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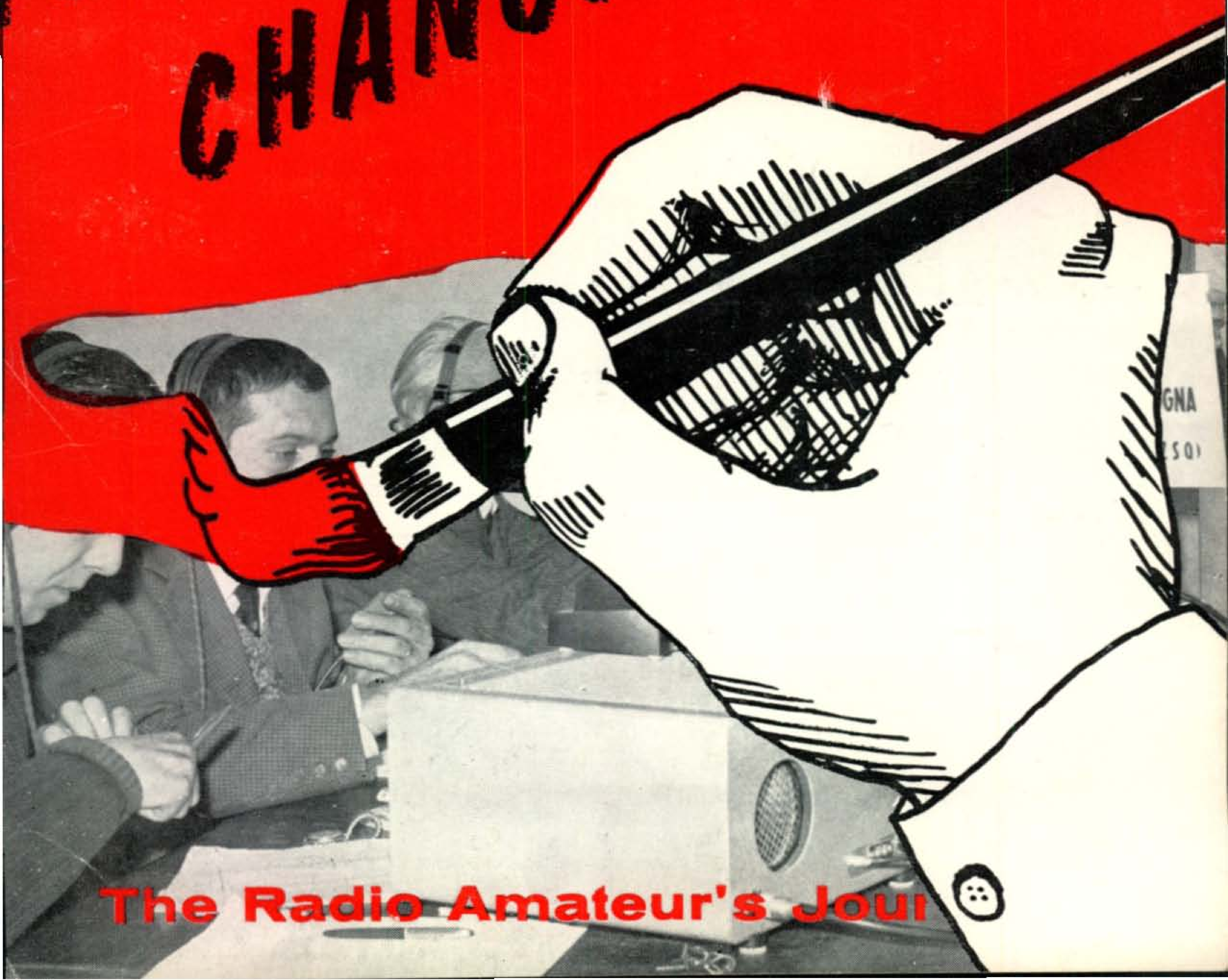

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For further information, check number 2, on page 108

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JULY 1966 VOL. 22, No. 7

CQ

The Radio Amateur's Journal

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DEPARTMENTS

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For further information, check number 4, on page 108

ZERO BIAS

ONE of our favorite subjects for noon-time "bull-sessions" here at *CQ* is "Why have newcomers ceased to flock to amateur radio as they once did?" Well, we've tossed the question around quite a bit recently, and we've come to one major conclusion: A vast proportion of prospective amateurs have become active on the Citizen's Band, and have, (at least temporarily), shelved their ham-license aspirations. Why? Beacuse it's easy to get on the air with CB and considerably more difficult to become an amateur. A recent survey in one of the major CB magazines produced an interesting statistic: some 51% of the CBers polled indicated a strong desire to become amateurs, while an additional 7½% were already licensed. Of course the CBers questioned represented only a small percentage of the total number licensed, so figures can't be projected to show "total prospective amateurs" without some correction.

Readers of *S9*, (the magazine polled), represent a large part of the "hobbyist" element in CB, so let's be generous and allow that one-third of the total number of CBers have let their licenses become inactive, and another one-third are engaged in legitimate "business and personal" communications—not ham-style ragchewing. The remaining one-third—in the neighborhood of 250,000 people—are active in hobby-type operation on the Citizen's Band! *This* is the group which is directly represented by the survey in *S-9 Magazine*. Let's then project their survey statistics to give some actual numbers: 51% of 250,000 is over 125,000 prospective amateurs! Also, some 18,000 CBers seem to be amateurs already.

Taking only half of that 125,000 figure would indicate that amateur radio in the US is due for a whopping increase in its numbers before long. When? Well, it couldn't be too far away, could it? Or *could* it? Haven't there been some 500,000 or more CBers for several years now? There is no reason to believe that more CBers harbor amateur radio aspirations now than four years ago, so we can estimate that as long ago as 1962, nearly 100,000 CBers would have liked to become amateurs—*but didn't*!

Another interesting point: The readers of *S9* have continually been warned *against* hobby-type operation, (illegal on CB), with repeated emphasis of the strong possibility of losing their licenses, being fined, or even imprisoned! And yet the desire to emulate amateurs is so strong that they disregard all warnings and persist in amateur-style operation!

Ah, now the picture clears. Looking deeper into the thinking of those 100,000-plus prospective amateurs, we now realize that even though they admire and aspire to amateur radio; even though they recognize the legal limitations of CB as a hobby; even though they yearn for the freedom and versatility of an amateur license, they just *haven't become hams*!

Let's digress for a moment to quiet the shouts of those readers who, in their smug, self-satisfied way, sneer and say "Humph! CBers? Who needs them? They're nothing but a bunch of clods and lids who aren't worth having anyway!" Wrong, very wrong. You might be justified in feeling that way about the 49% of the hobbyist-CBers who *don't* wish to become amateurs, but remember that even *without* CB, *many* of these 125,000 would have seriously entertained the idea of becoming amateurs *just as you once did*. Because a fellow has taken a shortcut to getting on the air doesn't mean that he wouldn't be a useful addition to the amateur cult, if he could be enticed into it, and away from CB.

Getting back to those 100,000 fellows, though, let's investigate *why* they haven't become amateurs. It couldn't be for economy reasons, because the same survey shows an average dollar outlay of $563 for each reader polled. It couldn't be for lack of interest either, obviously. The only reasons the vast majority of amateur-inclined CBers have for *not* becoming amateurs is the difficulty of learning the code, and, to a lesser degree, the difficulty of the written exam.

Now the big question: Do we want to do anything about enticing some of those 100,000-plus CBers to become amateurs? The answer most hams would give is a firm "No!" I disagree, to some extent, and I hope you'll bear with me while I try to explain.

I earnestly believe that amateur radio is very wrongly closing the door to a very large group of potential amateurs simply because they hold CB licenses. Let me pose a hypothetical question: If in 1950 100,000 citizens had openly and sincerely shown a desire to become radio amateurs, would they have been encouraged or discouraged? Without a doubt, they would have been encouraged, and what's more, they would have been taken by the hand by 100,000 hams, and led into this wonderful hobby in the fastest, easiest, and most respectable way. It actually happened. Something called the Novice license was inaugurated!

The number of amateurs who have ever gone out of their way to *dis*courage a "prospect" is so small as to be insignificant. We just don't think that way—unless the prospect is also a CBer, in which case he's treated as though he had an extra eye in the middle of his forehead! And all along I thought hams were pretty bright fellows!

Have I done anything to convince you that we should do as much as is humanly possible to encourage some CBers to start on the road to true amateur radio? If so, I'll pick up next month with some thoughts about *how* this big enticement" campaign should shape up. If not, give me the opportunity to convince you in a personal letter.

73, Dick, K2MGA

OUR READERS SAY

The Conical Monopole

Editor, *CQ:*

In my little blurb, "The Conical Monopole," *CQ*, Jan. '66, which you so kindly purchased and printed, I must not have made it crystal clear to our fine readers that it is an *entirely* new antenna concept. To the best of my knowledge it has never before been expounded upon, either in antenna manuals or in engineering handbooks. It is of little or no kin to the contrivance related to in a letter you received, and subsequently relayed to me (via Xerox copy) from one MSgt Donald L. Hutchin, 58th ARRS, Box 2143, AP 09231, N.Y. His letter relayed some good information concerning a type of vertical that vaguely resembles the Conical, in appearance only, I might add.

The Conical has a uniform radiation take-off angle of 35° over its entire frequency range and a radiation lobe of less than 15° between half-power points, which makes it a "low angle signal-squirter," and consequently higher in gain than a dipole. The antenna the Sgt. referred to is merely a pole-supported broad-banded "loop." I think if he were to check closely he would find his wire loop will not work too well between the harmonically related points of frequency coverage. The conical is uniform over its entire range, and works well above and below design frequencies, but the take-off angle rises to unsatisfactory angles. The impedance of the conical is determined by the relationship of the lower wire to the Peripheral radiator, the pole distance "D" and the crossarm distance "W". The type of ground, be it a slant roof or a drooping guy has no bearing of any real consequence on the feed point impedance. I have erected hundreds of these Conicals in every conceivable place in the world and they work, anywhere, anytime, all the time. The conical is only as dangerous as a tree. I have climbed up them with over 2 kw of rf on them. The voltage points are well out of reach and the current points are broadly scattered around its base. You have a devil of a time getting a bite, even at 2 kw.

I've received (and answered) a veritable flood of mail. Each day brings at least 3 or 4 letters; the record was 21. However, only 30% sent a s.a.s.e. (What became of our once proud ham manners). I might add, concerning the Conical, the "natural" impedance is near 70 ohms. Fifty ohm coax works, but gives funny reactions to certain small segments of its range. Most rigs will load 70 ohm coax, so I advise it's use. The ring that the coax center ties to is not critical, only 6" to 1 foot off of the ground and few inches away from the base of the antenna. Also, the finished product should look much like the picture on p. 59, *not* the sketch on p. 60. Best of luck on the Conical. It isn't critical or fussy and can be built out of anything, anywhere and gives excellent results at all times.

Loren Stroup, W5WEV/4
Smyrna, Tenn.

DX and DXpeditions

Editor, *CQ:*

It was with much interest that I read and re-read the letter from Norman A. S. Fitch, G3FPK/3AØBT, that appeared in the letters column of April 1966 issue of *CQ*. Your January Editorial started the ball rolling on the DXpedition controversy and letters such as the one from G3FPK and this one should keep it going for some time to come.

> "OUR READERS SAY" welcomes letters about nearly anything of interest to amateurs, whether about *CQ* itself, the state of the hobby, or whatever else you have on your mind. The most interesting letters will be selected for publication each month; just keep them legible, keep them short, and above all, keep them clean! Something bothering you. We're not mind readers, OM, so drop us a line.

The subject of DX is, in itself, controversial. Some hams would have no part of it, some can take it or leave it alone, and some can't live without it. On the whole, avid DX'ers are among the most enthusiastic hams in the world. They keep themselves informed about the latest happenings in the DX world through bulletins, letters, on-the-air QSO's, and telephone calls. Those who keep up successfully and land a lion's share of the good DX eventually end up on the DXCC Honor Roll. Those who can't cut the mustard are known as also-rans. If the DXCC program is viewed as a type of race with the front-runners fighting to keep ahead and the others trying to catch up, a lot of the controversy can come to an end. Most of the griping is done by those who just don't understand what's happening.

First, and foremost, I am a DX'er. I don't mind spending prodigious amounts of time in a pile-up if I can get a "new one" out of it. I am still far off the 280-country mark, however. I am one of the also-rans in the race for the Honor Roll, but I haven't given up hope by any means. Almost every DXpedition that hits the air helps me move up another notch. I am in favor of more and better DXpeditions even if I miss one now and then.

Keeping this in mind, I must take exception to G3FPK's statement: "Surely this (DXpedition) money could have been spent better in buying a native amateur in a rare country some reliable equipment so that his country would be regularly on the air over a long period." I wish I had a dollar for all the times I have read something like the following in a DX column, bulletin, etc.: "ZZØZZ on Xanadu Island shows up now and then, but a pileup scares him off and he goes QRT in five or so minutes." Should we have to put up with this kind of stuff when Don Miller, W9WNV, or Gus, W4BPD, etc. can work upwards of 100 stations per hour and several thousand in 72 hours? Having a native in each of the DXCC list countries, regularly active, is an ideal situation, Mr. Fitch, but it is a far cry from reality. Look over the DXCC list sometime; roughly 30% of the countries listed aren't inhabited. Therefore, there aren't any natives to send gear to for the purpose of regular operation. By the same token, how many people go to the Spratly Islands on vacation? Heard, Navassa, and other uninhabited chunks of rock could be placed in the category. Without *voluntary* contributions from *interested* DX'ers, these spots would remain blanks on the lists of the majority. The ARRL DXCC Committee sets the criteria for what shall and what shall not be a "new country." If a chunk of uninhabited rock happens to fit the guide, then it is up to some interested ham or group of hams to get the activity up. If weather or other uncontrollable factor limits activity to only twelve or 24 hours, that's life. I, for one, would rather miss a "new one" now and then than risk a repetition of the K7LMU/ZL2AWJ tragedy.

Furthermore, an operator on a DXpedition has the unique privilege of having the world at his feet, DX wise. He can work whomsoever he pleases. If another chap asked him to listen for his buddy, it's his option to do just that or go on through the pile-up. Contributions could enter the picture at this point. No DXpeditioner is going to ignore the very people who helped him get where he is. Again, it is the operator's choice as to who gets worked and who doesn't. Now and then, some are going to get told to "shut up" by others. 99% of the time it will be because they are not following the pattern of the pile-up. If a DXpeditioner is listening up from his transmitter frequency by five kc, it will do more harm than good to call him on his transmitter frequency. All one can accomplish by that move is to make it impossible for others to copy. One deserves to be told off if he makes that sort of blunder.

I want to go on record now as stating that DXpeditions can benefit all DX'ers and not just those at 280 countries or better. I just hit 262-worked thanks to Don Miller at Suvarov Atoll as W9WNV/ZKIS. I know he stayed more than 24 hours at that spot. If he was out to help only

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OUR READERS SAY (Continued)

those at 280 countries or more, he could have left after only 3 or 4 hours. He averaged better than sixty QSO's per hour, sometimes working as many as six stations at one time. If this type of operating is not attempting to give as many stations as possible a "new one," than I don't know what is. I, for one, appreciate what a fellow ham is doing for me and my DXCC total and I will continue to back him up in every way possible. That applies to *all* DXpeditions, whether I work them or not. They are out there giving it all they've got; not sitting in a comfortable shack griping about all the rare spots that haven't been activated. There are the talkers and the doers. I'll put my money on the line for a doer any day of the week.

A1C Tracy Levy, Jr., W4FRO
Patrick AFB, Florida

H. F. Broadcasting

Dear Sir:

Captain Paul H. Lee's (W3JHR) long and detailed defence of h.f. broadcasting is most interesting. But are there not several fallacies in the argument?

Firstly, he writes as though the amateurs had a monopoly of all the h.f. frequencies and were grudging giving space to h.f. broadcasting. In fact, from 1 to 27 mc the exclusive amateur bands represent in Europe only 900 kc (1100 kc in USA, I believe).

The 80-meter band is not exclusively amateur. It is a shared band. 40-meters in Europe is only 100 kc wide —7.0 to 7.1 mc (300 kc in USA—7.0 to 7.3). 20-meters is 350 kc wide and 15-meters is 450 kc wide. Total 900 kc in Europe (1100 kc in USA). I have omitted the 10-meter band which is not normally open for sky wave propagation at present, and ground wave is fairly short range, about 20 to 30 miles. So we hardly monopolize the frequencies; 900 kc (1100 kc USA) in 26,000 kc!

Secondly, and far more important, Captain Lee argues that with fewer centres of population and a scattered population, h.f. broadcasting is necessary for many countries to reach their own population. But as every amateur knows, on frequencies above, say, 10 or 12 mc the skip is normally fairly long and therefore, (except under sporadic-*E* conditions or other unreliable phenomena) are quite unsuitable for distances under 1000 miles. It would seem, therefore, that on this basis only the 40-meter amateur band comes into question for broadcasting within most countries' own territory, and this has already been reduced to 100 kc in Europe. Does the world grudge the amateur service a paltry 100 kc (300 kc in USA) between 4 and 12 mc, i.e. 100 kc in 8,000 kc!!! Come, really, Captain Lee.

As regards the 20 and 15-meter bands the skip as we know is normally fairly long and the government broadcasting stations' interest in this range indicates a desire to transmit not so much to their *own* people as to the people of *other* countries. This, to anyone who listens to these broadcasts proves to be the case. A large number of these broadcasts are not even in the language of the country of the transmitter, but are *aimed* at foreign countries

Captain Lee refers to the competition between basic ideologies. Here is the purpose of their h.f. Broadcasts. They consist largely of political propaganda *aimed* by one country *against* the other. They are a weapon in the ideological war. To refer to them carrying the truth to their people is a euphemism. They would better be described as weapons of political propaganda used by nation against nation. Otherwise owing to skip conditions the broadcasting authorities would not be so interested in the h.f. frequencies.

A truly dispassionate consideration of these h.f. broadcasts must show that the prime object is to propagand to *other people*, not to give coverage in the broadcaster's own country.

Lastly Captain Lee cites the Communication Act of 1934 which specifies the suspension of licenses for whose who "willfully or maliciously interfere with any radio communications," which is presumably based on international agreements.

Has Captain Lee never heard the official jamming stations? Here, surely, is willful interference. (I admit when I hear a jammer in the amateur bands I am always interested to know what the jammer is jamming. I don't believe governments bother to jam amateur transmissions. Therefore, it seems to me that they are jamming an illegal broadcast by another government in the amateur band, and this has confirmed my suspicions. I can, therefore, draw my own conclusions as to who pirated the exclusive amateur band first.)

Captain Lee wants to clean up the amateur operation. He apparently does not care about cleaning up the professional operation with official broadcast stations illegally operating on the exclusive amateur bands, and I have logged harmonics and other spurious radiations of official broadcasting stations falling in the amateur bands. These stations dispose over far greater resources of test equipment, etc. and are supposed to be operated by professional operators who are paid for this work. Surely they should set an example and, to quote Captain Lee, "present a proper image to the rest of the world" before the poor "amateur" using only his own meagre resources (not the taxpayers bottomless purse) is criticised for his misdemeanours.

Captain Lee seems to want action taken against the poor individual amateur who transgresses, while powerful government jammers and the broadcaster illegally in the amateur bands who attracted the jammer are allowed to get way with it. One law for the rich and one for the poor.

I do not support Captain Lee's thesis.

E. M. Wagner, G3BID
London, England

F.M. Mobile Techniques

Editor, *CQs*

If f.m. mobile operating techniques follow the pattern given in the May issue of *CQ*, then we few-and-fast-disappearing amateurs of radio might as well give up, turn in our licenses, and watch the CB-inspired mob take over the once-amateur frequencies. No farther departure from true amateur operation can be imagined.

These f.m. wonders never build or design any equipment; they just take the cast-offs of commercial users, alter the frequency a piddling trifle, then ape the commercials (as prostituted by the CB "Highway Patrol" imitators) in operating procedures. They never make a General Inquiry call, they never permit a newcomer to join a conversation in progress. All they do is to hold a mutual-admiration society meeting on "reserved" frequencies. How far can one get from the true amateur spirit of an ever-widening circle of friendship? How much do they advance the state of the art?

They boast that the technical qualifications of the operator (whether he has passed a government-supervised license examination or has merely committed perjury to get a "Lazy Liars License") has no standing relative to admission into their charmed circle. This is easy to comprehend: It requires no technical ability to push a button and say "10-4"! And that seems to be the ultimate in "amateur" operating procedures and techniques, as visualized (and practiced) by these self-styled paragons of radio operating virtues.

Then, consider their "high ideals" of communicating within their little closed-circuit, private-band kingdom. They limit their transmissions to ten seconds. Just how much Public Service works can be accomplished in this length of time? Just how do they justify their claim to their highly-exclusive kingdom?

If one set out to define a mode of operating (including the obtaining of equipment) that represented the very antithesis of the justification for existence of amateur radio, as set forth in the FCC Rules and Regulations, he could find no more accurate a definition than that contained in the May *CQ* article. Heaven forbid that this may ever become a common style of operation on the once-amateur bands!

Carl C. Drumeller, W5EHC
Oklahoma City, Okla.

For further information, check number 6, on page 108

Announcements

Burbank, Calif.

The San Fernando Valley Radio Club, W6SD, will hold its 10th Annual Hamfest Picnic Sunday, July 24, from 10 A.M. to 6 P.M. at the Lockheed Employees Recreation Center, 2814 Empire Ave., Burbank, Calif. Tickets: $1 donation. For more information contact W6SD at the above address.

Canada/Manitoba

The Third Annual International Ham Fest will be held at the International Peace Gardens on the border between North Dakota and Manitoba on Saturday afternoon, July 16 and Sunday, July 17. For further information contact Robert Withey, WAØHUD.

Conconully, Wisc.

The Okanogan Valley International Hamfest will be held this year in Conconully State Park, Conconully, Wisc., on July 23 and 24. Registration for hams is $1 and a "piece of junk"; XYL's 50¢. For further information, contact K7RZH.

Terre Haute, Indiana

The Wabash Valley ARA will hold its eighteenth annual VHF Picnic on Sunday, July 31 at Turkey Run State Park, about 40 miles north of Terre Haute, one mile off of U.S. 41 and on Indiana Route 47. One dollar ($1.00) registration.

Regina, Sask., Canada

The annual Saskatchewan Hamfest will be held July 1, 2, and 3. There will be picnics, contests, and banquets. For more info., contact VE5JU, 2117 McPherson Ave., Regina, Sask.

Ellicotville, New York

The Southwestern New York V.H.F. Assoc. will hold its eighth annual field day and picnic July 16 and 17 at Wades Sign Shop, Ellicotville, N.Y. Route 242. WB2GXE, Club Station will monitor 50.40, 145.05 a.m. and 146.94 for f.m. mobiles.

West Glacier, Montana

The Annual Glacier Waterton International Peace Park Hamfest will be held at the Apgar Campground near West Glacier, Montana, July 23rd and 24th, 1966. Contact Anaconda Hamfest Committee, P.O. Box 1209 Anaconda, Montana 59711 for more information.

Henderson, Kentucky

The Annual Hamfest of the Henderson Amateur Radio Club will be held on Sunday, July 31, 1966, rain or shine at the Audubon Raceway. For more information, contact K4RGL, Box 83, Henderson, Ky.

Nashville, Indiana

The Indiana Radio Club Council, Inc. will hold its annual Hamfest and family picnic on July 10, 1966, at Brown County State Park, near Nashville, Ind. Contact John C. Jones, W9FZW, 3338 E. New York St., Indianapolis, Ind. 46201.

Point Lookout, N. Y.

The Federation of Long Island Radio Clubs, Inc. will hold their annual Hamfest and Picnic at the Hempstead Town Park, Point Lookout, L.I., on Sunday, July 17, 1966. Admission to the Hamfest, exhibits, etc., is free.

Stevens Point, Wisc.

The Point Radio Amateurs Ltd. will host the annual Wisconsin Nets Association "WNA" picnic July 10, 1966 at Iverson Park in Stevens Point, Wisconsin. Iverson Park is on the east side of Stevens Point on Highway 10. Registration begins at 10:00 A.M. For further information contact K9GSC, 822 Wauona Trail, Portage, Wisc. 53901.

Bootleggers in the Bahamas

Don R. Thompson, VP7NS, Pres. of the Bahamas Amateur Radio Society lists VP7AL, VP7AN, VP7AR, and VP7AV as unlicensed calls. All QSL cards received for those persons will not be answered.

[*Continued on page 102*]

For further information, check number 7 on page 108 ➤

NOW! A 3-BAND SSB TRANSCEIVER KIT FOR 189.95

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■ Full band coverage on 80, 40 and 20 meters. ■ Receiver offset tuning (up to ±10kc) without altering transmitter frequency. ■ SILICON SOLID-STATE VFO for drift-free and voltage stable operation in both fixed and mobile installations. ■ Built-in VOX. ■ Panel selected VOX, PTT & STANDBY. ■ High level dynamic ALC to prevent flat-topping or splatter and permit the use of a linear amplifier. ■ Automatic carrier level adjustment on CW and AM. ■ Dual ratio ball drive permits single knob 6:1 rapid tuning and 30:1 vernier bandspread (over 10 degrees of scale). ■ Position of hairline adjustable on panel. ■ Illuminated S-meter/PA Cathode Current Meter and tuning dial. ■ Fast attack, slow decay AGC. ■ Grid-block break-in CW keying. ■ Product detector for SSB and CW, triode detector for AM. ■ TR relay with auxiliary contacts for use with high power linear amplifier. ■ Includes mobile mounting bracket.

ADDITIONAL SPECIFICATIONS

FREQUENCY COVERAGE: 3490-4010kc, 6990-7310kc, 13890-14410kc. SSB EMISSIONS: LSB 80 and 40 meters, USB 20 meters. RF POWER INPUT: 200 watts SSB PEP and CW, 100 watts AM. RF POWER OUTPUT: 120 watts SSB PEP and CW, 30 watts AM. OUTPUT PI NETWORK MATCHING RANGE: 40-80 ohms. SSB GENERATION: 5.2 Mc crystal lattice filter; bandwidth 2.7kc at 6db. STABILITY: 400 cps after warm-up. SUPPRESSION: Carrier-50db; unwanted sideband-40db. RECEIVER: Sensitivity 1uv for 10db S/N ratio: selectivity 2.7kc at 6db; audio output over 2 watts (3.2 ohms). PANEL CONTROLS & CONNECTORS: Tuning, Band Selector, AF Gain, RF Gain, MIC Gain with calibrator switch at extreme CCW rotation, Hairline Set (capped), Mode (SSB, AM, CW, Tune), Function (Off, Standby, PTT, VOX), Carrier Balance, Exciter Tune, PA Tune, PA Load, Receiver Offset Tune, MIC input, phone jack. REAR CONTROLS & CONNECTORS: VOX Threshold, VOX delay, VOX sensitivity, Anti-VOX sensitivity, PA Bias adjust, S-Meter zero adjust, power socket, external relay, antenna connector, key jack, accessory calibrator socket. METERING: PA cathode on transmit, S-Meter on receive. SIZE (HWD): $5\frac{13}{16}$" x $14\frac{1}{4}$" x $11\frac{1}{4}$". POWER REQUIREMENTS: 750 VDC at 300 ma, 250 VDC at 170 ma, -100 VDC at 5 ma, 12.6 VAC at 3.8 amps.

The Model 753 is an outstanding value factory-wired at $299.95.

