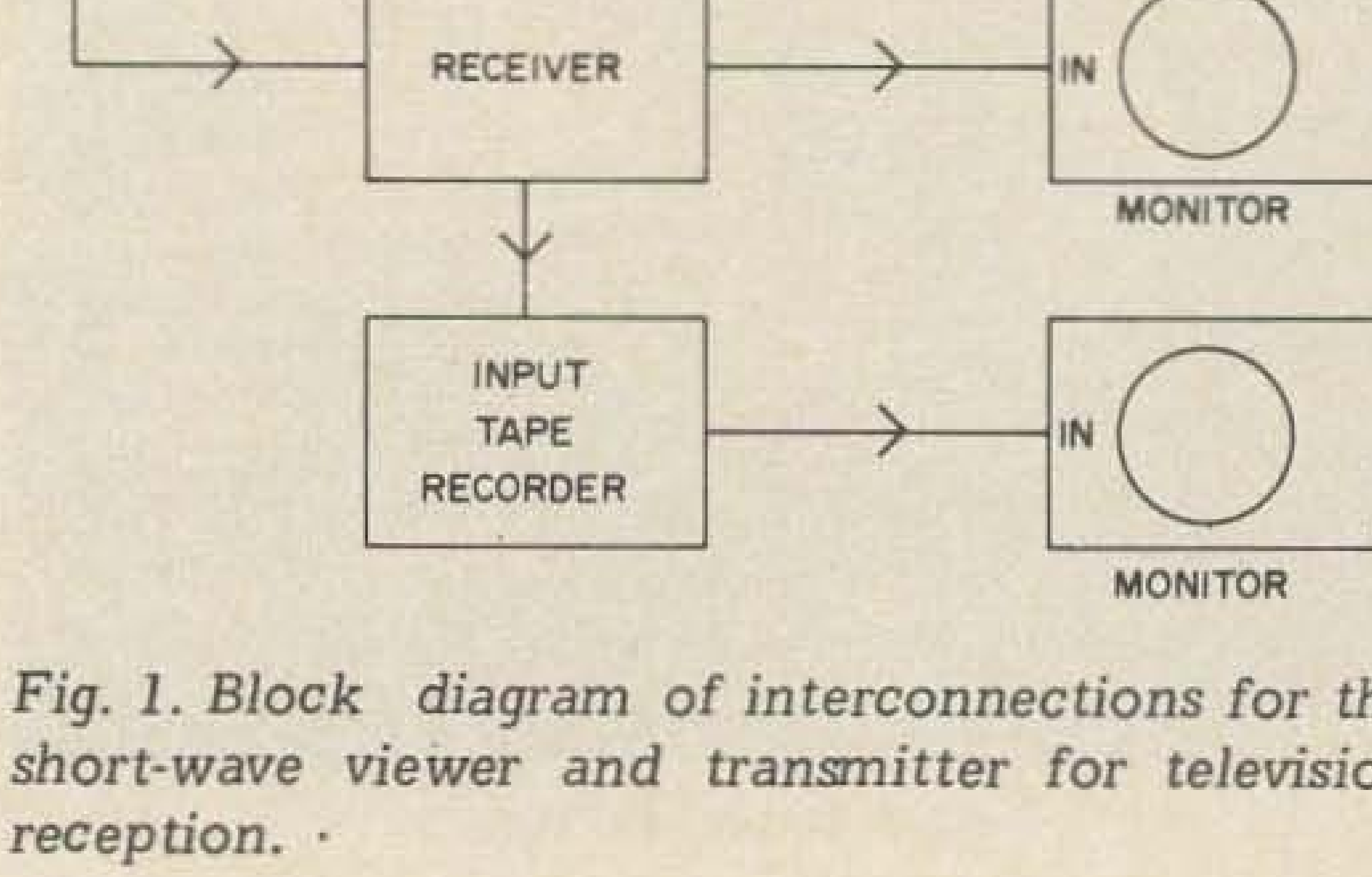


Fig. 1. Block diagram of interconnections for the short-wave viewer and transmitter for television reception.

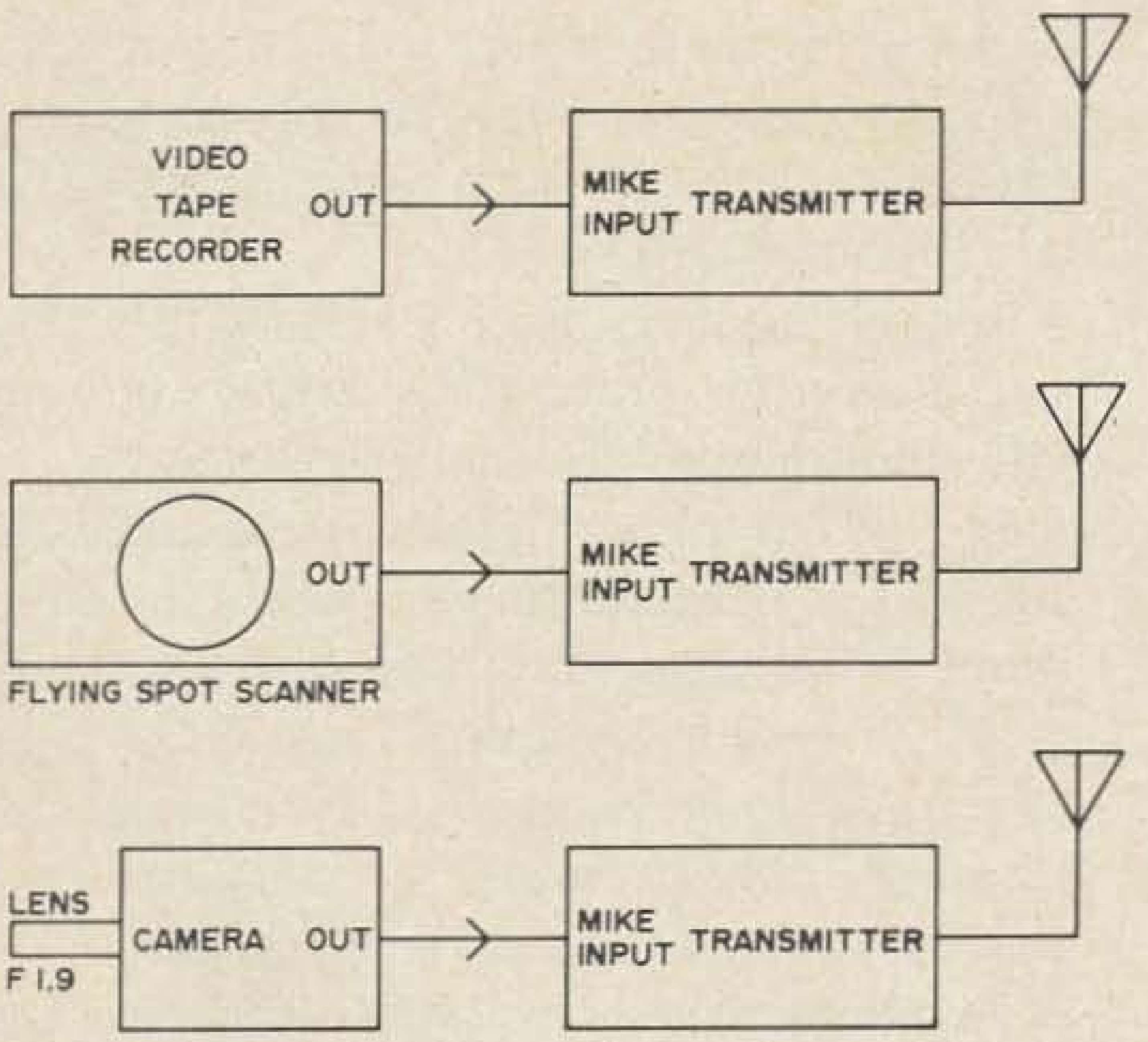


Fig. 2. Block diagram of interconnections for the transmission of pictures.

The difference between amateur television on 432 MHz, where objects can be seen moving, and SSTV, is that the picture must be static. Call signs, photographs of self, yl, xyl, family, shack, cartoons and written messages can be easily transmitted anywhere in the world with surprisingly good definition. But it is fascinating to contact a station 10,000 miles (or even 50 miles) away and exchange a series of pictures.

To make this technically feasible on a world-wide basis, a standard has been reached which all SSTV amateurs use, as follows:

Number of lines	120
Time per frame	8 seconds
Modulation (white)	2300 Hz Modulation FM
Modulation (black)	1500 Hz
Sync.	1200 Hz
Sync duration	
Horizontal	5 milliseconds
Vertical	30 milliseconds

Normally after transmitting video signals, the same frequency is used for sound to announce the fact that you are looking for slow scan contacts. Although technically it is possible to use vision and sound simultaneously on either sideband, I have not heard of this method in use yet. For reception of the pictures, all that is necessary is for the output from your communication receiver speaker terminals to be fed into a cathode ray assembly called the monitor.

The cathode ray tube is the special long-persistence type, usually P-7 phosphor. The incoming signal is truly slow scan and, unlike commercial television which appears to be instantaneous due to the high line and frame rate, appears to *paint* the picture from the top left to the bottom right of the cathode ray tube, taking a total of eight seconds to complete the picture on the tube. That is why you have to use a P-7 phosphor. When this eight second period reaches the bottom of the tube, the sync signal starts the process over again. The normal practice is to transmit each picture for three or more frames, enabling the receiving amateur to get a full picture and tape record. Intensity of the picture is frequency – modulated according to the standards already listed, i.e. for highest brightness, 2300 Hz, for black, 1500 Hz, and for line and frame synchronization by 1200 Hz blacker than black pulses at the line and frame rates. The bandwidth is thus limited to the normal voice grade communication frequencies into the transmitter microphone socket for transmitting and into the receiver circuits for reception.

Now don't think that this is too complex for you. I only commenced operating in this mode on April 22, 1971, and have already had over 80 two-way television contacts with Greece, Sweden, Italy, Alaska, U.S.A., Puerto Rico and Guadeloupe Island. I have received short-wave viewers' reports from Norway, Russia, Czechoslovakia, Singapore, Austria and Australia. This should prove to the doubters what a great deal of activity

Typical logo used by SSTV hams.

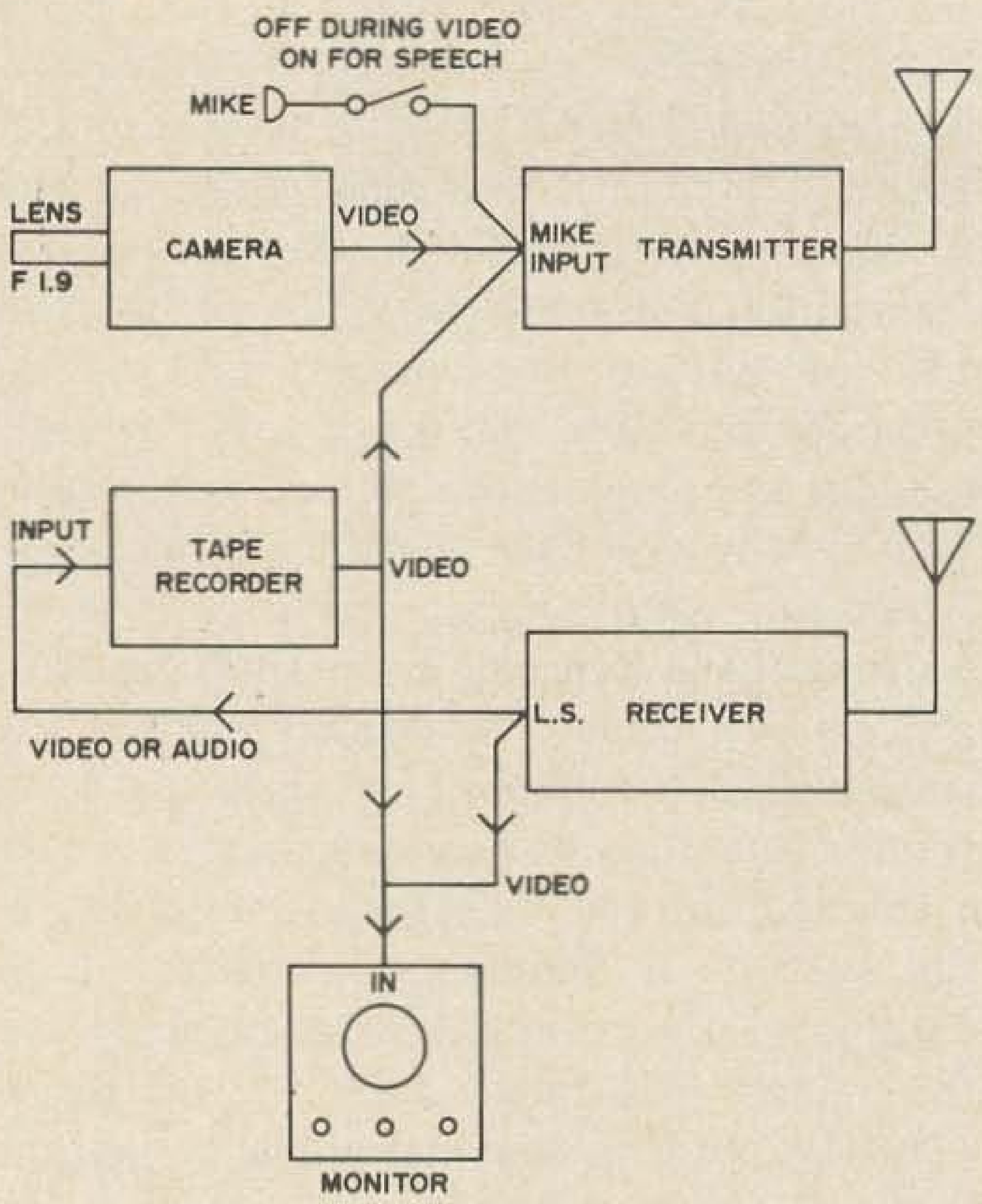


Fig. 3. SSTV interconnections at G5ZT.

there is; it is increasing daily. I understand that there are over 30 countries using SSTV and that some amateurs already have over 20 C. to their credit. I predict that by 1975 the first DX/CC/SSTV certificate will have been issued.

It is a pleasure to find the slow scan amateurs such a friendly bunch, with no rush to get rid of you for the next QSO. Contact for an hour or more is quite normal and the experts are always willing to give you every assistance and advice. The most popular frequencies in use are 3845, 3740, 7050, 14230, 21100, 21430, 28100 and 28600 kHz, the two main long distance frequencies being 14230 and 21430 kHz.

All you have to do is to tune your receiver to the signal which sounds similar to RTTY or high speed Morse with a noticeable "pip" every eight seconds. If you hear the station on sound then that is the correct tuning position to receive the picture.

A tape recorder is almost a "must," since you should tape all signals. Then you can play them back at leisure for checking purposes, proving reception to your friends or taking photographs of the pictures.

For transmitting you can use any of the following methods to feed the picture into your transmitter microphone socket:

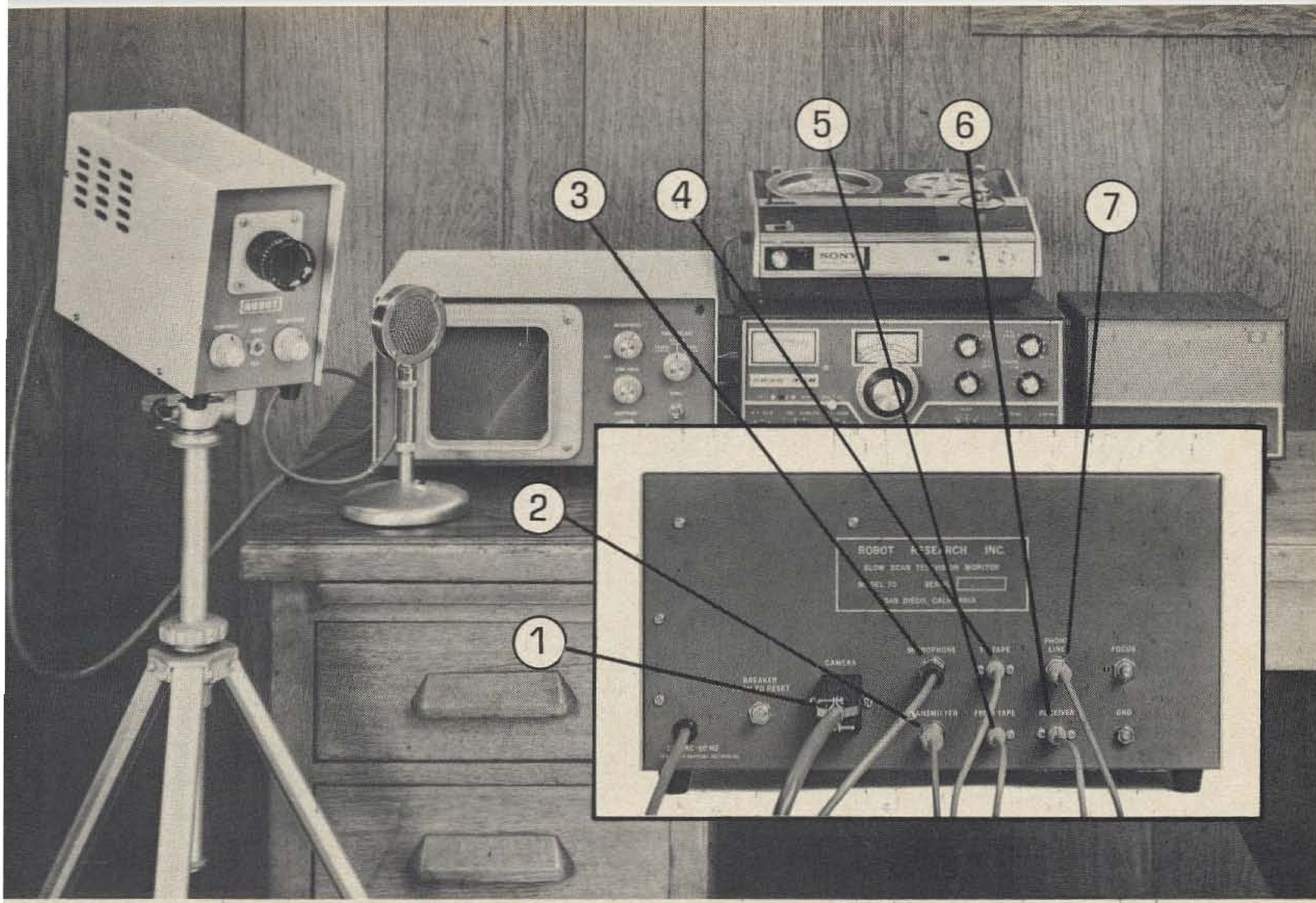
1. Use a video tape recorder. Get an SSTV amateur to make a video tape of your call sign, photographs, etc. All you do is feed recorder output into your transmitter microphone socket.
2. Use a Flying Spot Scanner. With this, you can make up your own version of your call sign to feed into the transmitter.
3. Use a video camera. This is the ultimate for SSTV. You can have a target stand in front of the camera on which to place any writing or photographs or you can turn the camera on yourself, your shack, etc. Camera output again is fed into the transmitter as in the other methods.

The video signal is adjusted to give the same transmitter rf output level as your voice peaks, or just slightly lower, being careful on SSB not to go beyond the specified carrier insertion levels or, if using an AM or FM transmitter, the same levels. If, for example, your SSB transmitter instructions say speech peaks of 150 mA, then I would adjust the video level to around 100 mA.

If you build your own equipment, see the appendix for numerous articles on equipment. If you want to get on the air quickly by purchasing commercial equipment, there are three firms that I know of producing equipment:

Robot Research Inc., 7591 Convoy Court, San Diego CA 92111. Camera and monitor.

The ID picture of FG7XT, as received in England by G5ZT.



Convert your ham station to a complete SSTV station in 7 easy steps:

Just add a Robot monitor and camera and follow these simple instructions:

All popular ham radio sets may be used with the Robot SSTV equipment and absolutely no modification is required. Pictured above is a complete SSTV station. The inset photo shows the back of the Robot monitor, with all connecting cables. To convert your existing amateur station to an SSTV station:

Connect the cable supplied with the Robot Model 80 camera to the socket ① on the back of the Model 70 monitor. Power is then supplied to the camera from the monitor and the video image from your camera is displayed on the monitor.

Next, connect the transmitter connecting cable ② to the microphone jack on your transmitter or transceiver. Your microphone cable now connects to the microphone jack provided on the back of the Robot Monitor ③.

Phono jack ④ connects the signal from your camera or radio receiver to your tape recorder so that it may be recorded for later viewing or transmitting.

Phono jack ⑤ also connects to your tape recorder so SSTV signals previously recorded on audio tape may be displayed on the Robot monitor for viewing, or transmitted, whenever you wish.

SSTV signals coming from any radio receiver or transceiver are relayed to the Robot monitor for viewing and recording by means of cable ⑥ which is connected to the receiver by means of a "Y" connector in the speaker lead.

SSTV signals are connected to the phone line ⑦ to provide two-way SSTV exchange with other Robot SSTV sets connected to the phone line.

After these connections are made, the station is operated by switches on the monitor front panel.

That's all there is to it. As you can see, absolutely no modifications of your existing equipment are required. All necessary cables are included with your Robot monitor and camera.

For a demonstration of Robot SSTV equipment, contact your Robot dealer. Write us for complete information on Robot SSTV equipment, and the name of your nearest dealer.

ROBOT

ROBOT RESEARCH, INC. 7591 CONVOY COURT, SAN DIEGO, CA 92111 (714) 279-9430

This is how SM4AMM must look after receiving TVI complaints.

L.E. Babcock & Company, Inc., P.O. Box 281, Acton MA. SSB transceiver with SSTV add-on units. See 73 magazine May 71.

E.K.Y. Video Vision Co., Box 15, Stockholm NJ. Monitors, monitor kit sets. See 73 magazine April 71.

It will take you no more than one hour after receiving the ready-made equipment to be on the air . . . as simple as that! Reception is remarkably good since even signals as low as S3 will provide a picture and S7 signals will take a lot of QRM punishment. Various simple cabling connections for the viewer and transmitting amateur are shown in Figs. 1 and 2.

The big advantage of taping all contacts is that you can edit the tape, keeping the best pictures and sound reception as a permanent record to photograph at your leisure. I used a standard Philips tape recorder which cost me $10 secondhand, and I bought an ordinary camera for $20. Having set up the camera for correct aperture and focal length, give the film an eight second time exposure when the picture on the monitor starts at the top. It will take eight seconds to reach the bottom. The photographs in this article were taken by this method. Times for long distance communication will be the same as for phone contacts mainly operating on 14230 kHz or 21430 kHz. It is just a question of being on the air at the right time to catch the DX – often 0300 GMT for me!

. . .G5ZT

Appendix.

Macdonald, C. "A New Narrow-Band Image Transmission System," *QST* August and September, 1958.

Macdonald, C. "Slow-Scan Image Transmission, A Progress Report," *QST* April, 1960.

Macdonald, C., "S.C.F.M. An improved system for Slow-Scan Image Transmission," *QST* January and February 1961.

Plowman, J.A., "Slow-Scan Picture Transmitter," *The British Amateur Television Club*, London, 1961 (out of print).

Macdonald, C., "A Compact Slow-Scan TV Monitor," *QST* March, 1964.

Macdonald, C., "A Slow-Scan Vidicon Camera," *QST* June, July and August, 1965.

Macdonald, C., "Twenty-Meter Slow-Scan Tests," *QST* September, 1966.

Simpson, R., "Narrow-Band TV Using Pseudo-Random Dot Scan," in Technical Correspondence, *QST* January, 1967.

Sulu, G.V. (Editor), Amateur Television Issue, *SIRAN* Journal of the Bangalore Amateur Radio Club (South India Radio Amateurs Newsreel), March, 1967.

Cohen, T.J., "An Economical Slow-Scan Television Monitor," 73 July, 1967.

Hutton, L.I., "A Slow-Scan Television Picture Generator," 73 October 1967.

Anon., FCC Proposal on Slow-Scan TV, *QST* November, 1967.

Anon., ARRL Comments on FCC Proposal on Slow-Scan TV, *QST* February, 1968.

Anon., F CC Approval of Slow-Scan TV Docket, *QST* September, 1968.

Taggart, R.E., "Slow-Scan with Regular Vidicons," in Technical Correspondence, *QST* December, 1968.

Hutton, L.I., "A Fast-Scan Vidicon in the Slow-Scan TV Camera," 73 February 1969.

Watson, D.J. and Horne, S.M.K., "New Solid-State Camera and Monitor for Slow-Scan Televison, *Ham Radio* April, 1969.

Popkin-Clurman, J.R., "A Simple Inexpensive FM to AM Converter for Slow-Scan TV and Facsimile,' 73 June, 1969.

Hutton, L.I., "A Slow-Scan Television Signal Generator," 73 July, 1967.

Miller, D.C., "Slow-Scan Television" *CQ* July and August, 1969.

Taggart, R.E., "A Procedure for the Reception of Slow-Scan Color Pictures Using Additive Synthesis," 73 November, 1969.

Backman, A., "SSTV" 73 December, 1969.

Taggart, R.E., "Slow-Scan Television," *Ham Radio* December, 1969.

Cohen, T.J., Harmon, D., and Veazey, D., "Sampling Techniques," in, Taggart, R.E., "Slow-Scan Television," *Ham Radio* December, 1969.

Backman, A., "Slow-Scan Television, Radio Communication" *(R.S.G.B.)* February, 1971

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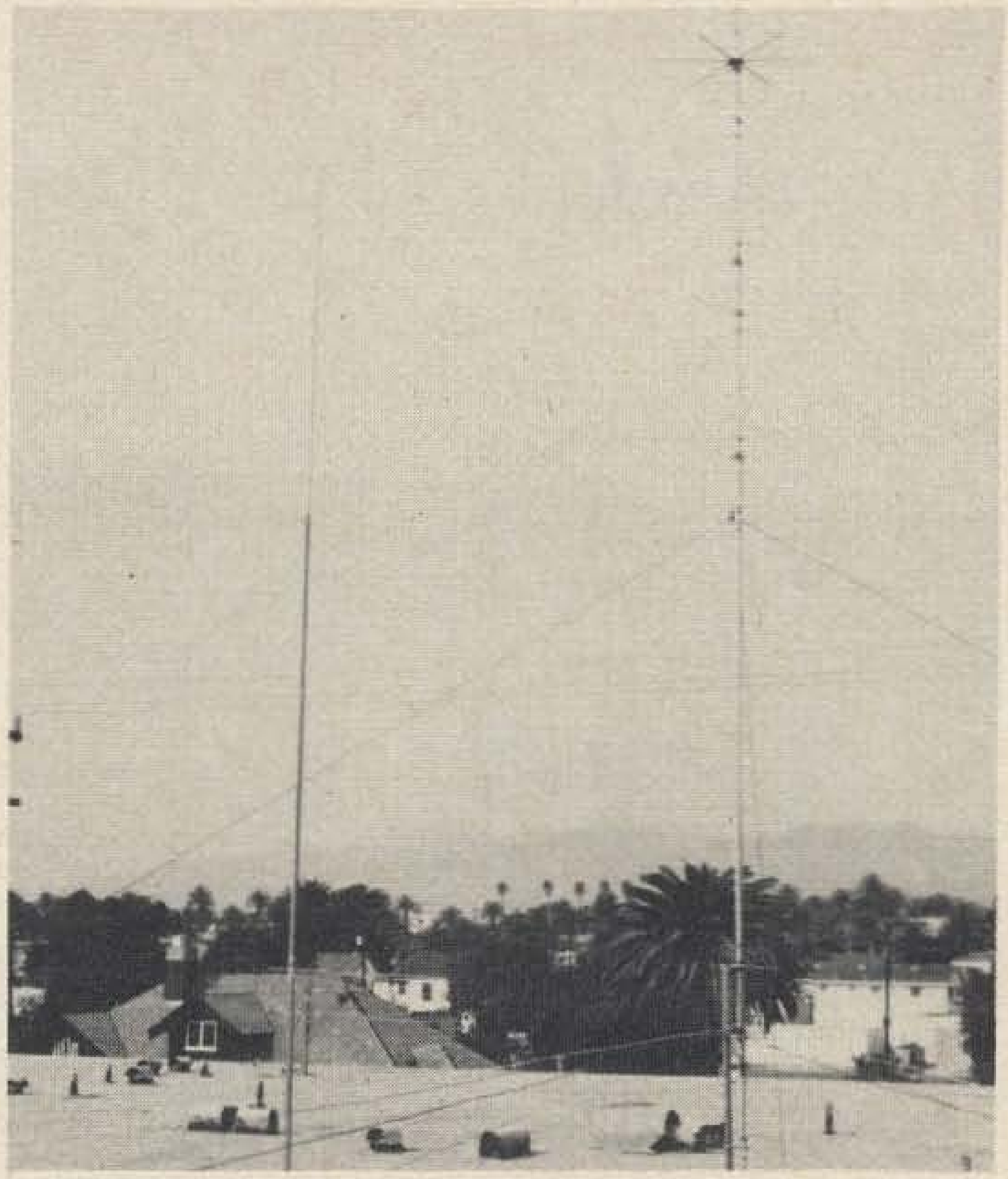
Santa Monica CA 90403

BEAMING the VERTICAL ANTENNA



The user of a groundplane or trap-vertical type antenna experiences the limitations of its omnidirectional characteristics. Heavier QRM during reception and reduced radiation in a desired direction are inherent to this type of antenna, despite the low vertical angle of propagation which is favorable for DX work.

One classic solution is to utilize two identical verticals, spaced ¼-wavelength apart, and phase driven with an appropriate length of interconnecting feedline. Such arrays will exhibit a cardioid or "figure-8" horizontal pattern, dependent upon the phasing-line length and feedpoint. This arrangement is suitable only for single band operation due to the phasing requirements, and in the case of trap verticals may involve the significant expense of the duplicate antenna. The directional pattern is broad, fixed to the plane of the twin antennas, and can only be reversed by somewhat complex coaxial switching of the phasing line.

The fact that verticals lend themselves to the application of parasitic elements in Yagi-type configurations, seems to have been somewhat neglected. The purpose here is not to give detailed construction of such an array, but rather to present some ideas which I have found to accomplish effective directional characteristics for my commercial trap vertical. These are equally applicable to any ¼-wave vertical, and may be adapted to the needs and space availability of the individual. The final section describes how such parasitic elements may be fabricated from readily available materials at very modest cost.

Vertical Reflector

The simplest application of a parasitic element is a vertical reflector spaced 0.25 wavelengths from the groundplane driven element. The photograph shows a 21 MHz reflector used in conjunction with a popular trap vertical. Figure 1 illustrates the arrangement of the reflector with a single band groundplane antenna.

0.25 wavelength spacing between elements is suggested for several reasons: (a) It affords the optimum gain for a single parasitic element. (b) The reflector length is an electrical ¼-wave at this spacing to achieve correct phase relationship. (c) The base of the reflector should be connected to the same electrical ground as the antenna. This may be achieved by

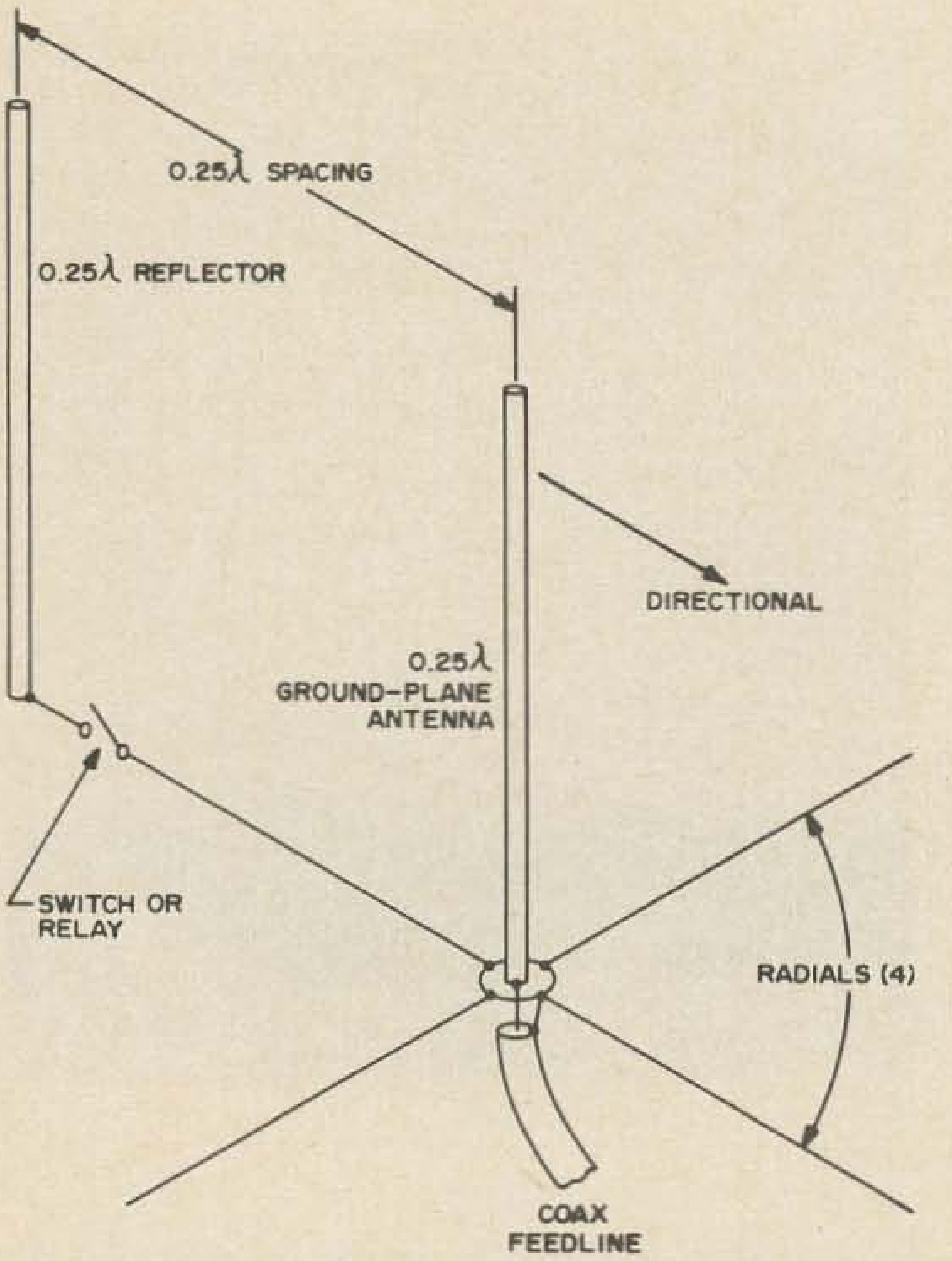


Fig. 1. Simple reflector for ground plane antenna.

connecting it directly to the end of one radial used with a groundplane. (If the vertical antenna is ground mounted without radials, a ¼-wave wire should be run from the base of the reflector to the antenna feedpoint ground.) (d) 0.25 wave spacing has the minimum effect on the antenna's radiation resistance, and thus minimum change to feedline matching and SWR.

If the base of the reflector is otherwise insulated, the element may be made non-functional by breaking the connection to the radial wire. This can be done by inserting a switch, or remote operated relay, close to the reflector base. Directional or omnidirectional operation may then be selected at will.

True, the single, fixed position vertical reflector is constrained to "beaming" in one direction. But when some added punch to a particular part of the world is desired, the 5 dB gain from this simple expedient is well worth a few dollars for the aluminum tubing used. The equivalent increase of x4 power would cost up to one hundred times as much.

Director elements may be added in-line for improved gain and front-to-back ratio. However, to achieve worthwhile results directors must be spaced 0.1 to 0.15 wavelengths from the antenna (and each other). This requires that they be adjusted to an electrical length shorter than 0.25 (dependent on actual spacing) for correct phasing. The additional elements and close spacing will significantly reduce the antenna feedpoint impedance, requiring special matching arrangements if SWR is to be kept low on the feedline. This is not conducive to switching out the parasitic elements for omnidirectional operation, unless a complex relay system is acceptable. For the 2–3 dB extra gain, the cost and effort increases out of proportion, and the single reflector offers the most for the least.

For those who desire it, formulas for deriving the proper length to spacing of directors are the same as those used for horizontal Yagi-beams, divided by 2.

Variable Directivity

While the single fixed reflector provides an easy method of fixed direction beaming, the ability to vary directivity may be ultimately desirable. Figure 2 depicts an array utilizing four fixed directors arranged around the vertical antenna at 90° intervals. The eight-position switching system shown operates relays at the base of each reflector, so that one or two reflectors are activated for a given switch position. This effectively allows 360° rotation in 45° steps. Since the beam width with a single reflector, at ½ power points, is approximately 60°, the rotational capability is pretty adequate.

A simpler version can be made using a four position switch, and accomplishing electrical "rotation" in 90° steps. However the difference in cost is just that of the switch.Another method of beam rotation, applicable to the 28 and 21 MHz bands, is shown in Fig. 3. Here the reflector (and if desired, director) are mounted on a rotatable boom. The boom is attached to a bearing and bracket assembly, clamped to the mast which supports the vertical antenna, and is at "ground" potential. The boom can be rotated by the "armstrong" method, and incorporate a means of locking in a

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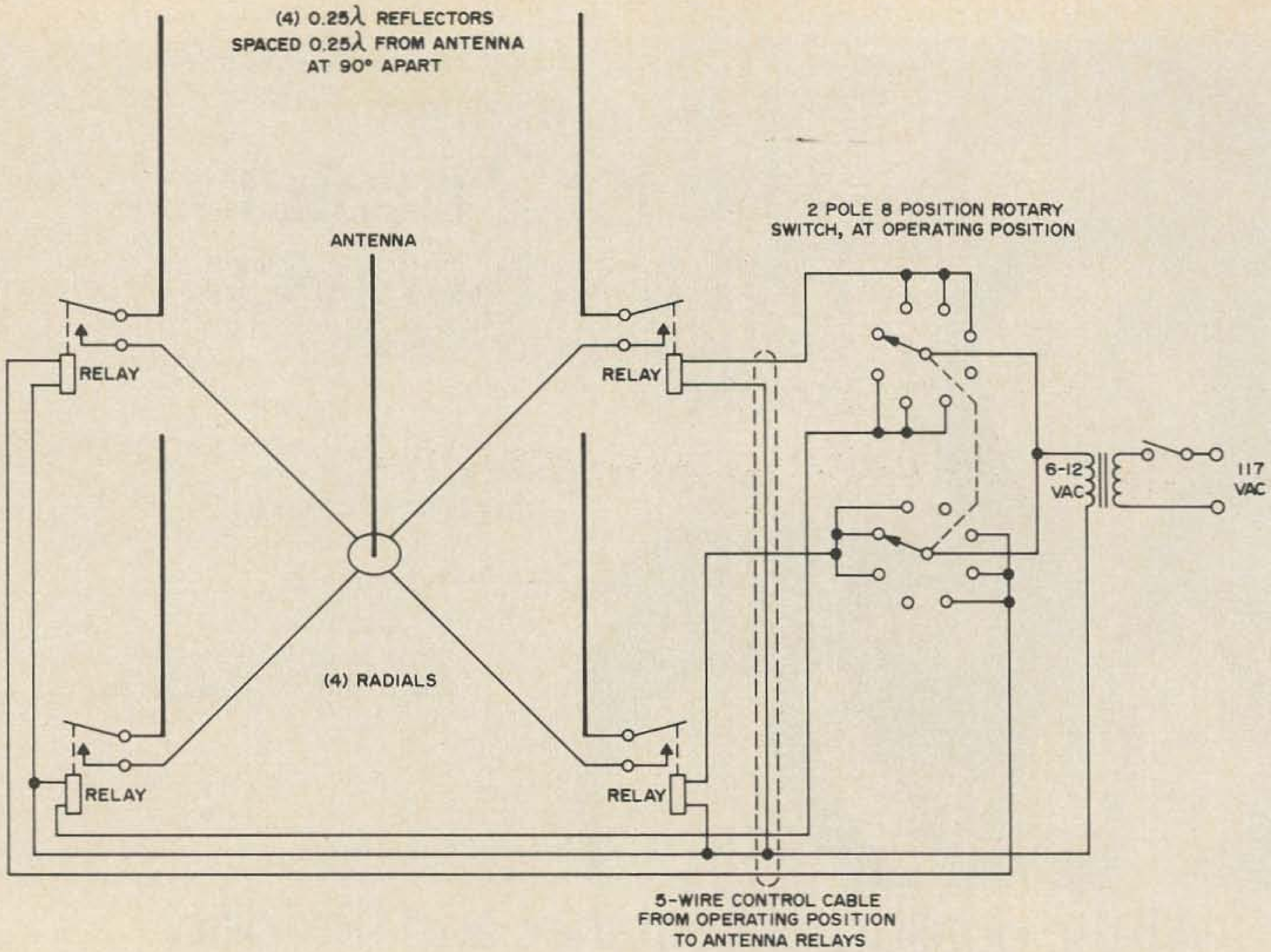


Fig. 2. Four reflector array for variable directivity.

prescribed direction. Or a suitable motor drive will permit remote operation from the shack.

The parasitic elements may be clamped directly to the boom, in which case the permanent electrical connection will not allow for omnidirectional use of the antenna. If the latter is desired, the parasitic elements must be insulated from the boom and connected by relay switching for beam application. Detailed methods appear under the constructional section below.

A single boom may incorporate parasitic elements for both 28 and 21 MHz, either by using separate elements of the right length and spacing or, alternatively by using a method described under the "Multi-Band" section that follows. In the latter case a compromise in spacing will be necessary.

Multi-Band Applications

So far we have considered using parasitic elements basically for a single band. For those who have a favorite DX band, this may prove adequate. But for the man who has a five band trap vertical, and wants to benefit from DX on more than one band, the problems multiply.

If you have a lot of real estate, or a very large flat roof and complacent neighbors, you can extend on the method of Fig. 2. All it takes is four more reflectors and relays for each band, suitably spaced from the trap vertical. This is possible for 28 through 14 MHz. For lower frequencies, full length ¼-wave reflectors get to be big and cumbersome, and a full 5-band array with 20 assorted elements is an unlikely prospect for the majority.

The situation can be compacted by using a 3/8-wave reflector on the upper of two bands; say 14 and 7 MHz. The reflector will be long on the higher frequency band and display inductive reactance. This may be adjusted by incorporating the correct value of capacitve reactance between the base of the reflector and the groundplane (radial wire). Similarly, the reflector will be short for the

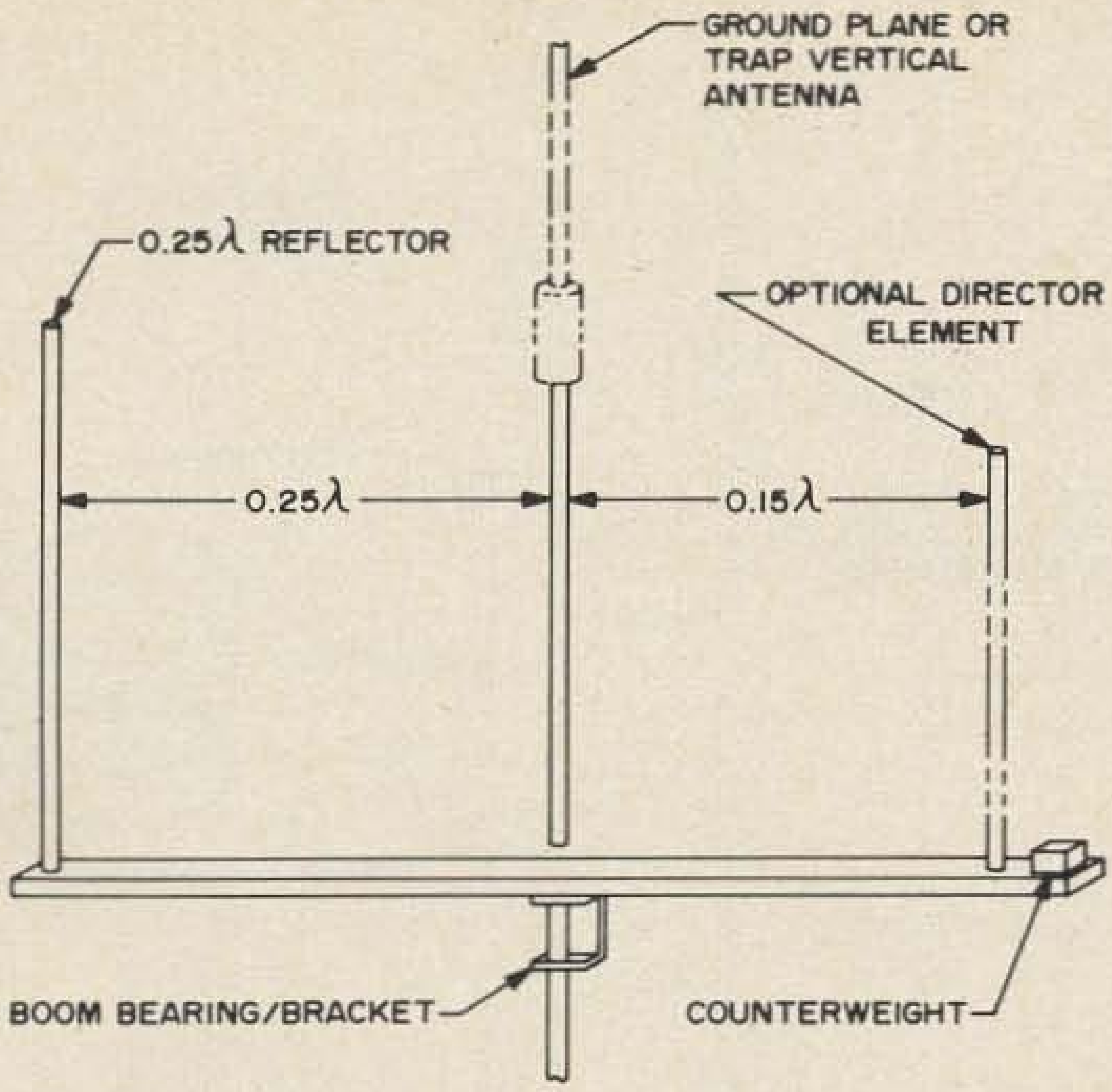


Fig. 3. Rotatable reflector for vertical antenna.

lower frequency band, with capacitive reactance which can be tuned with a series inductance.

The 3/8th wave reflector for 14/7 MHz will be approximately 24 feet high; probably the practical maximum for most installations. However the principle can be applied for 7 and 3.5 MHz where space permits, and strong enough material is used for the 50 foot height.

A 3/8th wave reflector for 28 MHz can be resonated with a series inductance on 14 MHz. Since the reflector length is about 12 ft, it can be resonated both on 21 and 28 MHz with different values of series capacitance, permitting triband operation with a single parasitic element. Figure 4 illustrates the triband reflector, using two relays to insert the appropriate values of capacitance or inductance. Omnidirection is obtained by switching to one of the bands not being used.

In all cases the 3/8th wavelength reflector will require a compromise in spacing from the antenna. 0.25 wavelength at the highest frequency is recommended. This will result in 0.125 spacing at half frequency with inductive loading, and less than optimum gain. About 3 to 4 dB gain should be attainable with careful adjustment. In the case of the triband version, spacing at 21 MHz will be about 0.18 wavelength when the reflector is spaced 8 feet from the antenna for 0.25 wave spacing at 28 MHz. A gain of 5 dB can be achieved on both 28 and 21 MHz.

It should be noted, however, that the closer spacing on the lower bands will have more effect on the antenna impedance, matching, and transmission line SWR.

For the lower frequency bands of 7 and 3.5 MHz, a more compact single reflector may be constructed utilizing the same trap principle applied to multi-band vertical antennas. The reflector is split into two sections, insulated from each other. The lower section is made a resonant length for the higher frequency band (7 MHz). A parallel tuned circuit is connected between the two sections, and resonated to the higher frequency band to function as a high impedance at this frequency. The upper section is adjusted to a length that, in conjunction with the lower section and inductance of the tuned circuit, will function as a tuned reflector at the lower frequency (3.5 MHz).

Figure 5 shows a typical trap assembly which may be made from 2½ in. diameter standard coil stock. The parallel capacitor is a mica type, rated at 2,500V. Resonance is accomplished by removing coil turns while checking with a grid-dip meter, until the tuned circuit is adjusted to the middle of the 7 MHz band.

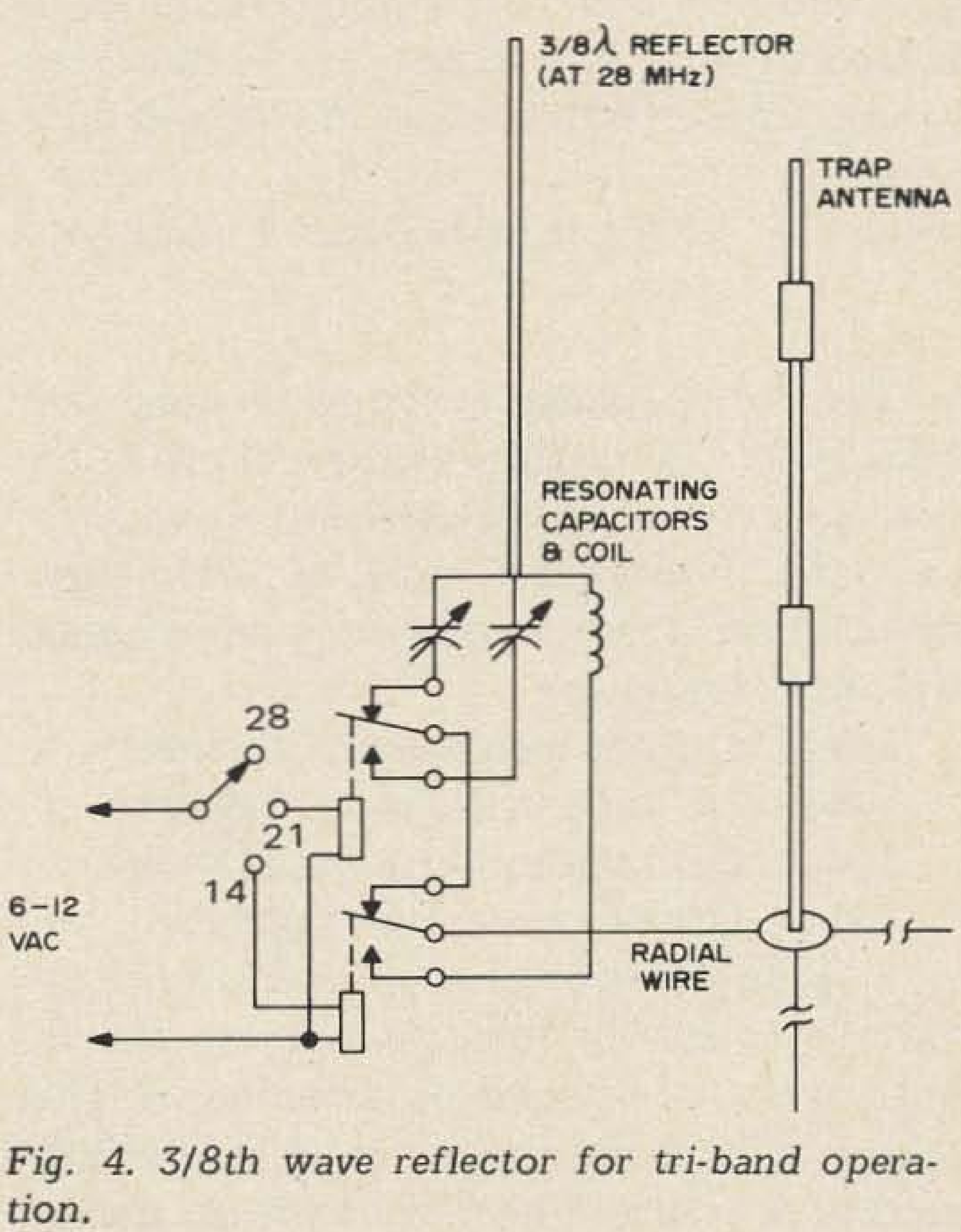


Fig. 4. 3/8th wave reflector for tri-band operation.

Appropriate values for a 7 MHz trap are: Capacitor – 50 pF. Inductance – 9 microhenrys.

Using Barker and Williamson type 3905-1 coil stock, approximately 18 turns will be required.

The trap-type reflector should also be spaced 0.25 wavelength at the higher frequency (7 MHz), from the antenna.

Construction

Previously I mentioned that parasitic elements could be inexpensively fabricated from readily available material. My source of such material is the "do-it-yourself" aluminum rack of the better hardware stores. Practically all such stores carry a supply of aluminum tubing of various diameters and lengths; the larger the store, the better the variety.

For handy reference the following table lists the standard sizes of aluminum stock which are distributed for consumer use, and are suitable for construction of parasitic elements.

Type	Outer Diameter	Wall Thickness	Length
Solid rod	3/8 in.		72 and 96 in.
Round tube	5/8 in.	0.093 in.	72 and 96 in.
Round tube	3/4 in.	0.055 in.	72 and 96 in.
Round tube	7/8 in.	0.055 in.	72 and 96 in.
Round tube	1.0 in.	0.055 in.	72 and 96 in.
Round tube	1 1/4 in.	0.055 in.	72 and 96 in.
Square stock	1 x 1 in.	0.062 in.	72 and 96 in.

The 96 in. lengths are convenient for 28 MHz use. For other bands it will be necessary to assemble elements from two or more telescoping sections. Diameters listed above that provide snug telesocping fits are as follows:

3/8 in. OD rod into 5/8 in. OD tube
5/8 in. OD tube into 3/4 in. OD tube
3/4 in. OD tube into 7/8 in. OD tube
7/8 in. OD tube into 1 in. OD tube

I assemble two telescoping sections by cutting a 1½ in. long, lengthwise slit in both walls of the larger diameter of the mating tubing. A stainless steel hose clamp around the slitted end will securely clamp the inner section after adjusting to the total required length.

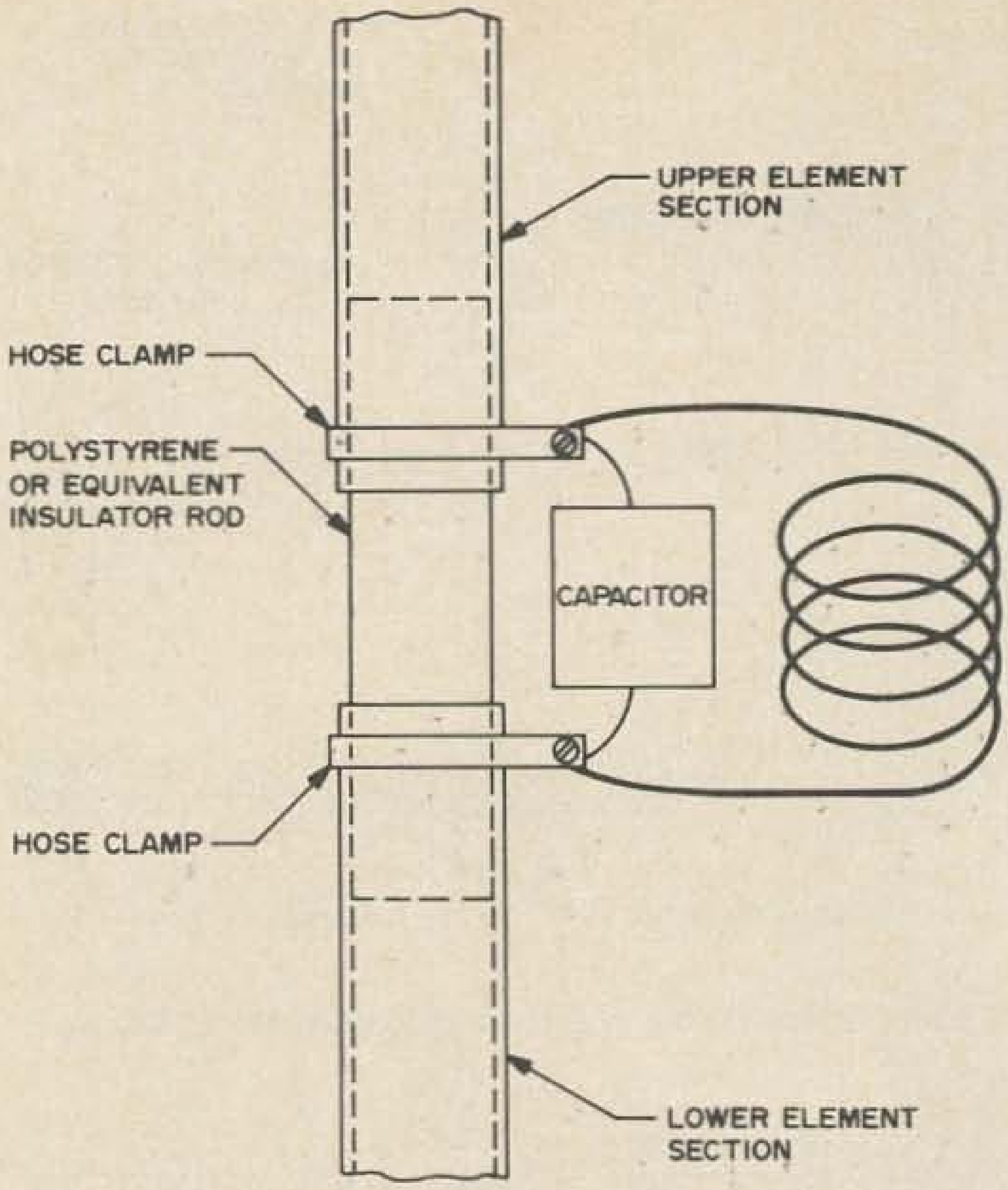


Fig. 5. Trap assembly.

Unfortunately the 1 and 1¼ in. tubing do not fit snugly. Also you may not be lucky in finding all the mating sizes at your local hardware store. In such cases undersized inner sections may be clamped to outer sections using the trick shown in Fig. 6. I cut a 1½ in. lengthwise slot in one side of the outer tubing. At the termination of the slot the tubing is cut crosswise for half of its diameter. The slot must be wide enough that the resulting two ears can be compressed with a suitable size hose clamp to securely grip the inner section. The photograph shows such an assembly for a 15m reflector, using 1 in. and ¾ in. OD tubing.

The consumer-available hardware store tubing is made of a relatively soft alloy.

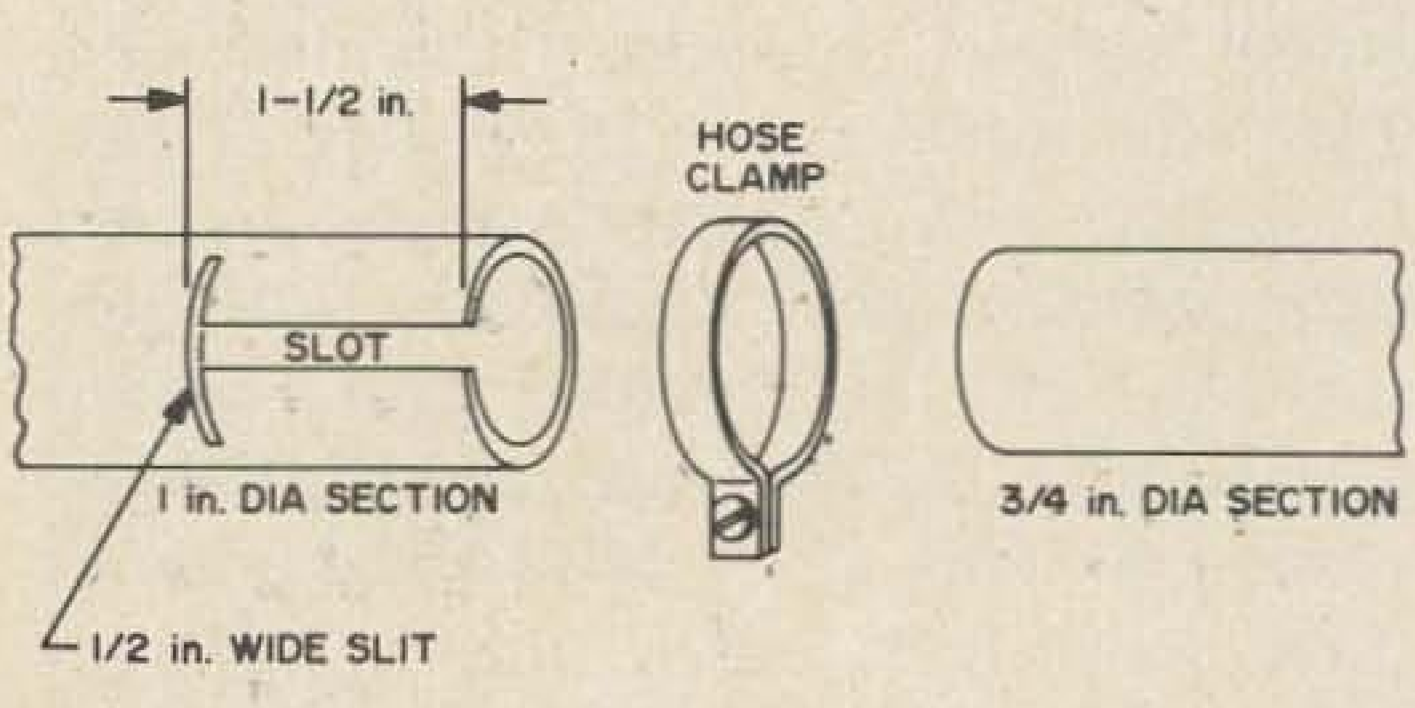
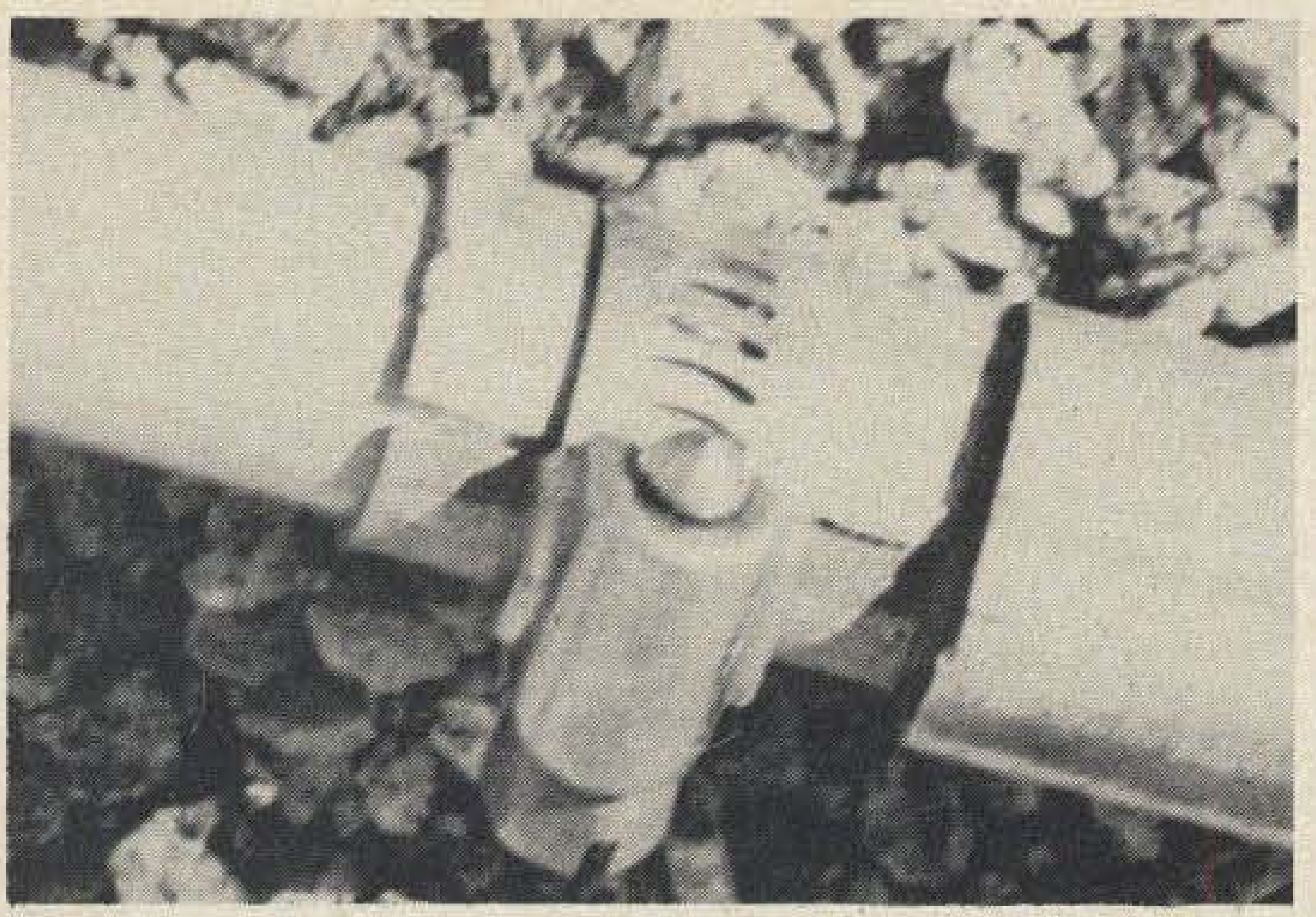
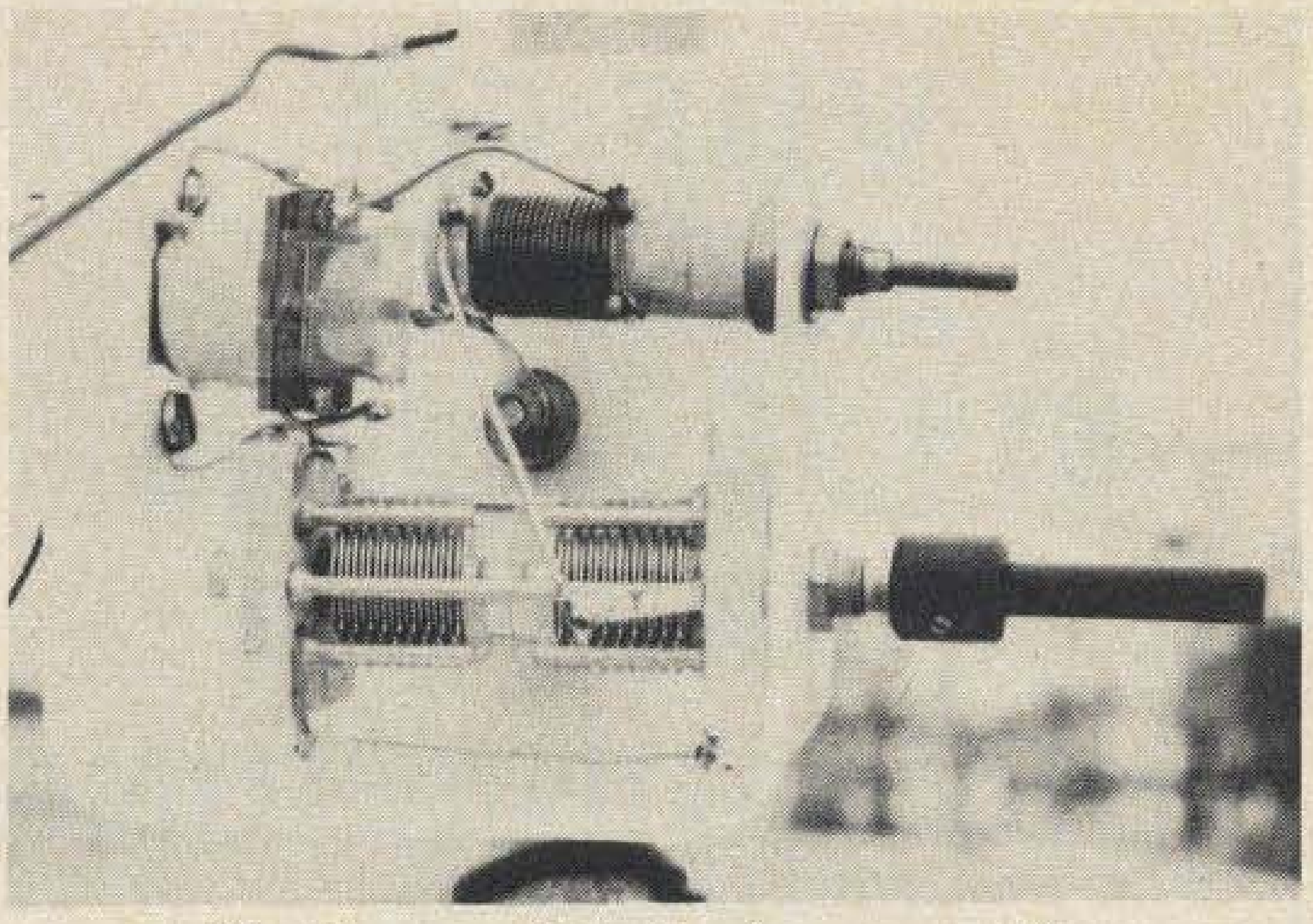


Fig. 6. Method for joining unmatched sections.



Typical joint of unmatched sections of tubing.



Weatherproof tuning box assembly.

While convenient for elements up to 20 ft in height, longer lengths are not recommended without guying. Three telescoping sections of 72 in. lengths is preferable to two of 96 in. Telescoping reinforces and reduces top weight.

Referencing Fig. 3; the rotatable boom can be constructed from a 96 in. length of 1 x 1 in. square stock, joined to a 72 in. length of the same stock with two short sections of 1 in. angle stock, bolted to the square stock to make a reinforced joint. Parasitic elements are made from 5/8 in. lower and 3/8 in. upper sections. The elements may be attached to the boom by drilling a snug fitting hole through both sides of the square stock. The element is inserted through both holes and secured on each side with a small diameter clamp. If the element is to be insulated from the boom for switching purposes, a 2 in. length of 3/8 in *ID* plastic hose or tubing should be slipped over the lower end of the element. The holes in the boom will have to be increased to accept the larger diameter of the insulating sleeve.

Weatherproof housings for accommodating relays, coils and capacitors are also available from your neighborhood hardware store. These are better known as "freezer boxes," and are made from soft polyethelyne material. The square ½ and 1 pint sizes are most suitable for protecting antenna components. The soft material compresses under hardware, forming a natural moisture-tight gasket for mounting and terminal screws.

Figure 7 illustrates a typical installation, with a DPDT relay switching a reflector tuning inductance or capacitor. The mast mounting clamp shown also serves as the electrical connection to the reflector element. The lid of the box is attached after assembly and the joint sealed with polystyrene cement. Alternatively the joint may be covered with a couple of layers of plastic insulating tape.

Conclusions

I said at the beginning that this was an idea-provoking article. Obviously it requires complementary imagination for the individual to suit his own requirements. The fellow with a vertical mounted on a roof peak will be hard put to install multiple reflectors. But a short boom (even of wood) will enable him to install a 28 or 21 MHz reflector.

Some of the techniques suggested may be combined. For example, the 3/8th wave

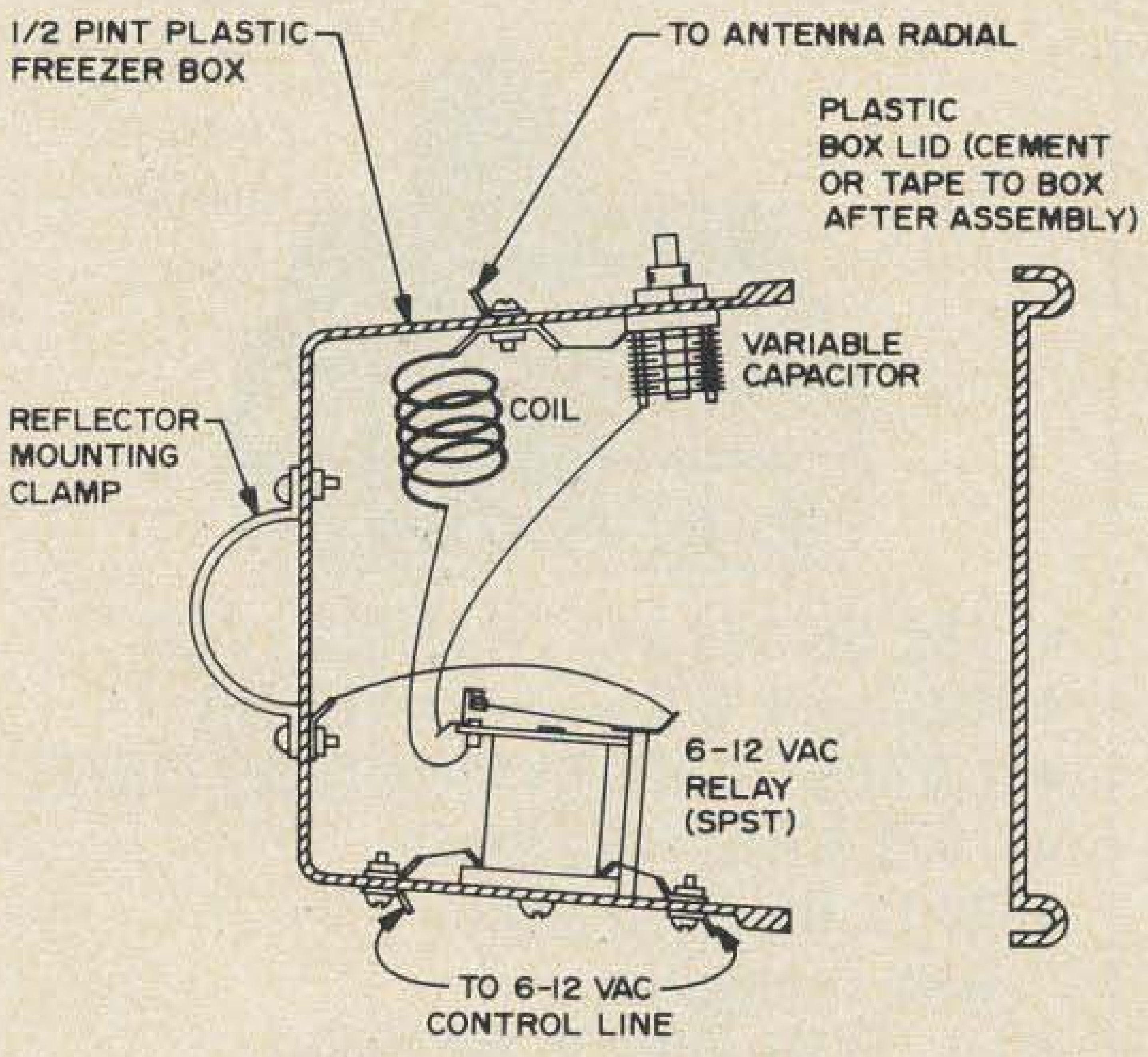


Fig. 7. Typical weatherproof box assembly for reflector tuning components.

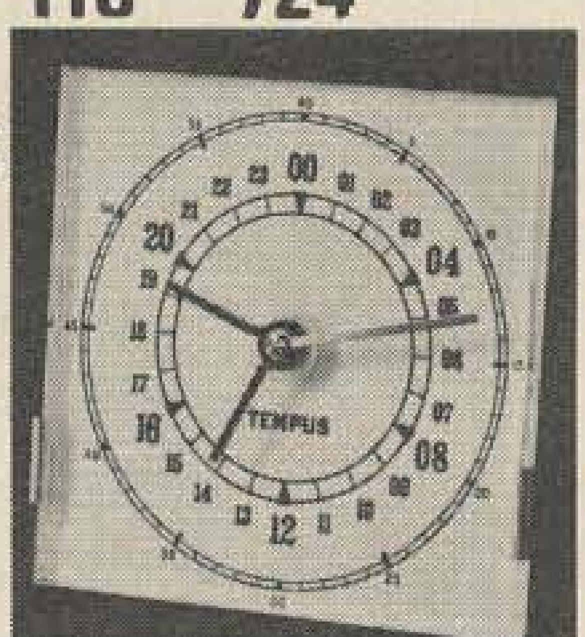
reflector shown in Fig. 4 can be used with the rotatable boom in Fig. 3.

No formulas for element lengths on various bands have been included, as these are well covered in the regular amateur radio handbooks which should be in every shack . . . for convenience a reference guide is included.

While the hardware store aluminum stock is suggested for most applications, it must be emphasized that for heights exceeding 20 ft, or where severe wind or icing conditions prevail, precautionary measures must be taken to avoid collapse of the rather soft alloy. If in doubt, structural tubing of the 61ST variety, available from large metal supply houses, is the best bet.

W6AJZ■

References:
1. "The Radio Amateur's Handbook" chapter 14, Antennas.
2. "The ARRL Antenna Book" chapter Multi-Element Directive Arrays.
3. "Radio Handbook" Editors and Engineers Ltd., chapter High Frequency Antenna Arrays.
4. "Beam Antenna Handbook" by William I. Orr, W6SAI; Radio Publications, Inc.



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ACTIVE FILTER DESIGN AND USE PART 1

If you have ever tried to "homebrew" an i-f bandpass filter, or incorporate a variable notch filter or Q-multiplier in your receiver's existing circuitry, you have an idea of many of the problems associated with passive RLC filters. Imagine being able to build a filter not only lossless, but with gain; one capable of matching different input/output impedances, without bulky and inaccurate coils, and all in less space and with better performance than the old iron core, resistance-coupled black box. Active filters, constructed both from transistors and integrated circuits, offer all of the above advantages in addition to ease of altering performance without rewinding coils or utilizing taps.

Figures 1 through 4 show simple filters with specific functions. Digging back into filter design theory for a short while will help us to see how the component values and their placement in the filter is determined. Every filter may be primarily identified by the number of branches containing L or C components. Thus, Figs. 1 through 3 all show two-pole filters of the second order; Fig. 4 a six-pole design. Resistance normally shown in RLC filters as input/output impedance is not considered part of the passive network, although other values of resistance such as that found in the coils and the value of conductance in capacitors, together known as dissipation, cause insertion loss and a degraded response shape at the band edges. Naturally, the tighter the specifications for a filter, the more complex the design must be, five- and six-pole types being common.

The design of passive filters is mostly accomplished with the help of tables containing constant values for the desired components necessary for a particular shape factor. These constant figures are then scaled to real component values. Designing RLC filters "from scratch" is a

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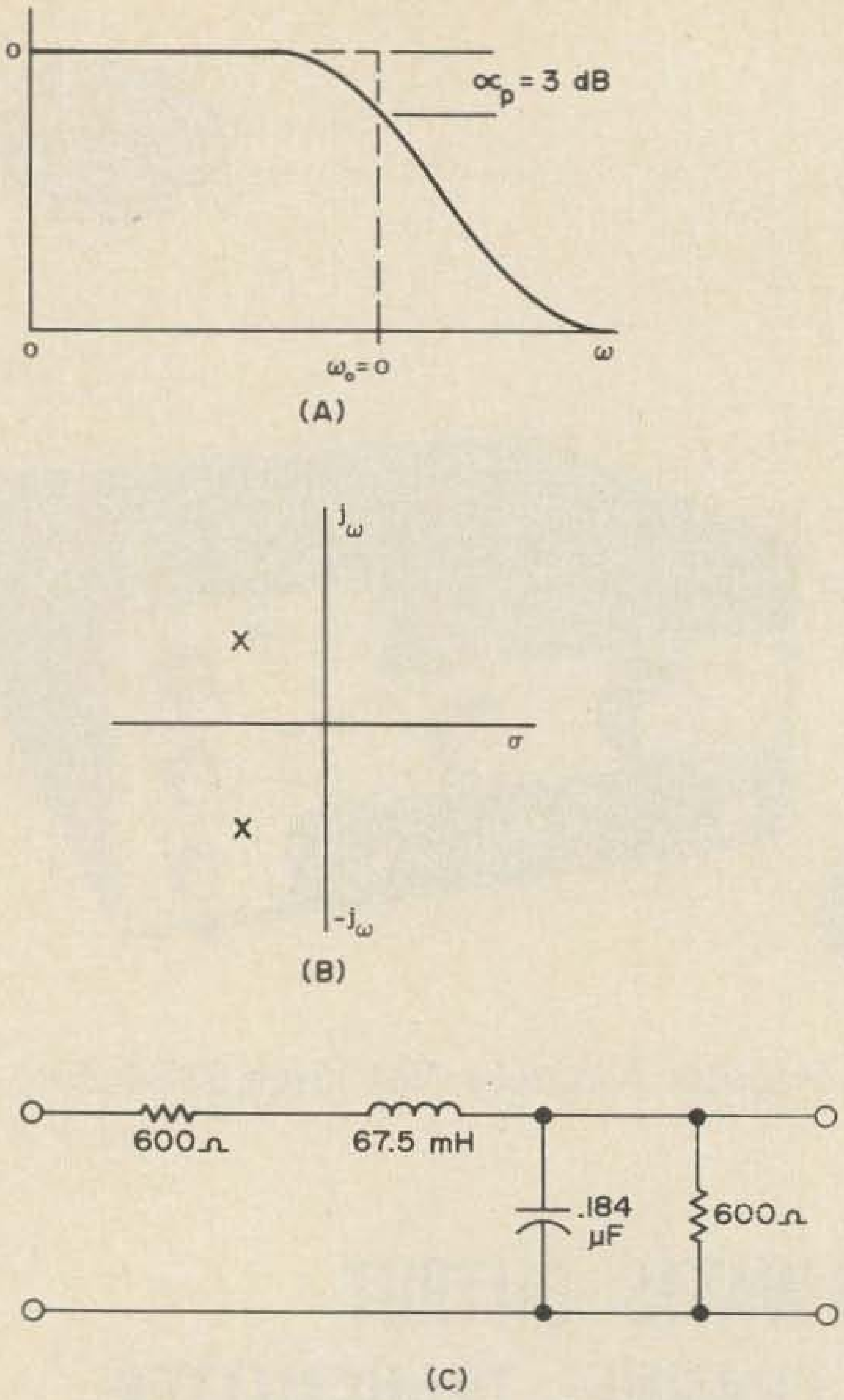

Fig. 1. Low-pass Butterworth (ideal response).