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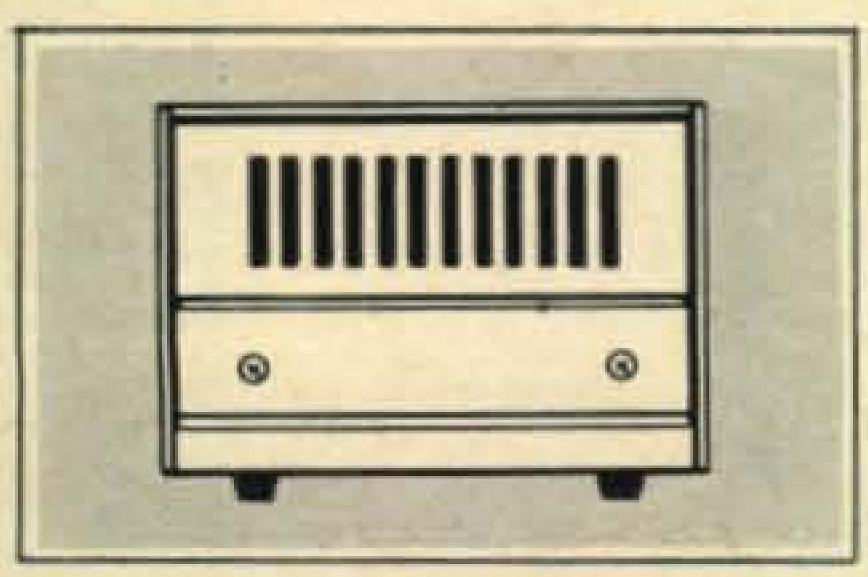

Model 751 Solid State AC Supply/Speaker Console.
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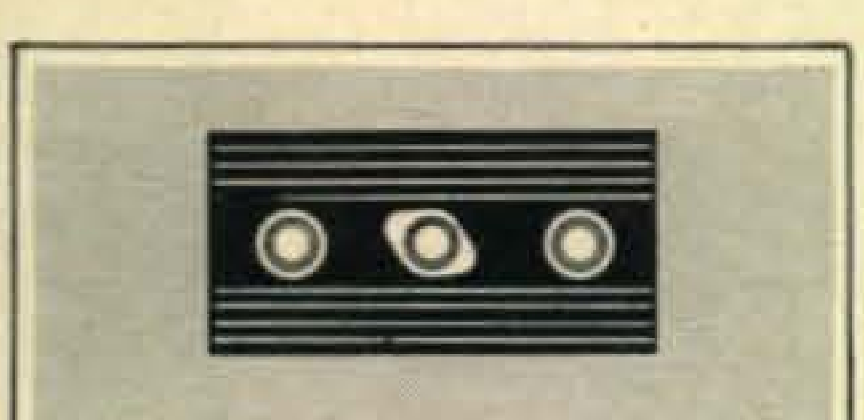
Kit $79.95 Wired $109.95



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BEAM ANTENNAS for the H.F. RANGE

BY EUGENE FULLER,* W2FZJ

The author presents a multiband beam antenna designed for 10, 15, 20, and 40 meters. He has avoided the use of traps and interlaced elements by employing tuning stubs switched by relays. The approach has been experimental and the antenna, while it performs satisfactorily now, is still being worked upon. The author would like your comments.

For some time I have had a desire to experiment with antennas in the h.f. range with the idea of coming up wtih a new approach to the problem of providing a multiband rotatable array with the desirable gain and front-to-back ratio characteristics.

Design

The first approach was to consider interlaced elements. This was discarded because of the extreme inefficiency in the use of aluminum tubing since only a small fraction of the elements are in use on any one band at a time. The second approach was the use of traps. Two major objections to traps soon ruled these out. First, they complicate the problem of maintaining the mechanical integrity of the element and second, considerable care must be taken in the electrical design to insure that they won't burn out and to keep the losses, which are inevitable, to a minimum. I now had narrowed the approach down to multi-band, trapless elements.

Perhaps the best known trapless multi-band beam now in use is the G4ZU type. I have built both the mini-beam and the super mini-beam and found their performance to be good on 10 and 15 meters and only slightly under par on 20 meters. The mini-beams served as a convincing example of the efficiency and practicability of three very useful principles. First, was the use of stubs to switch from one band to another. Second, was the idea of using an antenna tuning network with low loss open wire line to feed directly into the center of a non-resonant radiator. And third, that elements could be shortened to as little as 0.3 wavelength without seriously affecting their efficiency.

Because of the complexity of the problem of trying to match a multi-frequency antenna of this sort to a single feed line, the impracticability of running separate feed lines for each band, and, in my case, the 300 foot run which was required to get to the antenna, it was decided definitely to adopt the use of low loss open wire feeder. It now remained to come up with an element configuration which could handle the desired harmonically related frequencies.

After much juggling of figures it was decided that it should be possible to make one element work on 10, 15, 20, and 40 meters by making it about 45 feet long and bringing it to resonance with stubs in the center. This element length was arrived at by asking what was the maximum useful length which could be used on 10 meters and then, what was the minimum length which could be used on 40 meters and still maintain reasonable efficiency. Since it was desired to keep the pattern of the antenna from splitting into a clover leaf, the maximum element length for the best forward lobe characteristics would be equivalent to the "double extended zepp" or approximately 1.28 wavelengths. (At this point it was decided the frequencies to be considered would be 7.15, 14.3, 21.45, and 28.6 mc.) At 28.6 mc, using the long wire equation $L = 984 (N-.025)/f(mc)$, we have approximately $984 (1.28-.025)/28.6 = 43.2$ ft. On the other hand

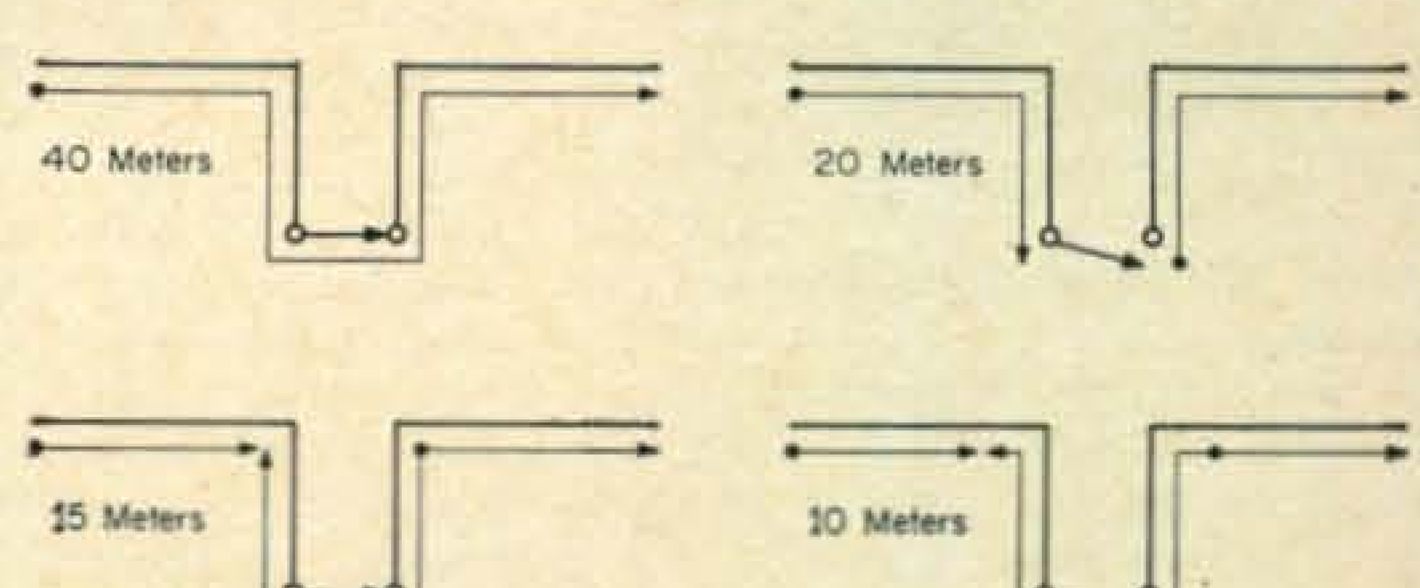


Fig. 1—The resulting element and stub current and phasing for the lengths indicated in the text.

*1183 Wall Road, Webster, New York.

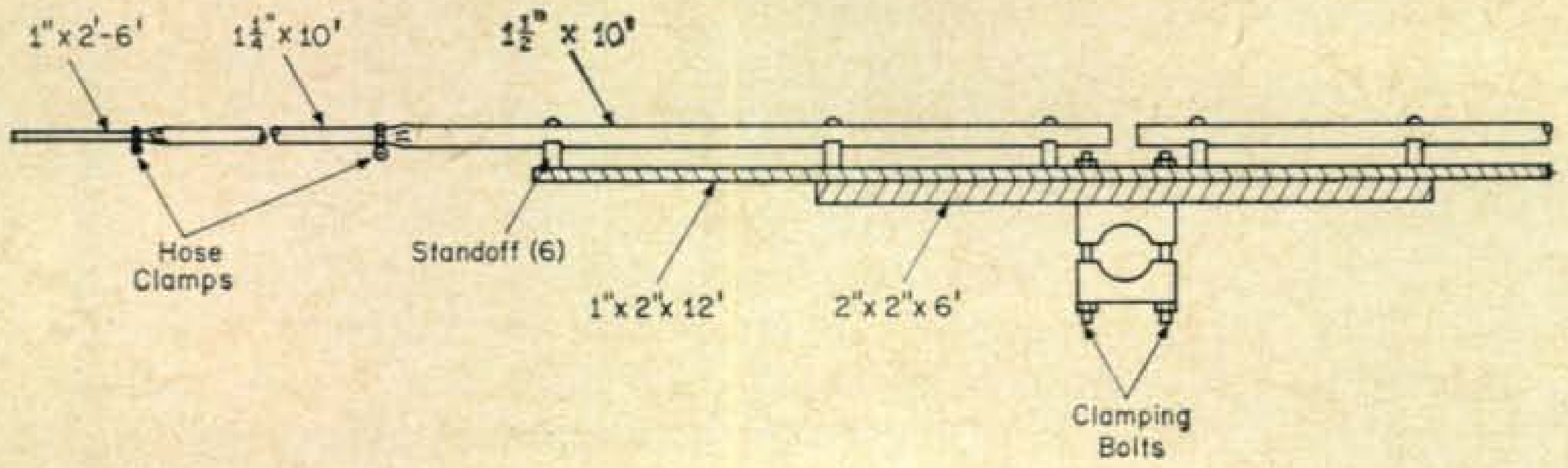


Fig. 2—Construction method used for the elements. The boom clamp is made from 2 × 6 with a 4" diameter hole.

the minimum desirable length for 40 meter use was considered to be .30 wavelength, as illustrated by the mini-beam, $984(.3-.025)/7.15 = 37.8$ ft.

After considering these dimensions it was decided to pick element lengths which would correspond to collinear half-wave operation on 15 meters. Since the actual element length is relatively non-critical it is the resonant length after adding the stub that really counts), a set of figures were settled on for element lengths after consulting most of the well-known beam antenna handbooks and reference books. The element lengths were then settled as follows:

Reflector: $2 \times 501/21.45 = 46.8$ feet
Driven Element: $2 \times 473/21.45 = 44.2$ feet
1st Director: $2 \times 445/21.45 = 41.6$ feet
2nd Director: $2 \times 440/21.45 = 41.0$ feet

Next, the element spacing was determined by similar process of compromises, *i.e.*, what is minimum for 40 meters and what is maximum for 10 meters? After electrical and practical considerations were taken into account, it was decided to equally space four elements on a thirty foot piece of irrigation tubing. This results in just over 0.07 wavelength spacing on 40 meters and just under 0.30 wavelength spacing on 10 meters.

Having settled on the element lengths and spacing it was now necessary to devise a practical method of bringing the elements into resonance, with the proper phasing, at the various frequencies. After quite a number of schemes had been considered, one was finally hatched which appeared to be by far the simplest and most straightforward. It was based on the fact that a 40 meter half-wave antenna would also be approximately resonant on 20, 15, and 10 meters. Therefore, if the resonant length could be made equal to a half-wave on 40 meters and the phasing could be altered from one band to the next to keep the currents in the elements adding in phase, the objective would be met. This was accomplished by taking the basic element earlier derived, splitting it in the center, and inserting a stub, with a shorting relay on the far end, which would bring the antenna to resonance on 40. The resulting element and stub current phasing is shown in fig. 1.

To feed the antenna it had been decided to use open-wire feeders with a tuner at the transmitter end. To keep the s.w.r. to a reasonable level a stub was attached at the center of the driven element the same as with the other elements. The feed line was then attached to the element at the same point as the stub. Although no impedance measurements have been taken, this point of the element should be a medium impedance on all bands. Keeping in mind that if the matched transmission line loss was kept down to 0.5 db by use of open wire line, that the additional loss due to an s.w.r. of 5:1 would only be about 0.7 db. It was decided that this would be acceptable.

Construction

Because of the winter icing conditions and high winds in the Spring at this location it was decided to perform a fairly thorough analysis of the ice and wind load which might be expected on the antenna. After calculating the element loading associated with ½" of radial ice and 70 m.p.h. winds, it was found that, using an average element diameter of 1¼", either force by itself would run between 15 and 20 pounds per half element. Bending moments were then calculated and a rough stress analysis was run to come up with the element construction.

Element Construction

The resulting construction of each half element consists of three pieces of aluminum tubing: 1 piece of 1½" o.d. × 10' Channel Master t.v. mast, 1 piece of 1¼" o.d. × 10' Channel Master tv mast, and 1 piece of 1" o.d. long enough to make up the difference.

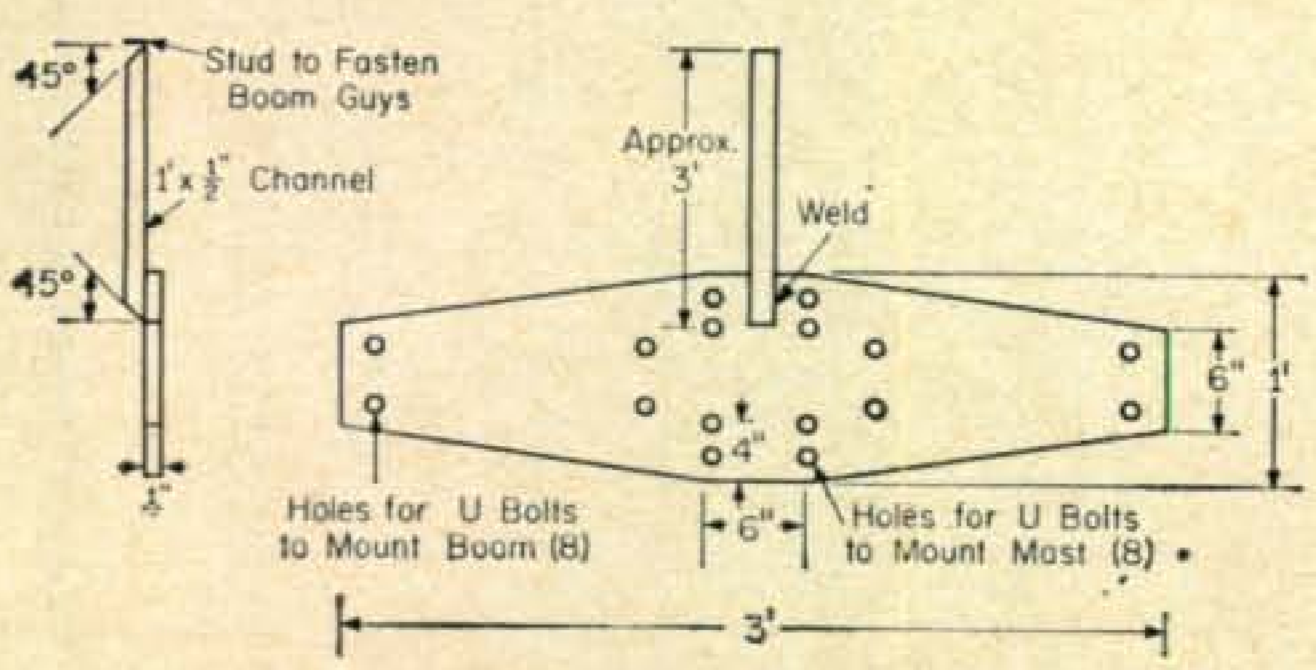
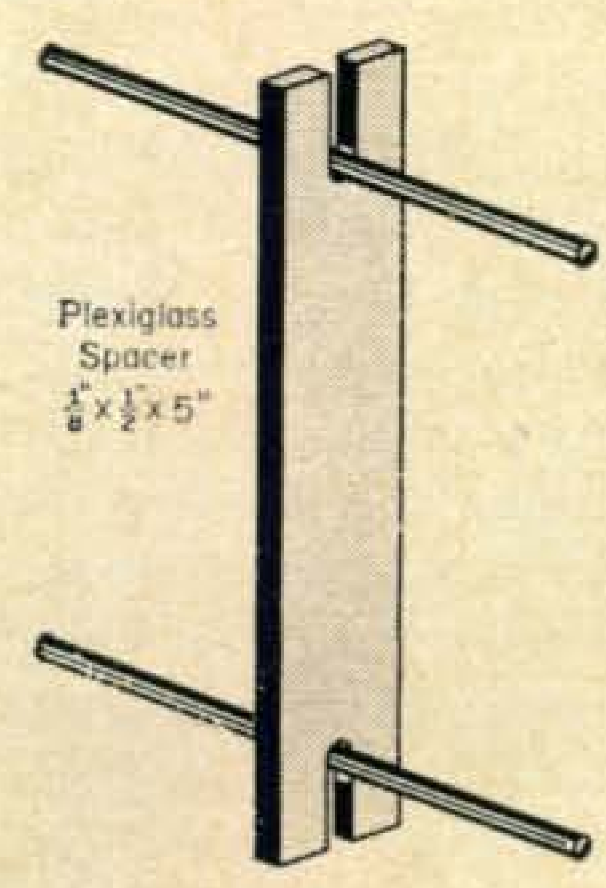


Fig. 3—Dimensions for the mast to boom plate made from ¼" steel plate. The 3 foot angle iron is used to support the boom guy wire.

Fig. 4—Stub construction requires plexiglass spacers ⅛" × ½" × 5" every two feet. The wire is heated with a soldering iron and forced into the plexiglass slot cut with a hacksaw.



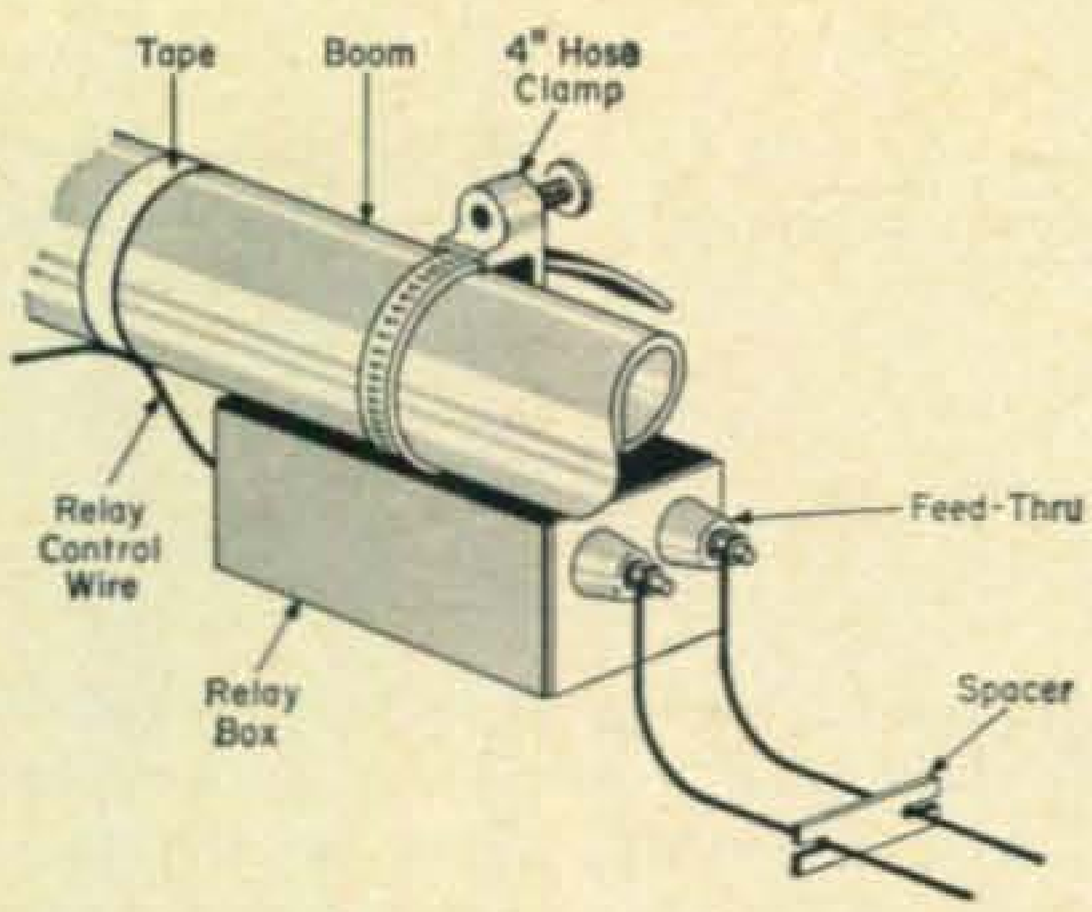


Fig. 5—Mounting of the relay on the boom at the end of the stub. Relay coils should be fed power according to local electrical codes.

The ¼" increments used in element section diameters is made possible by the fact that one end of each mast section is necked down to allow stacking of sections. If however, the little butt tap is removed and the swedged portion is split with a hacksaw, the next smaller size fits snuggly in. The swedged section is about six inches long and when clamped with a standard aircraft hose clamp, it provides a very adequate joint. Standard procedures were followed in steel-wooling the inserted portion of the elements and coating them with a protective compound such as Penetrox.

Three standoff insulators were used for each half element. These were purchased from the Mosely antenna line and are the larger of the two types available, measuring 2½ inches overall height. The element support consists of a 12 foot 1 × 2 glued and and screwed onto a 6 foot 2 × 2. These should have a minimum of two coats of good exterior grade house paint.

The boom to element joint is made by drilling a 4" hole in a piece of 2" × 6". This is then split in a horizontal plane and bolted onto the element support to use as a clamp. (See fig. 2). The boom is a 30′ length of 4" diameter irrigation tubing.

After the first element was constructed, it was loaded with a 25 pound weight about 10 feet in from one end. The element sagged several feet, but was quick to return to normal, with no permanent set after the load was removed so the design was considered satisfactory.

Boom To Mast Joint

Next, the boom to mast joint was constructed. This was made as a trunkated diamond shaped plate with four "U" bolts to hold the boom to the plate and four more to hold the plate to the mast. Saddles were made to go between the boom and its mounting bolts to distribute the forces on the boom. These saddles were made by cutting half sections of 4" i.d., ¼" wall, pipe. Since the mast is 2" o.d., ¼" wall steel tubing, it was not felt that saddles would be necessary under the mast mounting bolts. A 3-foot piece of small (approximately ¾") channel was welded to the plate to furnish the boom guying point. With all of the elements and hardware mounted it is possible to see through the inside of the boom from one end to the other without guys, but it was decided to add them anyway as an added safety factor for the boom and to help stabilize the outboard elements. (See fig. 3.)

The other three elements were then built and mounted on the boom, the boom to mast joint was assembled, and this much was mounted about eight feet above the ground ready for the stubs, relays, feedline, and tuning.

The stubs were made by taking two #12 wires and melting on plexiglass spacers about every two feet. (See fig. 4.)

The relays used are heavy duty normally open, double make type with 25 amp contact rating and about ¼" gap when open. These were mounted inside appropriate sized plastic refrigerator dishes with r.f. leads brought out through steatite feedthroughs and the relay control line brought out through a small clearance hole. A mounting plate was added to allow clamping the box to the boom. (See fig. 5.)

The feedline used from the driven element to a point on the stationary side of the rotator is Saxton type INS-500 which is a flexible, fully insulated, web type 500 ohm twin lead. This is anchored to the mast and boom by use of aircraft clamps and standard TV standoffs. (See fig. 6.) From the rotor on down standard 500 ohm open wire line was used.

The cable supplying power to the relays is a standard vinyl jacketed multiconductor flexible cable. It is taped to the boom and mast and a slack loop is left to allow rotation.

The complete antenna is shown in fig. 7.

Tuning

Because of the ease of coupling a grid dip oscillator into the tuning stubs by using a clip lead about a foot long from one side of the stub to the other with two or three turns around the g.d.o. coil, it was decided to approach the tuning problem from the standpoint of resonating each element to a predetermined frequency. Many techniques and different percentage differences between elements have been tried, but only the final set will be presented. Because of the variation in element length and spacing in terms of wavelength on the various bands, the figures represent a compromise which results in reasonably good patterns on all bands.

The procedure requires only a g.d.o. and a

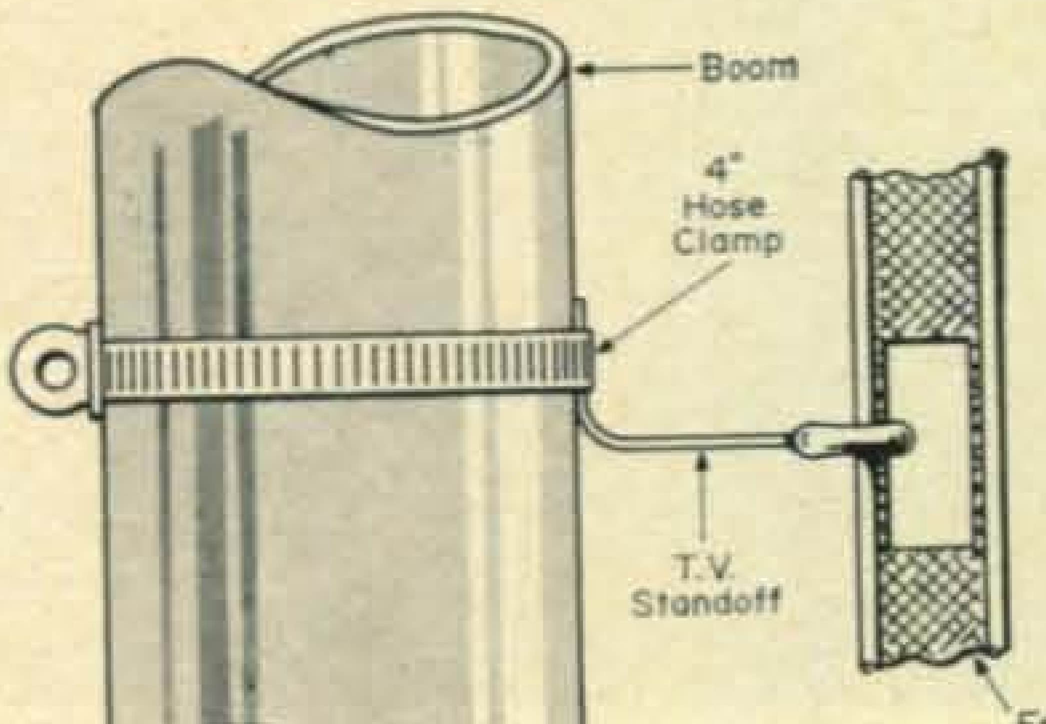


Fig. 6—Method of supporting feedline along the boom.