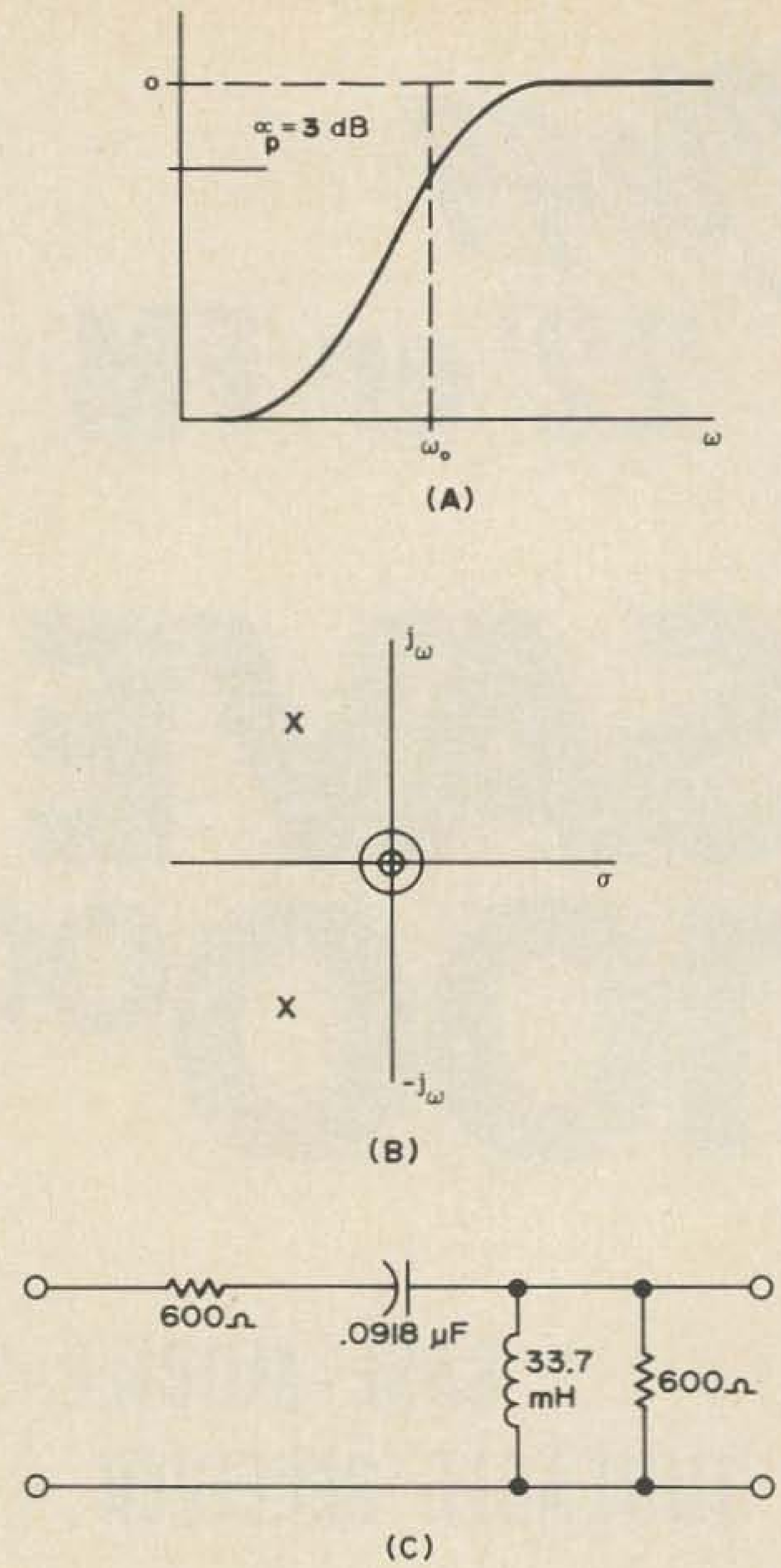

Fig. 2. High-pass filter.

task of great complexity and more suited to computer analysis. By utilizing a complex plane with theoretical component values plotted in complex impedance form, a pole-zero plot of the filter is made. Figures 1A through 4A show the pole-zero plots for four simple filters of different types. Since current/voltage node values are necessary to determine the resulting waveform, this design procedure does not lend itself to amateur filter construction.

Although active filters do away with inductances, in order to simulate the desired response, they must provide the same basic parameters as the coils in the passive filters. The main difference in operation is the ability to increase the Q, or gain of the active filter. In addition, the active filter can be designed so that changing input/output impedances, as a result of tuning internal or external circuits, has little or no effect on filter response. To better understand how filter design is fitted to the desired frequency response, we should begin with basic passive filter types.

In the design of the low-pass filter shown in Fig. 1, we begin by specifying the desired parameters. If we desire a filter with less than 1 dB attenuation from 0 to 2 kHz, and more than 20 dB attenuation above 7 kHz, with 600Ω input/output impedances, we must first determine the bandwidth ratio:

$$y = \frac{7\ \text{kHz}}{2\ \text{kHz}} = 3.5$$

The attenuation ratio of Butterworth response filters is given as:

$$A = \sqrt{1 + \omega^{2n}}$$

Where $\omega = 1$ radian per second, any value of n, or number of poles, will give an attenuation ratio equal to $\sqrt{2}$. Naturally, substituting other values of frequency for ω will provide a passband attenuation for Butterworth filters. By computing these various frequencies with different values of n, we can obtain a simulated response shape for filters with various numbers of poles. A two-pole Butterworth filter provides 0.93 dB attenuation at 0.7 of the cutoff frequency of 2 kHz.

As the frequency component of ω becomes higher, the attenuation increases. Similarly, as the number of poles increases, so does the filter attenuation, thus creating a sharper stop-band cutoff. At 3.15 of the cutoff frequency, the stop-band attenuation of a two-pole Butterworth filter approaches 20 dB. A reevaluation of the bandwidth ratios gives:

$$y = \frac{3.15}{0.93} = 3.39$$

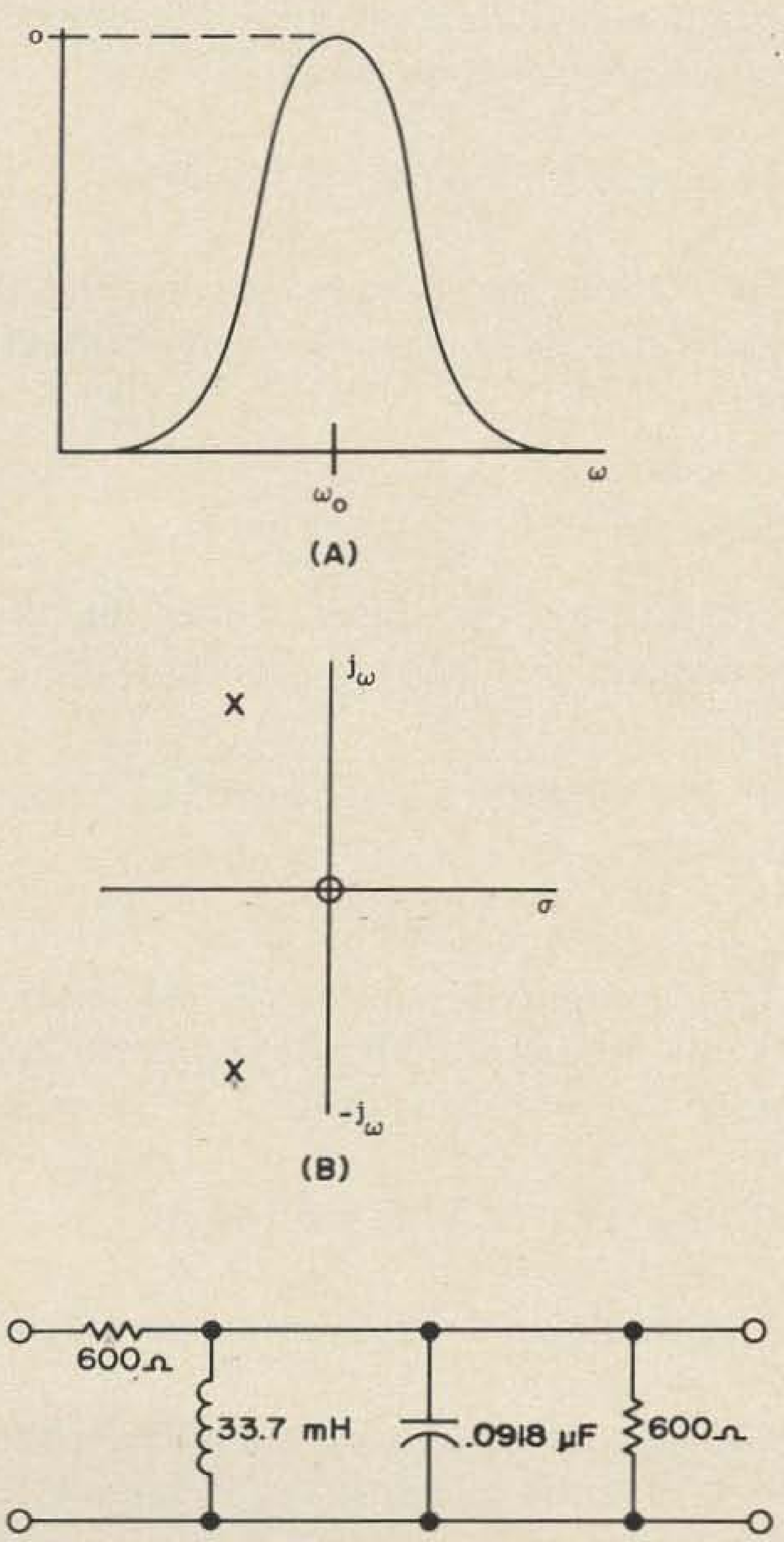

Fig. 3. Bandpass filter.

Since this performance is better than our specified ratio, all requirements can be met with a two-pole Butterworth design. To preclude otherwise necessary computations involving resonant frequencies and cutoff formulas, we can design by means of a normalized prototype. A low-pass prototype is normalized for 1Ω terminations and a cutoff of 1 radian per second. From these values, as shown in Fig. 5, the resistances/impedances and cutoff frequency must be altered to fit our specifications. By means of impedance scaling, we can alter the resistances to allow the filter to operate between terminations of any value. Impedance scaling does not affect filter response, and is accomplished by simply multiplying

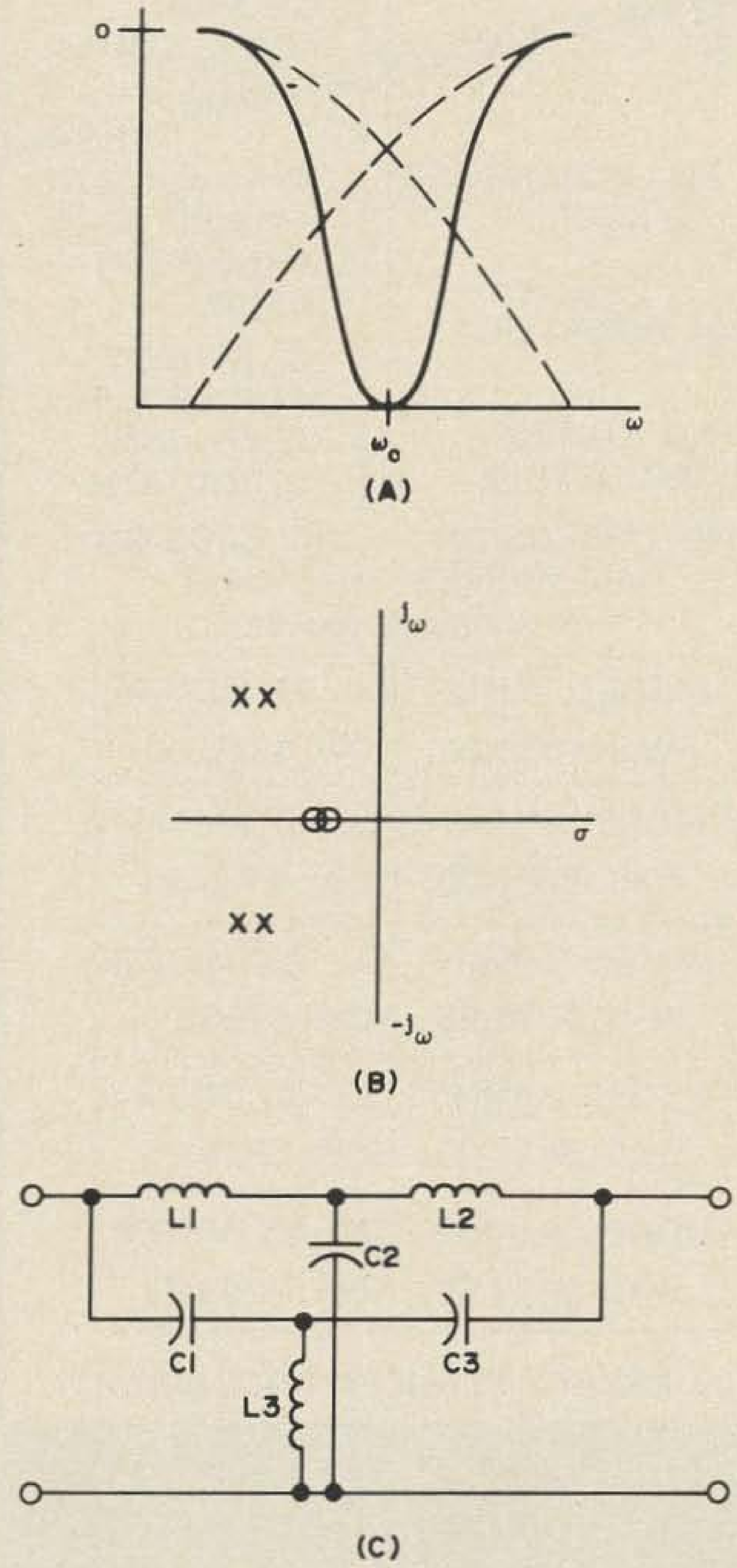

Fig. 4. Bandstop filter.

all resistances by the desired impedance value, 600Ω in this case. In order to adapt the normalized cutoff frequency to 2 kHz, we employ frequency scaling. Frequency scaling leaves all impedances unchanged but applies a constant to the reactive elements. In scaling the inductance to the required filter value, the following formula is used:

$$L' = \left(\frac{R'}{R}\right)\left(\frac{\omega}{\omega'}\right) L$$

Where the primes denote values after impedance scaling.

Substituting the filter values in this formula gives an inductance constant of:

$$= \frac{(600) \quad (1)}{(1) \ (2\pi \times 2\text{x}10^3)} L$$

$$= 47.71\text{Lx}10^{-3}$$

This computed value is the inductance constant in millihenrys. Applying this constant to the prototype gives:

$$(47.7\text{x}10^{-3})\,(1.414) = 67.5 \text{ mH}$$

In scaling the capacitance to the required filter value, the following formula is used:

$$C' = \left(\frac{R}{R'}\right)\left(\frac{\omega'}{\omega}\right) C$$

Substituting the filter values in this formula gives a capacitance constant of:

$$= \frac{(1) \quad (1)}{(600) \ (2\pi \times 2\text{x}10^3)} C$$

$$= 0.13\text{Cx}10^{-6}$$

This computed value is the capacitance constant in microfarads. Applying the constant to the prototype gives:

$$(0.13\text{x}10^{-6})\,(1.414) = 0.184 \ \mu\text{F}$$

The completed filter is shown in Fig. 1C.

Highpass filter design is simplified to the extent that the response requirements can be applied to low-pass filters by inversion of the high-pass requirements. Thus, if we change the positions of the inductor and capacitor in the low-pass filter just completed, and replace the element values by their reciprocals, we have a prototype for the high-pass filter. By utilizing the same specifications, the low-pass response can be used as high-pass response by allowing the attenuation to remain as is and treating the frequencies as reciprocals. Figure 6 shows the resulting prototype for specifications similar to the low-pass filter, and Fig. 2C gives the end values.

Normal bandpass filters are symmetrical about a center frequency. Figure 7 shows the bandpass response with shape parameters. Once again the design process is simplified by utilizing a suitable low-pass design. If the value of Q is correct, the bandwidth will be the same for the low-pass and bandpass filter. The required value of Q is given as

$$Q_c = \frac{f_o}{B_3}$$

If, for simplicity, we use the original low-pass requirements, we obtain a value of Q_c:

$$Q_c = \frac{1\text{x}10^3}{2\text{x}10^3} = 0.5$$

This low value of Q is not typical for a bandpass filter, but is due to the simple requirements on the original low-pass filter and serves to show the necessary calculations.

Having chosen a suitable low-pass prototype, it must be frequency scaled to the cutoff frequency ω_c:

$$\omega_c = \frac{1}{Q_c} = \frac{1}{0.5} = 2$$

Due to the fact that the bandpass filter will be resonated at $\omega_o = 1$, the LC components must have reciprocal numbers. Referring to the calculations for the high-pass filter, it will be noted that the prototype element values for this filter were also reciprocals of the low-pass elements. In designing the high-pass filter, we need only transform the values of the low and high-pass filters. The cutoff frequency (the highest frequency at which maximum attenuation occurs in the passband) of ω_c in the low-pass filter becomes f_2 (Fig. 7) of

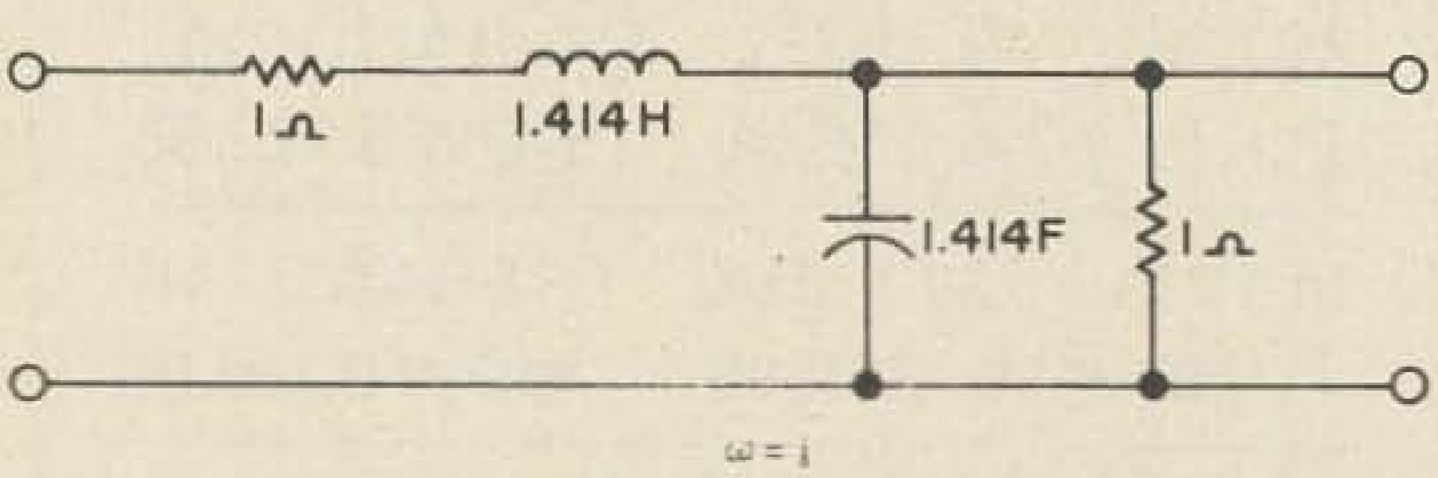

Fig. 5. Low-pass filter prototype.

the bandpass waveform. Similarly, the cutoff frequency of ω_c for the high-pass filter becomes f_1 of the bandpass waveform. In order to maximize the waveform at f_0, we need the least amount of attenuation at this frequency. The simple bandpass of Fig. 3C will be recognized as nothing more than a parallel resonant circuit at f_0. To increase the attenuation on either side of f_0 (narrow the passband), we must either increase the gain or the Q. When using RLC circuits, we can only decrease R as far as possible and increase Q to maximum. As the frequency of interest becomes lower, higher values of Q become increasingly more difficult to achieve.

In order to achieve a smaller bandwidth in passive circuits, we must increase the number of filter sections used. When such an increase is necessary, the insertion loss is raised. Designing with active RC filters solves these problems by first of all removing the inductance. This solves the problem of stray coil capacitance, low Q at low frequencies, and mutual coupling between coils.

The bandstop filter of Fig. 4 can also be considered as a combination of the low-pass and high-pass designs, with the transformation utilizing the reciprocals of the bandwidth ratios used for the bandpass design. If we remove L_2 and C_1 from the design of Fig. 4C, we are left with a low-pass filter and a high-pass filter. As noted, transformations of an adequate low-pass design are possible; however, to

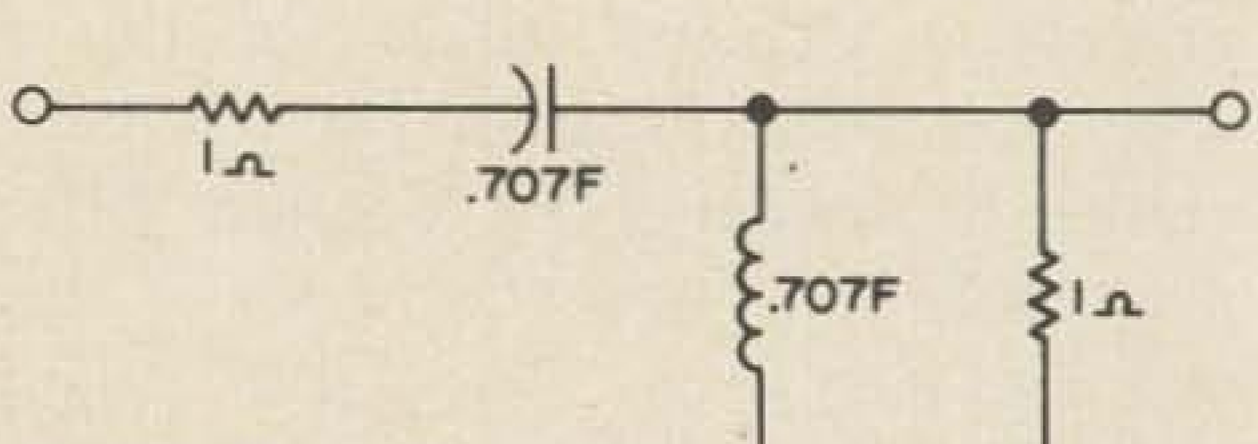

Fig. 6. High-pass filter prototype.

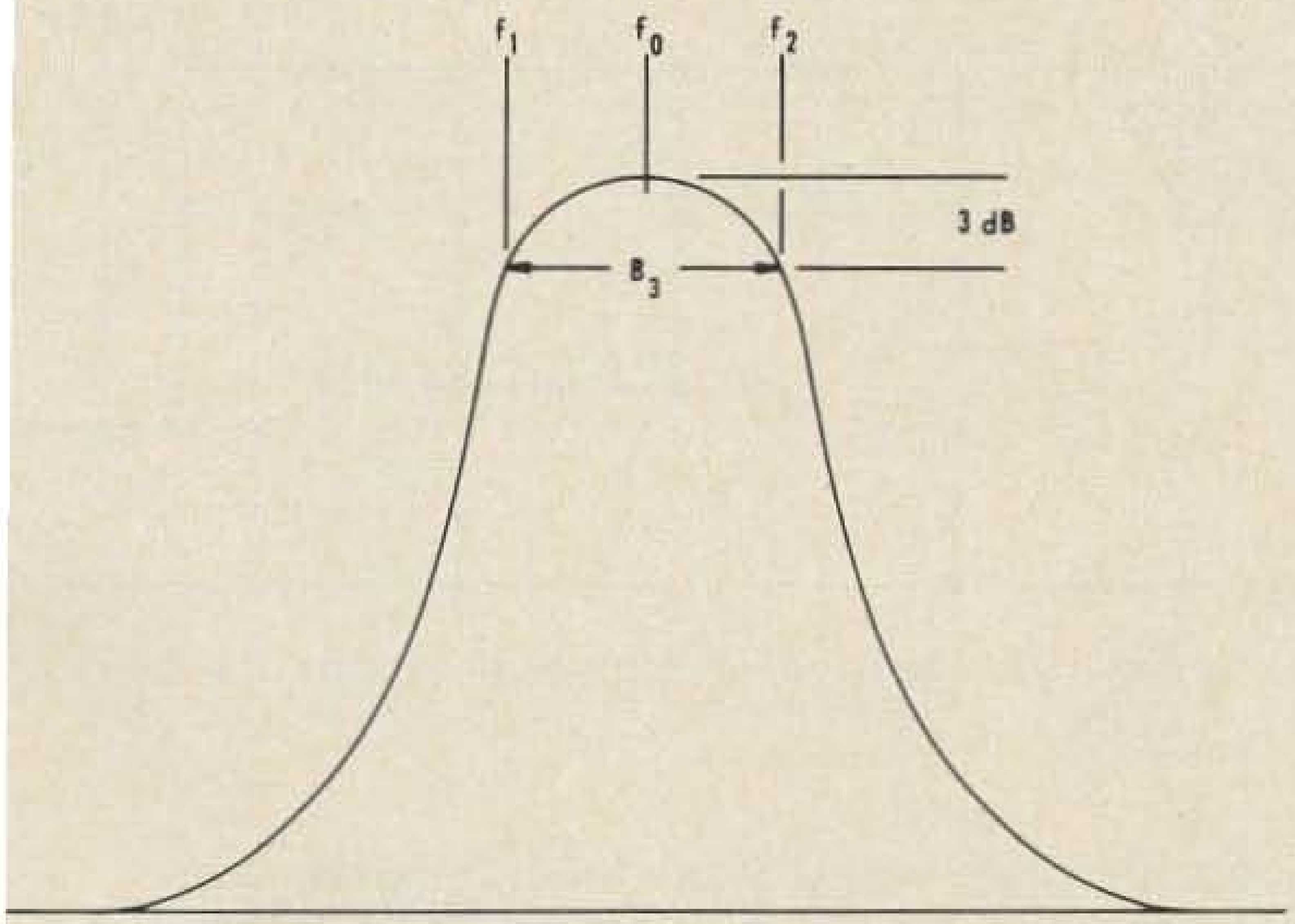

Fig. 7. Bandpass response parameters.

preclude degradation of performance, additional measures are sometimes necessary. In the bandstop design we have paralleled a high-pass and a low-pass filter. Once the input and output terminals of these filters are common, the impedance value of the original filters is no longer 600Ω. Consequently, the response shape of the filter is nearly unrecognizable. To prohibit loading of the circuit, each filter must have a high impedance in that portion of the circuit which produces an overlapping response with the other filter. Otherwise, the best response that could be expected would appear like the dotted line in Fig. 4A. Inserting a component presenting a high impedance in the series branch of the input or output of each network will serve to separate the filter responses. In the case of the low-pass section, we already have an inductor in the series branch of the input, so another coil is added to the output branch. In the high-pass section, the output branch is already coupled by a capacitor, so we add a capacitor to the series input branch.

Since we will be working with amplifier stages in the design of active filters, the same requirements to asssure stable operation at needed gain are valid. Consequently, the first parameter to be specified for an active filter should be necessary gain. Unfortunately, we cannot simply say a gain of 10 dB is necessary between input and output terminals, as we might be able to do with a normal amplifier stage. Because we have removed the inductors from the passive network, we must substitute a method of obtaining complex values for poles and zeros in order to simulate the required waveform. Phase shifts become more important and feedback is necessary to match impedance, stabilize the filter, increase gain, or a combination of these. As in the design of any circuit, tradeoffs must be made for optimum operation. The overall active network exhibits a value of sensitivity which affects its operation. Networks employing positive feedback are subject to oscillation, which might be created by element variations in a Q-sensitive circuit. Negative feedback tends to decrease the gain to unity, but nearly eliminates the Q sensitivity. Gain is directly related to the input/output impedance ratio. This level may be changed by appropriate resistance; however, the optimum dc current value must not be lowered in the process. Choosing high-gain transistors (minimum beta of 150) will allow maximum circuit alteration to achieve the desired response without making the circuit unstable.

Figure 8 shows a two-pole active filter incorporating positive feedback. In addition to the fact that C1 provides positive signal feedback to the first amplifier, it also acts as a complex zero function without a direct ground reference. Consequently, a change in device parameters caused by temperature or impedance may allow this "floating" zero function to alter its position in the frequency plane, thus distorting the desired filter waveshape. If we consider Amplifiers A1 and A2 as transistor stages, Fig. 8 would show them them connected in a common emitter configuration. However, changing the output points of each stage to the emitter will provide a network with unity gain, low Q and freedom from

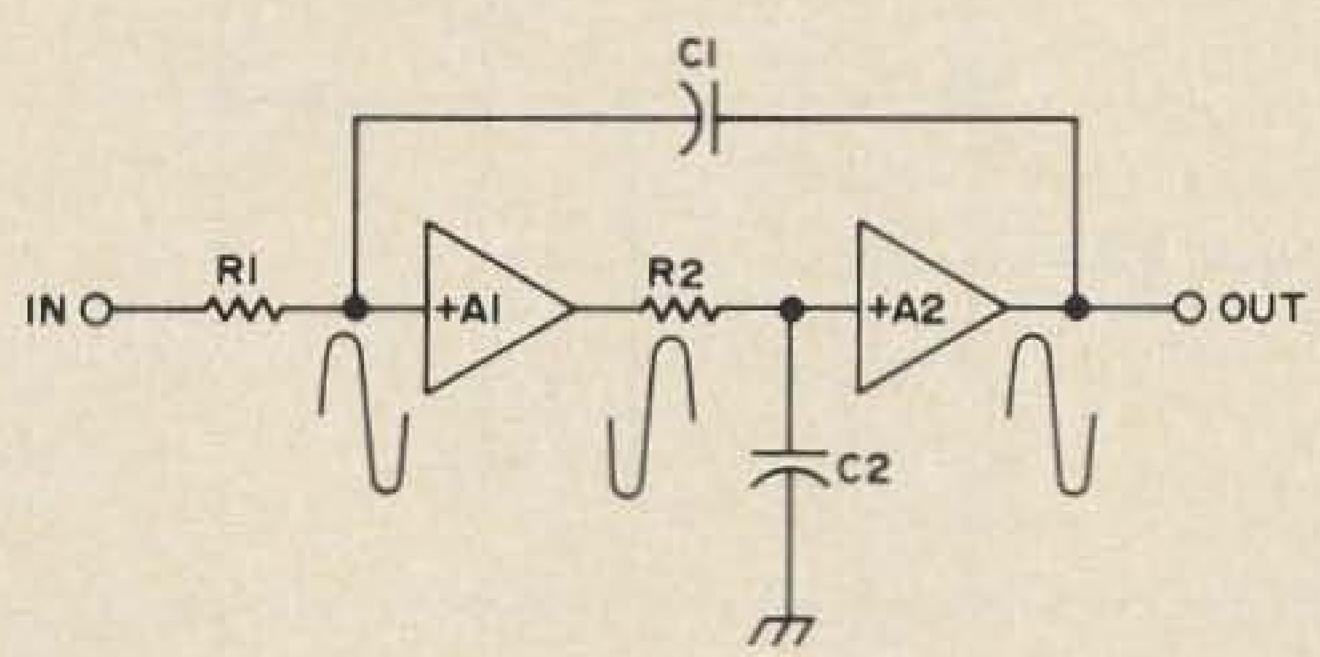

Fig. 8. Active filter with positive feedback.

possible oscillation. In such a configuration, a large ratio of component values will be required and the source must be a current amplifier.

Figure 9 shows a high-gain operational amplifier utilizing a twin-tee network to provide negative feedback. This network operates as a bandpass filter, thus requiring high Q and gain. The inherent high gain of the operational amplifier allows the filter shape, or Q, to remain insensitive to changes in amplifier level. The required ratio of network values in this design is low, but the parameters are difficult to adjust due to the number of elements required. Figure 10 shows the same type of active filter using two operational amplifiers. This circuit incorporates resistive damping to preclude operation as an oscillator. A minimum number of components are necessary and the filter adjusts easily. A constant-current source assures freedom from impedance loading which might affect the filter response.

An additional advantage of inductorless RC networks is the possibility of temperature compensation. A positive temperature coefficient exhibited by a resistor can be offset by a negative temperature coefficient capacitor.

There is virtually no comparison in physical size between the passive and active networks. This becomes most evident when comparing low frequency filters using large iron core inductors, to integrated circuit networks. The small size is further enhanced due to the fact that shielding and physical separation of components to preclude mutual coupling is of minimum importance in most active filter designs.

Component specification problems are

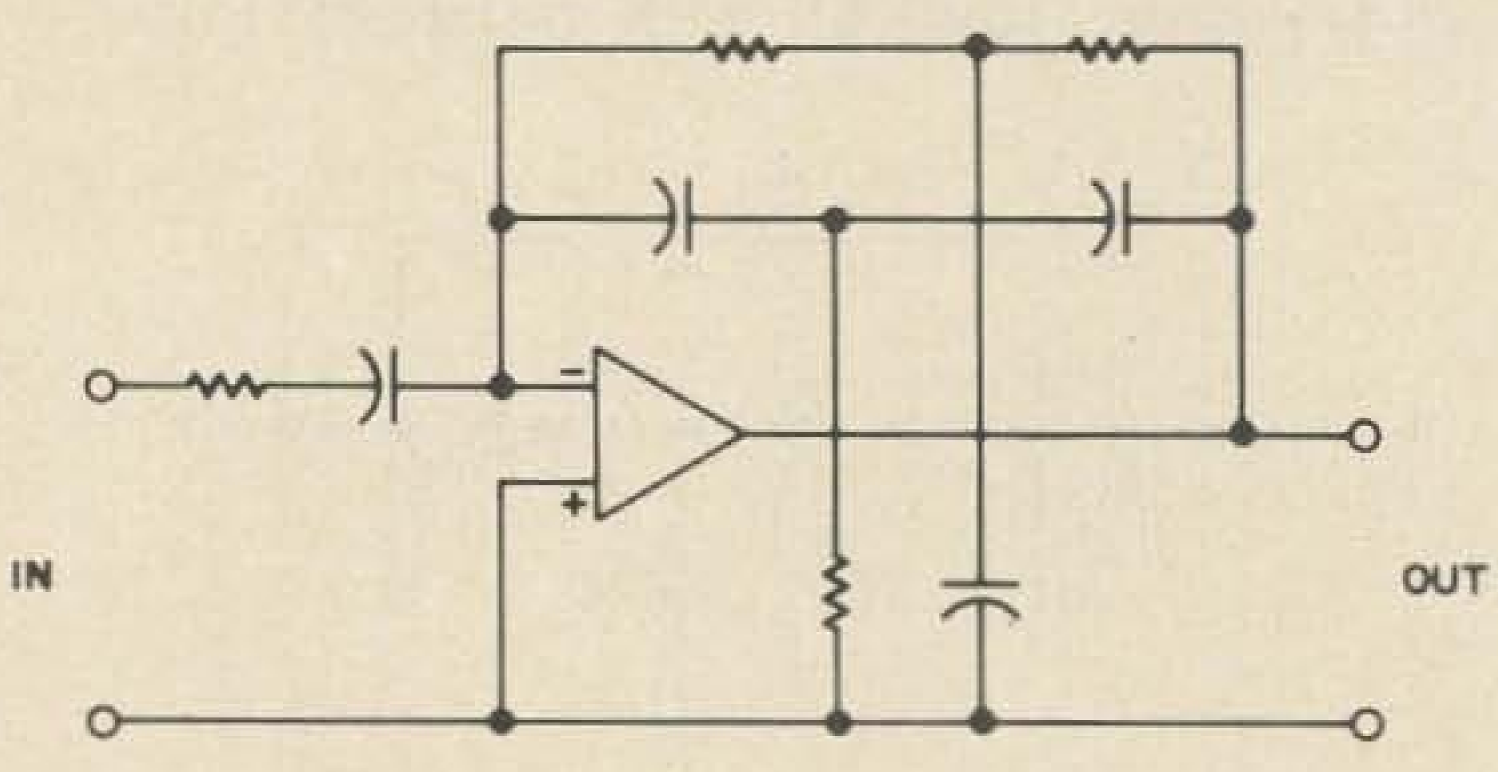

Fig. 9. Twin-tee network provides negative feedback.

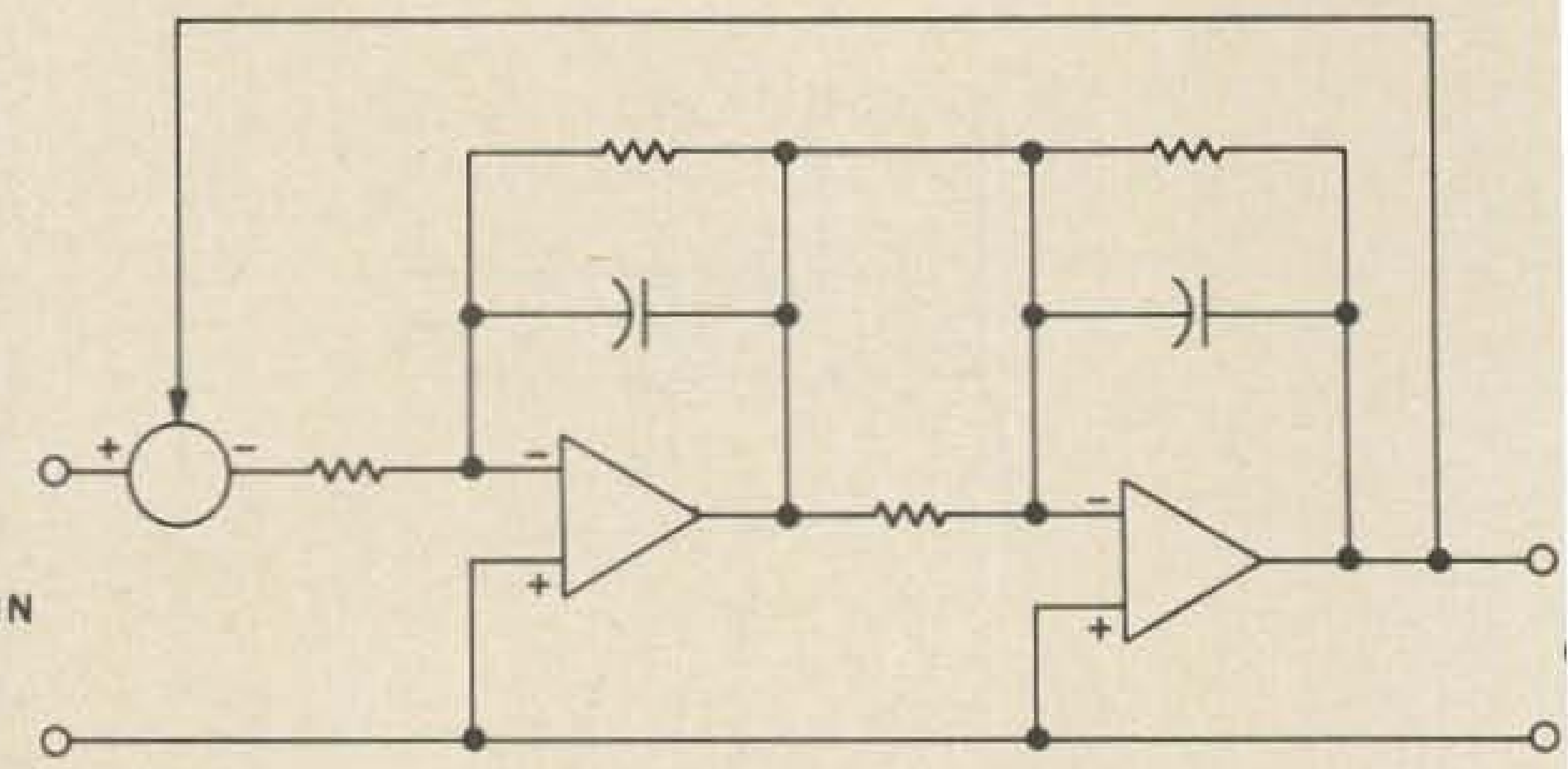

Fig. 10. Resistive damping maintains stability.

considerably eased without having to worry about coil problems. Depending on the circuitry chosen, Q and bandwidth are varied by either resistors or capacitors. The tolerance of these components is usually within 10% and the capacitors should have reasonably good thermal stability. Active networks utilizing transistors will require biasing resistors in addition to the frequency compensating components. Operational amplifiers will require a minimum of outboard components for frequency compensation. An overall comparison of cost between the passive and active networks is hard to make. At the lower frequencies, the active networks are much cheaper to design and construct due to the cost of heavy inductors used in the LC circuits. At the higher frequencies, cost is somewhat dependent on performance, but there is never a time when cost is prohibitive. Normally, component costs for the active filter more than compensate for the problems and labor required in design and construction of inductor filters.

Performance of the active filters surpasses that of the passive networks at the lower frequencies, and more than equals them at the higher frequencies, all with the main advantage of doing away with the many problems associated with inductors.

. . .K3PUR■

References:

Simplified Modern Filter Design. Philip R. Geffe; Rider Publishers

Active Filters: The Road to High Q. Joseph Mittleman; Electronics, May 27, 1968

Active Filters: Positive Results From Negative Feedback. Gunnar Hurtig; Electronics, March 31, 1969

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Or, raise your own antenna and eat the goodies yourself.

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First, scout around the community for a tall telephone pole . . . then at night . . . no, that won't work. On second thought, go to the telephone or power company and ask if they are planning to take down any poles in the near future. Tell them you would like to have one so you can erect an antenna to assist in disasters or tracking tornadoes – public service, you know. For a small fee they may deliver, dig a hole, and set the pole for you. We have dreamed long enough, so let's get down to copper tacks and go to work.

Prepare the pole before setting it by sawing the top off straight so the saddle (Fig. 4) will bolt on properly. Drill the holes for the saddle and install it. Drill pilot holes alternately on each side of the pole for large lag screws to be installed for steps. You may have a desire to climb it for one reason or another. The view is certainly nice from up there. Be sure the steps are positioned so they will not interfere with the drive shaft.

Set the pole so the top of the saddle is as level as possible. To accomplish this you can eyeball it, use a plumb bob or a level. A 40 or 50 ft pole should be set in the ground approximately 8 ft. Install 5/8 in. lag screws for steps, and now you're ready to do some measuring and locating of components on the pole.

Saddle Construction

To determine the length of U-channel required and how much overhang is needed, one must first determine how far the drive shaft will be from the pole. This will be dependent upon the rotator and mount position. A piece of 4 or 6 in. iron U-channel may be utilized for the saddle. Cut the end on each side as shown in Fig. 1, and then bend the end down and weld as shown in Fig. 2.

Fig. 1.

Fig. 2.

Obtain two narrow sturdy pulleys and a steel rod for axles. Cut the slots for the sled and pulleys as shown in Fig. 3. Install pulleys in the slots and weld or bolt axles to the underside of the U-channel. Drill a ½ in. hole near the center of the U-channel for lag screwing into the top of the pole.

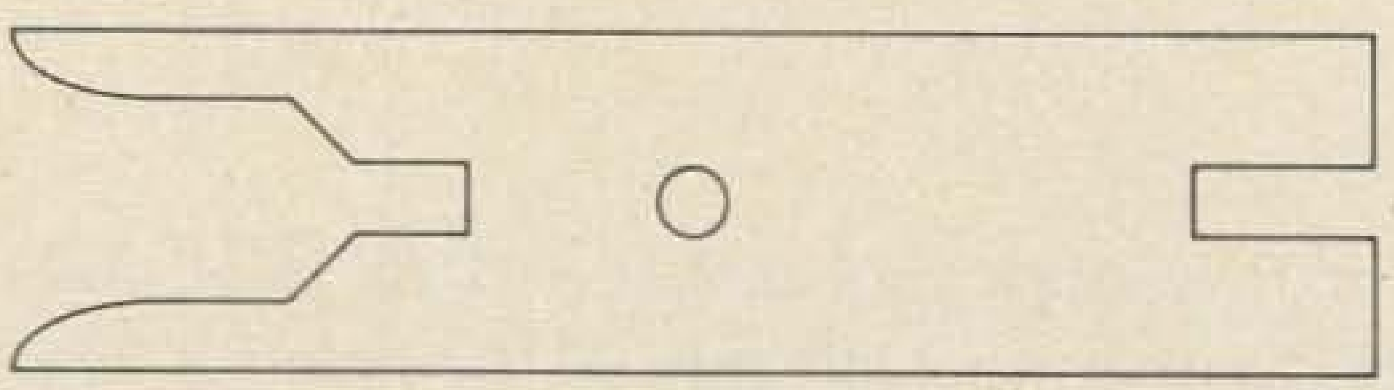

Fig. 3.

Weld a short piece of ¼ in. steel rod next to the pulleys and bend them over the pulleys to prevent the steel cable, when installed, from jumping out of the pulley grooves. Cut and weld a 16 in. piece of U-channel to fit inside of the saddle as shown in Fig. 4, so the center of the sled slot is the same distance from the pole as the center of the rotator drive assembly. The taper of the pole may have to be considered so the drive shaft will be perpendicular when installed. Drill a 5/8 in. hole approximately 6 in. down from the top and another hole approximately 14 in. from the top. Before installing the saddle, make the sled to fit the saddle-sled slot without binding.

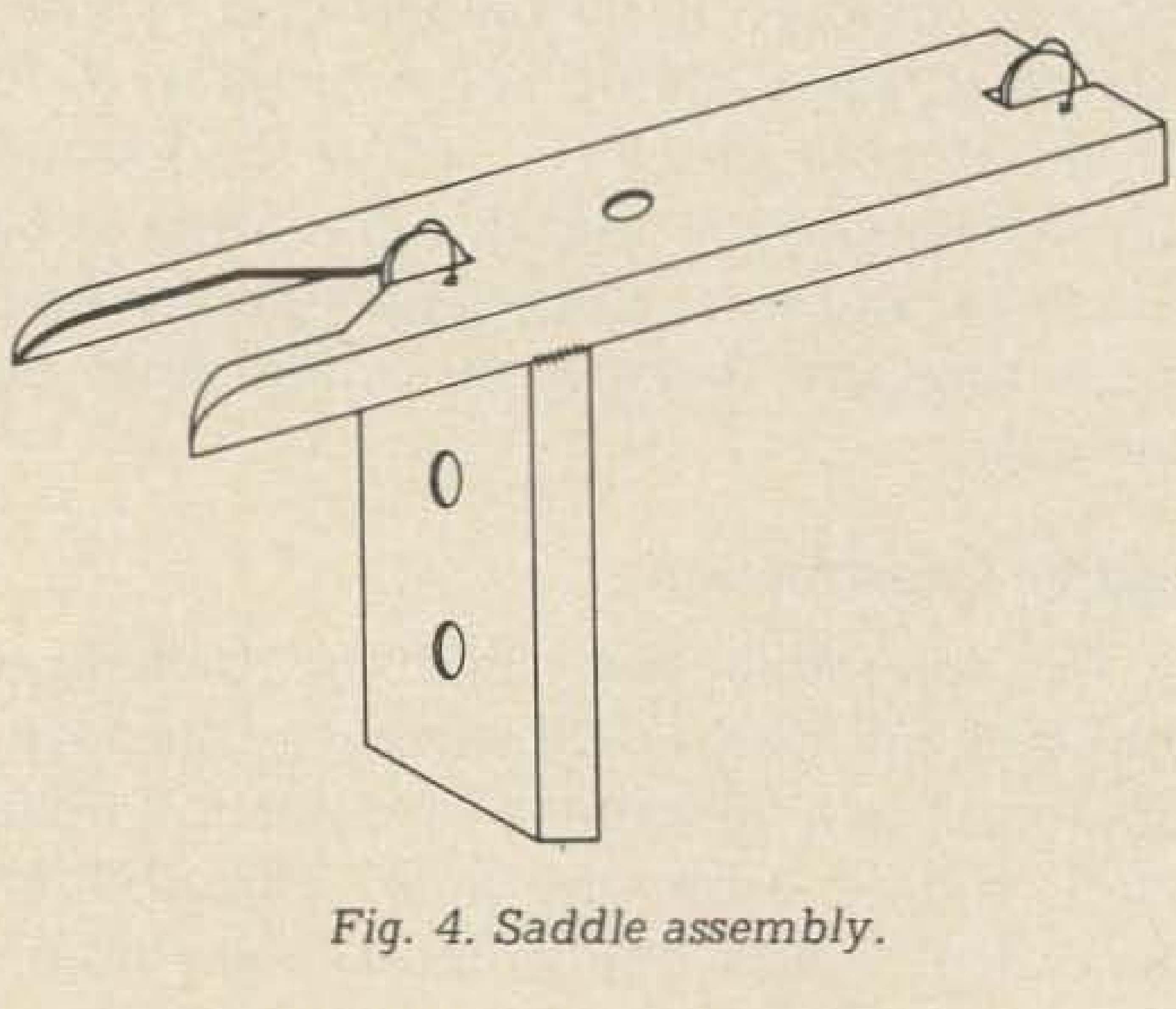

Fig. 4. Saddle assembly.

Sled Construction

The base of the sled is constructed from 1/8 in. steel approximately 7 in. long and approximately as wide as the U-channel. Cut a 2 in. hole near the center and bend the front as shown in Fig. 5. Drill a 3/8 in. hole in the center at each end approximately ½ in. from the edge.

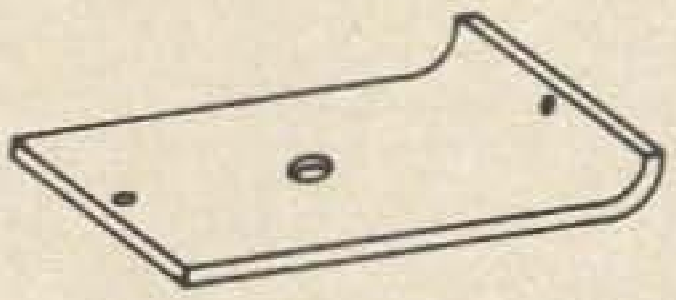

Fig. 5. Sled.

Using 1 in. strap iron, bend it to fit the shape of the slot in the saddle as shown in Fig. 6.. Weld this guide to the bottom of the sled as shown in Fig. 7. Be sure it is positioned so the drive shaft will be vertical.

Visit a salvage yard and purchase a thrust bearing that will slip over a 1¼ in. pipe. The thrust bearing is used to carry the weight of the antenna system on the saddle and not on the rotator, plus allowing ease of rotation. The thrust bearing is not required if these features are not desired. Position the thrust bearing on top of the sled and over the hole so the drive shaft can be inserted through both assemblies. Weld the outer race of the bearing to the sled so that when a load is placed on top of the bearing it will be free to rotate. This completes the sled construction.

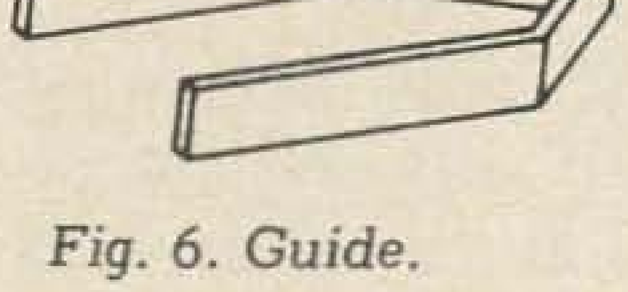

Fig. 6. Guide.

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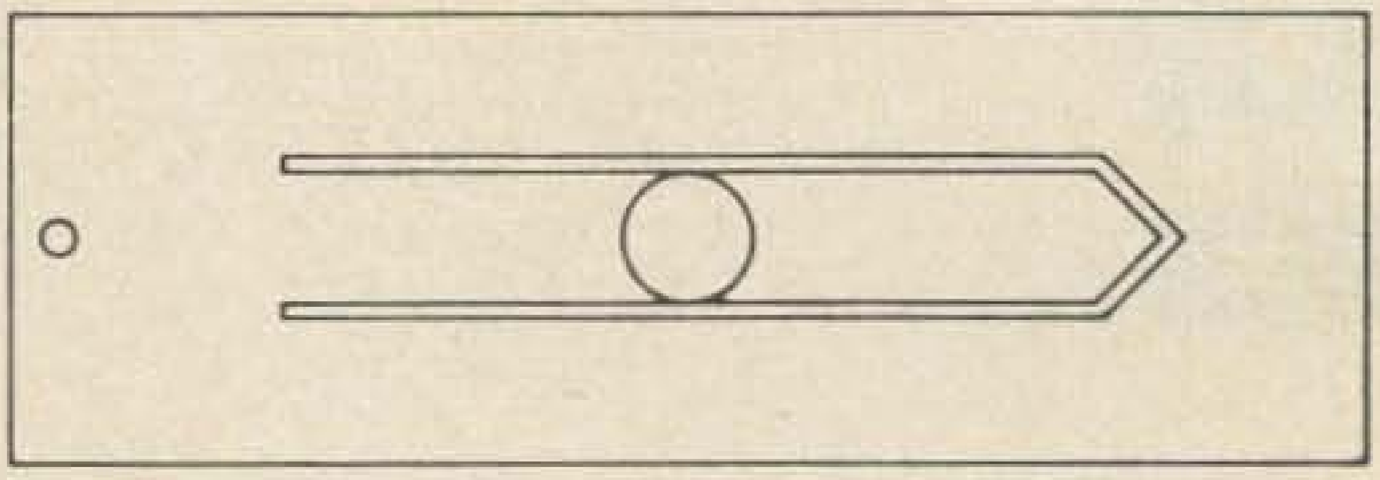

Fig. 7.

Drive Shaft Bracket

The drive shaft L-bracket stabilizes the hinge point during rotation and lowering of the antenna. A 4 in. wide and approximately 12 in. long piece of 1/8 in. steel should be bent into an "L" shape. The hole in the bracket for the drive shaft can be measured and cut after the drive shaft is temporarily installed, to make it easier to locate the exact position for the hole. The drive shaft is then placed through the hole of the bracket. The bracket is positioned just below the hinge point and then lag screws are used to fasten it to the pole. The hinge point cannot be determined until the antenna height above the pole is known. The antenna height above the pole can be 10 ft or greater depending upon weight and wind load of the antenna. The hinge point will be approximately halfway between the antenna and the ground. The length of the lower portion of the 1½ in. drive shaft is from the rotator to the hinge point and the upper portion from the hinge point to the antenna.

Hinge Construction

Cut two pieces of 1½ in. pipe, 24 in. long. Drill a half-inch hole, 3 in. from one end, through each piece. Drill another half-inch hole, 9 in. from the same end. These holes have to be drilled accurately, so half-inch bolts can be inserted through both pieces. It is suggested that when one hole is drilled through each, they be bolted together before drilling the second hole. This will assure alignment of the two pieces. Two similar holes must be drilled in the lower drive shaft and these must be drilled accurately so all three pieces can be bolted together as shown in Fig. 8.

Weld the two pieces to the upper portion of the drive shaft or bolt them together if desired. In either case, keep the lower section bolted together to assure alignment

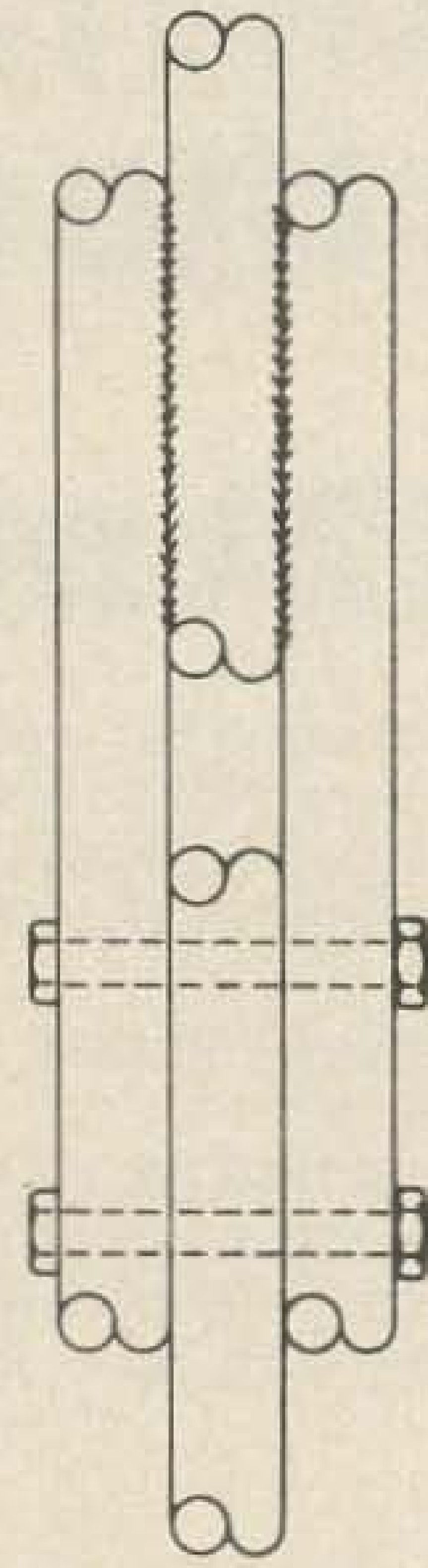

Fig. 8. Hinge assembly.

when completed. It is suggested that a washer be installed to allow ease of removal of the lower drive shaft after the welding operation. Removal of one bolt will allow the drive shaft to hinge on the other bolt. Two bolts are used for added strength.

The upper drive shaft is inserted through the sled assembly, winch installed on the pole, and ¼ in. steel cable run from the winch up over the two pulleys on the saddle and down to the ground, where it is attached to the front of the sled. Insert the lower drive shaft through the center bracket and attach the other end of the drive shaft to the rotator. Hoist the upper drive shaft so the

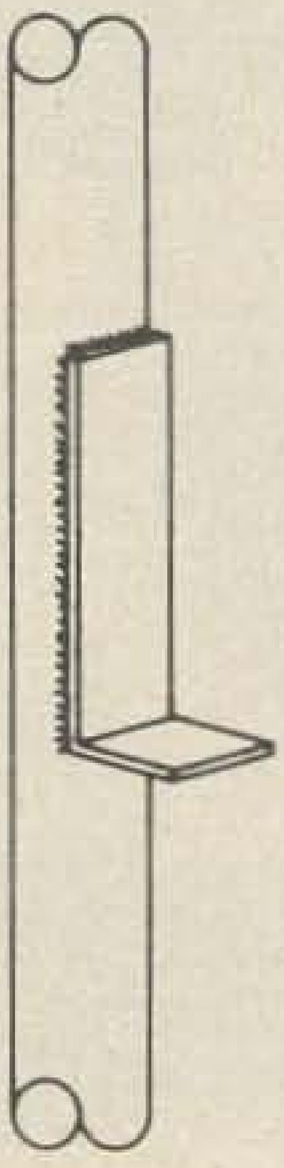

Fig. 9.

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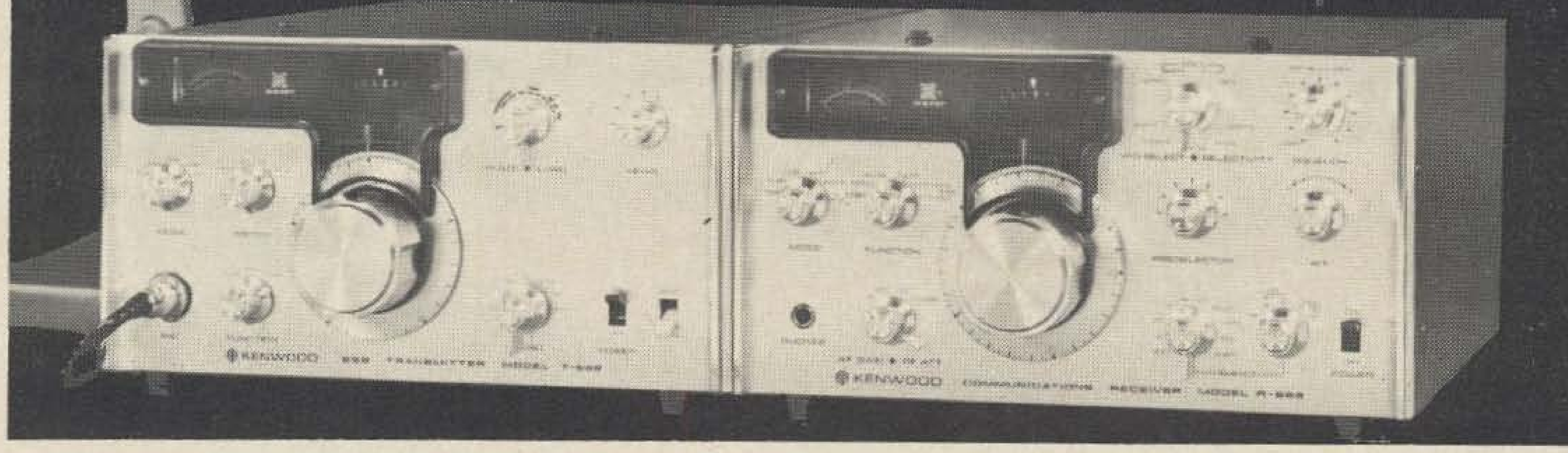

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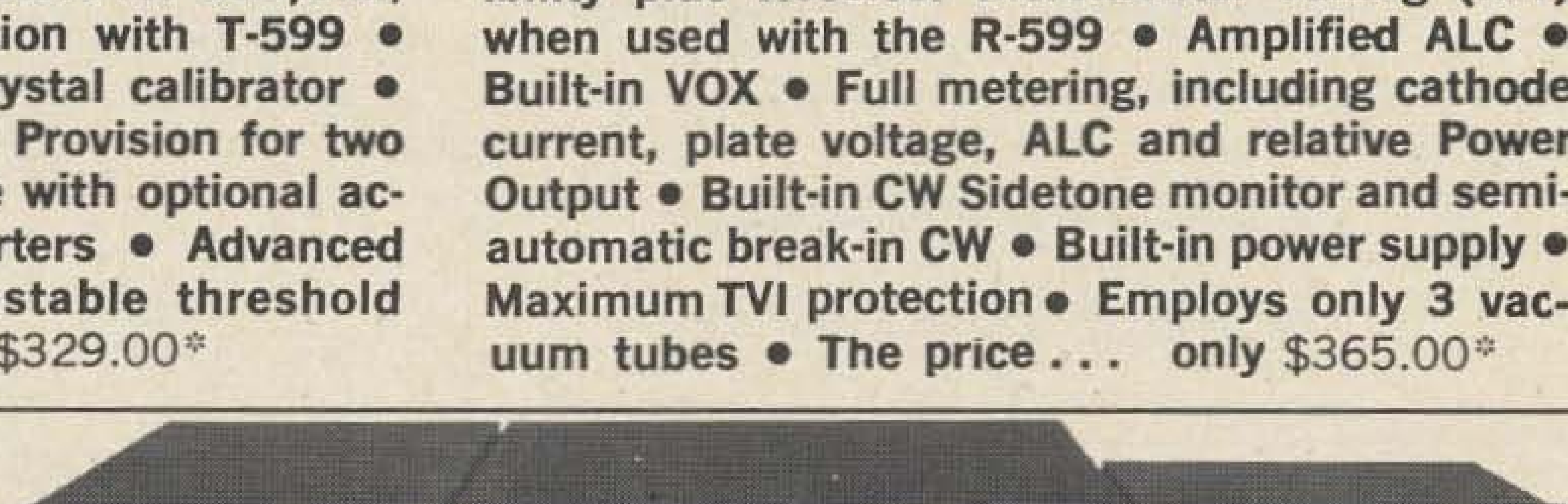

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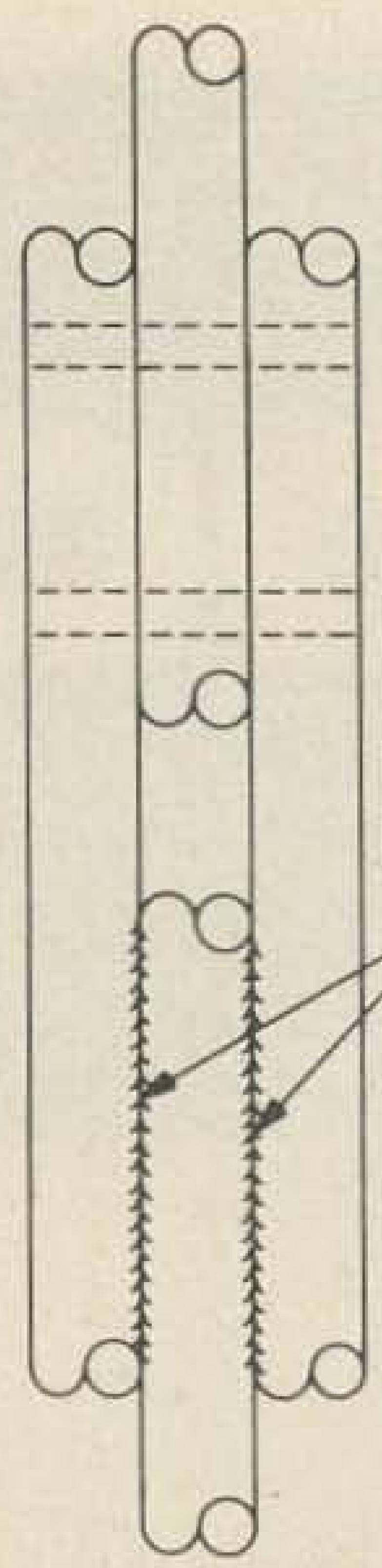
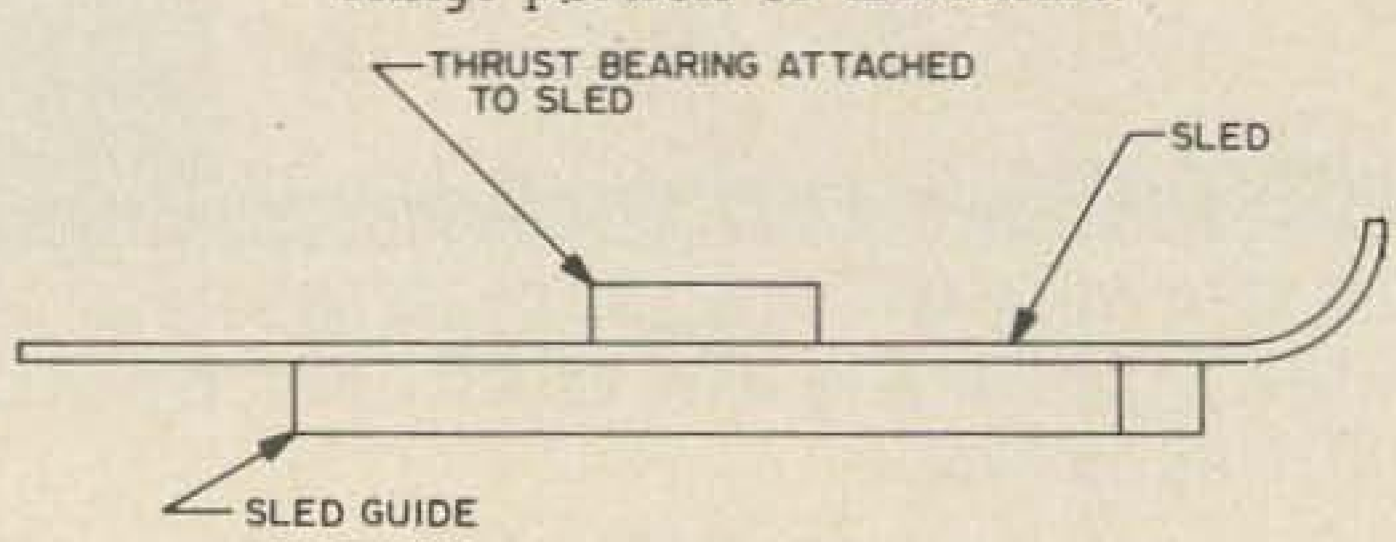
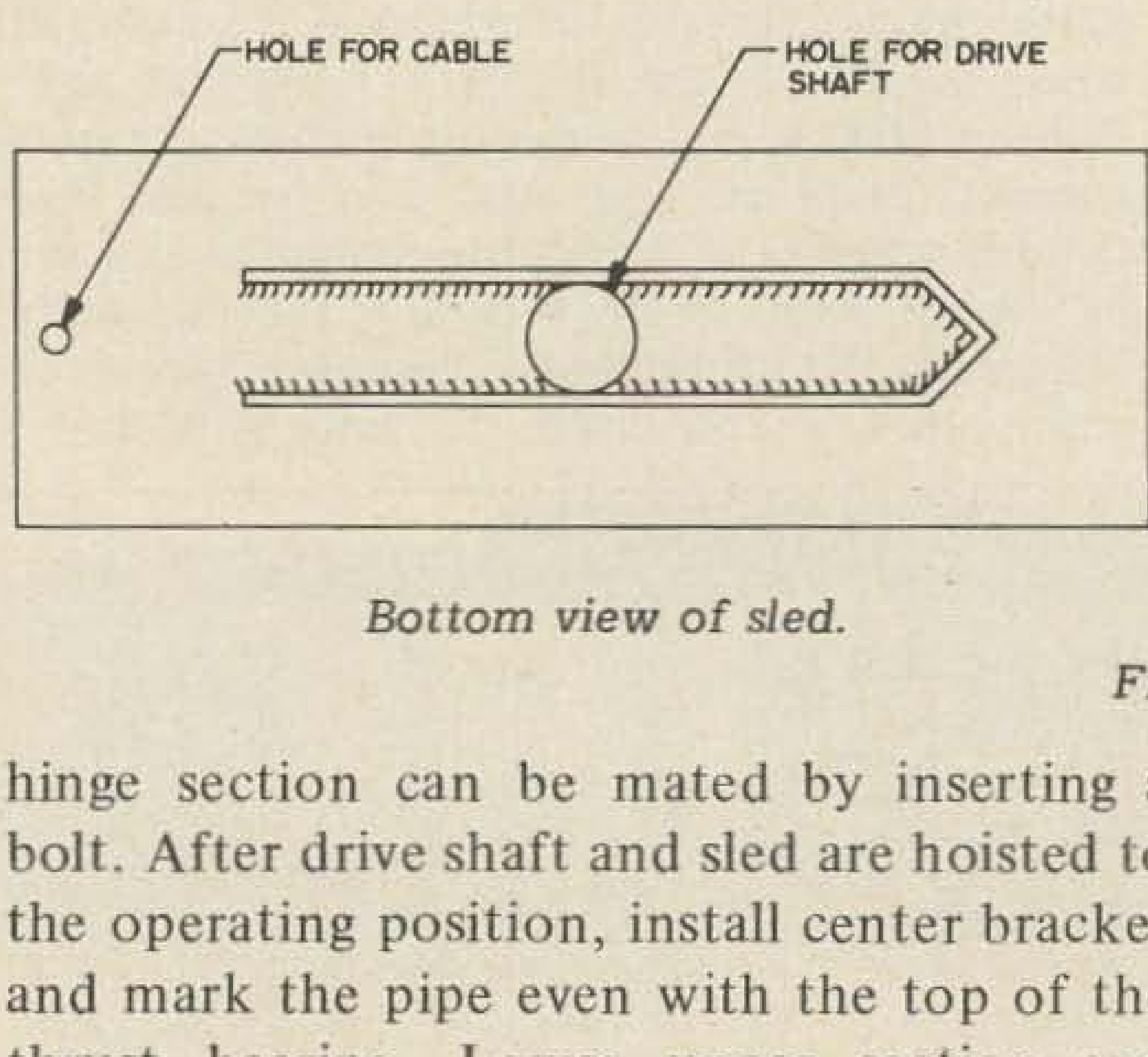


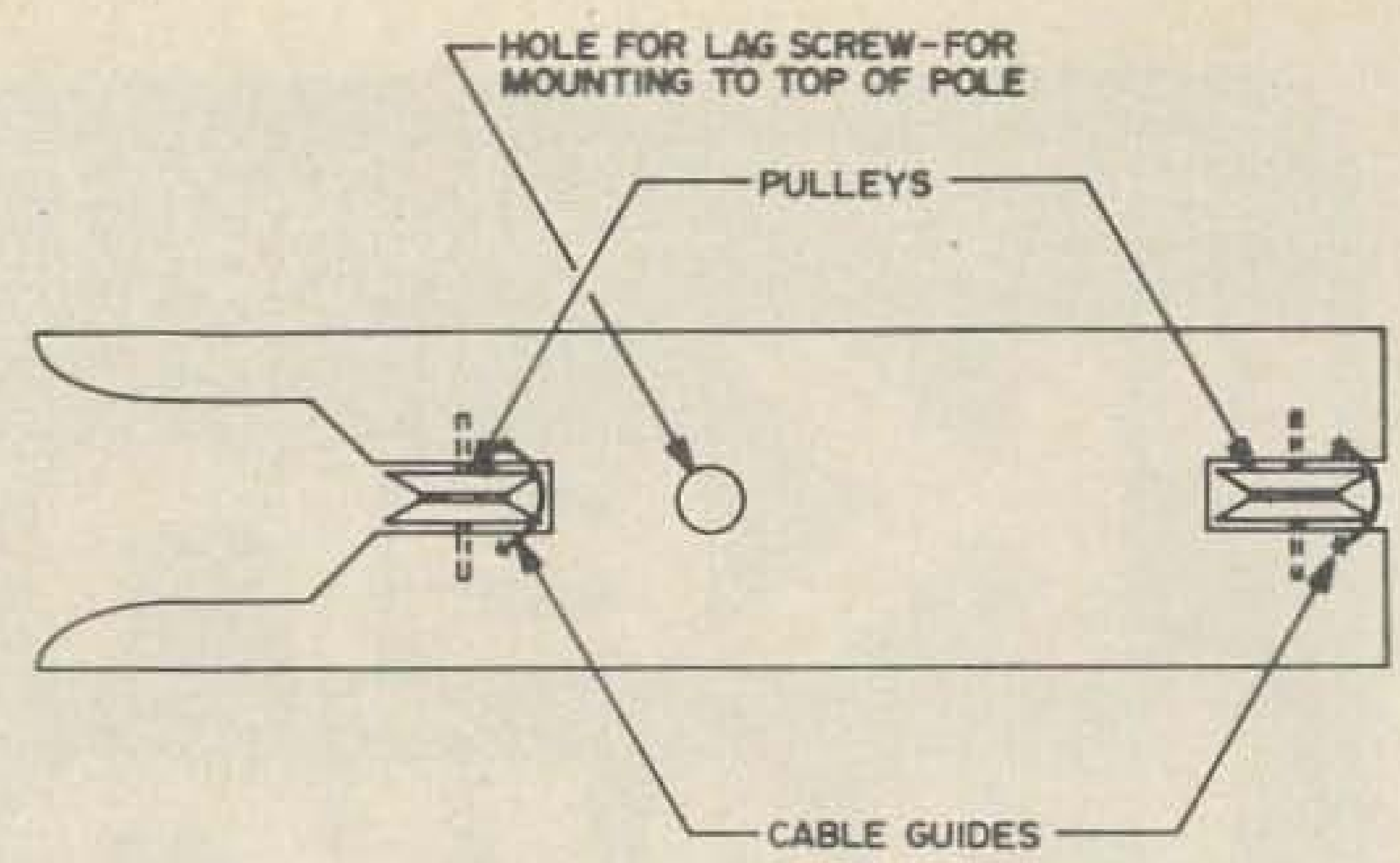
Hinge portion of driveshaft.



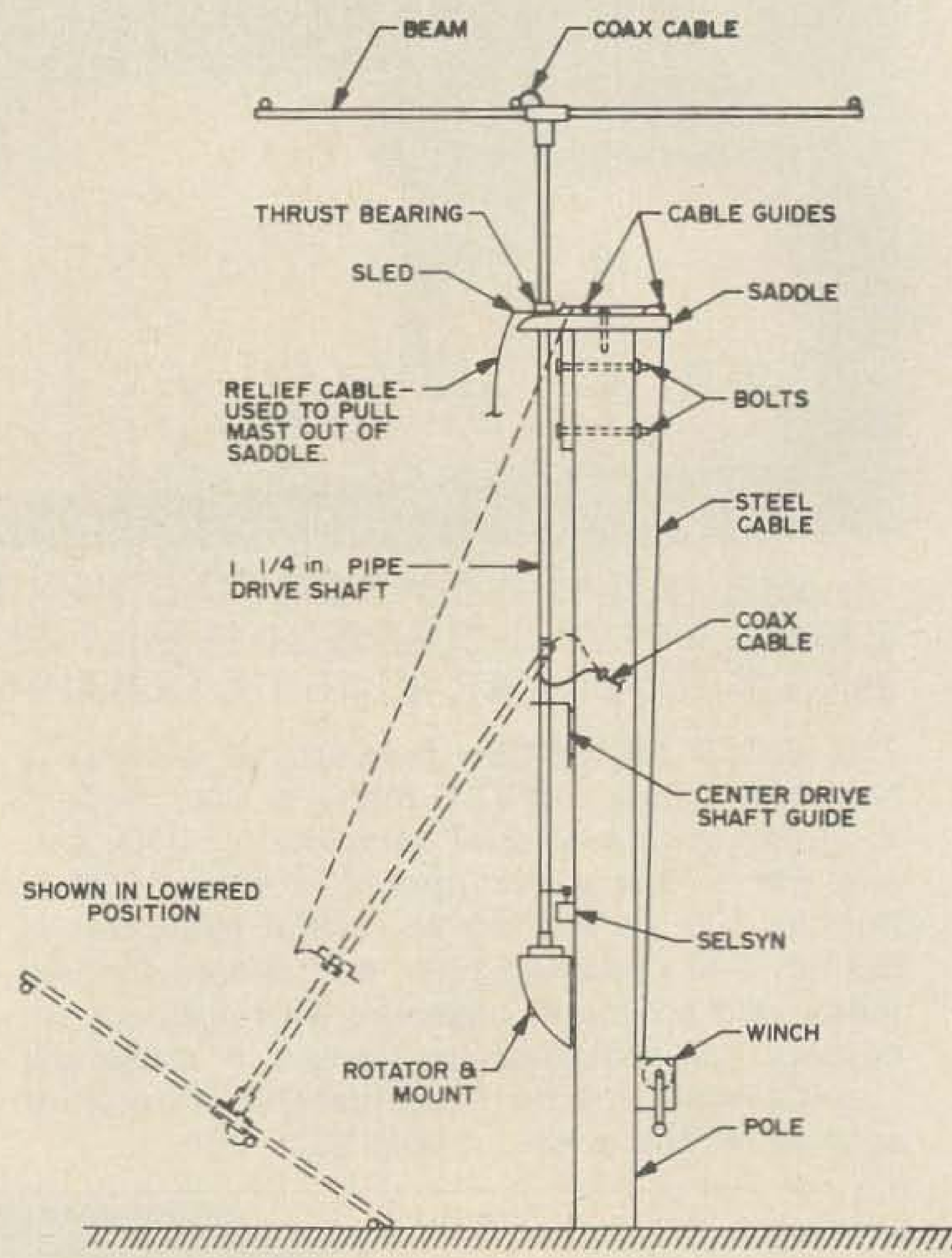
Side view of sled.



Bottom view of sled.



Top view of saddle.



The whole shebang.

Fig. 10.

hinge section can be mated by inserting a bolt. After drive shaft and sled are hoisted to the operating position, install center bracket and mark the pipe even with the top of the thrust bearing. Lower upper section and weld inner race of thrust bearing to the pipe a small fraction of an inch below the mark, so the weight will be carried by the bearing and not the rotator when in operating position. Attach antenna and route cable down center of pipe and out of the hinge. Provide sufficient slack in cable to allow for more than 360° of antenna rotation. A reversing switch can also be installed, or a limit switch, if desired. Be sure to install a good ground system. I have used this type of system for over ten years at two different locations without one speck of trouble. More recently a Cliff Dweller antenna was installed above the TA-33 Tri-band Mosley beam with excellent results. No guy wires clutter up the yard, and antennas can be lowered and raised single-handedly. It is suggested that a piece of strap iron as shown in Fig. 9 be welded to the pipe where the antenna attaches with U-clamps. This will prevent the antenna from rotating on the pipe or slipping down the pipe if it should loosen.