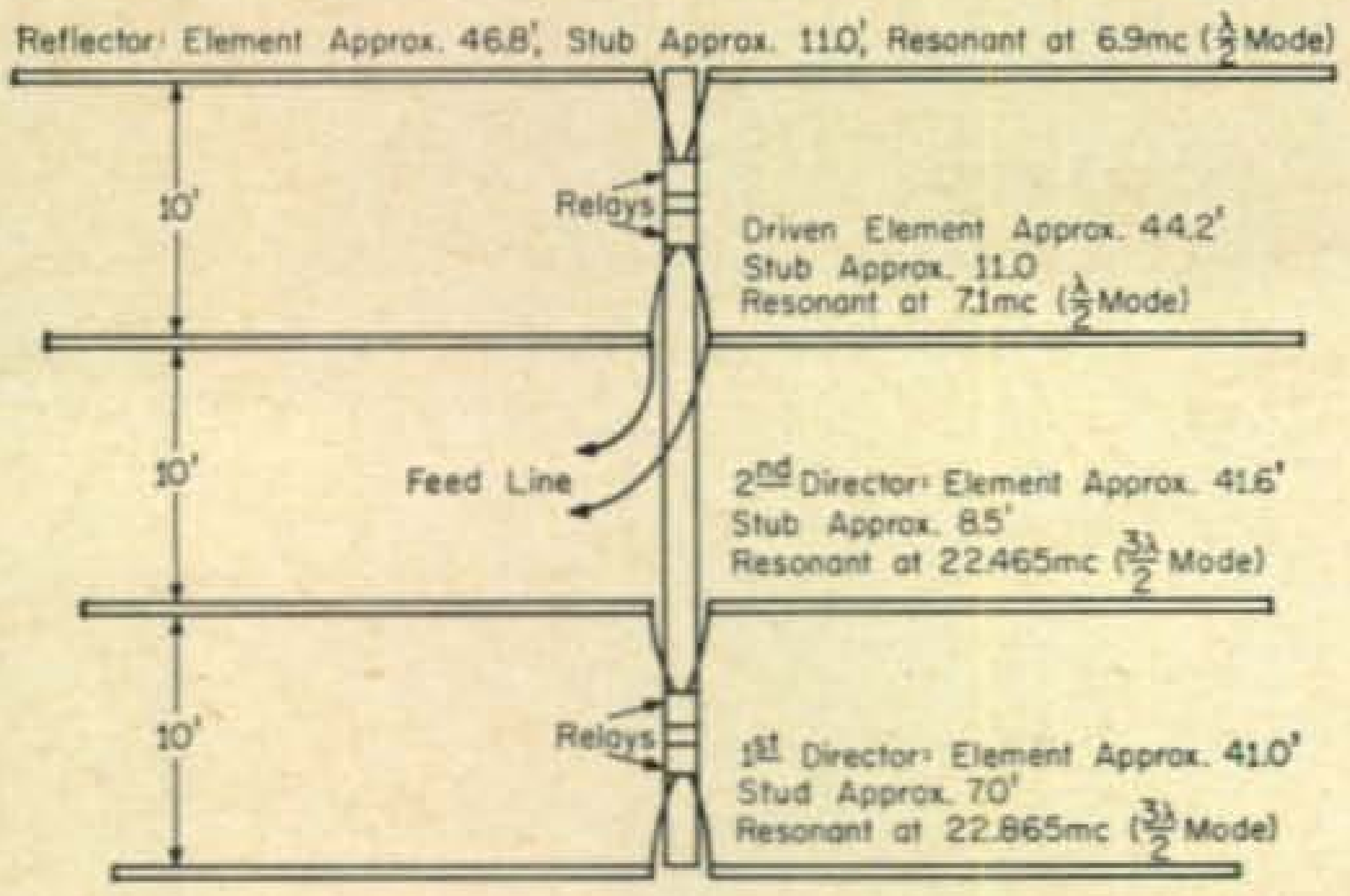


Fig. 7—Complete antenna element and stub dimensions.

general coverage receiver (with a 100 kc calibrator) to check the calibration of the g.d.o. In my case the receiver was moved out to the antenna, set to the desired frequency and monitored with b.f.o. on. When the g.d.o. passed through the desired frequency the audio heterodyne was unmistakable. Although the calibration on some g.d.o.'s is reasonably good, it is recommended that the receiver be used because the loading on the g.d.o. at the element's resonant frequency is often enough to pull the oscillator off calibration by a significant amount. It is also suggested that frequencies derived below be adhered to within plus or minus 0.5 to 1.0%. Beam patterns taken under various element tuning conditions indicated that changes in the order of 1 to 2% had a definite effect on the antenna pattern.

Because of the effective lengthening of the elements with increasing frequency (noted by checking that resonance occurred at less than harmonic multiples), it was decided to resonate the reflector on 40 meters. This insured that on all higher frequencies, its resonant frequency would be below the operating frequency to insure reflector action. Also, at 40 meters the stub should be shorted and the pick-up loop for the g.d.o. accomplishes this.

Although from the standpoint of element "lengthening" the directors should be resonated on 10 meters, they were tuned to slightly shorter than normal lengths on 15 meters to again take advantage of being able to couple into the end of the stubs with a shorting loop.

The driven element was somewhat of a toss up, but since the biggest compromises up to this point had been taken on 40 meters, it was decided to try to help even things out by tuning it on 40.

After looking over figures that others had used, a height correction factor to correct for the capacitive loading effect of the ground on the antenna of 100 kc on 40 meters and 35 kc on 15 meters was decided on. This is to help compensate for the change in tuning when the antenna is raised from 8 feet to the operating height of 53 feet. Another correction which was considered was that the relays would add some length to the stubs when they were connected. To compensate for this the leads on the g.d.o. pickup coil were made approximately equal to this.

After all these compromises and corrections were made the following self-resonant element frequencies were calculated.

Reflector:
$(7{,}150 - 2\%) - 100 = 6.900$ kc
Driven Element:
$7{,}200 - 100 = 7.100$ kc
First Director:
$(21{,}450 + 5\%) - 35 = 22{,}465$ kc
Second Director:
$(21{,}450 + 7\%) - 35 = 22{,}865$ kc

Standard beam tuning techniques were used from this point on. Stubs were cut plenty long to start out and shortened a little at a time, switching from one element to the next without trying to bring an element all the way in on the first pass. Coupling between elements is quite appreciable, so those which were not being tuned had their stubs shorted to keep them near resonance.

Results

Figure 8 shows the final patterns taken with the antenna at 53 feet. These patterns were taken by receiving a signal (transmitted from a few miles away) on an NC-183D with the a.g.c. turned off and figuring 5 units per "S" unit and one unit per db above S9. Upon checking the receiver with a calibrated signal generator it was found that about 2.5 units equal one true db. (Pattern dissymmetry was caused by local conditions.)

In operation the antenna has provided most gratifying results. It has compared quite favorably on all bands with other antennas in the vicinity after appropriate compensation was made for height and power variations. These included the usual assortment of quads, tribanders, monoband yagis, and a commercial 40 meter beam with loaded elements.

Mechanically the antenna has held up very well for nearly two years now. This period has seen icing up to about ¼" and numerous storms with winds from 50 to 70 m.p.h. The only "failure" was when a stub flipped once in a wind storm shorting itself about halfway along the length. This problem was eliminated by looping the center of the stub back up to the boom and anchoring it with an open wire type of standoff insulator which is held to the boom by a 4" hose clamp.

Future Plans

In the near future I plan to try two changes to this design. First is to drive the reflector with an open wire transmission line from the driving point of the radiator. This line will be transposed to obtain proper phasing for reflector action. This will be used in an attempt to force a higher front-to-back ratio, particularly for 40 meters. The second change will be to fold each half of the loading stub back along its associated half-element with a double fold to bring the ends back to the relay on the boom. This will be done to try to improve the front-to-end

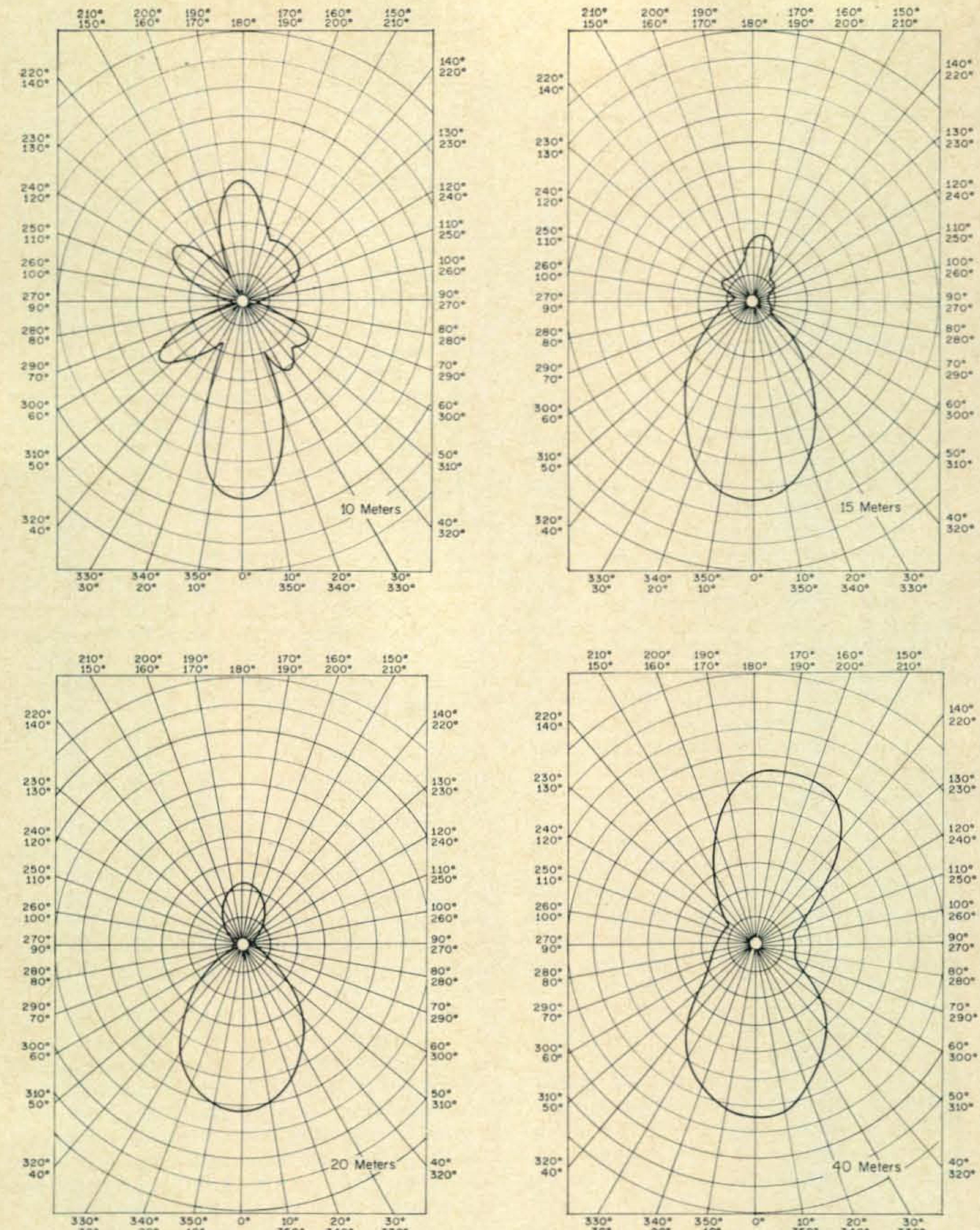


Fig. 8—Polar patterns for the antenna on each of the four bands.

ratio and may provide sufficient current cancelation on 10 meters to provide a more unified pattern.

This article is presented not so much with the idea that someone would choose to duplicate this antenna, but rather as a stimulus to those interested in antenna experimenting to deviate from the beaten path of the conventional yagi and quad. Any comments or questions (accompanied by a s.a.s.e.) would be appreciated.

I would like to thank Floyd, WA2WVL, LaMar, WB2MFX, Howard, W2PUN, Bob, W2ALL, and Ham, WØIVZ for their assistance and encouragement and my XYL for maintaining the "widow's watch" during the many many hours spent "out at the pole." ■

For further information, check number 9, on page 108

The HA-650 in a table-top position with the whip antenna retracted and folded in place across the panel. The dial window is just to the right of the antenna tip, the S-meter is behind the antenna at the left of the light-colored half of the panel.

CQ Reviews:

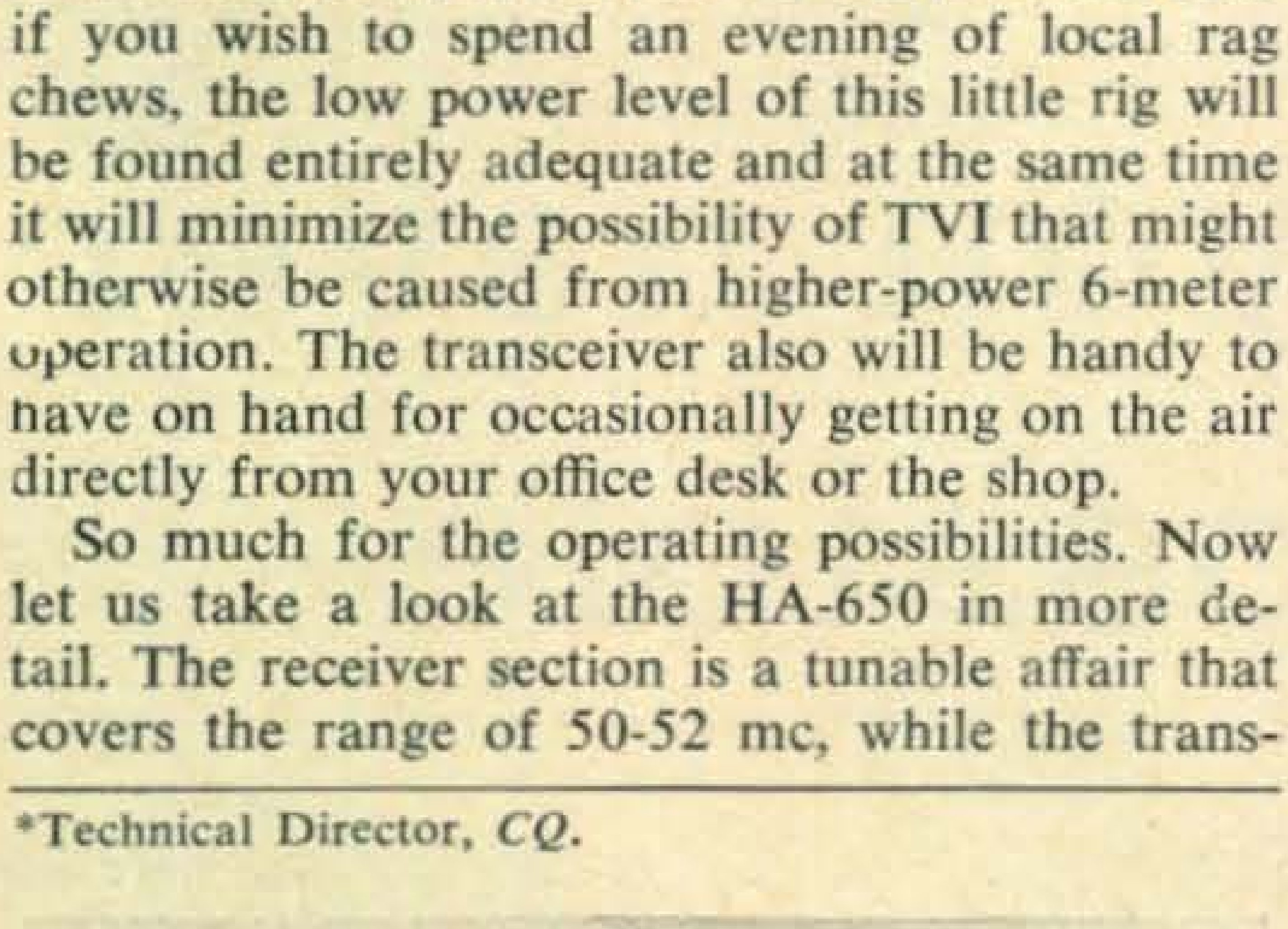
The Lafayette HA-650 6-Meter Transceiver

BY WILFRED M. SCHERER,* W2AEF

A LOT of power is not needed to work out reasonably well on 6 meters, making battery-powered portable-gear operation quite feasible and attractive. One piece of gear for such use is the Lafayette HA-650, an all-transistorized 6-meter portable transceiver. Running with 2½ watts carrier input, this unit is just the ticket for an afternoon of relaxing enjoyment with armside operation from your sunchair, for portable operation from your favorite week-end spot, for field and emergency communications, or for mobile work. Beside this, if you wish to spend an evening of local rag chews, the low power level of this little rig will be found entirely adequate and at the same time it will minimize the possibility of TVI that might otherwise be caused from higher-power 6-meter operation. The transceiver also will be handy to have on hand for occasionally getting on the air directly from your office desk or the shop.

So much for the operating possibilities. Now let us take a look at the HA-650 in more detail. The receiver section is a tunable affair that covers the range of 50-52 mc, while the transmitter is crystal controlled with six switchable crystal positions available. It is powered by ten self-contained "D-cells" but it also may be run from an external 12 v.d.c. source, such as a car battery, for which a suitable plug and cable is provided.

*Technical Director, *CQ*.



The HA-650 installed in its plastic carrying case that is equipped with a shoulder strap and which has a side pocket for the microphone as seen at the right foreground.

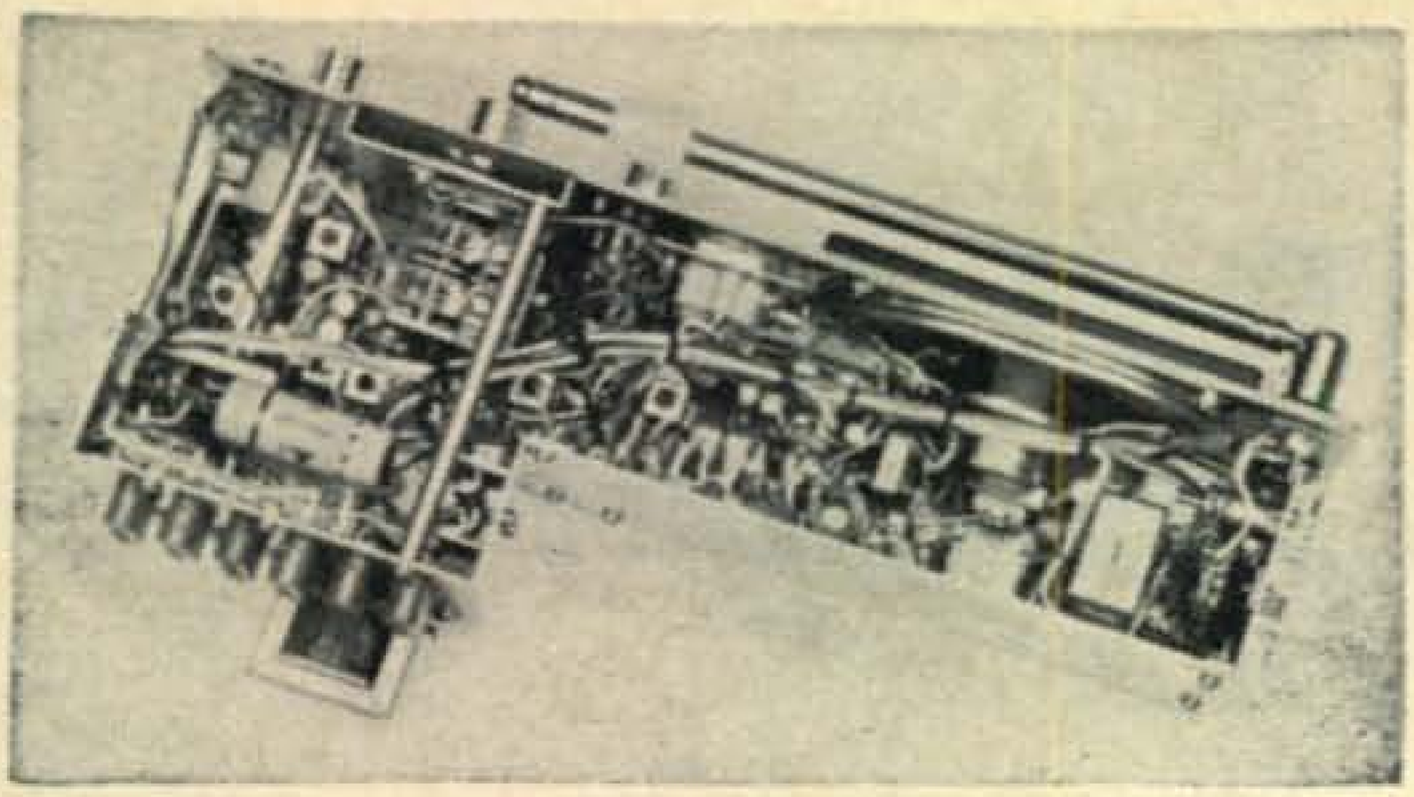
A 52" collapsible fold-over whip is located on the front panel for general field use, while a separate connector allows operation with a more elaborate external antenna. There also is an S-meter, a phone jack, a built-in loudspeaker, and a switch for spotting the transmitter crystal frequencies on the receiver.

The entire unit is housed in a metal cabinet, size 9½" W. × 5½" H. × 2¼" D., which is held in a plastic carrying case equipped with a shoulder strap that enhances its portability, particularly for field trips or emergency operations. The carrying case may be removed for mobile or home-station installations.

Circuitry

Circuitwise, the receiver is a single-conversion job using a 1650 kc i.f. with silicon mesa transistors used in the r.f., i.f. and h.f. oscillator stages. The r.f. input circuit, which includes a shunt-connected diode to protect the first transistor from damage by strong r.f. pickup, is fixtuned for 50-52 mc, while the mixer input is gang tuned by a dual-section variable capacitor that also controls the tunable h.f. oscillator operating in a grounded-base circuit at 48.35-50.35 mc. The base bias for the r.f. and i.f. a.g.c. controlled stages is obtained from a zener-diode-regulated source which also feeds a second "cascaded" zener diode to provide additionally-regulated voltage for the h.f. oscillator. This "double-barrel" regulation ensures maximum frequency stability during widely varying 12-volt source voltages such as may be encountered with mobile operation. There are two i.f. stages, each stabilized with neutralization. A double-tuned bandpass coupler at the input to the first stage adds a measure of improved selectivity needed for 1650 kc i.f. use.

A germanium diode is used for the det./a.g.c. and another diode of the same type functions both as a noise limiter and a squelch. The noise-limiter action is realized with a conventional arrangement wherein the a.n.l. diode is in series with the detector output and the a.f. amplifier input. Squelch operation is obtained by making



Top interior view of the HA-650. The h.f. oscillator's tuning capacitor is at the upper right corner of the square-shaped section at the foreground of which are the six transmitting-crystal sockets. The small round-shaped object in front of the speaker magnet is the final r.f. output transistor which is clamped with a metal plate used as a heat sink. When the unit is installed in the case, the battery holder fits in the oblong space in the foreground. A separate removable back-cover is used on the equipment case.

the diode non-conductive (acting as an open switch or a high resistance) with a small reverse bias obtained from a distribution network in the voltage supply source during no-signal conditions. This, in effect, disconnects the detector output and prevents background noise from being heard. When a signal is received, the a.g.c. causes a forward bias to appear across the diode which then conducts and passes the detector output on to the a.f. section which consists of three stages: a gain amplifier, a driver and a push-pull class-B power-output stage. The latter is stabilized by a thermistor in the emitter circuit.

Using epitaxial silicon mesa transistors, the transmitter starts off using conventional 8.3 mc crystals in an oscillator which triples in the output. This is followed by a multiplier stage that doubles to 50 mc. Three capacitively-coupled tuned circuits in the output of this stage provides a 50-52 mc bandpass that allows uniform drive without necessitating retuning when the frequency is changed and which highly rejects spurious-signal responses at harmonic frequencies that might otherwise cause TVI. A straight-through amplifier then drives the final power amplifier to 2.5 watts input. The output tank is a series-tuned affair that is link coupled to the antenna through a pi-section filter for 50-ohm loads. Both the driver and the final stages are modulated, a necessity for obtaining full modulation when transistors are used.

The HA-650 is supplied wired for negative-ground mobile systems; however, a positive-ground supply may be used by reversing two jumpers on an internal connecting board. If the polarity is accidentally reversed, a high-current silicon diode, shunted across the supply line, will conduct heavily and blow out a one-ampere protective fuse in the external 12-volt cable and thus prevent incorrect polarity from damaging the transistors.

On transmit the current consumption is 400 ma. Operation may be had at input potentials from 12 to 15 volts.

Performance

The receiver in the HA-650 is rated at a sensitivity of 1 μv for 10 db s.n. ratio, which is just about what it measures. Although this is not up to that of the more exotic converters, it is sufficient for the intended use of the set; in fact, sitting in our back yard on a Sunday afternoon and using only the built-in whip antenna, we were able to copy 6-meter stations 75-100 miles away and during a band opening on another occasion plenty of signals were heard over 1000-1500 mile paths.

The selectivity, rated at ± 3 kc at 6 db down and ± 8 kc at 40 db, is better than usually experienced with a 1650 kc i.f. and also was adequate for the job at hand. The frequency stability was better than customary with a tunable 6-meter affair, remaining within 1 kc after a few minutes warmup from a cold start. The a.f. quality was good and with about as much volume as could be expected from a small size speaker. An a.f. output variation of 20 db was experienced with r.f. input signal levels below 6 μv, but above this point the a.g.c. held the a.f. to within 12 db.

A particularly nice feature of the receiver in the HA-650 is the squelch which almost completely silences the receiver during standby periods, so you're not annoyed with a constant background noise (at normal a.f. output settings); however, an even more desirable advantage of the squelch is that when you run across a carrier, it pops right up at you, making it easy to quickly find even the weak signals which otherwise would be difficult to locate in the background noise, especially if the carrier is not being modulated at the time.

The noise limiter, too, is extremely effective. Operating at a location where power-line noise was exceptionally heavy, S1 signals were easily readable, but with the noise limiter shorted out (there is no A.N.L. ON-OFF switch) the signals were lost entirely in the noise.

Image rejection ran in the order of only 20 db, so interference from stations operating 3.3 mc below the desired signal could be encountered. Such signals (46.7-48.7 mc) may be those of Forestry, Conservation, Highway Maintenance or Special Emergency Communications services; however, the possibility of hearing the latter may be of some use in special cases.

Transmitter Results

Using the internal battery supply, the transmitter put out a good 1.5 watts of carrier which could be modulated with relatively good waveform up to about 90%.

On-the-air operation from an indoor location while using the whip antenna provided many good QSO's over a range of 15-20 miles. We did not try the little job out on a home-station antenna, but judging from past experiences with low power on 50 mc, this no doubt should provide surprisingly good coverage as should the use of a portable beam at some high location.

[*Continued on page 102*]

OSCAR NEWS:

First USA-Russian Space Contact Reported

BY GEORGE JACOBS,* W3ASK

Another "first" can be added to the long list of firsts in the history of amateur radio. On December 22, 1965, K2GUN in New Jersey established contact with UP2ON in Lithuania via the OSCAR-4 amateur radio communication satellite. Despite the TELSTARS, RELAYS, ECHOES, SYNCOMS and EARLYBIRDS whirl-in space, the honor for establishing space communications between both countries goes to amateur radio!

The radio amateurs involved in this historic event were Warren E. Butler, K2GUN (ex-W8FSY, WØZRP, W9ZRP and JA5AL), of Scotch Plains, New Jersey and Valdas Simonias, UP2ON, of Kaunas, Lithuania. The contact took place during OSCAR-4's second orbit at 1100 GMT on December 22. Using c.w., both stations heard each other during a five-minute period, through the satellite's 144-432 mc. translator. Although signals were strong (S6-7), the erratic operation of the translator made reception difficult.

The equipment used at K2GUN consists of the following:

144 MC TRANSMITTER: Push-pull 4X150A's running 1 kw input.

144 MC ANTENNA: Two wavelengths, seven-element Quad, horizontally polarized, rotatable in azimuth, estimated 17 db gain and 32° beamwidth. Eight-element Yagi, vertically polarized, rotatable in azimuth and elevation.

432 MC RECEIVER: Homebrew transistorized converter into a 75A4 receiver. Parks 432-2 converter into an NC303 receiver.

432 MC ANTENNA: Six wavelengths, 17-element Quad, horizontally polarized, rotatable in azimuth, estimated 22 db gain and 18° beamwidth. Five wavelengths, 15-element Quad, vertically polarized, rotatable in azimuth and elevation. Measured gain of 21 db and beamwidth of 20°.

UP2ON's equipment consists of the following:

144 MC TRANSMITTER: 1 kw input

144 MC ANTENNA: Nine-element Yagi, with 13.6 db gain.

432 MC RECEIVER: Homebrew converter into a 3-30 mc. communication receiver.

432 MC ANTENNA: 15-element Yagi.

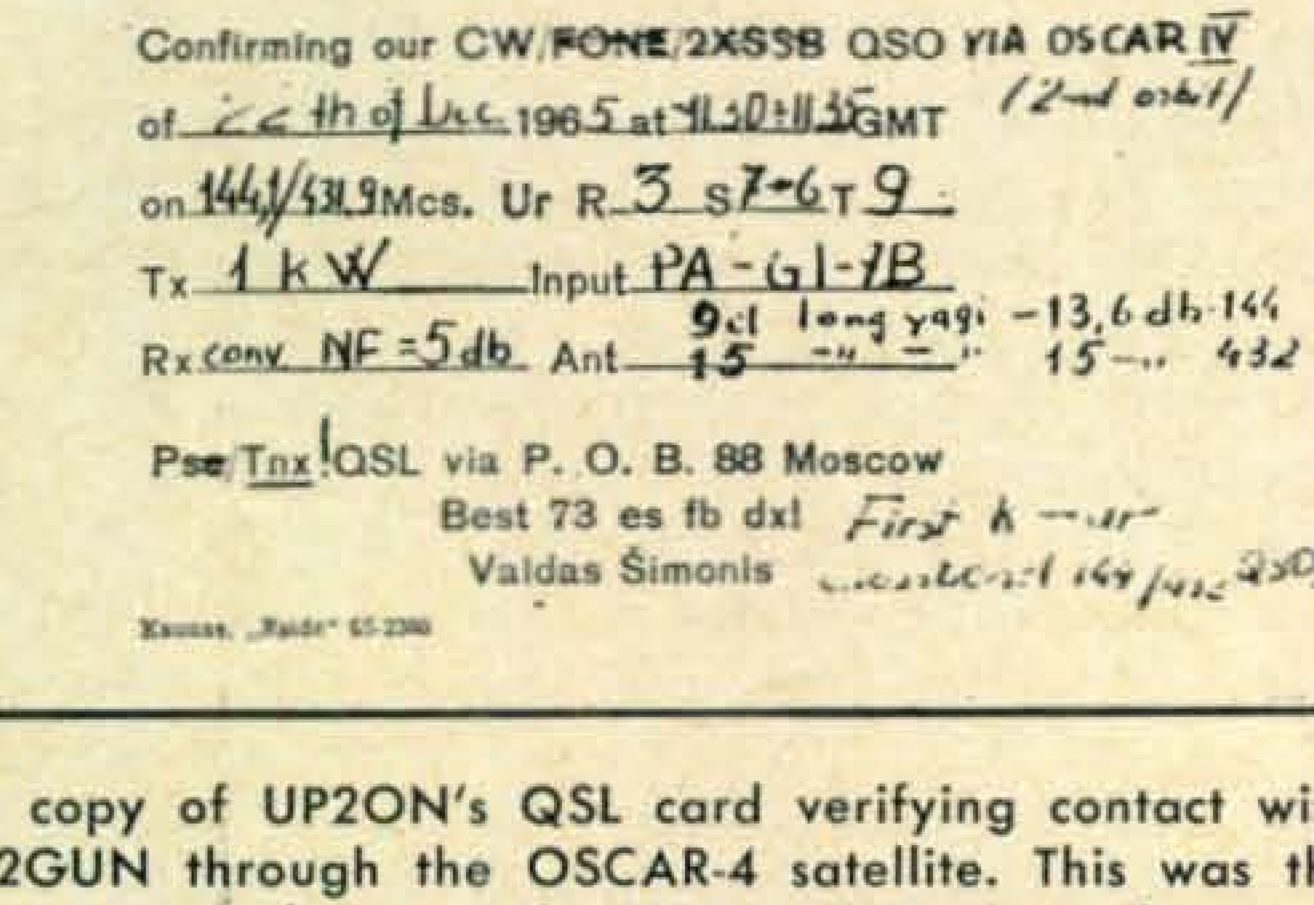
With the report of the K2GUN-UP2ON contact, the OSCAR-4 Honor Roll for two-way contacts through the satellite's translator stands as follows:

W4AWS-W6YK	WA2WEB-K2MWA/2
K2GUN-UP2ON	W6GDO-W6FZA
DL9AR-DLØVB	SM7OSC-G3LTF
W6GDO-K6HCP	K1LSY/6-W6YK
W6GDO-K5WXZ	

Other two-way contacts may have been made through the satellite, but they have not as yet been reported to Project OSCAR Headquarters at Foothill College, Los Altos Hills, California.

At the present time, OSCAR-4 continues to orbit the earth in a highly elliptical orbit. Since mid-February, however, the satellite's 144-432 mc. translator has been inoperative, and its 432 mc. beacon transmitter has been operating erratically. It is believed that radiation from the Van Allen belts may have caused damage to the solar cells mounted on the satellite's outer surfaces.

*Space Communications Editor, *CQ*. 11307 Clara Street, Silver Spring, Md. 20902.


TO RADIO K2GUN
Confirming our CW/FONE/2XSSB QSO VIA OSCAR IV
of 22 th of Dec 1965 at GMT (2nd orbit)
Ur R 3 S 7-6 T 9
Tx 1 kW Input PA-G1-7B
Rx conv NF=5db Ant
Pse/Tnx QSL via P. O. B. 88 Moscow
Best 73 es fb dx! First
Valdas Šimonis

A copy of UP2ON's QSL card verifying contact with K2GUN through the OSCAR-4 satellite. This was the first contact between the USA and Russia to be made through any communication satellite.

Other OSCAR News

Several amateur radio groups in various parts of the world are assembling what may become OSCAR-5. In Germany, the final touches are being made to EURO-OSCAR, a 144 mc translator similar to OSCAR-3; in California, a satellite is being built which will contain a 2-10 meter translator; in other parts of the USA 432 and 1296 mc beacons are being built as well as multichannel telemetry units; and in Australia and Canada work is also beginning on OSCAR satellites. The race is on for OSCAR-5. It is still too early to know which satellite design will win, and when it may be launched. Fingers are being crossed, however, that at least one package may be ready for a launch late this year.

Project OSCAR Headquarters has announced recently that Harley Gabrielson, W6HEK, has been appointed the new President of the OSCAR project; Lance Ginner, K6GSJ, Vice-President; Ed Hilton, W6VKP, Secretary, and Bob Walton, W6CYL, Treasurer. ■

For further information, check number 20, on page 108

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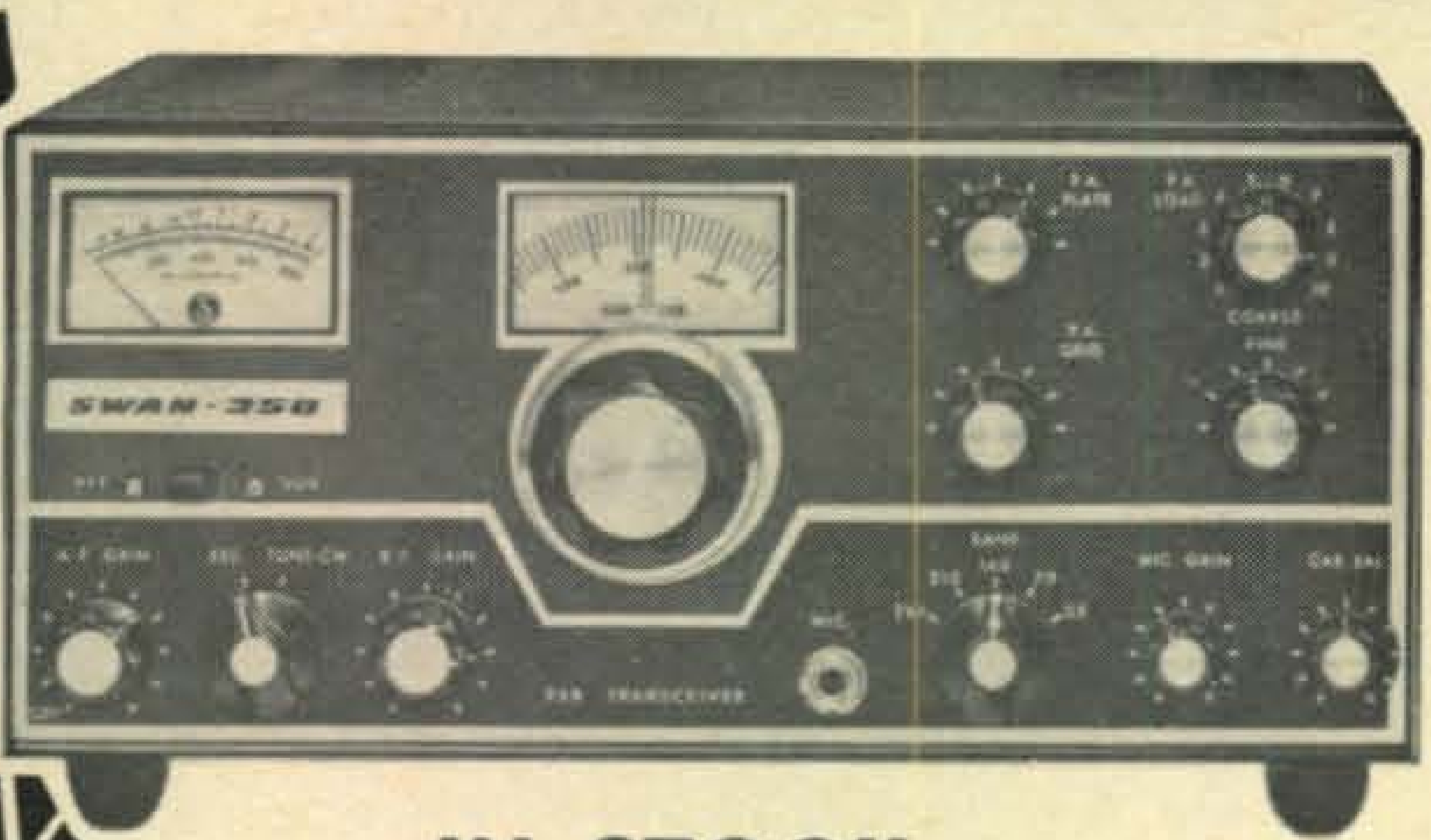

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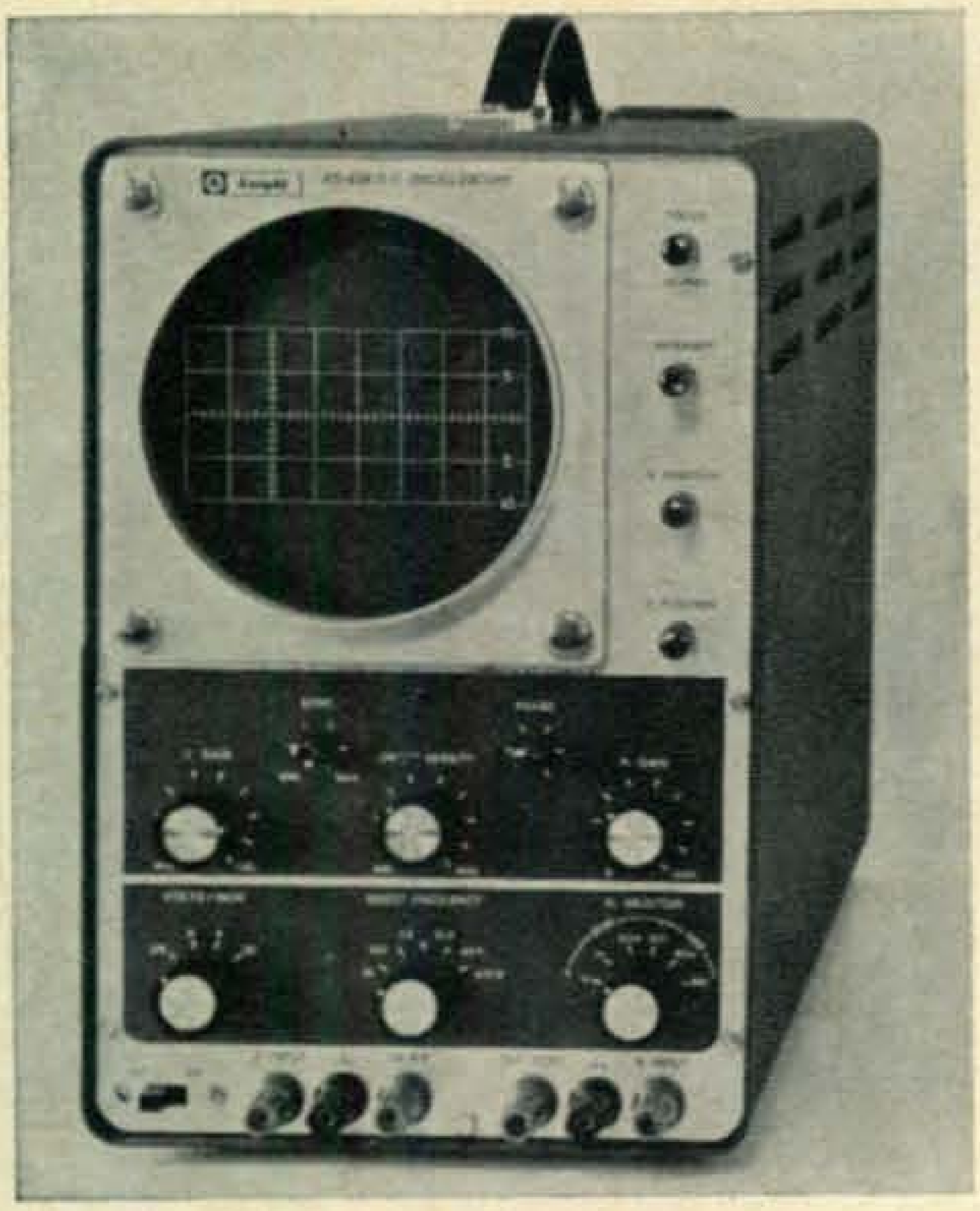


The Oscilloscope

Part I

BY WILFRED M. SCHERER,* W2AEF

This month, Technical Director W2AEF begins an interesting discussion of one of the most intriguing pieces of amateur test equipment: The Oscilloscope. As intriguing as it is, however, it's probably the most misused and misunderstood instrument the ham is likely to encounter. Let's see if Bill can clear the fog.

THE oscilloscope is a form of voltmeter that provides a visual display of a.c. voltages (a.f. and r.f.), indicating both their waveforms and their instantaneous values. As such it may be used to determine absolute or relative amplitudes or voltages, waveform distortion, audio frequencies, phase, modulation and keying characteristics on transmitter r.f. envelopes, filter responses and for many other associated applications.

The heart of the oscilloscope is the cathode-ray tube (c.r.t.) which is used as the indicating device instead of a meter. In this tube, the electrons which are emitted from the cathode are accelerated and concentrated by specially shaped electrodes to form a narrow beam which is directed toward the center of a fluorescent screen at the end of the tube. See fig. 1. The screen is coated with a phosphorescent substance which glows, with a slight degree of persistence, when it is bombarded by the electron beam. A spot about the diameter of the beam will then be visible where it strikes the screen.

Before the beam reaches the screen however, it must pass between two additional pairs of electrodes positioned at right angles to one another. When a voltage is applied across one pair of plates, the electron beam is attracted toward the plate with the more positive charge. This pulls the beam toward one side so that it will now strike the screen at some point off center. The amount of deflection will be proportional to the potential difference between the deflecting plates.

If an a.c. voltage is applied across the "horizontal" deflecting plates, the beam will swing back and forth between each plate as the polarity of the applied voltage reverses on each half cycle. The spot will then sweep horizontally across the screen at a rate equal to the a.c. frequency and it will appear as a continuous line due to the persistence of vision of the eye. This is further augmented by the persistence of the screen material. Similarly a.c. applied to the "vertical" deflecting plates will appear as a vertical line.

If a different a.c. signal is applied to each pair of deflecting plates, the total force acting upon the beam will be the vector sum of the instantaneous values of each signal. Thus, when the *same* a.c. voltage is simultaneously applied to both pairs of deflecting plates, there will be equal forces attracting the electron beam from two directions 90° apart, resulting in a line on the screen that is tilted 45° as shown at fig. 2.

In the above case, the phenomenon is quite readily understood, but for a more complicated situation refer to fig. 3 which shows how the waveform of a a.c. signal is produced as a display. When the horizontal signal is swept across the c.r.t. screen at a uniform (linear) rate over the same time period required for one cycle of the a.c. signal applied to the vertical plates, a trace of the wave results. Any number of a.c. cycles may be similarly reproduced simply by correctly proportioning the time required for the horizontal signal to traverse the screen in relation to the

*Technical Director, *CQ*.

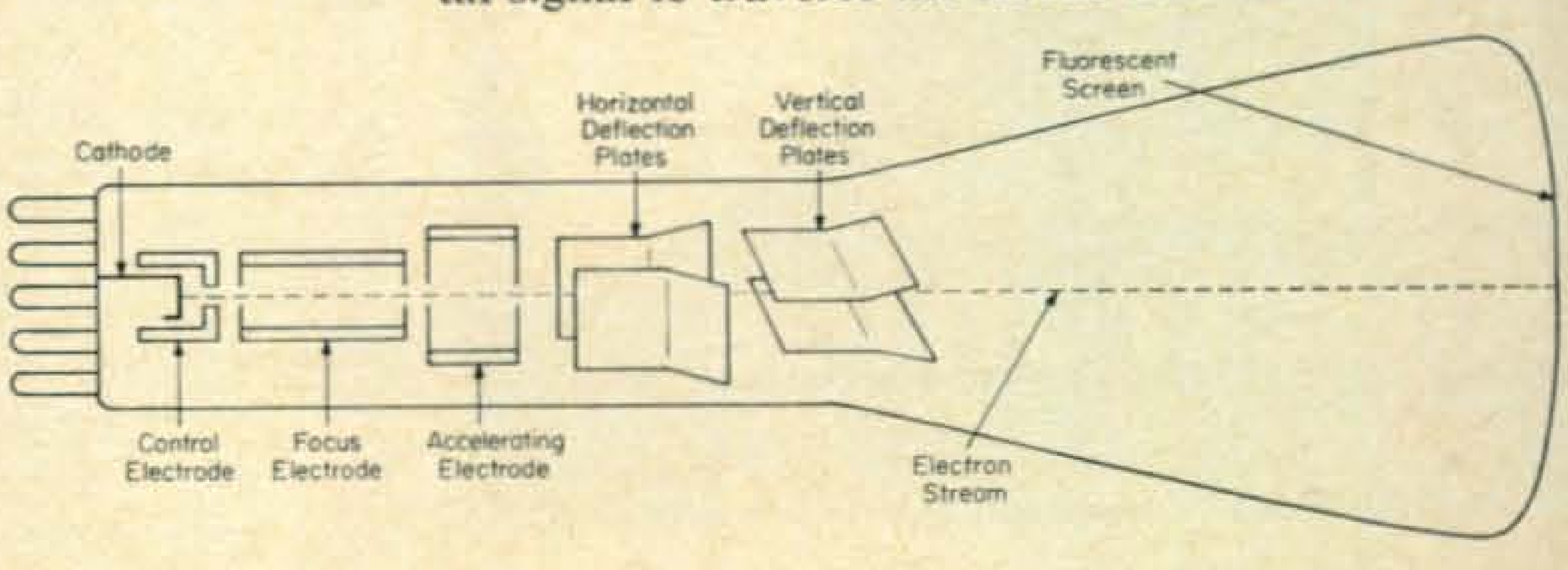


Fig. 1—Operation of cathode ray tube. Electrons are emitted from the cathode and are accelerated and focused into a narrow beam that passes between two pairs of deflection plates. A.c. applied to the plates will cause the beam to be swung from side to side. As the beam strikes the screen, it produces a lighter image.

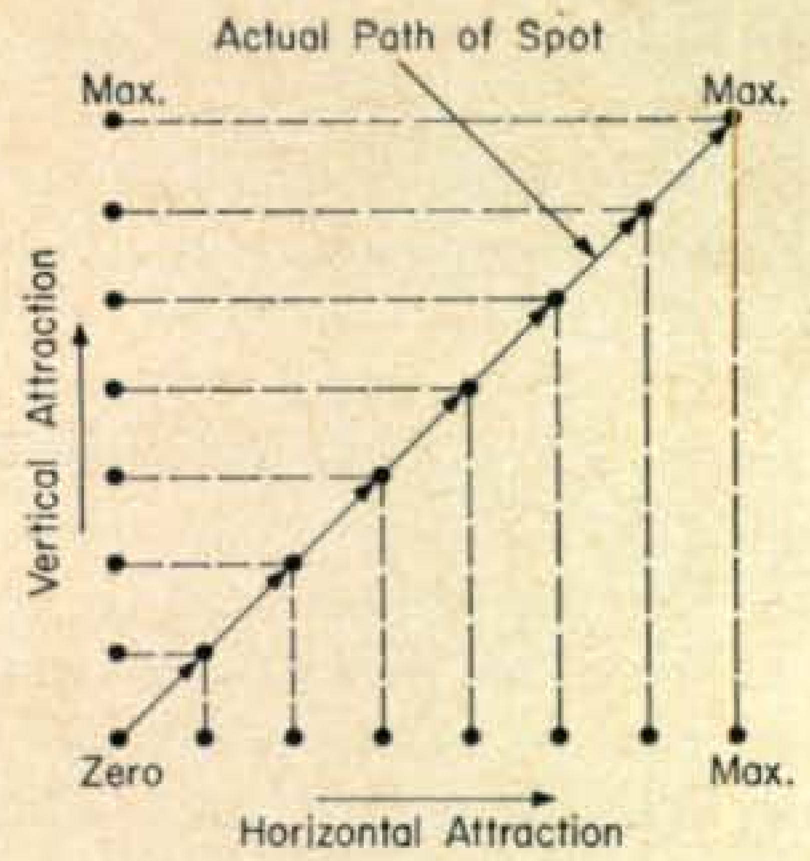


Fig. 2—An a.c. voltage applied to both the vertical and horizontal deflecting plates produces a trace which is the vector sum of the vertical and horizontal voltages. As shown here, the *same* a.c. voltage is applied to both sets of plates, so the actual path of the spot is along a 45° plane as shown correlated with dashed lines to the points to which the spot is *attracted* at given instants by the vertical and horizontal voltages.

frequency of the vertical signal. For example: if the horizontal-signal frequency or the time required for one sweep across the screen is one-half or one-third that of one cycle of the vertical signal, two or three cycles, respectively, will be displayed.

Horizontal Sweep

Horizontal linear-sweep voltages in the oscilloscope are obtained from a built-in oscillator that produces a saw-tooth waveform the aplitude of which steadily increases at a uniform rate, until the end of one cycle at which time the amplitude almost instantaneously drops back to zero, before the next cycle starts. See fig. 4. A return trace, during the time the saw-tooth signal amplitude returns to zero, usually is less

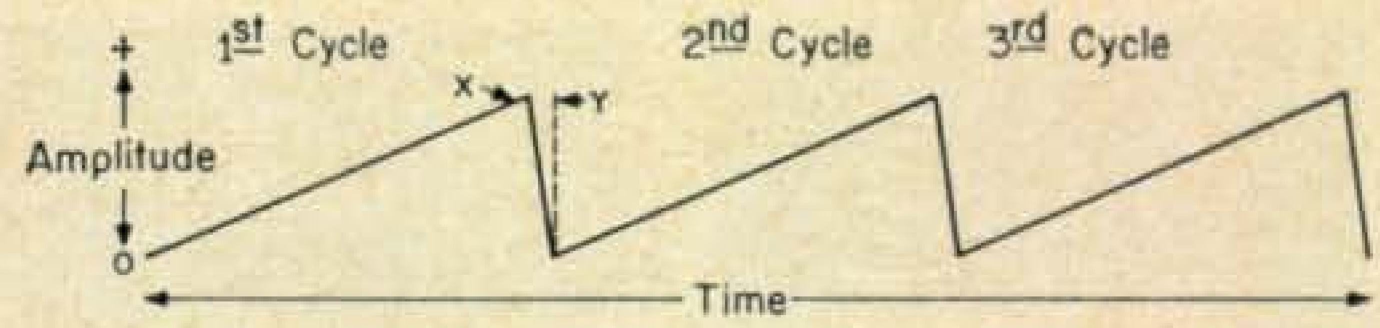


Fig. 4—Three cycles of saw-tooth waveform. The amplitude of each cycle increases linearly until near the end of the cycle, when it drops to zero during a minute fraction of the total cycle time, as indicated at X-4.

brilliant, because the "fly-back" time is much faster than the rising-amplitude time. Some scopes have built-in provisions for completely blanking out the return trace.

The oscillator frequency can be continuously varied from about 10 c.p.s. to 100 kc with a COARSE-FREQUENCY selector and a VERNIER-FREQUENCY control. The saw-tooth oscillator is a free-running affair and thus is subject to frequency instability which may cause the pattern on the screen to be unstable or drift to the left or right, so a SYNC control is provided with which a sample of the input-signal frequency is applied to the oscillator, causing it to lock-in on frequency. The display pattern then remains fixed.

The potential that is required to swing the electron beam is in the order of 50-100 volts for a one-inch deflection on the screen. Most of the voltages to be observed with the oscilloscope are very small, so they must be amplified before an adequate degree of deflection can be realized. A.c. amplifiers are therefore included in the oscilloscope which will produce one-inch deflection with a minimum input signal of about 25 mv. The amplifiers in general-purpose scopes usually cover a frequency range from a point below 20 c.p.s. up to 50-100 kc, while wideband

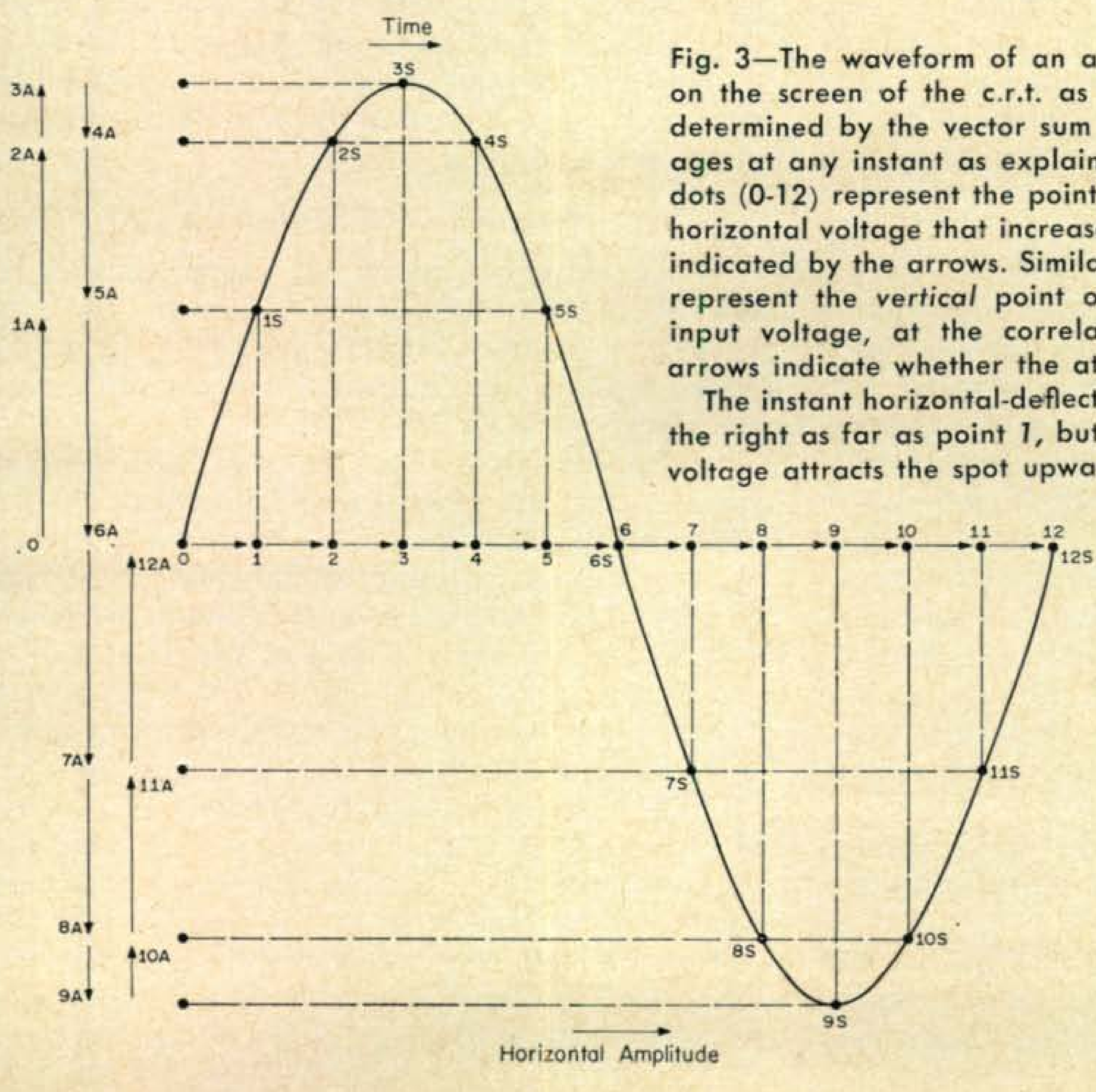


Fig. 3—The waveform of an a.c. vertical-input signal is produced on the screen of the c.r.t. as follows: The spot traverses a path determined by the vector sum of the vertical and horizontal voltages at any instant as explained in fig. 2. The horizontal row of dots (0-12) represent the point to which the spot is *attracted* by a horizontal voltage that increases at a uniform rate in the direction indicated by the arrows. Similarly, the vertical line of dots (0-12A) represent the *vertical* point of attraction, due to the sinewave input voltage, at the correlated uniform time increments. The arrows indicate whether the attraction is up or down.