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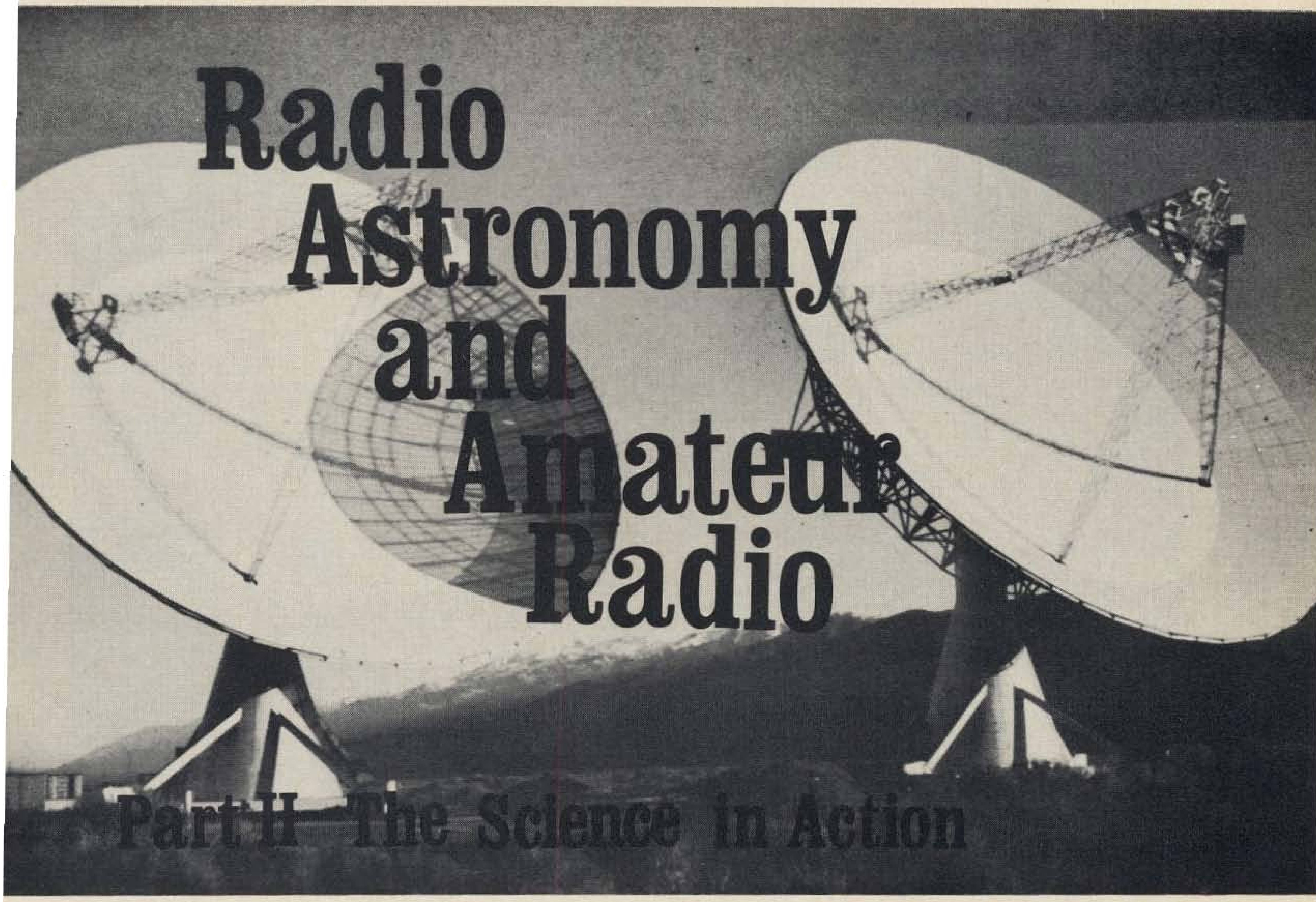
Radio Astronomy and Amateur Radio

Part II The Science in Action



Ed. Note: The first half of this two-part series contained figures numbered 1–4. Hence, in this section, which is a logical continuation from Part I, the figures are numbered sequentially from 5 to 8.

The radio spectrum extends up to about 40,000 MHz, and is grouped into seven classifications because of the vast differences throughout the total radio frequency spectrum.

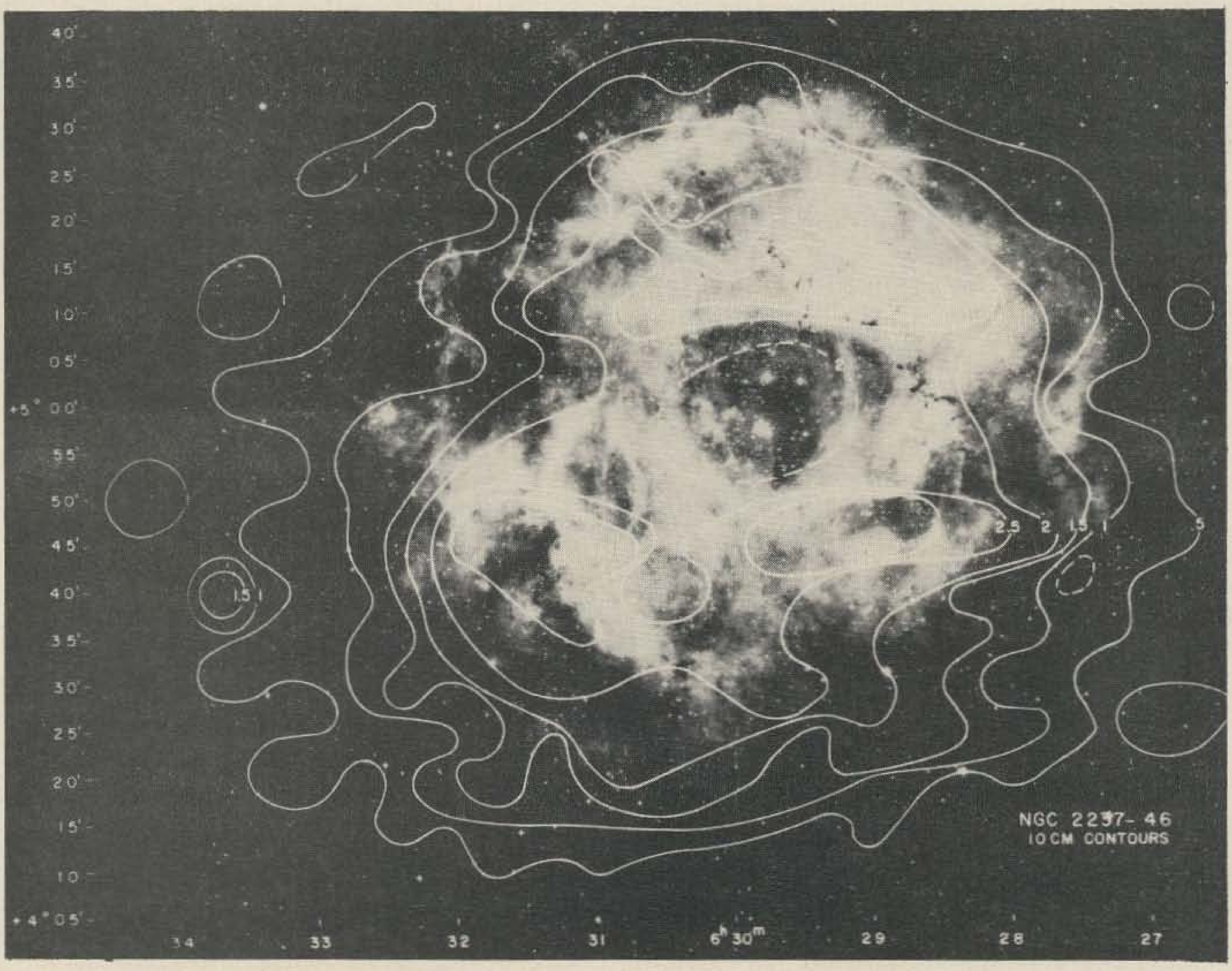
10–30 kHz Very low freq.
30–300 kHz Low freq.
300–3000 kHz Medium freq.
3–30 MHz High freq.
30–300 MHz Very high freq.
300–3000 MHz Ultrahigh freq.
3–30 GHz Superhigh freq.

If the radio spectrum were a yardstick, the first 10 in. would contain 98% of all radio communications used for military, aviation, radar, two-way radio, ship-to-shore, ham radio operations, mobile telephone, AM broadcasting, FM broadcasting, international broadcasting, VHF television, and UHF television broadcasting.

It would seem that the last 25 or 30 in. of the yardstick or 25–30,000 MHz would be the best place for observing with the radio telescope. But at frequencies above 3000 MHz it becomes a major problem to reduce noise coming from the source in space.

While the problem at superhigh frequencies is atmospheric absorption, at lower frequencies the ionosphere reduces the signal level of waves passing through the charged layer. In addition, this layer in the upper atmosphere can cause signals at low angles to skip back into space just as radio signals on the reverse side are bounced back toward the earth.

The upper layers of the atmosphere (Fig. 5) form thick layers or bands of ionized particles when these atoms are excited by ultraviolet energy from the sun. Obviously, while thick bands of ionization are formed during the day this same upper



*The Rosette nebula – a radio stellar source observed at the 10 cm wavelength or about 3000 MHz. The white lines outline the radio contours and are superimposed on an optical telescope photograph of the Rosette nebula. Numbers along the base of the photograph are known as right ascension (RA), which together with the declination angle along the left side of the photograph give the astronomer the exact position of the source on the celestial sphere. NGC-2237-46 located in the lower right corner indicates the new general catalog number of the source. This was a list of optical star clusters, nebulae, and galaxies compiled in 1888. The cataloging of sources is a must in order to let astronomers locate sources quickly. This particular nebula is relatively young and hot; notice how the areas of intense radio energy correspond to areas of intense visual light. (*National Radio Astronomy Observatory.*)*

rather than an audio signal varying at an audio rate. This varying dc drives a pen which is set in a movement very similar to a meter movement. A change in voltage causes the pen to swing in the same manner as the needle of a voltmeter.

If the variations of the pen follow each small change of input, the final product will end up being a mass of confusion so some way must be used to smooth out the rate of pen movement. The exact rate depends on the type of observation being made. Normally a capacitor and resistor are placed in the pen circuit to even out the fluctuations. (See Fig. 8.)

Another important stage in the telescope is the noise generator, which provides a calibration source of a known intensity, for plotting relative intensity and actual intensity at the receiver.

Types of Radio Telescopes

Telescopes may be either of the radiometer type or of the interferometer type.

The radiometer is a simple single radio telescope used to observe radio sources much like an optical telescope.

An interferometer consists of two or more antennas which are used in conjunction with each other. If two antennas are used they both feed a single receiver.

The use of two antennas as in Fig. 8 actually increases the effective aperture of the telescope; thus much more resolution can be built into a receiver without making it physically larger.

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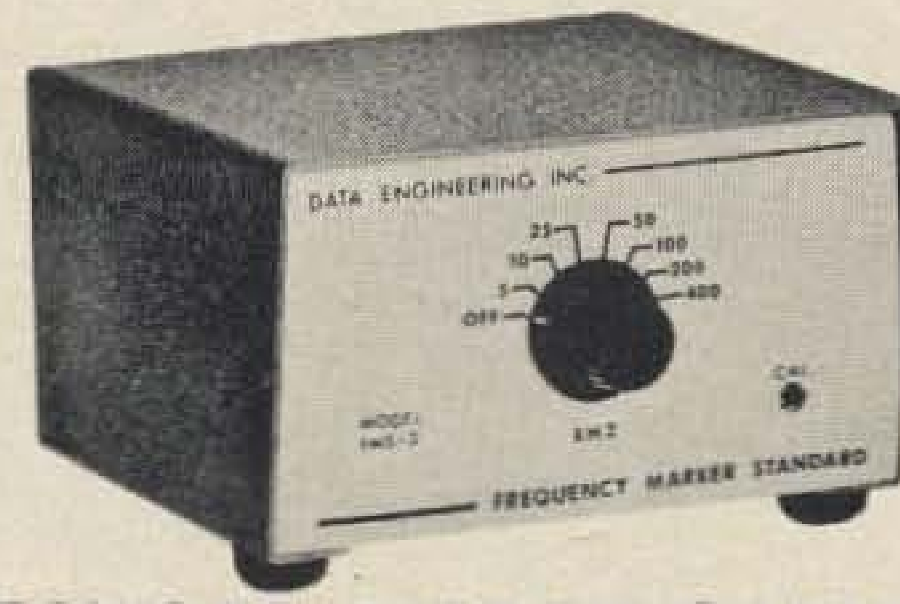

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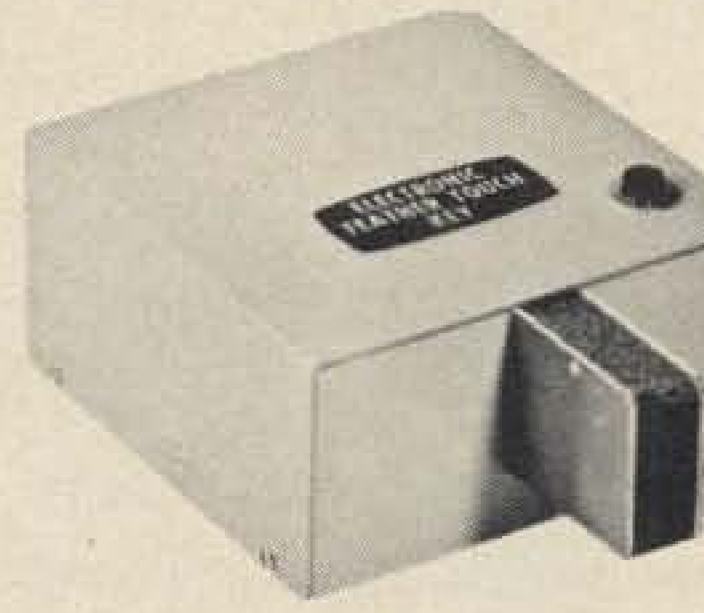

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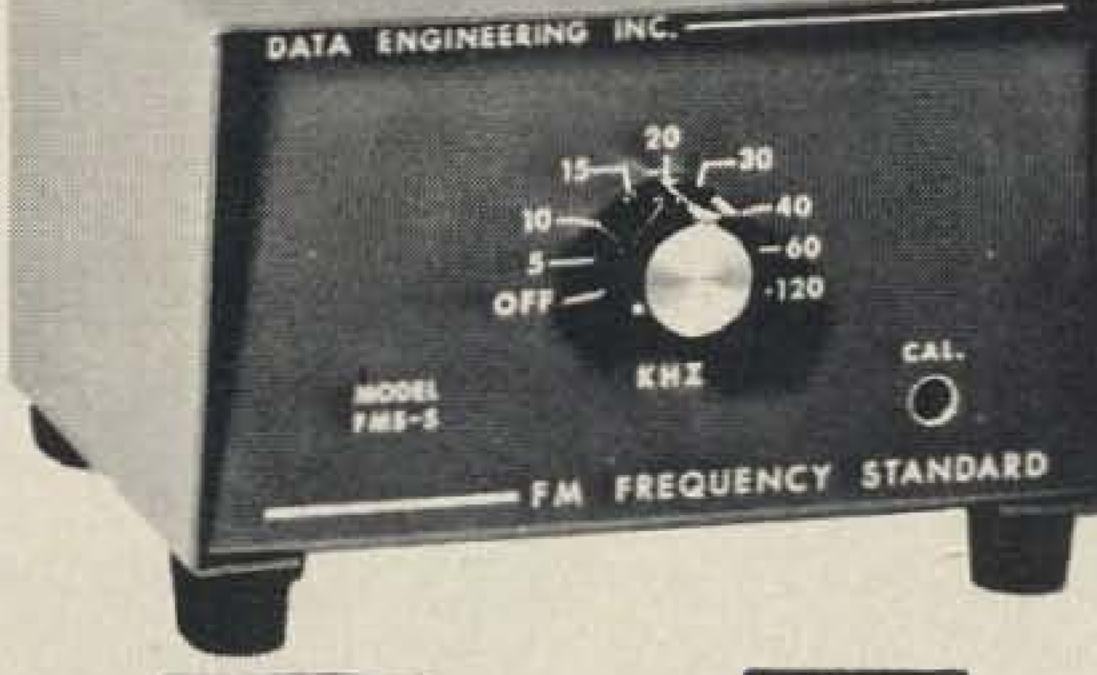

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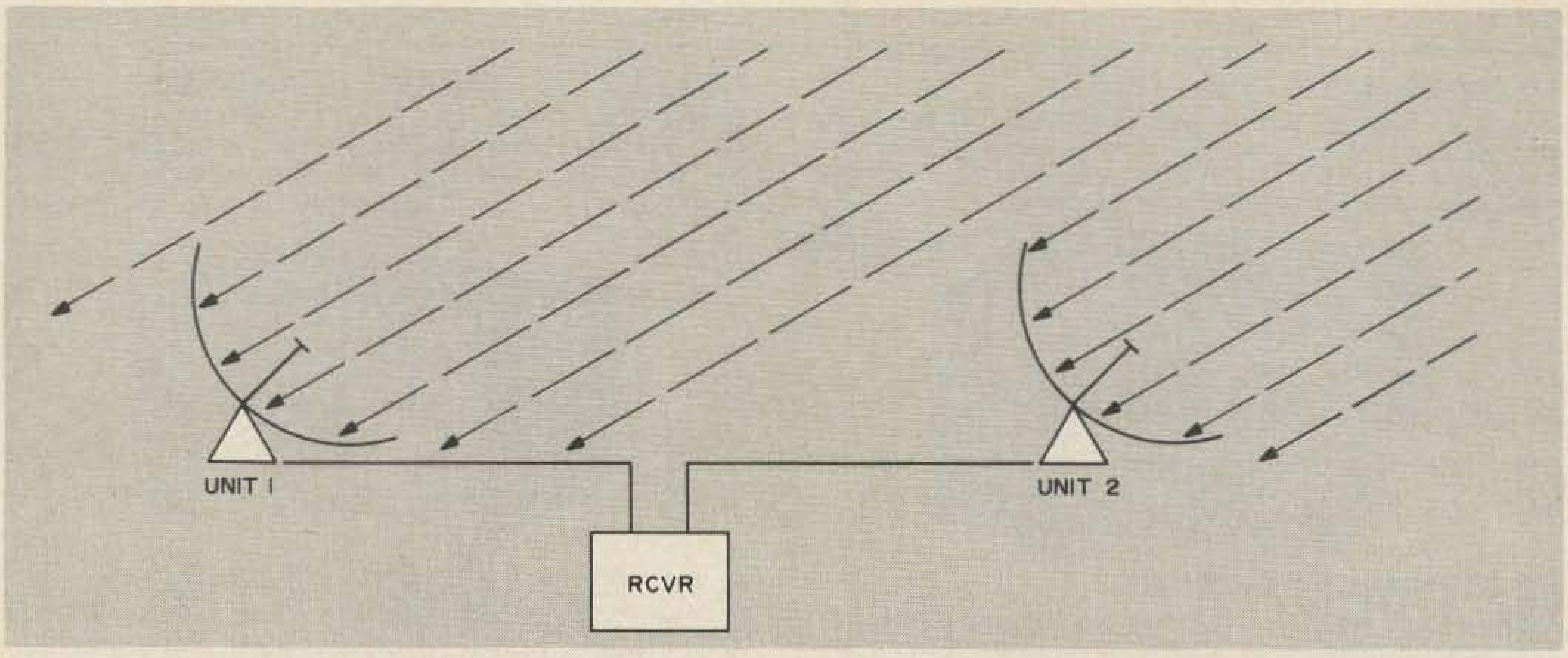


Fig. 8. Energy from space arrives at telescope 2 first, causing a phase differential between the two antennas; this "difference" is useful in determining astronomical data.

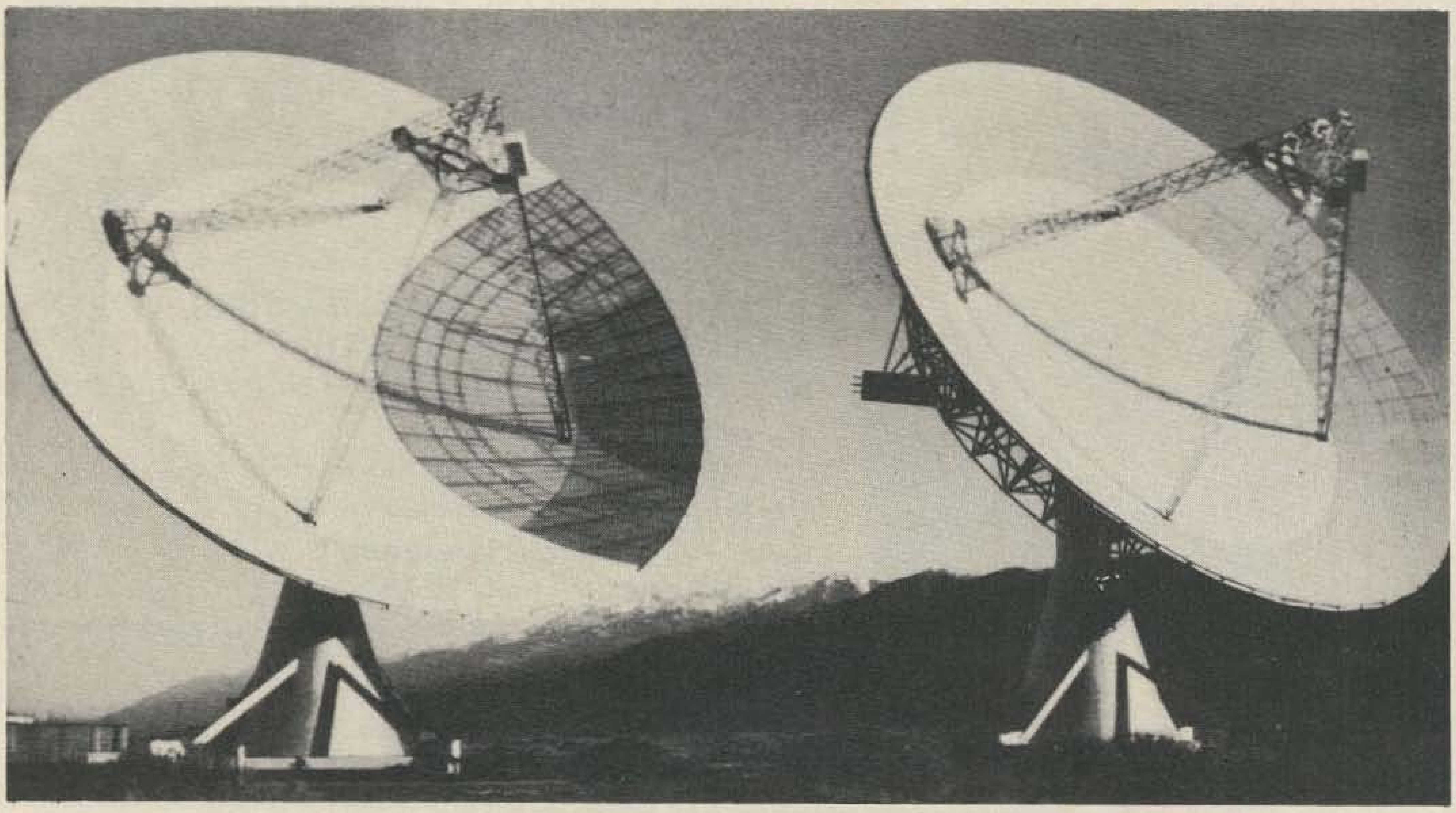
Antennas

One of the most important factors in the performance of a telescope is the antenna. The antenna of a dish type telescope does the exact same job as a mirror of a reflecting-type optical telescope. It gathers energy and focuses it to a specific point.

Parabolic. The dish is not the only antenna being used for radio astronomy; in many cases the dish is the most inefficient antenna which might be selected. For example, because a dish needs to be at least 10 wavelengths in diameter, at wavelengths longer than 20 meters a movable antenna becomes almost impossible even for the professional with unlimited funds.

The dish is a broadband device with a rather flat gain curve over several megahertz. It is important to be broadbanded for most radio astronomy applications. It does no good to have a broad intermediate frequency if the antenna has a sharp gain response.

The higher in frequency one goes with the same size dish antenna the more efficient the antenna will perform. This is because the higher the frequency the shorter the wavelength: The wavelength (λ)



Twin 90 ft telescopes at Owens Valley Observatory operated by the California Institute of Technology through funds provided by the Office of Naval Research. (Office of Naval Research.)

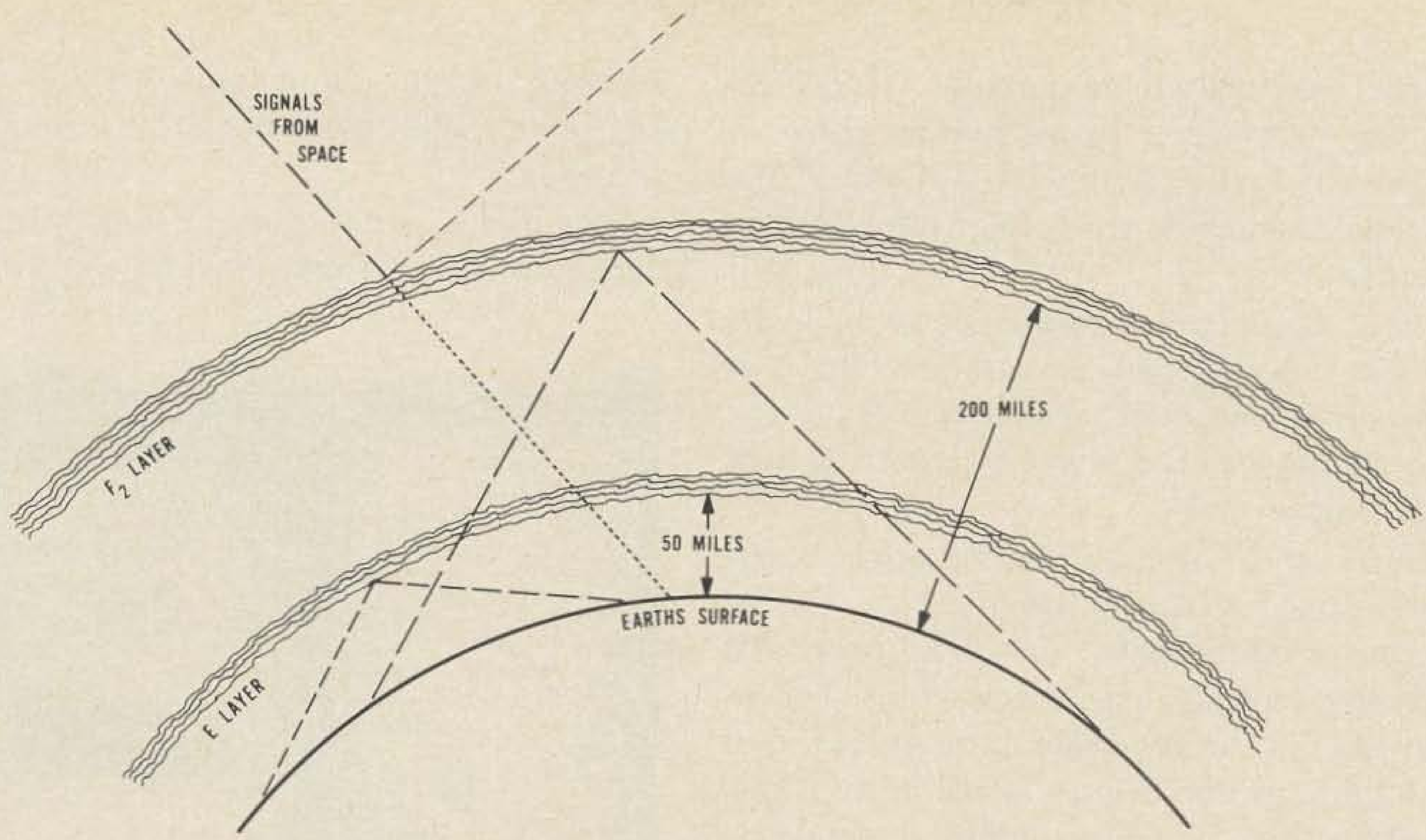


Fig. 5. The E and F ionosphere layers reflect signals from space as well as signals from earth.

atmosphere is transparent to medium and high radio frequencies during the night.

The ionosphere is not one solid layer but consists of a series of layers at different heights above the earth's surface.

At a height of about 70 miles, the first ionized layer (E) exists. The second layer consists of a single layer of ions during the night but splits into two separate layers during the day. The average height of the F layer is 175 miles.

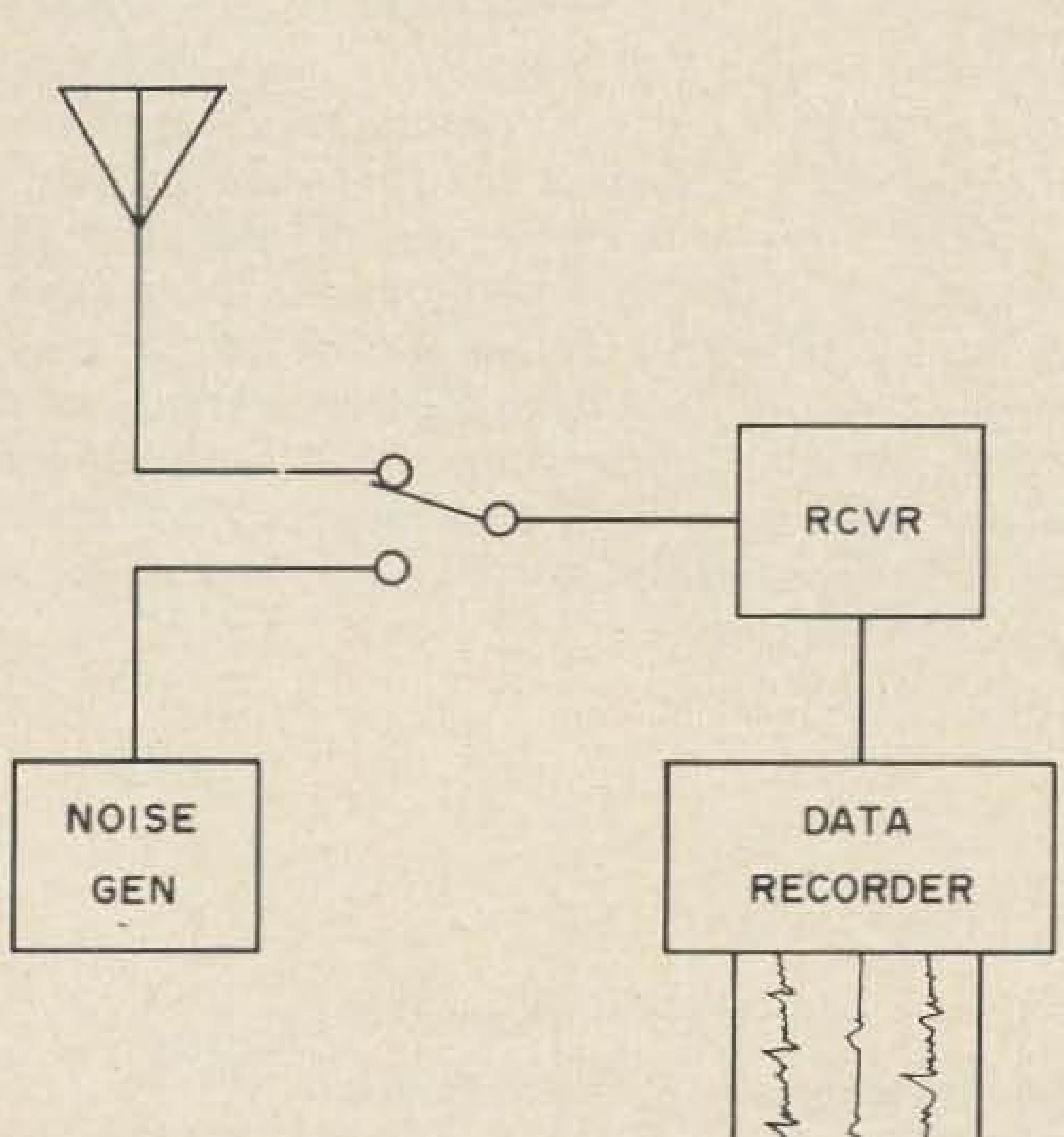


Fig. 6. Simplified data gathering system consists of a noise source, receivers and antenna, and a method for recording the incoming information.

The Basic System

Almost all radio telescopes in use today consist of an antenna, receiver, data recorder, and noise generator for calibration.

Figure 6 shows a block diagram of a simple system.

The receiver operates on the standard superheterodyne principle not too unlike a standard home television set.

An expanded telescope is diagrammed in Fig. 7. Note that the various stages of the receiver portions are displayed in greater detail.

A signal is induced into the antenna and is transferred to the input of the rf amplifier stage via a coaxial transmission line. The rf amplifier is usually a broadband device with a low internal noise and 10–30 dB of overall gain. The most important function of the rf amplifier is to establish a low noise level throughout the system. It is obvious that excess noise generated in this stage will be fed back and amplified along with the desired signal in each of the succeeding amplifier stages of the receiver.

The next stage after the rf amplifier is the mixer. This stage along with the oscillator combine to lower the output frequency to the intermediate frequency.

The oscillator is removed in frequency from the carrier frequency by a difference of the intermediate frequency. The oscillator can be made to operate either above or below the carrier frequency but always the difference must be that of the intermediate frequency.

This stepdown in frequency is the heart of the superheterodyne principle for it is easier to attain high sensitivity, selectivity, and stability at the lower frequencies than at the higher ones.

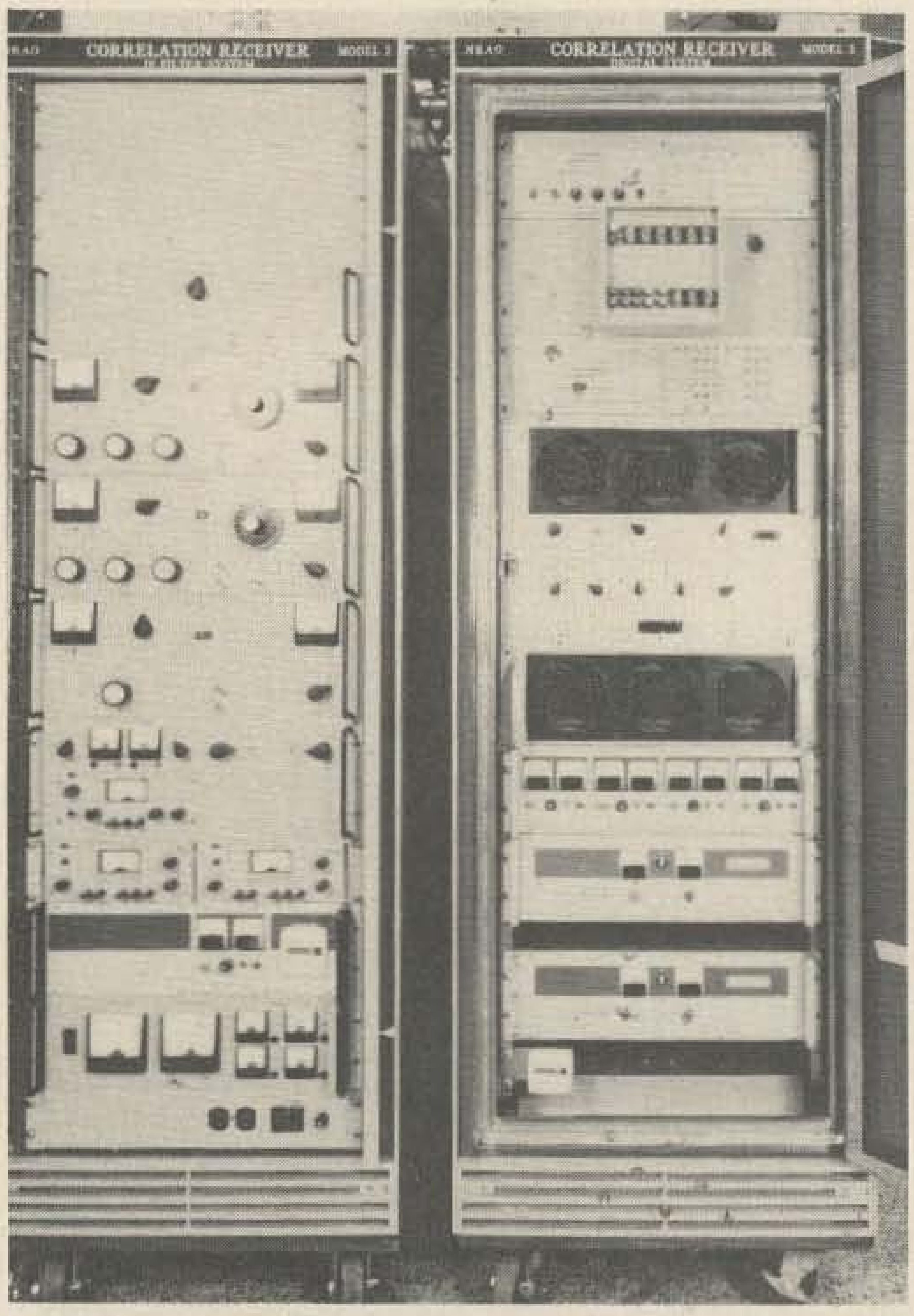
Just as the rf amplifier determines the noise level of the entire receiver, the i-f amplifier determines the sensitivity and selectivity of the entire telescope. The i-f amplifier is usually made up of at least 2 or 3 amplifiers; and 30 to 120 dB in total gain is the norm. The bandwidth depends on the type of signal the observer wishes to receive. If some discrete narrowband signal is being received the bandpass of the i-f amplifier must also be narrow. Such a signal might come from a spacecraft or satellite.

For natural radio noise a wide bandpass must be used, on the order of 3–6 MHz. At lower frequencies it is almost impossible to find 3 MHz with no other man-made radio signals which would interfere with the observation. As a consequence, the radio astronomer must be content with only a few kilohertz of bandpass at frequencies below 100 MHz.

After the i-f stage has amplified the signal and established the receiver's bandpass, the signal is sent to the detector stage, where the i-f is blocked by a diode, leaving only the variations which appeared on the original frequency.

After the detector, the signal is sent to either an audio frequency amplifier if the receiver output is a speaker or a dc amplifier if the final output is to be a pen recorder.

If a pen recorder is used a dc amplifier is needed to convert the signal to a varying dc



*This unique receiver was designed and built at the NRAO and is used for receiving spectral lines of elements which fall within the radio spectrum. The i-f amplifier is contained within the rack on the left. The i-f stage is the first stage inside the "shack"; this is because the rf amplifier and mixer stages are mounted out at the antenna. Several narrowband filters are located in the i-f stage to allow for a very accurate determination of frequency. The rack on the left contains the digital switching system, a memory bank, and various power supplies. (*National Radio Astronomy Observatory.*)*

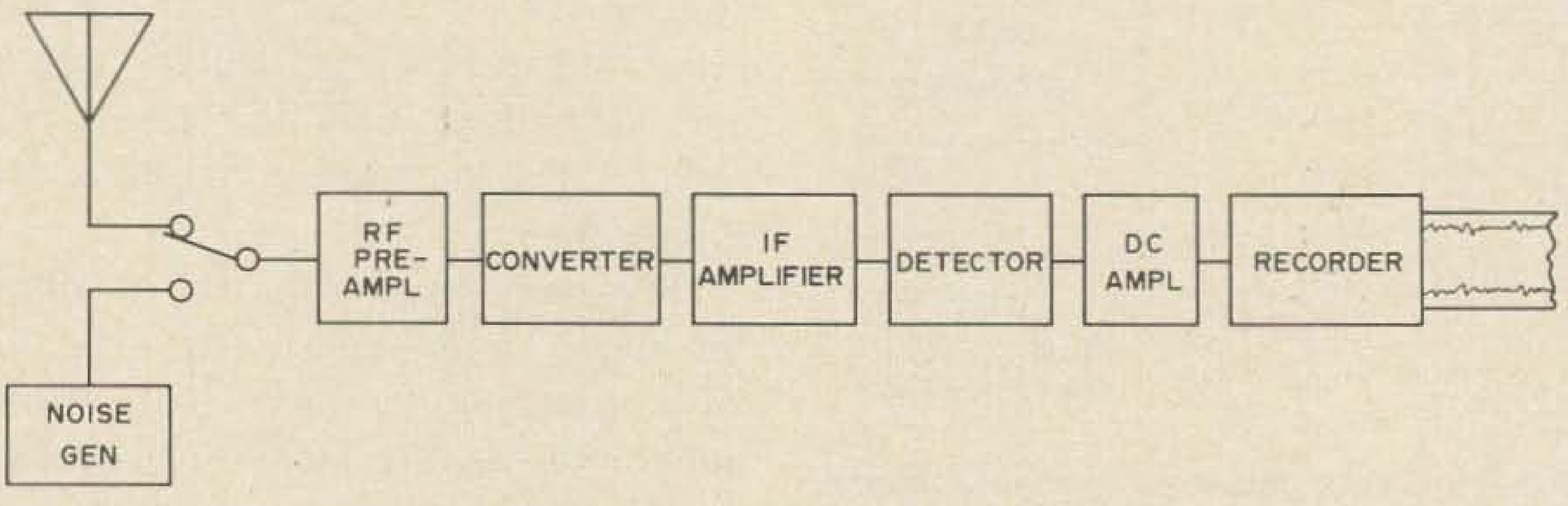


Fig. 7. Block diagram of a complete radio telescope system.

is equal to the frequency (f) divided by the speed of light (c).

Collinear. The collinear (phased array) antenna is definitely an "up and coming" antenna. The need for phased-array antennas has come about as a result of the need to track high speed missiles at close range, where it becomes impractical to turn the antenna mechanically. Many satellite tracking antennas as well as the ABM radars are of the phased-array type. During the 1950s and 1960s parabolic (and parabolic derivative) antennas were used. The first radar signals bounced off of the moon were made using a phased-array radar antenna.

Phased arrays like the parabolics are broadband antennas. Unlike the parabolic, which must be built to close tolerances, the phased array is not particularly critical.

Yagi Beams. Very high gains can be had with this antenna; however, it has one serious drawback: As the elements are added to achieve more gain, the frequency response is narrowed. This is not a real problem at frequencies below 30 MHz; however, at VHF and higher a yagi with the same gain as a collinear or parabolic would have a bandwidth of less than 1 MHz, which would impose serious limitations on performance. A parallel would be an optical telescope with both ends of the visible light spectrum filtered out.

If one specific narrowband signal were to be observed, such as a weather satellite, a yagi would be a superior antenna because interference several megahertz removed would be partially filtered out by the inefficiency of the yagis at those frequencies.

The yagi itself consists of one driven element and several parasitic elements. A longer element in back of the dipole serves as a reflector. Shorter elements in front of the driven element serve as "directors."

Helix Antennas. A quite popular antenna for telemetry and weather satellite acquisition is the helix. The helix is a compromise antenna. For a given size and cost the helix is slightly less efficient than the other antennas already described. However, it is extremely broadbanded and will receive signals polarized horizontal, vertical, or circular.

In a yagi which is polarized vertical or horizontal (depending on the position of the dipole), a loss of 2 dB occurs when a signal is received which is opposite in polarity from the receiving antenna.

A helix overcomes this loss even if the antenna itself does not have as much total gain as the yagi.

Problems the Amateur Can Work On

In this day of massive government spending what chance has the amateur in making a significant breakthrough? Actually, the chances are fairly good if the ham is willing to put forth some extra effort. Much listening can be done with standard ham gear; most communications receivers that cover 15 meters are capable of receiving noise from Jupiter and the sun and of hearing general galactic noise.

Some of the unknowns are:

1) How does the planet Jupiter produce its strong radio noise? Does it have something to do with the famous red spot on Jupiter?

2) How and why do sunspots usually appear on the surface of the sun at about the same time that ultraviolet energy causes changes in the ionosphere?

3) The radio observation of sun flares.

These unknowns still exist even though jovian noise, general sun noise, and sun flares may be received with relatively simple equipment; and many books, articles, and papers have been written about the subjects. Maybe, if *you* are not afraid to adventure into the unknown, it might be *you* who discovers the origin of jovian noise or the mechanics of a solar flare. The public library in section 522 has numerous books on astronomy and radio astronomy. You as an individual have the tools and much of the knowledge to again let ham radio make a meaningful contribution to science and technology.

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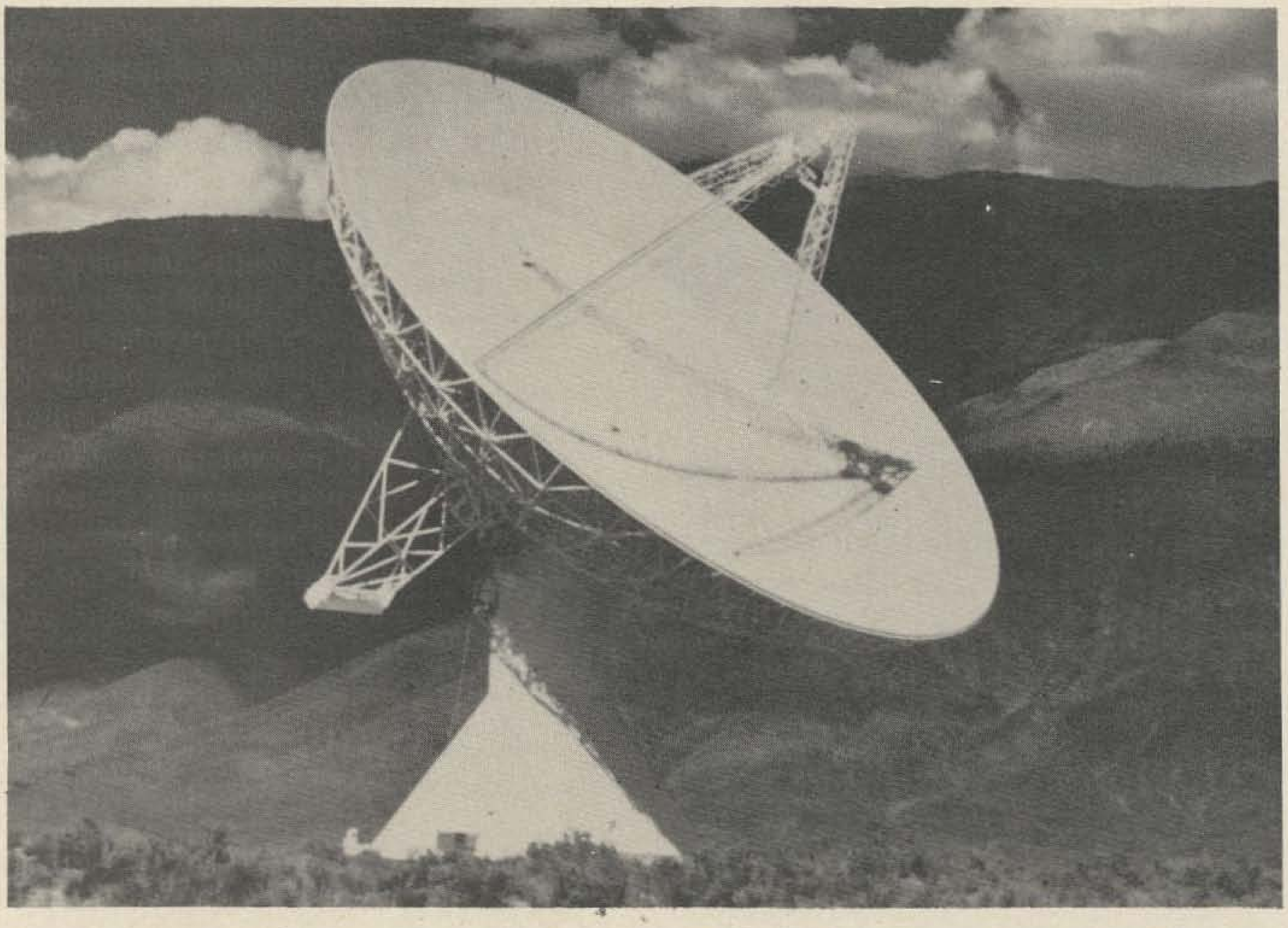

Owens Valley Observatory 130 ft telescope operated by the California Institute of Technology through funds provided by the Office of Naval Research and the National Science Foundation. (Owens Valley Observatory.*)*

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PATENTING YOUR INVENTION

Henry Hunter (the name is a *nom de plume*) is a lawyer and registered patent attorney. He holds degrees in both engineering and law and is a licensed amateur radio operator. Requests for additional information cannot be answered by the author and should be addressed instead to a registered patent attorney or agent of the inquirer's own selection. See the *Directory of Registered Patent Attorneys and Agents* cited in the bibliography accompanying this article.

Amateurs have contributed much to the advancement of the radio and electronic arts. Notwithstanding the dominance of research and development in recent years by the technical and scientific staffs of institutions, universities, and large corporations, the independent inventor has not become obsolete or even less effective. Large organizations have the advantage of funds with which to purchase equipment and the pooled talent required to utilize such most effectively, but true inventiveness – which is a more modest term for genius – is born, not bought. When God wishes man to discover more – or utilize one of – His wonders, He does not form a corporation, float a bond issue, or build a laboratory. Instead a child is born: a Marconi, a Morse, a Fleming, an Edison, or a Tesla. Although research groups and large laboratories will probably continue to pour forth discoveries and inventions, not all men of inventive talent will necessarily join their staffs, and individual inventors in small laboratories, basement workshops, and university carrels will also continue to conceive and discover a significant proportion of the inventions of the future.

While large research organizations and laboratories usually have patent counsel on their staffs or on retainer, individual inventors and smaller organizations usually do not. This article is not intended to serve that need, however, but merely to provide some general orientation and answers to certain common, general questions, and to point out the necessity of seeking competent professional advice immediately when needed.

Is Your Invention Patentable?

A United States patent may be obtained by any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement thereof, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any publication in this or any foreign country before his invention or discovery thereof, or more than one year prior to his application.

Patents are not granted for inventions that are useless or inoperable, for the literary content of printed matter, or for methods of doing business. Patents may be obtained, however, for designs and for certain types of plants.

Public use or sale of an invention in this country more than one year before filing a patent application, whether by or with the consent of the inventor or by another person, perhaps an independent inventor of the same idea, or perhaps one who has taken the idea without authority, will bar the grant of a patent. Additionally, use or publication of the invention in this country, before a patent application has been filed, may prevent the inventor from later obtaining foreign patents. Since it usually takes several weeks, at least, to prepare the drawings and specifications of a patent application, if an inventor wishes to apply for a patent on his invention he is usually well advised to consult his patent attorney as soon as possible after first making his invention.

In order that your patent attorney may give you an opinion as to the patentability of your idea and the probable costs of preparing a patent application, it is usually necessary that a preliminary search first be made on the patents previously issued by the United States Patent Office. This search usually takes three to four weeks to complete. Only a registered patent attorney or agent is qualified to render a professional opinion as to the patentability of an invention.

Will A Patent Guarantee a Profit?

A patent is a document issued by the United States granting to an inventor the right to exclude all other persons within the United States from making, using and selling his invention within the scope of the patent claims for 17 years from the date the patent issues. The patentee can manufacture, use, and sell his invention within the United States so long as he does not infringe on someone else's patent (although he can also do these things without a patent). He can sue and recover damages and an injunction against those who infringe his patent. He can also assign all or part of his patent to others or license others to manufacture, use or sell his invention in all or certain parts of the United States. These are the usual ways in which patentees may profit from their invention. A patent is a badge of the inventive ability of the inventor and may afford him a measure of personal satisfaction in addition to whatever monetary reward it may bring to him.

The commercial value of a patent to a patentee is extremely difficult to appraise. Where the inventor is "ahead of his time," the invention may not achieve commercial success for a considerable length of time. Sometimes the invention may have its most successful application in a field of use quite dissimilar from that in which the inventor first sought to market it. Sometimes, too, due to high manufacturing costs, firmly established competition, failure of the public to accept the invention, or for other reasons, the inventor is unable to realize any financial reward from his patent, no matter how ingenious and useful it may be.

The final test of commercial value lies in the market place. Until a patent issues to the inventor, however, or at least until a patent application has been filed with the Patent Office, an inventor who reveals his invention to a prospective purchaser does so at the risk of losing it. An expressly confidential disclosure can reduce this risk, but many manufacturers will refuse to examine an invention revealed to them in confidence for fear of subsequent claims against them in the event that they, themselves, have invented or are working on the same idea. On the other hand, if one to whom an inventor discloses his invention, even in confidence, steals it, the inventor's remedy in the courts may be extremely expensive, time-consuming, and uncertain. If the invention is believed to have any substantial value, it should be worth protecting by the filing of a patent application at the earliest possible date. The filing of a patent application establishes with the Patent Office a date of invention for the applicant and gives him some practical protection for his claim of priority and exclusive ownership of his invention so that he can thereafter state that there is a "Patent Pending" on his invention and reveal it to others with more security. Consideration should also be given by the inventor to the desirability of filing foreign applications in those countries in which the invention may have commercial value within one year of the United States filing.

There is no objective test of the personal value of a patent. For some, the prestige of having a patented invention can result in advancement or job security. For others, personal satisfaction alone may, or may not, be worth the expense of seeking a patent. This is an individual matter which the inventor alone can decide. A patent will, however, give your invention legal protection, and hence make it a more saleable commodity, but it will not guarantee a sale nor a profit.

Cost of a Patent

First of all, there is no guarantee that the Patent Office will grant you a patent on your idea. If you apply for a patent, your patent attorney will prepare a patent application for you: a technical document containing an oath, a specification precisely and fully describing your invention in certain form, and a number of claims "staking out" your invention. In preparing and prosecuting your patent application your patent attorney is striving to obtain the broadest possible claims for your invention, so as to reduce the risk of some other inventor "inventing around" your invention, and to give you the strongest possible patent. It usually takes upwards of a month or six weeks to properly prepare the application. The Patent Office, after an extensive search of its records, allows the claims or, more frequently, objects to one or more of them as claiming too much. Your patent attorney may then respond by amendment of the application and by argument. This is called prosecution of the application. This process is repeated until the Patent Office decides to take final action, at which time it may either refuse to issue a patent at all or may issue a grant with only those claims which it has decided to allow. Your patent attorney may, if you elect to do so, appeal any rejection first to the Board of Appeals of the Patent Office and then to either the Court of Customs and Patent Appeals or to the United States District Court.

There is an additional proceeding known as an interference in which a patent application can become involved in the Patent Office. This proceeding is held to determine which of two or more applicants for patent, or an applicant and a patentee whose patent has been issued less than one year, is entitled to patent certain claims. While the prosecution of a patent application may take from six months to several years, if an application becomes involved in an interference proceeding the prosecution period may necessarily be extended an additional year or more.

It is thus impossible to foretell how much, in all, it will cost to seek a patent on a particular idea. However, your patent attorney can usually give you an estimate, in advance, of the cost of preparing and filing a patent application on your invention. Also, after the position of the Patent Office on your case is revealed by the first "Office Action," if prosecution is needed he will be able to give an estimate of the cost of preparing and filing a response thereto. The cost of further responses to Office Actions can be similarly estimated by him, in advance, after each Office Action is received. These services, and the charges therefor, are usually spread over several years. Further, you are at liberty to abandon your application at any time, if you should wish to do so.

The Patent Office minimum filing fee for filing a patent application is $65.00, but, depending upon the number and type of claims, can be $100.00 or more. If an assignment is to be recorded at the time of filing the application, the Patent Office requires an additional $20.00 recording fee for this purpose. There is in adition a final fee required by the Patent Office when a patent is issued. This charge varies with the

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PA3-1ED	50-250mw	60-80W	"
PA3-1DD	5-15W	60-80W	136-175MHz
PA3-1EE	50-250mw	80-120W	"
PA3-1AE	.75-3W	80-120W	"
PA3-1DE	5-15W	80-120W	"
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nature of the case, but usually approximates $124.00 to $135.00. Drawings required to accompany the application must be made by an experienced patent draftsman and cost from $40.00 to $45.00 per sheet. The Patent Office has special requirements which drawings must meet or be rejected and with which only an experienced patent draftsman is familiar. The number of sheets of drawings required will be determined by your patent attorney and depends upon the complexity of the invention and the particular views thereof necessary to supplement the specification.

The fee of the patent attorney for preparing the application depends upon the amount of time which must be spent in preparing the specification and claims and conferring with the patent draftsman plus, if not billed separately, time spent in conference with the inventor relative to the application. Separate statements are customarily rendered for consulations when no application is filed, and for consultations concerning matters not germane to the filing of a United States application.

It might be said that an inventor should be prepared to expend a total of at least $650.00 to $800.00 to file and prosecute through to final Office Action a United States patent application covering a simple mechanical invention, and from $800.00 to $900.00 on a moderately complex mechanical invention or a simple chemical or electrical invention. The cost of seeking a patent in more complex cases increases proportionately. These estimates are in addition to the cost of the usual preliminary patentability search and opinion, which is usually from $100.00 to $200.00, depending upon a number of factors. Of course, if the patent application becomes involved in an interference proceeding or if an appeal is taken, considerably more expense may be involved. All of these quoted figures can be expected to change from time to time, in step with changes in the required government fees and the fees for other kinds of professional services. The expense of filing foreign patent applications depends upon the country and in many cases must include the cost of translations.

Before investing in a patent application and its probable subsequent prosecution, an inventor or his financial backer is almost invariably well advised to obtain the opinion of his patent attorney as to the patentability of the invention, based upon a preliminary search of the Patent Office records made by an experienced patent searcher selected by the patent attorney.

If the inventor wishes to assign an interest in the invention to another person – as, for example, to a financial backer in return for financial assistance in preparing and prosecuting the patent application – such an assignment may be made at the time the patent application is filed, without the necessity of waiting for a patent to issue.

How to Apply for a Patent

Step 1. Reduce your idea to written form, describing it completely in writing and also preparing a simple sketch or sketches to illustrate it.

Step 2. Show and explain your invention to two people whom you trust and who are technically capable of fully understanding the structure and operation of your invention. Have them sign and date a statement to this effect. Keep this.

Step 3. Show your sketches, written description, and any model you may have (though a model is not essential) to a registered patent attorney or agent. This can often be done initially be mail, but it is usually desirable for the proper protection of your invention that he be able to discuss the invention with you directly, in person, before preparing the application. Complete communication relative to the invention is essential to one seeking the broadest possible patent protection thereof. For this reason it is usually best to consult a registered patent attorney or agent in your state in preference to one with whom you can communicate only by mail.

Step 4. If your patent attorney or agent recommends a preliminary patentability search, advance the expense thereof, allow him to obtain such a search from a patent searcher selected by him, and request him to render his opinion thereon.

Only a patent attorney or agent registered by the United States Patent Office is qualified or licensed to give you a professional opinion as to the patentability of your invention, and registered patent attorneys and agents cannot ethically, and do not, advertise. Registered patent attorneys and agents are subject to the Rules of the United States Patent Office and must conform to the standards of ethical and professional conduct generally applicable to attorneys before the courts of the United States. Further, registered patent attorneys must conform to the Canons of Ethics of their respective Bar Associations.

Step 5. On the basis of examination of the prior patents revealed by the search and the professional opinion of your patent attorney or agent as to the patentability of your invention, you will then be in a position to decide whether or not you wish to file a patent application. If so, your patent attorney or agent will be able to quote you the cost of preparing and filing the drawings, specification, claims, petition and oath which constitute your application for United States Letters Patent on your invention.

Hunter

Publications Relating to Patents and Trademarks

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Directory of Registered Patent Attorneys and Agents, Arranged by States and Cities, as of Dec. 1968. Catalog No. C 21.9/2:968. $1.50.

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Rules of Practices in Patent Cases. Jan. 1970. Subscription price: $2.00; 50¢ additional for foreign mailing. [RPC] Catalog No. C 21.14:P 27/970.

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Bill Hoisington K1CLL
Far Over Farm Road,
Peterborough NH 03458

20 dB BEAMS

In times past in order to make an extended expanded beam with both vertical and horizontal spacing greater than a half wave, I have gone to great trouble and expended lots of time on impedance matching leads from antenna elements to a common fifty ohm point, like with the 32 elements on two meters in the following paragraph.

Two 50 ohm leads from two 2-element yagis brought together makes a 25 ohm point, and then a coaxial quarter wave transformer is needed to bring it back up to fifty ohms again. When these two yagis were matched and phased together, another four elements had to be matched, and then go through the whole affair again. I did this eight times, plus a lot more like 4 and 4 (four times!), then 8 and 8 and then 16 and 16, and finally got a beautiful 32 element job with exciting gain, but *heavy*!

There were so darn many quarter wave transformers, pieces of RG8/U, connectors, etc., that I couldn't even haul my regular mast up with this heavyweight on top. For about one day and night I did get it up on a "jury-rig" out by the barn and started operating and working areas I never knew about before, on strictly ground wave without an opening. The second day a high wind started the mast swaying, and with the weight of all those matching sections and cables it was too much.

Another Wrong Path

You can profit by my mistakes and save *your* time. In any Read and Do program it is easy to make a false start with an idea that looks fine from a distance but soon bogs down in "details, details."

This is what happened with the projected use of the new 300 ohm shielded antenna cable. The idea here was to wire up six small yagis with this cable, join them together at one 50 ohm point, and proceed. Here's what happened.

1. The cable proved particularly difficult to handle. It is quite stiff, and the 300 ohm wires are quite small and get cut off easily. This probably could have been overcome.

2. The problem develops. Most TV antennas are designed for 300 ohm cable, so that is no problem for the TV people, but most amateurs need 50 ohms.

3. The problem gets worse. This new cable is designed to be 300 ohms under *balanced* conditions. When *not* balanced, it no longer is 300 ohms because those two wires are close to the shield. And I certainly wasn't ready to put 432 mhz baluns on 16 small yagis (on each one!) much less on 32 of them if a second 32 element was needed for that last 3 db of gain.

4. It also looked now as though it would need a balun for each cable at the distribution box end also. That did it. Crossing off the use of that nice new shielded 300 ohm cable (anybody for 100 feet at half price?), I went to the 50 ohm unbalanced line box you see detailed later in this article,

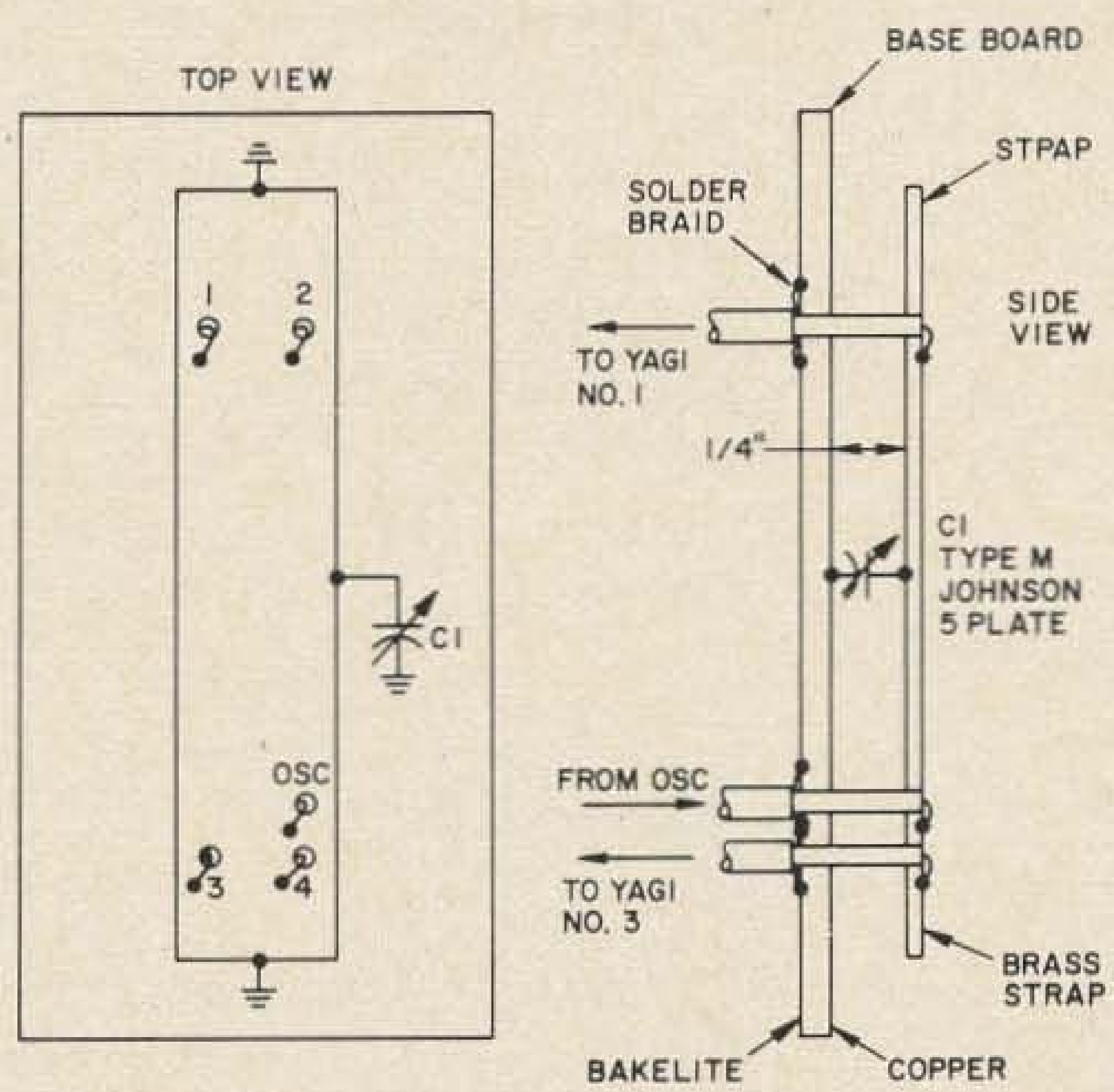

Fig. 1. Strap line rf distribution box.

which not only did a fine job, but removed the limitation of having exactly six, no more and no less, small beams to add together. Several days were lost on *that* one. Be my guest.

A Right Way To Do It

The making up of big beams of an arbitrary number of elements by adding one or more 2 element yagis at a time is accomplished by the use of a distribution box. We will start with the simple strap line type of unit and work on the basic 2, 4, and 8 elements first.

This strap line rf distribution box is shown in **Fig. 1**. With this little gem you can add on an uneven number of 2 element yagis if you want, and have them matched and phased properly. I have just finished checking this. Not that you would normally be attracted by a combination of 3, 5, or 7 small yagis, but there can be times when it might be convenient. This can come about on six or ten meters when you have a two-over-two and want to add another two, as in **Fig. 2**.

Overall Beam Size

As always in vhf beam work, mechanical considerations creep in, especially in a mid-winter blizzard! "If the beam stayed up over the winter, it was too small," is the old-time vhf man's slogan.

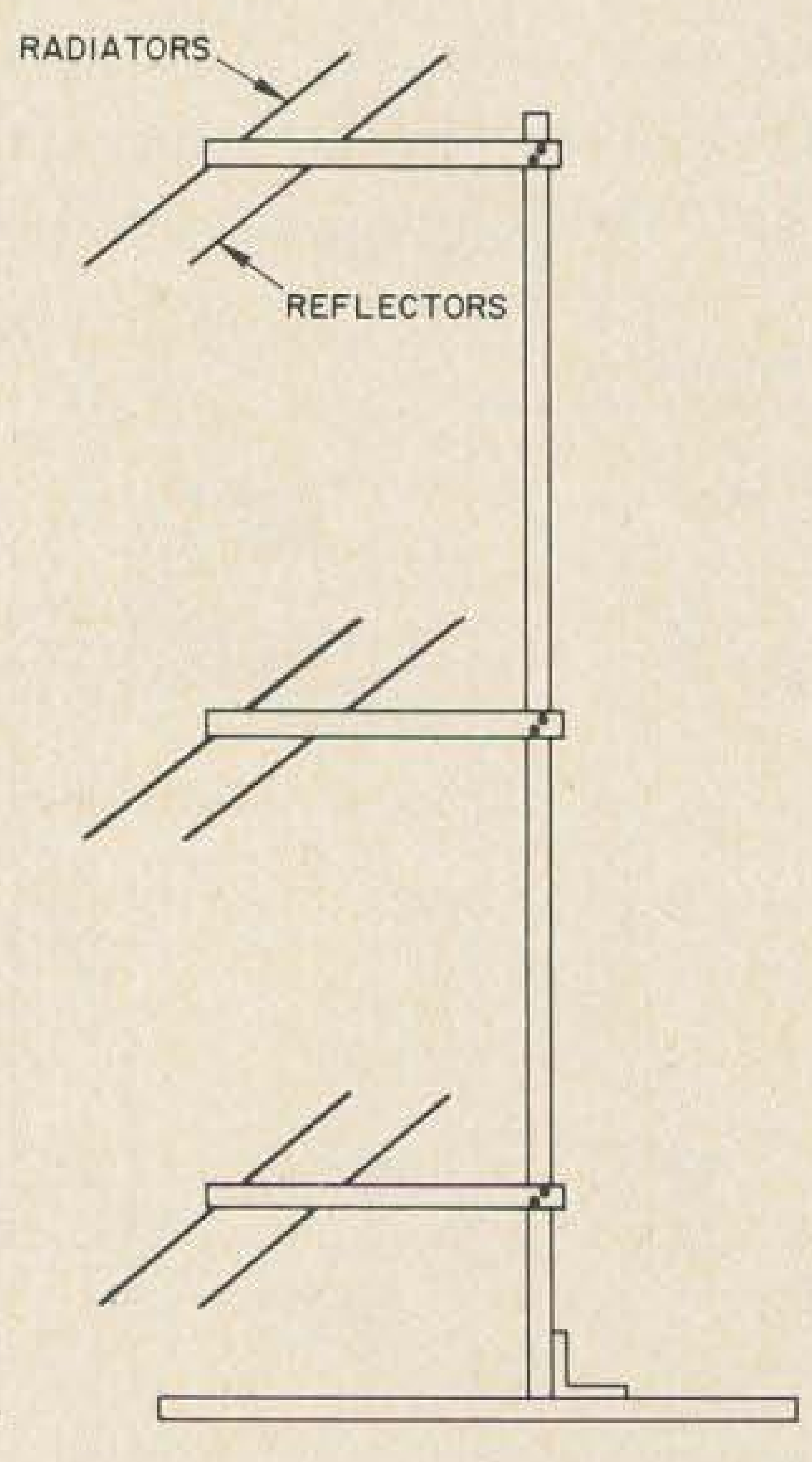

Fig. 2. 3 yagi beam.

Instead of using two-element yagis, you can increase your total power by using more than two elements per yagi. Your inter-element yagi spacing will change then, so watch that item. Some examples will be shown later. I just checked again yesterday for maximum-gain interspacing on 432 with the "standard" 2 element yagis described herein. Maximum gain side spacing radiator tip to tip is 10 inches. Vertical spacing is 18½", CC (center to center of elements).

This outlines the useful capture area and shows the fallacy of the half wave type of spacing, if you want to get the maximum gain from all that aluminum you bought, put together, and are trying to keep way up there.

Details of the "Standard" Two-Element Yagi to Get You Started

I have had good luck with aluminum clothesline material, especially for indoor

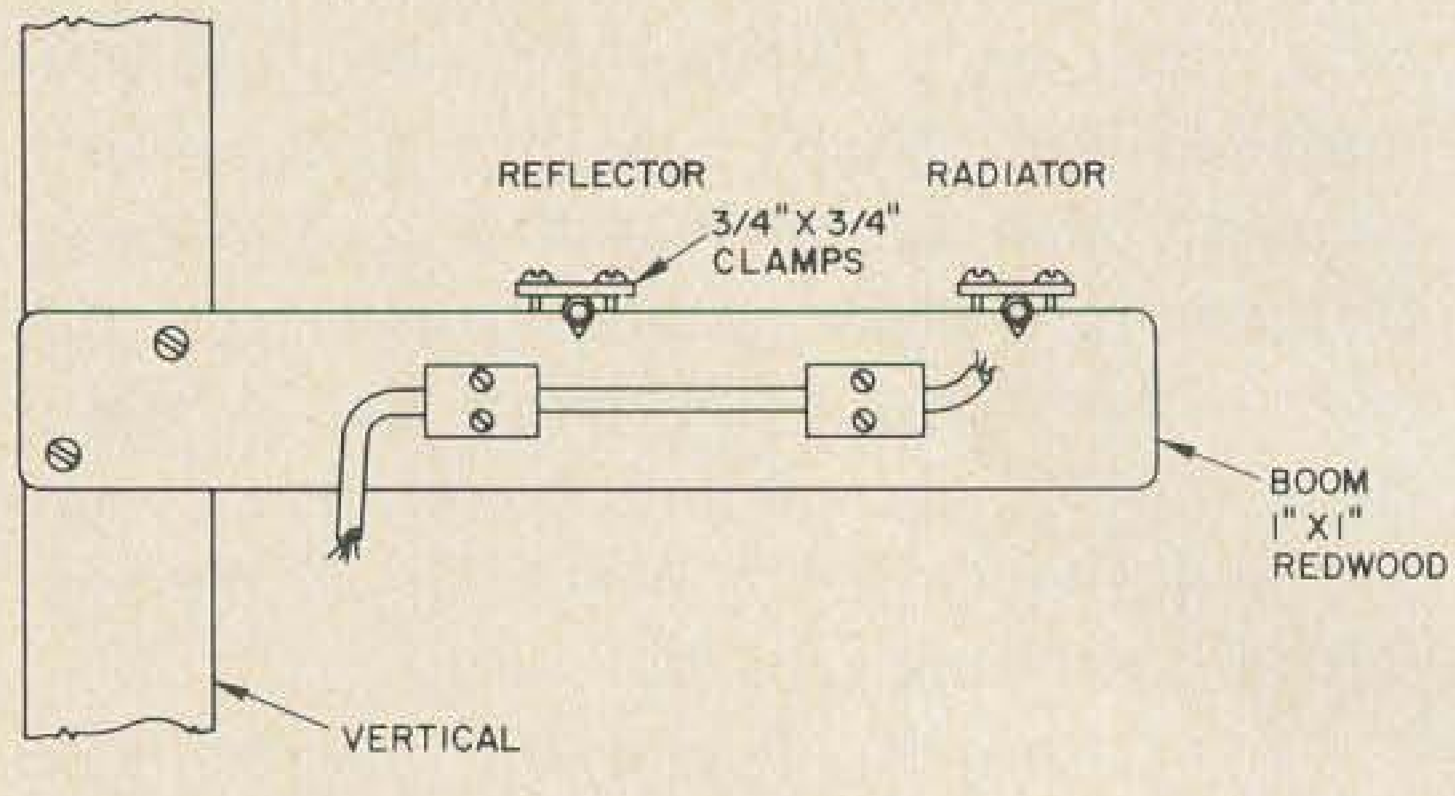

Fig. 3a. Side view, basic 2 element detail.

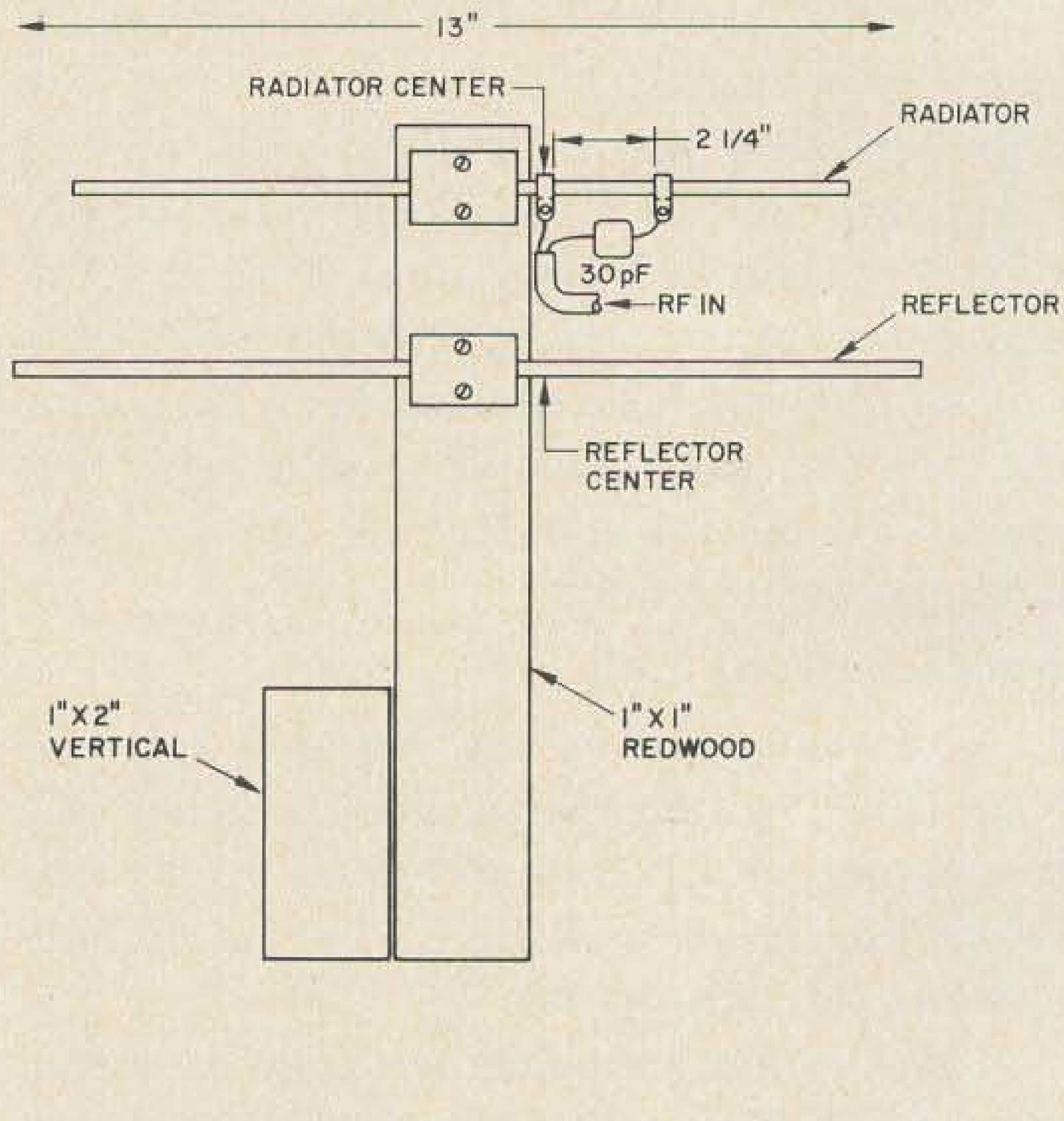

Fig. 3b. Top view, basic 2 element yagi, 432 mhz.

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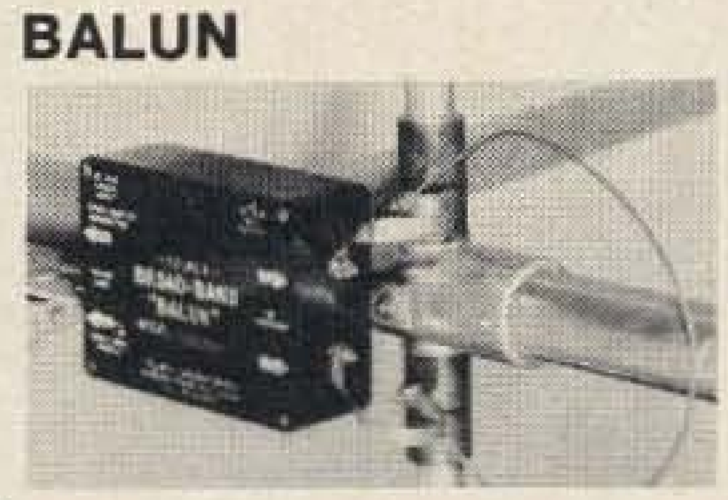
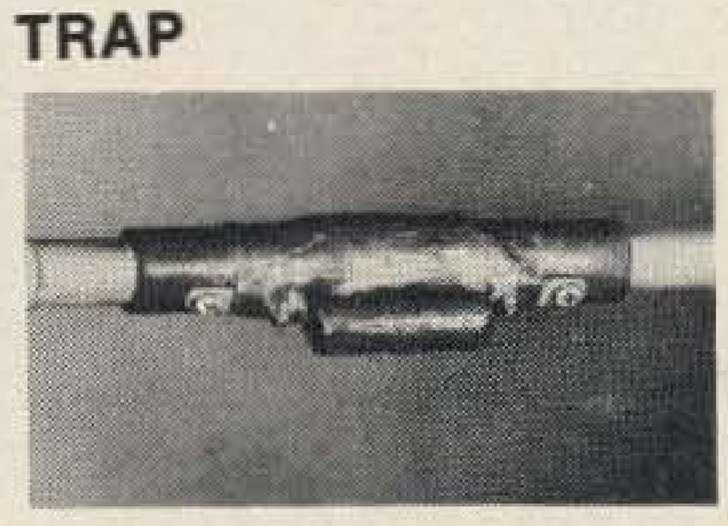


TRAP



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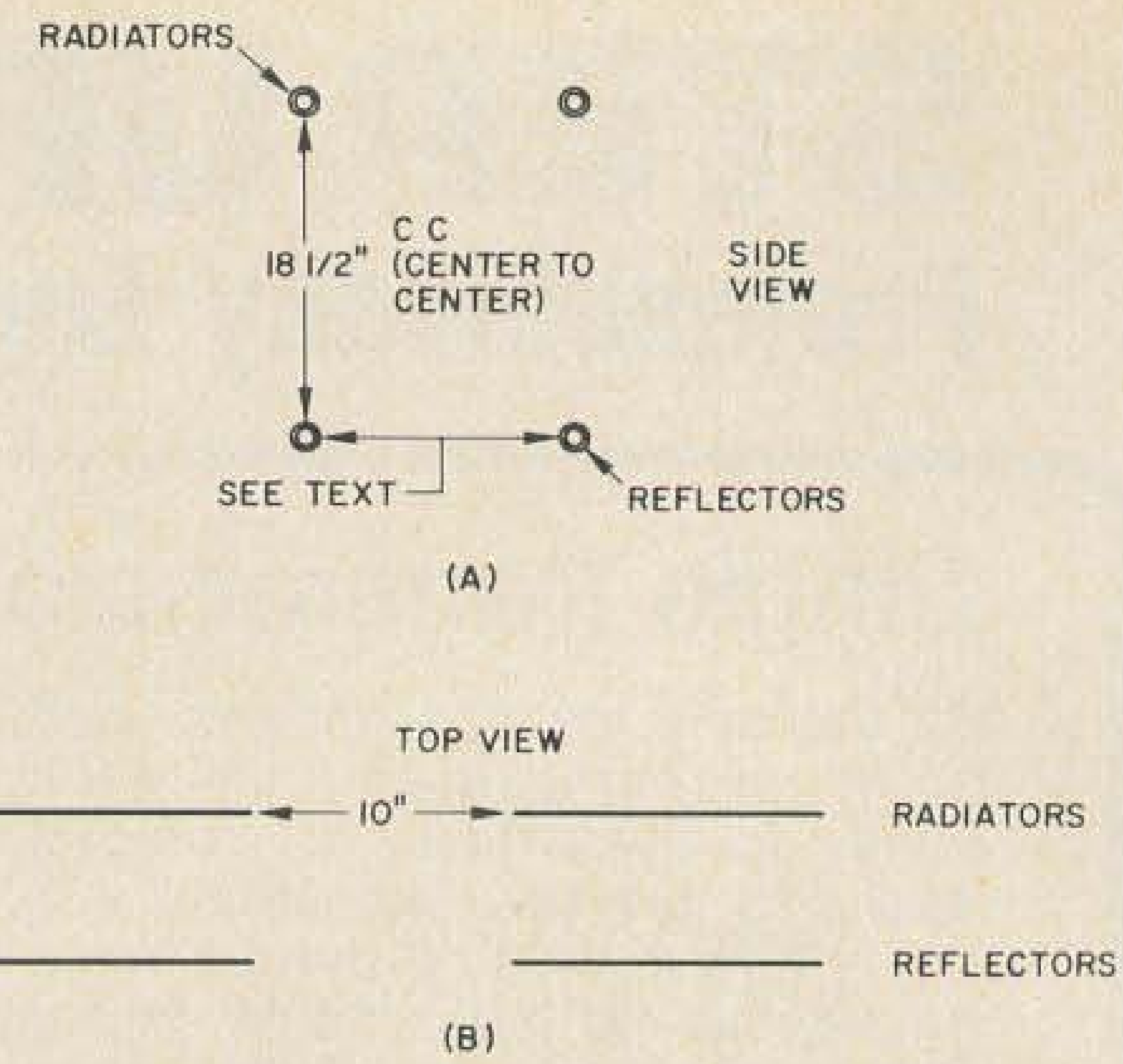

Fig. 4a. Element spacings, basic 2 element yagi.

and mobile work. If you accidently snag it on something, no harm done, just straighten it out and keep calling! It also can be found in almost every hardware store.

Fig. 3a shows some details and the use of the 1 by 1 redwood, also handy in most lumber company stocks.

You can make up lots of linen-base or fiberglass-base bakelite ¾" x ¾" cable and element holders, if you're shooting for the big beam. Remember, as far as booms are concerned, you have a choice between a large number of 2 element yagis or a smaller number of 5 element ones. I hope to find a good balance for you on this matter before I'm through.

Fig. 3b is the top view of the same basic two element job. All this work is done on 432 mhz, which can be translated to other bands by scaling up or down. However, my advice is not to trust this scaling implicity. Check it out with a small antenna range yourself. I even do this on twenty meters, and find that I can light a bulb in an aluminum dipole *five hundred feet* in front of a good 20 meter 3 element beam (the kind I used to make an sell at UHF Resonator Co., Rye, NY). I'll admit there was a good kw behind that beam at the time.

The basic 2 element described is inexpensive, but not "cheap." By the time you're all done and get that still-far-ahead 20 db gain, there will be lots of time and work spent by you.

The joint between the cable, center, C1 and its mechanical support can be improved for outside work. I have snarled this item on

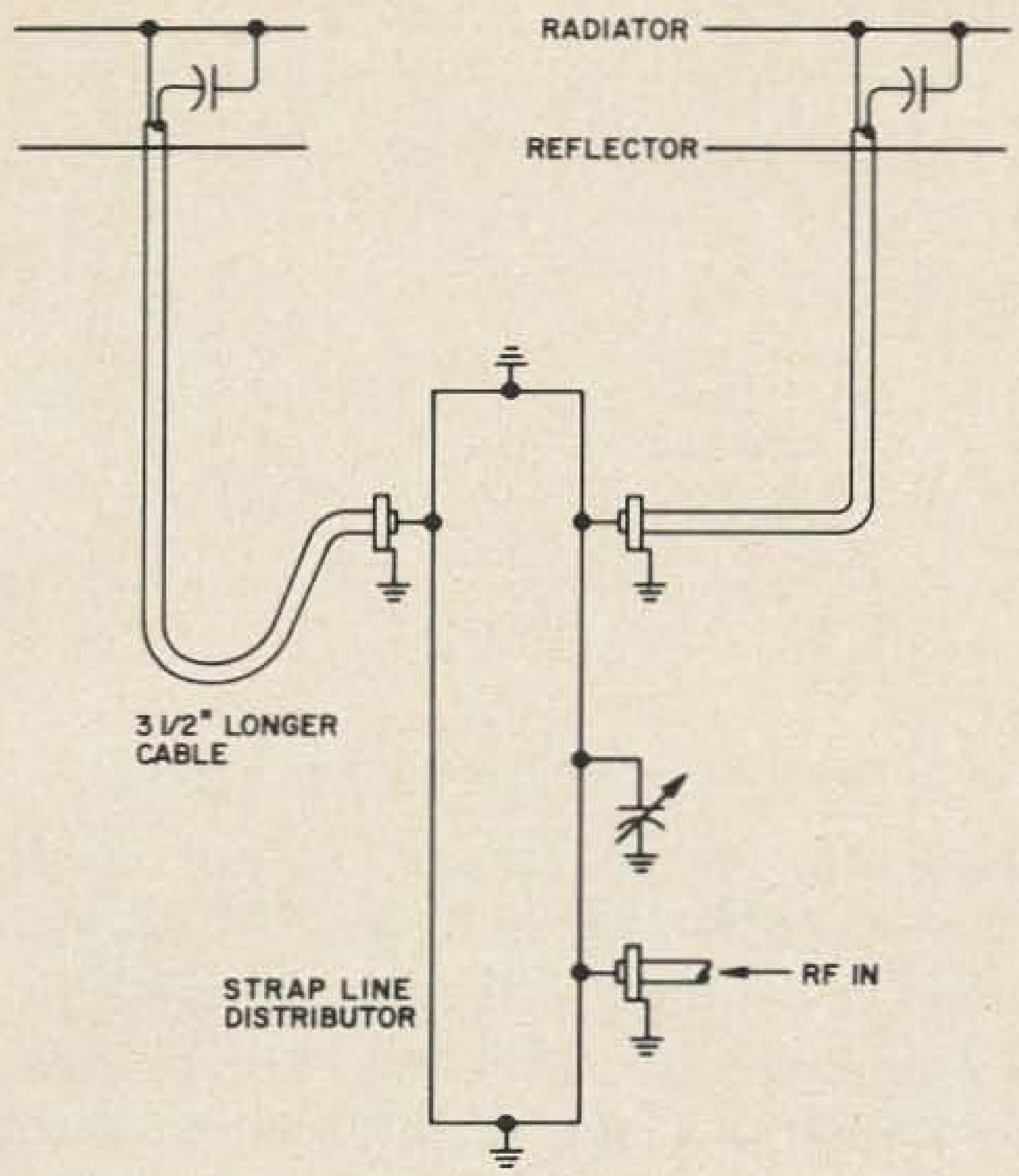

Fig. 5. Unequal cable length set up.

branches and been off the air on top of a mountain more than once! One of those little plastic boxes will do the trick for an enclosure.

The 3 DB Gain of the Second Yagi

Just finished the second one and hooked it up using the half wave distribution box (rf that is) shown in **Fig. 1**. Wow, the old meter sure climbed! Haven't checked yet for sure by the distance method, but it looks like at least 3 db, providing the diode is in a portion of its curve which is reasonably linear.

Figs. 4a and **4b** show the maximum gain spacings found, as mentioned before.

Effect of Unequal Cable Length Feeding the Small Yagis

Using the test setup shown in **Fig.5**, a 3½" cable was added to cable no. 2 to check the effect on the phasing using unequal cable lengths. It worked out exactly as it is supposed to, causing the placement of yagi no. 2 to move forward several inches for maximum gain. The added cable length causes a delay, which is compensated by putting yagi no. 2 nearer the receiver. This points up the desirability of possibly slotting the boom bolt holes to allow a final phase tune-up. So far I do not intend to do this, as I am counting on reasonably equal cable lengths to put the individual yagis in phase, but it is interesting to make it check and be sure of the effect. And then, you might just need it.

The "Parasitic" Colinear Effect

While tuning up a four element job as in **Fig. 5** and comparing gains with and without yagi no. 1 plugged in, I found that the *presence alone* of yagi no. 1, without being attached to anything, caused an increase from 10 to 13 on the meter dial, while plugging it in again jumped the meter to 15 or 16, where it should be for the full four element system. Unplugging it and removing it from the vicinity of the test stand caused the meter to register ten, which it should be for the test set-up involved when using only one yagi. So, for a gain check, remove the whole yagi, not just the plug!

This is the first time I have observed parasitic effects from colinear type elements out on the side. Might be some possibilities there.

"Insertion Loss" of the RF Distribution Box.

This business of insertion loss, a favorite term of precision engineers, only becomes important for you when it is large enough to be measured with your home-brew equipment. Naturally enough, when an engineer is handed a ten or twenty page specification from a military agency, and it says "insertion loss shall not be greater than 5 db," he's got to get crackin' on account of a little item called "Source Inspection" where some Civil Service lad from the military agency involved comes to the plant trying to ship some of those contracted items and says, "What about the insertion loss?"

With the four element beam being worked on, the insertion loss of the rf

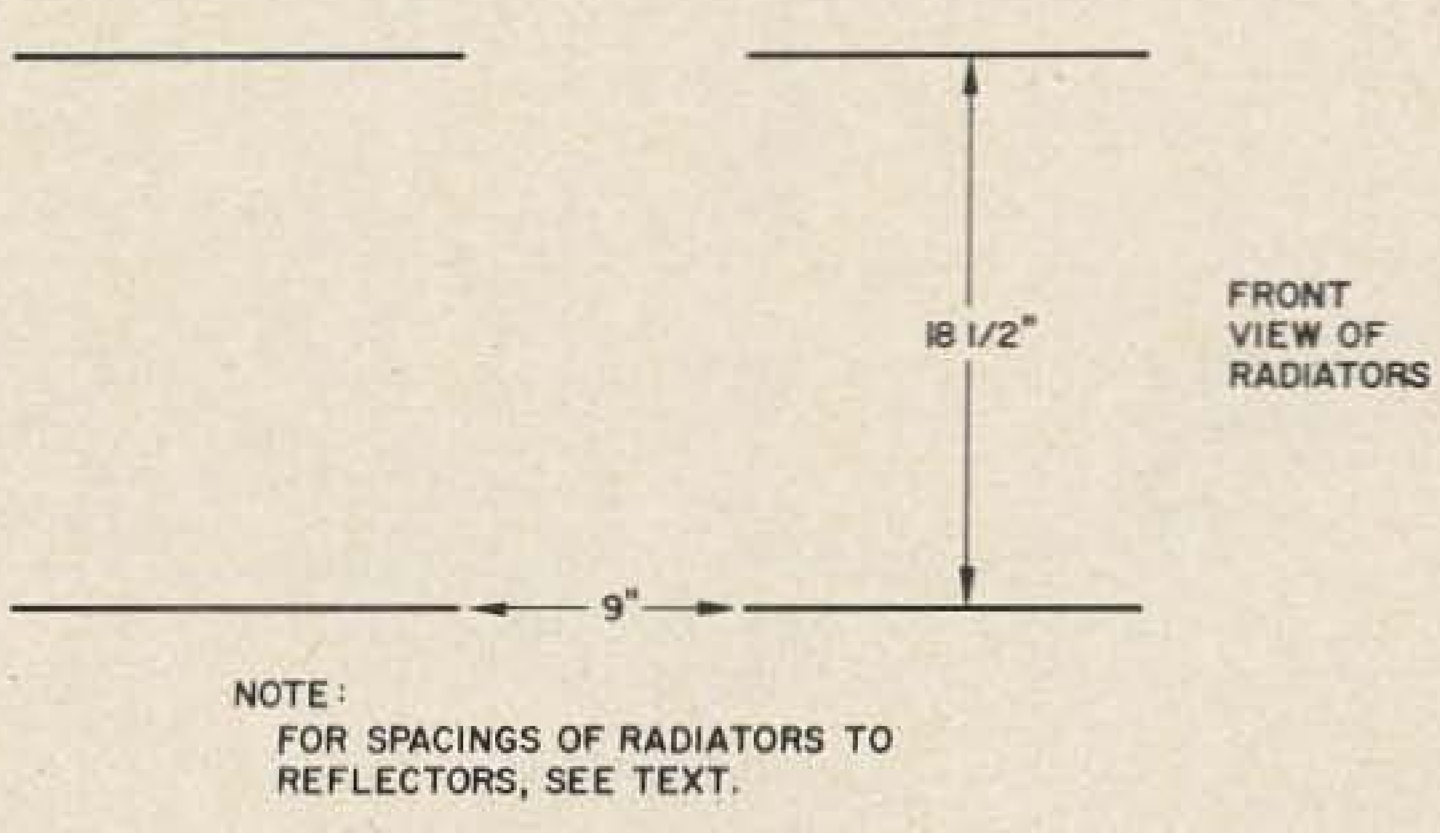

Fig. 6. 8 element spacings.

distribution box being used (Fig. 1) cannot be found to any great exactness because it is so small. As a matter of fact, checking the 2 element beam with and without the distribution box, at times it even shows a gain with it. There is a possibility that it is acting like a "secondary" cavity sometimes used with certain microwave oscillators to stabilize and increase the total Q of the system and raise the output. At any rate, it is certain that good rf distribution boxes can be made for amateur uhf at low cost.

Six and Eight Elements

Just for fun I tried out the gain from the addition of only one 2 element yagi to an existing 4 element beam, and sure enough, it had lots of gain.

A word of caution for indoor, table-top antenna work. If your receiving antenna is too close, (example, only six feet) it is possible that its main cone of reception (10 db points in this case) will be too narrow to see the additional third yagi in question. In this case you will not register the real gain on the meter.

Series Coupling Capacitors and the Strap Line Resonator

The use of the strap line resonator only a quarter of an inch from the ground plane evidently has a further advantage. Looking at Fig. 1, series capacitors can be added between the strap line and the ends of each cable center-conductor. However, in all the

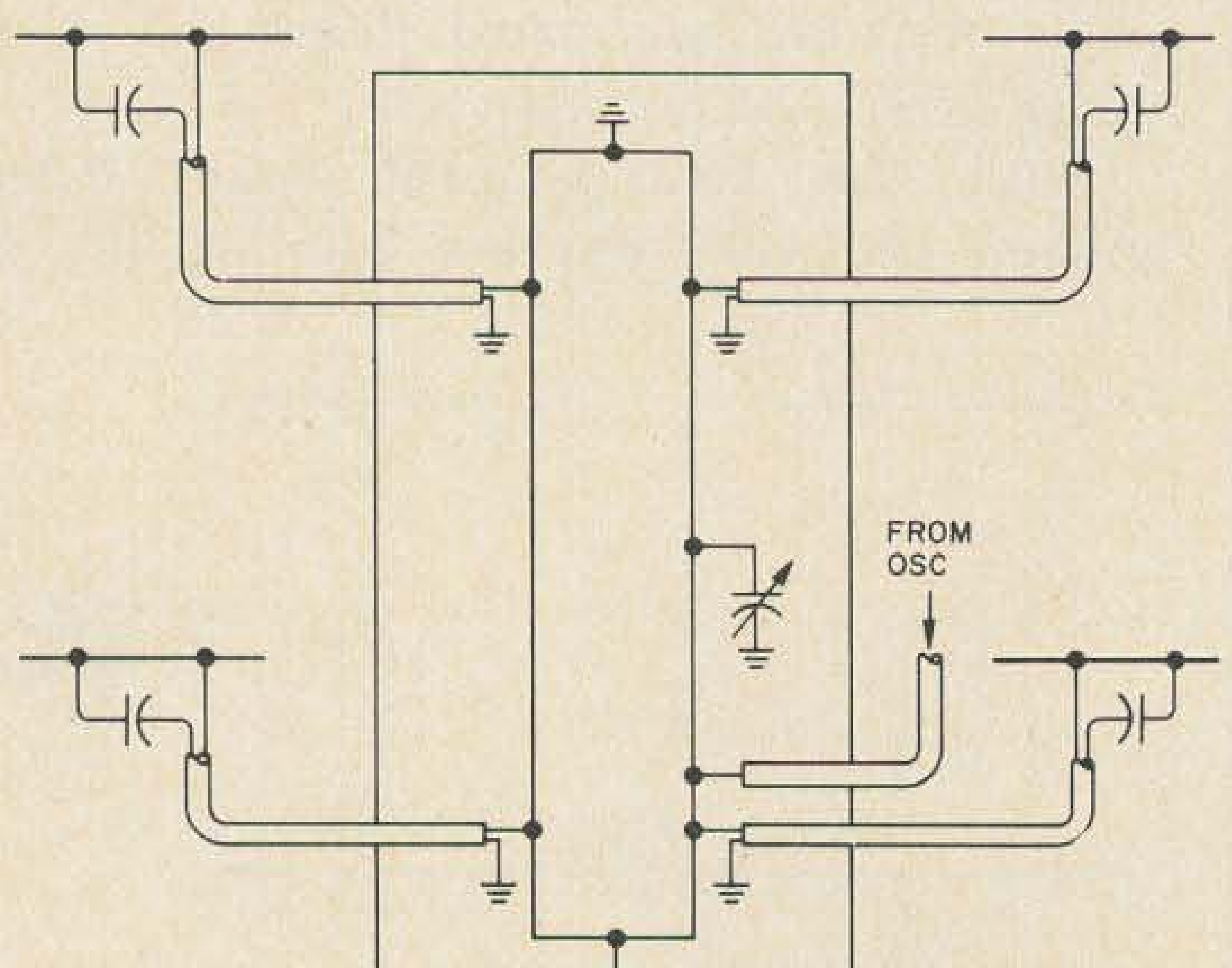

Fig. 7. Cabling diagram, 8 element.

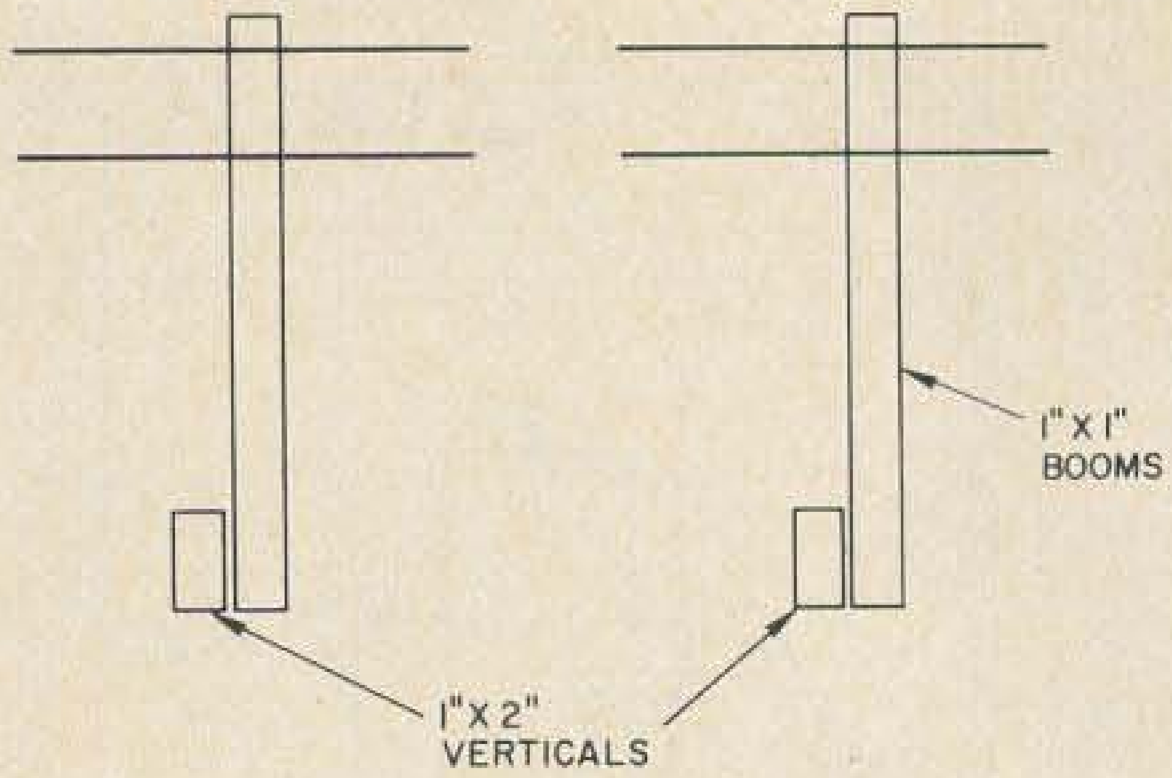

Fig. 8. Mounting detail, top view.

checks run so far, these are not needed. Theory says that when the center-conductor leaves the confines of the coaxial cable, as at the connection to the strap, inductive reactance begins to build up and requires the use of a series capacitor to cancel the inductance. Evidently the distance of ¼ inch is too small to notice at 432 mhz. As you can see in **Figs. 1** and **7** the four 50 ohm individual yagi cables are soldered directly to the strap.

Basic 8 Element Beam

Fig. 6 shows the basic 8 element beam with the final spacings of the elements and yagis. D, the spacing between radiators and reflectors, is a little controversial at present. D1 equals 2¼ inches, D2 equals 2½, and D3 and D4 equal 3 inches. This is probably due to the Gamma match capacitors, in which case one percenters may be called for. Will see what the answer is with the "Big Beam." Maybe a final tune-up point of this kind will give you that last db you're looking for.

Fig. 7 is the schematic of the 8 element, and **Fig. 8** shows boom mounting detail.

The gain of this basic 8 element beam looks very good. In the second part of this "20 DB Beam" article careful gain measurements using the distance method will be given.

The dipole; 2 element; 8 element; a 14 element yagi tuned up for maximum gain; and the 16 and 32 element beams being designed at present will be measured. Several other combinations may be tried as well, such as four 5 element yagis, four 10 element yagis, etc. *Another* 32 element may be added to the first for that last needed additional 3 db. This article may run into *three* parts, so just keep reading!

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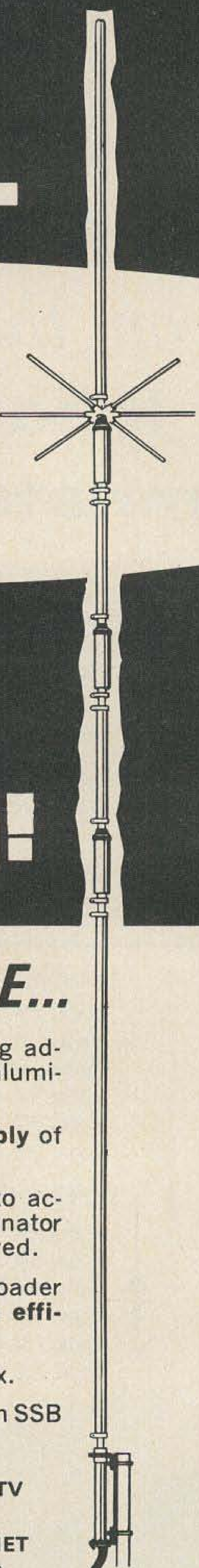

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IDENTIFYING AND CONVERTING G.E. PROGRESS LINE EQUIPMENT

In the surplus commercial FM equipment market, the General Electric Progress Line equipment has often been overlooked in favor of the somewhat more popular, and possibly more available Motorola gear. The lack of good conversion information basic enough for the FM newcomer, such as has been available on the Motorola gear, has undoubtedly contributed to the lack of interest in GE equipment. I hope to provide some basic information to the ham who has or may acquire a 150 MHz Progress Line unit and would like to use it on 2 meters.

The Progress line has gone through the usual adaptations and improvements right up to the present fully transistorized models. With the exception of the transistorized versions, and some later MTS combinations, they all contain similar and interchangeable transmitter and receiver strips with all the standard features incorporated that the average ham would require. Because it is more likely that you will come upon one of the earlier Progress Line units we will direct our discussion toward them.

Equipment Identification

As a means of describing the complete unit GE employs a combination nomenclature which tells us three things; the type of housing or application, the type of power supply and its voltage, and finally, the series designation. Table 1 will explain what each designation means. While the information given may not be an exact interpretation as might come from the factory, it is adequate

Table 1
Station Combination Identification

FIRST LETTER - Cabinet Designation
- M Trunk mount
- F Front mount
- T Table top
- W Trunk mount mobile telephone application
- WT Table top mobile telephone application

SECOND LETTER - Power Supply Designation
- A 6 volt vibrator
- E 12 volt vibrator
- A/E Dual vibrator type
- T 12 volt transistor
- U 24 volt
- O 117 VAC continuous duty
- I 117 VAC intermittent duty

NUMBERS - Station Combination Series
- 33 20–25W
- 36 40–50W
- 37 100W
- 38 250W

Note: Other designations may be found from time to time, but those included here are the most prevalent. This is not intended to be an all-inclusive list.

Example:

```
M A/E - 36 X X
|  |     |  | └ Control designation
|  |     |  └ Receiver bandwidth (W or N)
|  |     └ Series combination
|  └ Power Supply
└ Cabinet designation
```

for our purposes and covers most station combinations in the 144 to 174 MHz band. One or two letters may follow the combinations series number to indicate receiver bandwidth and the type of control. Where the station is locally controlled, no designation is used.

Unlike the Motorola designations, the GE combination nomenclatures do not tell exactly what kind of transmitter and receiver strips are employed in a particular unit. In most cases the strips are interchangeable, as mentioned above, and you may actually find most anything inside the case. The only way to be sure is to look. Type numbers are found on the top of the chassis along the rear edge and will look something like: *4ET20A1 Rev. B.* A quick look at Table 2 will tell you just what each strip is. In the example you will note that the type number is followed by an additional set of letters indicating the particular revision of the basic strip. GE, like all the other manufacturers, have a penchant for changing a resistor value somewhere along the line or possibly adding a capacitor to improve the performance. Don't worry too much about this because the strips are essentially the same regardless of the revisions.

It is possible that you may come across a unit that was used originally as a mobile telephone. These should not be confused with the later mobile telephone versions which were called *"MTS Mobiles."* The earlier Progress Line units which were used for mobile telephone service are generally distinctive by their somewhat longer cases, usually 20 in., required by the special accessory deck needed to make it operate as a telephone. These units will have a designation like *WTA-33-W* or *WI-33* and are basically MA/E-33 units which were manufactured to Western Electric specifications. All the standard functions of a straight two-way radio are incorporated in these units and appear at the 21 pin control cable jack.

Inside the unit the strips are connected by a wiring harness that originates in the power supply chassis and terminates in several color-coded plug-ended branches and the 21 pin control cable jack. In early mobile telephone combinations the VS1 Selector panel can be removed without affecting the normal functions. If the multifrequency deck is missing, single channel, and possibly two channel, operation can be accomplished by plugging the crystals into the appropriate sockets on the transmitter and receiver strips. Just let the two plugs, the black and the blue ones, which connected the Selector panel and the multifrequency deck hang loose, as they will not hinder the operation. Someday you may acquire a multifrequency deck and all you will have to do is plug it in and do a bit of minor retuning.

All tube type 150 MHz Progress Line combinations employ 4ER25 model receiver strips with the suffix A through F. If yours is an E or F, look for a lot more work, as

Table 2

Transmitters

Frequency Range	144–152 MHz		152–174 MHz	
Nominal Power	1 Freq.	2 Freq.	1 Freq.	2 Freq.
20–25W	4ET20A1	4ET20A11	4ET20A2	4ET20A12
40–50W	4ET21A1	4ET21A11	4ET21A2	4ET21A12

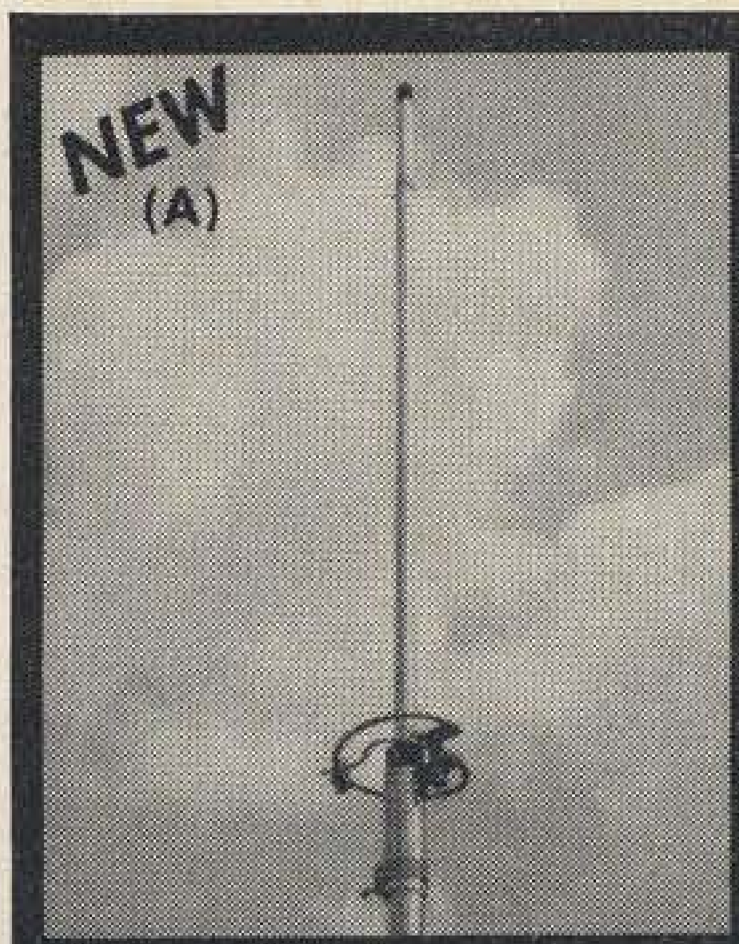
All transmitters are continuously adjustable for 0–15 kHz deviation for narrow or wide band operation.

Receivers

Frequency Range	144–152 MHz		152–174 MHz	
	1 Freq.	2 Freq.	1 Freq.	2 Freq.
Narrow Band	4ER25A1	4ER25A11	4ER25A2	4ER25A12
Wide Band	4ER25B1	4ER25B11	4ER25B2	4ER25B12
Narrow Band[1]	4ER25C1	4ER25C11	4ER25C2	4ER25C12
Wide Band[1,2]	4ER25D1	4ER25D11	4ER25D2	4ER25D12

[1] These receivers are later versions and employ fewer tuned stages to attain the same rated performance.

[2] Models 4ER25D03 and 13 are 130–150.8 versions.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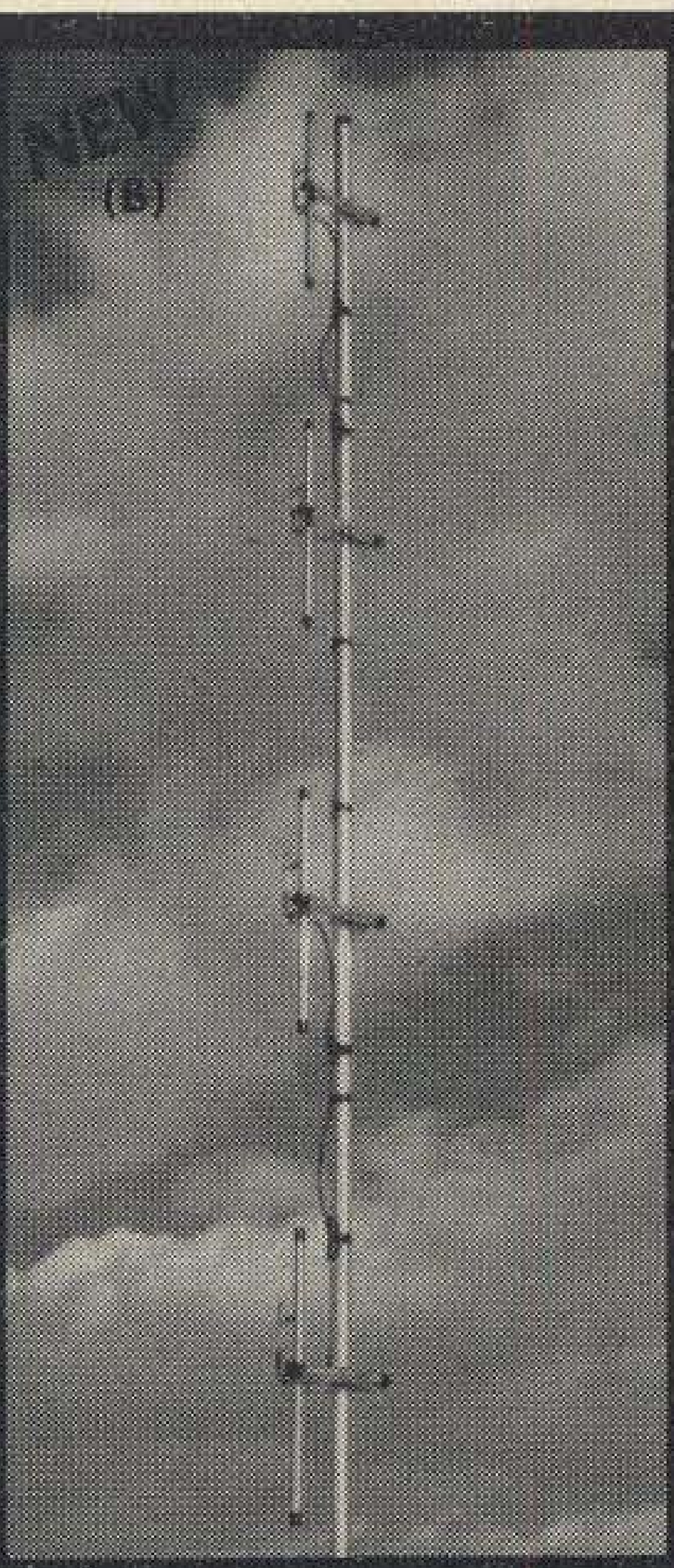
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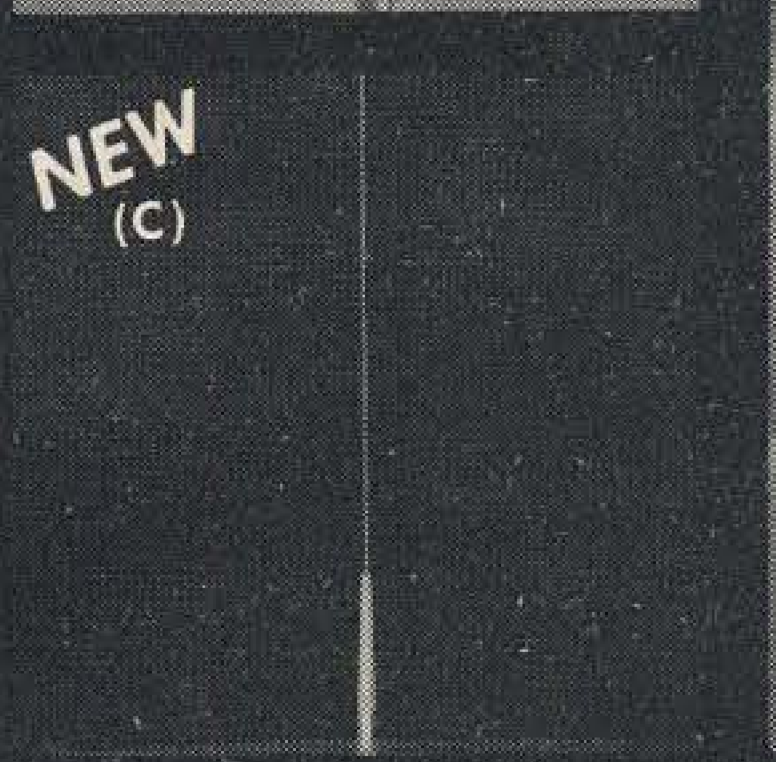
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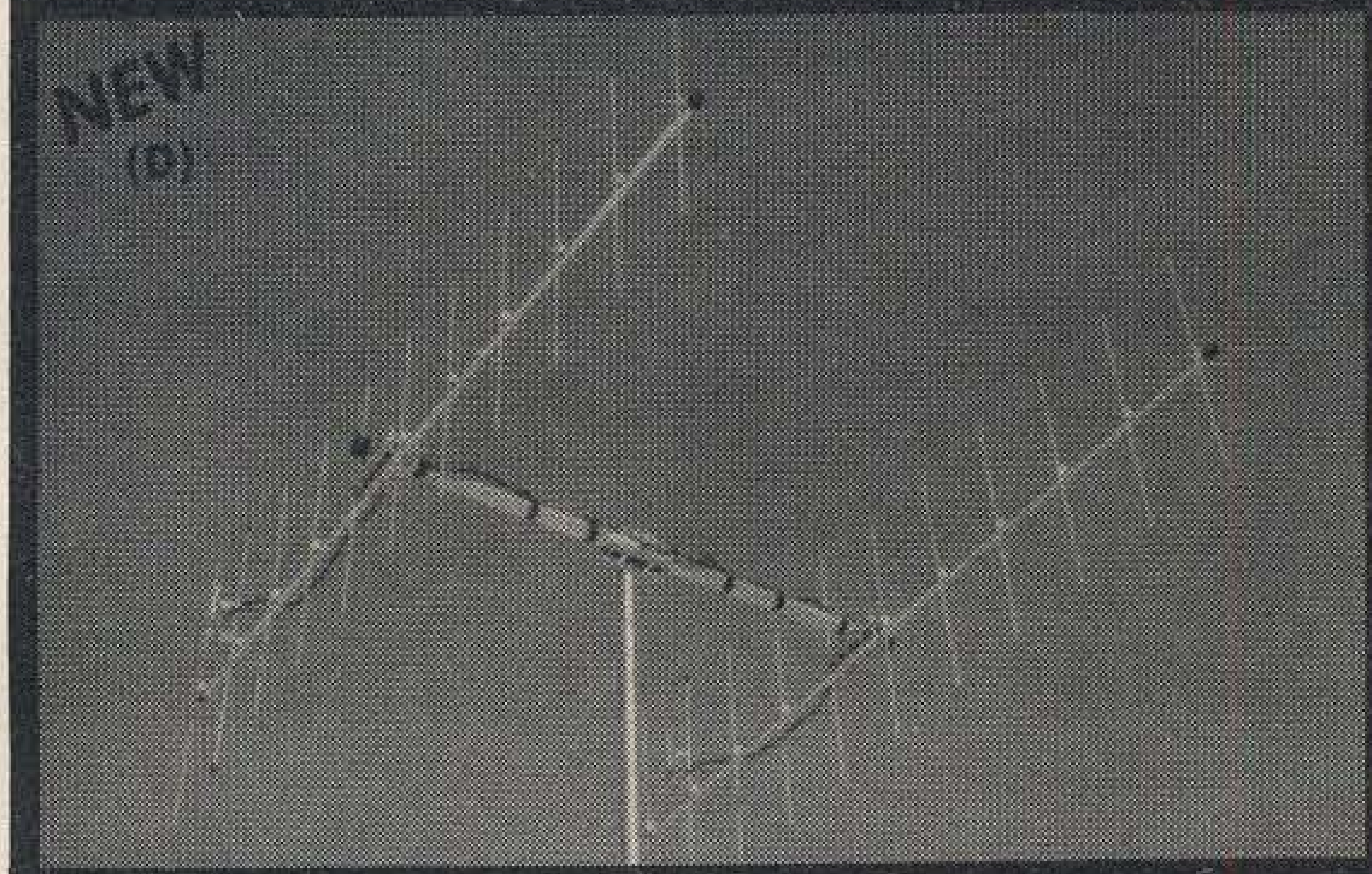
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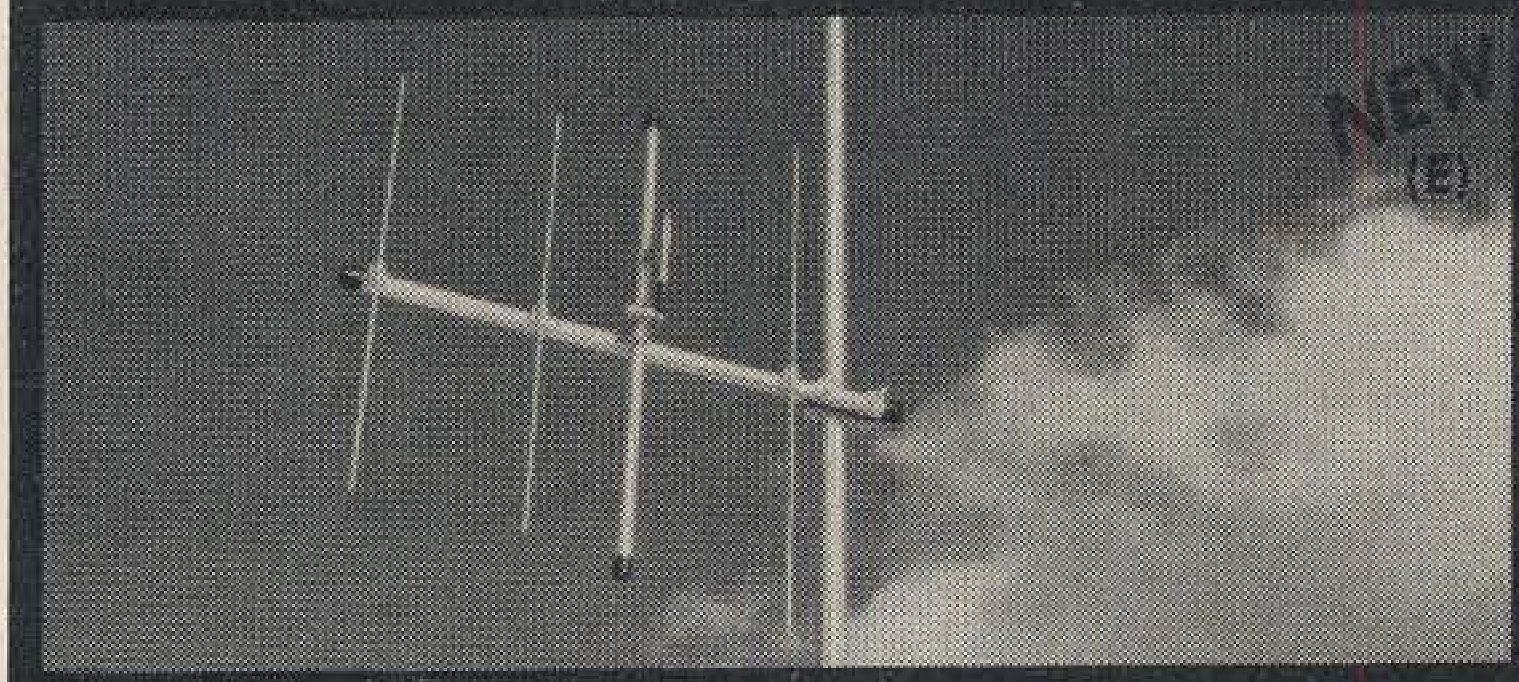
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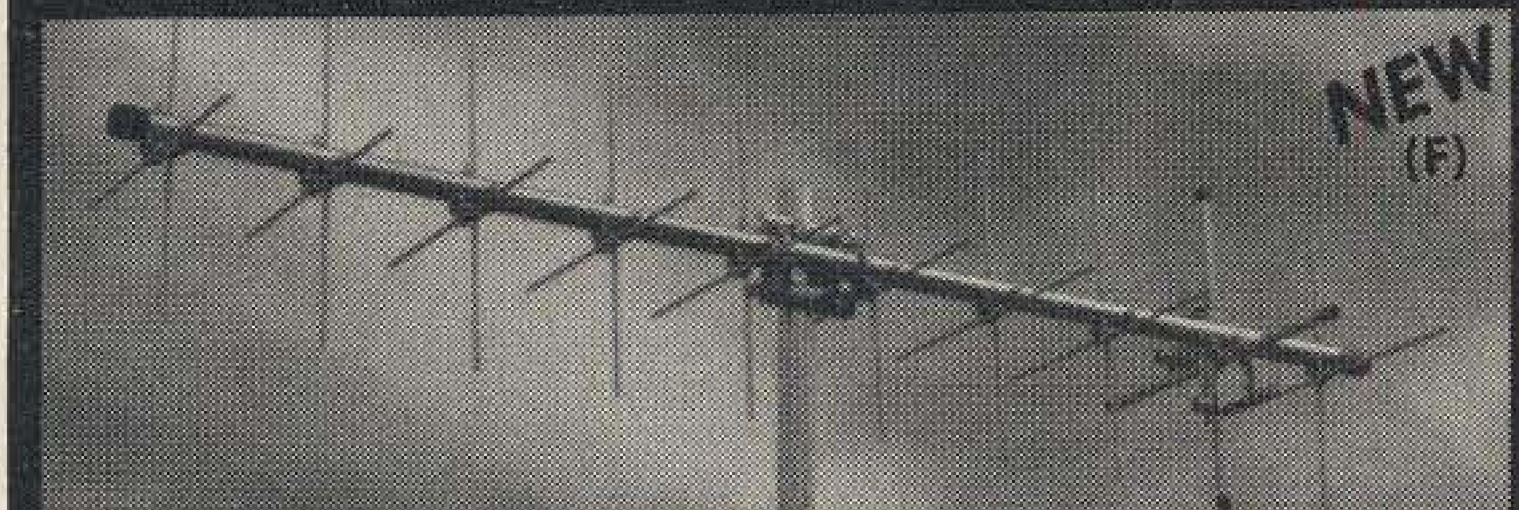
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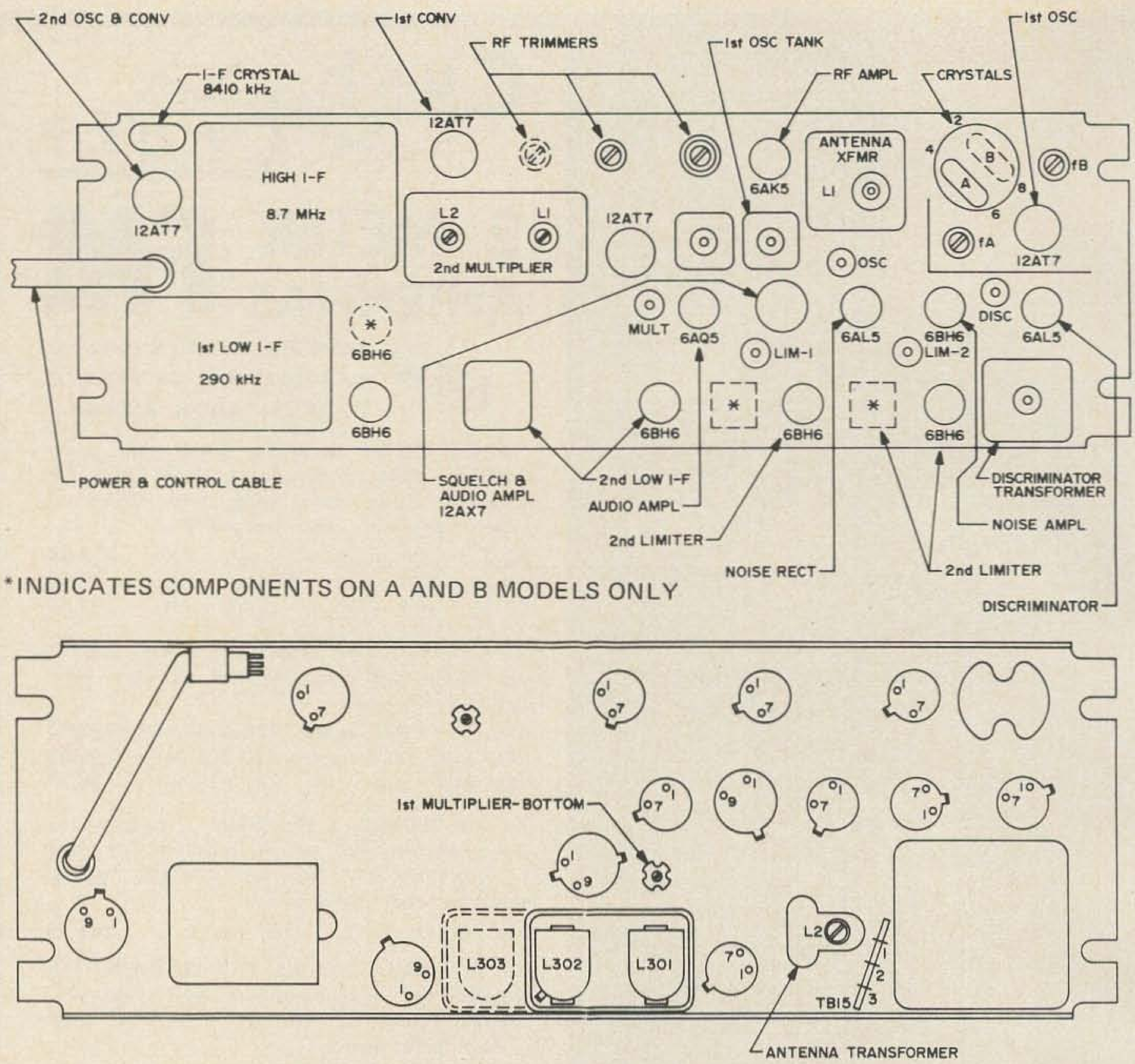

Fig. 1. Location of components on receiver chassis.

these are used in later duplex combinations and will require external modification to provide squelch and volume controls. You can also expect to rework or replace the power supply as it will be delivering power to both the transmitter and receiver at the same time. You will also find that your Progress Line unit will have either a 4ET20 or 4ET21 transmitter strip in it, even in the duplex combinations, although the duplex versions utilize a duplexer which will have to be replaced by an antenna relay or a TR switch. A recent article (*QST,* June 1971) may help in converting from duplex to simplex operation in the later MTS Progress Line units.

Now let's get down to the business of the actual conversion. More than likely you will find that your unit will be for the 152 to 154 MHz portion of the band. A few simple steps will bring the unit into the FM portion of the 2 meter band.

Crystals

For best results and ease of ordering, commercial standard crystals are the easiest. All you have to do is specify the type number of the strip you are ordering the crystals for, the crystal frequency, the channel frequency and whether you intend to use it in an oven. Check your favorite crystal catalog for the specific information they require.

The transmitters have a multiplication factor of 24, so just divide the desired operating frequency by 24 to determine the crystal frequency. The first oscillator crystal frequency for the receiver can be determined by subtracting 8.700 MHz from the channel frequency and dividing the results by 12. If you are lucky the receiver will have the i-f crystal in it; if not, order one for 8.410 MHz. While you are waiting for your crystals to come in the mail, you can start on the next steps.

Receiver Conversion

To obtain at least rated sensitivity[1] it is necessary to pad several places in the receiver. The trimmers used in these receivers can be turned a full 360° and will give the impression of being fully peaked when actually you are only passing through the maximum capacitance point of the trimmer. You can approach the padding in one of two ways: install a new capacitor of the correct value at each point to be padded or get a handful of 4 pF capacitors and parallel the existing capacitors with them. The purists among us will undoubtedly use the first way, the rest of us the second way. Either way use good quality 500 wvdc tubular ceramics with −80° temperature coefficient.

In the A and B models there are seven places to be padded and six places in the C and D models. Start by removing the strip from the unit to facilitate handling as you will be turning the chassis over several times. Refer to Fig. 1 to locate the coils that are to be padded. Be sure to check Table 2 to determine if padding is necessary in the receiver you have.

A quick inspection of the antenna transformer and the rf trimmer cans will tell you what is required to remove them so the coils can be reached. L1 will come off with the can and can be removed by taking out the three screws on the side of the can near the antenna input jack. Note the position of the screws in the slots so that L1 can be replaced in essentiallly the same place, although you may want to slide it up or down for best results as indicated by the LIM-1 meter reading when you tune up.

The can which contains the second multiplier coils is far more difficult to remove and care must be exercised to prevent damage to the components inside. When the receiver was manufactured the components were installed in the loose can and then wired. The can was positioned on the chassis and the leads fed through to the bottom side and soldered in place. Reversing this procedure, while difficult, is probably better than trying to remove the can without unsoldering, although I have done it in this way. Remember to tag the leads. The following list indicates the required padding capacitor values.

	Coil	Existing Capacitor Value	Change To
Antenna	L1	10 pF (C2)	14 pF
Transformer	L2	6 pF (C4)	10 pF
Rf Trimmers	L301	3 pF (C309)	7 pF
(see note	L302	9 pF (C306)	13 pF
below)	L303	None	4 pF
Multi-2	L1	7 pF (C2)	11 pF
Transformer	L2	10 pF (C3)	14 pF

Note: In the C and D models L303 has been eliminated. However, use the values given for L303 for L302 in these receivers.

If the receiver strip is equipped with a trimmer below the opening marked fB, the receiver is capable of two frequency operation. However, upon inspection you may find that pin 3 of the first oscillator tube socket had been permanently soldered to ground, which makes channel A operative continuously. Assuming you want two frequency operation, unsolder pin 3 from ground and add a short length of hookup wire between pin 3 and lug 1 of TB15 (lug 1 is the one with the green braid covered wire leading directly to it from the cable). TB15 is directly below the antenna transformer (see Fig. 1). If it is not already in place, add a wire similarly between pin 8 and lug 2 of TB15. Leave both of the 0.02 uF disk capacitors in place on TB15. Also solder a short piece of hookup wire between pins 1 and 6 to complete the plate circuit of the section of the oscillator. You should now be able to select channel A or B from the channel selector switch on the control head.

If the control head is not equipped with a channel selector switch one can be added easily. Install an spdt toggle switch in a convenient location on the control head and ground the common terminal. If the control cable leads are marked, connect wire #12 to one side of the switch for channel A and wire #13 to the opposite side for channel B. If you are adapting a control cable that is not numbered, simply ring out for conti-

[1]Rated sensitivity: 0.5 μV (20 dB quieting method).

nuity between pins 4 (channel A) and 5 (channel B) of the 21 pin control cable plug and connect the loose ends to the control switch as described above.

All 4ER25 type receivers can be converted to two frequency operation by adding a 39K, ½W, 10% resistor and a 3 to 12 pF ceramic trimmer as shown in Fig. 3 and making the changes described above for frequency selection.

Tuning the Receiver

With the appropriate crystals in their sockets, apply power to the receiver and let it warm up. Using a 20K ohms/volt vom with a 2½–3V dc scale, ground the positive lead to the unit in the GND test jack on the power supply chassis. Insert the other lead into the OSC test jack. Tune the first oscillator tank to maximum and then back off on the gentle slope side until you have a reading of about 1.35V. If you are using commercial standard crystals cut specifically for the unit, you will generally get the greatest output from them at or very near the correct frequency. Adjust the oscillator trimmer (fA or fB) for maximum meter reading and then readjust the tank coil until you again have about a 1.35V meter reading. In multifrequency applications the oscillator must be tuned on the highest channel frequency.

Next, move the test lead to the MULT jack and tune the first multiplier coil, both top and bottom alternately, for maximum meter reading.

With the meter probe in the DISC jack, connect a signal generator to the antenna input jack and zero the generator to the discriminator. Move the meter probe to the LIM-1 jack and reduce the generator output to the lowest value that gives an indication on the meter. It is possible that you may not get a reading at this time. If this is the case, move the meter probe to the LIM-2 jack and with maximum signal generator output, adjust the antenna transformer top and bottom, the two trimmers of the MULTI-2 transformer and the two or three rf trimmers for maximum indication. Return the meter lead to the LIM-1 jack and repeat each of these steps. As the meter readings increase due to tuning, reduce the generator output to the minimum needed to give an indication. Too much signal will saturate the limiters and give a poor indication. Occasionally move the meter probe back to the DISC jack and zero the generator as necessary.

Finally, with an antenna connected to the receiver, listen for an on-the-air signal and adjust the OSC-1 trimmer so that you get a zero discriminator reading. Remember that the guy you hear may not be exactly on frequency, but if someone else can hear him

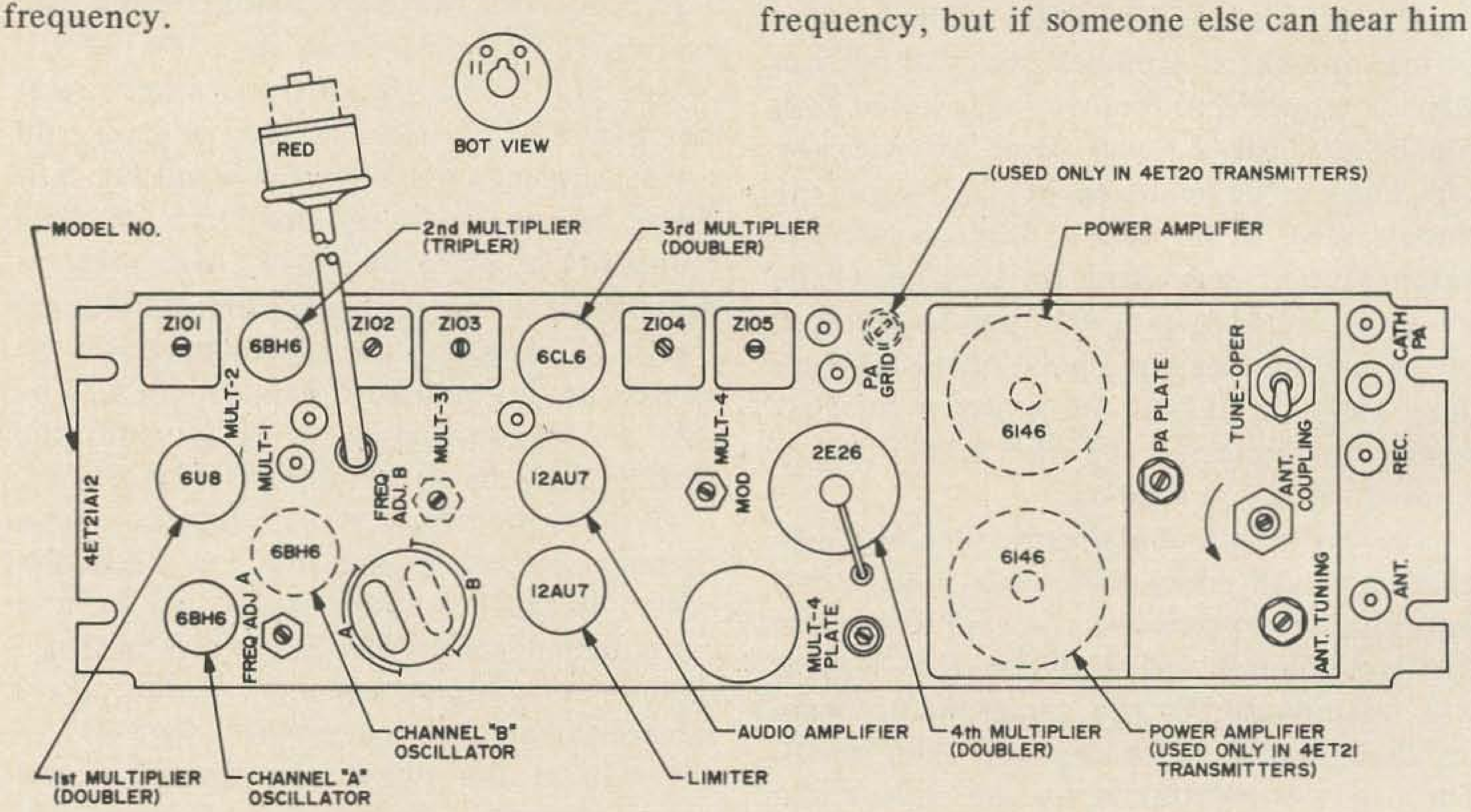

Fig. 2A. Location of components on transmitter chassis.

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TPL802	5W	80W	2M	$165.00
TPL802B	1 to 3W	80W	2M	$180.00
TPL502	5 to 15W	35-55W	2M	$ 99.00
TPL502B	1 to 3W	45W	2M	$125.00
TPL252-A2	1W	25W	2M	$ 85.00
TPL445-10	1 to 2.5W	12W	440MHz	$125.00
TPL445-30	4W	30W	440MHz	$215.00
TPL445-30B	1W	30W	440MHz	$235.00

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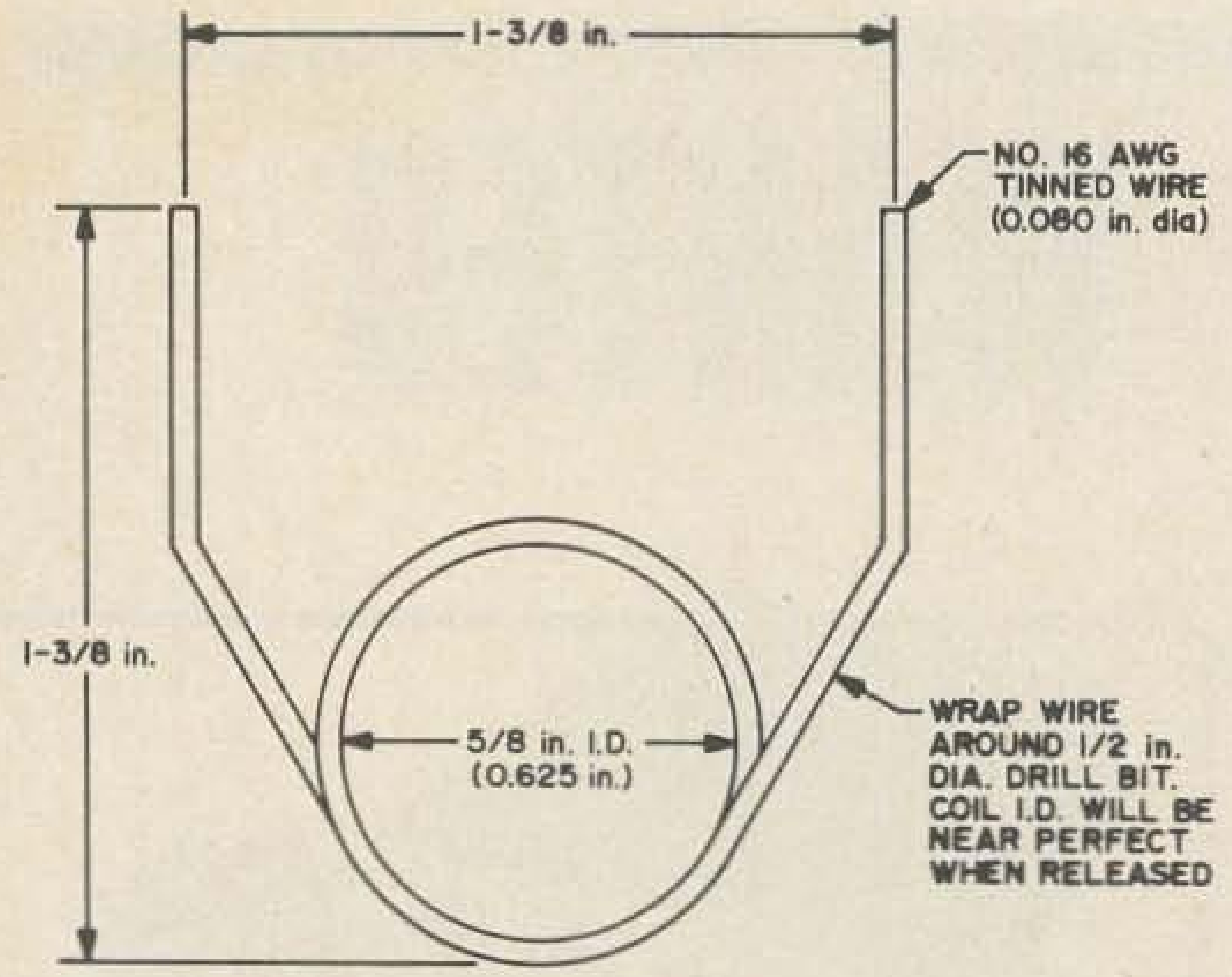

Fig. 2B. Power amplifier plate coil replacement.

it's a good bet that he is at least close. You can always touch it up a bit later on when you find someone known to be on frequency or when you acquire that secondary standard.

It is worthwhile to go back over all of the above adjustments while listening to a steady, clean signal that gives about 0.5 to 1.0V LIM-1 reading.

That's about all there is to getting your receiver to work reasonably well. Adjustment of the i-f, limiter and discriminator stages will usually not be necessary and should be avoided. If you must adjust these stages get a copy of the appropriate bench alignment procedure published by GE, if possible, before you attempt it. The coils in these stages are overcoupled and must be loaded with the proper load resistor to make them critically coupled and then tuned in the proper sequence for good results.

Transmitter Conversion

Only one relatively simple change is required to make the 152 to 174 MHz units work in the 2 meter band. The power amplifier plate coil (L113) must be replaced with a new coil made up as shown in Fig. 2B. The coil should be fabricated of tinned 16-gage wire (0.08 in. diameter) wound 1 1/3 turns at five turns per inch, to an internal coil diameter of 0.625 in. (5/8 in.).

Remove the perforated cover from the power amplifier housing, pull out the 2E26 drive tube and the PA tube so you can reach the coil to work on it. Carefully unsolder the rf choke attached to the bottom of the coil loop. To make coil removal and replacement easier, remove the nut holding the PA plate tuning capacitor and the two screws on either side of it and slip the coil, capacitor and the steatite posts out of the housing. Unsolder the large recetangular plate coil and remove it from the clips. It may be possible to make your new coil out of the old one,although I have never tried it. Insert the ends of the coil into the clips to the approximate position and solder one side. Reinstall the entire assembly into the housing. Adjust the coil up or down until it is even with the load coil by heating first one side, then the other, and making slight adjustments in the coil height until the correct position is reached.

With the loading coil turned fully counterclockwise, adjust the new plate coil so there is 1/16 in. between it and the loading coil. Solder the free end of the rf choke to the center bottom of the front loop of the new coil, i.e. as you look into the open end of the PA housing. Be sure that in soldering in the rf choke you have not shorted the plate coil. Recheck the coil turn spacing and the distance between the two coils, and if all is well replace the tubes, plate caps and the housing cover and proceed to tuning up the transmitter.

Tuning the Transmitter

Transmitter tuning is basically a matter of peaking and dipping the various stages and should present no formidable problems. With the proper crystal in its socket, apply power and let the transmitter warm up. Flip the TUNE-OPERATE switch to the tune position and turn the ANT COUPLING countrol fully clockwise (uncoupled). The transmitter must be in its case or resting on a metal plate while it is being tuned or it will be detuned when it is returned to the case. Connect the unit to a dummy load for the initial tuneup procedures.

Plug the positive meter lead into the GND jack on the power supply and the negative lead into the MULT-1 jack. The oscillator and modulator stages are working properly if the reading is 1.5V or more. Move the meter lead to the MULT-2 jack and tune Z101 for maximum meter reading. *Do not key the transmitter for longer than 30 seconds at a*

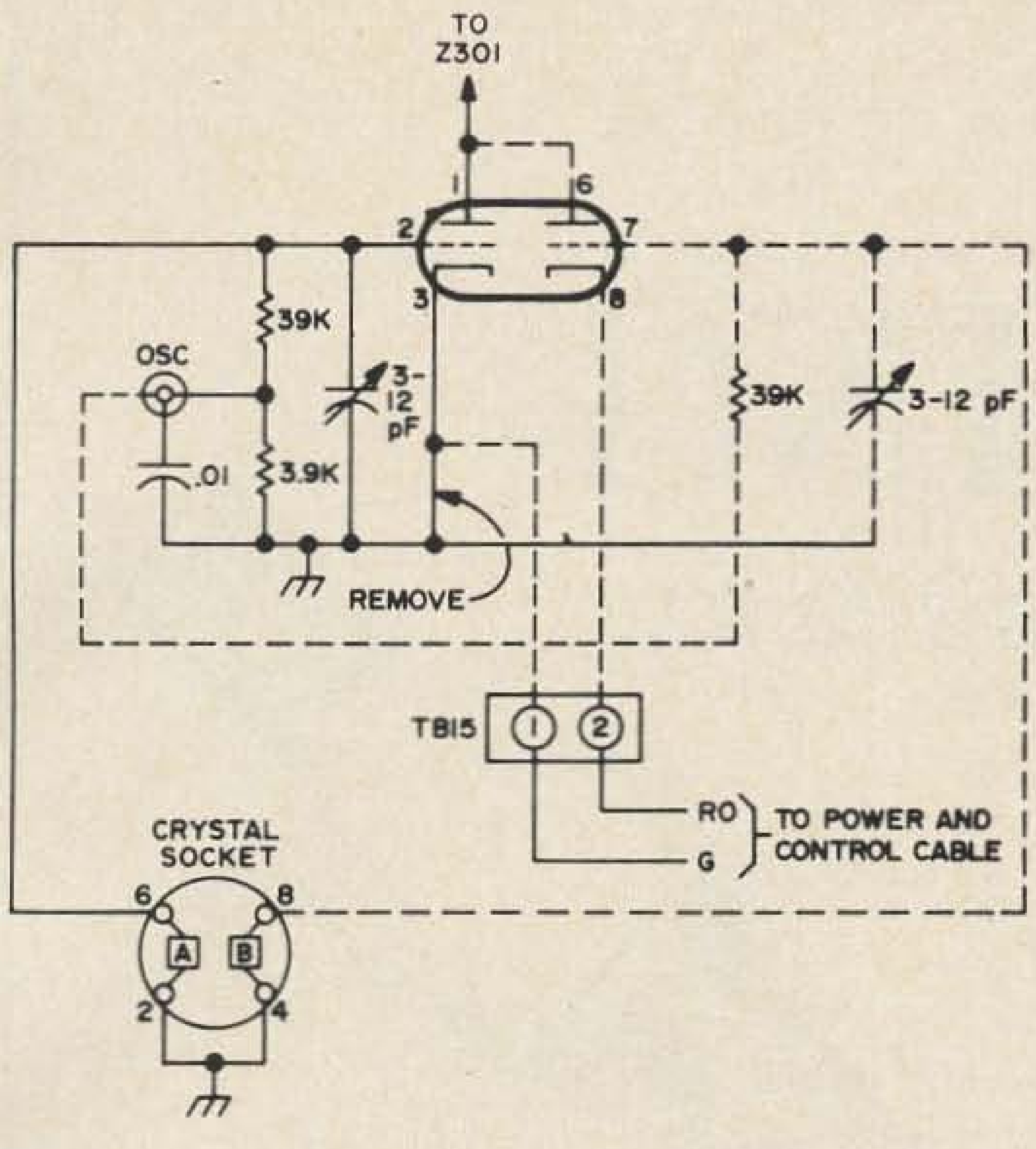

Fig. 3. First oscillator circuit of receiver. Add dotted wiring for two frequency operation.

time until after the MULT-4 plate has been tuned.

With the meter lead in the MULT-3 jack, alternately peak Z102 and Z103 for maximum meter reading. The best way to tune this stage is to turn the adjusting screws in about ¼ turn each alternately, until the maximum reading is reached. If a peak cannot be obtained, connect the meter to the screen (pin 6), using the 300V scale, of the 6BH6 second multiplier and tune Z102 for a slight dip in screen voltage. It is possible to tune Z102 and Z103 to the wrong harmonic of the crystal frequency. If this is suspected, turn both of the adjusting screws all the way out (counterclockwise) and retune to the first peak in the manner noted above.

Next, plug the meter into the MULT-4 jack and alternately tune Z104 and Z105 for maximum meter reading. If this stage is badly misaligned, pretuning can be accomplished by tuning Z104 for a slight dip with the meter lead plugged into the MULT-3 test jack.

Now move the meter lead to the PA GRID test jack and alternately tune MULT-4 PLATE and PA GRID controls for a peak (MULT-4 PLATE only in ET-21 type transmitters). A small voltage reading will be present at the start because of the fixed bias at this point.

For each of the following steps the negative meter lead must be plugged into the GND jack and the positive lead into the CATH PA jack.

Tune the PA PLATE for a dip. Dip MULT-4 PLATE and PA GRID (if it is present). Flip the TUNE-OPERATE switch to the operate position and quickly redip these controls. Alternately tune the PA PLATE and ANT TUNING controls until a lower reading cannot be obtained. When the minimum reading is reached, retune ANT TUNING for a peak. If there is no indication of a peak increase the coupling by turning the ANT COUPLING control slightly counterclockwise until a peak can be seen. Increase the ANT COUPLING until the meter reads 1.4V and again adjust the ANT TUNING for maximum indication. The ANT COUPLING should now be increased until a reading of 1.6V for ET-20 models and 1.5V for ET-21 models is obtained.

Move the negative meter lead back to the PA GRID jack and the positive lead to the GND jack and retune MULT-4 PLATE and PA GRID for maximum indication. Once this is done, and with an antenna connected, return the meter leads to the CATH PA and GND jacks as in the steps just above, and adjust the ANT TUNING control for maximum meter reading. The ANT COUPLING should be readjusted to 1.5 or 1.6V.

The transmitter should now be putting out at least its rated power of about 25W. Greater output can be obtained by increasing the ANT COUPLING or replacing the 6146 final with a 6146B in the ET-20 models. There is the danger of overloading the power supply, however, unless the unit is equipped with a high power supply (two transformers) which may be present, particularly if the unit had once been used as a mobile telephone. In this case it may be possible to obtain up to 40 or 45W from a single 6146B final. The modifications described above should result in performance at least equal to the manufacturer's ratings assuming all of the tubes are good. A gain antenna will help immensely and with a good preamp ahead of the receiver, sensitivities as low as 0.1 to 0.2 mV are possible.

. . .WB9CXE

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PHASING MULTIBAND VERTICAL ANTENNAS

Most amateurs don't have the space for rotatable directional antennas for the 40 meter band—not to mention 80 meters—yet these are our most crowded bands under average conditions. Some sort of directional antenna is of tremendous value for stateside contacts and almost a must for DX. Many hams with limited space are using trapped multiband verticals. With a decent ground system, these are wonderful antennas, but they aggravate the QRM problem even more with their omnidirectional characteristics.

The use of two or more multiband trapped verticals and the proper phasing and switching setup provides an inoffensive (to the neighbors, I mean) and very effective method of obtaining directivity. This is essential for overcoming at least some of the QRM on receiving, and for giving that extra kick to your signal that can mean the difference between a solid QSO and none at all.

If you are presently using one trapped vertical, you already have almost half the system. I am sure every dedicated 40 meter operator will take pleasure in hearing Radio Moscow drop 20 to 30 db at the flip of a switch.

Some Theory

Since many handbooks barely mention phased verticals, a little theory is in order. For an example, let's use two identical verticals spaced one-half wave length apart (**Fig. 1**) and driven equally and in phase. The fields of the antennas are uniform in all directions in the horizontal plane and look like point sources of circular waves as viewed from above. Any point along the line W-E is a half wave length further from one vertical than the other. In other words, at any point along the W-E line, the two radiated waves are 180° out of phase and cancel. At any point along the N-S line (broadside) the

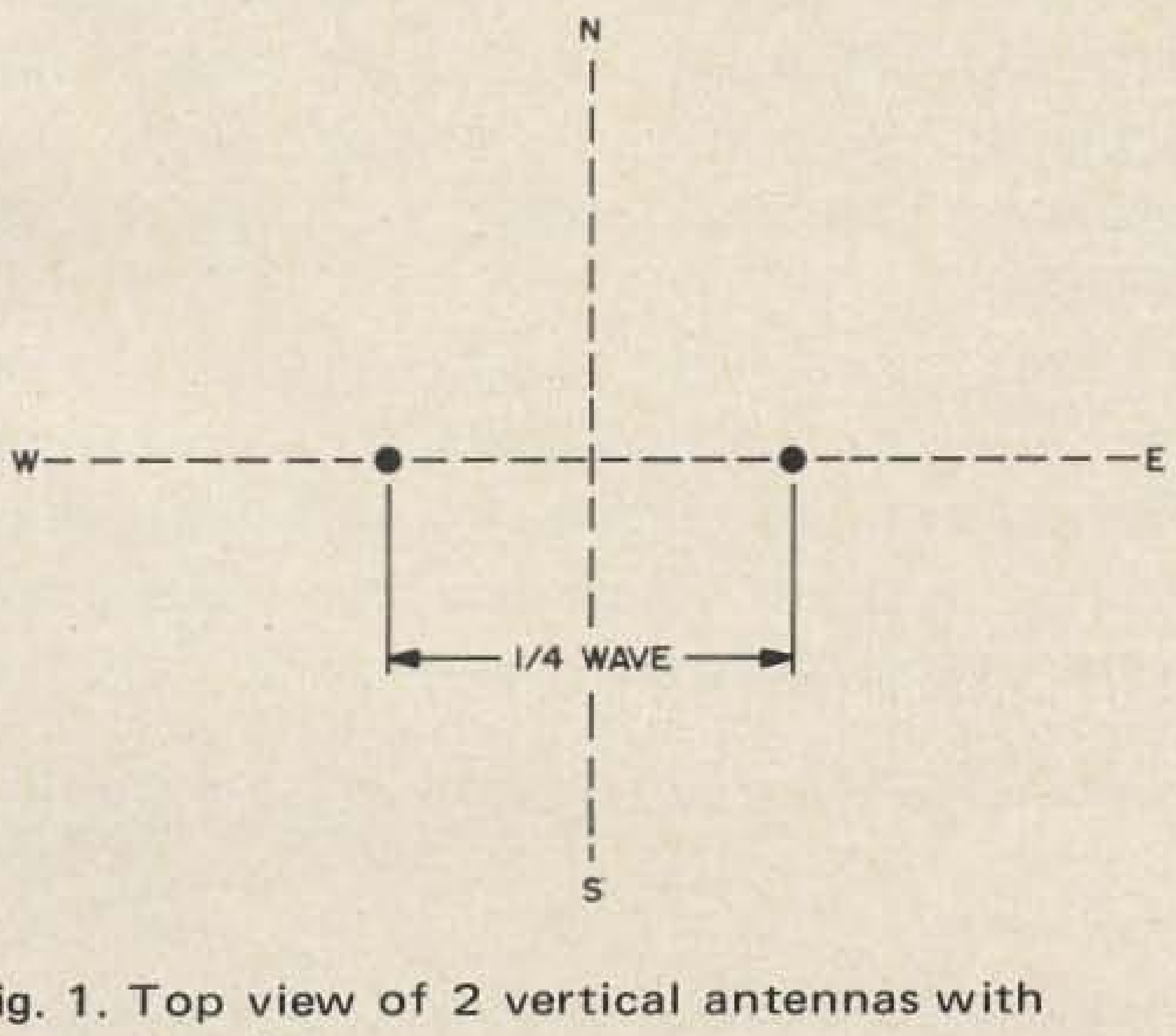


Fig. 1. Top view of 2 vertical antennas with ½ wave spacing.

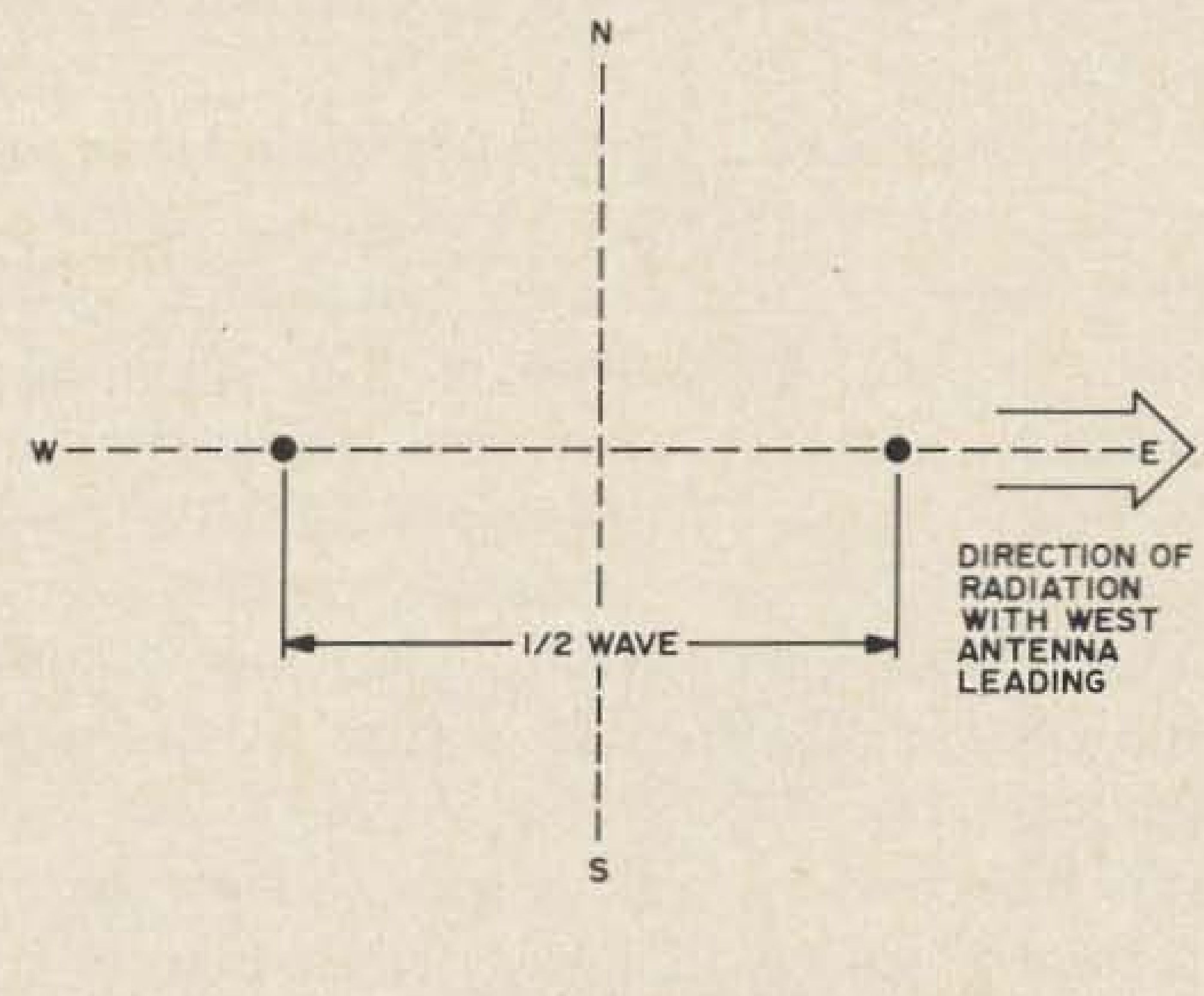


Fig. 2. Top view with ½ wave spacing.