The instant horizontal-deflection voltage attracts the spot toward the right as far as point *1*, but at the same time the vertical-input voltage attracts the spot upward as far as point *1A*, with the net result that the vector sum of both attractions causes the spot to actually be drawn to point *1S* (on the sinewave) as shown with the dashed lines from *1* and *1A*. Likewise, 2S is correlated with the horizontal and vertical instantaneous points 2 and 2A, and so on throughout the whole cycle.

Actually, a spot occurs at every instant of time, and a complete display of the entire sinewave, as indicated along *1S, 2S, 3S*, etc., is obtained. Only a few points are shown here for clarity.

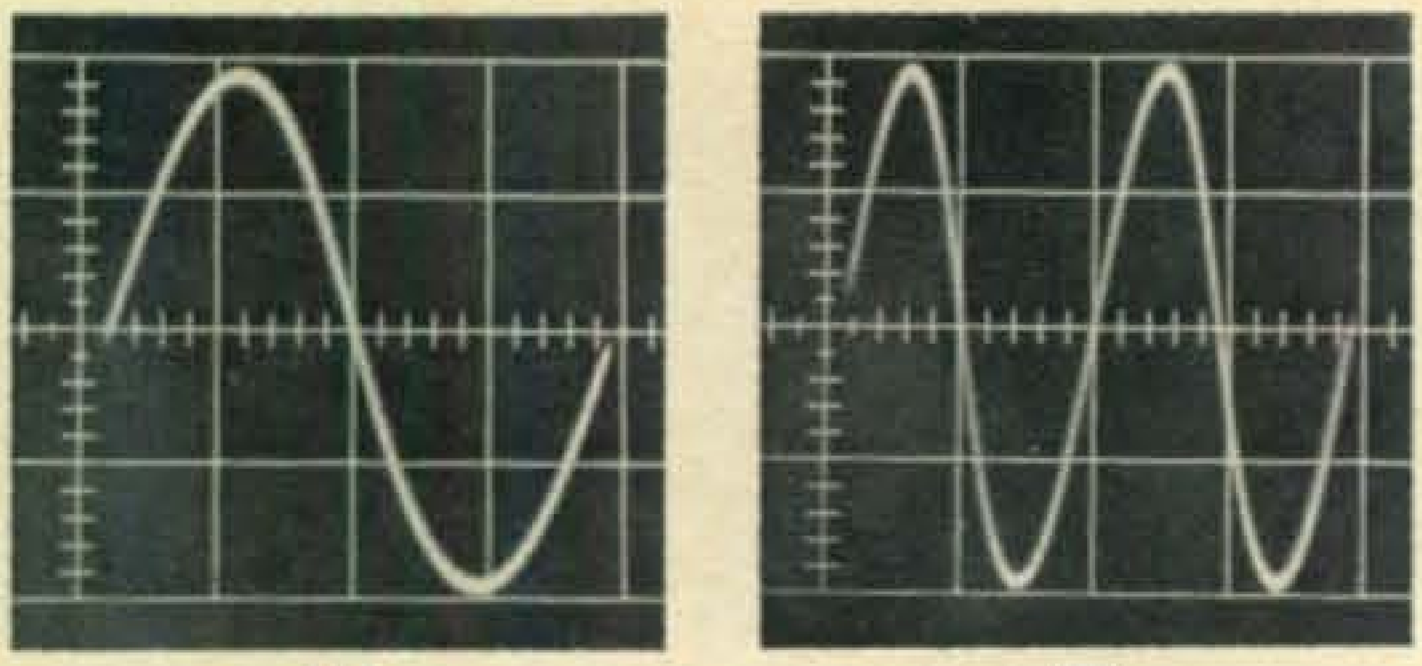


Fig. 5—(A) One sine wave cycle produced using a linear *horizontal* signal. (B) Two sine wave cycles produced as in (A).

models go up to about 5 mc. Many of the more recent oscilloscopes provide d.c. amplification also, the advantage of which will be taken up later. The amplifiers are equipped with gain controls and in many cases an attenuator is included for adjusting the vertical-input level in specific steps. For cases where it is desired to use the scope at frequencies above the range of the in-internal amplifiers, especially at radio frequencies, provisions may often be found for applying the signals directly to the deflecting electrodes without the use of the amplifier.

The oscilloscope is equipped with a transparent scale, called a graticule, that is placed over the face of the c.r.t. screen. It has uniformly spaced vertical and horizontal lines which form square grids that may be used as references for voltage calibration, observations at instantaneous points along the trace, tilt angles, relative amplitudes, etc. The horizontal axis is called the "X Axis" with the negative side (or zero time) at the *left* and the positive side at the *right*. The vertical axis is called the "Y Axis" with the positive at the top, the negative at the bottom. The "Z Axis" normally would be the plane looking in and out of the screen, but in cases where a "Z Axis Input" is provided, it is used to vary the intensity of the trace at a desired instant by means of a pulsed signal, an application seldom required with amateur gear.

Voltage Measurements

The height or width of the image displayed on the c.r.t. screen is dependent on the amplitude of the signal and since the entire waveform is shown, the instantaneous voltage at any portion of an a.c. cycle can be determined if the instrument is appropriately calibrated. From this it may be realized that many voltage measurements can thus be made that cannot be done with conventional type voltmeters, especially where peak or instantaneous voltages are involved. You do not have to be concerned with whether or not the instrument responds to or indicates peak, r.m.s. or average values; and further, readings can be made with the scope on *any* type waveform and at any portion of the wave. Instruments that incorporate direct-coupled amplifiers will also measure d.c. voltages.

Many oscilloscopes are therefore provided with a "voltage calibrator" that supplies a reference voltage against which the instrument scale may be calibrated. This voltage generally is obtained from a portion of the 60-cycle heater voltage, producing a sinewave with a known peak or peak-to-peak voltage. Once the scope has been calibrated accordingly, a built-in attenuator with discrete steps is then used to provide different voltage ranges, effectively functioning like the range selector on a v.o.m.

We'll not take up space here to go into a description of how to initially set up the scope for basic operation, as this normally is well covered in the manufacturer's instructions. On the other hand, the following procedures are suggested for becoming familiar with the general performance of the instrument as may be needed subsequently.

Sync Operation

First let us take a look at the operation of the sync. Connect the voltage-calibrator output or the 60-cycle test terminal (sometimes otherwise provided) to the hot side of the vertical input and adjust the VERTICAL gain until the height of the image on the screen is one or two inches. Then, with the SYNC control at minimum and the SWEEP-FREQUENCY selector at the lowest range, adjust the HORIZONTAL gain until the width of the image is about the same as the height. If necessary, adjust the vertical and horizontal POSITIONING controls so that the image is at the center of the screen.

Next, slowly adjust the SWEEP-VERNIER control until one or two cycles of the input signal are seen in as stable a position as possible. In all probability the pattern will tend to move sideways as the sweep-oscillator frequency attempts to drift, so rotate the SYNC control until the image stands still. A slight readjustment of the SWEEP-VERNIER may have to be made at the same time. The correct adjustment will be indicated when sync is maintained while the signal amplitude is varied over most of the c.r.t. screen. Too much sync may cause distortion of the pattern or again produce instability.

Frequency Observations

If the frequency of an a.c. signal applied to one set of deflecting plates is known, the frequency of another signal applied to the other plates may be determined as in the following exercise:

Set up the scope with a 60-cycle vertical-input signal as just described for checking sync operation. Slowly adjust the SWEEP-VERNIER until *one* cycle of the vertical-input signal is observed. See fig. 5A. The frequency of the sweep oscillator will now be the same as that of the input signal, or 60 c.p.s.

Next, slowly rotate the SWEEP-VERNIER until *two* cycles of the input signal are seen. See fig. 5B. The sweep-oscillator frequency will now be 30 c.p.s., or *half* that of the signal, (or taking the opposite viewpoint, the frequency of the vertical signal will be *twice* that of the oscillator).

Now, if the SWEEP-VERNIER is adjusted for *three* visual cycles, the ratio will be 3 to 1 and the sweep rate is 20 c.p.s. Similarly the ratio will be 4 to 1 with a 15-c.p.s. sweep when *four* cycles are seen.

It may be noted that as the sweep frequency is dropped below 30 c.p.s., the trace appears to flicker. This is normal, because the spot is then moving across the screen at a relatively slower rate where the persistence of vision or that of the screen material no longer is sufficient to produce the appearance of a continuous line.

Lissajous Figures

The patterns just described will be obtained only when the sweep is linear. If a *sinewave* is applied to *both* the vertical and horizontal inputs, a similar trace will result, except that instead of an abrupt start and finish of the trace, a continuous pattern folded back on itself with a complete train of loops will be seen as shown at fig. 6. This is called a *Lissajous Figure*.[1] The principle of frequency comparison is the same as described above; that is, the number of cycles or loops indicates the ratio to the reference signal.

When the vertical and horizontal signal frequencies are identical, only one loop will occur and it will appear as a stationary circle. See fig. 6A. At other frequency ratios the pattern will be a closed loop of sinewaves as shown at fig. 6B-F.

When the reference frequency is applied to the *horizontal* input, the unknown frequency applied to the vertical input will produce horizontal sinewaves if the unknown frequency is *higher* than that of the reference and the pattern will appear to rotate in the horizontal plane (on a vertical axis) when the two frequencies are not an exact ratio. Conversely, if the unknown is lower in frequency, the sinewaves will lie vertically, with any rotation taking place in the vertical plane (on a horizontal axis).

The ratio is determined by the number of loops touching an imaginary horizontal edge, to those touching a vertical edge. For instance: at fig. 6C there are three loops along the horizontal edge and one loop at the vertical side. The ratio therefore is 3 to 1, so if the reference frequency at the horizontal input is 60 c.p.s., the unknown frequency at the vertical input is $3 \times 60 = 180$ c.p.s. On the other hand, at fig. 6D the ratio also is 3 to 1, but since the sinewaves are vertically oriented, the unknown frequency is $60 \div 3 = 20$ c.p.s.

The *exact* frequency ratio exists only when the image stands still. If a drifting image appears to rotate slowly enough to permit counting the number of loops, the error will be small. This may be checked by determining the length of time it takes the moving image to make one complete revolution. For example: 1 cycle of rotation in 1 second is a 1-cycle difference, 2 cycles of rotation in 1 second is a 2-cycle difference, 1 cycle of rotation in 2 seconds is ½-cycle error, etc.

[1]Strictly speaking, a Lissajous Figure is any display produced on the c.r.t. by a combination of vertical and horizontal signals; however, common usage of the term refers to the type patterns indicated in the text.

*Technical Director, *CQ*.

When a fairly high ratio is involved, increasing the horizontal amplitude to spread out the trace will make it easier to count the loops, but if the ration is greater than about 10:1, it still may be difficult to discern the number of loops, especially if the image cannot be made absolutely stationary. In such a case, it will be better to use a higher reference frequency such as 440 or 600 c.p.s. obtained from WWV or another accurate source.

Lissajous Figures may be demonstrated by using a variable a.f. sinewave oscillator connected to the vertical input of the scope, while a 60-c.p.s. signal from a line-power source (the 60-cycle test terminal, for example) is applied to the horizontal input for the reference. In order to become familiar with interpreting these patterns and seeing how they are formed, it might be well to follow through with such an exercise.

Our discussion so far has covered only some of the fundamental principles of operation with the oscilloscope. Other basic functions, such as those concerned with phase, distortion and modulation, will be treated in future installments; as will practical applications related to amateur gear. ■

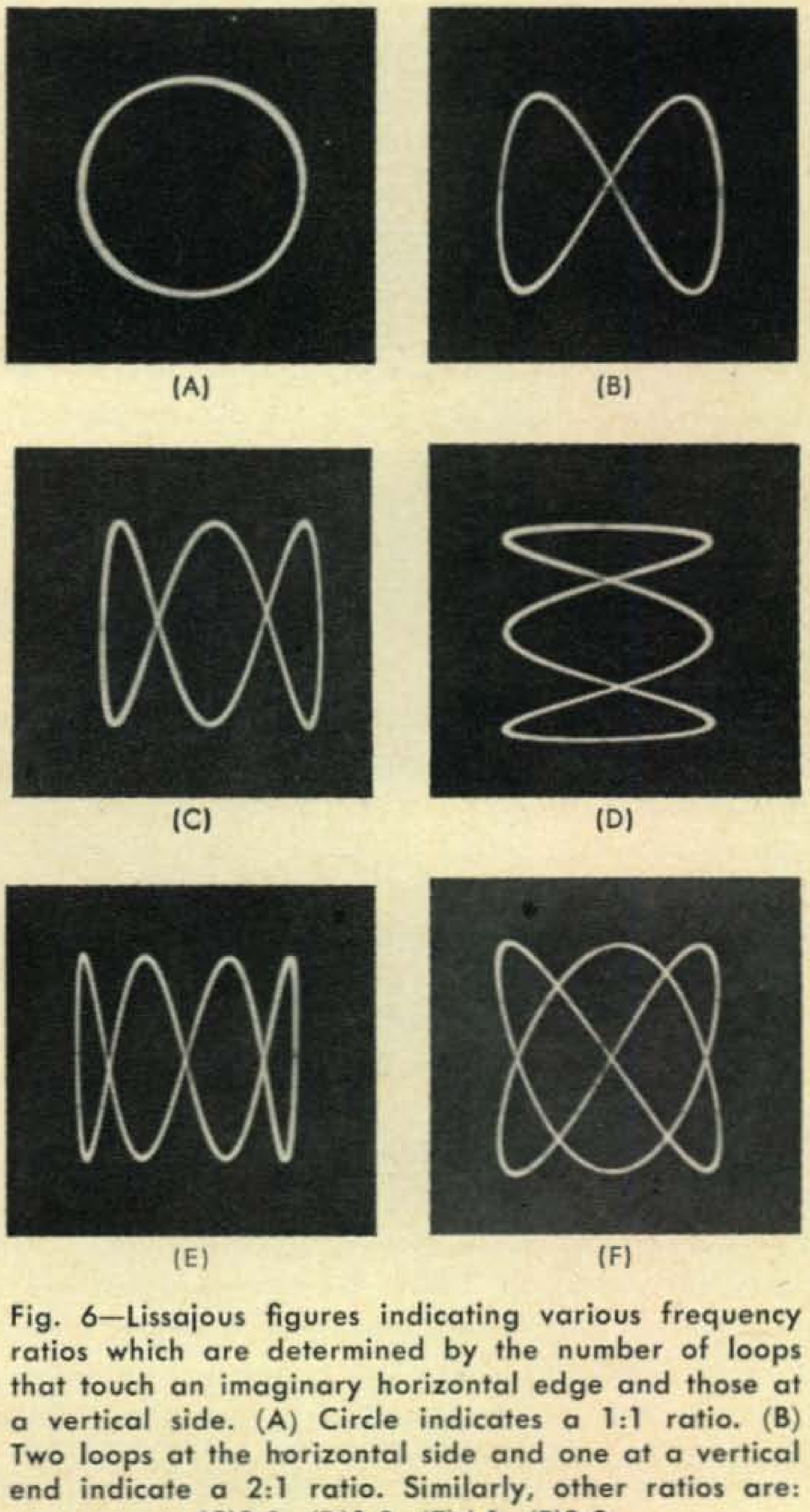


Fig. 6—Lissajous figures indicating various frequency ratios which are determined by the number of loops that touch an imaginary horizontal edge and those at a vertical side. (A) Circle indicates a 1:1 ratio. (B) Two loops at the horizontal side and one at a vertical end indicate a 2:1 ratio. Similarly, other ratios are: (C)3:1, (D)1:3, (E)4:1, (F)3:2.

Because we're new to readers of this magazine, may we introduce ourselves, our policies, & purposes

We intend to render prompt service at fair prices and to stay in business a long, long time

These are interesting days for ham radio.

More of you are licensed than ever before and yet there is a higher degree of uncertainty about our privileges and future.

The science of our art has become more complex and difficult to understand. Communications gear is smaller and harder to maintain.

Our country needs a very large reservoir of trained radio personnel.

More and more of you are living under restricted physical conditions and more and more of you are on the go, moving quickly from one place to another.

The number of distributors merchandising ham radio gear today is fewer and those who still sell this type of merchandise generally do so as a part of a larger type of business, varied in scope and appeal.

° ° °

These facts are irrefutable, yet they paint a true picture of ham radio today. A most inconsistent part of the picture lies in the distribution of the product. At the end of World War II and for the preceding 25 years, the mark-up available to the distributor was an even 50%. As an illustration, a communications receiver having a list price of $250 would be invoiced out by the factory at $100 to the distributor and the distributor in turn would sell the set to its technically competent customer at 40% off list, or $150. The distributor had, by simple arithmetic, a full 50% on which to work. He paid his salaries, taxes, and other legitimate business expenses from this figure and still had room for a respectable profit. As a result of this price structure, there were literally 10 times as many distributors available throughout the country then as there are now and it was possible then to seek technical help from a substantial number of these concerns without having to go clear across the country on a mail order basis to do shopping. For the past 20 years, the Radio Electronic Television Manufacturers Association and their successors, the EIA, have been singularly successful in promoting a different concept of pricing.

These days, the use of a list price as a basis of thinking is largely disregarded. There is usually the "amateur net" to contend with and from this "amateur net", the distributor derives a gross operating revenue averaging 25% from the manufacturer. This is an amazing inconsistency and not properly a reflection of the distributor's needs for with ½ the gross, the distributor has to pay higher wages than ever before, higher taxes, and generally has greater business expenses. If you think he has motivation out of such an arrangement, or a reasonable profit, you are largely wrong. The EIA ought to change its discount schedule. This is the single reason why the distribution in this country today, of amateur equipment, is so miserable. We in the business must concentrate on "deals" wherein our gross profit is larger. These deals represent errors of bad judgment on the part of the original manufacturer who is seeking relief. They *do not* represent that which is best for the ham. So, in a most primitive way, the distributor is torn between his desire to survive economically and his desire to do the right thing for his customer.

Consider wages. In order for us to attract the technically competent type of personnel required for this business, we have to pay a wage scale sufficiently high to keep the same man from succumbing to the inducements of the defense industry yet we must have this type of help; otherwise, how can we implement the type of service which you take for granted from a distributor.

This, then, is the amazing paradox of our trade,—the desire on the one hand to be the kind of house you want, rendering fast personal service, giving expert advice, carrying a diverse stock in depth, and providing a clean, unfettered atmosphere in which to purchase, and on the other hand, a wish to operate profitably, to pay our bills as they become due, and to derive a living so to speak from doing the thing we like most of all to do.

° ° °

How would *you* resolve this problem? Here at Harvard, we have decided on a definite policy and adherence to this policy is one promise we will make to you, our ultimate customer. These are our Ten Commandments or principles:

1. We will sell only that merchandise which we conscientiously know to be sound. We will not knowingly sell you any cheap, slipshod gear which will not do the job expected nor give you all the service and maintenance-free life you seek. This means that we cannot always purchase every item in a manufacturer's line. Hams aren't dopes—they know the difference between a communications set and a low priced SWL receiver.

2. Merchandise purchased from the Herbert W. Gordon Company has to do what it's expected to do. If it fails, we want to be able to back it up with prompt service. We will sell only that merchandise which, in addition to the manufacturer's warranty, can be serviced by us as well. In short, if we cannot guarantee the set and provide for its servicing in our repair department, we do not want to handle that merchandise. To that end, we maintain a large stock of in warranty repair parts. Life is too short to waste time tying up a set for weeks at a time.

3. We want to be able to offer a very broad assortment of used material to the trade. New hams appear each day and when a young fellow is getting started, we agree with his Dad that there ought to be a low price level available with which to test his sincerity. To this extent, we have a large assortment of used equipment, quite possibly the largest such assortment in the country.

4. We wish to make available to the experienced ham all of the latest equipment designed and produced commercially and we wish to provide him the opportunity of comparing the selling features of one set against the features of another set. Such side by side comparisons are possible only in a specially-designed display area. We have that display area available now with 27 antennas to choose from, and with expert help to boot.

5. "'Tis human to err and your choice might indeed represent a mistake for you. We have to be big enough to understand these things and to make allowances for the error of your choice. We, therefore, have a 2-week exchange period which permits you to return new merchandise which you purchase, for full refund or credit provided only that the original packing and original condition of the set have been preserved. We feel similarly that you ought to be provided with the means of going up in quality within a short period of time of your original purchase without being penalized. Accordingly, you may return any set within 60 days and have your full purchase price credited to the higher priced set of your choice.

6. Merchandising houses such as ours should stock all the necessary items commonly needed by a ham—the rotators, the towers, the beams, the coax, the fittings—and if you should be building your own, all of the likely material that you will want from transformers to sockets.

7. In this day of sophisticated radio, it isn't everyone who knows everything about our subject. We don't ourselves, but if we have a good reference library and a photo reproducing device, we can come pretty close to satisfying all of the technical questions sent our way. To that end, we have over 3,000 technical manuals, better than 200 standard texts and the leading ham periodicals going back to 1917—all available for your reference and what's more, the persons who work here have been selected for their attitude of being helpful and informative, as well as friendly.

8. We want our customers satisfied for in the final analysis a satisfied customer is the only kind to have. Knowing that you're happy will let us sleep nights.

9. We want to represent the things we sell accurately and honestly. We do not wish to use highfalutin words to describe a hundred dollar radio. What adjectives would we have left with which to describe the HRO-500 for example?

10. We want to take pride in our job and earn the respect of our neighbors in the business community.

* * *

To do these things of which I speak and to ensure our survival, requires that we charge a fair price. John Ruskin once said "It is unwise to pay too much, but it is unwise to pay too little. When you pay too much you lose a little money, that's all. When you pay too little, you sometimes lose everything. Because the thing you bought is incapable of doing the things you bought it to do. The common law of business balance prohibits paying little and getting a lot . . . it can't be done. If you deal with the lowest bidder, it is well to add something for the risk you run, and if you do that, you will have enough to pay for something better." While we have every wish to be competitive, so to speak, with the other jobbers or distributors throughout the country, it is nevertheless important to point out that our pricing reflects a desire to adhere to these principles and you, the customer, should not make the mistake of assuming that any given piece of equipment as represented by the XYZ Sales Company and selling for such and such a figure is identical with the same model being offered by this firm. There is a vast difference between a thoroughly reconditioned and overhauled communications receiver painstakingly restored to its original performance and the kind of set which is sold "as is" after having been owned and kicked around 5 or 6 years. Please compare apples with apples, pears with pears, etc. Some pieces of equipment are employed as production tools for three consecutive shifts. The equipment may well see hard service; its tuning bearings may well become worn; its accuracy permanently lost.

(Continued on next page)

(Continued from page 29)

RECIPROCITY PROMOTERS MEET

Two old friends, Barry Goldwater, K7UGA, and Alberto Calleja, XE1NE, met in early May in Mexico City. Alberto has been doing much the same job for Mexican amateurs as did Barry for U.S. operators in the field of reciprocal licensing. Incidentally, Alberto's beam (right) towers 272 feet above 7500 foot high Mexico City!

C. W. and Extended Coverage for the SBE SB-34

BY KATASHI NOSE, *KH6IJ

This compact mobile rig has been modified for c.w. operation. Further modification was necessary to change the frequency coverage in order to tune the c.w. portion of the bands.

The Sideband Engineers SBE-34 is a compact transceiver which is completely self-contained, except for microphone (or key) and antenna, and is a true portable.

However, there is no provision for c.w., and frequency coverage is strictly for phone operation. Extending the frequency range is no problem; it merely entails switching in the proper crystal(s).

C.w. operation poses somewhat of a more difficult problem. The first approach was to construct a simple transistorized code oscillator to feed into the microphone jack. By feeding pure audio tones into the microphone one gets a steady carrier (c.w.) *provided* the suppression is adequate, and, provided the audio is a pure sine wave; otherwise you are liable to hear from the FCC.

A simple transistorized audio oscillator proved unsatisfactory since a check showed that the signal was A2 (tone modulated). Something more elaborate than a simple code oscillator was required. Since I wanted to use the set for c.w. mobile operation, the compact feature of the set would be destroyed by any external bulky device.[1] Moreover since this is a transceiver, there is no way to monitor one's signal for carrier suppression, or determine the quality of emitted signal when operating in the field.

The final solution proved extremely simple and it consisted merely of wiring the key in parallel with the TUNE-OPERATE switch and using a reverse contact key.[2]

*Dept. of Physics, Univ. of Hawaii, Honolulu, Hawaii.
[1]SBE now markets a c.w. code adapter for $39.95.
[2]In fairness to the reader it must be pointed out that *any* modification voids the manufacturers guarantee.

A study of fig. 1 shows that in the TUNE position, carrier injection is accomplished by inserting a small amount of 456 kc oscillator signal after the mechanical filter, thereby upsetting the carrier balance and providing a c.w. signal for tuneup purposes.

Further study of the circuit diagram shows that an RCA phono plug in the rear panel provides bias for a linear amplifier. Since a linear was not used, this jack was used for the key. Conversion to c.w. therefore, merely entailed running one wire from the front panel tune-operate switch (which conveniently has an empty position) to the rear apron jack, after unsoldering the emitter lead of Q_{23} which is not used.

Keying

The only catch is that, with this system a reverse contact key must be used. This is no problem if one uses a military J-38 surplus key which has a bakelite base. Merely reroute the wiring so that the back stop is used as a contact, not the regular contacts. This means that you have to be a "positive sender" (crisp keying) because the signal is keyed as soon as you depress the key.

Since 456 kc is being keyed, the contacts must be clean at all times. This is no problem if you merely wiggle the key arm sidewise a few times during the day. Use a coaxial cable or microphone cable for the keying lead. No key clicks result since there is considerable *RC* time lag in the coax and stray wiring at 456 kc.