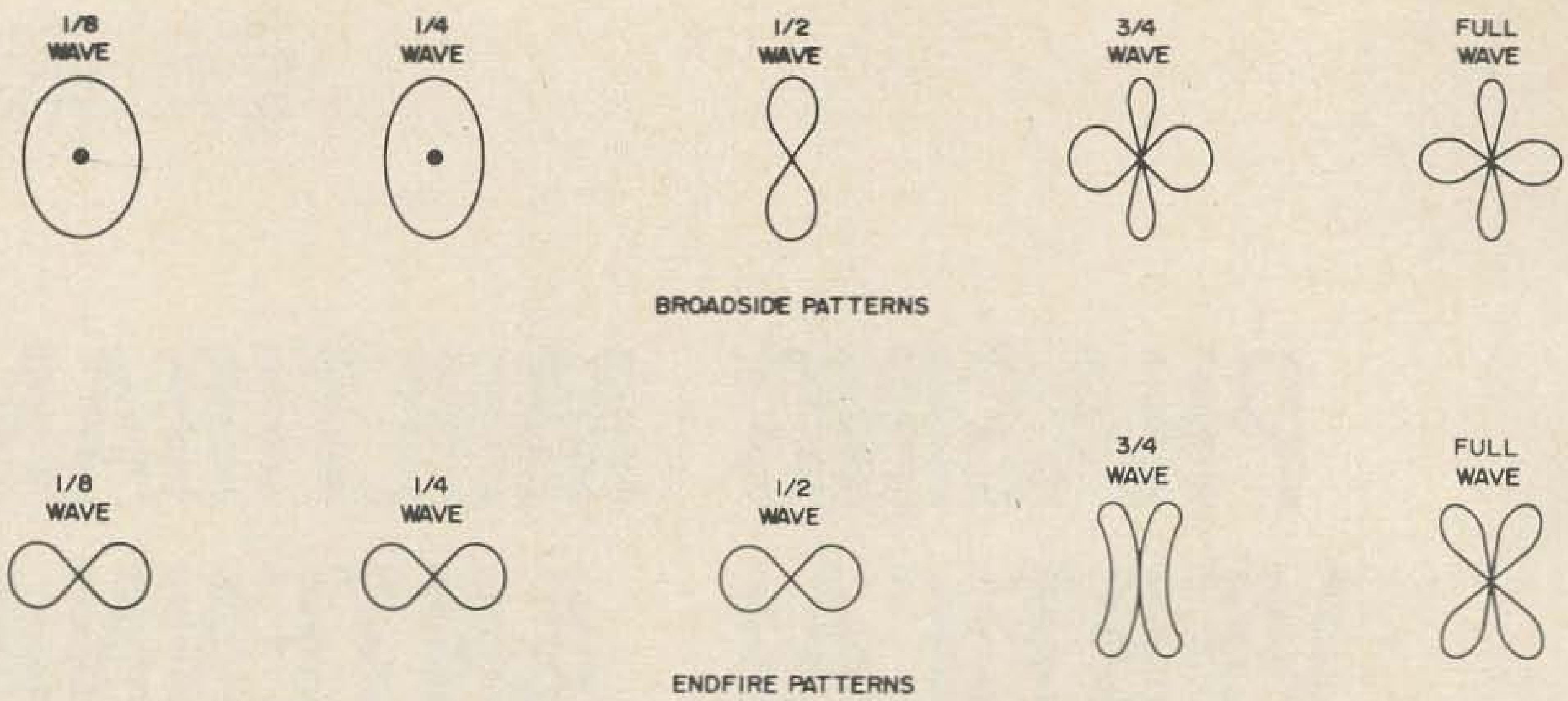


Fig. 3. Phased vertical radiation patterns for various spacings.

waves are in phase and reinforce. This then is a broadside array.

If the antennas in **Fig. 1** were driven 180^{o} out of phase, by feeding one antenna directly and inserting a 180^{o} coax delay line in the other feeder, there would be reinforcement along the W-E line (endfire) and cancellation on the W-S line. So by using the same antennas and switching the appropriate length of coaxial cable in and out of the feedline, we have a choice of two directions, N-S or E-W.

If the verticals are spaced a quarter wave length apart (**Fig. 2**) and driven 90^{o} out of phase with the west leading, the pattern will be a cardiod (heart-shaped) toward the east. Broadside gain for half-wave spacing is 3.86 db and 2.3 db for endfire with side attentuation around 20 db. A front to back radiation of up to 30 db can be achieved with quarter wave spacing for the cardiod pattern. Radiation patterns for various spacings are shown in **Fig. 3**.

As with any multiband system, there are some disadvantages. Definite endfire–broadside patterns are obtainable with eighth-wave, quarter-wave, and half-wave spacing. For full-wave and three-quarter-wave spacing, the patterns are not so cut and dried. A full-wave broadside pattern somewhat resembles a 4-bladed propeller, and the full-wave endfire pattern fills in the gaps between the 4 lobes (or blades). Even so, this directivity can be used to advantage by careful plotting on a great circle map or by the use of an "S" meter.

Practical Design

The first step in setting up a phased vertical system is to decide on the spacing. This will be determined by either physical limitations (how big your yard or roof top is) or by your choice of bands. For example, if you enjoy 40 meter DXing, quarter-wave spacing for 40 meters will result in very usuable eighth-wave and half-wave patterns for the 80 and 20 meter bands respectively. The antenna will be most effective on 40 because the quarter-wave spacing also yields a cardiod pattern on this band. The three-quarter and full-wave spacing result in the four lobed patterns on 15 and 10 meter bands.

The second step is deciding in which direction to beam the patterns. For instance, mounting the verticals on the N-E–S-W plane will put a 40 meter cardiod pattern towards Europe and another towards Australia and New Zealand. The broadside pattern will fall on Alaska and South or Central America. Reference to a great circle chart centered on your QTH will resolve this problem.

Step three is tougher: the physical mounting of the two radiators. As with any vertical antenna, success or failure lies in the ground system. There are too many hams who curse the vertical antenna that they

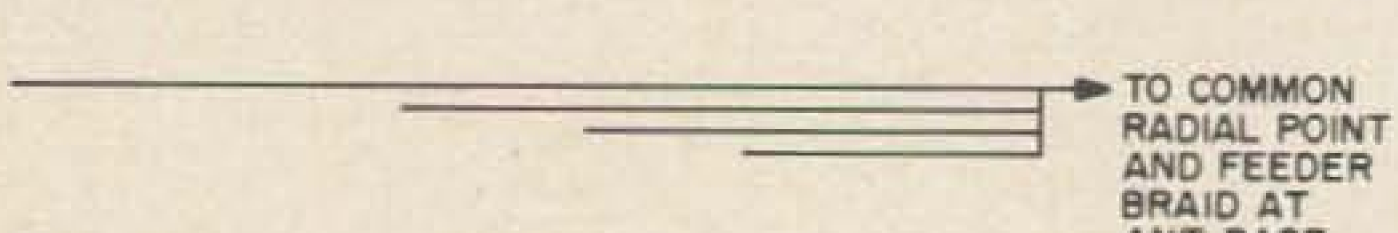


Fig. 4. TV rotator cable cut as a 4 band radial.

"tried back in 19 and Blah Blah" and took down the following spring because it didn't work. Almost invariably, further questioning reveals an inadequate ground system or attempts to use the antenna for consistent short range work. Having successfully used verticals at five different locations in four states, I would recommend a roof or mast mount with at least three drooping radials for each band. Multiconductor TV rotator cable can be used to avoid having your yard

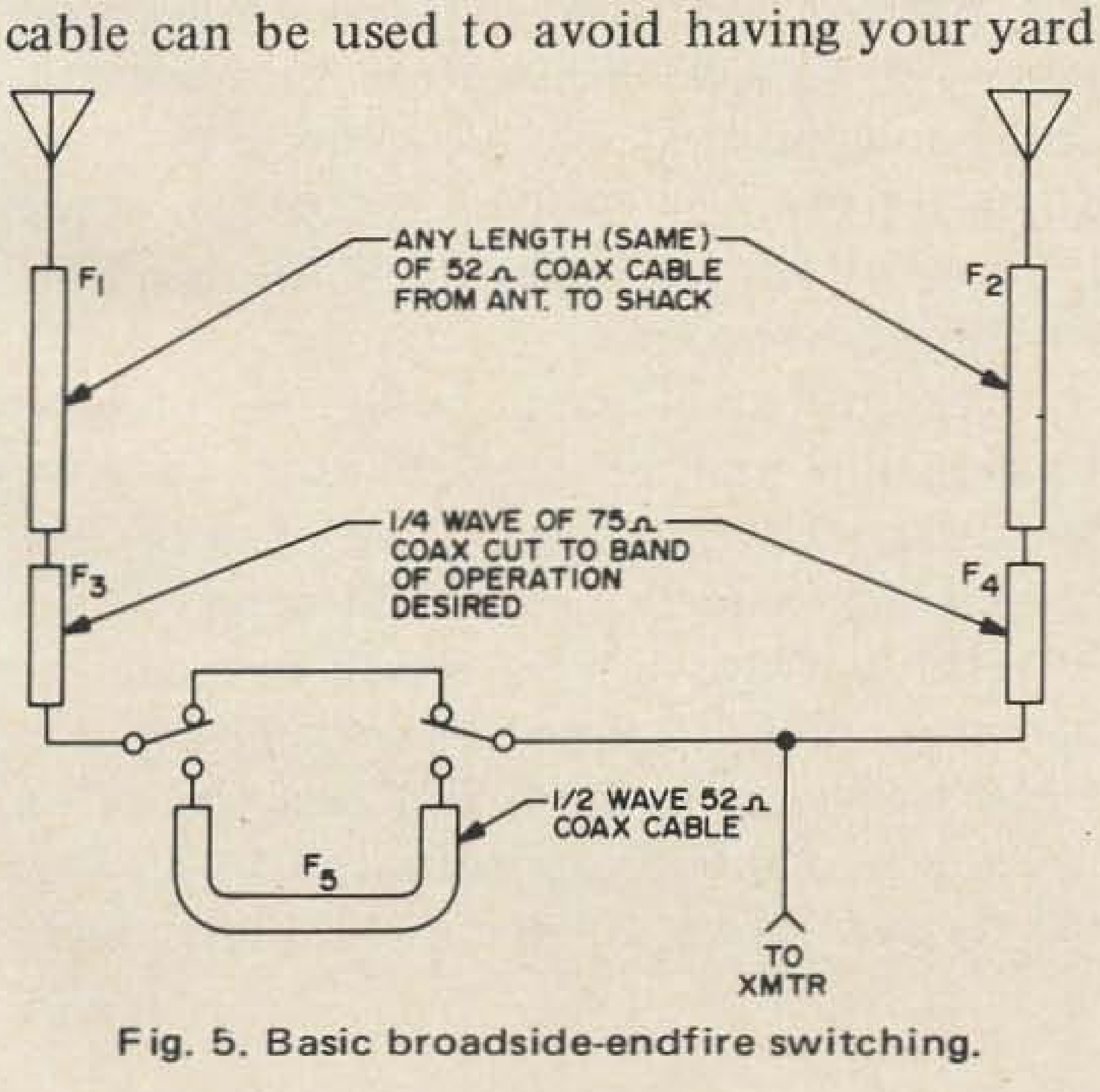


Fig. 5. Basic broadside-endfire switching.

look like a giant spider's lair. Measure and cut each conductor to a quarter-wave for each band desired, as shown in **Fig. 4**. Tie and solder the antenna end to a lug and you've got a multiband radial. Three such radials drooping from the base of the vertical make a very effective counterpoise. A roof mount in the average location has the added advantage of allowing you to mount the radiators well clear of nearby objects, thus helping maintain identical radiation patterns. Bear in mind that the success of the phasing depends on the words "identical patterns." If you are fortunate and live in a swamp, it would, of course, be best to use buried radials.

All directional and band switching can be done from inside the shack. Identical coax feeders of the same length are brought from the base of each antenna into the shack. The lengths of these lines can be ignored for the phasing line calculations because they are the same length.

Phasing Lines

Fig. 5 illustrates the basic endfire–broadside arrangement using full to one-eighth-wave spacing. Feeders F1 and F2 are any equal length needed to bring the feeders to the switching point. F5 is shorted for broadside, and switched in the circuit for endfire. **Fig. 6** shows a cardiod pattern setup for two directions. F5 in this case is one quarter-wave long, and the antennas are spaced a quarter-wave length apart. If F5 is switched out of both feed lines, the antennas are in phase and a broadside pattern results.

The phasing line lengths can be calculated from the formula: one-quarter wave x velocity factor frequency. The velocity factor for regular coax is .66, and for polyfoam it is .75. It is necessary to switch phasing lines F3, F4, and F5 for each band. This seems rather complicated at first glance, but it can be done with two switches. The switches can be mounted in a large minibox with coaxial connectors on the rear for all the phasing lines and antenna feeders. The use of coaxial switches would be the best approach although rather expensive. Excellent results can be obtained with good quality ceramic switches such as ones currently available on the surplus market. If the switch box is built using coaxial connectors for all the phasing lines, it might be wise to purchase these surplus also in order to keep costs down.

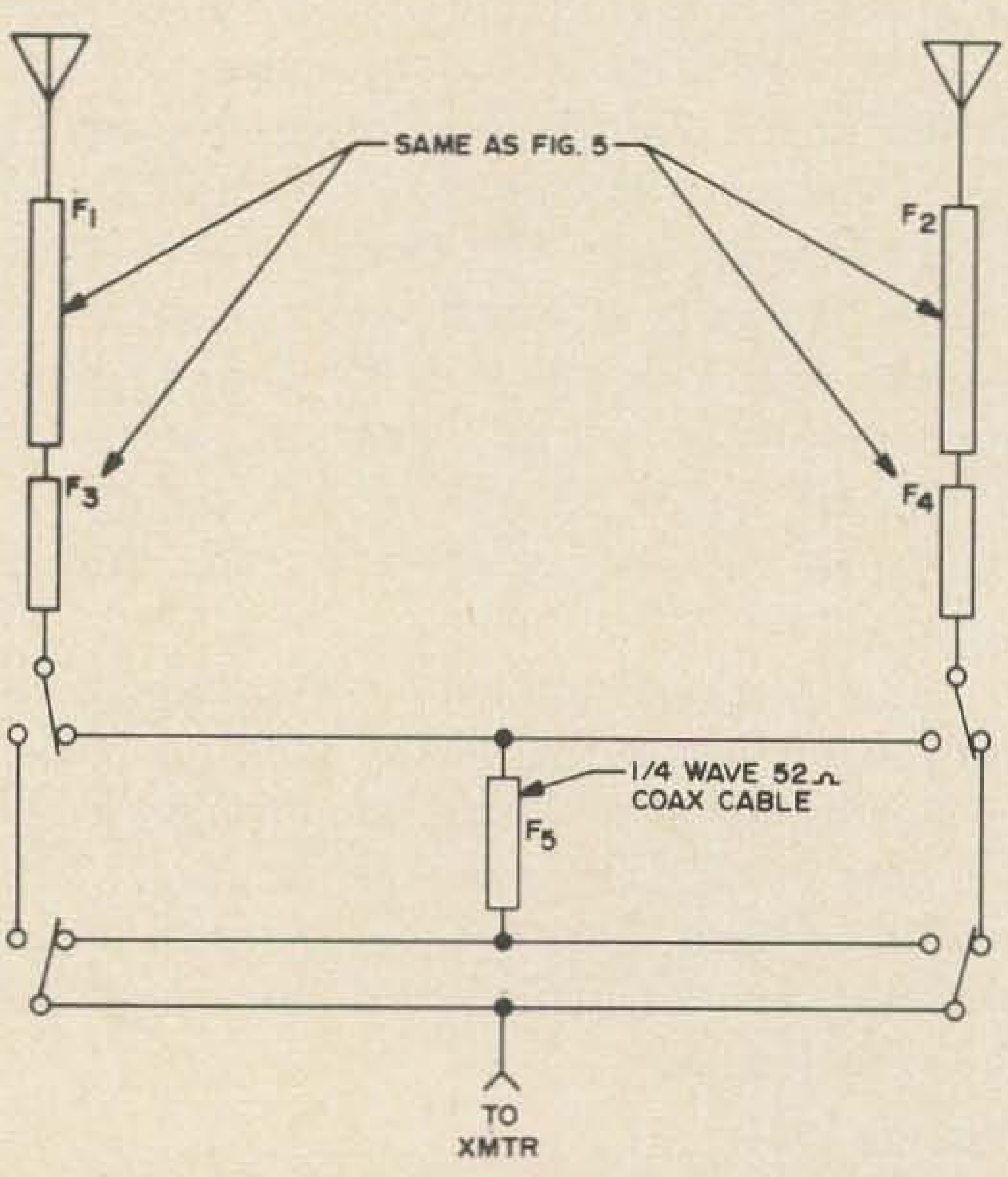
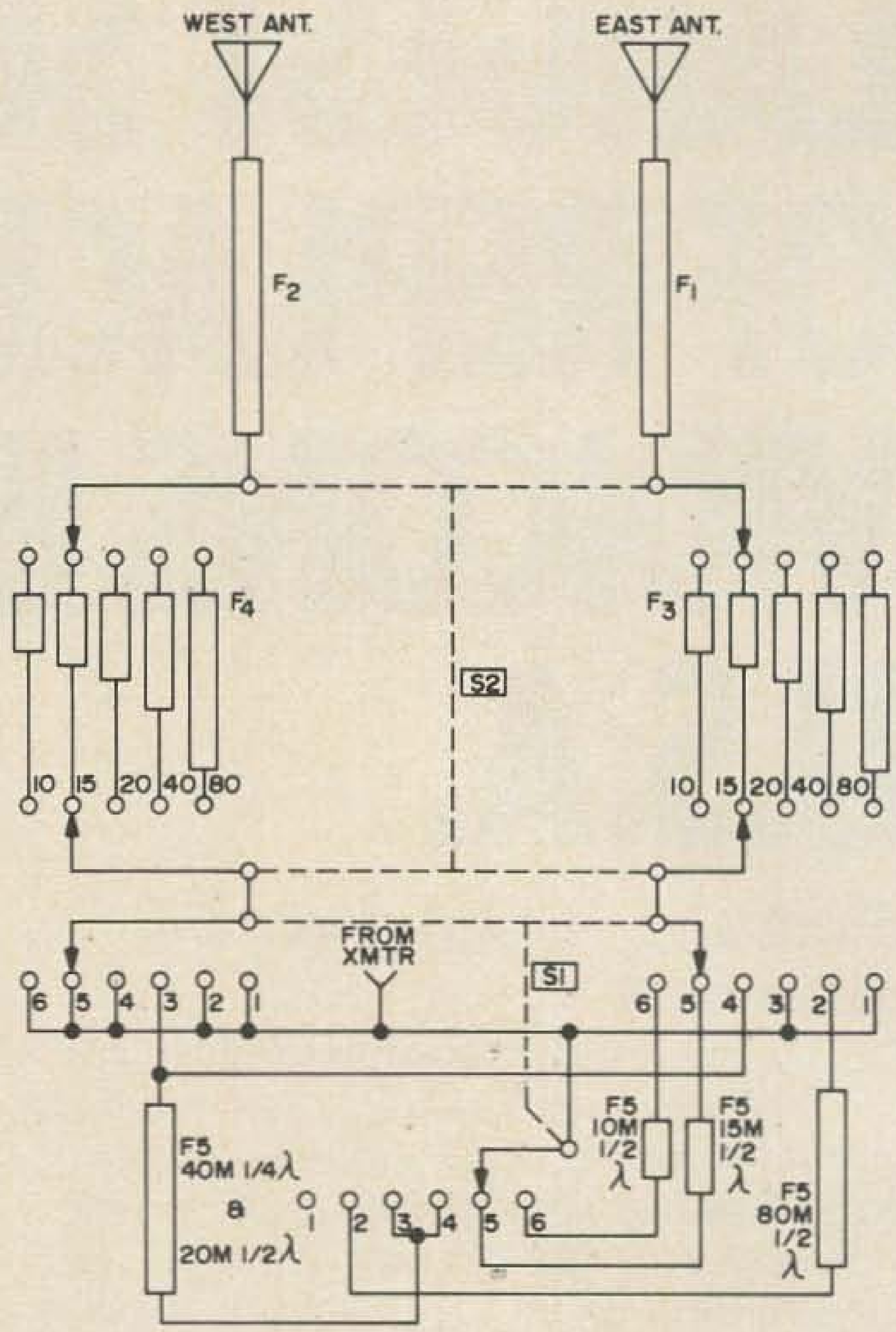


Fig. 6. Basic cardiod switching with quarter wave spacing.



F1 & F2 = EQUAL LENGTHS OF 52Ω COAX CABLE.
F3 & F4 = 1/4 WAVE TRANSFORMER OF 75Ω COAX CABLE.
F5 = PHASING LINES OF 52Ω COAX CABLE.

S1 SWITCH POSITIONS

1. ALL BAND BROADSIDE.
2. 80M END-FIRE.
3. 40M WEST CARDIOD AND 20M END-FIRE.
4. 40M EAST CARDIOD AND 20M END-FIRE.
5. 15M END-FIRE.
6. 10M END-FIRE.

Fig. 7. Switching arrangement for 5 band trapped verticals.

Switch Box Construction

A practical example of a band switching system evolves from **Fig. 5** and **6**. This is shown in **Fig. 7**. Two switches are used: a 5 position, 4 pole and a 6 position, 5 pole. If the trapped verticals in your installation cover 40 through 10 meters, one position can be eliminated or terminated in your dummy load for tune-up purposes. Keep leads short and no problems with high SWR will be experienced.

To avoid confusion, both ends of each phasing line can be marked with adhesive tape and a ball point pen. The phasing lines can then be neatly coiled and stacked in a box (or perhaps a wastebasket) under the operating table. A lot of effort is involved in a good antenna system, and this one is no exception. I think you'll find, as I did, that the returns versus effort ratio is pretty high.

. . . KØWF

Jerry Selenke W9JER
Vocation Central
Donaldson IN 46513

HAM TV: A Public Service

Ham radio has, since its inception, been permitted and sometimes tolerated by the federal government primarily because of its value to the nation in times of disaster. As a consequence of this, ham radio clubs have frequently allied themselves to the various Civil Defense programs around the country. Like many of these clubs, the Marshall County Amateur Radio Club of Plymouth, Indiana, has followed this route. Unfortunately (?), no calamity appeared to afford our club the opportunity to make use of our meticulous preparations. Our energies were channeled toward preparing for events whose possibility of coming about were remote.

Consequently, the club began looking for a service-type project to which the club could devote itself. Although some members put the project described here on a par with the above mentioned calamity in terms of actually reaching fruition, the club decided to give the project a try.

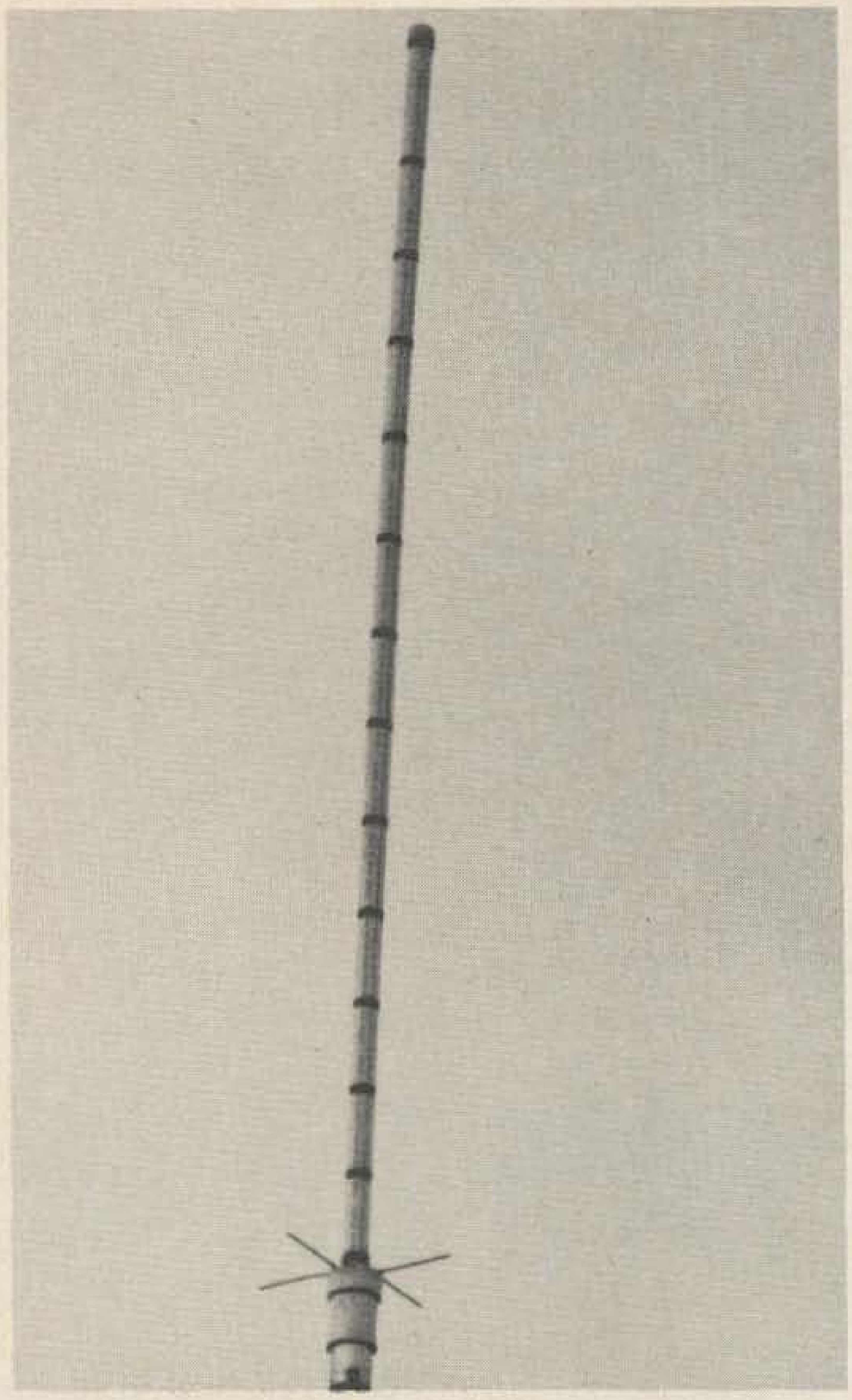
The motto that "amateur radio exists because of the service it renders," took on real meaning for our club. On September 6 (Labor Day), some 15,000 people viewed the annual Blueberry Parade in Plymouth, Indiana. Among these were 100 shut-in nursing home patients. The latter were provided with the televised coverage of the parade through the courtesy of the Marshall County Amateur Radio Club.

Shortly after an article on ham TV activity in this area appeared in the local newspaper I was approached by the publicity chairman for the parade. After considerable discussion with other active ham TV'ers, Wayne Zehner WA9INM and Bob Newcombe K9ZLM, who confirmed that the project was within the realm of technical capability even with our homebrew and sometimes downright crude equipment, it was decided to approach the club with the idea. After the question of legality was solved, the club decided to give it a try and preparations began in earnest.

Since the purchase of 432 MHz antennas was beyond our financial resources, an antenna construction fest was organized. These antennas were bow-tie types with a solid metal reflector constructed out of blocks of wood and aluminum salvaged from discarded highway signs. To facilitate construction it was decided to not use gain antennas at the receiving end of the network with the exception of one nursing home which was located approximately 5 miles from the transmitting site. At this location a 16-element collinear coupled with a preamp was installed. The lack of gain at the receiving ends was offset by a 10-element vertically polarized collinear transmitting antenna (July 71 *73*) constructed by WA9INM and K9ZLM. Vertical polarization was mandatory since the nursing homes were scattered at all points of the compass.

WA9INM began converting a surplus ART-28 for an outboard on a Motorola T-44 strip. After exhausting the expletives in the English langauge, WA9INM found that the Motorola strip wouldn't develop enough drive for the theoretically half-gallon ART-28. Due to a lack of test equipment operating in the 430 MHz range, this fact was discovered too late to allow time to start over. It was decided to use an RCA CMU-15 bare-foot. The fact that it developed an adequate 20W in a test run two weeks prior to the actual parade proved this unit to be more than sufficient to insure completely

W9JER asking for a video check from WA9INM at the business end of the in line and off the air monitors. WA9TZP, club president, is at left next to the club TV idiot card.



Ten-element collinear transmitting antennas constructed according to description in the July issue of 73.

snow-free pictures at all 5 receiving locations.

After the antennas were constructed, the only problem – equipment wise – was obtaining converters for each of the receiving locations. Somehow the club managed to scrape up a sufficient number of ultraverters of the type Americans used to use before the FCC required manufacturers make UHF tuners standard on all TV sets. These ultraverters were slugged to tune 432 MHz and used channel 3 for the i-f.

On the test day everything was set up as closely as possible in the same manner as it would be on festival day. The 10-element collinear transmitting antenna and transmitter was set up on top of the 60 ft Plymouth Building on Michigan Street next to the reviewing stand. The transmitting antenna was on top of a 30 ft portable mast which gave us a total of 90 ft. To achieve

WA9INM watches for parade as W9JER pans local scenery.

this height, it was necessary to run 400 ft of RG-59U video line from the TV camera at street level to the transmitter. In order to overcome the line loss the target on the camera had to be turned up to an undesirable level. Regardless of the negative effect this would have on the camera when operating continuously for at least 2 hours, the video information portion of the signal rose to almost or equal level as the sync pulses which made for considerable tearing of the picture. Dick Basham K9ILU solved this problem by procuring a video amp from our local telephone company and his employer. He also obtained five combination headset-microphone sets from them which were used for closed communications with the camera, transmitter site and camera spotters.

Realizing that the FCC might frown upon duplication of services provided by commercial concerns, it was necessary to use the audio portion of the telecast from WTCA, the local radio station. The local engineer cooperated fully by setting up the announcers' table directly across the street from our camera site. Each nursing home was then provided with an FM radio, and in effect had a description of each parade entry as it passed, because the cameraman was plugged into a portable radio and thus was able to keep the camera on the entry being described by the radio announcer.

The day of the parade itself finally arrived with – you guessed it – rain. However, since hams in general have always been amply blessed with optimism, the club assembled and began setting up the transmitter, camera and all other related paraphernalia. Just when we began to lose some of that optimism, Mother Nature cooperated and the moisture ceased. Despite being a little damp, everything worked, and the club members took up their stations; Dick Basham K9ILU and Dale Schrom K9KRT, transmitters; Bill Washburn WA9TZP (the club president) as camera spotter and public relations; Wayne Zehner WA9INM and Bob Newcombe K9ZLM as troubleshooters; Everett Easterday WB9GSI, Red Easterday WB9AHF, Carl Bovee W9DHF, Mildred Bovee K9ZLB, Clarence Shaffer WA9VRK and Fred Doss WA9VRV at the various nursing homes; and I was on the camera.

For ID purposes a test pattern containing WA9INM's call letters under whose call the televising was conducted – and who incidentally was the prime mover behind the whole project – was positioned so that it could be shot at 10 minute intervals.

Amazingly, everything proceeded as planned, with only one exception. The first time Jerry W9JER, the cameraman, tried to zoom in a well-endowed majorette, he got the full force of 100V. Somehow there was ac on the camera chassis. This coupled with wet feet made for a "shocking experience." Not wanting to interrupt the coverage, WA9INM, the chief engineer, declined to reverse the ac plug. The televising continued, but the situation eased as everything began drying out.

About midway through the parade the odor of burning insulation permeated the camera platform. The thought of a $1200 camera going up in smoke sent everyone scurrying to ascertain the source of the odor. The problem was solved by an untechnical bystander who pointed out the smoking brakes of a horse-drawn wagon. It seems that the old timers constructed their wagon brakes out of material similar to that used in today's wire insulation. At least they smelled the same.

Aside from a brief light shower, the remainder of the parade went off without a hitch and even the transmitter did not blow as expected, since a CMU-15 is not rated for continuous duty. As soon as the last parade two or more cameras, coverage to all nursing homes in the county, a TV repeater so that mobile units could be utilized, and (get this) televising in *color*. Fortunately, Mother Nature interrupted these discussions before they got out of hand by providing a drenching downpour exactly 15 minutes after the parade ended.

Besides giving the small Marshall County Amateur Radio Club a project on which to work together, the project – more importantly – provided some of our senior citizens with a little happiness and a break in the daily routine.

Each of the nursing homes made formal comments to the local newspaer, and a representative from the National Nursing Home manned by WB9GSI sent in the following: "It was just fabulous! We were so glad we were included and it gave our employees a chance to see the parade also. The men coming in beforehand to set everything up gave the patients a great deal of enjoyment. If the club ever tries to do this again, we hope they think of us."

. . .W9JER

A part of the audience viewing the parade at one of the nursing homes.

entry had disappeared down the street, everyone chipped in and began disassembling what to our mind was the greatest thing that ever happened to Marshall County. All reports from the nursing homes were superlative, not only from the hams stationed there, but also from the patients and staffs.

Even before the equipment was fully disassembled, talk turned to how we could improve the system next year . . . such as

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THE MODIFIED SUCTION-CUP ANTENNA

A few simple modifications to the original suction-cup antenna provide greatly simplified tuning. The modifications also permit the antenna's tuning network to be used as an antenna coupler for random-length single-wire antennas, thus further extending the versatility of the unit as a simple, multiband, portable antenna.

The original suction-cup antenna consisted of a surplus folding whip antenna about 10 ft long with a loading coil at its base. It was intended for quick setup, particularly on an automobile, whenever a multiband antenna was desired for temporary operation. Apparently, the idea was appealing to many amateurs who wanted some portable operating capability while on vacation or some other trip but didn't want to install a regular mobile antenna installation. The whip and coil were wired together as shown in Fig. 1 (A).

The main objection that was heard about the antenna was the difficulty involved in finding the two correct coil tap positions, particularly when large frequency excursions were made. Although a procedure was outlined for finding the positions, many amateurs apparently found the procedure too time-consuming when they simply wanted to set up for portable operation for a short period of time. Various means were explored to simplify the tuning of the antenna. Details are given on one method that lends itself to simple modification of the original antenna and other methods are mentioned for the benefit of those who might like to construct a suction-cup antenna for the first time and, therefore, have more freedom in the placements of the tuning components. With the modification, tuning becomes a matter of simply tuning a variable capacitor instead of adjusting two coil tap positions. Generally a single coil tap position need only be changed when changing bands.

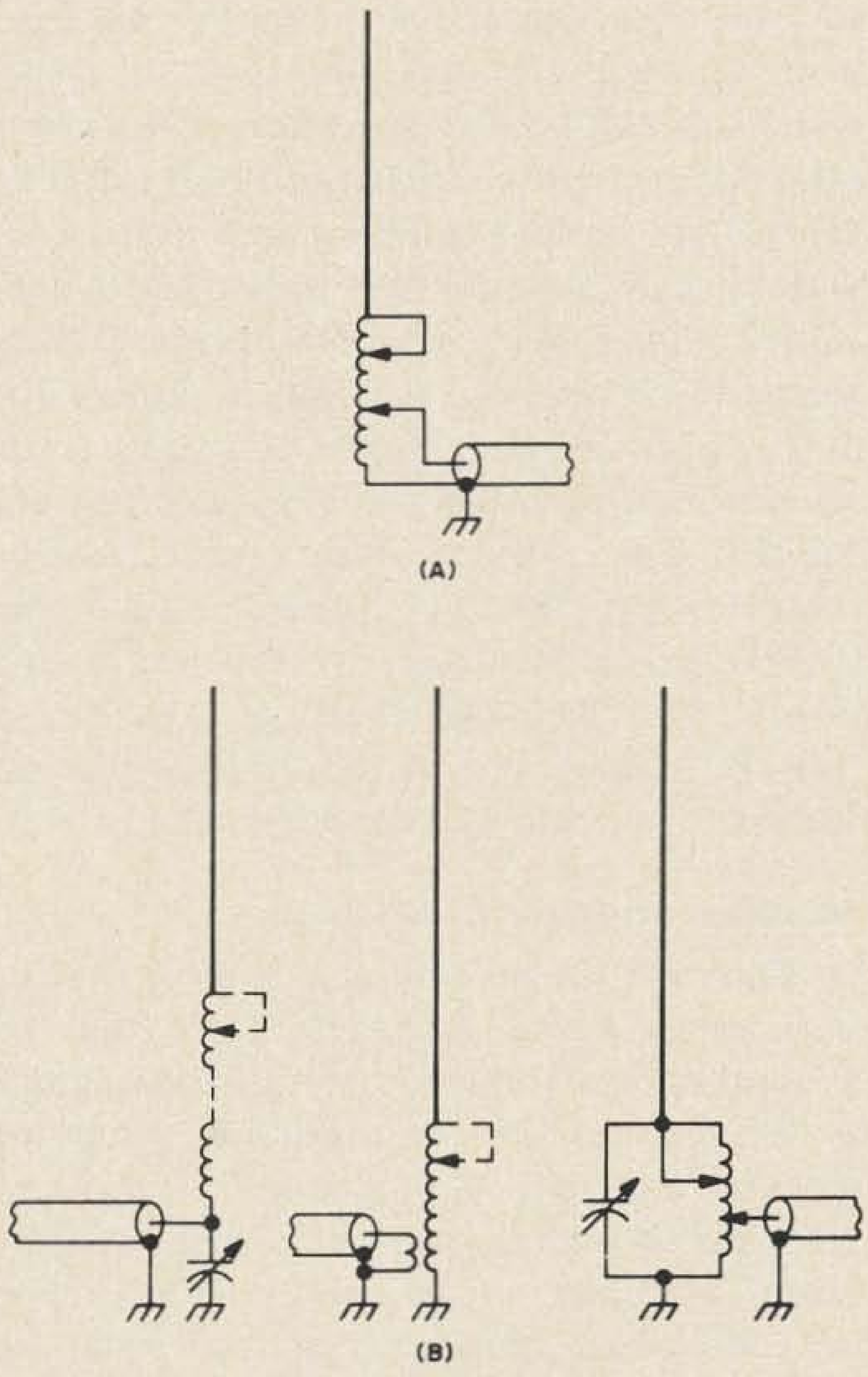


Fig. 1. The basic antenna loading scheme (A) and three networks which were considered in order to provide simplified single-band tuning (B).

Tuning Methods

There are several ways by which the coil taps shown in Fig. 1 (A) can be replaced for single band operation by a continuous tuning scheme. Some of these possibilities are illustrated in Fig. 1 (B). The simplest scheme is probably that there a variable capacitor is placed from the coax center conductor to ground and an extra inductor added to the basic whip loading coil. The extra inductor and the capacitor form an "L" network which can be tuned as desired to match the loaded whip. Although the scheme is generally simple for new construction, since only one inductor need be used which combines the loading and "L" network inductances, it does have a disadvantage in that the variable capacitor has to be fairly large. In fact, several thousand mmf may be required on 80 meters for a 10 ft whip. Fixed capacitors can, of course, be paralleled with a wide range variable capacitor. Another possible scheme is to leave the coil taps as in Fig. 1 (A) but use a 100–200 mmf variable capacitor across the entire coil. Such a scheme will eliminate the need to change the upper coil tap for operation over most of one band but the capacitor is subject to a fairly high voltage gradient and has to be a wide-spaced type for any appreciable transmitter power. The best compromise scheme seems to be that shown in the middle of Fig. 1 (B). Link coupling is used to couple to the loading coil in order to eliminate the transmission line coil tap. The series capacitor modifies the effective coil reactance so that adjustment of the one coil tap left is only needed for bandswitching. A capacitor of 250–325 mmf and medium spacing is sufficient for medium power transmitters.

Modified Antenna Construction

Figure 2 shows how the original suction-cup antenna was modified. Note that the ground end of the loading inductor is actually at the top of the inductor. As in the original, the coil is supported by two metal brackets (homemade of thin brass or copper strap) attached to the lower whip section. An additional bracket is added to support the variable capacitor (a Hammarlund RMC type unit). The capacitor has two threaded mounting holes on the bottom (not insulated from the frame or rotor). A screw is used directly to attach the lower whip bracket to the capacitor.

Since the middle bracket carries the mounting screw for one of the automobile top carrier-type suction cups, a small flat metal bracket about 1 in. long is used to offset the capacitor mounting from the bracket. Instead of depending solely upon the bracket's electrical contact to the whip, a No. 10 piece of wire is also run from a ground lug on the lower mounting hole on the capacitor to the terminal connection at the bottom of the whip. The lower end of the loading coil is connected to one of the stator terminals of the capacitor. About an 8 in. piece of wire with an alligator clip is connected to the other stator terminal in order to effect bandswitching by shorting out portions of the loading coil.

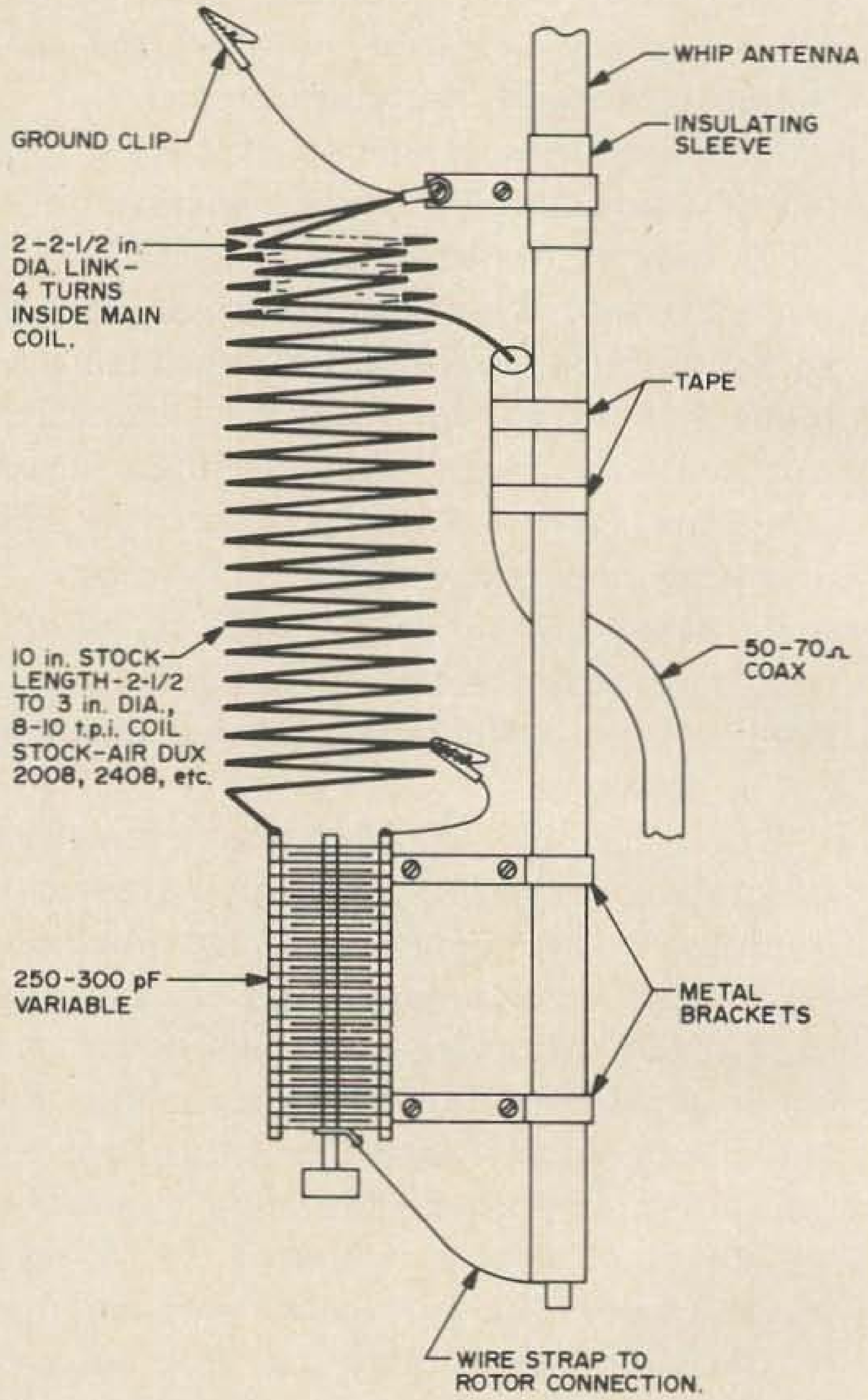


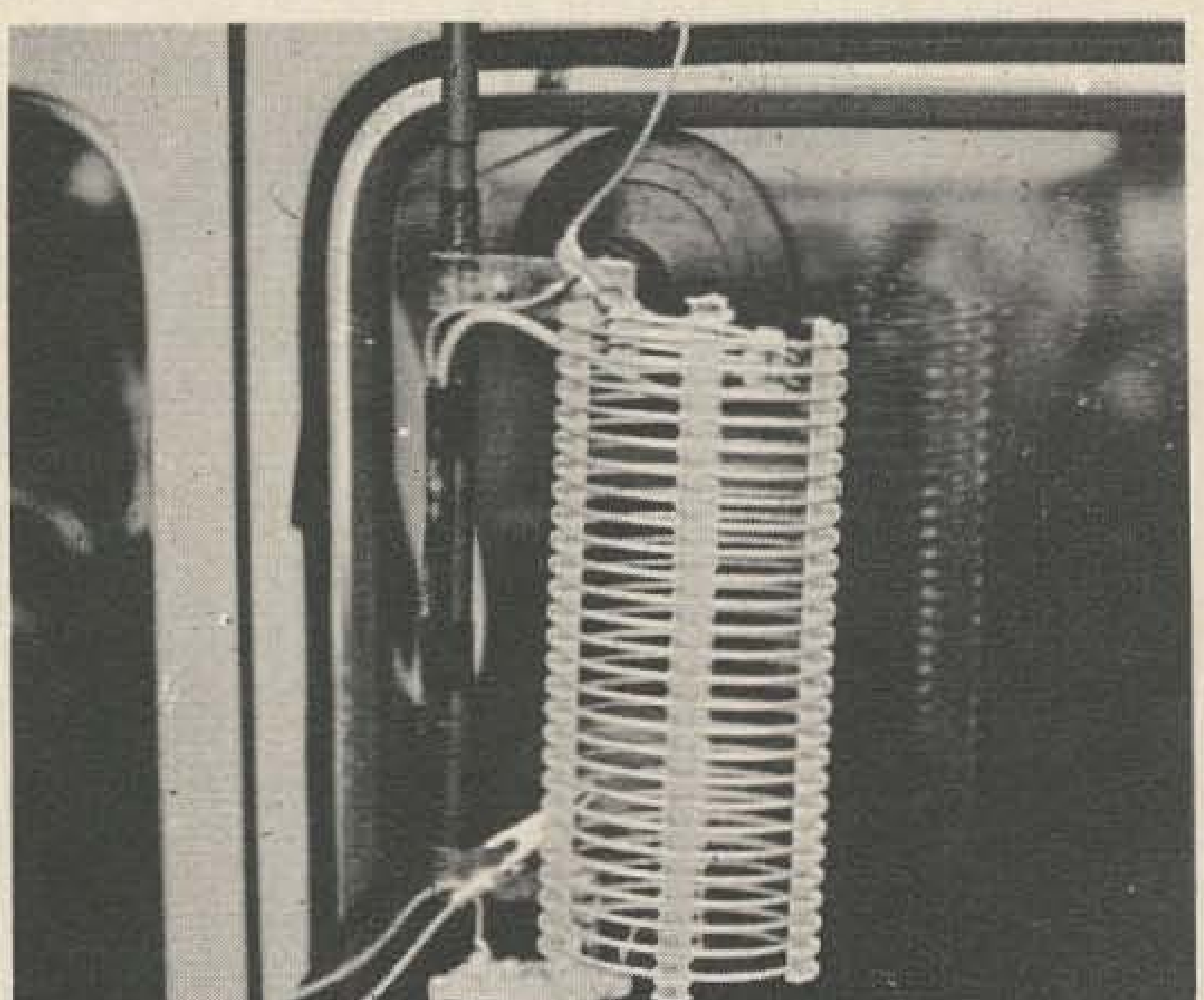
Fig. 2. Construction of the tuner components on the lower section of the whip. The suction cups, attached to the top two metal brackets, are not shown.

The coaxial transmission line coupling link is made of a piece of standard coil stock one diameter smaller than that of the loading coil. It fits easily within the top portion of the loading coil and is cemented in place by Duco cement used between the ribs of the two different diameter coil stocks. The coaxial transmission line is taped to the whip antenna rod, as shown in Fig. 2, with the inner conductor connected to the link coil and the shield to a lug on the upper whip bracket. Care must be taken that the shield of the transmission line is insulated from the whip antenna where it is taped to it for mechanical support.

The foregoing paragraphs were not intended to provide an extremely detailed description of the antenna's construction but mainly to highlight those areas which might require clarification. The use of components of widely different manufacture or construction will yield the same results but the same basic construction techniques should be observed.

Adjustment

Proper adjustment of the antenna requires, at least initially, the use of an swr meter placed in the transmission line as near to the antenna as possible. The capacitor should be set at its mid-scale value. On any selected frequency band, the band coil tap on the loading inductor is then experimentally determined to produce the lowest swr. Varying the capacitor setting will then allow operation with the same coil tap position over a major portion of any low-frequency amateur band. Once the correct coil tap position has been found for a band, it is not necessary to monitor the transmission line swr. The variable capacitor can simply be adjusted for maximum field-strength indication response using the coil tap determined to be correct for mid-band operation. If desired, once the correct coil tap position for a band has been determined, a pin and jack arrangement can be used for bandswitching. Standard banana-type plugs and jacks, for instance, are very suitable. The jacks are soldered on the coil at the correct mid-band position, as determined by swr measurements, and the alligator clip shown in Fig. 2 replaced by a banana plug.



Typical installation of the modified suction-cup antenna. Placement of the tuning capacitor at the bottom facilitates ease of tuning. Use of a Mueller 63C insulated clip instead of the uninsulated type shown is preferred.

Summary

The suction-cup antenna can easily solve the antenna problem for many temporary or portable operating situations. With variable tuning, the basic antenna becomes even more versatile and easy to adjust. A very handy feature of the modified antenna is its ability to serve also as an antenna coupler. For instance, if one is in a portable situation where it is possible to erect a long-wire antenna for greater efficiency, the tuning network of the suction-cup antenna can be quickly converted into an antenna coupler for the long-wire antenna. A shorting connection (by means of clip-on leads) is made from the rotor terminal of the variable capacitor to the upper (ground end) terminal of the loading coil, thus forming a parallel resonant circuit. The long-wire antenna terminal is then tapped on the main coil at a point producing minimum swr in the coaxial transmission line with the parallel resonant circuit peaked for maximum transmitter loading. Almost any random length of long-wire antenna can be easily tuned in this manner.

. . .W2EEY

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300 MHz FREQUENCY SCALER

This summer 73 Magazine is publishing a three-part article on building an IC frequency counter good up through the VHF range. That design has a built-in frequency scaler, and is good through almost 300 MHz. For those who have a low-frequency counter and just need a scaler to extend the range, here is a simple design which can be built for about $20.

The heart of the unit is a Fairchild μ6B95H9059X divide-by-10 scaler IC, which costs about $16 in unit quantities; we call it a 95H90 for short, and it's IC1 in Fig. 1, the schematic diagram. The output of this IC is fed into a 2N5771 PNP transistor which amplifies the output and provides a voltage change. If you have a counter which will go up to about 15 MHz, then this part alone will extend your range to 150 MHz. But if you have a slower counter, then you will need IC2 as well. This is an inexpensive ($1.30 or so) SN7490N TTL decade counter, which does a second division by 10. Both IC's together will take a 150 MHz signal and divide it down to 1.5 MHz.

The IC's need a voltage between +5 and about +5.3 volts. While you could build a power supply, that only increases the cost. The easiest way to provide power is with four D cells or a 6-volt lantern battery, which provides +6 volts. The 1N4001 diode, or another silicon power diode, drops this to about +5.3 volts. The scaler needs about 150 mA, so a set of four D cells will last about 10 or 20 hours with intermittent use.

Figure 2 shows a printed circuit board layout which can be used to mount the scaler, and Fig. 3 shows the parts placement on the board. Leave the copper border around the board, to act as the ground connection for the board. Use phono jacks or rf connectors, and bypass the +6 volt lead. The purpose is to let rf into the box only via the input lead.

In use, avoid over-driving the scaler. Start with a low input level, and feed in just

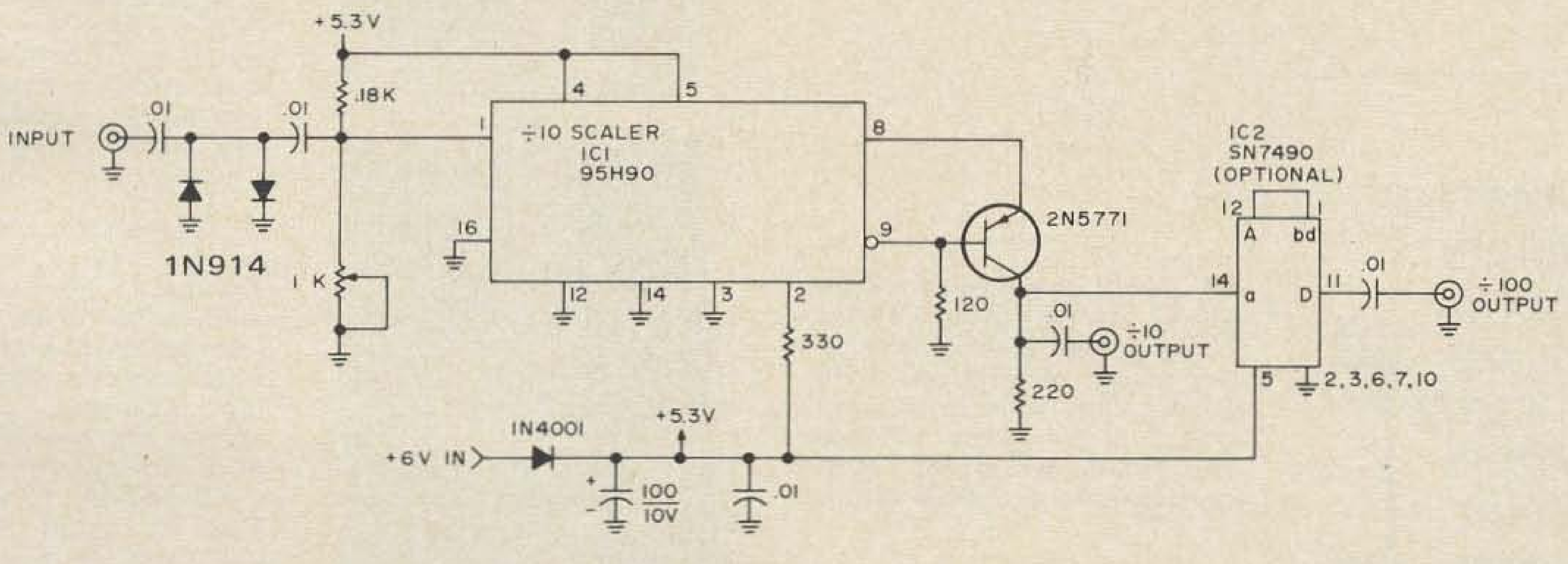

Fig. 1. VHF scaler schematic diagram. All .01 capacitors are disks. All resistors are ¼W, 10%.

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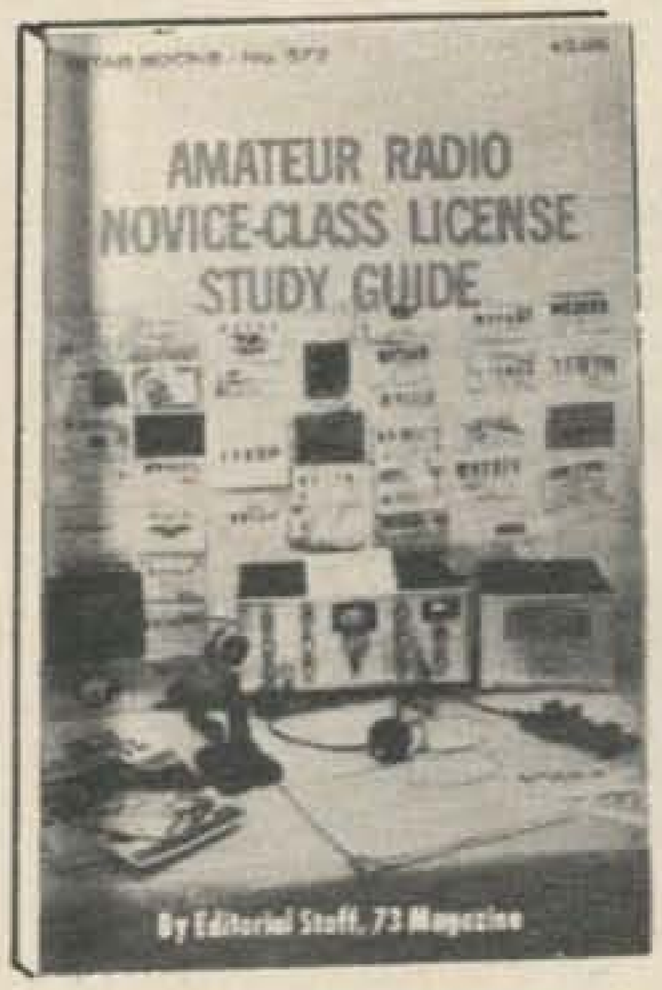

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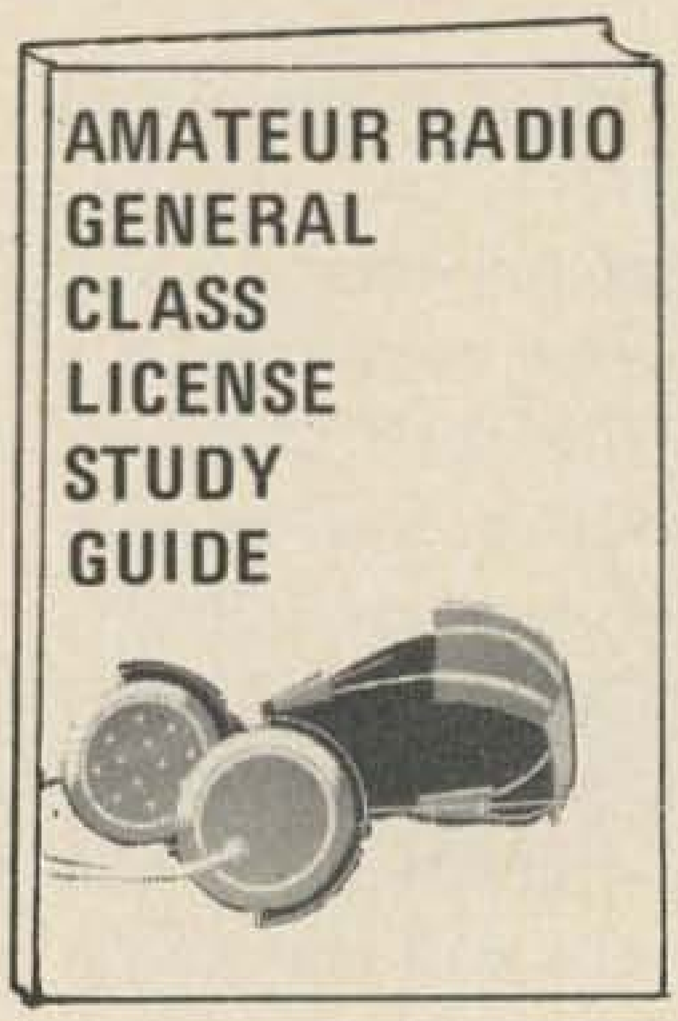

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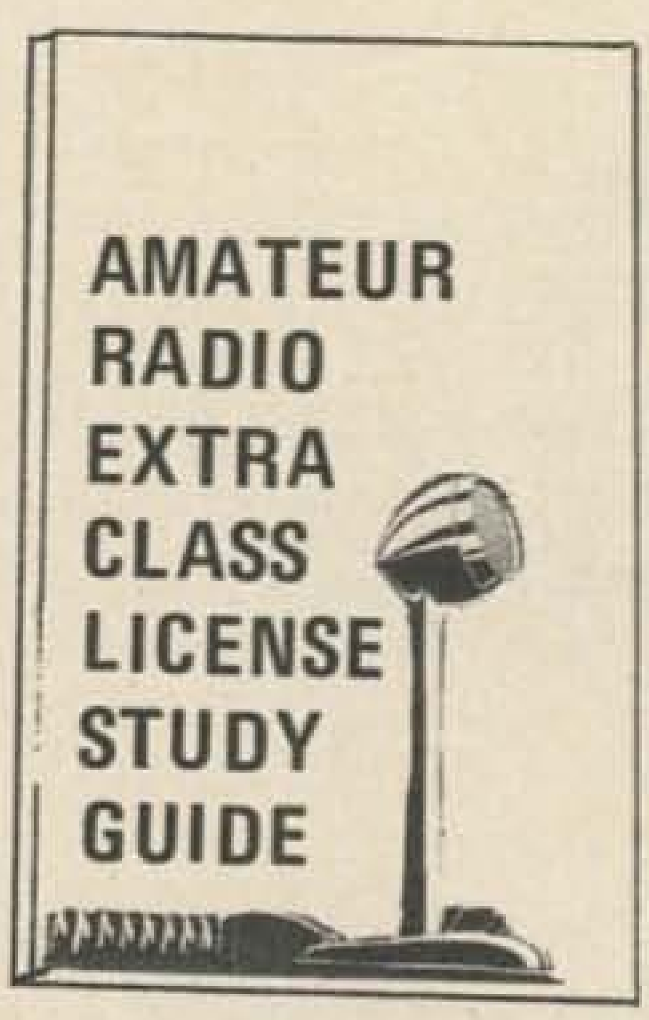

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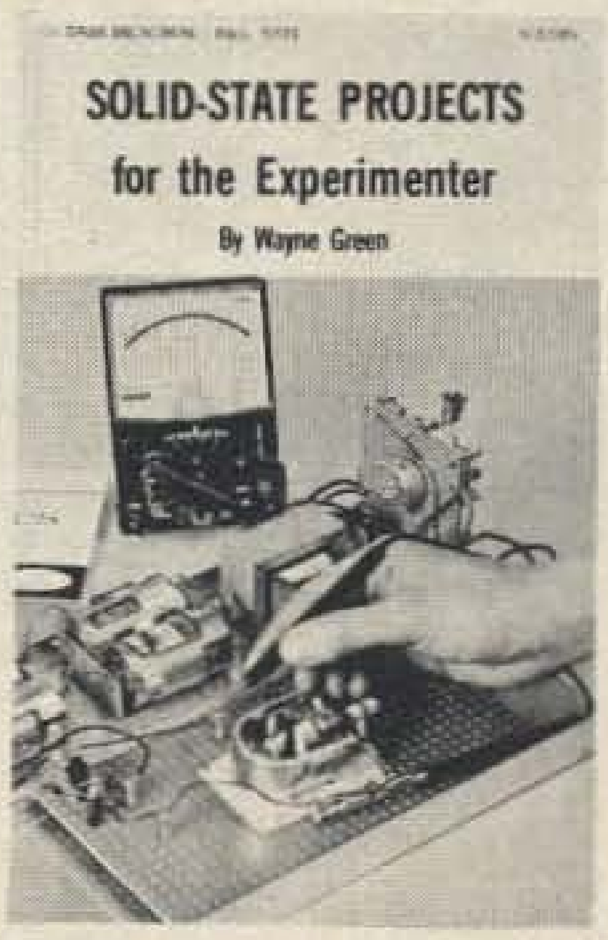

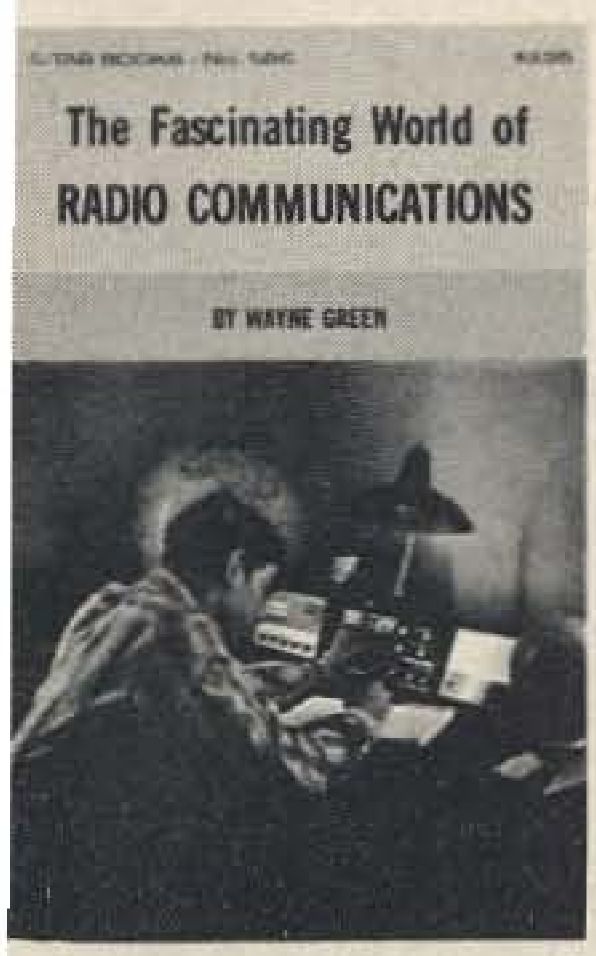

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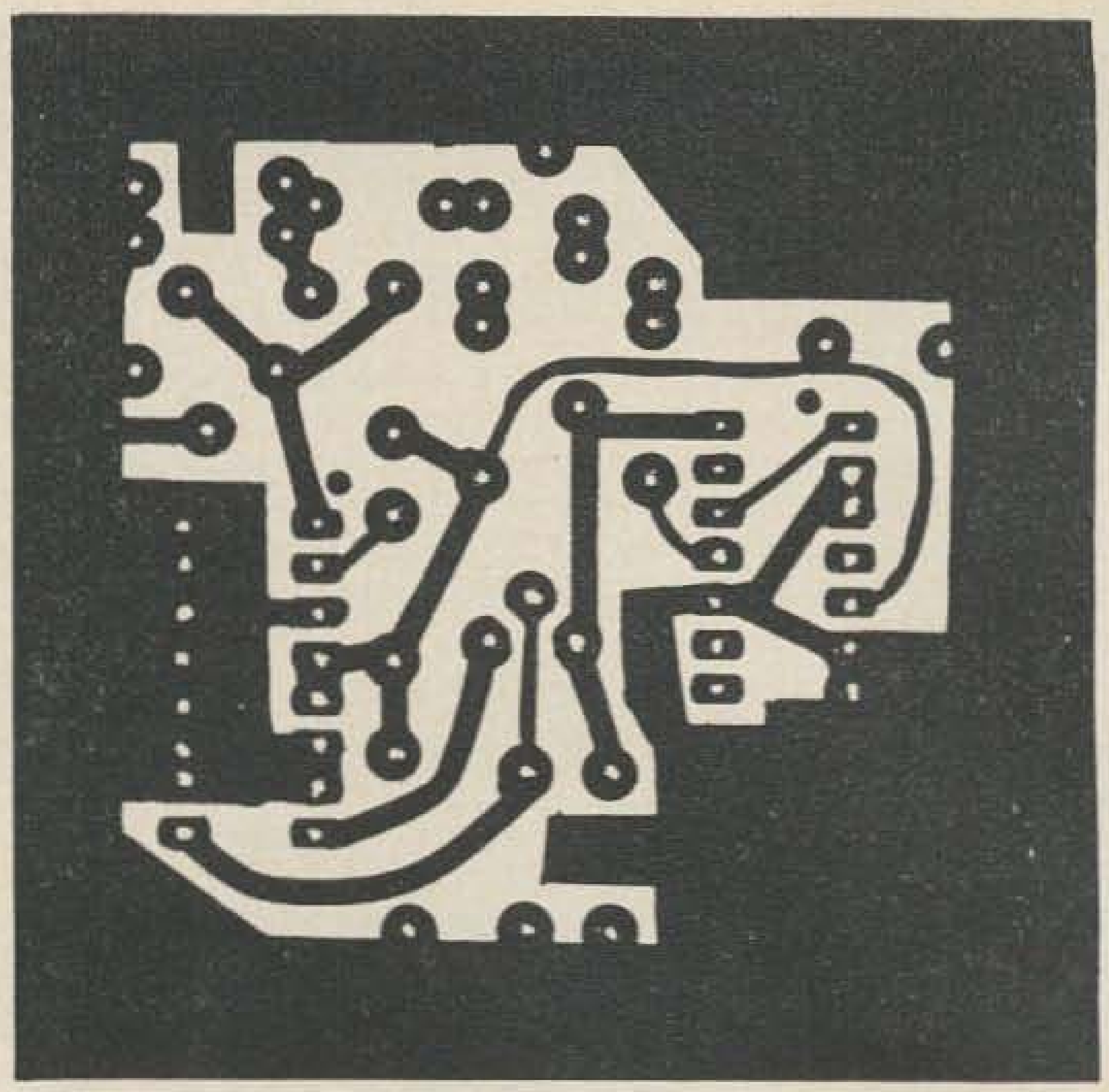

Fig. 2. Copper side of PC board, actual size.

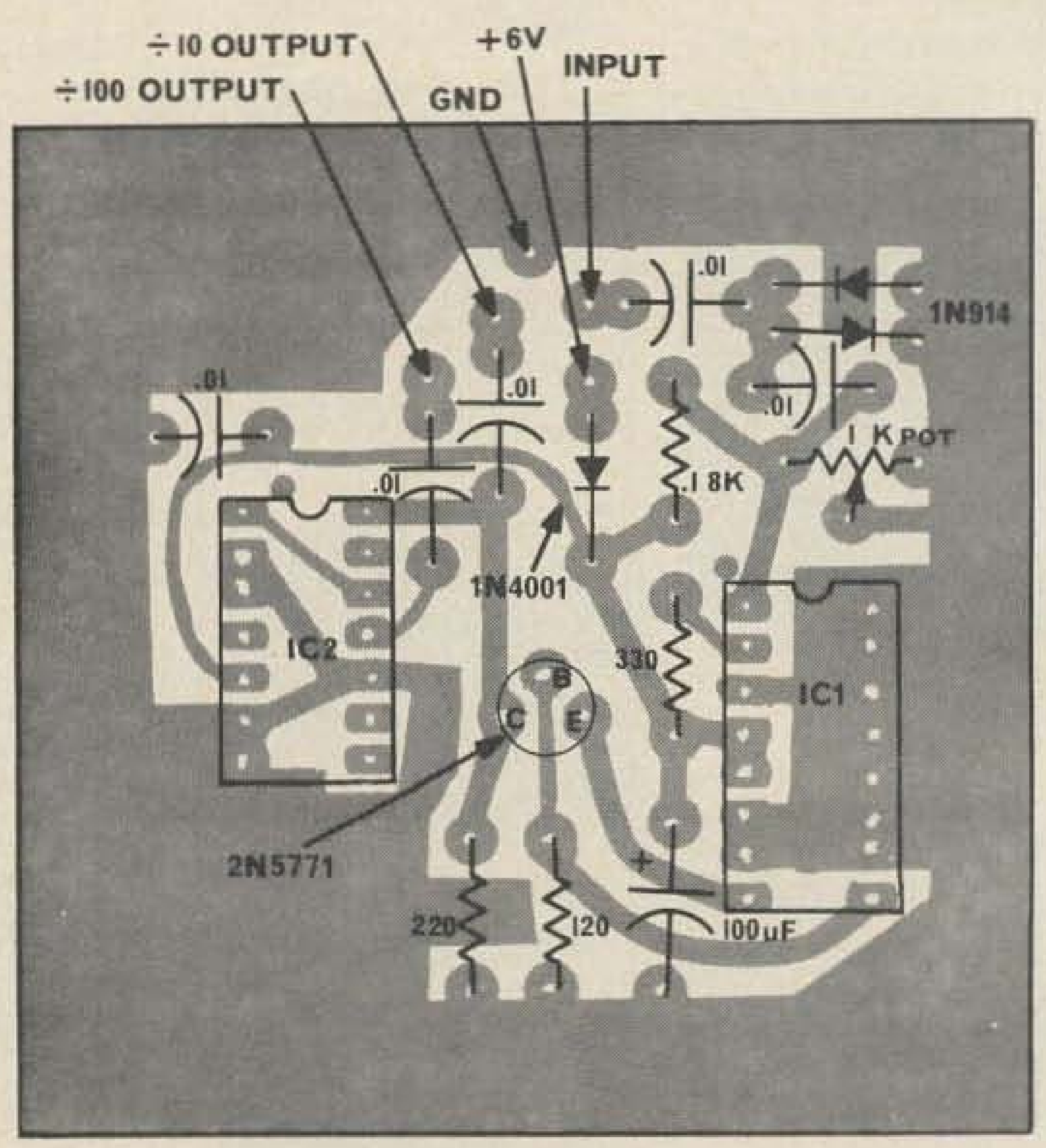

Fig. 3. Parts layout diagram (component side).

enough rf to get a counter reading. With a 19 inch length of wire connected to the input lead you should be able to activate the scaler with a 1 or 2 watt hand-held unit from a few feet away.

If you later decide to build the complete solid state frequency counter, you'll be happy to know that all the parts from the scaler will be usable for the counter later. But make sure to use sockets for the IC's (look into Molex Soldercon terminals for IC sockets).

...K2OAW

Ed Webb W4FQM/1
Technical Editor
73 Magazine

73 REVIEWS THE SAVOY BASSET VACUUM TRAP ANTENNA SYSTEM MODEL DGA-4075

When you open the box of the DGA-4075 you know instantly that the new Savoy Basset Antenna is made of full commercial grade parts. Quickly reading through the instructions you find that no soldering is required during assembly. All you need is a screwdriver, pliers, diagonal cutters and a tape measure. In fact you don't even need end-insulators as the nylon support line supplied with the antenna works perfectly.

Savoy supplies two very simple charts that are used to determine the length of the two sections of wire. First you pick your 40 meter center frequency to get the "A" wire element dimension. Then use that same frequency on the vertical side of the 80 meter chart. Where the 40 meter frequency and 80 meter frequency intersect on the chart gives you the second dimension for the wire sections. Now you have the two dimensions for the wire on each side of the traps. There is only one trap on each leg. The wire that Savoy supplies with the antenna is not the usual stranded type but the heavy duty copperweld solid type. Also included is a center insulator that is a broadband balun. The lead-in coax that comes attached to the balun is a half wave length on 80 meters. The feed line can even be pruned to make it an exact half wavelength at your specific 80 meter frequency. After shorting each wire element the amount shown by the frequency chart, you simply place the wire ends into the clamps on the traps and balun and tighten down the set screws – and you don't even have to strip the wire! After you have all of the wire sections together, put a support rope through the center insulator and hoist it up to the support point. Find a place to secure the nylon support ropes at the ends and you are almost ready to go. Once you run the RG-59/U feed line into the shack, the only soldering you have to do is to put on a PL-259 male coax plug along with a UG-175/U reducing adapter. That's it – all you have to do now is fire up the rig and get on the air.

In the past I have had the unpleasant experience of trap failure on both dipoles and verticals. This usually occurred while running a full KW on RTTY. Not only would the trap go but usually the final tube, too, unless I happened to catch it very quickly. When you open the box in which the DGA-4075 was packed, you are immediately aware that the traps are quite a bit larger than the two-inch types usually found on most trap dipoles. The traps supplied by Savoy are a good four inches in diameter and are hermetically sealed in heavy, clear plastic containers. When the trap coils are placed in the containers at the factory the normal air is removed and replaced with helium. This prevents any chance of moisture getting into the traps and causing a breakdown or arc-over. The larger diameter trap coil design allows the traps to have a higher Q which means that the overall antenna performance is better.

The Savoy DGA-4075 easily withstood a full KW input on RTTY and with an SWR of 1.3 to 1 on 80 meters. In fact, I cranked the Heath SB-220 up to produce a *broadcast* type of KW and the antenna took it with no problem. The same thing was tried on phone on 40 meters with equally excellent results. In fact the antenna works so well I will probably get the conversion kit Savoy offers to convert it to be used on 20 meters as well. All you do is add two more traps and you have a high power tri-band trap dipole. Of course Savoy offers a DGA 204075 right from the factory if you want a tri-bander from the start.

I am very happy to see Savoy offer an antenna of this quality and performance – it has been long overdue for the ham who wants to run high power on the lower frequencies with one antenna. The assembly constructions are clear and concise and contain a number of examples of how the antenna can be installed in various configurations. Savoy even has reflector and director kits, should you want to make up a wire beam. The DGA-4075 is a mere $49.50 and the DGA-204075 only $79.50. Other band combinations are available. Write to *Savoy Electronics, Inc., P.O. Box 7127, Fort Lauderdale FL 33304.*

. . .W4FQM/1

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Reprints from the FM Bulletin (Feb 67–Feb 68) including the new regs for 150 MHz marine two-way communications, mobile noise suppression techniques, a direction-finding antenna for 146.94 MHz, four transistor crystal controlled converter for 2m FM, three oscillators for tuning up FM receivers, inexpensive preamp for 2m and 6m, design info on antenna matching, discussion of repeater proposals before the FCC, description and details on Baltimore repeater WA3DZD, first five chapters of the infamous Chronicles of 76, a simple TVI eliminator, converting the GE mobile supply to ac operation, community public service, good and bad points of popular surplus 450 equipment, description of W6FNO repeater, using different modes in a repeater control mobile, how frequent should a repeater ID be?, using 2m FM between planes, multiple repeater power outputs, plans and circuit for a hand transceiver, how about a cross country 2m FM net?, mobile telephone setup using a 450 repeater, description of Buffalo repeater, 12 foot omnidirectional antenna a la Comprod and Prodelin, plans for encoder and decoder, SAROC goings on (ahem!), power amplifier for home builder, new telephone regulations for attachments, etc.

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The Bulletin is the place where the mass of FM information is published that doesn't make it into 73 because there just isn't enough room. It runs about 24 pages per month (8½ x 11).

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Order on page 107

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RADIO BOOKSHOP Peterborough, New Hampshire 03458

Order on page 107

BOOKSHOP

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An updated version covering everything you ever wanted to know about coax but didn't want to write to all the manufacturers and ask. Includes a lot you probably didn't even know you didn't know! Maybe a lot you don't even want to know. But it is all there – lengths of antennas and coax of different types for quarter, half and full wave feedlines and antennas for all amateur bands, coax connectors and how to use them, accessories, switches. What ham or even engineer can function without this reference data at hand?

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You already know how to use FM, but you still might enjoy having this book of detailed instructions and descriptions of the many tone systems used with repeaters for control. This book also contains a list of active repeaters and an exhaustive bibliography of all articles published in the ham magazines on the subject of FM during the last few years. The bibliography alone is worth the price of the book.

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Please enclose separate sheet listing books ordered.

Ed Webb W4FQM/1
Technical Editor

73 REVIEWS THE VANGUARD FS-160 FREQUENCY PRESCALER

In addition to the many solid state VHF/UHF preamplifiers and converters that Vanguard Laboratories make, they have entered into a new product line: a VHF prescaler. The model FS-160 is a prescaler or decade frequency divider that is guaranteed to operate up to 160 MHz. This means if you want to measure your 2m FM rig's frequency and have a counter that will read up to 15 MHz, all you need is the FS-160. The prescaler will divide your 146.340 MHz by ten and allow your counter to read 14.340 MHz. In the process of dividing you will lose the "ones" or Hertz digit resolution. It is impossible to *accurately* set a VHF transmitter to within ±10 Hz so you are not missing the performance of higher priced VHF counters. But you have gained a useful tool: you can now reset your transmitter frequency on 15, 10, 6 and 2 meters. Also the aircraft transmitter frequencies from 120 130 MHz and the business and marine frequencies from 150–158 MHz can be measured. The FCC requires your counter to be a high accuracy crystal time base so that you will meet the standards for these commercial frequencies. A first or second class radiotelephone license is required also.

By placing a short pick-up antenna to the input of the FS-160 prescaler and connecting the output to our Heath IB-101 counter, we have been able to read the frequency of hand-held portables up to a few feet away. Also, by placing the scaler and counter in the house pointing out the window to the driveway, we can very easily net the FM mobile rigs we have around. Receiver crystals can be netted on the bench by using a short piece of coax as an rf pickup by reading the local oscillator frequency in the 135–136 MHz range. This is usually 10.7 MHz below the desired receive channel frequency.