A.M. Phone

Phone operation is still carried out in the normal manner since none of the original func-

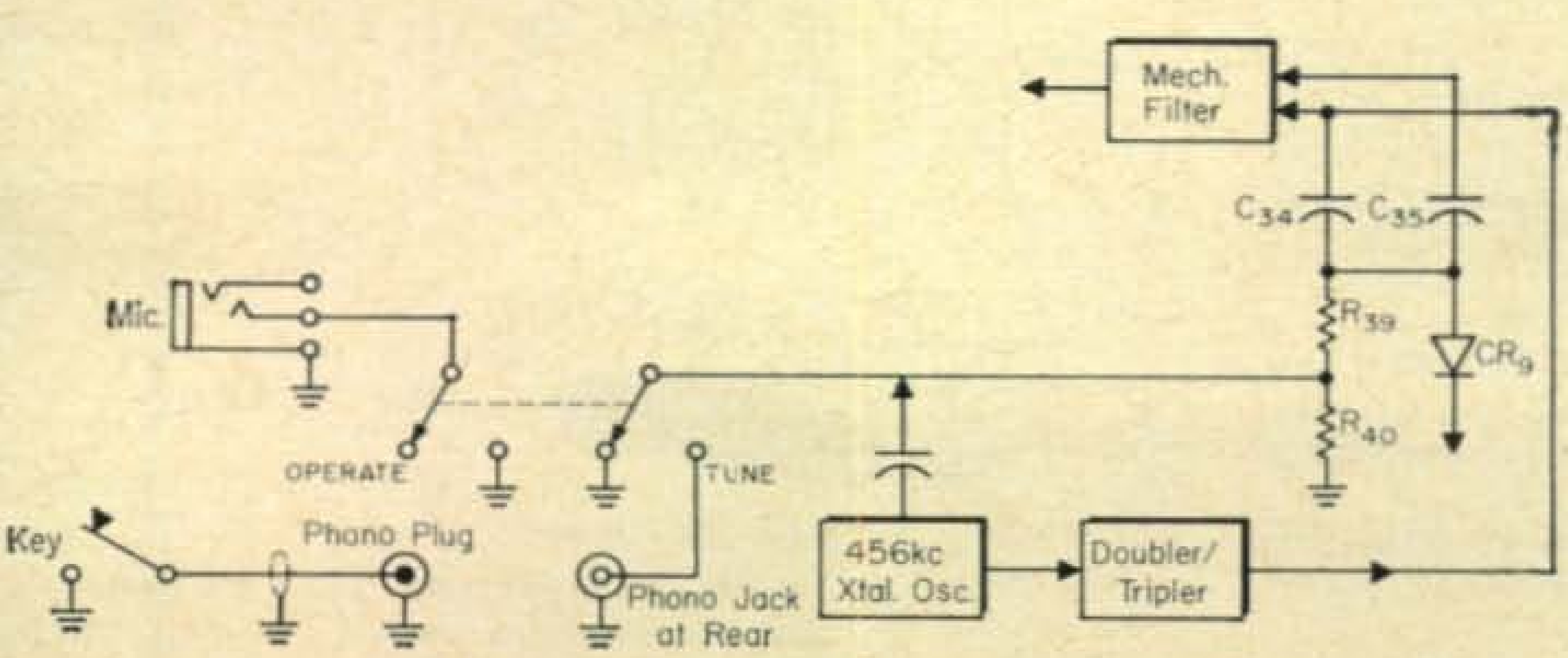


Fig. 1—Circuit of the TUNE-OPERATE switch of the SBE-34 transceiver. The modification for c.w. operation consists of adding the wire from the switch pole marked "Tune" to the phono jack on the rear apron. Note that a reverse contact key must be used, as described in the text.

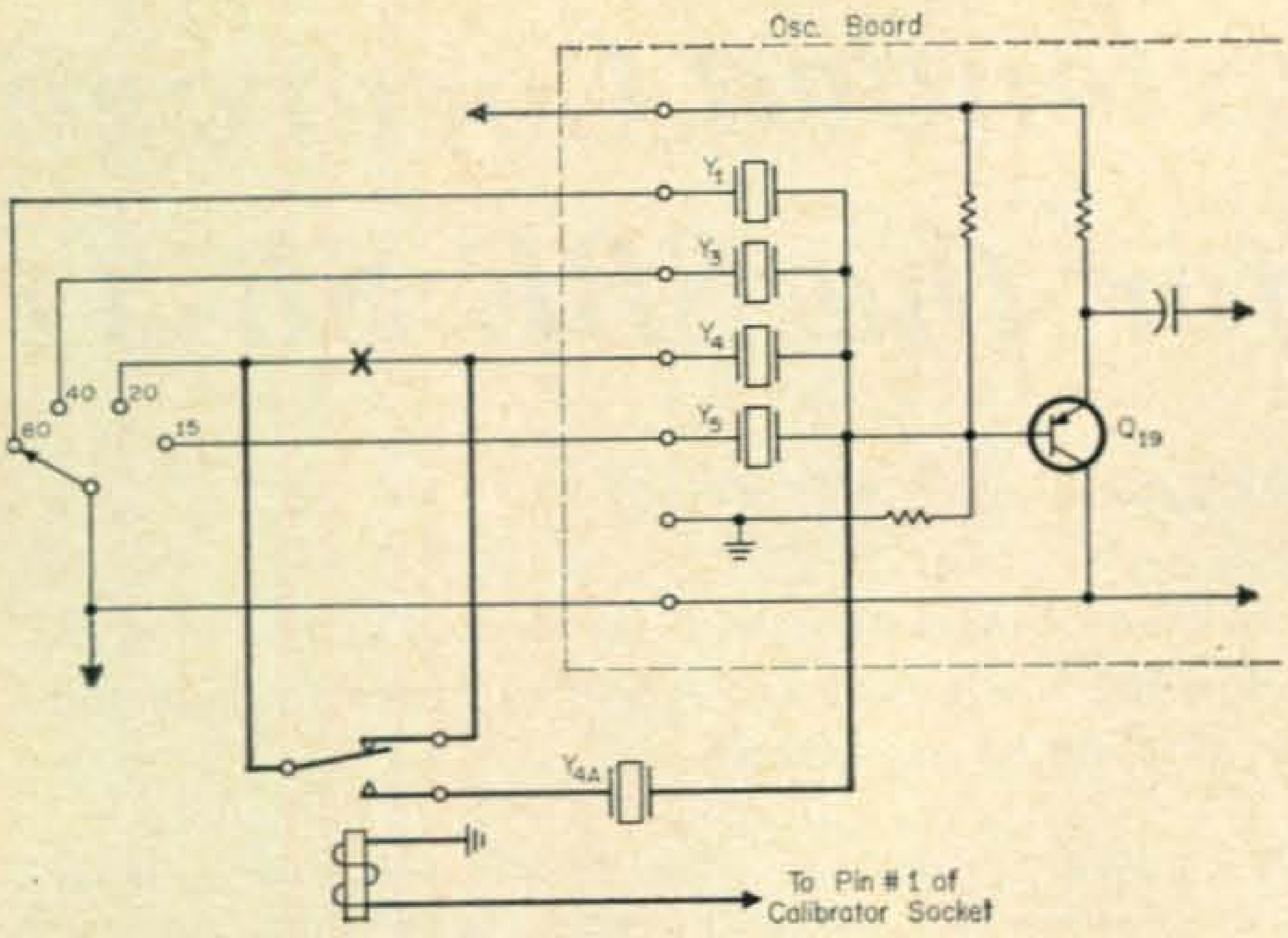


Fig. 2—The simple addition of a small 12-28 volt d.c. relay and an additional crystal, Y_{4A}, to the SB-34 allows extended frequency coverage. Heavy lines indicate additional wiring.

tions are altered. The TUNE-OPERATE switch in effect becomes a phone-c.w. switch. Incidentally you can go a.m. phone by operating phone in the tune-up position, something which SBE fails to mention.[3]

Frequency Coverage

For c.w. operation it was desirable to extend the lower limit from 14,100 to 14,000 kc. Frequency coverage is determined by crystals Y_2, Y_3, Y_4, Y_5 for 80, 40, 20, 15 respectively. The crystals normally supplied are 7200, 10475, 17,525, and 24625, which beats with 3175-3425 kc to get normal coverage of 250 kc segments. Therefore if one uses a 17,425 kc crystal to replace 17,525, one gets 14,000 to 14,250 coverage instead of the original 14,100-14350 kc. This is very convenient since to get true dial reading one merely subtracts 100 kc from whatever the dial setting is.

The easiest way to switch in crystals is by means of a miniature relay such as the Allied KH series, Advance MV series, Potter Brumfield SC series. Any miniature 12-28 volt d.c. relay will do if you can fit them in the space.

Both relay and crystal(s) are attached with masking tape to the existing crystal bank. To determine which crystal is which, tune to a suitable signal frequency and touch a lead pencil to the terminal board lead. The one which pulls the signal is the desired lead.

The relay is actuated by supplying 12 volts from pin #1 of the crystal calibrator socket. The front panel Calibrate switch actuates this relay and therefore frequency switching consists merely in turning on the calibrate switch. (See fig. 2) If there are enough contacts on the relay, one can switch in a family of crystals for any frequency coverage within the tuning capability of the *LC* circuits.[4]

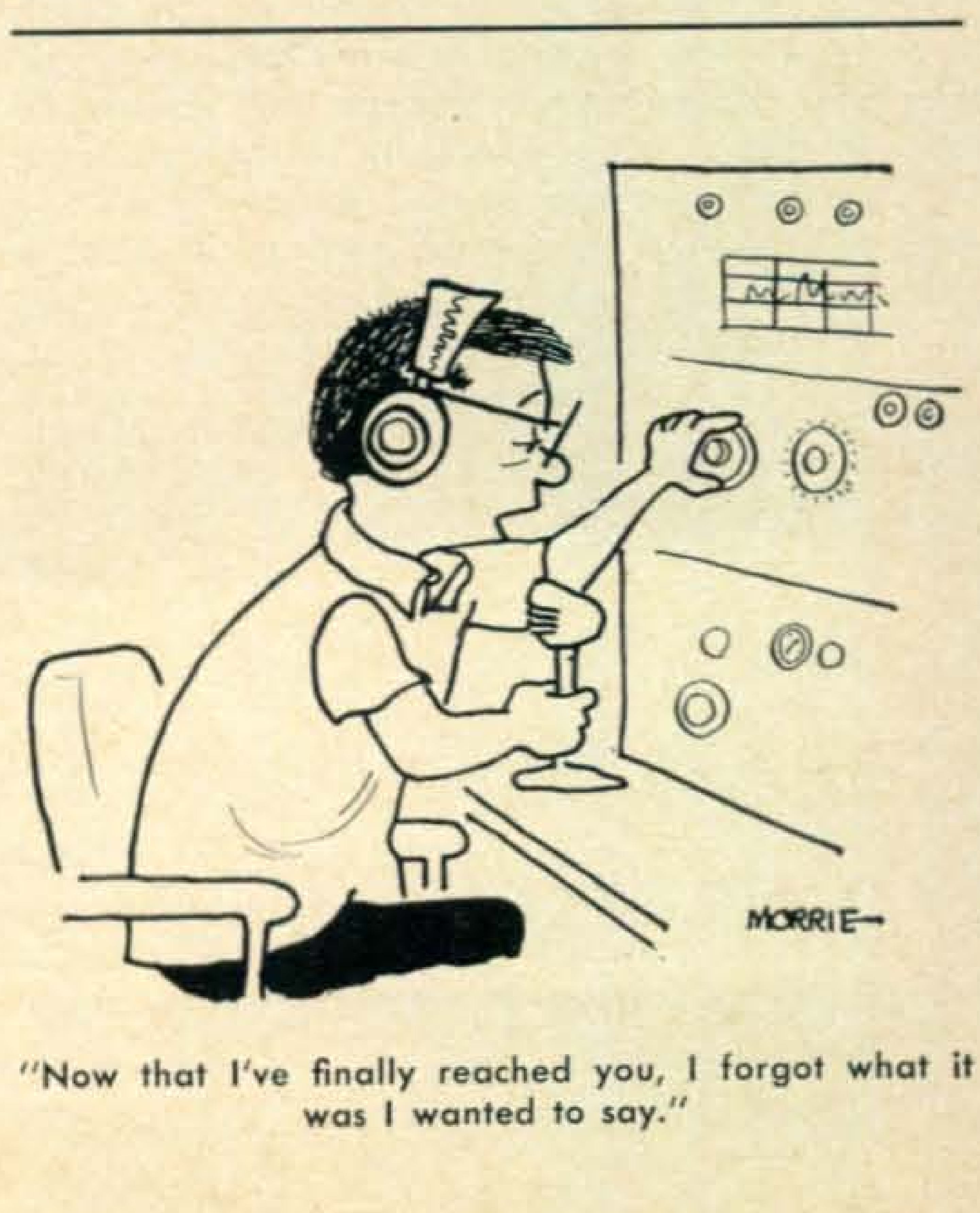
[3]Extended operation is not recommended in this mode since the plate dissipation will be exceeded unless external cooling is used. A series resistance is recommended to cut down the carrier injection.

[4]There is always the possibility of spurious radiation after this sort of modification, so a careful check of the spectrum should be made.

Summary Of Wiring

Extending frequency coverage and c.w. operation therefore consists of installing a jumper wire from the vox plug in the rear to the relay coil, another jumper wire from the front panel TUNE-OPERATE switch to the linear amplifier jack in the rear, taping a relay and crystal to circuit board. No cutting, drilling, or disfiguring of original wiring is involved.

During the summer of 1965, 9000 miles of mobiling was enjoyed from Quebec, to South Carolina, to San Francisco, from 11,200 feet elevation to the hot deserts of Utah on mobile c.w. The set looks like a BC transistor radio and was able to pass the guards at the dormitory from which I operated with a #30 wire antenna when not mobiling, and finally I was able to tuck it under my arm as hand luggage from San Francisco to Hawaii. Best of all it took me only one hour to install the set in the car at a motel, including antenna and ignition suppression. ■



"Now that I've finally reached you, I forgot what it was I wanted to say."

FOR SALE, SURPLUS: One radio transmitting station, will put out solid signal simultaneously on 2.5, 5, 10, 15, 20 and 25 mc, crystal-controlled; transmissions accurate to 1 part in 10^{11}. Apply National Bureau of Standards, Greenbelt, Maryland, after July 1, 1966.

WWV Moves

BY GORDON ELIOT WHITE

UNDOUBTEDLY the above ad will never be written, but it is true, Station WWV, near Washington, will leave the air at 0000 hours on Dec. 1, under present plans and the building will be razed to make way for a National Aeronautics and Space Administration lab.

At the same instant a new WWV in Fort Collins, Colorado, will come on the air with a stronger, slightly more accurate signal, better located to serve users in the western states as well as in the east.

The move of WWV to Colorado has been planned ever since the Bureau of Standards established its Radio Standards Laboratory at Boulder, Colorado, containing the super-accurate cesium atomic clock. Low frequency transmitters of WWVB (60 kc) and WWVL (20 kc) have been on the air since 1963 at the Fort Collins transmitter site.

The shift of WWV will bring the station close enough to the Boulder laboratories to improve frequency stability regulation. But the chief impetus for the move is to give better service to the thousands of laboratories on the west coast that did not exist when WWV-Washington was put on the air in 1923. According to Dr. A. V. Astin, director of NBS, the move will have very little effect on users in the east.

The standard frequencies will be maintained with the same services, tones, etc. as at Greenbelt. Power and antennas will be improved so that as far as propagation conditions allow, east coast users will continue to receive WWV almost as well from Colorado as from Maryland, according to the engineers at NBS. Of course the 25 and 20 mc signals will often be inaudible because of m.u.f. (maximum usable frequency) failure in the ionosphere, but the lower frequencies should be solid in most of the United States and, in fact, much of the world.

Accuracy Shifts

NBS admits that "for a small group of users within about a 25 mile radius of the Greenbelt location, who have been receiving WWV signals with very high accuracy because of their proximity to the station (Ground wave reception) may find the signal slightly degraded over the longer path." The problem is under study, and some possible special auxiliary service may be set up for the private and government labs in the Washington-Baltimore area.

For users with an extreme need of accuracy the move may require that they make adjustments in certain equipment. The super-accurate standards at Cape Kennedy may need realignment because of differences in the length of the propagation path from Colorado, and thus a minute time lag difference.

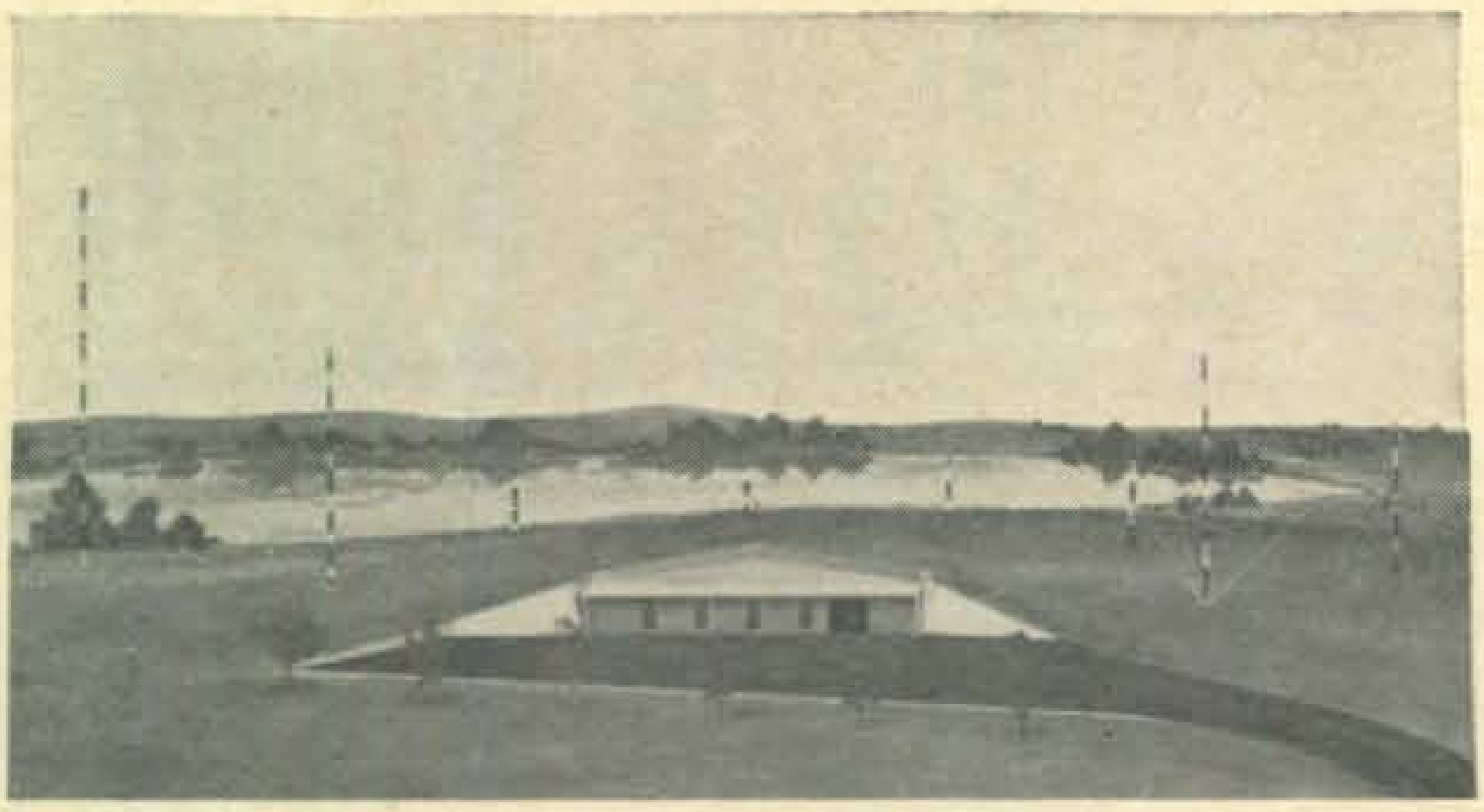
But for most amateurs the inconvenience will be negligible, NBS says. The chief sufferers will be those Washington area amateurs who have been using the 25 mc ground wave for receiver sensitivity checks.

Costs

The cost of the move will be just under the $970,000 that Congress voted in 1964. Although capable of putting out a 20 kw signal on 5, 10, and 15 mc, the new WWV will operate at 10 kw

Existing WWV transmitting station at Greenbelt, Maryland, near Washington, D.C. The station puts out signals on 2.5, 5, 10, 15, 20 and 25 mc. Antennas are ¼ wave dipoles on utility-type poles with 600 ohm open wire feel lines. The station is next door to NASA and its signals have interfered with delicate measurements at the Goddard Spaceflight Center.

Interior of old WWV station showing main transmitters for 5, 10 and 15 kc signals. Most of the equipment is of RCA manufacture, with General Radio monitoring equipment in the rack in the left-center of the photo. Not shown is the 25 kc transmitter, a converted BC-610 nor the oven rooms where the highly stable crystal oscillators are kept.



Artist's rendition of the new building at Fort Collins, Colo., for NBS. The radio station, WWV, will be partly underground to affect as little as possible the omnidirectional characteristics of its antennas. Each of the six distant towers is a vertical half-wave dipole, ranging from 200 feet in height for the 2.5 mc transmission to 20 feet for the 25 mc transmission. The two closest towers are monopole antennas, used as spares for any frequency; spare transmitters also are housed in the building.

on these frequencies under present plans. The 2.5, 20 and 25 mc transmitters will put out 2.5 kw each, with a possible 5 kw maximum power. All the transmitters are being installed by the Technical Material Corporation under a $297,000 contract.

Power

Provisions have been made, in power lines and space at Fort Collins, to install 100 KW linear amplifiers on 5, 10 and 15 mc if east coast users complain of weak reception. By comparison, the present station puts out 1 kw on 2.5 mc; 8 kw on 5 mc; 9 kw on 10 mc; 9 kw on 15 mc; 1 kw on 20 mc and 100 watts on 25 mc. (All power measured as output r.f.)

Feed lines at Fort Collins will be coax, versus the open 600 ohm line at Greenbelt.

A standby power cable will be provided, as will the new diesel emergency power plant bought for Greenbelt last year. The secondary incoming line will safeguard against accidents such as the perforated cable which put WWV on emergency power last February. The main transmitters and frequency standards were not affected, but secondary oscillators were thrown off frequency for several weeks.

Antennas

The new station will have eight antenna towers ranging in height from 20 feet (25 mc) to 200 feet (2.5 mc) in a large antenna farm designed to give omnidirectional characteristics at all frequencies. The 5,200 foot elevation of the site itself will add measurably to the get-outability of the signals.

20 KC Reception

WWVB and WWVL are considered the most accurate stations in the NBS array, with WWVL at 20 kc (NBS calls it 20 kHz or kiloHertz) being little affected by propagation conditions. In fact WWV in Greenbelt has been regulated by phase comparisons against WWVL for several years.

Normal receivers, even if they cover 20 kc, will not provide an audible signal from WWVL, but a rather simple three-stage, high-gain trf unit can be built to detect the carrier-only transmission. In the east a loop is needed for decent reception, with electrostatic shielding, to improve the noise figure and directional characteristics to null out NSS on 19.4 kc.

WWVH, at Puunene, on the island of Maui, in Hawaii, will not be affected by the switch to Colorado.

Capsule History

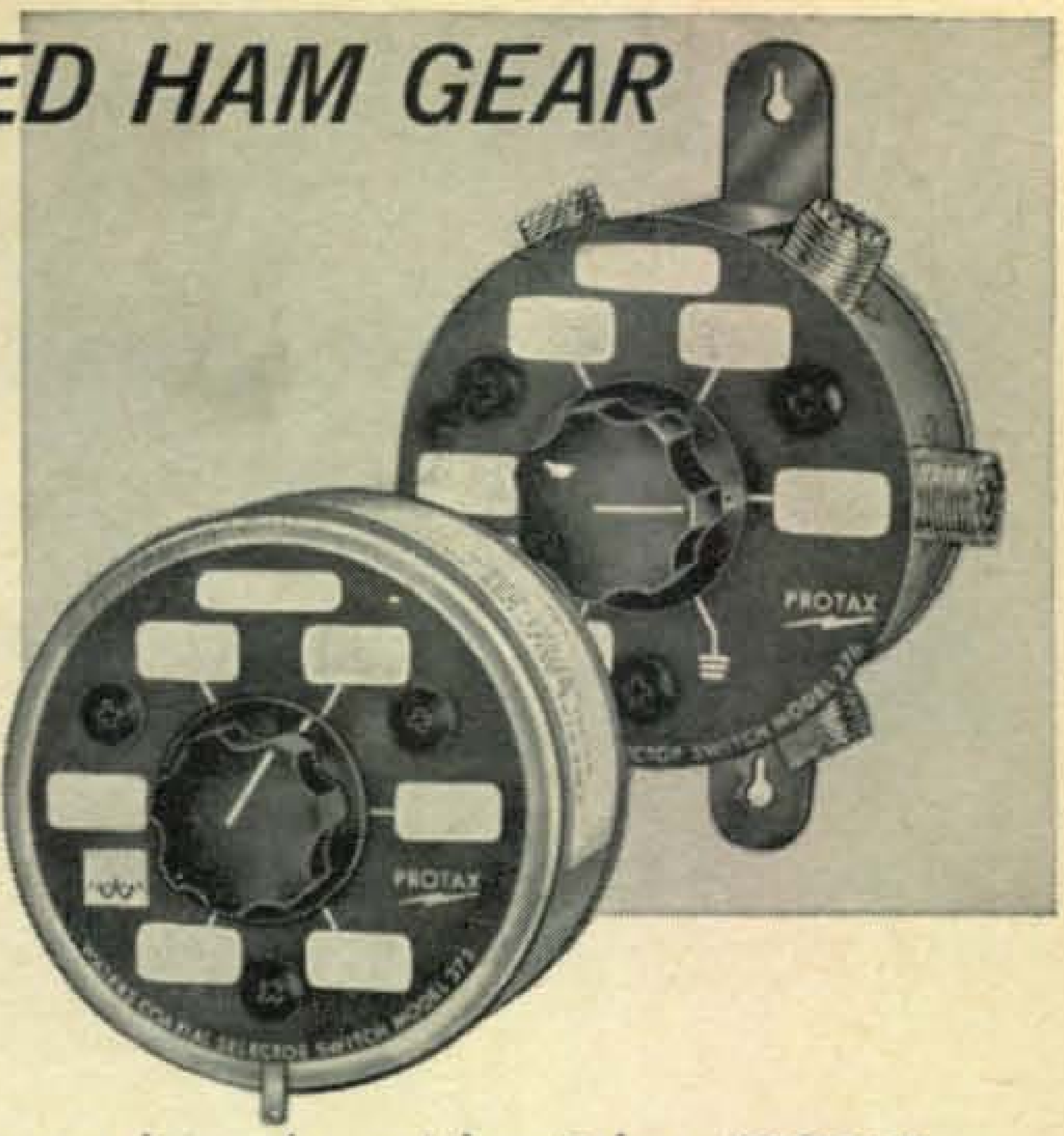
WWV was established in 1923 with a 1 kw transmitter and a frequency standard which did not even use a crystal. It has grown to cover eight frequencies, with vastly increased power, and its stability has increased to a fantastic 1 part in 100,000,000,000. Musical pitch standards were added to time and frequency in 1937. These are of course 440 600, and 1000 cycles. Radio propagation alerts and geophysical notices were added in 1950. None of these services will be changed. ■

New Amateur Products

Aquadyne RTTY Terminal Unit

A NEW transistor terminal unit for the reception of amateur radioteletype signals has been introduced by Aquadyne, Inc. The converter is housed in an attractive small case measuring only 3" high, 6" wide, and 7½" deep. Provision is made for receiving three different RTTY signal shifts: 850, 425, and 175 cycles. The converter operates the teleprinter magnet directly. Terminal units are priced at less than $100.00 (single shift model) and less than $120.00 (three shift model). For more details, write: Aquadyne, Inc., Box 175, East Falmouth, Mass. 02536, or check 60 on page 108.

CONVENIENCE ENGINEERED HAM GEAR
by *Waters*



PROTAX™
COAXIAL ANTENNA SWITCH
with
AUTOMATIC GROUNDING

Another first from Waters! Now, as easily as you switch from beam to dipole . . . from 40 meters to 75, you can switch your entire antenna system to ground with the newest addition to our line of coaxial switches, PROTAX, automatic-grounding coaxial antenna switch! Designed with the same advanced engineering skill that outmoded all other coaxial switches two years ago, PROTAX is another giant step forward in "Convenience Engineered" ham gear by Waters. In effect, PROTAX is two switches in one . . . a regular antenna-selector switch with power-carrying capacity of 1,000 watts that becomes a grounding switch for all antennas (leaving the receiver input open) when the rig is not in use. In two distinctive models: #375 — six position and ground with back connectors; #376 — five position and ground with connectors in radial arrangement. (#376 has its own wall-mounting bracket.)

Model 375 .... $13.95 **Model 376 .... $12.50**

Waters AUTO-MATCH

You'll boost your signals up to 4 db with AUTO-MATCH, the built-to-last mobile antenna. Operates all bands with only a change of Top-Center loading coils . . . has rugged new fold-over hinge . . . fits any standard base or bumper mount.

PRICES

MAST 370-1	$12.95
RADIATOR TIP 370-2	9.95
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COIL 370-20	13.45
COIL 370-15	12.75
COIL 370-11	11.95
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Waters REFLECTOMETER

Amazing new REFLECTOMETER tells you *both* forward and reflected power in RF watts on every transmission. Two separate scales insure accurate readings to 1000 watts. VSWR easily determined, too! Complete with directional coupler and cable.

Model 369 . . . . $115.00

Model 3002

Waters UNIVERSAL HYBRID COUPLER II PHONE PATCH

The ultimate in phone patches providing effortless, positive VOX operation . . . and it also connects tape recorder for both IN and OUT. Built-in Waters "Compreamp" increases low telephone line signals while simultaneously preventing overmodulation. "Compreamp" also operates alone (without patch) with station mike.

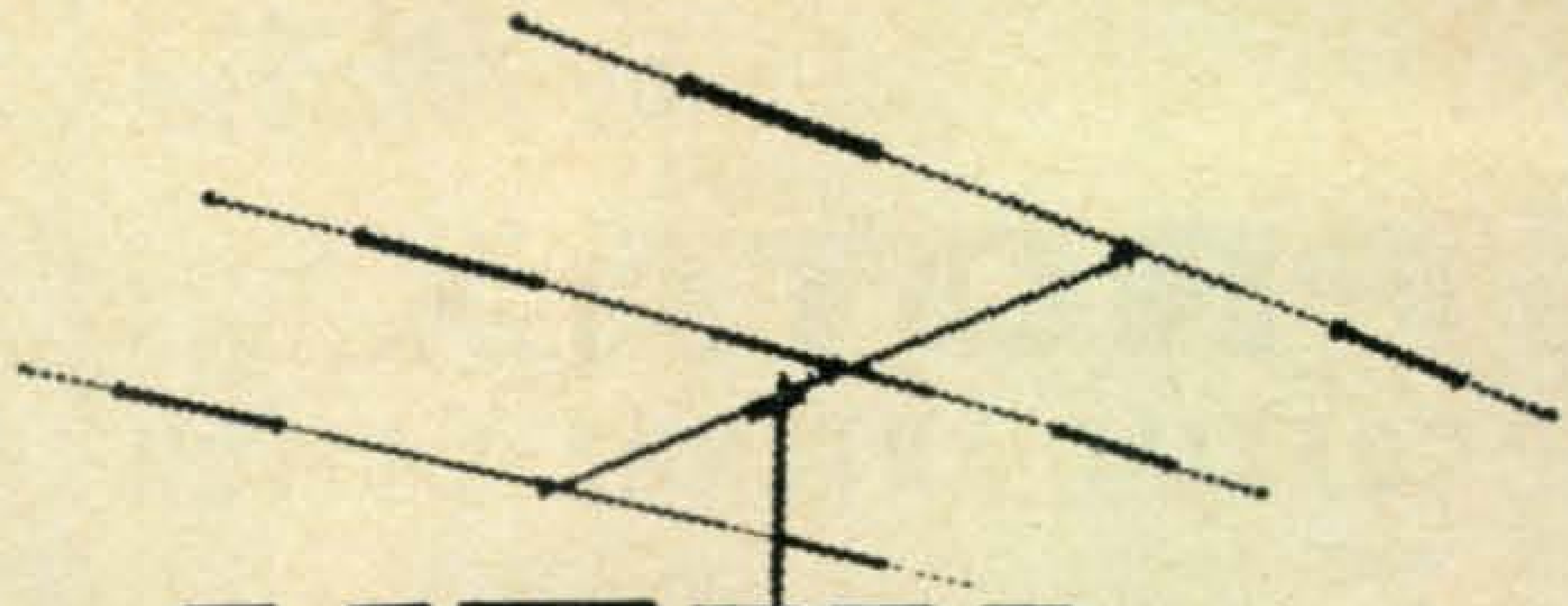
Model 3002 .... $69.95 (less battery)
Model 3001 .... $49.50 (without "Compreamp")

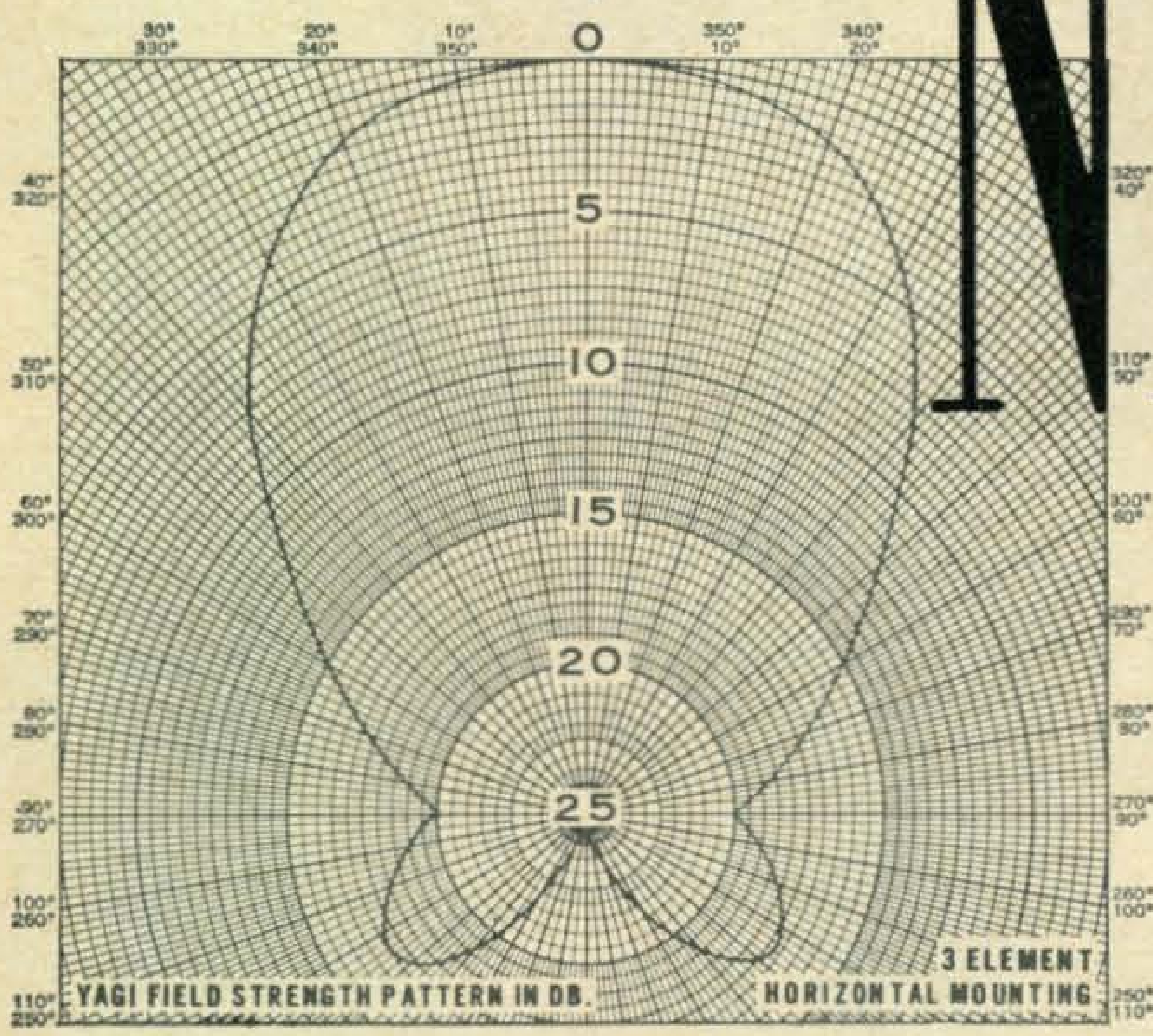
WATERS
MANUFACTURING INC.
WAYLAND, MASSACHUSETTS

WATERS PRODUCTS ARE SOLD ONLY THROUGH WATERS QUALIFIED DISTRIBUTORS

For further information, check number 14, on page 108

Mosley *TRAP MASTER*





NEW

Beam / WITH Advanced Matching System / FOR Added Gain

The Classic 33 You've been hearing about it – maybe you've worked Carl Mosley WØFQY– 'The Old Man Himself' using it. Now here it is . . . A Revolutionary New 3-element beam featuring an advanced Mosley-engineered matching system called 'Broad Band Capacitive Matching' with coax fed balanced element for more efficient beam performance and extra gain over comparative 3-element beams. A New Tri-Band beam rated for 1 KW AM/CW & 2 KW P.E.P. input to the final amplifier SSB on 10, 15, & 20 meters; with a full 8 db. gain on all three bands over reference dipole (10.1 db. compared to isotropic source); a maximum front-to-back . . . .
. . . The CLASSIC 33 . . . This new rugged beam in the Mosley Trap-Master tradition of quality beams brings you all the exclusive features of high priced beams – added gain, improved boom to element and mast clamping; wider element spacing. Priced well within your budget. What more could you possibly want in a 3-element Tri-Band beam? . . . .

. . . For Further Information Write Code 97 . . .

Mosley *Electronics, Inc.* 4610 N. LINDBERGH BLVD., BRIDGETON MO. 63042

For further information, check number 16, on page 108

The Classic Feed System

By W. E. "BARNEY" ST. VRAIN, WØPXE

DESIGNING ENGINEER - CLASSIC 33 PROJECT
MOSLEY ELECTRONICS, INCORPORATED
4610 N. Lindbergh Blvd., Bridgeton, Mo. 63042.

Code 107.

SINCE the introduction of multi-frequency beams several years ago, the method of feeding such antennas has been a subject of much disagreement. When these antennas were introduced a few years ago, Mosley Electronics ran a series of advertisements in the technical magazines explaining the method used on our Trap-Master and Power-Master series. Since that time we have tried a wide variety of feed systems endeavoring to improve on the original system.

Testing Other Feed Systems

In testing, we found a three band gamma system ineffective without isolation networks which resulted in the feed system costing about equal to the antenna cost; with a system using hairpins, the cost proved low but did not provide a better match than the original Mosley matching system. It became quite clear to us, the Mosley system was hard to beat, for we had found only one slight disadvantage, the elements needed to be stagger tuned to raise the feed point resistance from about 30 to 50 ohms. This slight detuning, which proved advantageous in increasing the bandwidth, brought about, in turn, a slight gain loss of about 0.5 to 1.0 db. at resonance.

The Classic-33 System

In order to give hams a new choice in beam matching systems and an antenna featuring maximum gain with increased bandwidth, we devised the matching method used on our New Classic 33 antenna, a method which takes advantage of the principle that antenna resistance at the center driving point increases as the antenna length increases. Figure No. 1 shows the radiator element of a three element beam at resonance having an impedance at the driving point (Z_A) of about 30 + J0 ohms. If the element is made longer, Z_A can be raised to about 50 + J50 ohms. (Figure No. 2) Since the reactance is inductive, it can be canceled with a series capacitor of 50 ohms reactance, leaving 50 ohms feed point resistance. (Figure No. 3) Series capacitors used on the Classic 33 are made by inserting a suitable length of heavily insulated wire into each half of the element tube at the center. The wires are terminated in a plastic tube enclosure with a type "N" connector for connection of the coaxial cable. To isolate the outer coax conductor from ground, the coax line is coiled for a few turns near the antenna end. This is designed to prevent the very unlikely affect of "Feed Line Radiation".

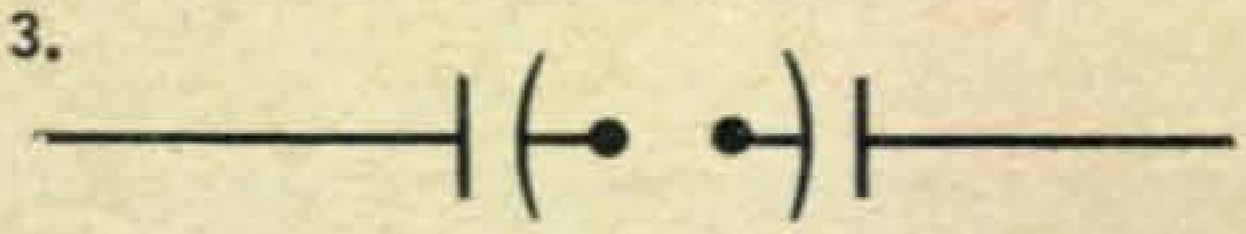
Fig. 1.

$L = \frac{\lambda}{2}$ $\quad Z_A = 30 + j0$

Fig. 2.

$L = \frac{\lambda}{2} +$ $\quad Z_A = 50 + j50$

Fig. 3.



$Z_A = 50 + j0$

Converting Other Beams

This feed system could feasibly be used on our other Trap-Master beams, but little would be gained and the antenna would need to be completely rebuilt. The big difference between the new Trap-Master beam and the TA-33 is that the latter has conversion features, while the Classic 33 does not. The engineers at Mosley designed the Classic 33 to give the ham a little extra gain on all bands. It is our conviction that discriminating DX'ers will find this new tri bander specifically suited to their needs, but hams buying the well-known TA-33 will still enjoy a superior quality DX antenna with a gain very close to that of the Classic 33.

For further information, check number 15, on page 108

Results of the

1965 CQ World Wide DX (C.W.) Contest

BY FRANK ANZALONE,* W1WY

We had high hopes for this one. Wasn't the sunspot cycle on the upturn, hadn't the 10 meter band opened up during the Phone contest, and hadn't George Jacobs predicted at least normal conditions?

Actually W3ASK had also forecast possible below normal conditions for part of the weekend, so that takes George off the hook.

The 10 meter band never did open up, 15 was spotty and 20 once again had to carry most of the load. However 40 proved to be quite productive and 80 showed surprising activity. Those that were equipped for 160 picked up some valuable multipliers.

Of course there are always the exceptions who come up with fantastic scores while the rest of the world is moaning. All in all however, conditions were not up to expectations and far below those we had the previous month in the Phone section.

This was the year of the dit, dit, dit, dit, dit; da dit, da dit. Why send a long double nine when a couple of short n's will do the trick. Who started this anyway? It sure caught on like wildfire.

This was also the year that the CX2CO domination was finally broken. And by who else but Don Miller, with a lush location out in the Pacific, where long path openings showed up on most of the bands and the added attraction of a VR2 prefix made it possible for a single operator to break the 2 million level. Ricardo did not have the fine band openings he experienced a month earlier and his score was far below his Phone winner. Don took full advantage of the hot band openings at the Fiji's and was on the air the full 48 hours of the contest.

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Multi staiton OK3KAG with Laco and Jurco in one of the operating positions.

TROPHY WINNERS

Single Operator, All Bands, U.S.A.
North Jersey DX Association Trophy
won by Victor C. Clark, W4KFC

Single Operator, Single Band. (14 mc)
K2HLB, Dr. Harold Megibow Trophy
won by Sonia Rotenberg, PY2SO

Single Operator, All Bands.
W9IOP, Larry LeKashman Trophy
won by Don Miller, VR2EW

Multi-Operator, Single Transmitter
W3AOH, Dr. Anthony Susan Trophy
won by ET3USA, Kagnew Radio Club
(Operators: K4FMA, K9UIW, others)

Multi-Operator, Multi Transmitter
Radio Club Venezolano Trophy
won by Station W3MSK
(Operators: W3MSK, W3EIS, W3FYS, W3PZW, W6HOH, K1ANV, K3EST, K6BHM)

Multi-Operator, Multi Transmitter
CQ Endorsement, World High Score
won by Station K2GL
(Operators: K2GL, K2DGT, K2UYG, W1GYE, W2GLM, W2IWC, W6KFV, WB2MFX)

World High Club Score
CQ Club Plaque
won by the Potomac Valley Radio Club

7G1A was manned by the same Josef Plzak that won back in 1959.

Our own Vic Clark went all bands for the first time since 1961 and W4KFC has finally become a Trophy winner. Vic can always be expected to turn in a fine performance, and this year's effort was one of his best.

Another first this year was the winning of a Trophy by a YL, Sonia Rotenberg, the da dit, da dit, gal from Brazil. PY2SO is not only at the top of the 14 mc list but this also represents the highest single band score in the world. Sonia would have us believe that some of the credit should go to the OM, Jose who not only took care of the kids but also kept her supplied with sandwiches and coffee. Congratulations Sonia.

Now who would ever expect the world high 7 mc score to come from the Canal Zone. But there it is at the top of the list, KZ5TW. Too bad the Israel Amateur Radio Club has not followed up its Trophy donation that they originated a few years ago.

Which brings up the point, that a favored geographic location is not always a contest winner. This year's winners more than ever show that so called favored areas eventually meet their match from unexpected areas. That is why we hesitate in making any changes in the scoring.

In the Multi classification, single transmitter honors were taken by ET3USA, making it a double for the boys of the Kagnew Radio Club, since they were also winners in the Phone section.

Larry Amodeo and the crew at W2PCJ with the aid of their "co-axial monster" made high score for the U.S.A. a very nice effort. This division makes it possible for a station to roll up a good score without having an elaborate lay-out. We wonder why stations out for a Club total don't make more use of this classification.

In the Multi-Multi category, K2GL retained the "Big Guns" championship, and Buzz Reeves and his crew turned the tables on Ed Bissel and the W3MSK gang who had edged them in the Phone contest. The Trophy however does go to W3MSK since K2GL was not eligible because of their win last year. They will however get an endorsement, an engraved plate for the base of their 1964 Trophy.

The YV9AA crew again made their safari deep into the interior, to the same location used on previous operations. However they ran into many problems and could not duplicate their Phone success. One problem was the interaction between bands. It seems their antennas were geared for phone operation.

The Frankford Radio Club got a shot in the arm; they now have a "Big Gun," who placed 4th in the world standings. "Sig" promises even bigger things for W3WJD next year.

The *CQ* Club Plaque once again goes to the Potomac Valley Radio Club by a comfortable margin. The Frankford organization more than doubled their last year's score. We thought they were going to make it this year because they had the most entries of all the clubs. However they still lack those real big scorers.

The Radio Club Venezolano had it in the bag with the YV9AA contribution both on phone and c.w. and other club members in the phone contest, but their activity in the c.w. contest was almost nil and for the lack of a key the Plaque was lost. Bet there is going to be lots of code practice down Caracas way.

We found it necessary to disqualify some entries, a few with very high scores (3 percent duplicate rule put into effect this year). It's understandable that in the excitement of contest operating, some duplicate calls will appear in your log, although a running check list will minimize this problem. However it is the obligation of the contestant to thoroughly check his log before submitting it, and all duplicates crossed out. We prefer seeing a log in its original form showing these deletions and also any other corrections. But we do demand that this is done, and not left up to the log checker, he has more than enough other work to do. And if he runs across these duplicates and other discrepancies we will be in no mood to be lenient.

STATION	BAND	CONTACTS	ZONES	COUNTRIES	POINTS
K2GL 2,513,448	1.8	21	8	11	38
	3.5	176	22	54	497
	7.0	521	29	91	1527
	14	674	34	113	1991
	21	319	29	98	916
	28	18	8	7	18
	TOTAL	1729	130	374	4987
W3MSK 1,956,801	1.8	17	7	11	38
	3.5	128	19	43	335
	7.0	295	29	85	829
	14	703	37	117	2015
	21	315	28	85	905
	28	9	6	6	15
	TOTAL	1467	126	347	4137
YV9AA 1,865,208	1.8	13	5	7	31
	3.5	239	14	27	692
	7.0	471	15	37	1320
	14	1074	28	64	3035
	21	503	20	45	1441
	28	36	8	12	95
	TOTAL	2336	90	192	6614
W3WJD 1,219,074	1.8				
	3.5	212	21	55	555
	7.0	219	27	68	607
	14	512	32	98	1476
	21	148	23	64	413
	28	5	5	5	12
	TOTAL	1096	108	290	3063
W4KXV 1,198,512	1.8	15	5	6	20
	3.5	83	16	36	222
	7.0	232	29	82	666
	14	542	33	98	1583
	21	162	26	69	455
	28	6	3	3	6
	TOTAL	1040	112	294	2952
W6RW 1,169,625	1.8	4	3	3	6
	3.5	84	19	28	214
	7.0	343	34	76	992
	14	464	35	93	1305
	21	205	24	47	578
	28	11	7	6	24
	TOTAL	1111	122	253	3119

Top Six, Multi-Operator, Multi-Transmitter.

Activity from the rare Faroes showed up in the operation of the club station OY6FRA. And the special call IØFGM, issued in commemoration of the 70th anniversary of the first radio telegraphic transmission, and sponsored by the Fondazione Guglielmo Marconi, was again activated.

A few DX-peditions and operation from rare spots added spice and excitement to the contest, namely, HV1CN by W9IOP, W9AC and W8DUS; Ebon Atoll, KX6SZ, by Iris Colvin on the Yasme DX-pedition; and Fernando de Noronha by PY7ACQ. Bruce Henke ended his European tour with a final fling to San Marino before returning home to W6JFJ. This trip, assisted by G3IRK in putting M1N on the air is a story in itself. A more leisure type trip was the one to St. Vincent's made by K1IMP and W1BPW in putting VP2SY on the air.

We are pleased to see the overall increase in the returns from the United States, thanks mostly to the increased clubs activity who are finding our contest a real exciting week-end. But only 6 entries from the 5th district is rather ridiculous. Especially when CX2CO's log showed over 30 and VR2EW's log over 50 W/K stations from the 5th district. We appreciate hearing from stations like KR6DB who said, that even tho he had a low score because of limited time he felt it was his obligation to submit his log to show his appreciation for the work done by *CQ* in organizing a contest that has such world wide participation. Louis will answer all cards sent via the KR6 bureau.

STATION	BAND	CONTACTS	ZONES	COUNTRIES	POINTS
VR2EW 2,499,536	3.5	101	19	36	287
	7.0	514	27	54	1441
	14	834	34	93	2391
	21	737	34	73	2146
	28	29	12	12	79
	TOTAL	2215	126	268	6344
CX2CO 1,253,275	3.5	13	7	10	26
	7.0	191	18	30	558
	14	673	32	71	1984
	21	563	23	57	1668
	28	68	15	20	189
	TOTAL	1508	95	188	4425
7G1A 1,079,049	3.5	19	6	6	55
	7.0	406	20	43	1200
	14	383	26	59	1089
	21	670	27	64	1955
	TOTAL	1478	79	172	4299
KH6EPW 920,142	3.5	106	9	9	324
	7.0	291	19	25	866
	14	834	32	49	2474
	21	364	20	25	1078
	28	4	3	3	6
	TOTAL	1599	83	111	4748
W4KFC 847,314	1.8	6	3	3	8
	3.5	104	16	37	293
	7.0	209	24	68	598
	14	404	31	89	1192
	21	114	21	55	320
	28	2	2	2	3
	TOTAL	839	97	254	2414
W3GRF 670,275	1.8	4	2	3	4
	3.5	69	15	35	184
	7.0	214	25	60	606
	14	299	28	80	866
	21	128	20	57	359
	28	3	3	3	6
	TOTAL	717	93	238	2025
W4BVV 668,150	1.8	4	3	3	6
	3.5	48	14	27	128
	7.0	136	27	68	385
	14	326	31	86	946
	21	150	25	55	429
	28	6	5	6	15
	TOTAL	670	105	245	1909
SM5BLA 643,200	3.5	212	12	54	263
	7.0	215	25	64	478
	14	480	26	63	1060
	21	158	22	54	209
	TOTAL	1065	85	235	2010
UB5WF 529,058	3.5	226	10	41	281
	7.0	162	24	62	310
	14	363	26	55	932
	21	113	25	48	295
	TOTAL	864	85	206	1818
W6ITA 510,440	3.5	33	15	16	79
	7.0	196	27	53	552
	14	283	30	71	801
	21	139	22	39	385
	28	4	4	3	6
	TOTAL	655	98	182	1823

Top Ten, Single Operator, All Band Category.

We received 1341 logs for this section of the contest, a figure slightly higher than last year's total. However when you add this to the 908 received in the phone section, which was quite an increase over last year's, we have a grand total of 2249, our best showing yet. A total of 678 certificates will be awarded this year, 369 for c.w. and they will go to 116 different countries.

Awards to Australia will be made by call areas instead of Zones as previously announced. Canadian awards will be restricted by Zone boundaries and will remain that way; unless our friends across the border can russle up a little more activity.

It would have been impossible for us to do our job this year without the help of the two new members to our Committee, Andy Bodony, WB2CKS, and Fred Capossela, W2IWC. These two took on a major portion of the work and their contribution was invaluable. Of course the old standbys, Ben Lazarus, W2JB and Andy Malashuk, W1GYE were not exactly idle, and I did not spend my space time looking at TV at night or my week-ends on the air chasing DX.

Our thanks too of course to the crew at *CQ*, Marcia, Al and Dick. And let's not forget Ellen White at *QST* who faithfully forwarded those logs that somehow found their way to 225 Main Street. And while we are on contest matters, to Bobby Plomitallo who again will be typing up all your certificates. That's about it for this one.

73 for now, Frank, W1WY

Foreign Club Scores

Radio Club Venezolano	8,826,147
Uruguay DX Club	3,350,583
Kagnew Station A.R.C. (Ethiopia)	2,294,155
Radio Experimentadores de la Baja Cal.	2,091,764
Swiss DX Club	1,837,408
OH–DX–Ring–Ry (Finland)	1,610,946
Moscow Radio Club (USSR)	1,378,923
Lvov DX Club (Ukraine)	1,172,470
Far East DX-ploiters (Japan)	1,070,985
Cuenca Radio Club (Ecuador)	1,061,070
Turun Radioamatoorit Ry (Finland)	752,710
Detschen Demokratischen DX Club	733,429
Kaunas Polytechnic R.C. (Lithuania)	644,186
SP DX Club (Poland)	485,166
Royal Air Force, Troodos A.R.C. (Cyprus)	463,267
Central Radio Club of Hungary	418,992
Carswell Amateur Radio Club (Guam)	304,160
Hammarbyhoejdens Wireless Society (Sweden)	215,042
Japan DX Radio Club	198,733
Khazkov Radioclub (Ukraine)	156,552
Radio Club of Tallinn (Estonia)	135,592
Pirmasens Amateur Radio Club (Germany)	125,928
Cheltenham Amateur Radio Soc. (England)	123,354
Bremerhaven Amateur Radio Club (Germany)	106,400
Vasteras Radio Klub (Sweden)	95,635
QRJ Radio Club (Japan)	71,092
Chiniak Amateur Radio Club (Alaska)	70,875
Shezuoka Radio Club (Japan)	58,395
Sir George Williams Univ. A.R.C. (Can.)	54,188
Kiskon Radiokerko Ry (Norway)	21,296
Goose Bay Amateur Radio Club (Canada)	19,592
Leningrad Radio Club (USSR)	18,631
Nec Fuchu Amateur Radio Club (Japan)	13,359

United States Club Scores

Potomac Valley Radio Club	**10,204,542**
Frankford Radio Club	8,854,874
Northern California DX Club	2,834,960
Southern California DX Club	2,678,080
Florida DX Club	2,573,554
128 Contest Club. (Mass.)	1,609,054
North Jersey DX Association	1,185,870
Orange County DXCC (Calif.)	836,729
Royal Order of Boiled Owls (N.Y.)	769,834
Tiajuana Tigers (?) (Calif.)	726,131
Ohio Valley Amateur Radio Ass'n.	679,967
Rochester DX Association (N.Y.)	434,055
Detroit Amateur Radio Association	329,072
Willamette Valley DX Club (Ore.)	306,452
QCWA DX Club of New York	274,322
Morris County Radio Club (N.J.)	241,968
Suffolk County Radio Club (N.Y.)	198,414
Southeastern DX Association (Ga.)	190,518
Western Washington DX Club	185,423
Catalpa Amateur Radio Society (Mich.)	145,116
Louisville Active Radio Operators (Ky.)	138,233
West Gulf DX Club	131,154
Long Island DX Association (N.Y.)	102,857
Keesler Amateur Radio Club (Tex.)	96,066
Warner Robins Amateur Radio Club (Ga.)	73,801
Central Michigan Amateur Radio Club	54,600
York Radio Club (Ill.)	52,328
Northwest DX Club (Wash.)	45,899
Lawndale Chicago Boys Club (Ill.)	33,616
Virginia Century Club	30,342
Hamfesters Radio Club of Chicago	28,196
Central Illinois Radio Club	25,984

Top Ten

ALL BAND SINGLE OPERATOR

VR2EW – 2,499,536

CX2CO	1,252,275	W3GRF	670,275
7G1A	1,079,049	W4BVV	668,150
KH6EPW	920,142	SM5BLA	643,200
W4KFC	**847,314**	UB5WF	529,038
W6ITA	510,440		

Top Six

MULTI-OPERATOR SINGLE TRANSMITTER

ET3USA	**1,071,312**	W2PCJ	769,834
UA3KAS	990,943	EL2AE	740,691
ZD8AR	844,662	WA6SBO	726,131

Top Six

MULTI-OPERATOR MULTI-TRANSMITTER

K2GL	2,513,448	W3WJD	1,219,074
W3MSK	**1,956,801**	W4KXV	1,198,512
YV9AA	1,865,208	W6RW	1,169,625

Bold stations are trophy winners.