The FS-160 is all solid state with a two stage discrete wideband input amplifier and IC frequency dividers. The first IC is a high speed divide-by-two that feeds three more flip-flops arranged in a divide-by-five configuration. A discrete voltage level translator and buffer stage feed the signal to the counter after being divided by a final decade. The power supply is voltage regulated by an IC regulator controlling a series pass transistor. Input and output jacks are of the BNC style and there is a separate amplifier output jack provided. An ac power switch and pilot lamp are also on the front panel of this nice little package. Other prescalers for up to 500 MHz are also available. The FS-160 sells for $129.50. Write to *Vanguard Laboratories, 196-23 Jamaica Ave., Hollis NY 11423*

. . .W4FQM/1

CARE AND FEEDING OF TAPE

Don Royer WA6PIR
16387 Mandalay Dr.
Encino CA 91316

For those who want to keep, store and retrieve tape, there seems to be several problems that are encountered. Having had these same problems for several years with about 25 RTTY picture tapes, a few tips may be in order.

Of the two types of punches, I prefer the chad type. Even though the little chads to get into things, the tapes are easier to wind, store, and to feed into the TD. But then, most of the punches are the chadless type, so I will try to cover both situations.

There are several types of commercial winders available. I have two of them – both motor driven. One is used for winding from the TD or reperf and the other for the necessary unwinding. On a long tape, I put the loose tape from the unwinder in a large wastebasket below the TD and then forget it, as it comes out fine. Chadless tapes may catch on themselves and require a bit of watching. In the absence of a winder, you can learn to wind the tape in a figure eight about your thumb and little finger with the start at the beginning of the bundle. In this way, the tape will not be twisted and will pull off the tape bundle with but a little help from you. To keep the ends free and windable, I usually pull about a foot of blank tape from the reperf at both ends. If you are thinking of building a winder, try to keep the center hub at least three inches in diameter as too tightly wound tape resets the chads in the chadless type back where they were and will not permit it to run properly in the TD. If you use the figure eight wind, tuck the free end into the bundle loop. With rolls from the winders, I like to use a small bit of solder to hold the roll together. If you have trouble learning to figure eight wind, get a local commercial Teletype gal to show you the simple technique.

Storage and retrieval are the real problems. I separate the tapes into subjects and store them in large plastic bags with ten or fifteen tapes to a bag. This keeps the tapes from drying out and lets me find any one tape without too much time. The title of the material on the tape, marked on the lead end with a heavy marking pen, also helps to speed identification. Making and keeping a list of the tapes in the same order as stored also helps and can be used to tell the others what you may have on hand that may be of interest to them. The marking pens will also write on the plastic bags that can then be stored in a drawer or cabinet.

Sometimes when making a tape or reperfing, your supply roll will run out; or you may have a break or tear in a tape. The simple side tear problems are easily fixed with a bit of Scotch tape trimmed to the edge of the tape. Otherwise, you may need a splice or patch. These are not the best solutions, and you should make a copy tape with the repaired portion, but a fairly good splice may be made with white glue to add a fresh roll to one that is running out. Overlap about an inch or so. Be sure the glue is dry (I use my lighter carefully to hasten drying). You can also punch a short piece of tape with the same characters and splice a bad spot in the middle of the tape. With the chadless types, they may be merely run together in the TD to hold the splice. But if you want to keep the tape for any time, take the time to make a new one.

When running a long tape on the air, don't forget the need to ID at least every ten minutes. If you have the narrow shift CW ID facility, that is fine and will lock up most of the machines. In the absence of the narrow shift (about 100 cycles), stop the TD and let the steady mark tone stay for a few seconds, then CW ID and repeat the steady tone to permit the other fellow to hit his standby switch and not interrupt his print. When making tapes, do make them as short as possible and leave out all those lines across the paper that are in some brag tapes, the "CW ID follows" bit and similar unnecessary characters or language.

So get all that tape off the floor, men. You may even find something you lost long ago.

. . .WA6PIR

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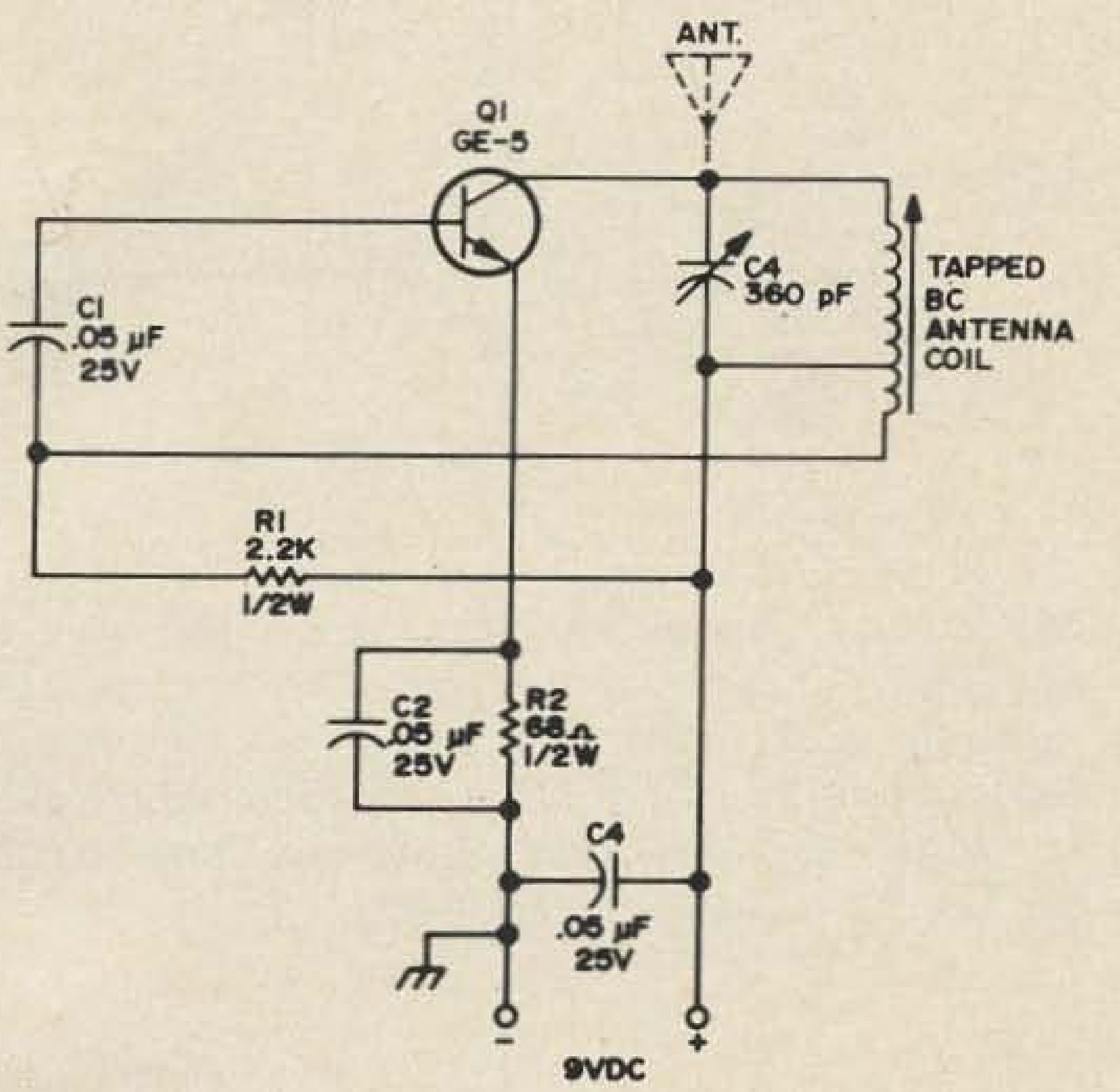
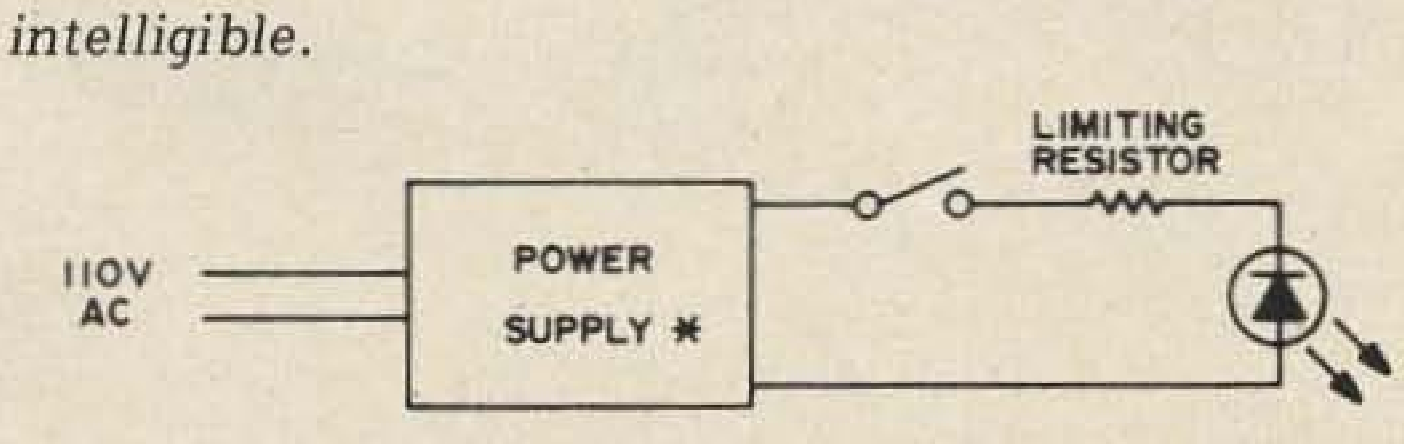
CIRCUITS, CIRCUITS, CIRCUITS...

The following circuits have appeared in the referenced books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.



Beat frequency oscillator (courtesy of Gerard Piette, Ontario, Canada). Place unit near receiver and tune C2 until SSB and CW signals become intelligible.



* IF POWERED FROM THE AC LINE, THE OUTPUT MUST BE 6 VAC (STANCOR TRANSFORMER NO. P8385 OR EQUIV). OTHERWISE, POWER SUPPLY IS 6 VDC AT 100 mA.

LIMITING RESITOR CALCULATIONS

$$\frac{V_S - V_F}{I_F} = R\ (\text{min.})$$

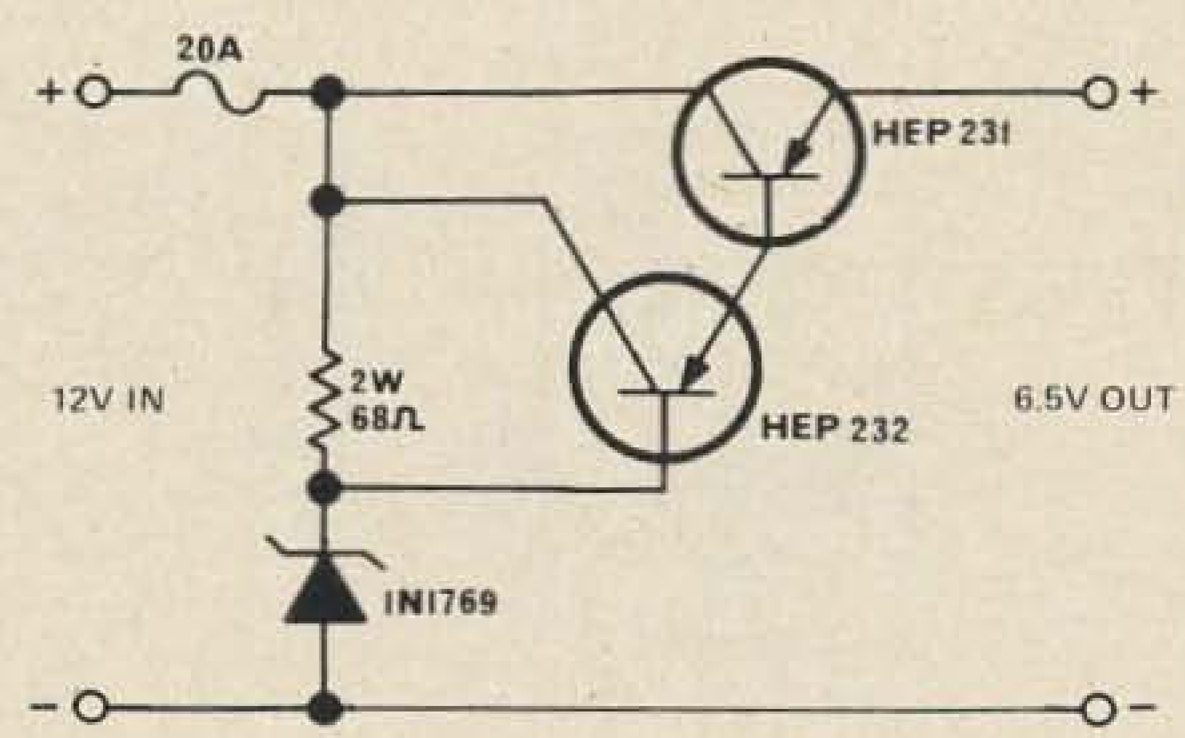
V_S = SOURCE VOLTAGE

V_F = LED FORWARD VOLTAGE

I_F = FORWARD CURRENT

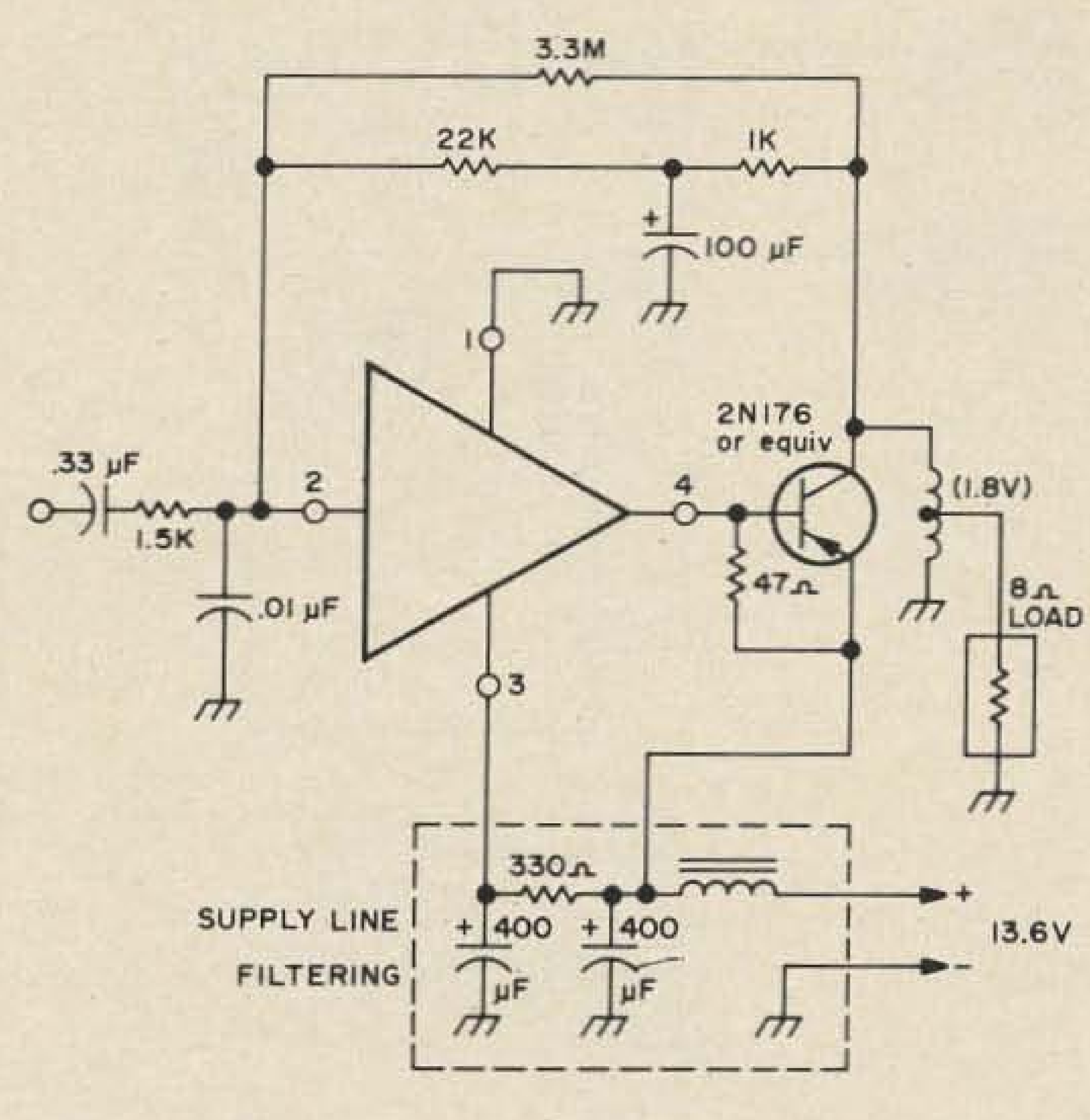
R (min.) = VALUE OF RESISTOR (in ohms)

The power requirements for light-emitting diodes are very low and the devices may be operated from a variety of power sources. However, it is necessary to limit the current to an LED, since, like a neon lamp, it can be damaged if permitted to draw excessive current. The simple formula will help to determine the correct resistance value. Courtesy Sprague Products Co., L.E.D. Application Notes.

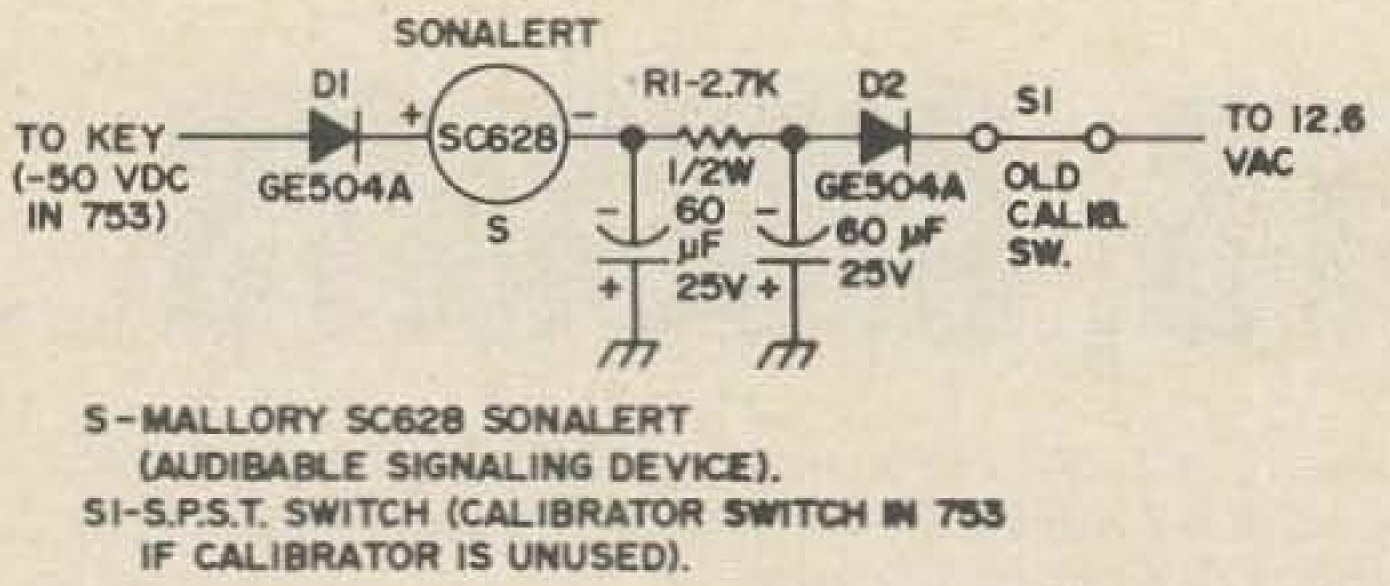


12 to 6 Converter

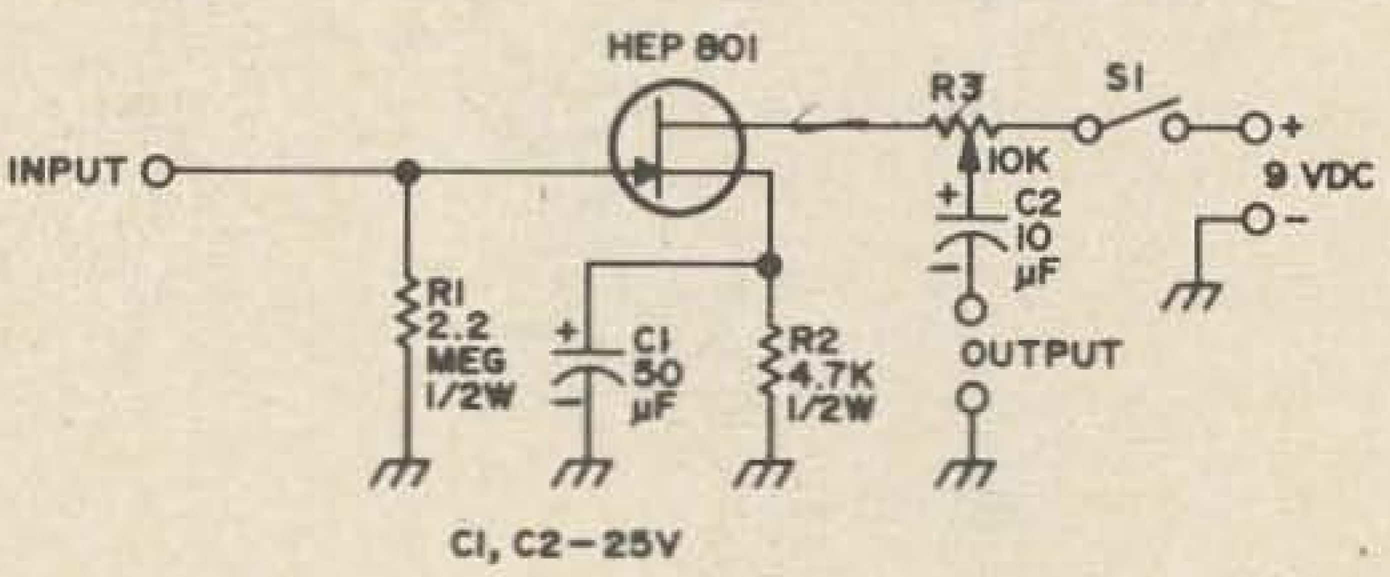
You say you got a real bargain on an old motorcycle FM rig, only to find out it was 6 volt? Fret no more. Below is a handy-dandy 12 volt to 6 volt converter unit, courtesy of KØWRL, which is suitable for low and medium powered gear. The transistors should be mounted in a suitable heat sink. From Grid Leak, Pueblo, Colorado.



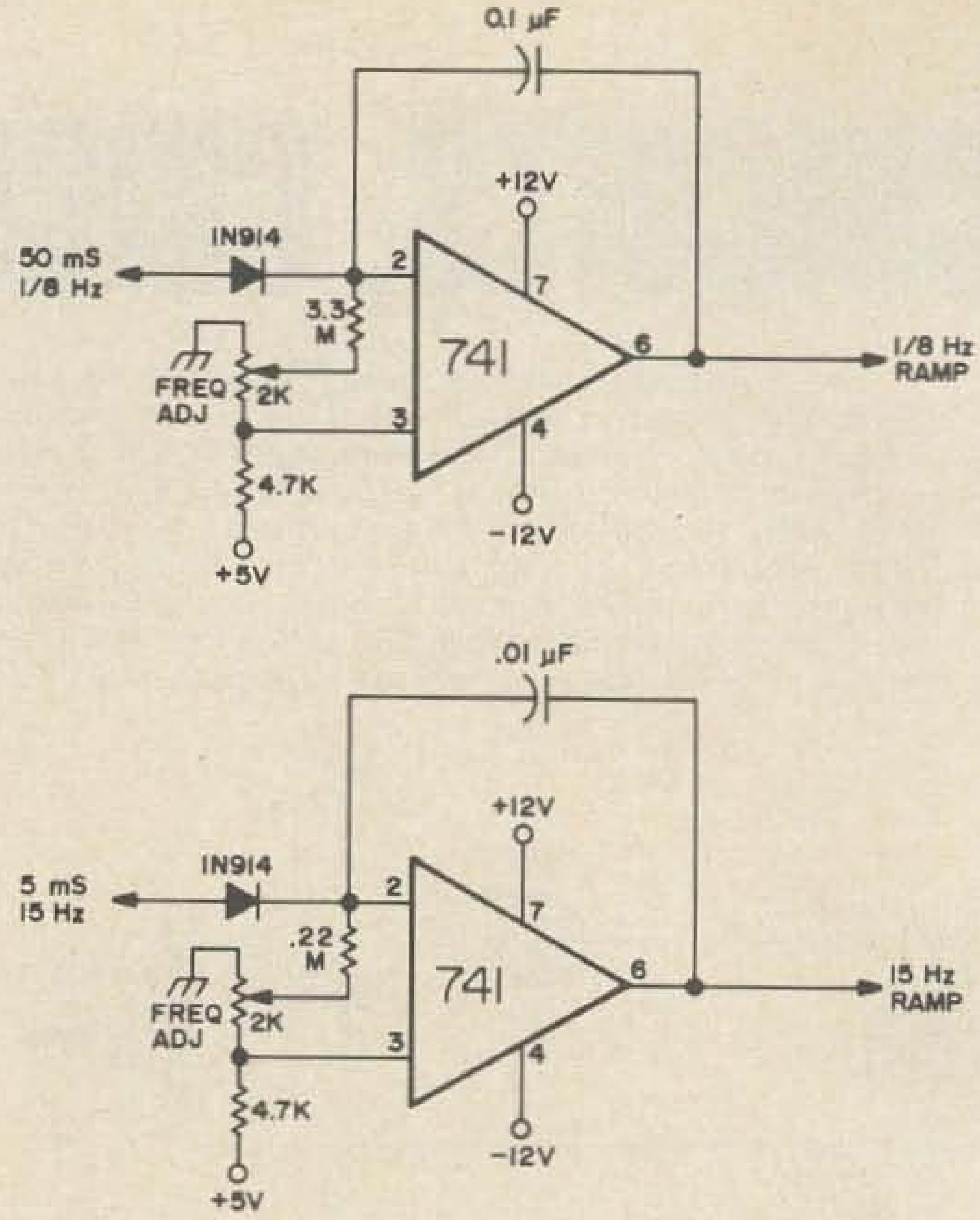
Typical 4 watt amplifier circuit application of a Motorola MFC4050 silicon monolithic functional circuit, a Class "A" audio driver designed for driving Class 'A" PNP power output stage applications. Circuit courtesy of the Motorola Functional Circuit Handbook.



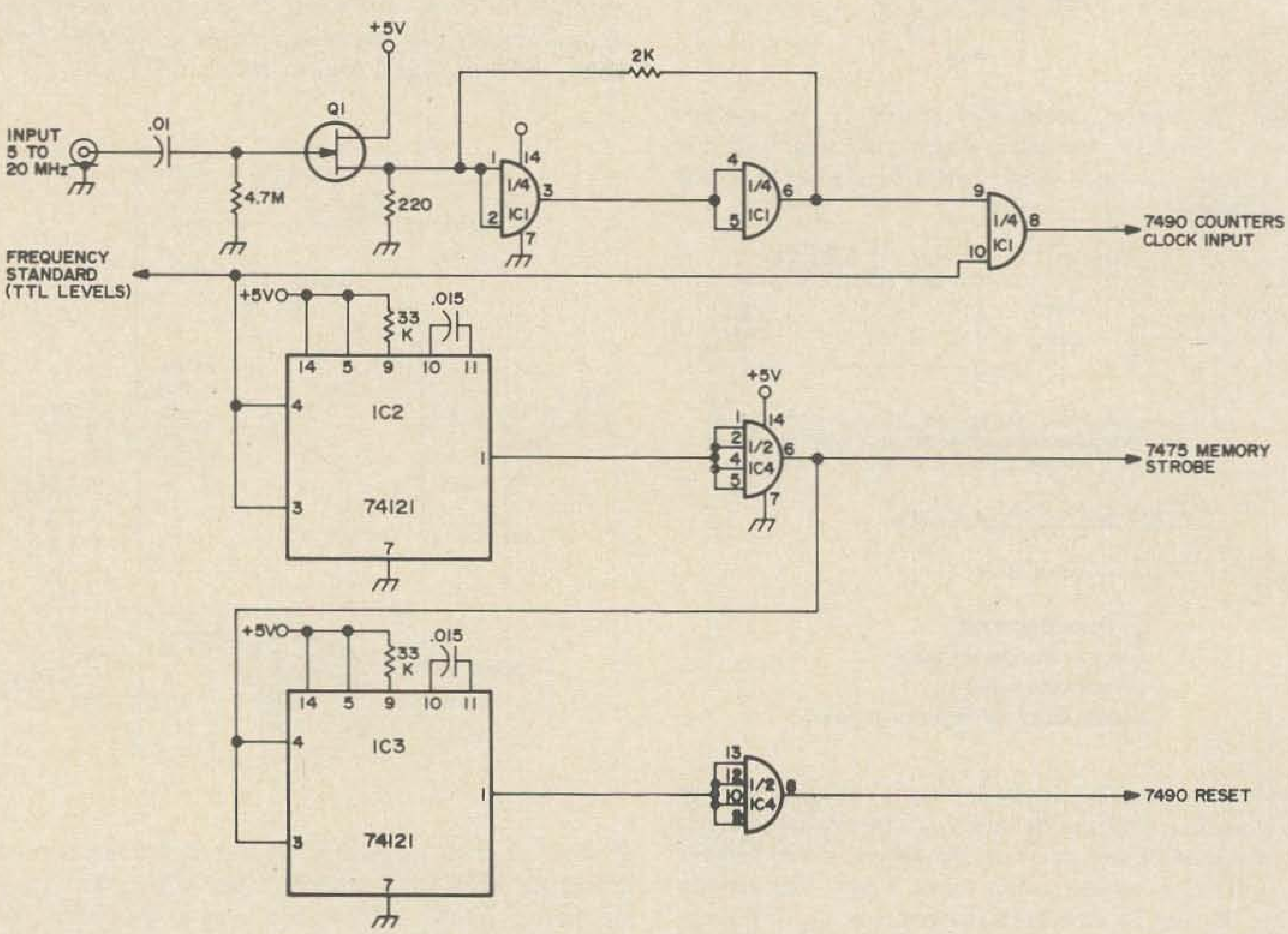
CW sidetone using Mallory SC628 Sonalert. For positive key voltage, reverse all polarities. (Thanks to Alex Szablak, New Hartford NY.)



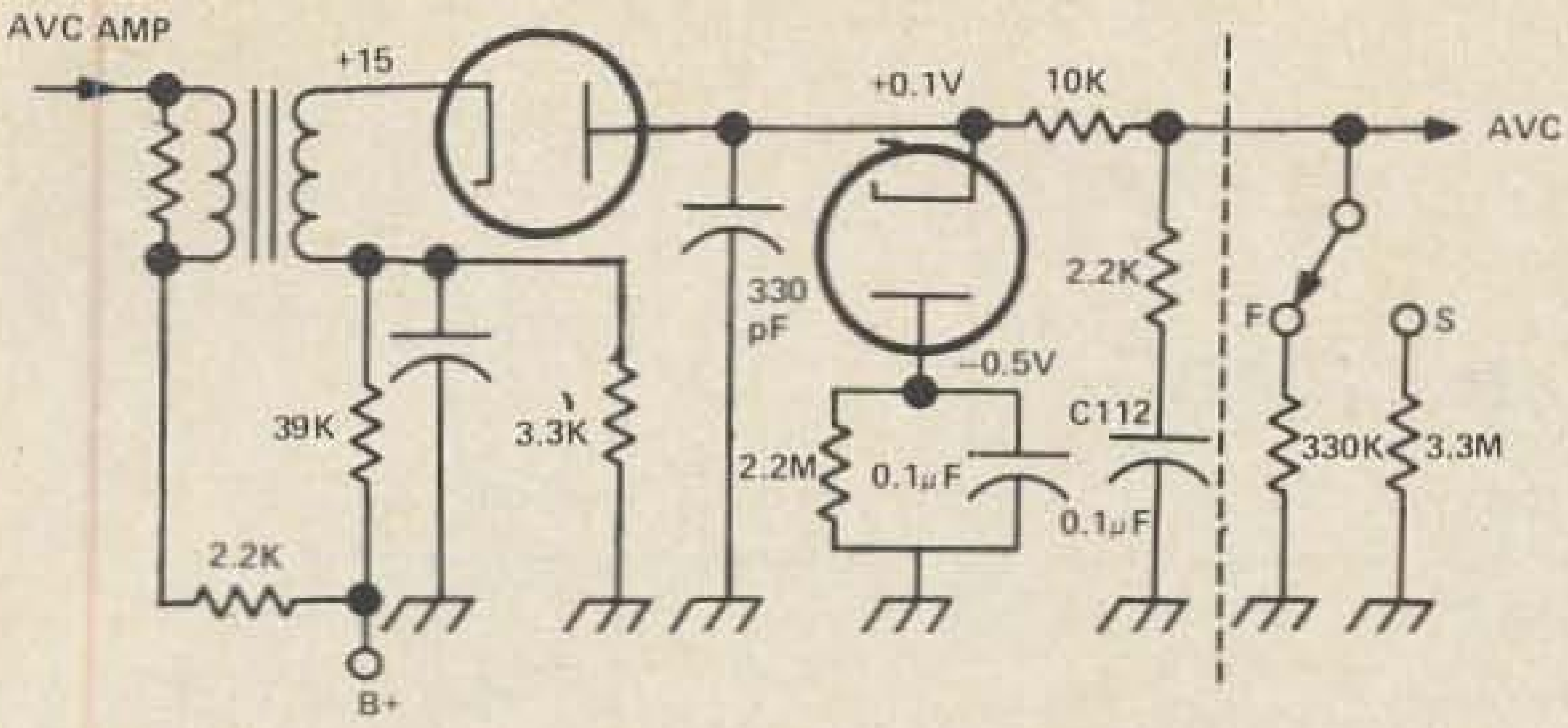
Microphone preamplifier. Mike output low? Fix it with this one. This is for use with a ceramic or crystal microphone or even a phone cartridge. Circuit courtesy Motorola HMA-33 Tips on Using FETs.



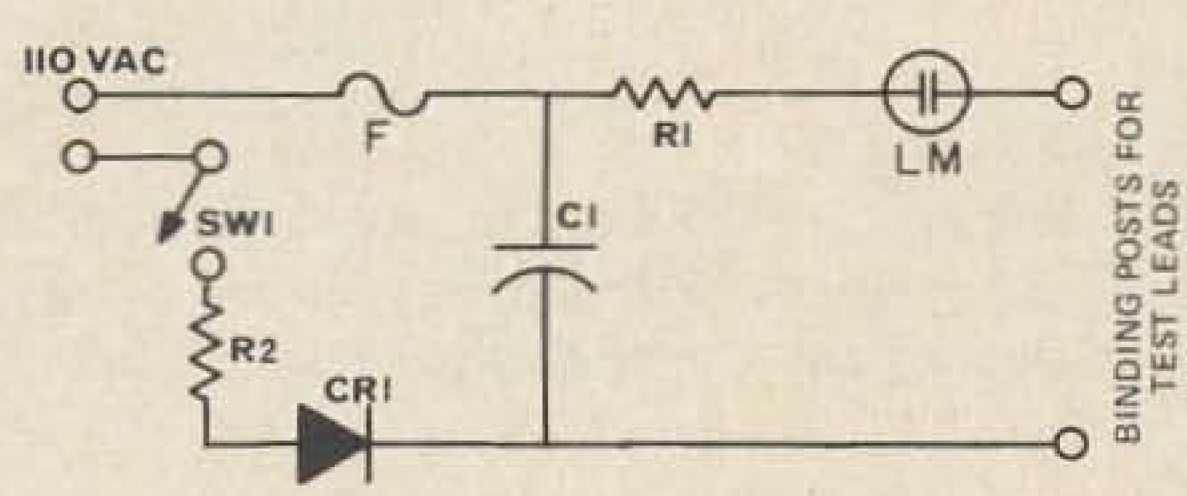
SSTV ramp generators. This circuit will give an extremely linear ramp for SSTV monitors, cameras, and flying spot scanners. The voltage varies from ≈ -10 to +10. A positive going pulse of +2 to +5V amplitude resets the ramp for the next sweep. (Thanks to WØLMD)



Frequency counter input: gating, strobing and resetting. The sensitivity is set by the ratio of the 220 to 2K resistors. (Thanks to WØLMD)



AVC modification for better SBB reception with the Collins 75A4 that lets you leave the rf gain wide open. It gives much longer AVC time constant and prevents audio "pumping" on speech. Change C112 from 0.1 μF to 1.5 μF mylar, 100V.



When testing a capacitor, the light will blink once or twice while the plates are loading and then will remain off. If the capacitor is not good, the light will continue to blink.

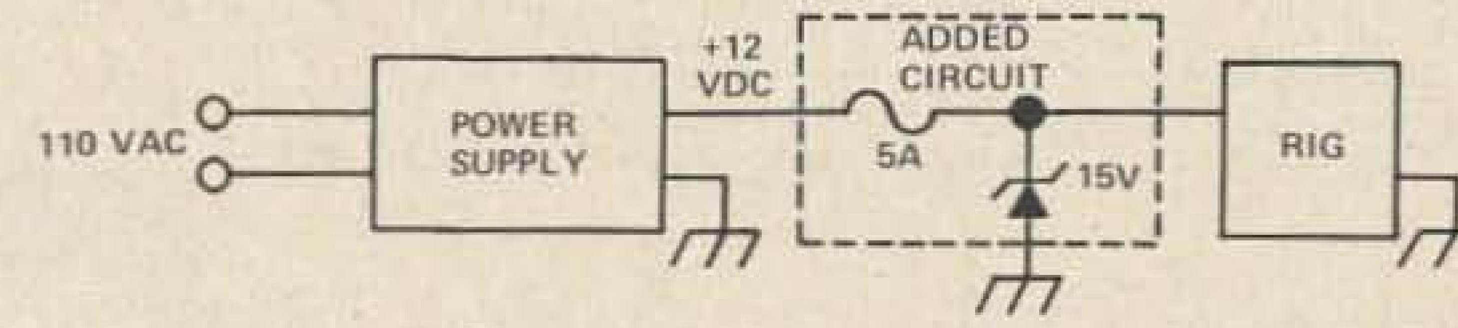
When checking capacitors wired into circuits, one end must be disconnected.

R1 – 47K 2W resistor, R2 – 330K 2W resistor, LM-1 – Neon lamp NE 51, C1 – 8 or 10 mic capacitor 450V dc, CR1 – 1M3611 diode (not critical), SWL – ST toggle switch, F – ¼A fuse.

From the Colorado/Wyoming MARS Newsletter.

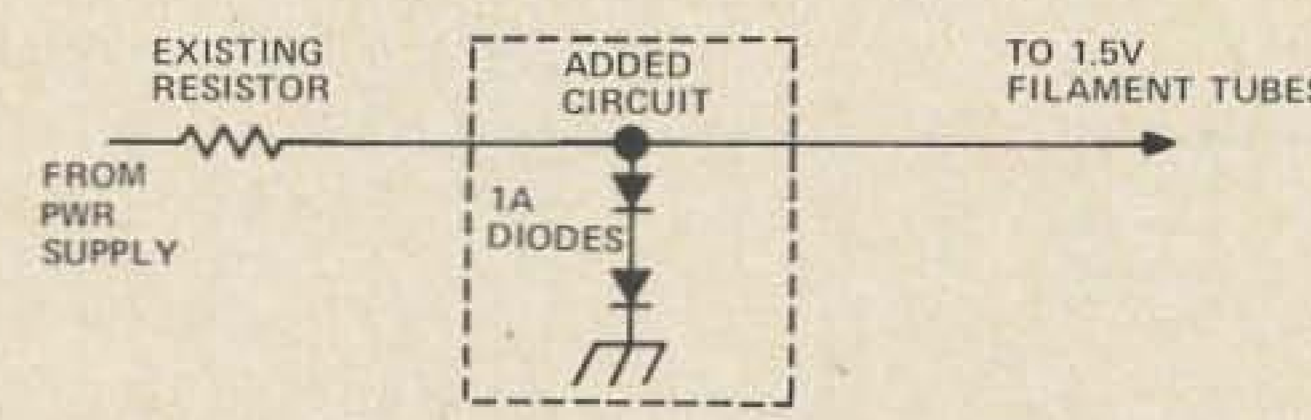
FOR YOUR OWN PROTECTION

Since everything fails at some time or another, thought should be given to what would happen to one of those solid state transistorized rigs should the line operated 12V supply fail. Many times when a supply fails, the output voltage rises to much greater than 12V. The results, as you can imagine, are disastrous, as several people have discovered. Therefore the following circuit is recommended to be used whenever operating from any non-battery supply.



The zener should be at least 1W and preferably 10W.

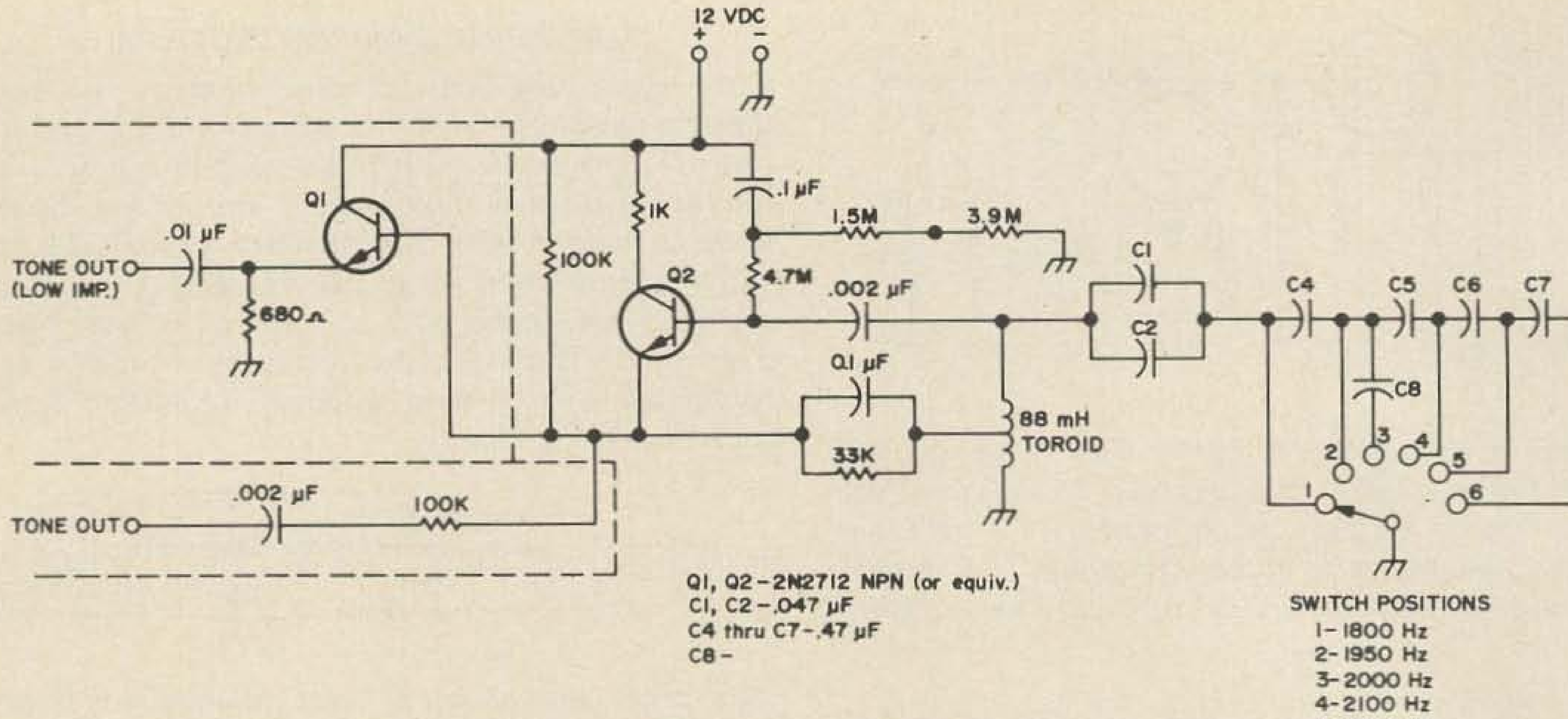
Along these lines, the following circuit can help to greatly prolong the life of filament type tubes in appropriate sets (H23, P33, MRT-9, etc.) when operating from supplies other than dry batteries. Some sets have two limiting resistors or balast tubes, one for receive and one for transmit. In this case, two of these diode sets must be used.



Circuit by Alan Tasker WA1NYR, reprinted from WA1KHB MRA Newsletter.

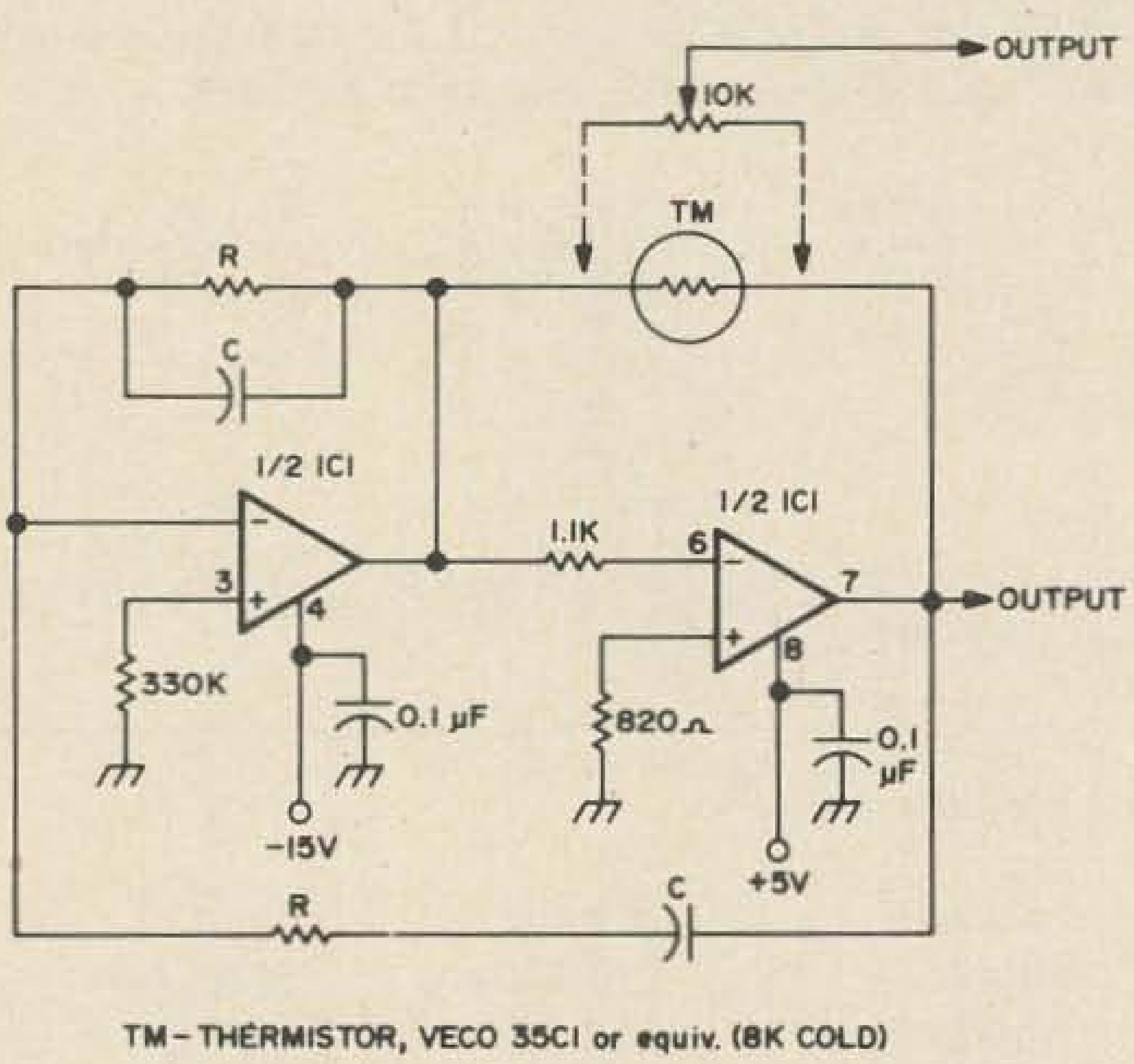
VHF/UHF Antenna Measurements

Frequency	¼ wave Free Space	¼ wave Antenna	¼ wave Radial	½ wave Free Space	½ wave Antenna
50 MHz	59.1'	55.5"	66.1"	113.1"	111.0"
50.5	58.5	55.0	65.6	116.9	109.9
50.5	58.5	55.0	65.6	116.9	108.8
51	57.9	54.4	64.8	115.9	106.7
52	56.8	53.4	63.6	113.5	105.7
52.5	56.3	52.8	63.0	112.5	104.7
53	55.7	52.4	62.4	111.5	102.8
54	54.7	51.4	61.2	109.5	38.5
144	20.5	19.3	23.0	41.0	38.3
145	20.4	19.1	22.8	40.8	38.0
146	20.2	19.0	22.6	40.4	37.8
148	19.9	18.8	22.3	39.9	37.5
220	13.4	12.6	15.0	26.8	25.2
221	13.4	12.6	15.0	26.7	25.1
222	13.3	12.5	14.9	26.6	25.0
223	13.2	12.4	14.8	26.5	24.9
224	13.2	12.4	14.8	26.4	24.8
225	13.1	12.3	14.7	26.2	24.7
435	6.79	6.33	7.60	13.58	12.76
440	6.71	6.31	7.52	13.42	12.62
445	6.64	6.24	7.43	13.27	12.47
450	6.56	6.17	7.35	13.12	12.34



TONE BURST GENERATOR

Tone-burst entry is becoming increasingly common as a requirement – repeaters in many parts of the country now require anything from 1800 Hz to 2400 Hz for entry. The circuit above is for a tone-burst generator to meet these requirements. Circuit courtesy of the Central Ohio Radio Club FM News, September, 1971.



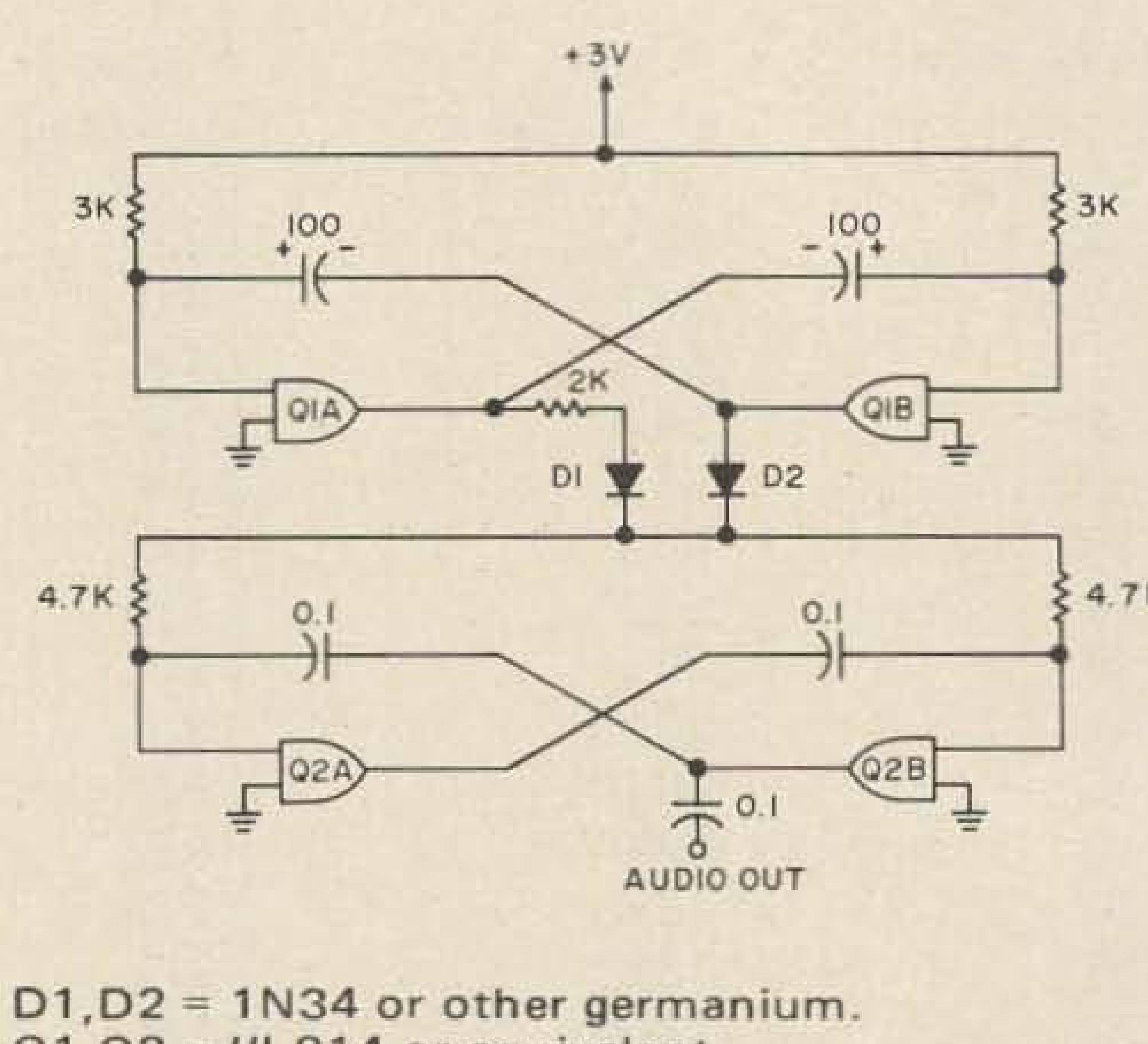
$$f_{OUT} = \frac{1}{2\pi RC} = \frac{.159}{RC}$$

A SIMPLE SINE WAVE GENERATOR

There are several applications where a good pure sine wave is useful such as a two tone test device for sideband rigs, sending CW with a phone only rig, etc. The Wien bridge circuit is one of the best and simplest methods of getting a good sine wave. In most Wien bridge oscillator circuits using integrated circuit op amps, very small values of R had to be used in the bridge because of the low impedance inputs of these devices.

In this circuit, the parallel branch of the bridge is connected from the inverting input to the output of one of the two op amps; thus it sees a very high impedance. The amplitude control is shown as a bead thermistor; however a 10K pot could be substituted as shown or any other method of output level countrol could be used. For a frequency of 1 kHz, R=330K and and C=470 pF.

The Motorola MC1458P, National LM1458, Signetics N558V and TI SN72558P are all identical and may be used above with no modifications. The Fairchild µA747 may also be used but leave the offset null terminals open. Two 741's are also suitable. If you use 709's you may have to include frequency compensation as all of the above mentioned IC's are internally compensated. (Circuit by Roger WB6ESP, reprinted from The Footprint, Foothills ARS, Mountain View CA.)



D1,D2 = 1N34 or other germanium.
Q1,Q2 = µL914 or equivalent.

Circuit shown above provides a square wave output from Q2 whose audio frequency is changed alternately by action of multivibrator Q1. The resulting warbling note provides an excellent burglar alarm or hidden transmitter signal. Circuit submitted by J.F. Walker W6GNL.

A. C. Spraggins W5EZM
Box 7152
Austin TX

ELLIPTIC FUNCTION FILTERS FOR RTTY

Most newcomers to radio teletype encounter similar types of problems which they experienced in single-sideband and CW signal reception. One such problem is that of selecting the desired signal from the unwanted noise in the channel through the use of suitable filtering.

The purpose of this article is to provide design information that will enable the average amateur to build a good set of channel filters for RTTY at modest cost. The filter to be described was chosen because of its inherent sharpness and ease of tuning. Other design configurations, such as the Butterworth and Tchebycheff, have been used successfully but perform less satisfactorily than the elliptic function type when it comes to skirt steepness.

The sharper skirt characteristic is readily apparent when the two types are compared as exhibited on Graph 1. Shape factor and band width help to maximize the signal-to-noise ratio. The graph compares the six-pole Butterworth filter described in *RTTY*

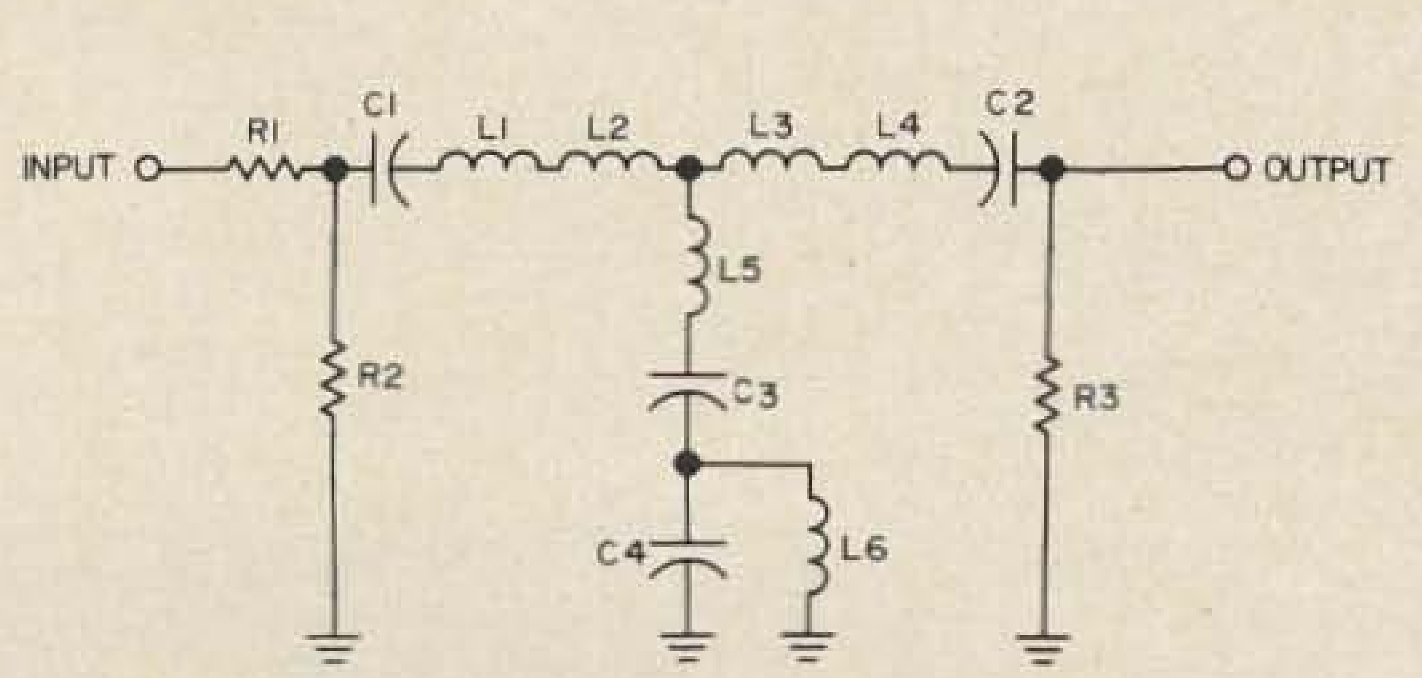


Fig. 1. Elliptical function filter.

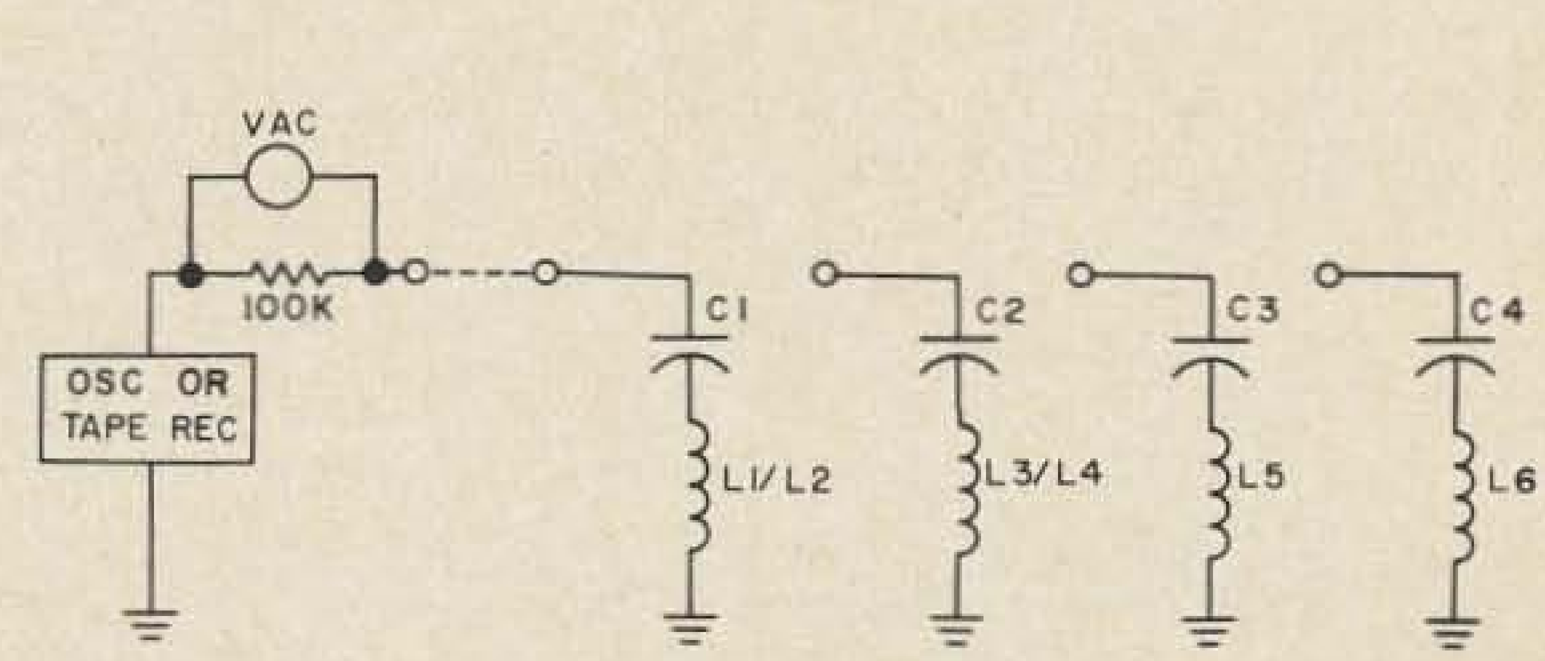


Fig. 2. Test jig for tuning filter elements.

TABLE 1

Frequency	C1, C2	C3	C4	L1-5	L6	R1, R3	R2
2125 Hz	.032	.072	3.3	88	1.67	150	200
2295 Hz	.028	.047	3.0	88	1.80	150	200
2550 Hz	.025	.047	3.2	88	1.24	150	200
2975 Hz	.017	.034	3.5	88	0.81	150	200

Capacitors are in microfarads
Inductors are in millihenrys
Resistors are in Ohms

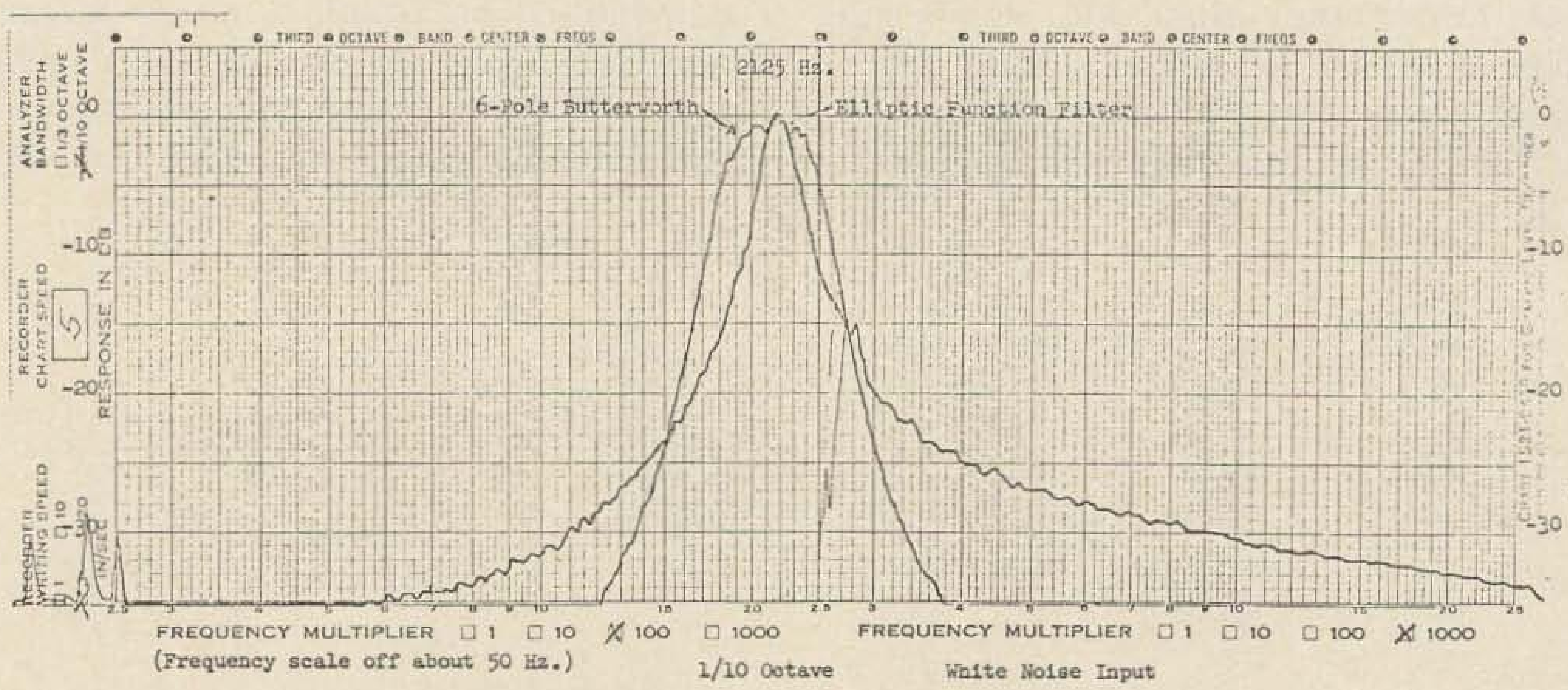
Journal, November, 1966, with a four-pole elliptic function filter of modern design.

There are basically two types of terminal units in use by amateurs. One type employs a linear discriminator while the other uses a clipper or limiter circuit. A narrow-band filter offers only about 1 dB improvement over a broadband filter when used in a discriminator type terminal unit. If a terminal unit uses a combination of both an FM and a linear system, then the narrow-band filter is the most desirable as the linear system is enhanced by its use.

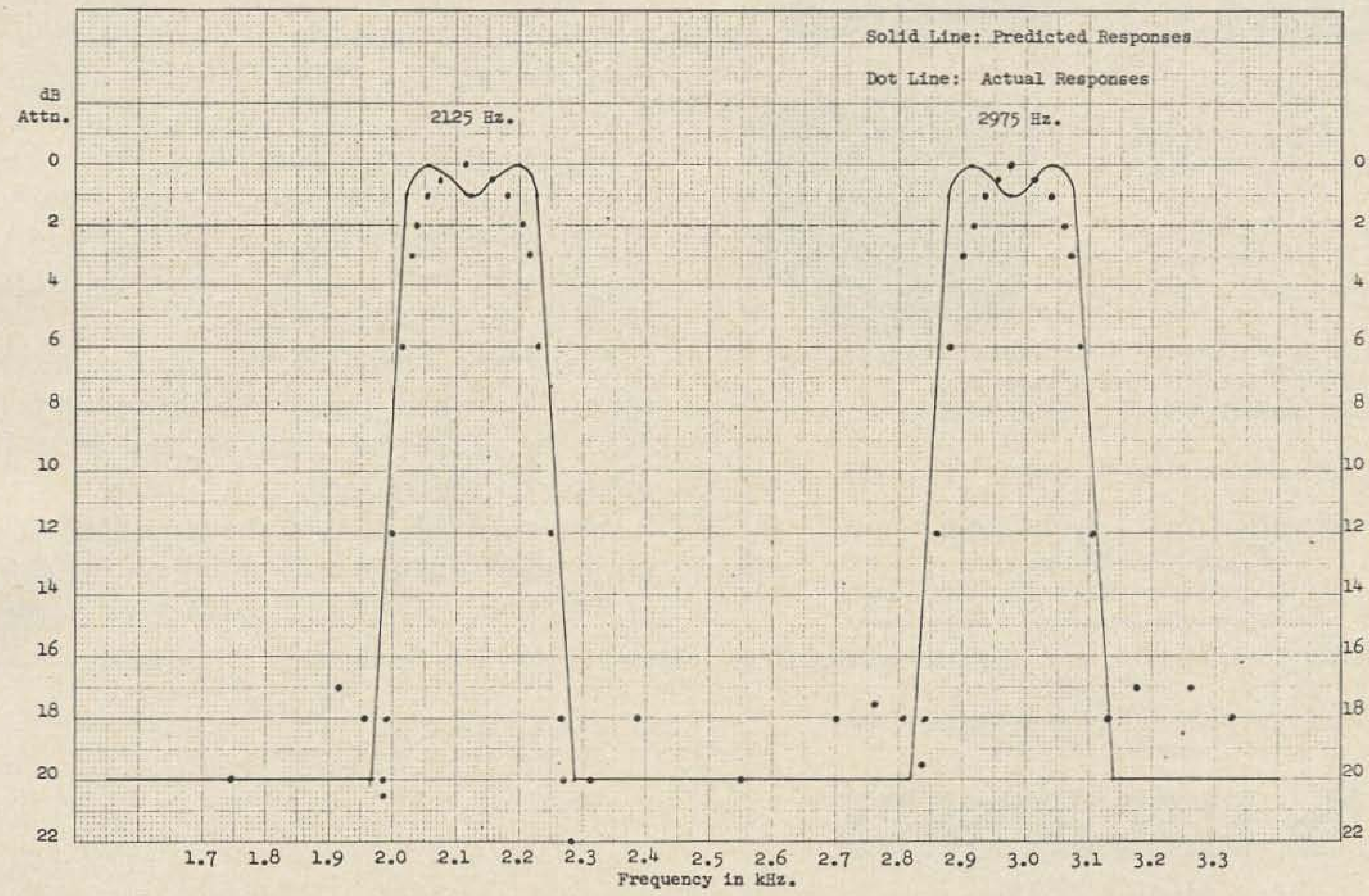
A linear system works best on single or dual channel copy when the signal is exhibiting a slow multi-path fade. The limiter type system responds best to signal flutter or quick, shallow fading to which the limiter seeks to maintain a constant level of output.

Construction of Broadband Filters

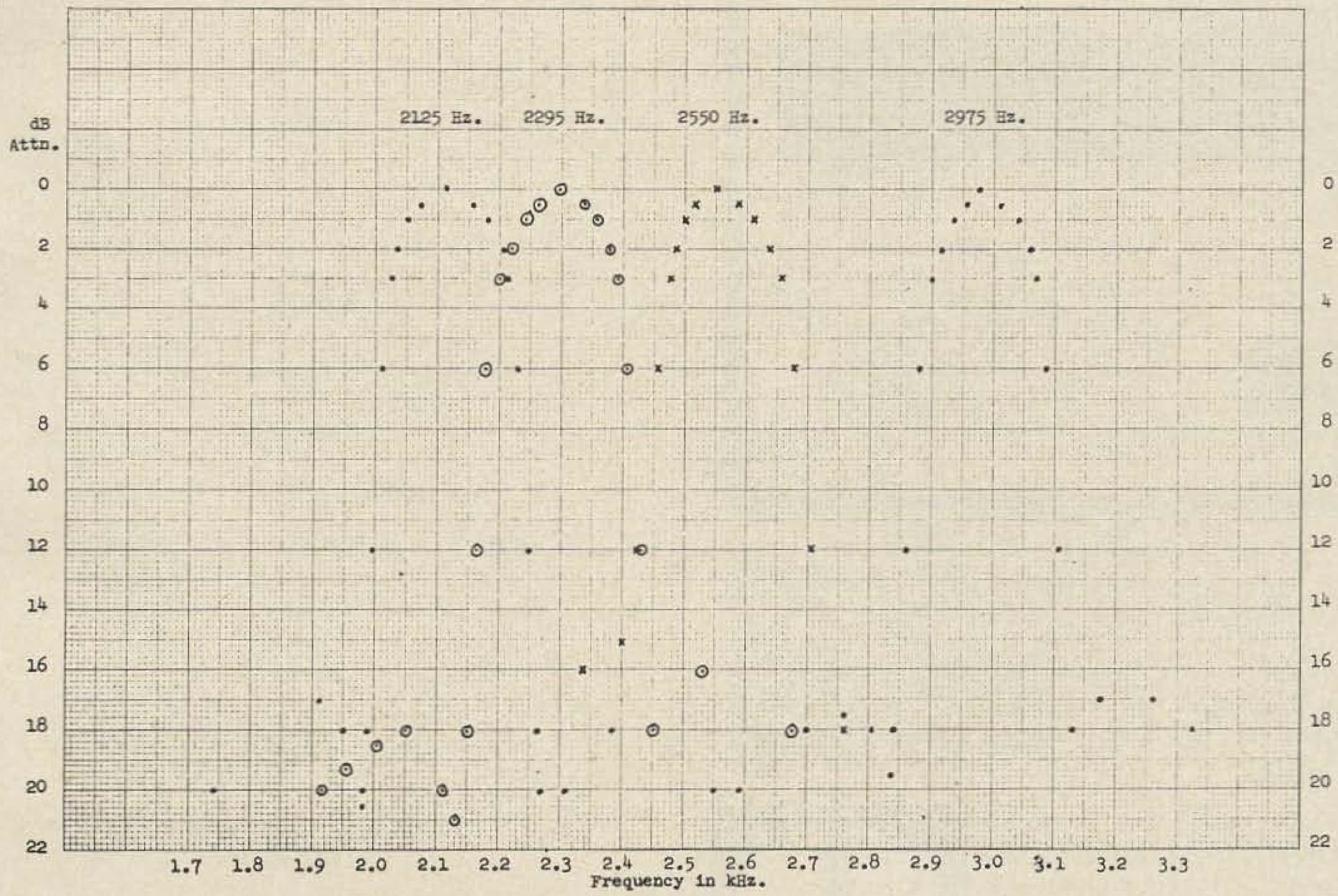
For some reason, there is not too much specific information available on RTTY filters for amateur use. Digital and other types of active filters are being designed from time to time but their cost and more involved circuitry usually tend to make amateurs rely on the simple passive types of filtering. The article in *RTTY Journal* provided the impetus for me to duplicate the filter set employed in the AN/FGC-1 military terminal unit. Sufficient test equipment was available to accurately measure the response of the constructed filters with a net result of remarkable adherence to the response curves provided. This was gratifying, to say the least, as there were many difficult component values to "bridge out." The filters were constructed on Vectorboard using 88 mH torioids in series to provide the large inductances which were required. The resulting 850 Hz broadband filters offered a good start toward a respectable terminal unit. The major drawback to using the filters is that considerable operation today is on narrow shifts of 170 Hz or 425 Hz. For this reason the construction of a new set of narrowband filters was begun..



Graph 1. 6-pole Butterworth compared with a 4-pole elliptic function filter.



Graph 2. Predicted responses and actual responses of 2125 Hz and 2975 Hz filters.



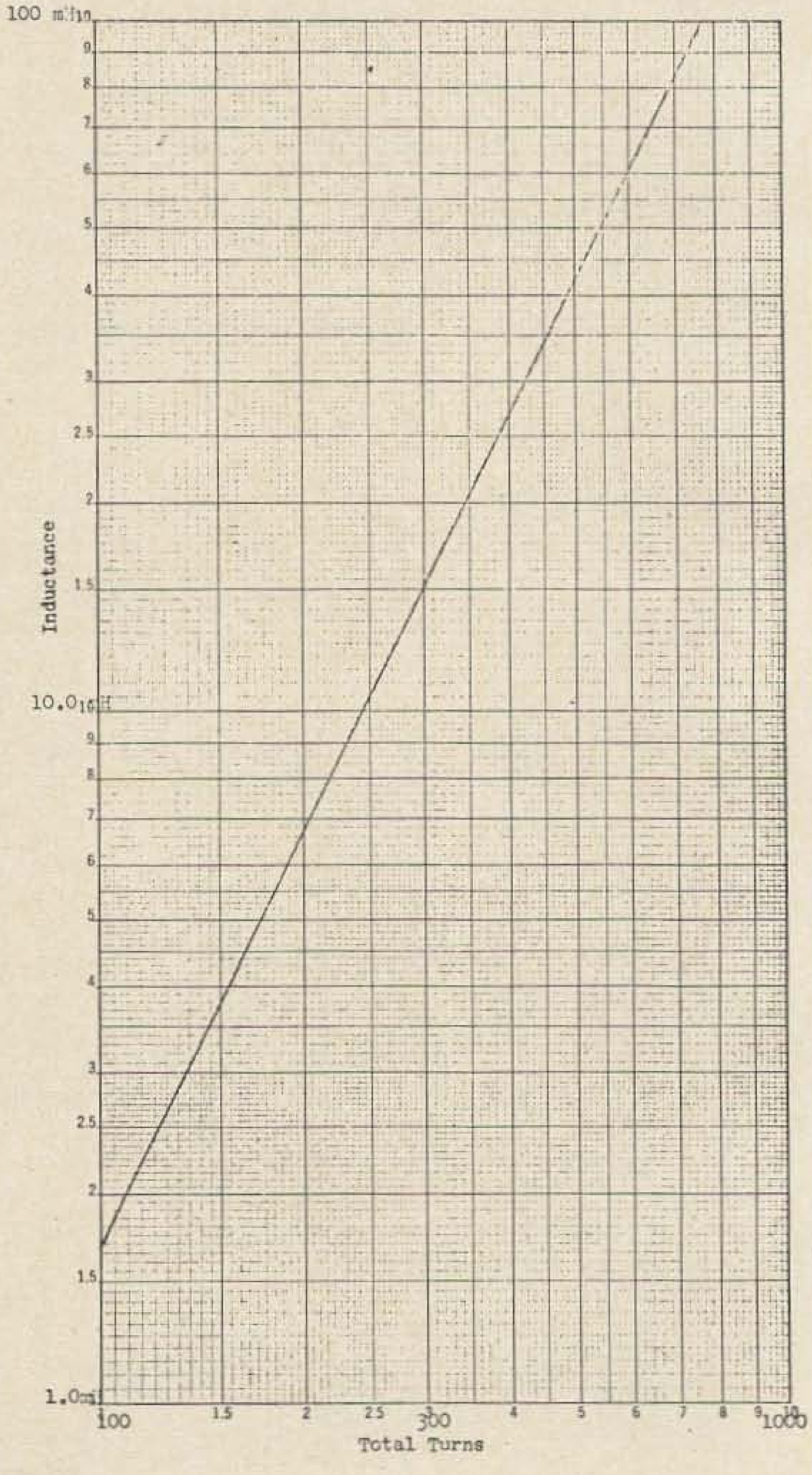
Graph 3. Actual responses of all four filters.

Designing Elliptic Function Filters

One of the best sources of filter design information is found in "Simplified Modern Filter Design" by Philip Geffe. A computer was used to derive tables provided in Geffe's book which greatly simplified the calculations involved. The simplest and sharpest elliptic function filter was selected and the design was made with due consideration given to the availability of parts.

The basic design of the elliptic function filter is shown in Fig. 1. All of the filters for 2125 Hz, 2295 Hz, 2550 Hz and 2975 Hz, use this configuration.

The equation used predicted a 1 dB ripple in the passband and 1 dB down on the slopes at 200 Hz wide. The actual lack of ripple in



Graph 4. 88 mH toroid: approximately 168 mH/1000.

the passband of the constructed filters may have been caused by insufficient Q. The predicted response curves for the elliptic function filters are shown in Graph 2. This graph has the response plotted for two filters with 850 Hz separation, namely 2125 Hz and 2975 Hz. Equally sharp responses were obtained for the 2295 Hz and 2550 Hz filters. Also shown on Graph 2 are the actual curves of the constructed filters. A frequency counter and ac voltmeter were used to accurately plot the responses. As can be seen, the actual filter responses were slightly narrower than the predicted responses. This presents no serious drawback to the system, however.

Narrow-band filters will not tolerate much signal drift but with today's modern receivers and afc circuits, drift is greatly minimized anyway. Parts layout is not critical but good quality capacitors must be used throughout the circuit or serious degradation of the response will be experienced. Do not use electrolytic capacitors.

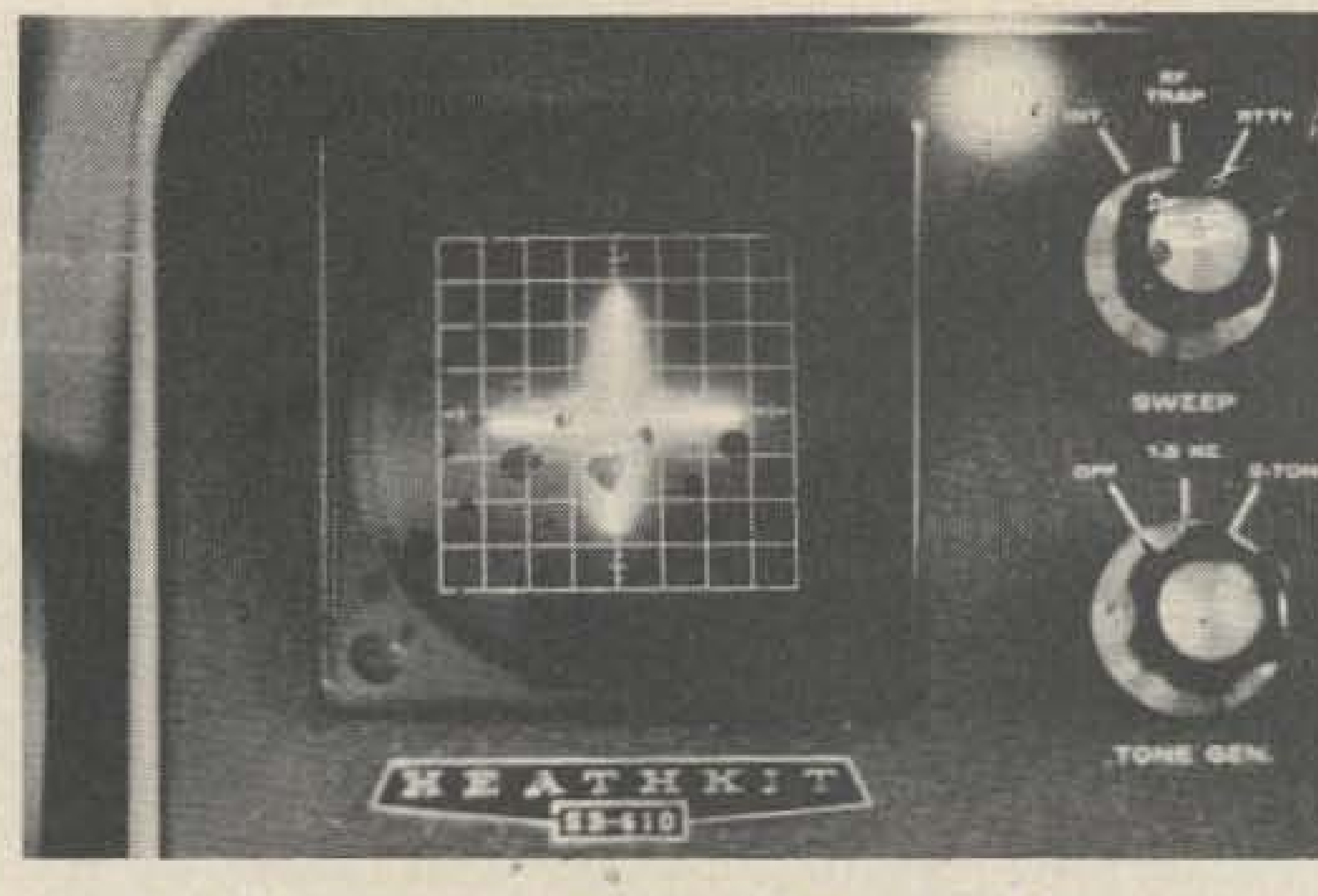
Table 1 indicates the values of components required for each filter. Some padding of the standard values will have to be done to obtain the values shown.

The Ubiquitous Toroid

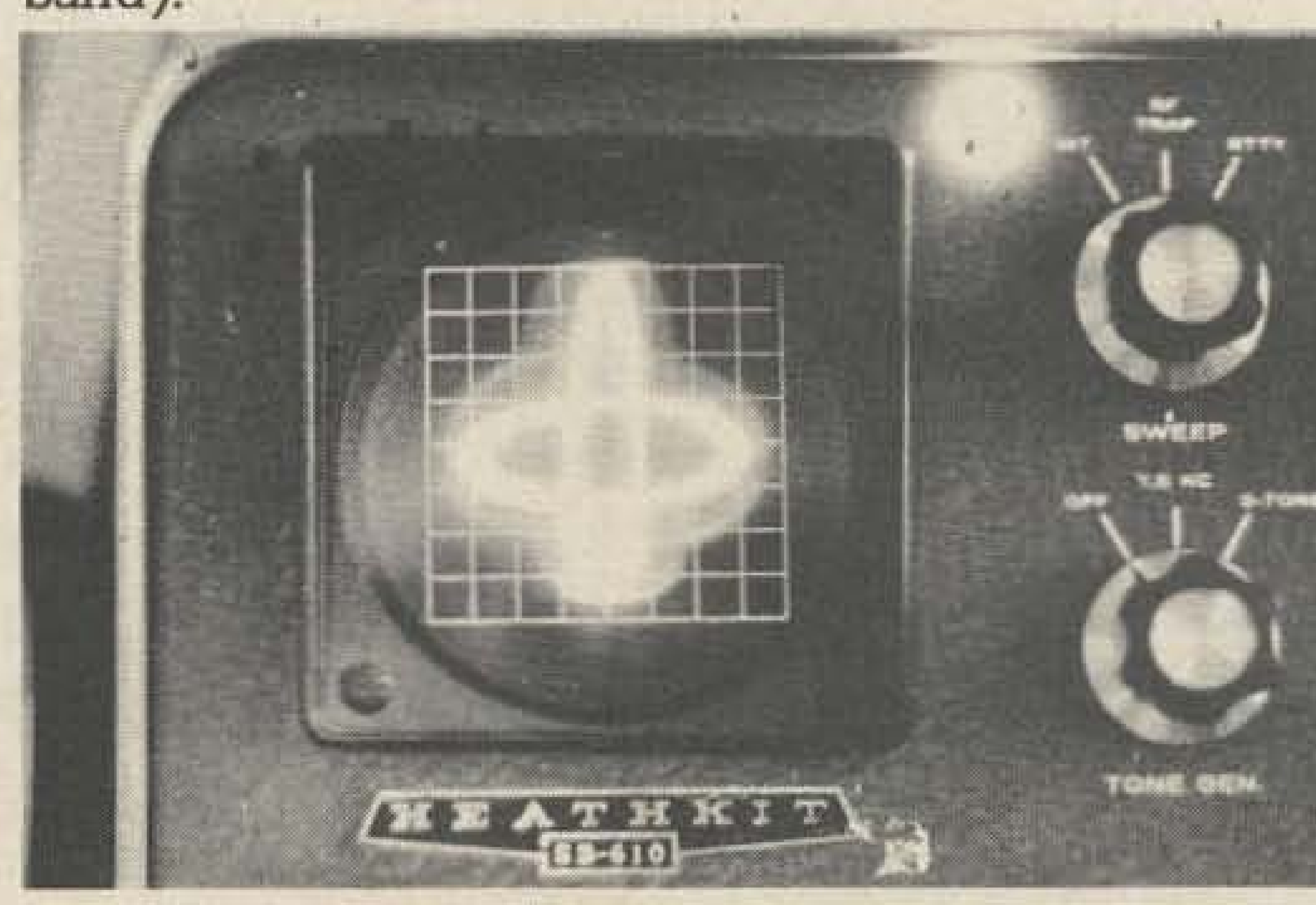
The 88 mH toroid inductor was employed wherever possible because of its acceptable Q and low cost. Only one inductor in each filter is not the standard 88 mH value. This is not too serious a problem, however, as will be shown later. Several 88 mH toroids were measured on a General Radio Impedance Bridge. The average inductance was calculated to be 86.8 mH. Further measurement indicates that the core of the 88 mH toroids has a permeability of approximately 168 mH per 1000 turns. This means that, by using logarithmic graph paper, a simple method of determining the number of turns required for a particular inductor can be achieved. A graph is presented for those amateurs who may find the information helpful in building the elliptic function filters or other filters.

Tuning the Filters

The most efficient way to tune each filter would be to use a calibrated frequency



(a) 4-pole elliptic function filters (200 Hz narrowband).



(b) 6-pole Butterworth broadband.
Fig. 3. Oscilloscope patterns.

generator and counter, along with a sensitive ac voltmeter. Not all amateurs have access to such equipment, but with a little resourcefulness, good results can be obtained. Try to find someone with a calibrated oscillator who will tape record about a foot or so of each desired frequency. Make a continuous loop out of each foot-long tape and play back the tape while feeding the tape recorder output (4Ω) into the filter circuits being tuned. Using the method shown in Fig. 2, tune each combination of elements to the desired center frequency. This will be indicated by a *peak* in the output level. Removing a few turns from each inductor may be necessary to get exactly on frequency. Padding with capacitors is much more difficult to do and the slight change in inductance won't severely affect the filter impedance.

Termination of Impedances

The input impedance of the filters is designed to work from the 4Ω speaker output of most receivers. A 600Ω receiver output may be connected directly to the filters by eliminating R1 from each filter. The output impedance is 150Ω. These impedances were chosen because of the desire to use the standard 88 mH inductors. Different impedances will require different inductors. There is about a 6 dB loss through the filters. Amplification may be required between the filters and the terminal unit if diode rectification is to be used.

Results and Findings

A comprehensive graph of all four filters is shown in Graph 3. It can be seen that the minimum channel separation between the 2125 Hz and the 2295 Hz filters is approximately 3 dB. Separation between other combinations of filters approaches 20 dB.

Oscilloscope patterns in Fig. 3 compare the familiar cross patterns used for tuning in a typical RTTY signal. The Butterworth filter pattern has a more oval shaped trace while the elliptic function filter pattern is almost a straight line. The Butterworth broadband filter allows more noise into the channel which may capture a limiter or otherwise interfere with the signal.

Conclusions

Good, sharp, narrow-band filters for RTTY can be constructed by the average amateur using inexpensive components and having limited access to sophisticated test equipment. Simple duplication of the theoretical filter design should yield the results obtained in Graph 3. More complicated designs will offer better solutions to signal-to-noise problems. This will no doubt increase the cost of constructing such filters and complicate their tuning. The lack of access to sufficient test equipment may preclude most amateurs from attempting to build such devices. There should, however, be continuing research performed in these areas by amateurs for amateurs.

There are four persons to whom I am indebted for their assistance in making this report a reality: Richard G. Coalter for his engineering talent, Dennis M. Pierce for his report-writing skills, Vicki Spraggins for her typing and patience in retyping, and Eric Sager for making me find the time to get it all together.

...W5EZM

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Step on the KLUTZ!

The question, "What's 'he' (meaning me!) doing in a 'ham' magazine?" is quite often asked.

The answer? Simple, really! Amateurs aren't all transistors, antennas and microfarads. They are real, honest-to-goodness individuals. They're interesting, inventive, sincere and ofttimes very funny people!

Some amateurs are electronic wizards, others are dexterous with key, bug and mill or have the unique ability to converse endlessly on a myriad of subjects and, of course, as in other fields, some are *klutzes*.

Every ham possesses some of these qualities – only the degree of proficiency varies.

When a ham blossoms forth, he becomes an authority in that area in which he excels and, as an authority, has a right to be heard and discussed.

Those of you who have followed my literary gamboling from "In the Beginning" to "Bob, Bob, Bobbin' along" know that I derive my material from personal experiences, and my forte is that I'm a *klutz*!

My soldering iron either refuses to melt the solder or sets fire to the whole damned bench, my hot-melt glue-gun delights in oozing glue onto the floor in a messy puddle to which my feet seem to be irresistably drawn (on at least two sticky occasions I thought I was paralyzed). Right now – as mute testimony to this fact – there are two shoes, an old sneaker, and one argyle sock stuck to the floor under my work bench.

At the operating position, my earphone-microphone always precedes my tongue into the coffee cup and the lumps on my forehead from banging into desk tops while reaching over for dropped articles are legendary.

On RTTY I say, "Hold up – gonna change ribbon!" I reach in my hand only to retrieve it with "RGR OM" stamped indelibly on my thumbnail.

In public, someone seems always to be just milliseconds ahead of me either causing spring-loaded doors to whomp me into semi-consciousness, or they've just stopped their dogs – leaving a meadow muffin – in the exact spot where I, in less than 1.5 seconds, will put my size 10 clodhopper.

Spray cans are my particular nemesis. If the can rattles before my wrist atrophies and the nozzle doesn't clog, then I somehow manage to reverse the spray head sending half a can of black lacquer or *Raid* up my sleeve. I've got a dozen shirts with dazzlingly colored right sleeves, my underarm looks like the NBC peacock and I can exterminate half the bugs in New England with a single salute!

Those of you who use typewriters know how easy it is to stick your fingers between the keys, but have you ever gotten a digit firmly stuck there? I have! Had to wrap that 50 lb Remington up in a baby blanket, fasten a mock nursing bottle near the top, and smuggle myself into the emergency room – mumbling to interested onlookers that the 'baby' has colic.

Then, in the examining room when I remove the blanket, exasperatingly jabbering an unheard explanation to a doctor, nurse and several corpsmen – all of whom are doubled up in helpless, convulsive, hysterical and tear-spilling laughter – as to how it all happened.

Okay, so you can send and receive 35 wpm or build a heat-activated 2 KW SSB transceiver no bigger than a match head. Well, I'm a *kultz*! That's my specialty – pure and simple. Who, then, is better qualified to point out the absurdities in hamdom than I?

My warped sense of humor only complicates the situation. I'm not intentionally sacrilegious – it just happens. Example: You're familiar with the phrases, "right 'hand' man," "The 'voice' of America," that police use 'leg' men, that reporters have a 'nose' for news. Fine. Now how about the ham magazine that bills itself as an "Official Organ?" I apologize, but every time I see or hear that phrase, my cracked psyche never fails to conjure up a giggle-producing mental picture. What's an "Official Organ?" The hams' ambassadorial stand-in stud with portfolio, sash and badge perhaps?

Based on the foregoing, I can assure you that the next few pages will definitely not be devoted to laborious and somewhat dubious methods of converting your toaster, sump pump and/or athletic supporter to 2m FM; nor will it render any advice on CB rig modification (albeit, I do have some poignant – if somewhat improbable – suggestions on what could and should be done with those over-modulated, 23-channeled, 27 MHz miscreants but I'm somewhat reluctant about openly diagramming them. The last time these anatomically improbables were expressed, they unintentionally influenced a contortionist who, as a result, not only filed a paternity suit, but billed me for postpartum care and I became the unwilling godfather to a cesarean Johnson Messenger II. I don't know what the guy was complaining about – what with the built-in mini-whip he had a perfectly functional curb feeler, paper-picker-upper and midget stabber.)

Neither will my latest literary faux pas delve into the realm of 'gimmicks.' For, to me, the only authentic "Automatic Nut Starter" is the jerk who hands a microphone to a Citizen Bander!

Before you jump to any erroneous conclusions, let me assure you that I have nothing against CBers – per se – even though it has been said that it would be apropos to define gross incompetence as a herd (a mob has a leader) of Citizen Banders armed with screw drivers. Anyhow, anyone who's unfortunate enough to have his tongue and colon joined so closely together deserves understanding, not criticism! I won't comment on the quote uttered by one learned gentleman who stated that a ham was nothing more than a Citizen Bander who had discovered a second use for his fist! . . . ah, well.

This article will consider the inane object, "Why does society view hams through traumatic and jaundiced eyes in much the same way that would observe an anti-social and not-quite-housebroken hippopotamus?" The *klutz* factor seems to overshadow all else.

Experience has taught me, after having it mentioned on several diverse occasions – which resulted in my being stepped on by Gentle Ben, kissed by a yeti, tossed summarily out of a friendship club, deliberately run down by a Welcome Wagon and mugged by a Good Humor Man wearing a peace symbol – that you should never voluntarily admit that you are, indeed, a ham!

[Small aside: Rapid calculation with my 98¢ Magi Brain Calculator shows that hams comprise only 1/1000th of the population. This makes us a very minor ethnic group whose acceptance by society would be greatly advanced if there were more hams.]

Therefore, I block-letter crayoned a brief note to the FCC urging "LOWER YOUR REQUIREMENTS!" to which they replied, "UP YOUR FREQ!"

Certainly anyone who's been a radio amateur for any length of time is all too familiar with the warning signs that precede the announcement that you are unacceptable. However, for those who aren't familiar, *beware*!

The first, most common and easiest to recognize reaction to hams by non- or anti-hams is an apoplectic facial contortionistic look – or GAWK – of sheer horror. Picture if you will Harry Greedy-Gut at a buffet supper, one hand full of canapes, the other clutching cookies. Spying some new delicacy he gulps down the canapes and reaches for the newest goodies, only to find that he has inadvertently swallowed someone's pocket watch. In frenzied horror he'll 'drop his cookies' and his expression will reflect unbelieving shock which will decrease only with the passing of time.

Chance observances like this are rare to witness and are, for all practical purposes, indescribable. The GAWK can, under certain controlled environmental circumstances – and only for familiarizational purposes – be closely simulated.

You can, for instance, don a tri-colored beanie, replete with propeller – grasp a full grown, malodorous and recently agitated polecat by the tail, wave it over your head and, with a purple popsicle stuck in your left ear, stomp through the largest department store in town plucking a three-stringed swinette and humming the first eight bars of "I Wanna Be Loved By You!" – or –

You can dash stark naked into a meeting of the local D.A.R., screaming "I'm a reincarnation of Paul Revere! Where's my pot? The guy in the steeple was a pyromaniac. One if by land, two if by sea; one lantern two lanterns; land-sea-air, hell! I don't know who or what's coming 'cause he burned down the whole ruddy church!" Then, slithering up to the chairwoman, whisper, "Ya know John Paul Jones was a Russky, Ben Franklin was a bookmaker and Johnny Appleseed was a litterbug . . . "

It may well be that because I am the titular head of a household comprised exclusively of anti-hams I've become overly sensitized – perhaps, as a *klutz*, I bring it on myself.

Gorgo, my XYL (Miss Vitriolic 1939–46), firmly believes that hams, left-handed pitchers and out-of-State drivers are all self-made men who (though perfect models, providing someone wanted to mold an idiot) quit work too soon and had nothing to work with except a superabundance of silly putty and chitlin's. That they would, therefore, join the nearest and most readily accessible chapter of W.O.W. (Witless Old Winos – not a bad group, actually. They send a bottle of Muscatel, a can of sterno or a jug of Aqua Velva with a slice of bread to a friend on Prohibition Repeal Day – it's called a Win-O-Gram!)

Although my crumb-grabbing, curtain-climbing jam-handed vidiot harmonics think it's great fun to invade my shack and in my absence steal pencils, paper and, in short, give the place the appearance of having been hit by several Molotov Blivets, they, at the tiniest flicker on any one of our mandatory 36 TV sets, set up a screaming wail of "Daddy's doin' it again – he's screwin' up Bozo" that can be heard for miles.

This disrespect is not the exclusive property of homo sapiens. It is shared, on at least a part-time basis, with the animal kingdom. I'm not too sure about inanimate objects yet, but I swear I've been karated by doors, tripped by tables and maliciously attacked by the recliner/rocker although Gorgo says that's foolish 'cause the recliner and I are totally compatible since we're both slightly off our rockers.

The Manning menagerie presently consists of a Mynah bird, a poodle, two Siamese cats and assorted fish, bugs, newts and . . . I dunno . . . just things!

While I am constantly being bitten by bugs, hissed at by snakes, eviscerated by cats, spit at by fish and the object of whatever it is newts do to show their disdain, I'll discuss only the Bird and the Dog.

Do you know what a Mynah bird is? It is supposedly a feathered creature incapable of thought that can hear, remember and repeat an unlimited amount of words or phrases. . . sort of a winged L.O.!

In reality it has only one real attribute. It can down an ounce of water and food pellets and, in 24 hours, reproduce five times its own weight in bilious bird dung. It's got tne makings of a Vice Director. (Here it is again – campaign slogan: "Being a Director's nice – as for me, I'm for VICE!)

My XYL's Mynah, Gus, is not only a dedicated and confirmed, but positively vindictive, anti-ham.

After ten months of listening to a tape repeat, "Hello there!" he remained unflinchingly mute. Yet after only one visit from an old Navy CW crony (strange individual whose limited vocabulary consists mainly of 15 four-letter words which he can interchange indefinitely and still remain intellectually coherent), Gus, that $70 feather-covered fertilizer factory, selected and committed to memory one foul unprintable suggestive phrase which details an action singularly abusive to one's hat. He reserves it for my 'on the air' time.

"How," I once in frustration asked a dim-witted relative, "do you stuff a Mynah bird?" to which he predictably replied, "Dahh . . . head first, I suppose!"

On the other hand, Fred, our French poodle, has developed not only a rather unique and demonstrative method of expressing his feelings towards ham gear, but I firmly suspect that he's somehow managed to enlarge his storage capacity in order to more dramatically emphasize his point.

By golly, if I ever catch that flaky looking pop-eyed pansy in the act, I'm gonna swooosh him with my CO_2 bottle, freezing him in that three-legged position, and auction him off at the next Op-Art festival as a frozen still life entitled, "Dog With Upraised Leg," or "Coldcocked Canine Critic!" (He might make a demonstrative hood ornament for an Edsel.)

Wanting to be perfectly objective, I must admit that there is some justification for society's apprehension. For while the Joe Normals are perfectly content to go from womb to tomb without making a wave, Joe Ham is busy fouling up the newly-arrived dishwasher in an attempt to determine how it works, dangling from the tippy-top of some elm tree with his pockets full of dikes, vice grips, instruction manuals and a hip-holstered walkie-talkie or, in general, doing something that appears unorthodox.

How do you explain that a ham is, first of all, a unique individual whose need to communicate is but the end result of an insatiable curiosity, boundless imagination and an uninhibited necessity to express himself?

A ham is really a state of mind. Like the man said, "The mind is like a parachute, it functions best when open!"

It is inevitable that with such an unlimited sphere of interests what sometimes starts out as normal and reasonable often results in a fiasco. Society never sees the success, only the fiasco. To them it's moronic – it's the *klutz* factor!

I've often thought that, instead of the diamond decal, hams ought to adopt a more expressive heraldic coat of arms consisting of a sprig of mistletoe embroidered on a flapping coat-tail floating in a sea of Lavoris (for Pucker Power) with a Latin inscription meaning, "It seemed like a good idea at the time!"

Lemme cite two instances which, even though reasonable at the time, eventually turned me into a *klutz*!

Peek-A-Boo

Having a rather high-pitched voice (it's possible I went from infancy to senility without ever having gone through puberty – my voice has never changed and I never had pimples – even an acne transplant didn't take) I have long envied those operators that come on like Gang Busters, sounding like Big John, Captain Marvel and Boom-Boom Bailey. Their deep basso profundo voices thunder in – even on Sideband – like AM Hi-Fi!

I've studied acoustics incessantly, built a triangular room, used a compressor and even fed my voice through an amplifier with the treble retarded and the bass at maximum with the end result that I still sound like a composite of Johnny Weismueller, Tiny Tim and Truman Capote!

In deference to Gus, my normal operating procedure is to use a set of cans with mike attached, leaving my hands free to pursue my secondary avocation of bending Barbie, Ken and Skipper dolls into obscene poses (I have the better ones bronzed and mounted, giving my ham shack the appearance of a cross-sectional view of a house that – if real – would require the services of a Madam!)'

One evening while in QSO with the head of a disgrunted Amateur Radio group called MUSIC (Mad and/or Miserable Until you Shove I.C.) [it was a boot-leg QSO since, as you know, MUSIC isn't allowed on the ham bands . . . a pun? So shoot me!], suddenly my eyes lighted on a newly acquired 30 gallon green plastic trash can. Aha, I thought, remembering some laws of acoustics, the perfect mini-studio!

Completely oblivious to everything, and without a moment's hesitation, I pulled the trash can over my head and shoulders and began happily discussing my new sound when . . . you guessed it . . . a knock sounded on the trash can.

There are many things that a glib-tongued enthusiast can rationally explain away – lipstick on the collar – that you buy Playboy for the articles – that a 2 KW $1,000 amplifier is an absolute necessity . . . but believe me, and I speak from experience, there is no way you can coherently explain to a tired, unimaginative (now jittery and open-mouthed) insurance salesman exactly what you are doing talking to yourself all alone in a weird little room with a huge trash bucket jammed over your head! Yet it seemed like a good idea at the time!

Where Were You When. . .

Not long ago, as you might surmise, I was doing two things at the same time. First, we'd had a new septic tank installed, and in order to remove the old one it was necessary to pump the contents of one into the other. I'd brought a '62 Rambler up close to the operation. The little Briggs and Stratton pump was chugging merrily away so I installed a dc to ac inverter in the Rambler. It appeared to work, so I climbed out and strategically placed myself between the car and the pump. Whoom! The engine caught fire!

Having learned that in situations like this panic is your worst enemy, I calmly went into hysteria and, with that inspired genius that at one time or another has caused me to be struck by lightning, removed a random finger and put a gigantic elm tree stump into sub-orbital ARC, I unhesitatingly reached for the only immediately available source of liquid (it seemed like a good idea at the time!).

At that precise instant in time that I pointed the outlet hose into the engine compartment, I was made immediately and quite dramatically aware that not only had I 'done it again' but I was making a popular chaos-describing phrase into a 'living legend' and a real life Cecil B. DeMille spectacular!

Startled by the tragicomic results, I dropped the hose, and, in fetal fashion, crouched – alternatively praying for the engine or pump to die, an escape route, or at the very least a poncho or bumbershoot! Luckily I discovered and grabbed an old Huck Finn type straw hat which I inverted over my head for a modicum of protection.

Besides accumulating in the hat and all over my huge frame, the gigantic pinwheel spray whirled up the side of the house, under the eaves, all over my lilac bushes (which, incidentally, have become the most productive, yet strangest smelling, in ten counties). And, as a crowning glory, the spray adhered to one leg of my 75 meter "V" (needless to say, I've received some odd remarks, on and off the air, about my antenna). It seems that my radiated power is directly proportional to the type of QSO. Bull sessions seem to have a marked advantage over normal or net operations.

I caught sight of Fred surreptitiously peering around the corner with an expression on his face that seemed to say, "Haaa haaa haaa, I couldn't have done better myself!" I grabbed the Huck Finn hat and taking as careful aim as I could through that weird rainbow, I let it fly.

Although I missed Fred, the hat passed close by Gus' window, causing him to set up a scalding idiotic laughter-filled chant of, "He did it! – He did it – blankety blank, he did it! He finally did it, sqwuaaak!"

The end result, aside from having to cut the grass in that area almost daily, was that not only am I and the house studiously avoided (even the yellow line in the road is bowed away from our driveway) but we had to sell the car – which wasn't easy!

We were in no position, financially, to trade off the Rambler, but it became an absolute necessity, because even a brass monkey can't drive around in 15-degree-below-zero weather with all the windows open.

We did however manage – 127 cans of aerosol spray later (it was actually 139 cans, but 12 of them went up my sleeve) – with the windows wide open, and on an exceptionally windy day, to unload it. I see it every now and again. They've painted it, but you can recognize it easily enough. Everywhere they park it, a tree grows!

The point, if indeed there is a point, is that as a ham you may be unfairly singled out as an odd-ball, but if it weren't for all you odd-balls, the rest of society would still be thumping dinosaurs on the head with blunt instruments for their evening meal. Be proud of your idiosyncrasies.

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TROUBLE SHOOTING FOR THE NOVICE

Sooner or later almost every piece of amateur equipment needs repair. Trouble shooting your equipment can be a very interesting part of your hobby.

The power supply is a good place to learn trouble shooting as the power supply must be working properly before any other part of the equipment can be checked.

The power supply may be an integral part of a piece of equipment or outboard and cable connected. For the type of trouble shooting to be described only the power supply will be considered. It will make little difference if it is integral or not. There will be variations to the typical power supplies in **Fig. 1**. The precautions, notes and sequence will apply to almost any power supply.

An excellent tool for checking for intermittents, broken wires and general probing can be made from a piece of ¼" plastic rod about 8" long. Sharpen one end with a pencil sharpener.

If the power supply is an ac-dc (transformerless) type use an isolation transformer to reduce the risk of serious shock. Any time a power supply is worked on, the filter capacitors should be discharged. Any time the power is turned on then off the capacitors should be discharged. Don't trust your life to a bleeder resistor. Remove any rings, this can save you a badly burned finger. Keep the bench clean and organized. A pencil and note pad are necessary on any repair bench. Keep notes of any wires disconnected and any components removed. The pad is also handy for noting voltages, resistances and etc.

Low voltage diodes can be tested by reading forward and reverse resistance. This test cannot always be used on high voltage diodes as the internal bias voltage of some diodes exceed the test voltage of the ohmeter and the diode will appear open when it is actually ok.

The only test equipment required is a vom and two sets of test leads. One set has insulated alligator clips. The other set has needle point tips. The needle point tips are better than the duller type as the points will pierce any resin flux or other material that could prevent an accurate reading. This is particularly important when working on surplus equipment that has been treated with moisture-fungus proofing.

The more elaborate test equipment will speed and simplify trouble shooting but you must understand the equipment to properly interpret the readings. As an example, an open secondary winding on a transformer can have enough inductance to give nearly a full voltage reading with a vtvm. A vom will load the open winding enough to clearly show it open.

The first step in any trouble shooting should be a good visual inspection.

The following key is designed to help you follow a logical sequence rather than take random tests and hope that you will luck onto the defective part. The key is based on the assumption that a symptom will indicate the failure of certain parts. As an example, if we have a defective power supply and turn it on and the pilot lamp lights it will be a waste of time to check the fuse but we might well check the rectifier tube or diodes. As you follow the key you will note that various symptoms will indicate checks until we have checked every part of the power supply right down to wires, sockets and plugs.

When using the key with a power supply that is not exactly the same as the schematic in Fig. 1, a quick comparison to your schematic will show the steps to follow. If your supply does not have a fuse just pass over the fuse check steps and continue on. If your supply has a three section filter capacitor and two chokes or resistors, make the additional checks when you come to the steps for checking these components in the key. Singular and plural on all components are interchangeable (where the key has diodes, diode will apply and so on). It makes no difference whether the pilot lamp is in the secondary as shown or in the primary circuit. The same steps and checks will apply to a half wave power supply. The key can be used for many low voltage supplies for transistor circuits.

Some of the checks may appear long and cumbersome. The filter capacitor checks are an example. Frankly, it is difficult to check capacitors with a vom. The capacitors are expensive and difficult to replace, so it is worth spending a little more time to be *sure* they are defective. We could reduce steps 15 and 19 to 'Test filter capacitors. Replace if defective.' If you do not have a capacitor tester the key would be of no value to you. Every Novice has, or should have, a vom.

Experienced repairmen use a mental key. This is why the TV repairman asks you, "what does it do?" He wants symptoms so he can use his mental key. As you gain experience in trouble shooting you will develop a mental key. If your key is good enough and generously cross-referenced you will be able to repair the 'tough ones'.

To use the key for trouble shooting determine the primary symptom. If the power supply has more than one symptom you might have to go through the key for each symptom to locate all the defects. The

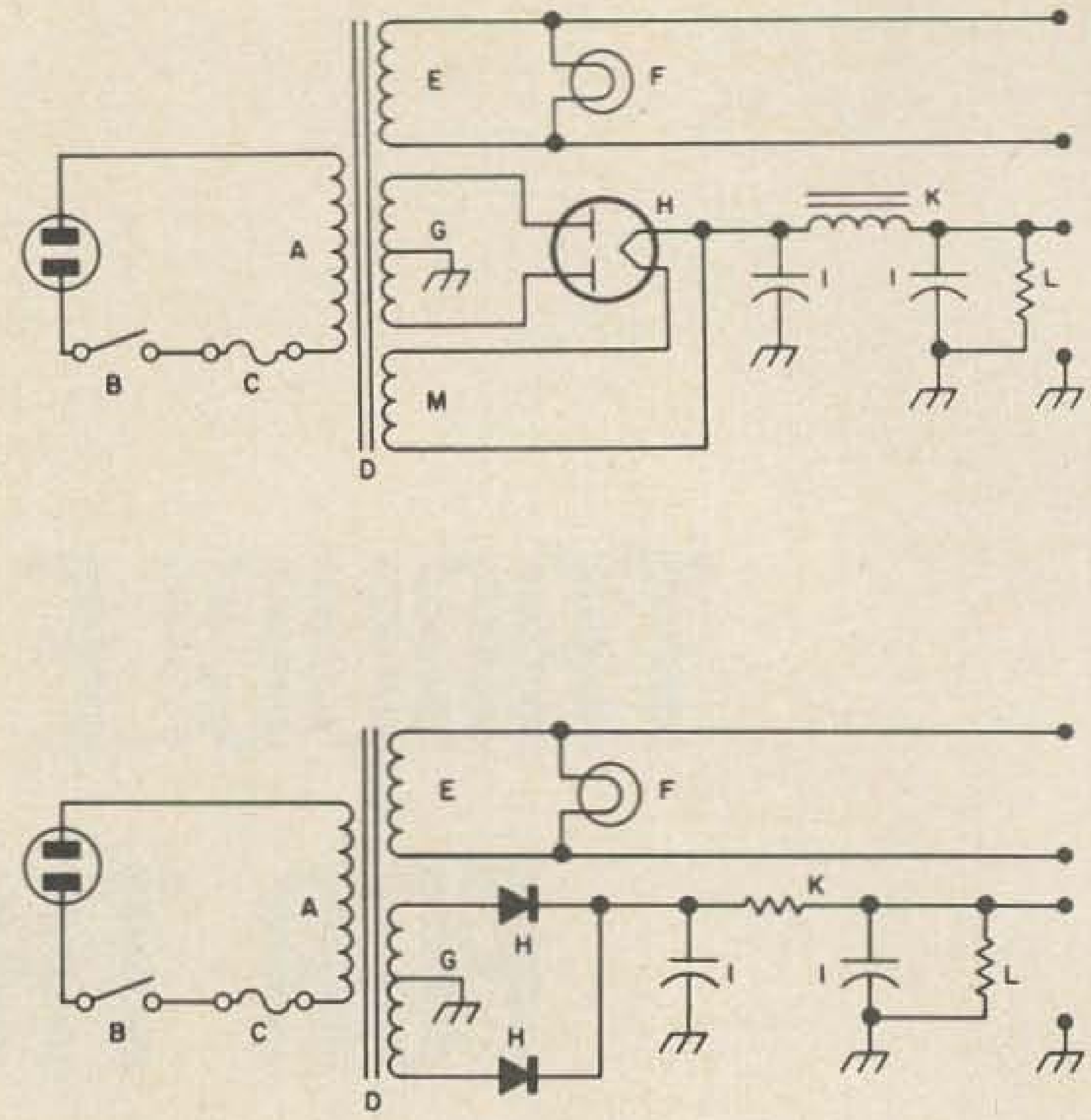

Fig. 1. These are typical power supplies used in Novice gear and were used for making the trouble shooting key. Parts identification: A–Primary winding; B–Power switch; C–Fuse; D–Power transformer; E–Filament winding; F–Pilot lamp; G–Secondary winding; H–Rectifier tube; H–Diode; I–Filter capacitors; K–Choke-coil type; L–Bleeder resistor; M–Rectifier tube winding.

key will indicate the repair for each symptom. The symptom will have a number for a check of a suspected component or components. If the component is defective the key will indicate the repair. If the component is ok the key will indicate the next check to make to locate the defective part.

Key to Power Supply Trouble Shooting

Power supply works – but
Hum is present. Go to 15
Power supply overheats
A. Power supply is overloaded. remove load. If power supply is now ok go to 21
B. Overheating is still present with no load. Go to 20
Power supply does not work – pilot lamp is known to be good Fuse blows. Go to 20
Rectifier tube or diodes are known to be good. Go to 1
Rectifier tube or diodes are not known to be good. If check 2 is ok go to 17
1. The power supply is turned on and the pilot lamp does not light. Go to 3
2. The power supply is turned on the the pilot lamp lights. Go to 10
3. Check outlet to be sure power is available. If no power, check house circuit. Power available. Go to 4

4. Check fuse. Do not depend on visual inspection. Use an ohmeter. If fuse is blown replace. If fuse blows again go to 20. If fuse is ok go to 5

5. Unplug power supply and using alligator clips connect ohmeter to power plug terminals. If ohmeter reads open go to 6. If ohmeter shows continuity go to 10. Be careful here because we may have an intermittent component.

6. Flex power cord at plug and where wire enters chassis. Watch for meter fluctuation indicating intermittent. If cord is intermit, replace it. If circuit is still open go to 7

7. Tap fuse holder. Watch for intermittent. If present, clean or replace fuse holder. If circuit is still open go to 8

8. Wiggle handle or knob on power switch. If intermit. clean or replace switch. If circuit still open go to 9

9. Check each component individually including transformer primary for continuity. Replace any open component.

This completes primary circuit testing. All defects in this circuit should now be repaired.

10. Check transformer filament winding for continuity. If open, replace transformer. If pilot lamp is in primary circuit check transformer primary. If open replace transformer. Be sure to remove any parallel load when checking transformer windings. If ok go to 11

11. Discharge filter capacitors. Go to 12

12. Check all connections for loose or broken wires. Press against wires with plastic probe for check for breaks. Replace any broken wires. If ok go to 13

13. Check any transformer windings not previously checked for continuity. See 10 for procedure. If any windings are open replace the transformer. If ok go to 14

14. Check filter choke or resistor for continuity. If open replace. If ok go to 15

15. A rough check of filter capacitors can be made by using an ohmeter. – to chassis (gnd). + to capacitor terminal (reverse for bias circuits). The ohmeter should show low resistance then slowly increase. If the meter stays on low or high ohms the filter capacitor is probably defective. If defective replace or follow through to 19 for confirming check. If ok go to 16

16. Check the bleeder resistor. It is just a convenient time to do it. Go to 17

This concludes ohmeter trouble shooting. We must now use power on testing to complete the trouble shooting. Observe all precautions discussed at beginning of article.

17. Check transformer secondary winding at tube plate pins or diode anodes for proper ac voltage. If low replace transformer. If ok go to 18

18. Check cathode of tube or diodes. Low or no dc voltage, replace tube or diodes. Diodes should be checked individually as only one may be defective. If ok go to 19

19. The filter capacitors can be checked under actual operating voltage. Remove all load from the power supply. The bleeder resistor can be left in if you determine the current flowing through it by ohms law. unhook the wire going from the rectifier to the filter components. Use the insulated alligator clips and MA meter. Connect – to filter circuit, + to the rectifier (reverse for bias circuits). Turn the power supply on. for the average power supply the capacitor leakage should not exceed 5-7 mA. If the bleeder resistor has been left in be sure to subtract the current going through it. If the filter circuit uses separate capacitors and the leakage is high check the capacitors individually as only one may be defective. The no load voltage of the power supply will be higher than the operating voltage but this is good for testing the filter capacitors. If there is no leakage through the capacitors and the resistance stayed high in 15 the capacitor is probably open or reduced capacity and should be replaced. The presence of hum confirms this.

This concludes the power-on trouble shooting.

20. Inspect components for evidence of overheating. Use the ohmeter to check for shorts. Inspect tube sockets, cable plugs and sockets for cracks and 'burn paths' where it could have arced over. Refer to 15 when checking filter circuits for shorts.

A faulty transformer will not always show a short to gnd (chassis). Remove all load from the secondary windings. if the transformer still overheats or smokes it is defective.

21. A fault in the equipment is overloading the power supply and causing it to overheat. Repair defective equipment.

This completes the trouble shooting key. If you have followed through the steps carefully the power supply should be repaired. There will be times when you will be in the mood to debate the following statement; when *everything* is ok the equipment *will* work. Happy trouble shooting.

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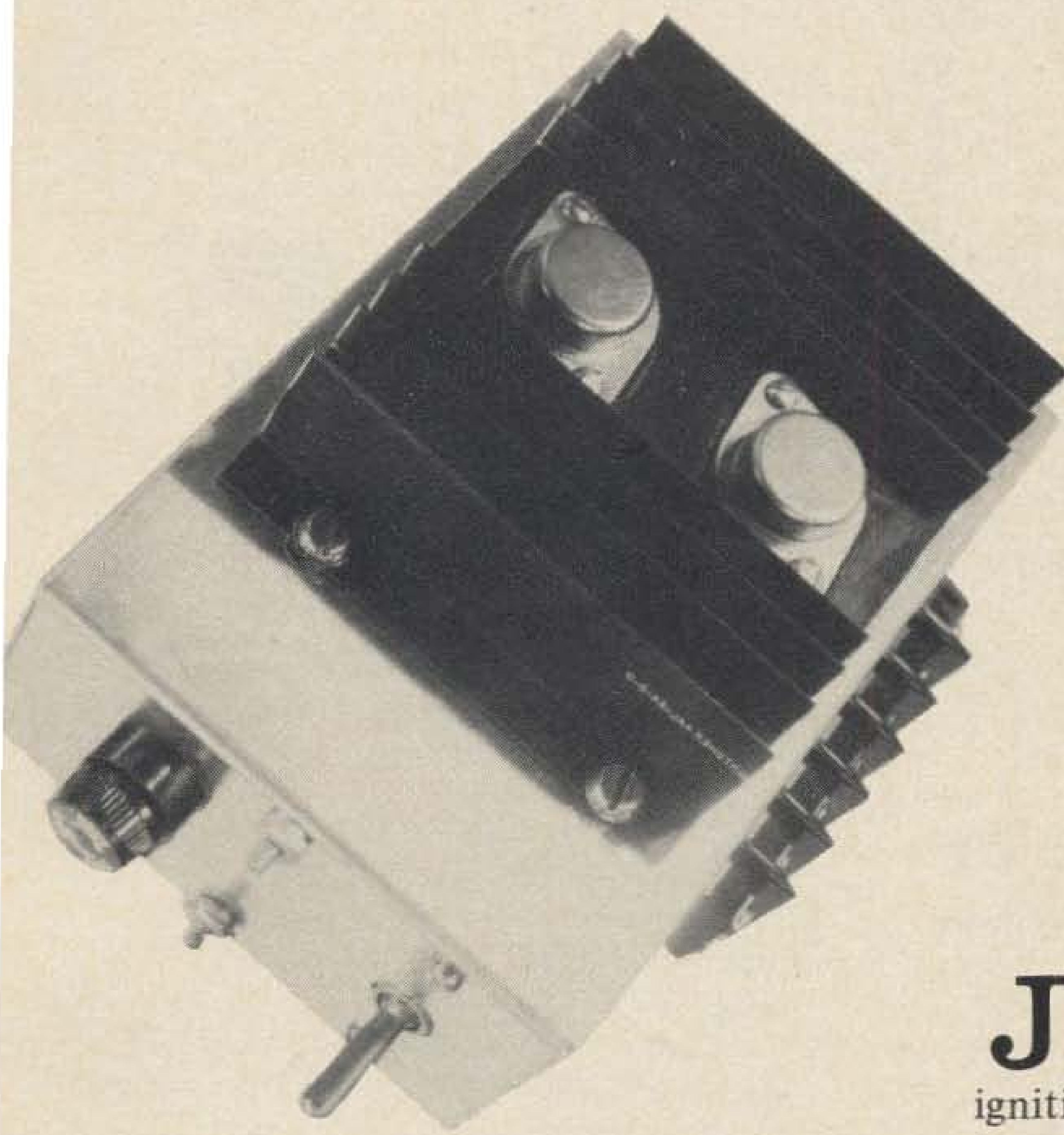
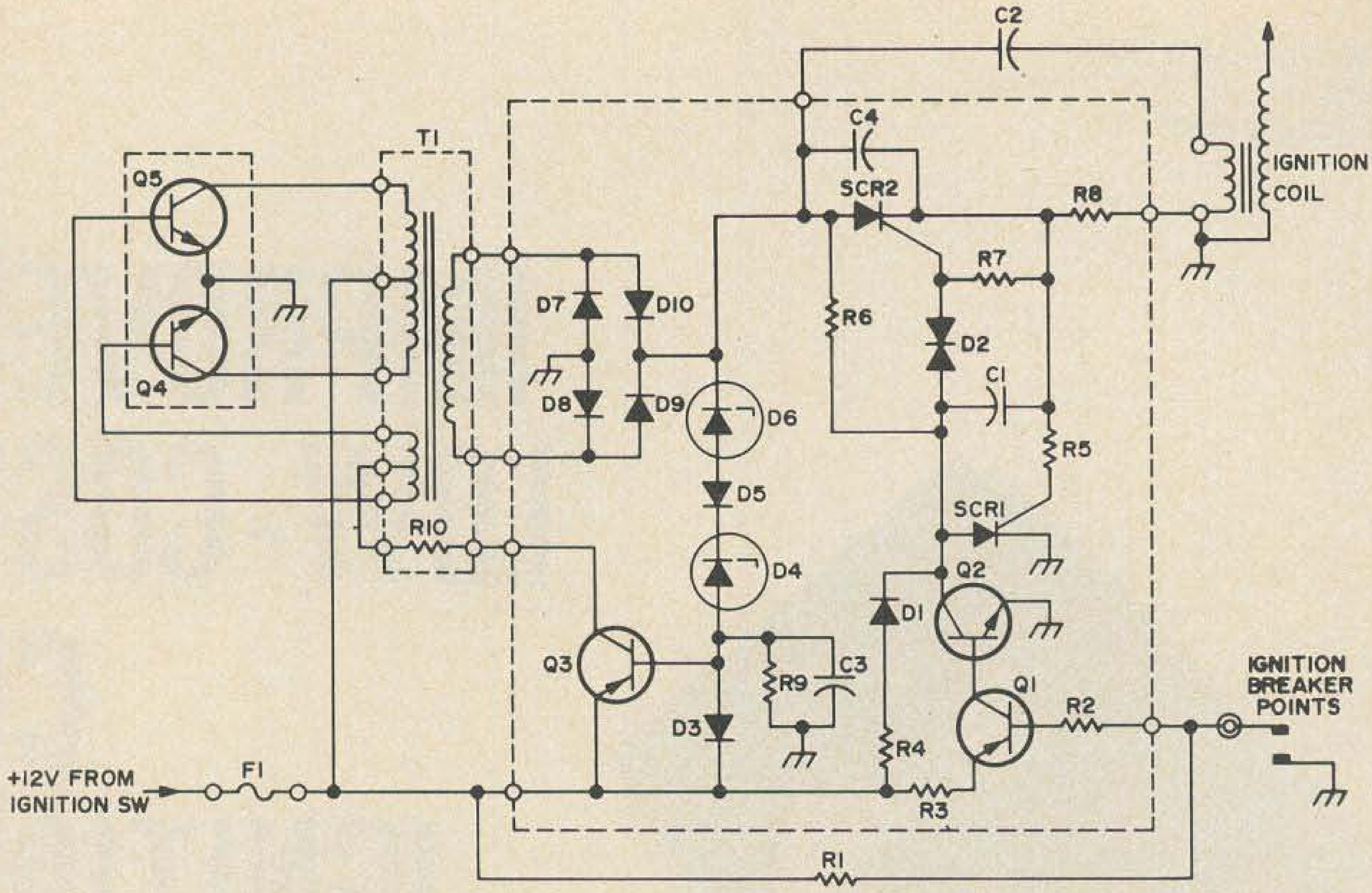
IMPROVED LOW-COST CD IGNITION



Judging from various construction articles written in recent years, solid-state ignition systems are going through a design improvement stage which bodes well for their final acceptance in the automotive field. Single-transistor, special-coil and multiple-transistor, standard-coil circuits have been around for about a decade, chalking up performance records ranging from good to miserable, with the latter heavily outweighing the former. For example, in my case, a 2N1167A transistor and special 400:1 coil was used for about 3 years with coil failure ending a frustrating series of ignition malfunctions due to point contamination and transistor characteristic change.

A well known automotive parts supplier in Chicago a few years back was vending many brands of transistor ignition systems with glowing praise of its "electronic promise." Today his catalog lists only a couple of high-priced reliable units and it is unlikely that this is due to a saturated market! Information gathered from individual users and garage repairmen point up



Parts List

C1 – .1,100V
C2 – 1.0 μF, 600V oil paper
C3 – .01
C4 – .01, I kV
R1 – 68, 5.0W
R2 – 4.7K
R3 – 2.2K
R4 – 220
R5 – 680
R6 – 150K, 2.W
R7 – 680
R8 – .5 (3 ft #32 E. wire)

R9 – 4.7K
R10 – 180/270 2.W See text
D1 – 1N914
D2 – MPT28
D3 – IN914
D4 – 200.V, 10.W zener
D5 – .75A, 400.V
D6 – 150.V, 10.W zener
D7–D10 – .75A, 1 kV
Q1 – 2N1132
Q2 – 2N697
Q3 – 2N1132
Q4, Q5 – 2N3055

SCR1 – Small 100.V sen. gate
like C106F2
SCR2 – 500.V, 20.A
F1 – 4.A
Q4, Q5 heatsink –
Birtcher #4AL-6-0-0
Q3 heatsink –
Fuse clip chassis
4x6x2 w/bottom cover
T1 – Core = Ferrox cube #K3-005-01-3E
Wire = 55' #26 Formvar, 4' Ω14 Formvar
Ins. tape Epoxy

Fig. 1. Schematic diagram of the improved low-cost CD ignition.

the basic fact that performance has been less dependable than the simple Kettering system. Besides, if it's more costly, why bother? A set of points and plugs every 10,000 miles is not too great a price to pay for dependability.

However, the search for improvement has continued and now a relative newcomer is in the spotlight, CD ignition. In spite of its greater complexity, capacitor discharge ignition offers much in the way of improved all-weather starting and considerable freedom from point problems. In addition, so-called "breakerless ignition" is more easily implemented with a CD circuit and indeed manufactured systems may be purchased; but for now they are too expensive for the average motorist..

This paper details some interesting results of experiments aimed at improved reliability of a CD system over a wide range of temperature, battery voltage, and ignition point resistance. These very important factors have been lightly regarded or ignored altogether by some designers. Circuitry for the unit shown in Fig. 1 has been simplified consistent with optimum performance and borrows some ideas found in two recent reports. [1,2]

Three objectives, listed in the order of their importance, were borne in mind during development and test: dependability, performance, and cost. Concerning the first, worst-case design limits for temperature, battery voltage, and point resistance were set at –40 to +85°C (still-air ambient), 6–16V, and 20 kΩ, respectively. This required silicon devices throughout, operated well below maximum ratings. All circuit elements are soldered in place – no

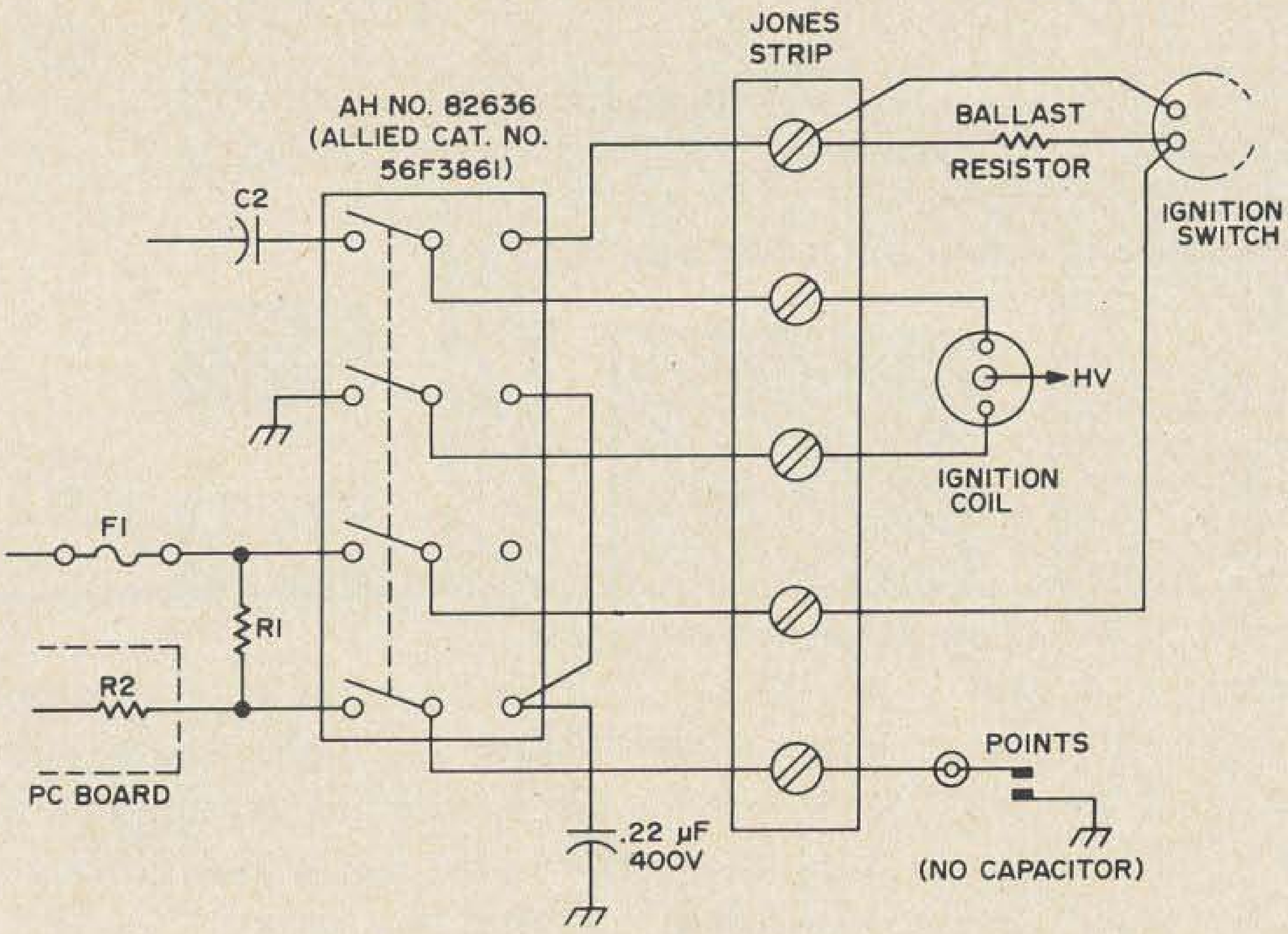


Fig. 2. CD/Normal via 4 PDT switch.

sockets allowed.

To simulate cold weather starting, all parts were cooled to -40°C in a large Dewar flask, point resistance increased by a 22 kΩ resistor and with 6V input, a 1.5 cm spark in air could be obtained, about 18 kV. At the other extreme, full spark energy of about 35 kV was available at 400 pps, 85°C at any voltage between 8 and 16V.

CD ignition requires a source of high voltage dc and this is ordinarily supplied by a dc/dc converter. Much of the cost is right here, in switching transistors and transformer. After experimenting for many weeks with overheated filament transformers pressed into converter service for which they were not designed, great elation was felt in reading the Morris-Morton article with its complete transformer construction plans. A toroid core was quickly obtained and wound to specs. Although lower cost switching transistors were used, performance was exactly as described and a major bottleneck resolved.

Circuit design followed transmitter practice, working from the output stage towards the input. A 1μF capacitor charged to about 350V and discharging into the primary of a regular 12V ignition coil via an SCR was chosen as the starting point. It was soon discovered that inexpensive SCRs were lacking in gate sensitivity and triggering by a UJT was marginal, especially at -40°C. A trigger diode in a standard

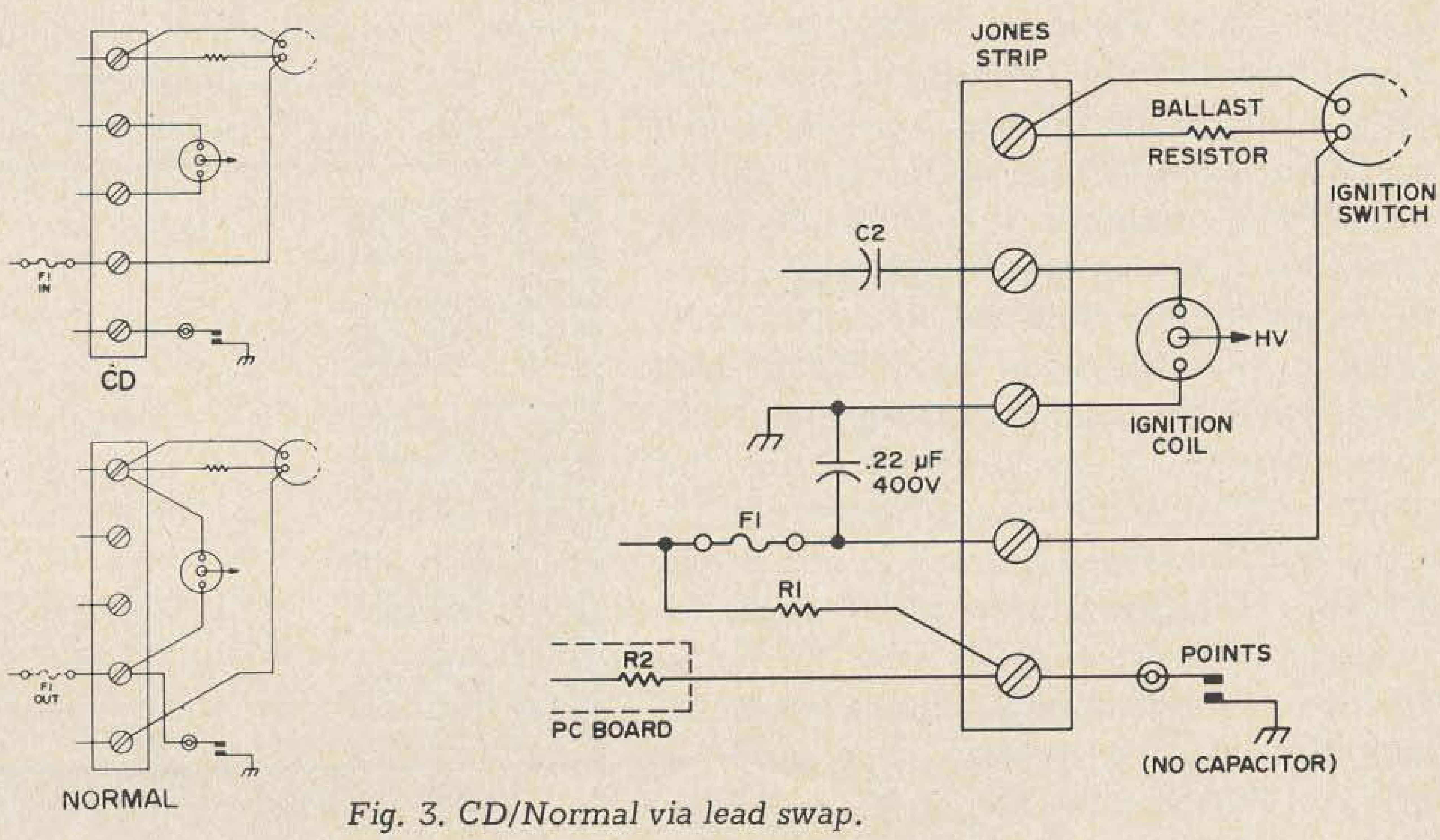


Fig. 3. CD/Normal via lead swap.

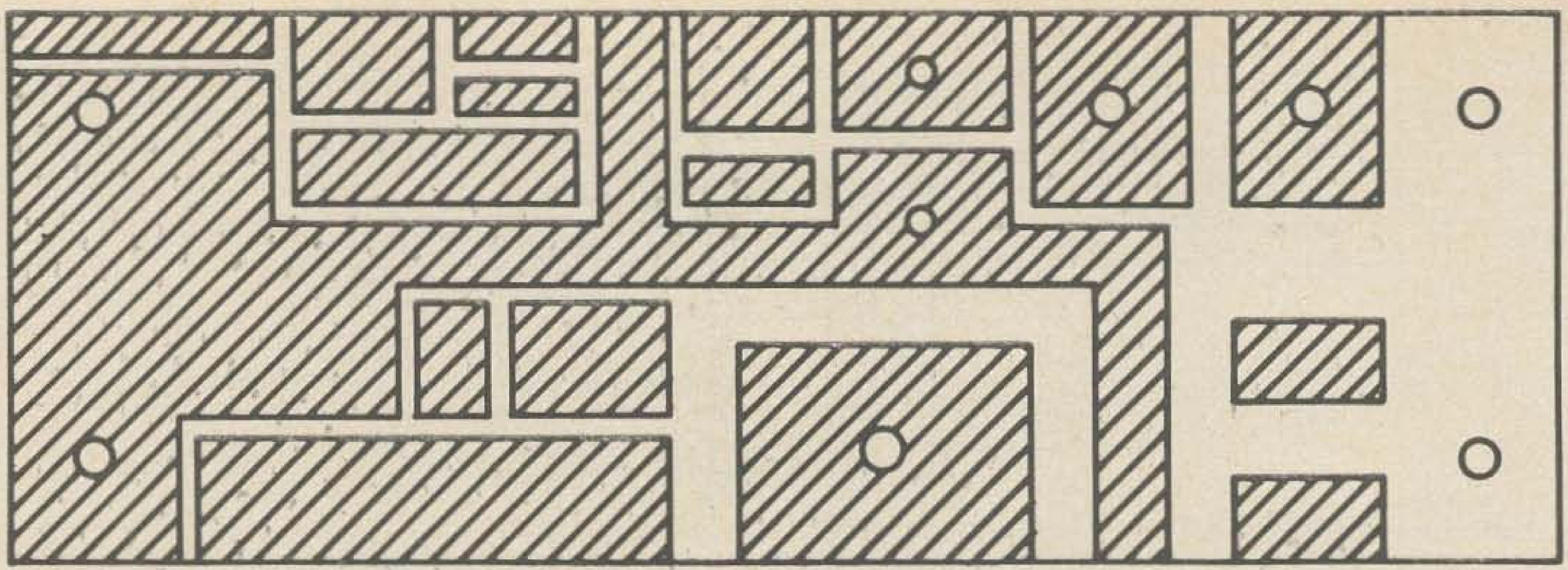


Fig. 4. Actual-size PC layout of board A.

circuit worked fine however, and was incorporated. Its RC time constant takes care of point bounce mentioned in previous papers. No-load B+ of 650V inadvertently applied to a 500V SCR was destructive and after the tears had dried, feedback regulation of the high voltage was added.

An SCR latch connected across the output SCR gate assures only one correctly timed ignition spark for each point opening. Point resistance tolerance and latch reset is controlled by a two-stage saturating switch which has outperformed all other circuits tried. It consists of an NPN switching transistor that can pull the SCR anode down to 0.2V at −40°C (worst case), causing positive reset. Signal inversion, current gain, and dc level shifting is provided by a PNP input transistor. Rate of point opening and closure, ranging from very slow during starting in subzero weather to 400 Hz for a V-8 at 60 mph does not and cannot upset proper operation.

Speaking of breaker points, it seems that oil fumes leaking past the distributor shaft upper bearing, creepage of cam lubricant, ozone inside the cap, and just simple oxidation of tungsten surfaces singly or collectively brings on increasing electrical resistance that can cause malfunction in an electronic system. Without R1, this circuit failed at 920 miles after initial installation, using brand new points running essentially "dry circuit." A single swipe across the points with a book match cover got us going again immediately, but it was a loss of 100% reliability. Current bleed via R1 of fractional ampere has proved to be a reliable solution during 22,000 miles of failure-free driving to date. Apparently a tiny arc at point opening time vaporizes whatever contaminant may be present, preventing buildup. The higher energy level in the high tension circuit requires clean, film-free surfaces on rotor and inner cap which is at it should be anyway.

There are some circuit details that, when properly dealt with, will insure utmost dependability. (1) Q1 must have low emitter-collector leakage when heated to 100°C; (2) SCR 1 should fire with 3 mA or less gate current and stay latched up when very cold, with 6V applied to R4; (3) Q3 should have a beta of at least 40 and be provided with a small heatsink, as it must dissipate 400 mW; (4) Q4 and Q5 must have a moderate-size heatsink as they heat to 100°C when all limits are high; (5) surplus high-power SCRs are inexpensive and a 20A unit will loaf along without heatsinking; (6) D3 and D5 protect Q3 from transient pulses normally present on the B+ line and D3 provides additional safety for SCR 2 by way of brute-force limiting via the zeners if Q3 should fail; (7) power zeners are also an excellent buy—use 'em; (8) procure a quality capacitor for C3—MIL-type oil paper in metal cans often

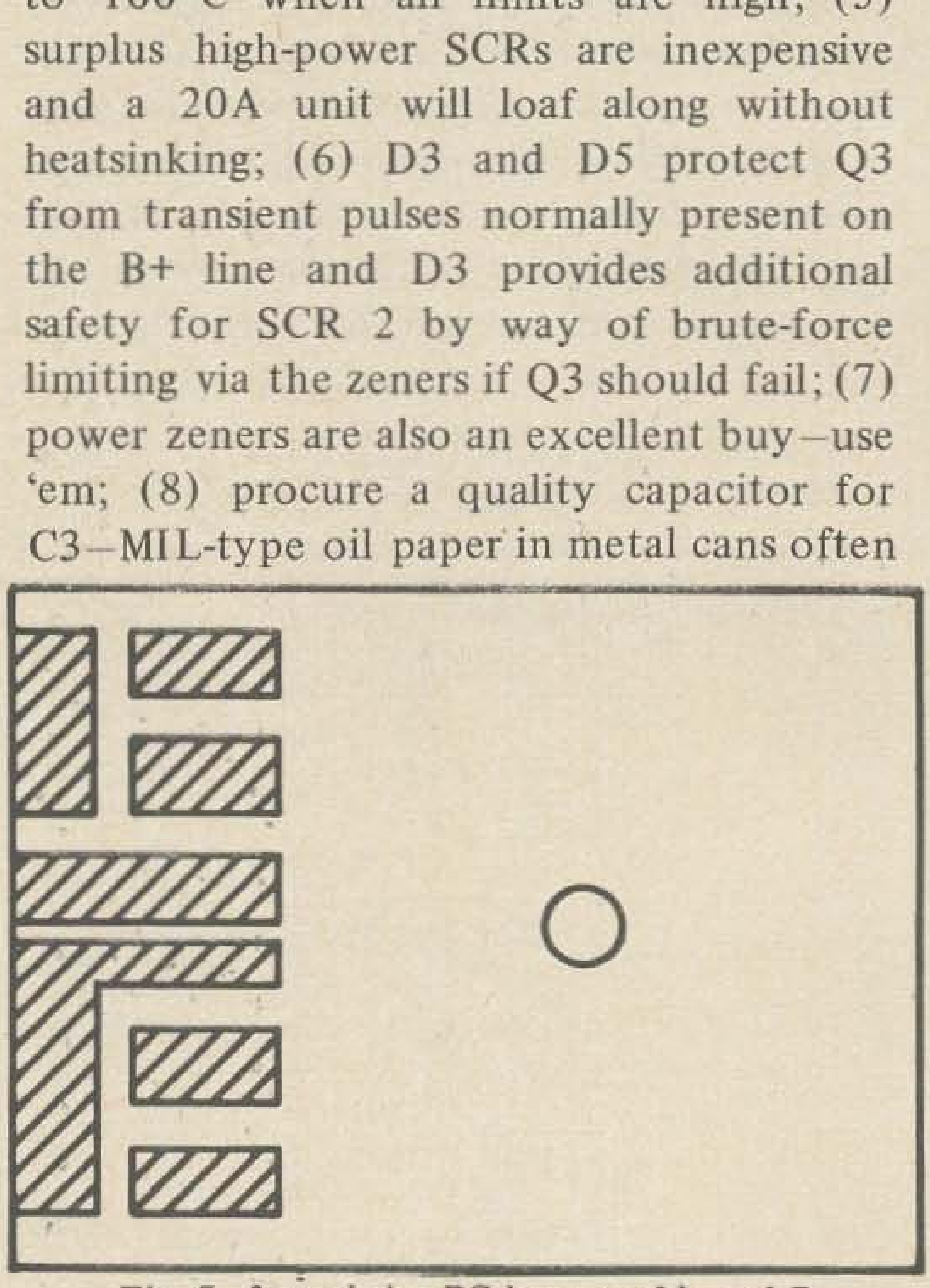


Fig. 5. Actual-size PC layout of board B.

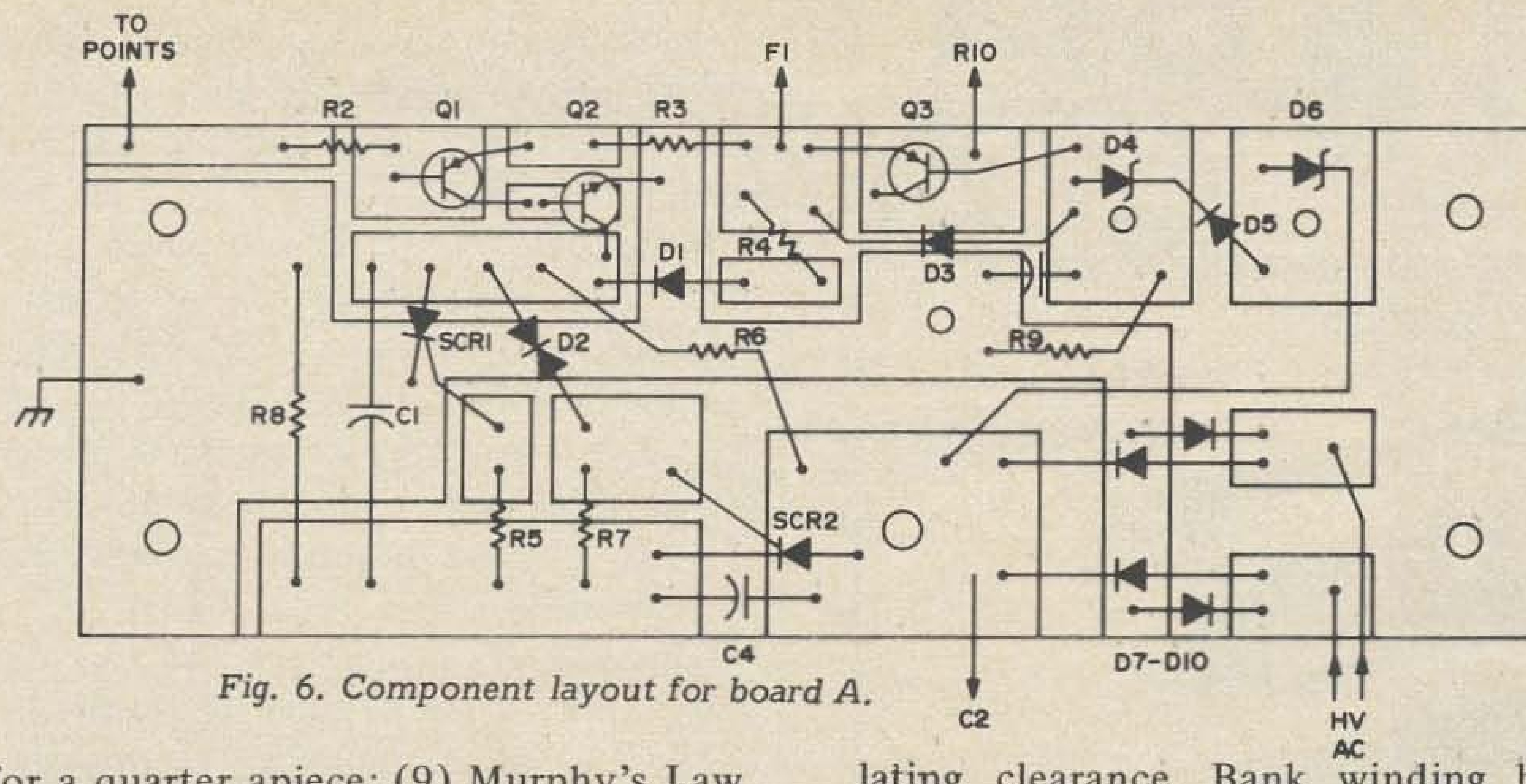


Fig. 6. Component layout for board A.

go for a quarter apiece; (9) Murphy's Law being what it is, switch-back to standard ignition can be provided for either by a four-pole double-throw toggle switch or rearrangement of leads on the Jones strip with quick-disconnect terminals.

Make the PC boards from 1/16 in. single-clad stock. They are designed for face mounting of components, which saves lots of drilling. Wire up the large one, deleting R1 for now. Mount Q4 and Q5 on their heatsink using 6 in. long coded leads. If reference 1 is not available, wind T1 in the following manner. Obtain the specified core and apply an even layer of thin insulating tape. Make a bobbin of strong flat material such as plastic or a tongue depressor and notch the ends to a 6 in. inner spacing. Once around is about a foot, so put on 50 ft of #26 Formvar insulated copper wire. Wind all of this wire on the core in 6 bank-winding sections of 45/50 turns per section and scramble wind where necessary to even the layers. Leave a 1/8 in. gap between start and finish for insulating clearance. Bank winding helps to minimize potential differences along the winding. Cover with a smooth layer of insulting tape. Then put on 20 turns of 14-gage insulated copper wire (4 ft) evenly spaced around the core, with ends opposite the first layer leads. Centertap this winding. Finally put on 10 turns of 26-gage wire, its centertap adjacent to the other, interleaving the small wire between the heavy wire.

Connect the transformer per schematic, then breadboard the entire circuitry for initial testing, using a spare or borrowed ignition coil. Provide a ½ in. sparkgap. Wire a 22 kΩ resistor between R2 and "points" (touch resistor lead to ground). Apply input voltage and watch the sparks fly!

A median value for R10 is about 220Ω. It can be optimized if test equipment is available. The dc/dc converter efficiency is maximized by use of the highest resistance value at R10 causing a 2.8A current drain at +14V when the system is delivering 400 pps into a 1/8 in. sparkgap. Too low a

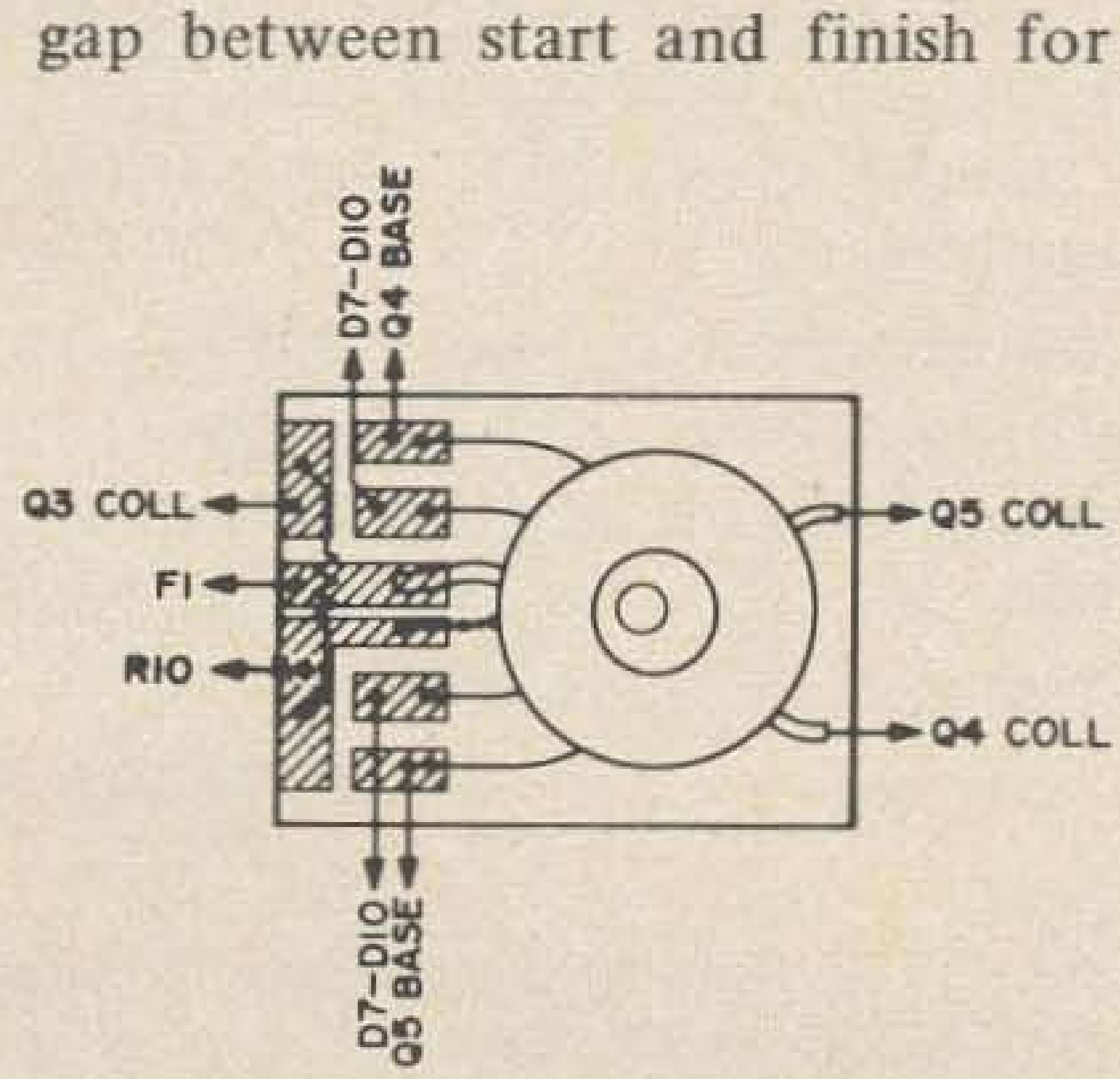
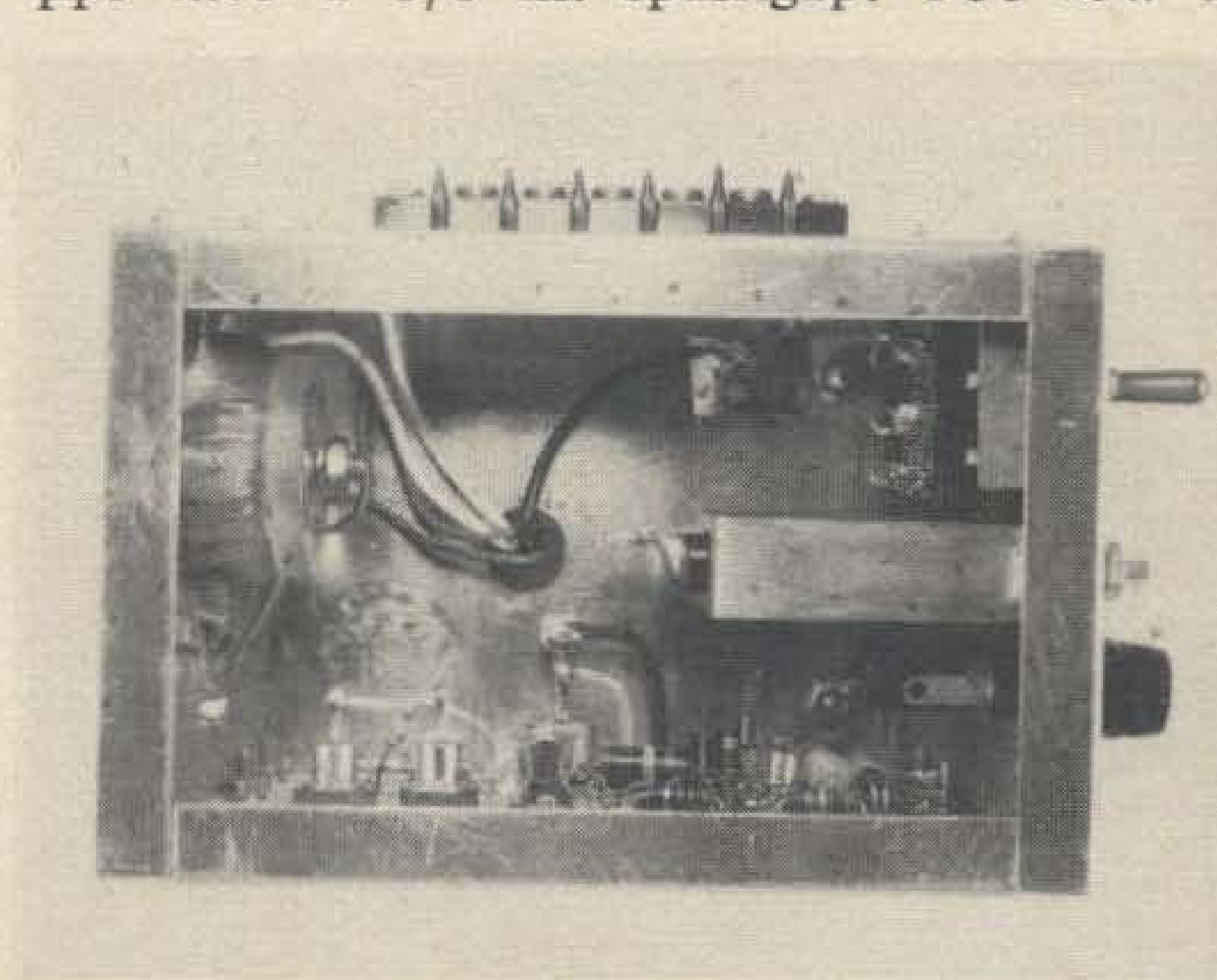
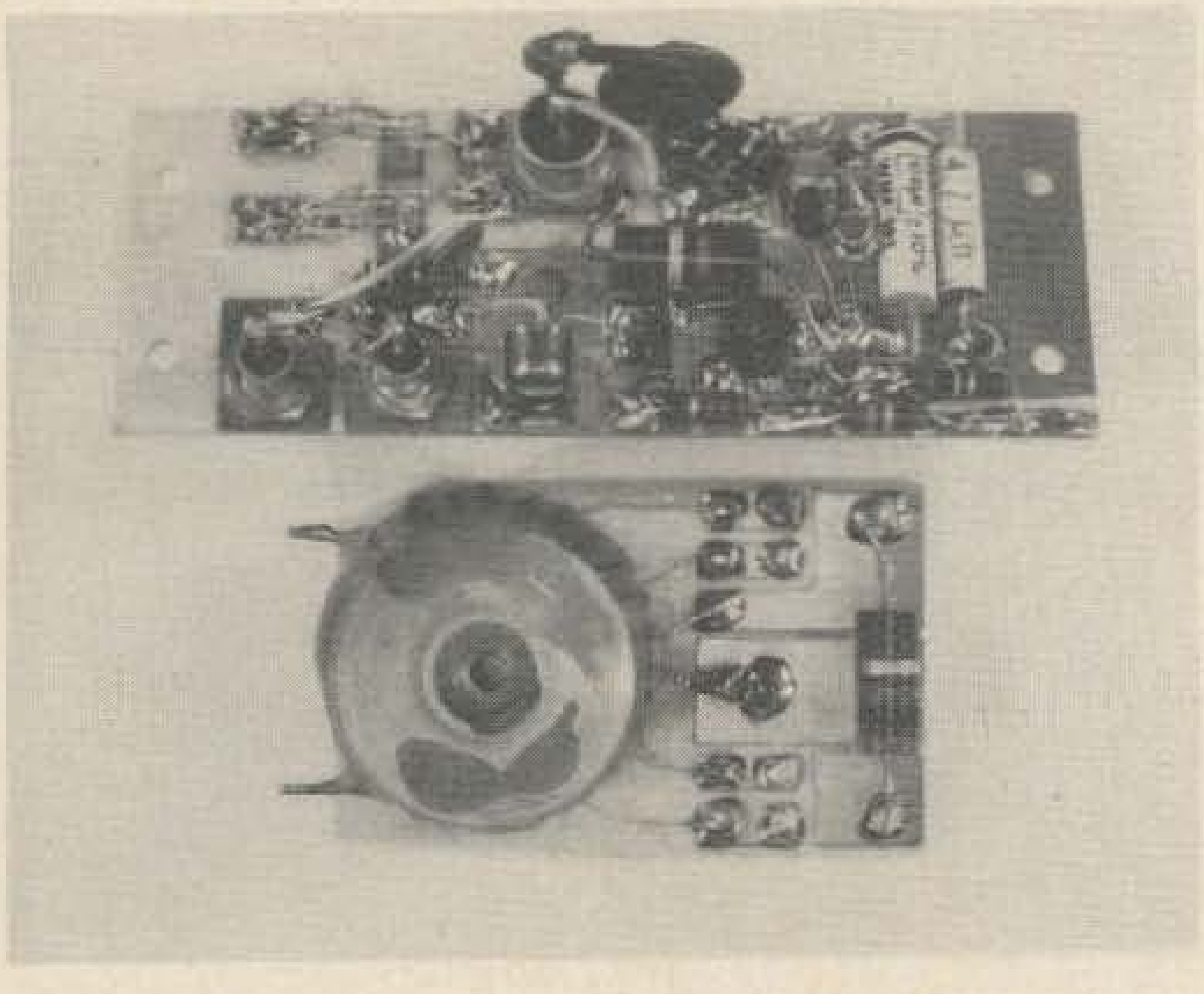


Fig. 7. Layout for board B.



value will cause excessive heating of Q4, Q5 and a tendency to "squeege"; too high a value will reduce B+ so that high-speed performance is poor. 180–270Ω are ballpark limits.

Mount the transformer on its PC board after completion of tests. Adjust lead dress, then coat generously with insulating epoxy, securing T1 in place at the same time. Leave a center opening for passage of a mounting bolt. After the epoxy has hardened, solder each lead to a PC terminal according to the drawing.



Packaging is the next order of business before actual installation and roadtesting gets under way. The photos show one arrangement using a 4 by 6 by 2 in. chassis with bottom cover. It is a good idea to make the unit drip-proof by sealing all openings with silicone rubber caulking available at most hardware stores. Centralize the large heatsink so that metal straps across the chassis ends can secure the box in place without interference. Don't forget to install R1.

Underhood installation of the completed unit should be such that radiator fan cooling air or incoming air in the case of rear engined vehicles can flow across the heatsink and there is protection from rain, snow, and puddle splashing. Don't overlook inside mounting. Although the air is relatively calm, temperature extremes are less and exposure to weather is avoided. Annoying whine at 1 or 2 kHz of the usual converter is nonexistent in this one which oscillates at 10 kHz. Position so that switch-back to normal is easy, in case of difficulty.

Electrical connection requires tapping into the ignition switch circuit ahead of any ballast resistor, disconnecting the points capacitor and possibly adding leads to tie into the distributor and coil. Check out the connection schematic to see how it's done.

This particular circuit lends itself well to "breakerless" ignition experiments, either optical or magnetic. One breadboard test made use of a variation of blocking oscillator, abrupt start-stop control being effected by a small permanent magnet in proximity to the oscillator toroid core. These ac burst signals drove Q1, eliminating all contact problems.

Acknowledgement is made for the many helpful suggestions and enthusiastic encouragement of my friend and colleague, Mr. Dario Dorigo. His CD in a Corvair is performing in excellent fashion.

. . .W1KNI■

References:

1. Unique CD Ignition System, Morris & Morton, Jan. '69, Electronic World.
2. High Efficiency DC/DC Converter, Levy & Blair, Feb. '69, Electronic World.

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LIGHTNING

Nikola Tesla watched, elated, as the needle on the ammeter pinned. The room was filled with a roaring, crackling noise and the smell of ozone permeated the air. The scientist walked outside. High atop his laboratory, a metallic globe was alive with a hissing blue cornona. While he watched, fascinated, a bolt of man-made lightning leaped from the globe to the ground. Seconds later, another bolt leaped out a little farther than the first; then another struck farther still. Tesla's machine even seemed to be drawing lightning from the air around it.

Suddenly the noise stopped. Silence closed in like a cloak as the machine went dead. Tesla rushed back into his lab. His machine was intact, but there was no power. The experiment had been terminated by a local power failure. Furiously he telephoned the power station demanding an explanation.

"You're not the only one who wants an explanation," the voice on the other end of the line retorted, "You've just melted the windings in three of our generators. It'll be a cold day in hell before we send any more power out to you!"

It is doubtful that even this brilliant scientist fully realized the awesome magnitude of power involved when he tried to produce lightning, for although it is usually dissipated with comparatively little damage, a single stroke of lightning can contain as much electrical energy as today's average family consumes in a week. A storm of moderate intensity can produce many times the energy of a nuclear bomb.

The actual amount of power in a lightning stroke is the subject of considerable disagreement in the engineering world. Some authorities say that the voltage represented by a lightning stroke is in the neighborhood of thirty million volts. Others claim the voltage can be as high as 900 thousand volts per foot. At that rate, the voltage of a stroke, which can be as much as ten miles long, would reach astronomical magnitudes. The current, on the other hand, is generally agreed by the various authorities to range from four thousand to a quarter million amperes. The duration has been measured at 5 to 50 microseconds.

The electrical charges that produce lightning are thought to be produced by friction between rapidly moving raindrops and the surrounding air. Thunderheads are known to contain vertically moving air columns which reach velocities in excess of 100 miles per hour. Raindrops and ice particles, moved about by these currents, develop electrical charges. The vertical movement accumulates these charges much in the same manner as the vertically moving belt in a Van de Graaff generator.

The turbulence within a thunderhead develops a strong negative charge in that region of the cloud where the temperature is between 0° and 32°F. A positively charged zone develops in the upper portion of the cloud, and the lower portion of the cloud contains both positively and negatively charged zones. From this it can be easily understood why 65% of all the discharges are within a cloud or between clouds.

Lightning strokes, either within or between clouds, or from a cloud to the ground, occur when the voltage between charges of opposite polarity exceeds the breakdown potential of the intervening air gap. This breakdown is of a different nature than the breakdown of a small air gap. There appears

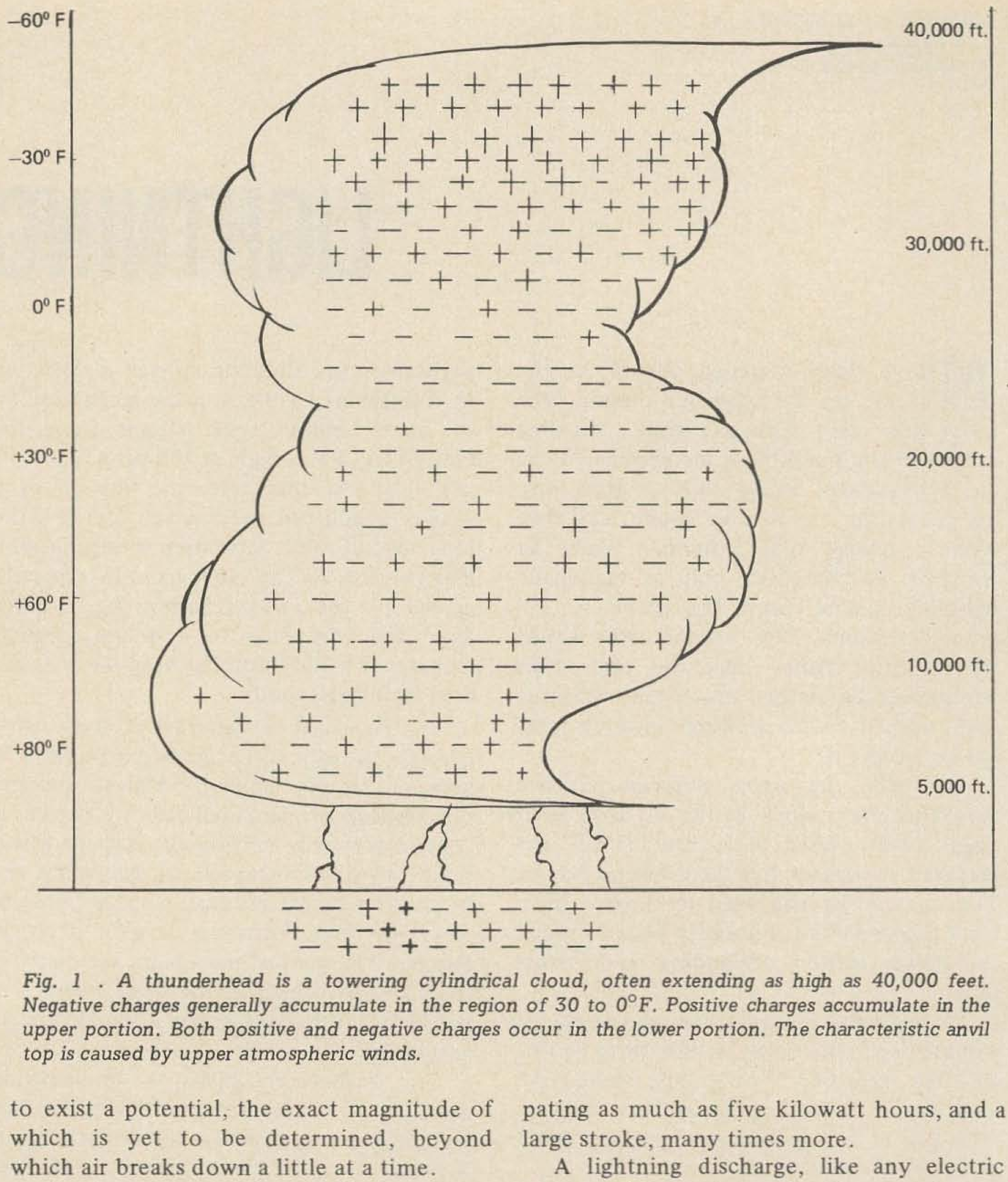


Fig. 1 . A thunderhead is a towering cylindrical cloud, often extending as high as 40,000 feet. Negative charges generally accumulate in the region of 30 to 0°F. Positive charges accumulate in the upper portion. Both positive and negative charges occur in the lower portion. The characteristic anvil top is caused by upper atmospheric winds.

to exist a potential, the exact magnitude of which is yet to be determined, beyond which air breaks down a little at a time.

As charges accumulate in the lower portion of a thunderhead, equal and opposite charges are produced by electrostatic attraction in the ground and all grounded objects below. As the potential passes the breakdown level, "leader strokes" begin probing their way toward the opposite charge. Usually the leaders start from the cloud, but sometimes from the ground. Advancing 50 to 60 yards at a time, and pausing about 100 microseconds between steps, the leader works its way toward the opposite charge. Then current flows, a small stroke dissipating as much as five kilowatt hours, and a large stroke, many times more.

A lightning discharge, like any electric current, follows the path of least resistance which is almost never a straight line. The potential gradient from a cloud to the ground is constantly being distorted by the turbulence of the atmosphere On the ground, moisture, temperature, and the varying quality of the ground itself play important roles in determining the path of a stroke. With all these variables, lightning has been observed to do some pretty strange things. A neighbor of mine had her house struck. The bolt travelled down a drainpipe, followed the electrical wiring across the cellar into the back shed, then jumped to a sink, scaring the tar out of her son who was repairing his bicycle in the shed.

Some of the phenomena manifested by lightning are so weird that it becomes hard to separate fact from fiction. For instance, ball lightning was long thought to be an old wives' tale. Too many credible observations by competent personnel have been reported, however, to pass it off as a myth. Present theories consider the phenomenon to consist of a small, heavily charged mass of ionized air that becomes separated from the path of a stroke and then drifts along with natural air currents until it either dissipates or finds a ground path where it discharges, sometimes with explosive violence. Sheet lightning is thought by some to be merely reflections of lightning discharges in a far-away cloud. Others think it is the instantaneous discharge of a large area of atmosphere, spreading the energy that would otherwise be discharged in a stroke over a wide area – a sort of high-speed Aurora Borealis.

People have gone to great lengths over the years to protect themselves from lightning, ranging from charms and prayers to more scientifically sound methods. When Mr. Franklin invented the lightning rod, all sorts of applications were tried. An early drawing depicts an umbrella with a lightning rod on top and a conductor trailing off along the ground. Good thinking, but a very dangerous device. Lightning rods today are confined to the tops of buildings.

Modern-day lightning rods are generally pointed, not so much to make them more likely to be hit as to prevent the buildup of charges that would lead to a stroke. It is generally known among those who work with high potentials that a point encourages corona discharge. Working on that principle, the point on a lightning rod constantly bleeds off accumulating charges thus pre venting their building up to a dangerous level.

In the communications field, lightning protection varies depending not only on the nature of service but on the geographical location as well. This is because the frequency and severity of thunderstorms varies throughout the continent. Equipment that is protected sufficiently on the west coast would go up like a Roman candle in central Kansas or on the Florida peninsula. In the latter two areas, electricians do as much business repairing lightning damage as they do putting in new installations. The Great Lakes region has 50% more thunderstorm activity than the New England coast. By contrast, southern Alaska has perhaps only

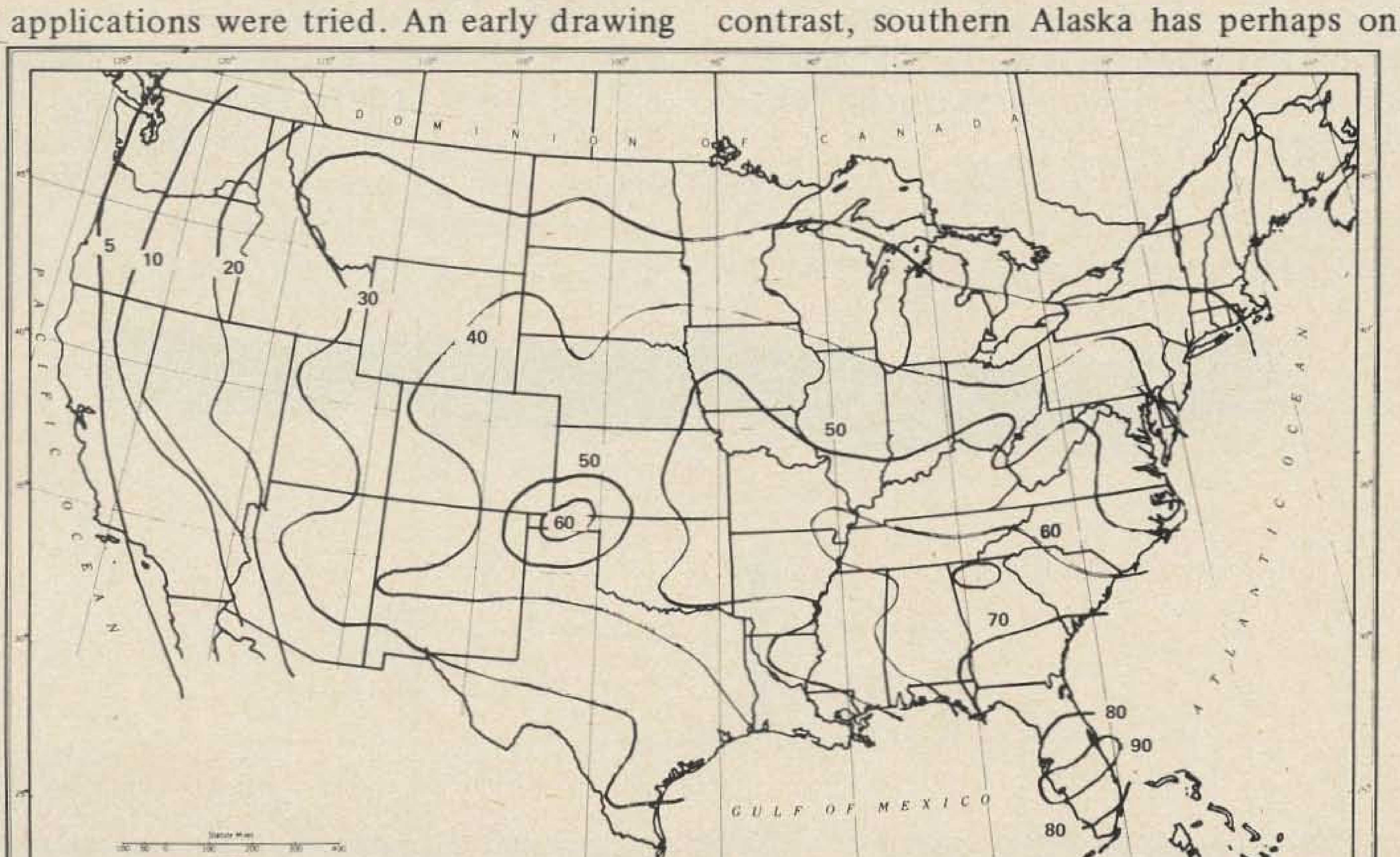


Fig. 2. Average number of days of thunderstorm activity per year in continental United States.

one day of thunderstorm activity in two years.

Protection requirements further depend on the amount of exposed wire and on the conductivity of the ground. It is much easier to protect equipment situated in a salt water marsh than in dry, sandy soil.

It should be realized that virtually nothing can protect an antenna or signal wire from a direct stroke. Considering the tremendous magnitude of current involved, it is easy to understand that even a very heavy ground conductor might be vaporized. However, proper protective equipment pays for itself, protecting equipment against a little-publicized phenomenom known as a ground surge.

In order to better understand a ground surge, picture for the moment the plates of a charged capacitor. When a conductor is connected between the plates to discharge the capacitor, current flows through the conductor from plate to plate, and *from all points on the individual plates to the conductor*. Comparing an electric charge in a cloud and the ground below it to the places of a capacitor, and imagining the path of a lightning discharge as the shorting conductor, it is easy to see that each time lightning strikes, current flows through the path of the stroke from the ground to the cloud; current also flows through the ground from all surrounding points to the point where lightning strikes.

If lightning struck a point several hundred yards from an antenna tower, current would flow down out of the tower and through the ground to the point where the stroke occurred. The magnitude of these surges can be as high as ten percent of the current in the lightning stoke itself – as much as several thousand amperes. If the equipment in your shack were grounded at more than one point, a ground surge might find an easier path through the interconnecting wires than through the ground. In that case, goodbye equipment. This one hideous thought clearly illustrates the reason for one and *only* one ground point in a well-protected shack.

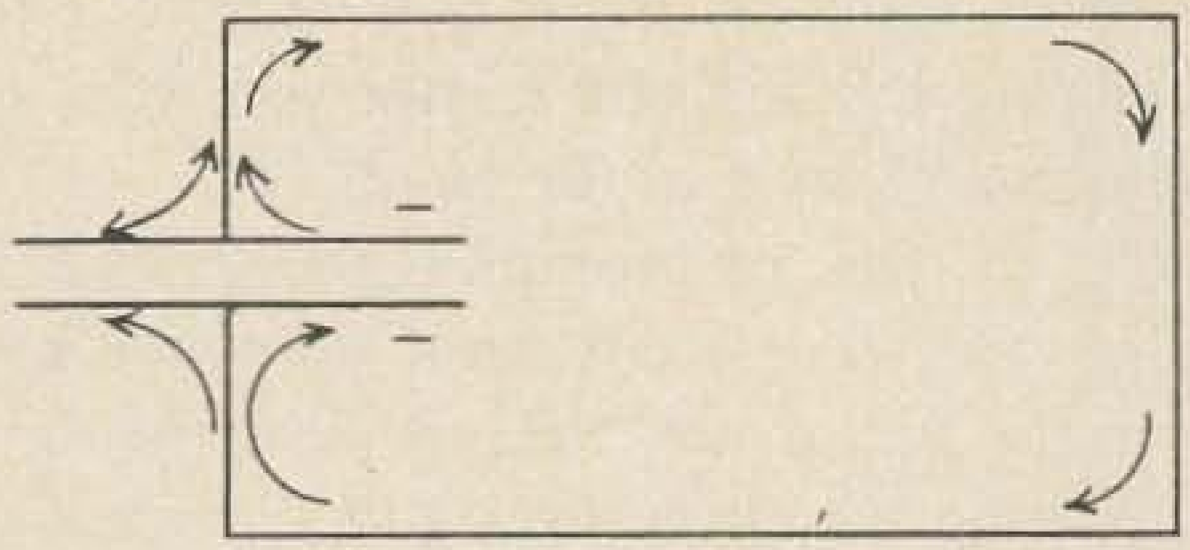


Fig. 3A. When a capacitor is discharged, current not only flows through the shorting path but through all parts of the plates as well.

Where remote control lines or other types of signal wires run long distances above ground, ground surges from lightning are a major problem. The railroads, using unshielded signal lines running for miles at a stretch, often go to great extremes to protect their delicate and costly signal equipment. Each line has a heavy-duty lightning arrester connected to ground at the point where it enters a wayside housing. Electronic devices such as carrier-current transmitters and receivers are further protected by high-speed gas discharge tubes on each terminal.

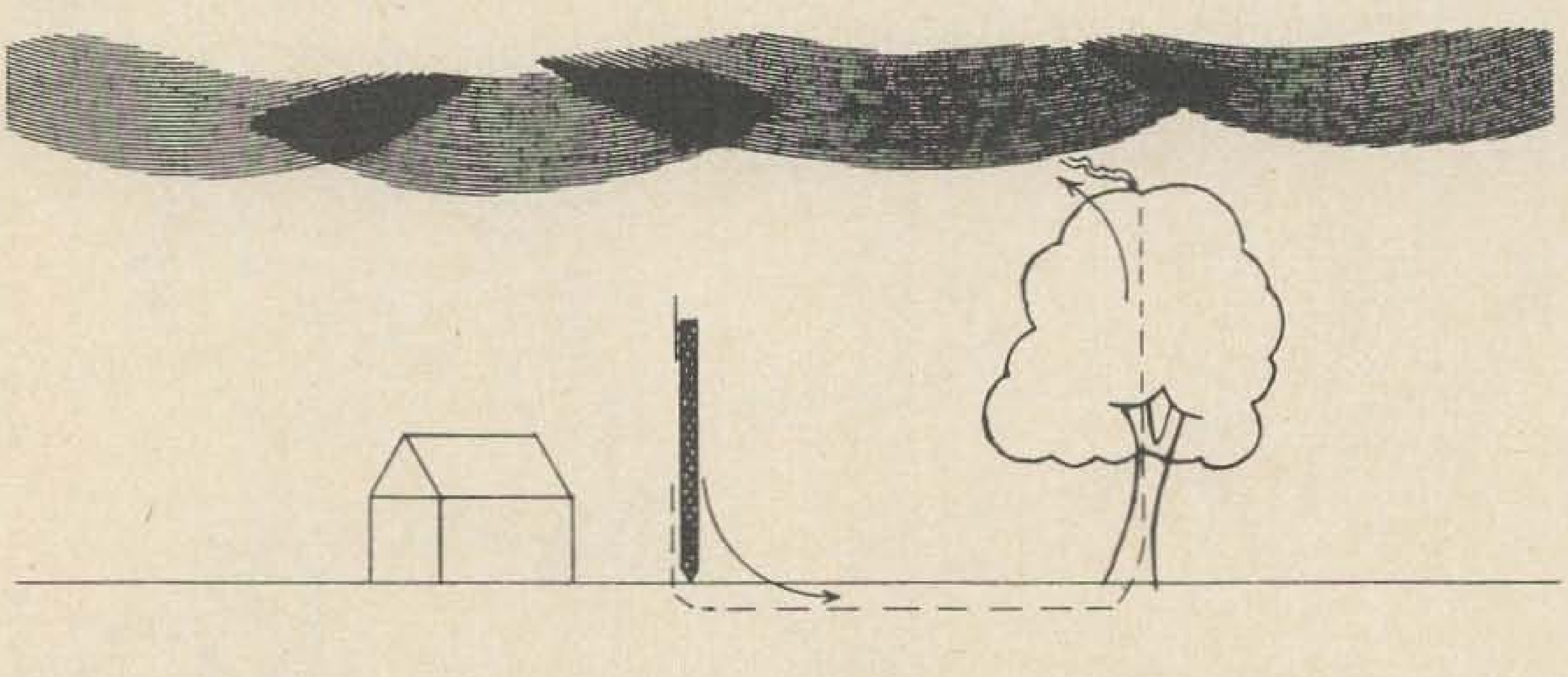


Fig. 3B. Picturing the sky as a plate of a charged capacitor and the ground as the opposite plate, a lightning stroke causes current surges to flow down out of nearby grounded objects, through the ground, and along the path of the stroke to the sky.

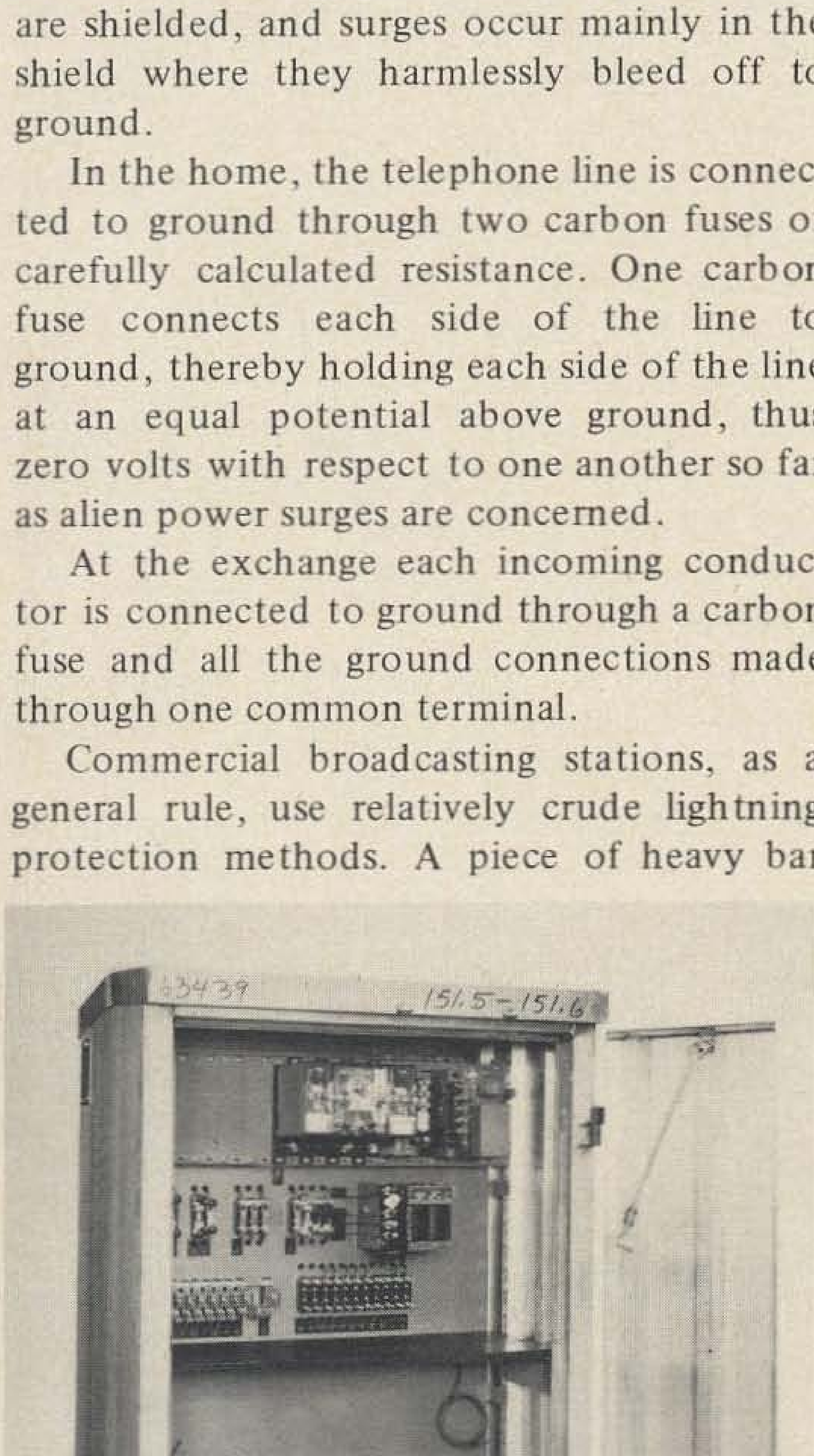
Every ground terminal within the housing, as well as a connection to the housing itself, is brought to one common ground point called the "prime ground terminal" which is connected to earth ground through the lowest resistance path possible. Railway signalmen have told of standing inside a wayside housing during a storm and seeing the arresters constantly flashing like a small fireworks display. A severe surge will cause a railroad arrester to blow off its glass covering with a report like a gunshot.

Although telephone lines often run long distances above ground, many types of cable are shielded, and surges occur mainly in the shield where they harmlessly bleed off to ground.

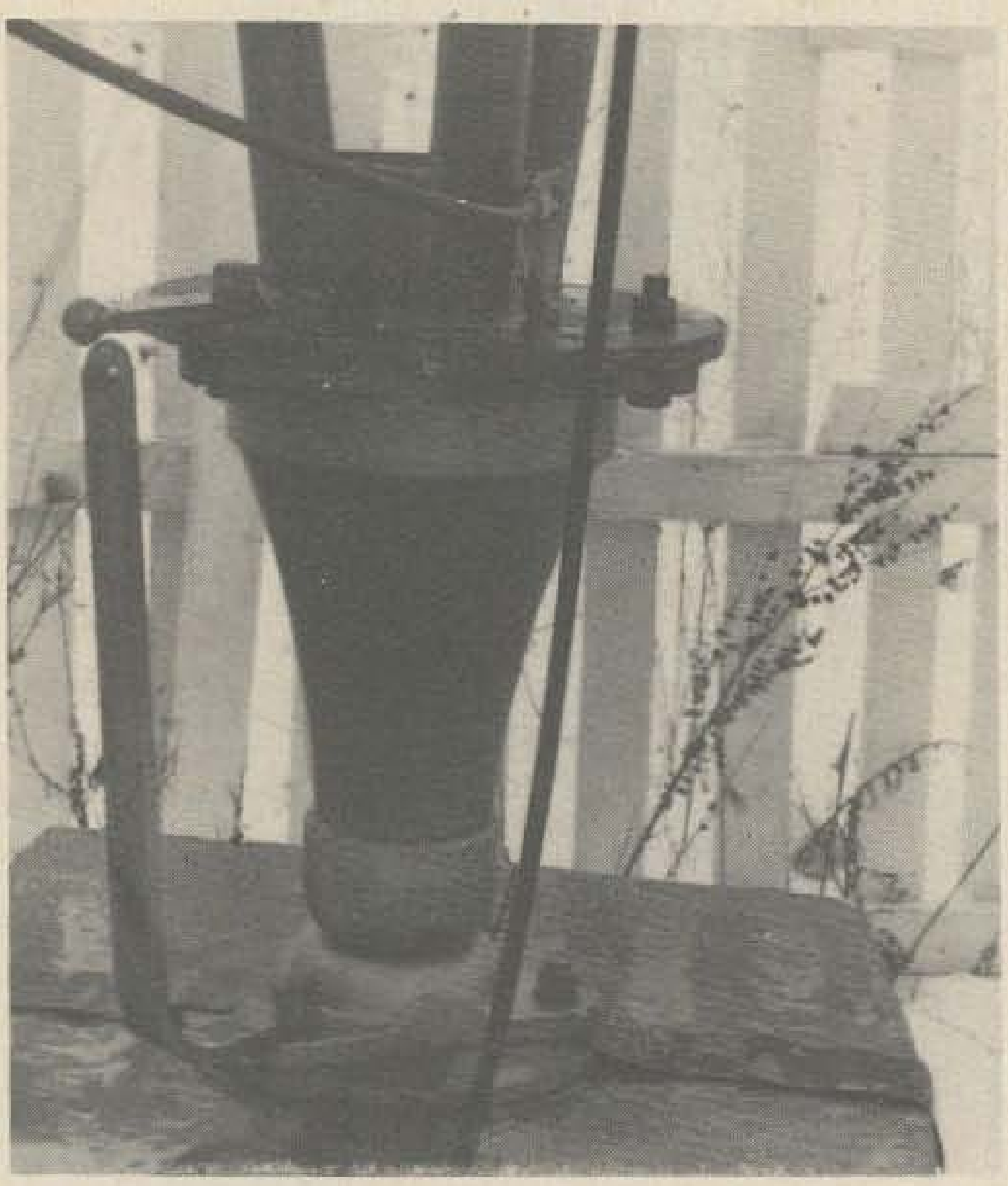
In the home, the telephone line is connected to ground through two carbon fuses of carefully calculated resistance. One carbon fuse connects each side of the line to ground, thereby holding each side of the line at an equal potential above ground, thus zero volts with respect to one another so far as alien power surges are concerned.

At the exchange each incoming conductor is connected to ground through a carbon fuse and all the ground connections made through one common terminal.

Commercial broadcasting stations, as a general rule, use relatively crude lightning protection methods. A piece of heavy bar



A typical wayside case for railway signal equipment. The lightning arresters are in the bottom row at the left of the case. (Photo courtesy General Railway Signal Company)



Lightning arrester at the base of a commercial broadcasting tower (WADD, Brockport NY).

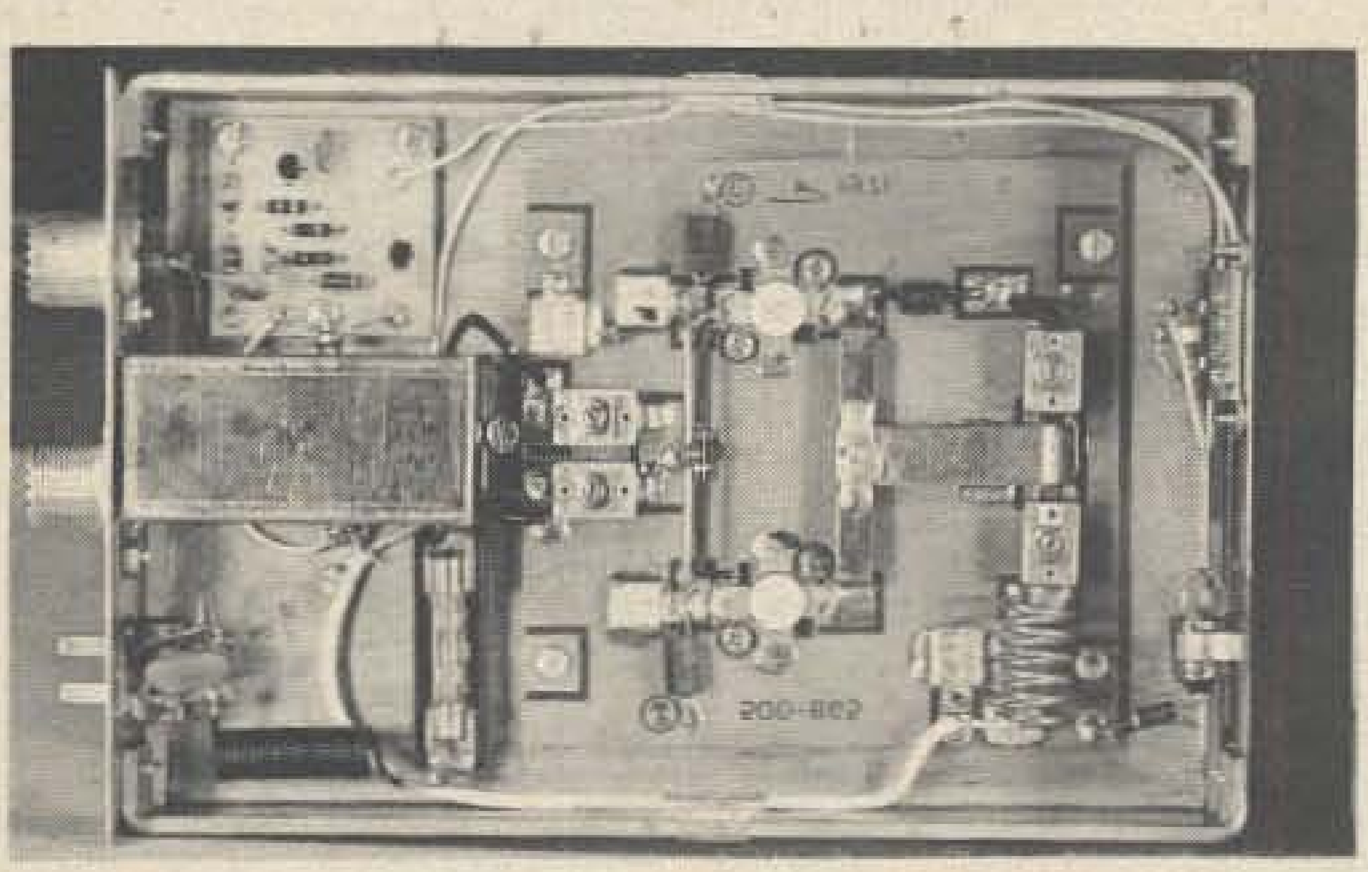
stock with a ball shape on the end is connected to the base of the tower and positioned in close proximity to a similar piece connected to the ground system. This is generally sufficient, since the transmitting equipment is quite rugged and of low impedance. About the worst that generally happens is that a breaker opens, putting the station off the air until an engineer resets it. There have been occasional colorful results however. The engineer of one local station told of a strike following the transmission line into the building and making a spectacular display as it zipped around the baseboards, finally grounding out via several electric outlets.

Lightning protection, then, depends upon many variables. Factors such as the amount of thunderstorm activity, the amount of exposed line, the equipment to be protected, etc. To even begin to describe the various techniques and the reasons for them would take a book of considerable size. Perhaps the main determining factors are the possible consequences of loss, and the economic status of the owner of the protected equipment.

. . .W2FEZ

Ed Webb W4FQM/1
Technical Editor

73 REVIEWS THE REGENCY AR-2 2-METER FM AMPLIFIER



If the growing number of manufacturers of power amplifiers for 2 meters, only two (as of this writing) are very conservatively rated on the input and output ratings of their amplifiers. One is on the west coast and the other is Regency in Indianapolis, Indiana. Regency again has followed the tradition started in the HR-2/2A transceivers of being very conservative on power ratings. They rated the HR-2 at 10 watts. It put out at least 12. They rated the HR-2A at 15 watts. It puts out almost 18.

The new AR-2 is made in a matching size and style to be a companion to the HR-2/2A transceiver. When you pick it up, you would think it was made of lead. It's hefty, yes, but not from lead: copper is the name of the heat sink material that is used. The AR-2 is literally an amplifier built on, or almost in, a huge copper heat sink. Does it get hot while transmitting? Not with PTT operation. With 10 watts input, Regency rates the amplifier at 38 watts output – ours put out 44. With 15 watts input, the AR-2 put out 58 watts, and with 17 watts inpuι to it, out came a full 67 watts. That kind of power output coupled to your 3 dB gain antenna will let you talk to the machine on the mountain just about as far as you can hear it. And would you believe that at almost 60 watts output (key down for an hour) this AR-2 barely gets above room temperature – that big heat sink really does its job. Even the collector output tank circuit is constructed of heavy silver-plated copper to better withstand the large rf circulating currents that are found in solid state amplifiers at these frequencies and power levels. The AR-2 uses 2 transistors in a Class C push-pull configuration. The transistors used are of the balanced emitter type with the new wide leads to provide low inductance lead runs. The AR-2 amplifier runs between 60 to 70% overall efficiency.

Installing the AR-2 is a oreeze. Just connect 12V tn it and plug in your antenna to the amplifier. Placing a short coax jumper between the transceiver and the amplifier completes the job. To tune the amplifier input up (to compensate for the input feedline lengths) it's best to have a Bird model 43 Thruline® or Model 4352 Ham-mate® watt meter. This is placed between the antenna lead and the AR-2. With the amplifier out of its case, key the transceiver and tune everything for maximum rf output. The amplifier switches itself in automatically when it senses watt or

Regency 2 Meter FM—American made at import prices

more at its input. If you want to run barefoot for short, direct hauls, just turn the amplifier power switch to the off position. When the amplifier power switch is in the on position, a front panel red light comes on each time the amplifier is keyed.

Maybe quadrupling your output power won't quite double your range, but with the additional power your transmit range doesn't run out before your receive range does. All those marginal areas where you were noisy into the repeater disappear and now you are full quieting. If you are out in the boondocks or hilly areas like southern New Hampshire, that extra power really does make a difference.

For more information on the AR-2 write to *Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis, Indiana 46226*. The AR-2 amplifier is priced at only $129. When you figure it out, that's only two bucks a watt output and that is cheap. Regency again has turned out a very nice unit at a modest price.

...W4FQM/1

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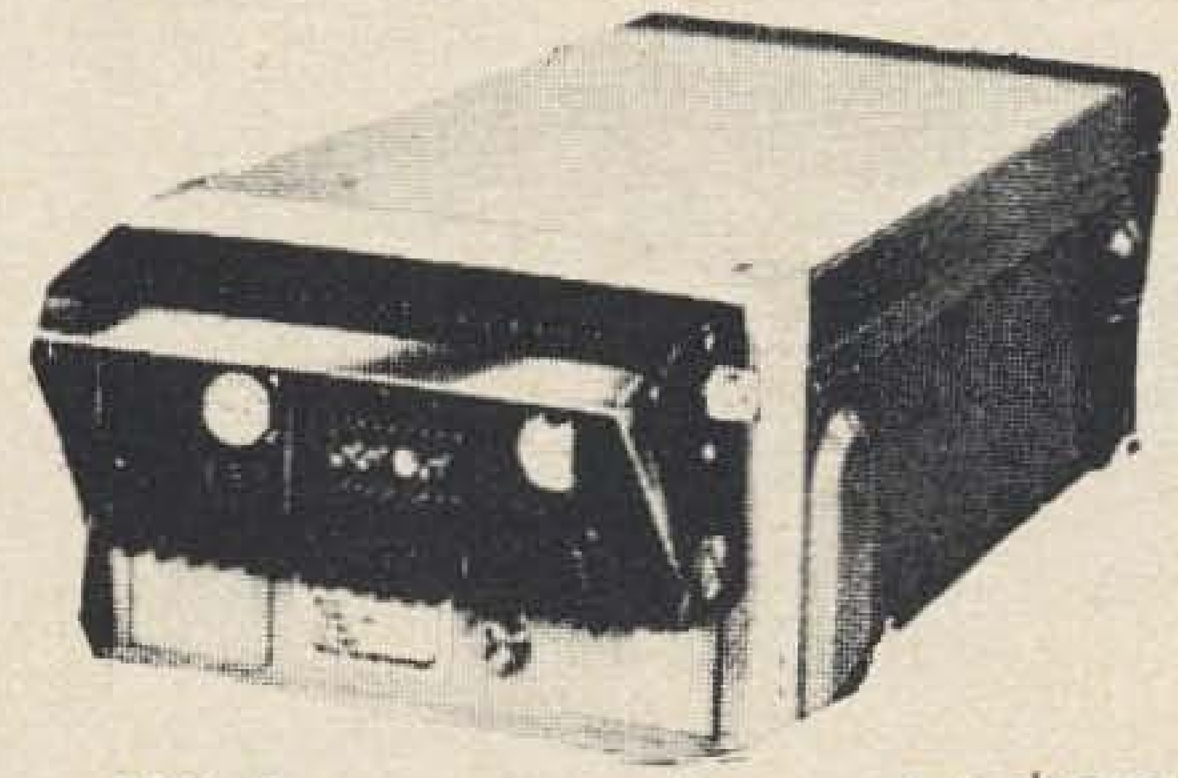

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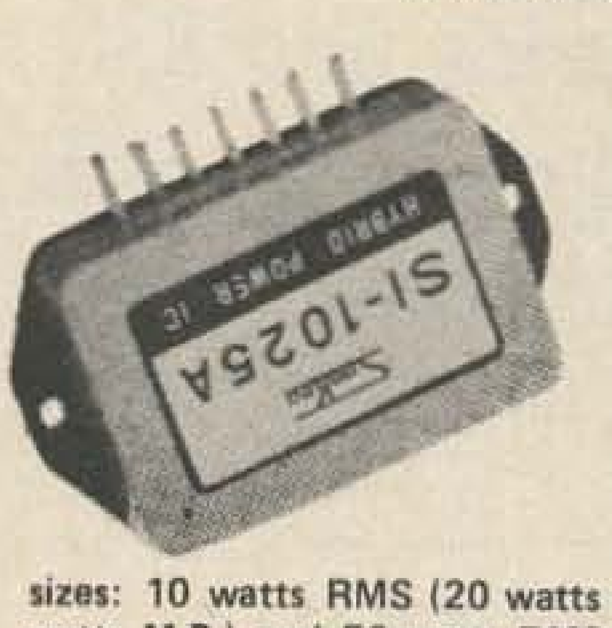

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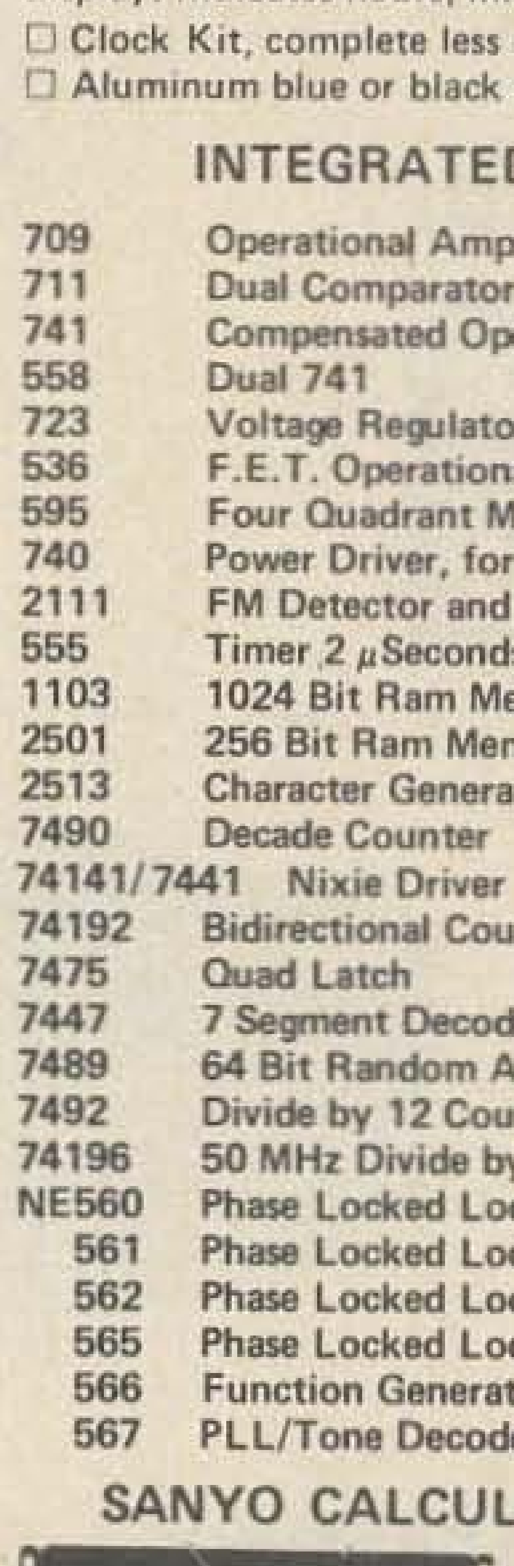

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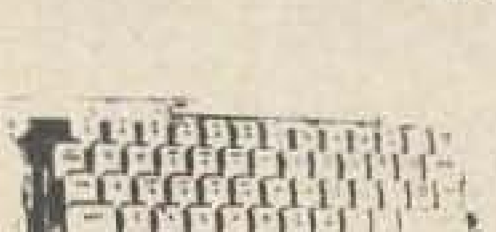

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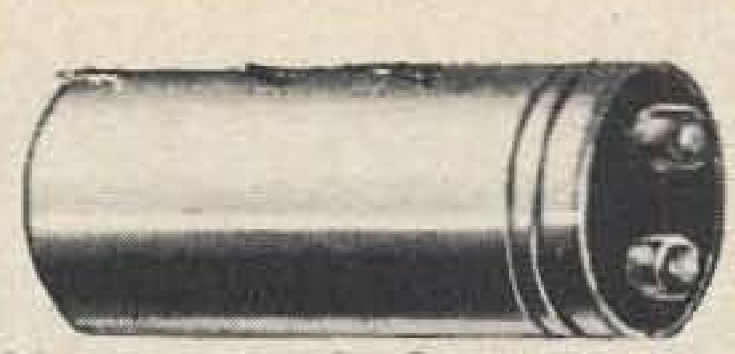

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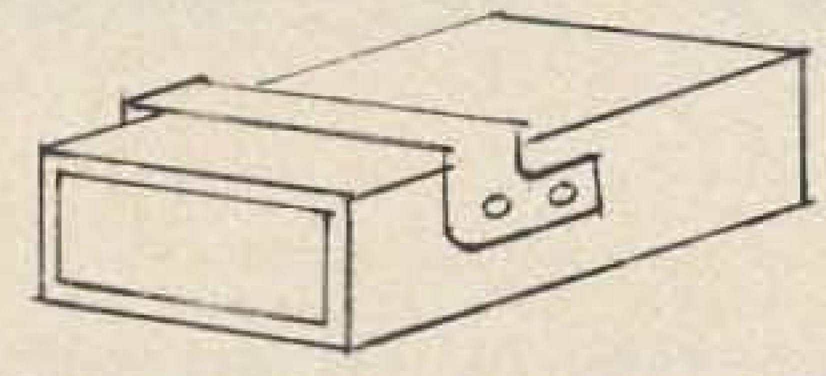

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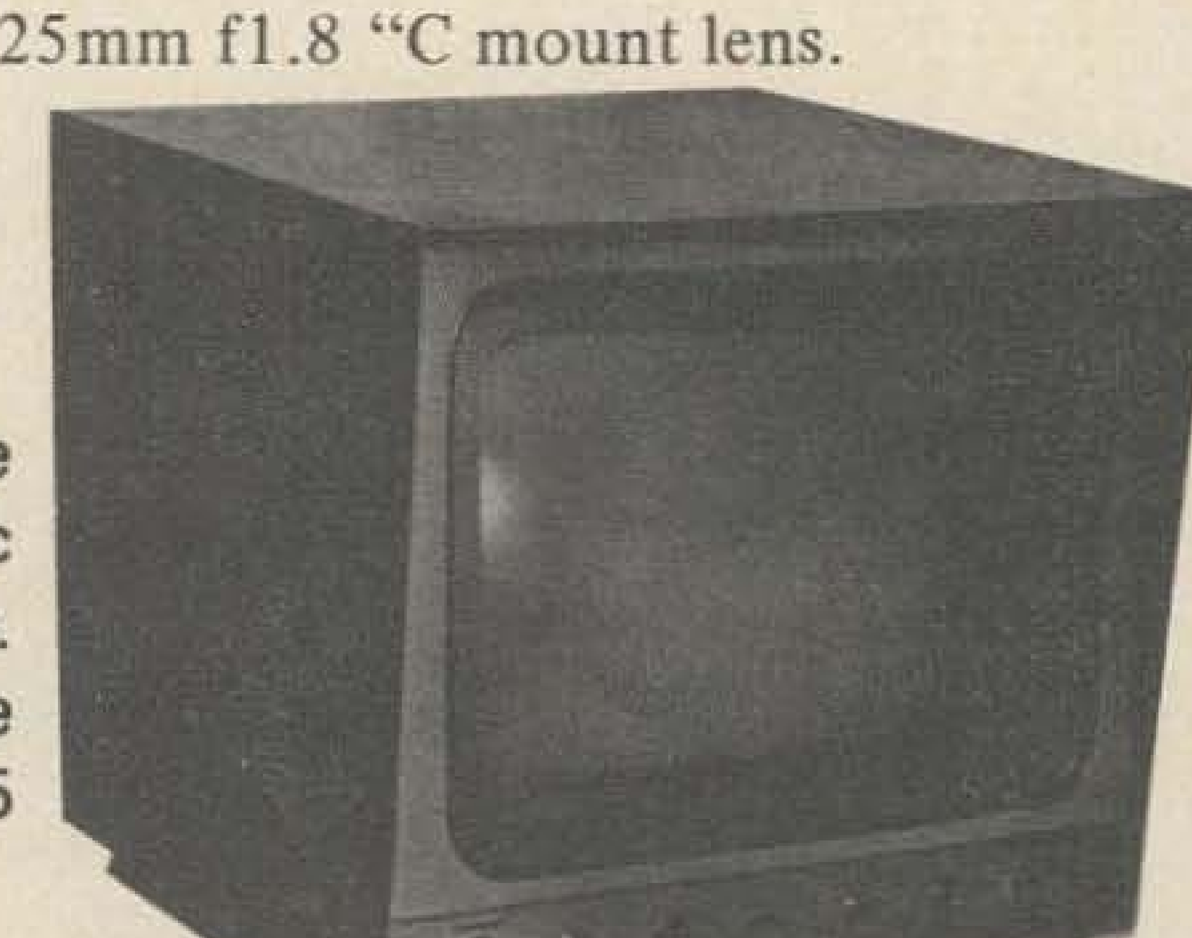

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7406	.52	.50	.47	.44	.42	.39
7407	.52	.50	.47	.44	.42	.39
7408	.32	.30	.29	.27	.26	.24
7409	.32	.30	.29	.27	.26	.24
7410	.26	.25	.23	.22	.21	.20
7411	.28	.27	.25	.24	.22	.21
7413	.58	.55	.52	.49	.46	.44
7416	.52	.50	.47	.44	.42	.39
7417	.52	.50	.47	.44	.42	.39
7420	.26	.25	.23	.22	.21	.20
7421	.26	.25	.23	.22	.21	.20
7426	.34	.32	.31	.29	.27	.26
7430	.26	.25	.23	.22	.21	.20
7437	.56	.53	.50	.48	.45	.42
7438	.56	.53	.50	.48	.45	.42
7440	.26	.25	.23	.22	.21	.20
7441	1.73	1.64	1.55	1.46	1.37	1.27
7442	1.27	1.21	1.14	1.07	1.01	.94
7443	1.27	1.21	1.14	1.07	1.01	.94
7444	1.27	1.21	1.14	1.07	1.01	.94
7445	1.71	1.62	1.53	1.44	1.35	1.26
7446	1.24	1.17	1.11	1.04	.98	.91
7447	1.16	1.10	1.04	.98	.92	.85
7448	1.44	1.37	1.29	1.22	1.14	1.06
7450	.26	.25	.23	.22	.21	.20
7451	.26	.25	.23	.22	.21	.20
7453	.26	.25	.23	.22	.21	.20
7454	.26	.25	.23	.22	.21	.20
7460	.26	.25	.23	.22	.21	.20
7470	.42	.40	.38	.36	.34	.32
7472	.38	.36	.34	.32	.30	.29
7473	.50	.48	.45	.43	.40	.38
7474	.50	.48	.45	.43	.40	.38
7475	.80	.76	.72	.68	.64	.60
7476	.56	.53	.50	.48	.45	.42
7480	.76	.72	.68	.65	.61	.57
7483	1.63	1.55	1.46	1.38	1.29	1.20
7486	.58	.55	.52	.49	.46	.44
7489	4.25	4.00	3.75	3.50	3.25	3.00
7490	.80	.76	.72	.68	.64	.60
7491	1.43	1.35	1.28	1.20	1.13	1.05
7492	.80	.76	.72	.68	.64	.60
7493	.80	.76	.72	.68	.64	.60
7494	1.18	1.12	1.05	.99	.93	.87
7495	1.18	1.12	1.05	.99	.93	.87
7496	1.18	1.12	1.05	.99	.93	.87
74100	1.52	1.44	1.36	1.28	1.20	1.12
74107	.52	.49	.47	.44	.42	.39
74121	.56	.53	.50	.48	.45	.42

Catalog Number	ANY QUANTITY PER ITEM(MIX) 1-99	100-999	1000 up	MULTIPLES OF 10 PER ITEM(MIX) 100-999	1000-9990	10000 up
74122	.70	.67	.63	.60	.56	.53
74123	1.21	1.06	1.00	.94	.89	.83
74141	1.63	1.55	1.46	1.38	1.29	1.20
74145	1.41	1.33	1.26	1.18	1.11	1.04
74150	1.63	1.55	1.46	1.38	1.29	1.20
74151	1.20	1.13	1.07	1.01	.95	.88
74153	1.63	1.55	1.46	1.38	1.29	1.20
74154	2.43	2.30	2.16	2.03	1.89	1.08
74155	1.46	1.39	1.31	1.23	1.16	1.08
74156	1.46	1.39	1.31	1.23	1.16	1.08
74157	1.56	1.48	1.39	1.31	1.23	1.15
74158	1.56	1.48	1.39	1.31	1.23	1.15
74160	1.89	1.79	1.68	1.58	1.47	1.37
74161	1.89	1.79	1.68	1.58	1.47	1.37
74162	1.89	1.79	1.68	1.58	1.47	1.37
74163	1.89	1.79	1.68	1.58	1.47	1.37
74180	1.20	1.13	1.07	1.01	.95	.88
74181	5.20	4.90	4.59	4.28	3.98	3.67
74182	1.20	1.13	1.07	1.01	.95	.88
74192	1.98	1.87	1.76	1.65	1.54	1.43
74193	1.98	1.87	1.76	1.65	1.54	1.43
74198	2.81	2.65	2.50	2.34	2.18	2.03
74199	2.81	2.65	2.50	2.34	2.18	2.03
NE501	2.99	2.82	2.66	2.49	2.32	2.16
NE531	3.81	3.58	3.36	3.14	2.91	2.69
NE533	3.81	3.58	3.36	3.14	2.91	2.69
NE536	7.31	6.88	6.45	6.02	5.59	5.16
NE540	2.16	2.04	1.92	1.80	1.68	1.56
NE550	1.24	1.17	1.11	1.04	.98	.91
NE560	3.57	3.36	3.15	2.94	2.73	2.52
NE561	3.57	3.36	3.15	2.94	2.73	2.52
NE562	3.57	3.36	3.15	2.94	2.73	2.52
NE565	3.57	3.36	3.15	2.94	2.73	2.52
NE566	3.57	3.36	3.15	2.94	2.73	2.52
NE567	3.57	3.36	3.15	2.94	2.73	2.52
N5111	.90	.86	.81	.77	.72	.68
N5556	1.87	1.77	1.66	1.56	1.46	1.35
N5558	.80	.76	.72	.68	.64	.60
N5595	3.40	3.20	3.00	2.80	2.60	2.40
N5596	1.87	1.77	1.66	1.56	1.46	1.35
709	.42	.40	.38	.36	.34	.32
710	.42	.40	.38	.36	.34	.32
711	.44	.42	.40	.37	.35	.33
723	1.00	.95	.90	.85	.80	.75
741	.44	.42	.40	.37	.35	.33
748	.48	.46	.43	.41	.38	.36
1N270	.15	.14	.13	.12	.11	.10
1N751A	.30	.28	.26	.24	.22	.20
1N914	.10	.09	.08	.07	.06	.05
1N4002	.15	.14	.13	.12	.11	.10
1N4154	.15	.14	.13	.12	.11	.10
2N3860	.25	.23	.21	.19	.17	.15

All IC's are supplied in 8-, 14-, 16-, or 24-pin DIP (Dual-in-Line) plastic package, except for NE536, NE537, NE540, and SE540 which come in TO-5 package.
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LED 7-SEGMENT DISPLAY

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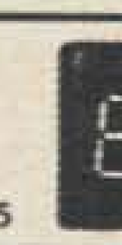
Large ¼" 7-segment LED readout similar to the popular MAN-1 but with improved brightness. Has left-hand decimal point. Fits in a DIP socket. Expected life: Over 100 Yrs. Regularly $12.95 in single lots. These are BRAND NEW with full data sheet and 4-page MULTIPLEXING Application Note. Needs a 7447 for driver and ONE CURRENT-LIMITING RESISTOR PER SEGMENT. We can supply you with one or ten thousand FROM STOCK. Also available, ±1 OVERFLOW digit at the same prices. Mixing of Regular & Overflow digit allowed.

Package of 8, 47Ω , ¼W limiting R's.....30¢

Incandescent Type of 7-segment display. With right-hand decimal point. Rated 8mA per segment at TTL supply of 5V. Design life of 50,000 hours. Needs a 7447 as a driver. In DIP Package. Each $3.25



MOLEX IC SOCKET PINS: Use these economical pins instead of soldering your IC's to PC boards. Sold in continuous strips in multiples of 100 pins only.

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ALLEN-BRADLEY MIL-GRADE (5-BAND) RESISTORS. Any of the 84 STANDARD 10% values from 2.7Ω to 22MΩ. ¼ or ½ WATT. EACH.................5¢

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1.0 µF, 3V.......25¢ 2.2 µF, 3V.......30¢
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0.47µF, 3V.......25¢ 0.01µF, 16V......10¢

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All values are available in both, axial or upright (PC Board) mount. PLEASE INDICATE YOUR CHOICE.
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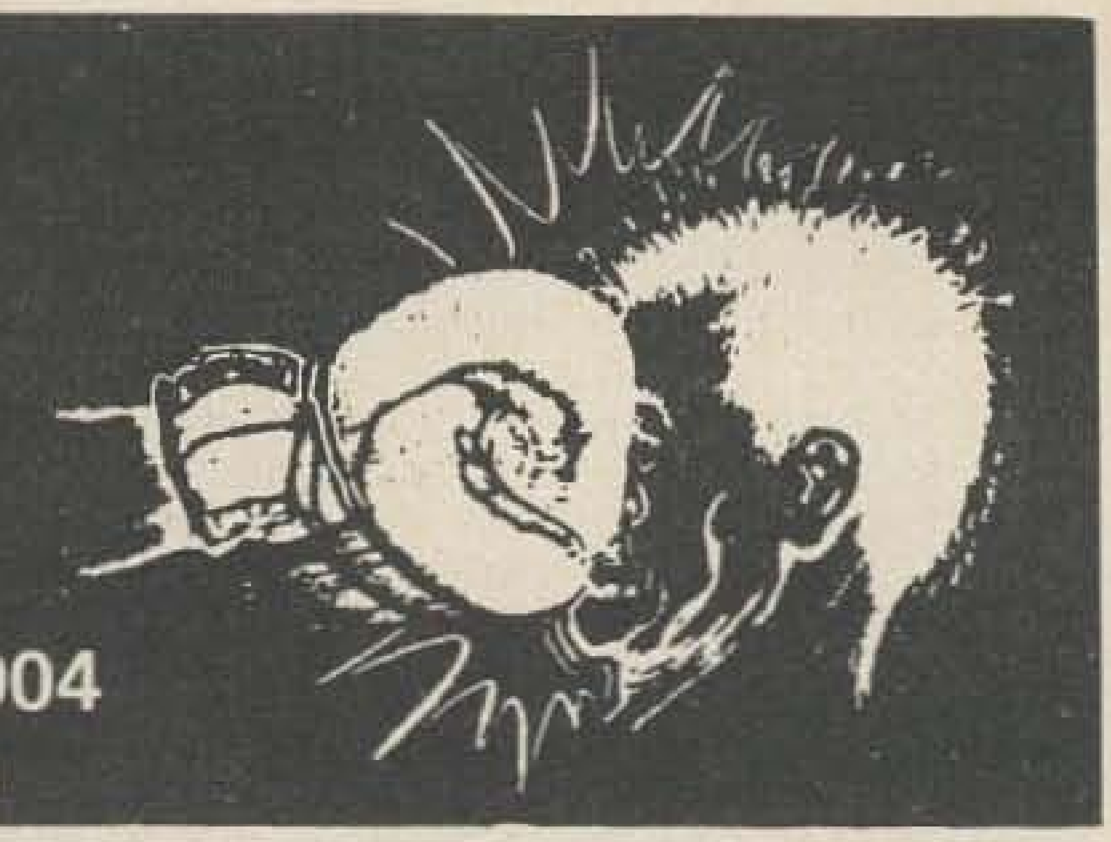

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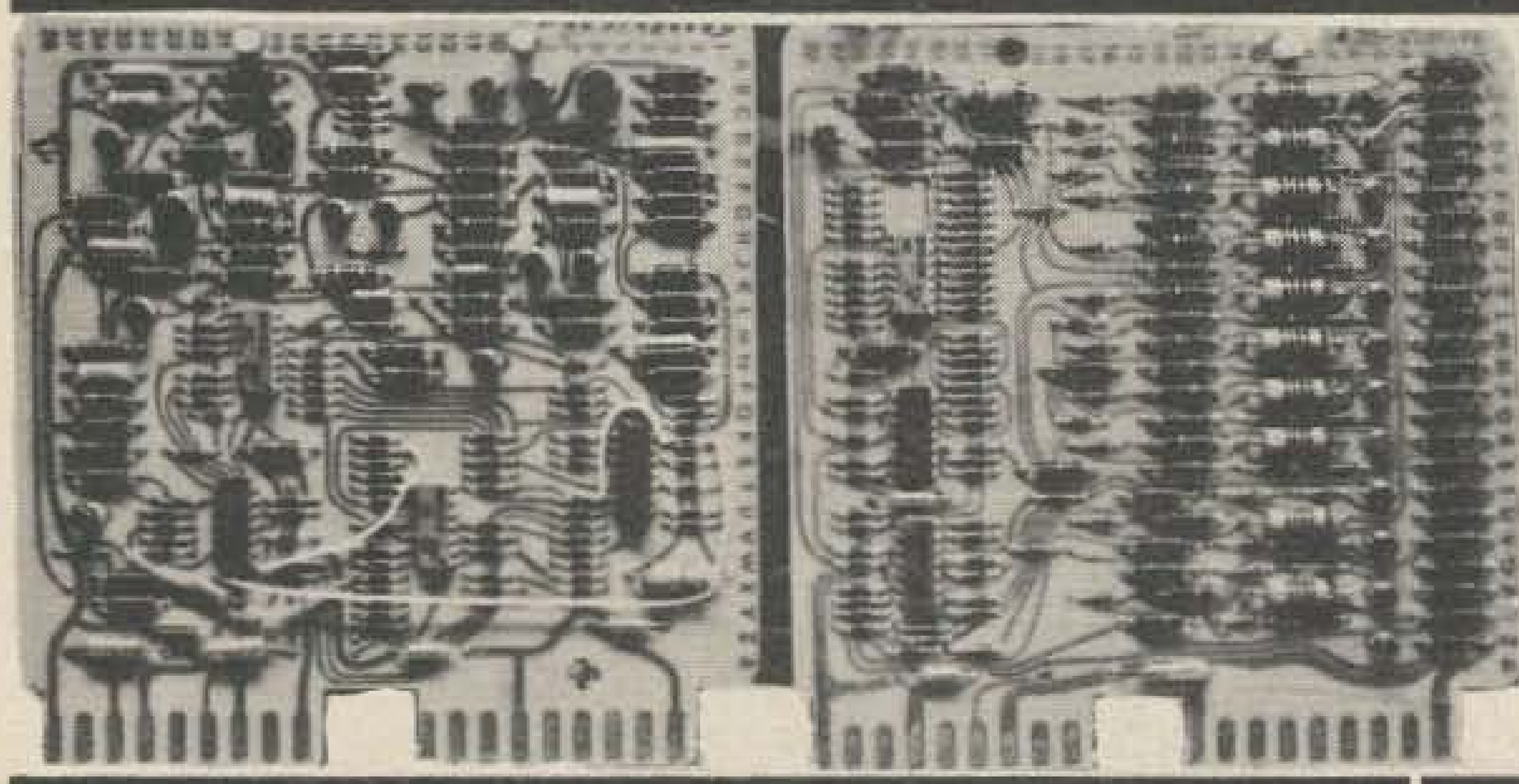

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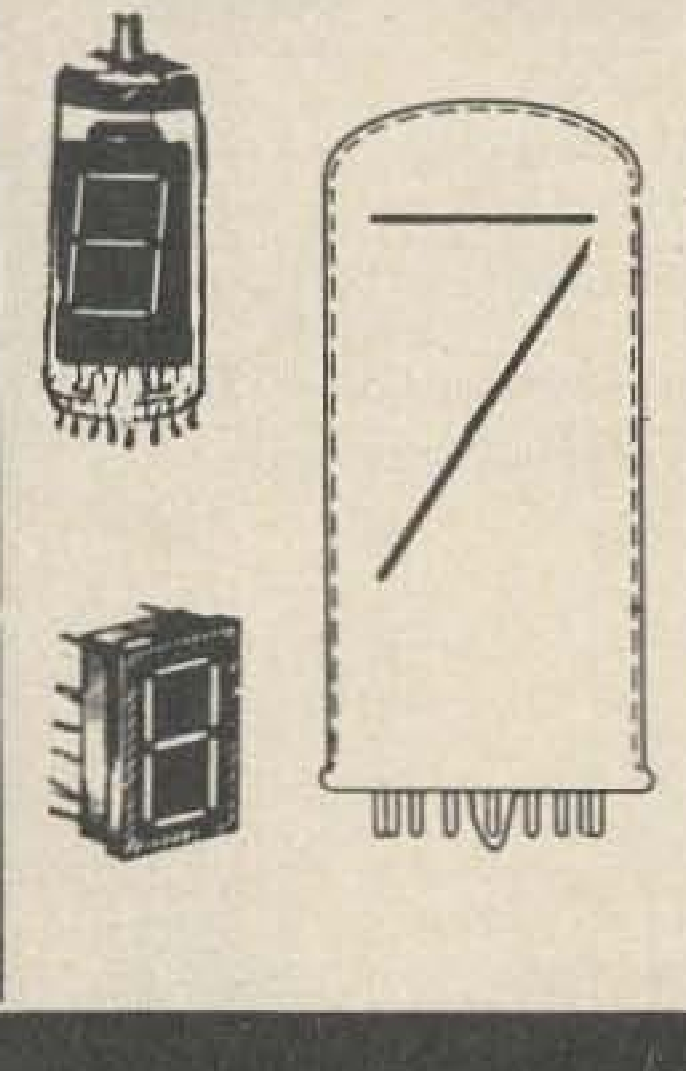

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GE Y1938 24V Standard
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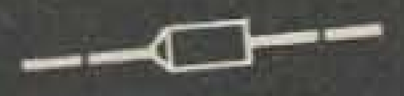
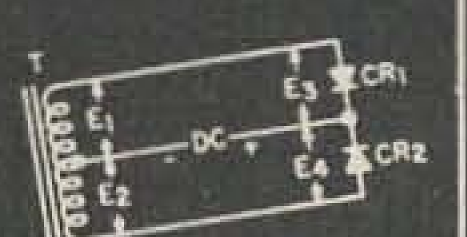
Transistors, brand new, factory marked.

	V	MW	Fr	Type	Use	Price
2N706	25	1W	400	N-S	Sw	4/1.00
2N1517	16	83	70	P-G	VHF	4/1.00
2N1711	50	3W	70	N-S	Pwr	3/1.00
2N2152	45	170W		P-G	Pwr	1.00
2N2218A	40	3W	250	N-S	Sw	3/1.00
2N2222	60	500	250	N-S	Sw	6/1.00
2N2369A	40	1.2W	500	N-S	Sw	3/1.00
2N2907A	60	1.8W	125	P-S	Sw	3/1.00
2N3013	15	1.2W	350	N-S	Sw	3/1.00
2N3055	70	115W		N-S	Pwr	1.50
2N3663	30	200	700	S-N	Amp	50¢
MJ2250	80	20W		N-S	Pwr	75¢
MJ2254	80	25W		P-S	Pwr	75¢
2N5194	60	40W		P-S	Amp	50¢
TN-53	75	800	100	N-S		4/1.00



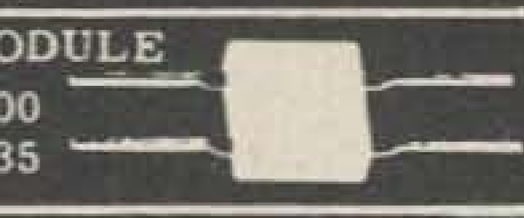
SILCON DIODE SPECIALS



1 Amp	1000piv	8/1.00	100/10.00
2 Amp	1000 piv	6/1.00	100/14.00
2 Amp	1200 piv	4/1.00	100/20.00
1 Amp	2000 piv	1.00	
1 Amp	3000 piv	1.25	

FULL WAVE BRIDGE MODULE

2 Amp	400 PIV	1.00
3 Amp	1200 piv	1.35



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- TS-35A X-band radar Test Set. 115 v. 60 Hz $35.00
- Bruel & Kjaer 1506 Comparison Bridge $75.00
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- Rutherford B-2A Pulse Generator $70.00
- Chadwick-Helmuth 102 "Slip-Sync" Frequency Modifier $50.00
- Krohn-Hite UF-101A Low-Distortion Power Amplifier. 20-20K Hz $90.00
- A.R.C. H-10 K-band test set, 23.5–24.5 GHz $50.00
- Digitec ZD-210A Digital Voltmeter. 0–1, 10, 100, 1000 volts DC $95.00
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- HICKOK 288-X FM-AM Signal Gen. $75.00
- H-P 526-C Phase angle plug-in for 524 counters. $100.00
- Northeastern Engineering 14–22C 100–220 Mc plug-in for H-P 524 counter $80.00
- H-P 400-C AC VTVM $30.00
- Ballantine 300 AC VTVM $30.00

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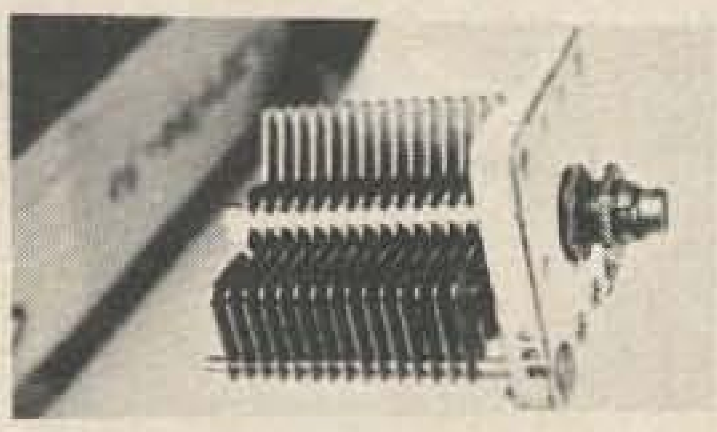
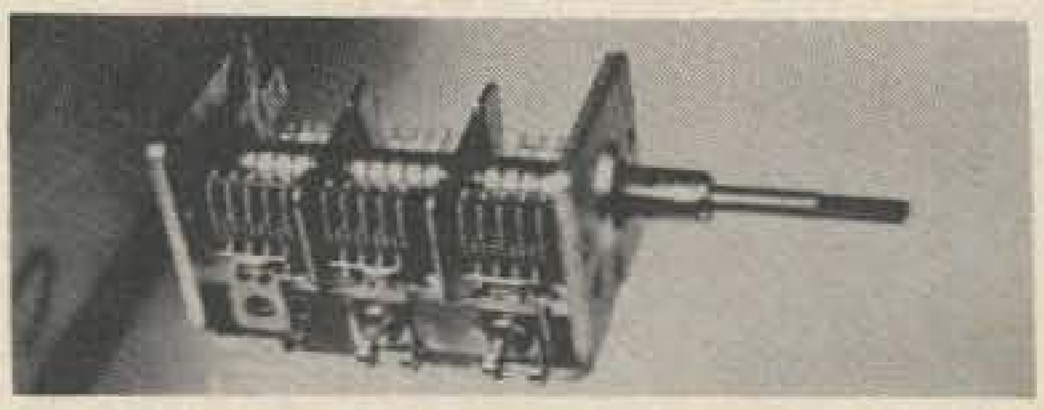
- DRAKE SPR-4 Receiver with Ham-band, Time-&-Freq. CB Xtal kits, calibrator. In absolutely like new condition $425.00
- DRAKE CPS-1 Power Supply for VHF converters. New $15.00
- OLSON "6" Six-meter Transceiver ... $55.00
- UTICA 650-A Six-meter Transceiver with VFO $75.00

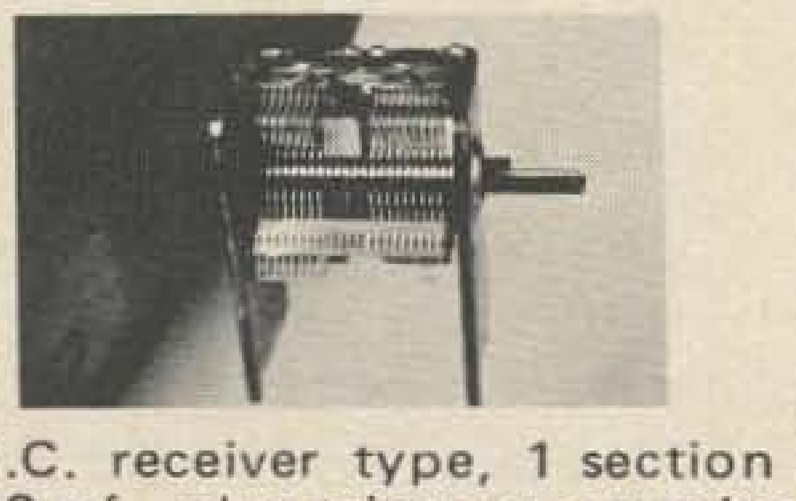
VARIABLE CAPACITORS



170 pf. max., 1000 vdc. spacing. 1 3/4" sq. x 2 5/8" long. 60¢ each, ... 2 for $1.00



3-section, 20 pf. per section, with vernier drive shaft; 1/8" d. inner shaft, ¼" d. outer shaft. 1 1/8" h. x 1¼" w. x 3 3/8" l. overall. 60¢ each 2 for $1.00



2-section, B.C. receiver type, 1 section 100 pf., 1 section 150 pf., plus trimmer capacitors on each section. 1 3/8" h. x 2¼" w. x 2½" l. overall. 60¢ each .... 2 for $1.00

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[25]	26	27	28	29	30	

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MEXICO	14	14	14	7	7	7	7	7A	7A	14	14	14
PHILIPPINES	14	14	7B	7B	7B	7B	7	7	7	7	14	14
PUERTO RICO	14	7A	7	7	7	7	7	7A	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	14	14	14	14	14	7A	7B
U. S. S. R.	7A	7	7	7	7	7	14	14	14	14	14	14
WEST COAST	14	14	7A	7	7	7	7	7A	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7	7A	14	14	14
ARGENTINA	14	14	14	7A	7	7	7A	14	14	14	14A	14A
AUSTRALIA	14	14	14	7A	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	14	7A	7	7	7A	14	14	14	21	21
ENGLAND	14	14	7A	7	7	7	7	7A	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7	14	14	14	14
INDIA	14	7A	7B	7B	7B	7B	7B	7A	14	14	14	14
JAPAN	14	14	14	7A	7	7	7	7	7	7A	14	14
MEXICO	14	14	7	7	7	7	7	7	7	7A	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	14	14
PUERTO RICO	14	14	14	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	7B	14	14	14	14	7B	7B
U. S. S. R.	7A	7	7	7	7	7	7	7	14	14	14	7A

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	7	7	7	7	14
ARGENTINA	14A	14	14	14	7	7	7	14	14	14	14A	14A
AUSTRALIA	21	21	21	14	14	7	7	7	7	7	14	14
CANAL ZONE	14A	14	14	7A	7	7	7	14	14	14	14	14A
ENGLAND	14	14	7A	7	7	7	7	7A	14	14	14	14
HAWAII	14A	21	21	14	14	14	7	7	14	14	14	14
INDIA	14	14	14	7A	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	7	14	14	14
MEXICO	14	14	7A	7	7	7	7	7A	7A	14	14	14
PHILIPPINES	14	14	14	14	14	7B	7	7	7	7A	14	14
PUERTO RICO	14	14	14	7	7	7	7	7A	14	14	14	14
SOUTH AFRICA	7B	7	7	7	7B	7B	7B	14	14	14	7B	7B
U. S. S. R.	7A	7	7	7	7	7	7	7A	14	14	7A	7A
EAST COAST	14	14	7A	7	7	7	7	7A	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

Why won't Don Wallace listen to anyone else?

W6AM doesn't have to, since he began using our professional quality VHF-FM 2 meter transceiver with exclusive *Astropoint*. The precise and powerful Astropoint system actually blocks out all interference. So when one of the nation's number one hams is having a 2-way conversation he won't have unwanted interference.

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Which is why Don Wallace hasn't been listening to anyone else lately. Not that he's choosy about who he listens to. Just whose equipment he listens on.

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