U.S.A. Winners & Runners-up

All Band	W3BES	462,647
28 Mc	WA4WIP	408
21 Mc	W3TLN	42,021
14 Mc	W1JYH	172,900
7 Mc	W5WZQ	82,176
3.5 Mc	W1HKK	20,212
1.8 Mc	W2EQS	451

Continental Leaders—Single Band

21 Mc

ZS6IW	440,213
OD5LX	82,992
G3HCT	80,276
VK4EL	80,178
W8WZ	49,098
DJ5BV	90,810
W8FGX	83,634
JA6AK	48,076
VK2GW	34,706
YV5BMN	17,064

14 Mc

PY2SO	**473,156**
9J2VB	317,044
VK3ADB	295,596
W7YGN	198,320
KA5RC	188,279
DL2DK	183,022

7 Mc

KZ5TW	156,456

3.5 Mc

DJ3KR	46,130
W8NBK	20,800
UL7CG	20,253
VK3XB	1,034

1.8 Mc

W1BB/1	2,520
VE2UQ	2,275
G3IGW	1,760
DL1FF	1,746

Number groups after call letters denote the following: Band, (A-all); Final Score; Number of QSOs; Zones and Countries. Certificate winners are listed in **bold face.**

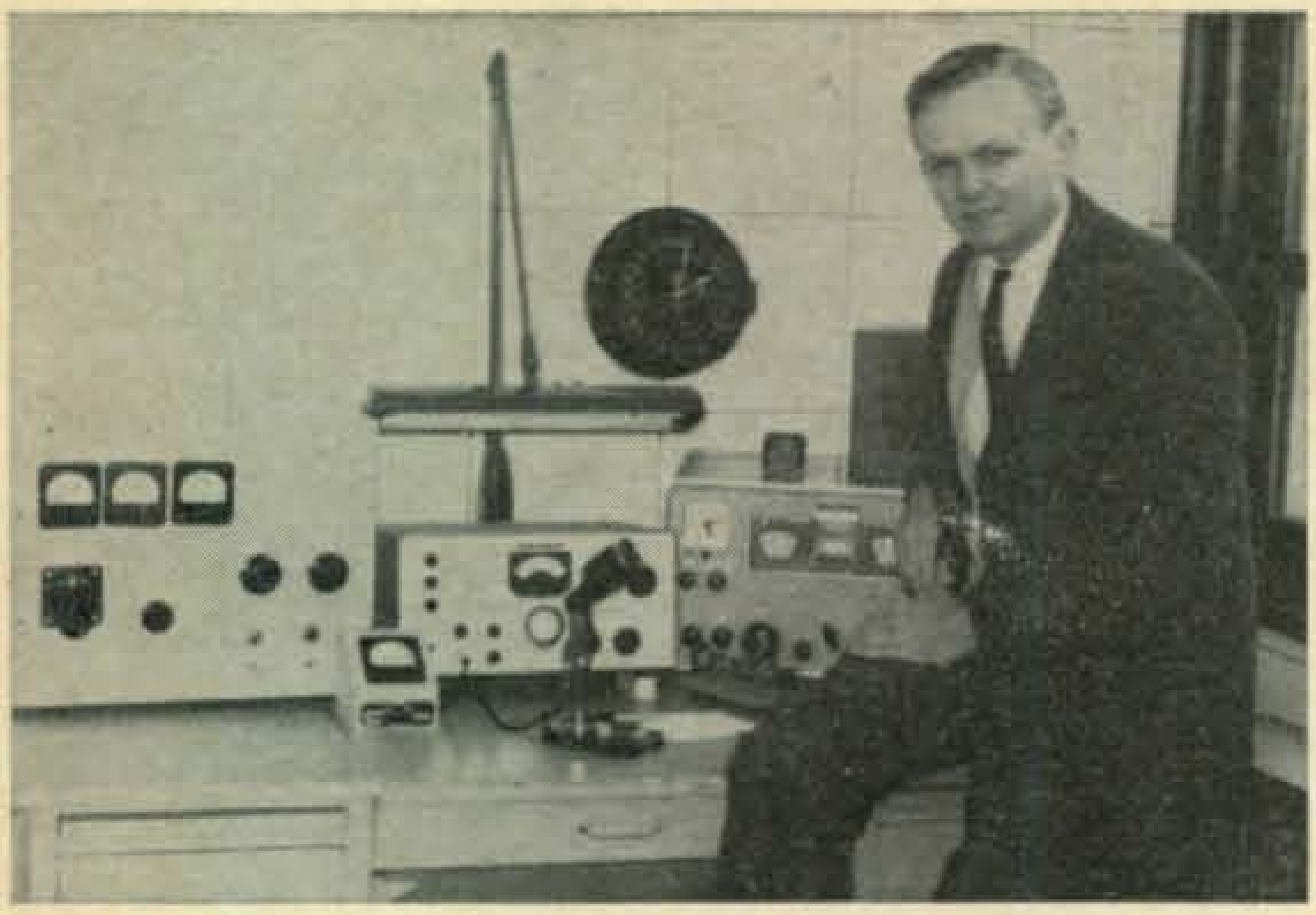
C. W. Results

SINGLE OPERATOR

North America

United States

K1HVV	A	238,896	398	69	147
W1WY	A	136,528	243	72	140
W1UUK	A	101,308	218	58	114
W1EZD	A	67,914	181	40	86
W1BIH	A	43,956	117	47	85
K1LMS	A	18,860	87	29	53
W1FTM	A	4,752	44	17	27
W1PLJ	A	3,655	30	20	23
K1VTM	A	1,881	22	14	19
K1DAT	21	22,950	108	22	53
W1JYH	14	172,900	454	32	98
WA1ANR	14	15,572	79	22	46
W1WAI	7.0	54,990	207	25	69
W1HKK	3.5	20,212	119	19	43
W1SWX	3.5	544	11	7	10
W1BB/1	1.8	2,520	43	6	15
WA2OJD	A	173,720	291	71	144
W2WZ	A	79,100	194	40	100
W2LQP	A	54,870	160	40	78
W2GKZ	A	30,820	98	47	68
W2HL	A	25,448	154	41	73
W2HDW	A	22,428	95	28	56
W2IWP	A	18,334	75	35	54
W2DOD	A	14,282	67	29	45
WA2EFN	A	7,056	44	24	39
W2JB	A	4,788	42	16	26
WA2KIZ	A	1,870	21	13	21
WB2LWE	A	1,330	17	11	16
W2LYO	A	841	18	12	17
WA2ZEZ	21	24,080	100	23	63
K2GXI	14	132,730	350	32	98
W2TQR	14	128,954	362	31	91
K2SHZ	14	96,034	286	34	84
K2ZWI	14	85,224	282	29	77
WA2MTI	14	46,620	184	22	68
WB2CRX	14	22,608	110	26	46
W2SZ	14	10,325	100	8	27
WB2SSB	14	9,180	73	13	32
W2CKR	14	8,955	71	16	29
WB2GGO	14	3,392	36	9	23
W2HAZ	14	735	16	6	15
K2LTY	7.0	19,642	116	18	43
K2KFP	3.5	5,530	56	11	24
K2CPR	3.5	2,156	31	9	19
WA2UWA	3.5	528	17	4	7
W2EQS	1.8	451	20	4	7
W3GRF	A	670,275	721	93	238
W3BES	A	462,647	555	85	208
W3LOE	A	389,276	439	98	219
W3MFW	A	371,460	431	88	214
W3MSR	A	289,800	449	75	155
K3NHL	A	226,839	322	79	170
W3MCG	A	196,174	288	76	165
W3MWC	A	180,440	307	57	139
W3IYE	A	156,996	278	65	131
W3KT	A	154,160	290	62	126
K3JLI	A	108,064	228	57	119
W3AYD	A	104,850	250	51	99
W3QQL	A	103,597	222	58	111
W3EQA	A	98,748	222	53	103
W3EVW	A	97,637	216	50	113
W3PN	A	87,912	208	49	99
W3YLJ	A	80,070	178	62	108
W3KDF	A	73,008	180	50	94
W3GRS	A	65,296	203	34	78
W3QMZ	A	62,274	174	50	80
W3NOH	A	59,882	142	54	104
W3KA	A	53,240	157	40	81
K3BNS	A	26,048	141	20	44
W3ISE	A	14,129	71	29	42
W3CAA	A	13,038	87	15	38
W3DBX	A	12,896	72	33	49
W3INH	A	12,496	63	25	46
W3FBE	A	7,560	58	13	32
W3GHD	A	5,489	49	21	35
W3DRD	A	5,200	37	17	33
WA3EEQ	A	3,882	34	19	25
WA3CVM	A	720	17	13	11
W3TLN	21	42,021	171	25	62
W3MFJ	21	37,914	153	25	64
W3AFM	14	165,510	416	32	103
W3YUW	14	161,200	429	33	97
W3AYS	14	53,700	185	26	74
W3CGS	14	43,911	128	41	78
W3BYX	14	36,223	141	26	63
W3PVZ	14	16,408	88	19	49
K3JGJ	14	15,180	76	30	39
WA3EIN	14	13,860	89	17	38
K3AIG	14	12,210	81	17	38
WA3BTA	14	2,465	31	9	20
K3UZY	14	722	14	7	12
W3KFQ	7.0	9,933	81	13	30
W3UVH	7.0	8,792	59	19	37
W4KFC	A	847,314	839	97	254
W4BVV	A	668,150	670	105	245
W4BJ	A	373,081	403	72	155
W4BFA	A	240,238	376	73	153
K4BAI	A	209,517	335	79	152
K4EZ	A	190,518	317	70	156
WA4IKU	A	152,342	268	71	140
W4LVV	A	95,635	225	50	105
W4GF	A	64,670	159	44	101
W4PTR	A	58,896	153	52	92
W4YDD	A	42,418	103	40	127
W4MVB	A	30,458	105	35	62
W4WBC	A	26,663	111	33	58
W4ZSH	A	26,361	92	38	63
W4DRK	A	20,274	77	36	57
K9KBW/4	A	14,931	68	30	49
K1GUD/4	A	7,952	54	21	35
WA4WIP	28	408	18	9	8
WA4OAE	21	30,342	176	22	56
WA4GCS	21	22,620	110	22	56
K4ISV	21	17,408	102	23	45
W4HGW	21	9,660	59	21	39
W4NTE	21	6,529	45	21	32
W4RKV	21	4,840	45	14	26
WA4DOU/4	21	510	13	7	10
WN4YZC	21	495	15	7	8
W4YGY	14	108,141	339	29	84
K4PDV	14	68,688	225	26	80
WA4VAP	14	210	8	6	8
KØLUZ/4	7.0	38,232	193	23	49
K4YFQ	7.0	25,025	112	24	53
WA5MUE	A	18,696	85	28	54
W5VLF	A	2,664	50	15	22
W5NOP	14	73,320	249	26	78
W5LGG	14	60,950	202	31	75
W5WZQ	7.0	82,176	248	33	74
K5JVF	7.0	14,820	84	22	43
W6ITA	A	510,440	655	98	182
WA6QGW	A	397,306	545	95	164
W6WX	A	271,064	400	91	157
W6KUT	A	171,302	311	72	122
W6LDD	A	169,022	278	85	128
W6NIX	A	160,720	293	78	127
W6LCX	A	150,110	312	67	103
W6ERS	A	123,670	263	65	101
W6GRX	A	120,582	242	70	104
W6ISQ	A	107,813	286	47	84
W6HB	A	95,375	192	62	113
W6PQT	A	80,960	188	63	97
W6LDA	A	73,920	178	61	93
K6BWX	A	48,240	140	56	64
WA6IVN	A	46,644	184	46	46
K6HOR	A	44,370	153	44	58
WA6IQM	A	37,054	139	40	57
W6KHS	A	34,691	108	47	66
WA6VAT	A	33,480	131	36	57
K6PJT	A	27,520	104	38	48
W6JKJ	A	22,933	114	31	40
W6WAW	A	21,804	120	32	37
K6SSJ	A	15,796	77	33	39
W6PLS	A	15,276	85	29	38
W6BIP	A	14,040	91	33	32
W6QDE	A	11,664	75	24	30
WB6EUZ	A	10,561	68	27	32
WB6EQV	A	9,030	83	21	22
K6TZX	A	6,837	50	26	27
W6BJH	A	6,578	52	20	26
W6QFU	A	5,358	40	21	26
W6CLM	A	4,464	44	18	18
K6CNV	A	4,144	40	14	23
WA6DMN	A	3,480	40	14	16
WB6KIL	A	1,705	20	14	17
W6EJA	A	854	21	6	8
W6IBD	21	35,700	184	24	44
W6PQW	21	22,098	135	20	38
K6CAA	21	16,500	106	23	37
K6BFZ	14	76,214	252	31	75
W6KNE	14	59,363	236	28	61
W6CYV	14	45,663	170	32	61
WA6MWG	14	22,680	114	23	47
W6VVR	14	11,570	63	24	41
WB6IZF	14	84	7	2	2
W6JZH	7.0	64,647	231	30	69
W6FSJ	7.0	50,921	206	30	57
W6NKR	7.0	22,608	111	25	47
W6KPC	7.0	21,788	153	20	32
W6VNJ	7.0	16,445	108	23	32



KA5RC—Bob Cleve is now signing HS1RC on 20 meter s.s.b. and c.w.

K6BPR	3.5	9,890	90	18	25
WA6GLD	3.5	2,295	32	13	14
W6JTB	1.8	99	18	5	4
W7AYY	A	67,500	206	52	73
W7MX	A	53,580	196	41	54
W7LNG	A	15,996	95	39	47
WA7CGR	A	12,354	81	28	30
WA7BOA	A	1,225	17	11	14
W7YGN	14	198,320	478	39	109
K7ADL	14	71,094	240	33	69
WA7ABW	14	50,864	203	27	61
W7LVI	14	45,899	199	26	53
W7RQN	14	43,650	208	24	51
W7TDK	14	19,520	112	23	38
K7CAD/7	14	12,100	80	20	35
W7VRO	14	6,401	65	16	21
W7MVC	14	1,036	25	10	14
W7JLU	7.0	9,006	86	17	21
W8DGP	A	135,744	232	84	140
K8YSO	A	1,247	19	14	15
WA8MAM	A	126	9	8	6
W8WZ	21	49,098	180	28	70
K8VDV	21	40,392	147	26	73
W8RXY	14	54,600	211	26	65
W8UCI	14	50,694	176	28	74
W8EW	14	36,040	150	26	59
K8SWE	14	25,191	105	22	59
WA8GUN	14	22,160	97	24	56
W8BVF	14	11,410	60	27	43
W8FGX	7.0	83,634	285	30	71
W8ZCK	7.0	36,292	149	25	61
K8NMG	7.0	608	12	8	11
W8NBK	3.5	20,800	126	20	45
W9IOP	A	312,666	459	83	163
W9EWC	A	183,920	343	69	121
W9RQM	A	70,176	179	46	90
W9ELQ	A	43,748	162	25	67
WA9HJM	A	16,728	95	34	48
WA9GYZ	A	13,578	70	28	45
K9DWG	A	8,378	55	25	34
W9IZF	A	4,304	39	20	28
W9ZTD	21	36,279	155	25	62
K9PPX	21	15,870	84	24	45
W9AQW	21	12,342	70	22	44
W9LKI	21	2,886	32	13	24
K9CSW	14	93,834	288	31	86
K9ECO	14	84,360	269	30	81
K9DDR	14	64,582	230	29	69
K9ZEL	14	48,076	168	30	71
W9SCZ	14	36,984	160	27	65
K9YHB	14	33,616	135	26	62
W9VL	14	18,559	96	20	47
WA9LHH	14	7,950	57	23	30
K9VQK	14	4,620	41	15	27
K9BUG	14	984	17	9	10
W9OHH	7.0	10,206	66	18	36
W9WJB	3.5	10,854	76	17	37
W9PNE	3.5	5,187	60	13	26
WØAIH	A	397,590	504	94	196
WØKAW	A	57,120	153	52	84
WØGNX	A	55,664	155	56	86
WAØKDI	A	23,716	88	38	60
KØYIP	A	3,034	28	19	22
WØJYE	A	2,773	31	15	18
KØYIZ	A	1,988	28	14	14
KØCER	21	4,193	34	20	27
WØQMD	14	27,450	113	27	63
KØJPL	7.0	255	8	8	7
Canada—Zone 1					
VE8BB	A	48,258	363	29	34
Canada—Zone 3					
VE7BDJ	A	81,738	324	56	58
Canada—Zone 4					
VE3ES	A	100,500	286	42	92
VE3NE	A	41,625	133	37	74
VE6VO	A	3,150	37	13	17
VE3FID	14	29,546	134	23	56
VE3BMB	21	3,660	52	12	18
Canada—Zone 5					
VE2ATU	A	72,120	237	44	76
VE1TG	21	37,760	267	20	44
VE2WA	14	54,194	200	26	72
VE2UQ	1.8	2,275	83	6	7
Canal Zone					
KZ5TW	7.0	156,456	864	24	58
Cuba					
CO2BO	A	304,616	1270	48	68
Dominican Rep.					
HI8XAL	A	327,420	833	56	124
Jamaica					
6Y5XG	A	27,440	176	32	38
6Y5BB	7.0	17,685	325	12	15
Mexico					
XE1FFU	14	644	61	4	3
Panama					
HP1IE	A	38,805	280	32	23
HP1AC	14	3,840	133	14	14
Trinidad					
9Y4VU	A	4,025	61	12	11
Turks Islands					
VP5AR	14	153,145	619	29	80
AFRICA					
Angola					
CR6AI	A	66,654	205	43	83
CR6EI	A	17,550	192	33	39
CR6DX	21	88,644	342	27	62
Canary Islands					
EA8EY	A	2,352	29	9	19
Ghana					
9G1FQ	A	315,828	821	47	77
Guinea, Rep.					
7G1A	A	1,079,049	1478	79	172
Liberia					
EL2Y	14	8,440	79	16	24
Libya					
5A3TX	A	437,524	833	53	125
Madagascar					
5R8AM	14	26,730	120	20	46
Mozambique					
CR7IZ	A	183,750	458	54	93
Republic of Congo					
9Q5PA	A	111,860	454	34	51
Rhodesia					
ZE3JJ	A	151,404	397	47	85
ZE3JO	A	53,010	178	37	58
ZE4JS	21	152,592	522	29	73
ZE1BL	14	61,918	269	26	57
Sierra Leone					
9L1TL	21	14,805	150	11	24
South Africa					
ZS2RM	A	101,556	307	44	73
ZS6JK	A	53,256	319	20	36
ZS1O	A	306	12	5	7
ZS6IW	21	440,213	1081	36	103
ZS2HI	14	168,264	541	32	76
ZS2U	14	18,760	120	27	40
ZS4AK	14	1,500	18	13	17
Swaziland					
ZD5M	A	72,930	252	39	63
Uganda					
5X5IU	14	84,304	333	29	59
Zambia					
9J2VB	14	317,044	800	33	101
ASIA					
Cyprus					
ZC4TX	A	16,245	110	20	37
Hong Kong					
VS6FF	A	192,600	755	56	94
VS6FO	21	9,823	138	19	28
VS6DS	14	12,816	153	20	28
India					
VU2GW	14	9,360	81	21	31
Iran					
EP2BQ	A	198,495	421	52	113
Israel					
4X4PC	21	50,562	306	18	40
4X4HW	14	182,100	627	28	72
Japan					
JA1BK	A	403,172	758	78	118
JA1IBX	A	226,893	539	65	94
JA1KSO	A	95,175	284	59	82
JA8CKC	A	88,250	278	52	73
JA1EZT	A	81,190	280	49	66
JA3AA	A	64,736	244	48	64
JA7AKQ	A	54,647	224	41	58
JA8SW	A	43,512	199	40	44
JA1PTI	A	27,832	151	36	35
JA2XI	A	23,490	147	25	33
JA1VX	A	23,236	115	32	42
JA2DN	A	21,630	88	49	56
JA1JKG	A	18,522	139	25	29
JA4BNT/3	A	16,728	106	33	35
JA7RH	A	15,552	119	21	33
JA7BJL	A	14,204	104	25	28
JA2EPK	A	11,094	87	27	31
JAØAC	A	10,875	59	30	45
JA1JAN	A	8,448	80	23	12
JA1DUH	A	8,096	75	20	26
JA8AJM	A	7,788	76	20	24
JA6CLO	A	5,676	55	21	23
JA7CVB	A	4,998	59	18	16
JA4BFT	A	4,454	60	16	18
JA1EYR	A	2,457	35	14	13
JA2FCR	A	2,088	33	14	15
JA3GRO	A	1,296	24	13	11
JA3HGL	A	1,225	23	12	13
JA2CPK	A	261	12	6	3
JA6BXA	21	32,076	179	23	43
JA5BJC	21	25,641	150	24	39
JA6PY	21	23,998	131	25	46
JA3EGE	21	21,900	137	24	36
JA1LPZ	21	18,847	147	19	28
JA7UJ	21	16,588	109	23	35
JA6AKW	21	15,660	109	21	33
JA1NLX	21	15,600	113	21	31
JA8ZO	21	13,320	123	16	24
JA2CUS	21	13,150	100	20	30
JA1HKP	21	12,243	88	22	31
JA7BMK	21	11,178	94	18	28
JA3DGC	21	9,849	78	19	30
JA3DAY	21	7,612	56	19	25
JA1IIX	21	4,588	55	13	18
JA1EM	21	2,448	38	12	12
JA1UVR	21	480	15	7	8
JA5AZJ	21	340	12	10	10
JA6YAF	21	132	8	5	6
JA1UPO	21	30	4	3	2
JA1CIA	14	106,124	467	28	58
JA6AD	14	105,462	427	30	63
JA8AA	14	105,225	486	27	48
JA1YL	14	85,988	412	25	49
JA2ANX	14	85,260	350	31	53
JA3BN	14	83,376	409	27	45
JA1BWA	14	74,448	320	30	58
JA7ARZ	14	52,000	286	26	39
JA1FDU	14	44,478	259	23	40
JA7JI	14	43,066	222	27	41
JA2TH	14	34,216	220	22	34
JA1DFQ	14	34,143	223	22	35
JA6PN	14	28,542	157	26	45
JA4OK	14	23,912	165	22	34
JA2HFL	14	20,196	143	22	32
JA2CPD	14	20,034	146	22	31
JA8GR	14	18,868	125	24	33
JA1HOM	14	13,416	108	20	32
JA3IG	14	11,656	132	14	17
JA1BNW	14	9,456	87	20	28
JA1AKH	14	9,000	97	18	22
JA4AQR	14	7,943	79	21	26
JA7IJ	14	6,308	78	17	21
JA3YEE	14	5,617	58	17	24
JA1PRF	14	5,538	70	17	22
JA1RJU	14	4,389	51	14	19
JA4DZ	14	4,020	50	16	14
JA3HLV	14	3,683	56	13	16
JA1ACA	14	3,366	39	14	19
JA2BNN	14	1,334	32	10	13
JA1CJU	14	1,104	27	11	12
JA8AGI	14	960	21	10	10
JA3DJ	14	231	7	4	7
JA6AK	7.0	48,076	261	22	46
JA1MML	7.0	34,953	220	24	37
JA1LWI	7.0	31,192	215	22	34
JA2AGP	7.0	12,985	99	21	28
JA3GHN	7.0	10,520	93	17	23
JA7AZL	7.0	7,040	96	15	17
JA3BKC	7.0	6,591	72	18	21
JA7BYH	7.0	4,025	72	11	12
JA1JEE	7.0	3,645	56	13	14
JA2EFL	7.0	2,808	48	13	14
JA2CEC/1	7.0	2,060	45	10	10
JAØOP	7.0	1,610	28	12	11
JA7BGU	7.0	1,242	30	8	10
JA1NOG	7.0	1,207	32	9	8
JA2CBK	7.0	450	30	8	7
JA7DNB	7.0	360	17	6	6
JA1QAP	7.0	225	14	4	5
JA1DSW	3.5	4,515	82	11	10
JA1DMX	3.5	3,699	57	13	14
JA1HGY	3.5	90	5	4	5
KA2JH	A	83,898	281	50	68
KA5RC	14	188,279	706	32	59
Korea					
HM1BB	A	62,500	277	40	60
HM5BF	14	34,916	233	22	36
HL9KB	14	9,695	130	14	21
Laos					
XW8BD	A	40,766	174	44	65
Lebanon					
OD5LX	21	82,992	402	21	55
Malaysia, East					
9M6CL	A	68,922	214	55	71
9M6DH	21	9,996	91	20	22
Malaysia, West					
9M2YY	14	15,020	153	20	38
Maldive Islands					
VS9MP	14	30,720	138	31	65
Muscat, Sultanate of					
VS9OC	14	20,358	145	17	41
Philippines					
DU7SV	A	126,488	462	44	53
Ryuku Islands					
KR6DB	A	55,770	238	45	65
KR6MM	14	57,835	347	28	47
KR6MB	14	36,936	199	26	50
KR6UD	14	9,828	72	25	38
Saudi Arabia					
7Z3AB	14	4,840	46	15	25
Singapore					
9M4RS	A	146,374	455	64	99
9M4MT	14	29,172	290	23	43
Taiwan					
BV1USF	14	15,390	171	24	30

Trucial Oman

MP4TBO	21	27.332	145	20	44

U.S.S.R.

Asiatic

UW9WB	A	499,872	750	68	186
UA9WS	A	226,842	524	35	119
UA9GC	A	59,280	280	19	57
UA9UG	A	35,154	273	21	41
UA9FM	A	33,812	152	19	60
UW9PT	A	27,621	127	31	68
UV9UT	A	10,250	98	16	34
UA9OO	A	6,800	71	8	32
UA9MT	A	2,550	41	9	16
UA9KCF	14	43,785	251	17	46
UW9AO	14	37,701	188	16	43
UW9DP	14	24,696	153	16	47
UW90A	14	23,940	192	19	58
UW90U	14	10,044	81	20	34
UA9DK	14	9,842	98	8	29
UA9PO	14	4,760	82	13	25
UA9VJ	3.5	2,116	46	8	15
UAØAG	A	168,746	455	39	100
UAØLJ	A	61,503	341	37	46
UAØGF	A	42,728	205	40	43
UAØLS	A	10,485	144	24	21
UAØNC	A	7,511	113	18	19
UAØMD	A	6,072	114	15	18
UAØMQ	A	5,940	104	13	14
UAØIJ	21	15,772	271	16	16
UAØNQ	7.0	545	63	3	2

Azerbaijan

UD6AM	A	121,290	352	35	95
UD6BV	14	7,406	87	11	23
UD6BW	7.0	9,207	102	6	25

Georgia

UF6HK	A	59,340	272	20	49
UF6DD	14	10,605	139	10	25
UF6AW	7.0	3,240	61	7	13

Kazakh

UL7CT	A	133,694	423	34	84
UL7JE	A	108,416	390	38	83
UL7ND	A	1,628	40	11	11
UL7GR	14	12,528	154	13	36
UL7RL	14	1,940	99	9	11
UL7JZ	7.0	3.364	66	9	20
UL7CG	3.5	20,253	180	10	33

Tadjikistan

UJ8AB	A	31,974	183	23	50
UJ8KAW	A	6,923	71	14	29

Turkoman

UH8BO	A	83,916	298	32	76
UH8CR	A	29,184	189	17	40
UH8BZ	A	21,489	138	16	41
UH8AA	21	53,874	263	22	60
UH8DH	14	980	25	8	12
UH8AE	14	850	20	6	11

Uzbek

UI8LB	A	44,323	144	44	83

Europe

Austria

OE3LI	3.5	12,740	235	10	39
OE1KU	1.8	160	42	2	8

Balearic Islands

EA6BD	A	2,730	67	10	16

Belgium

ON5AZ	A	192,177	566	51	112
ON4TX	A	176,305	372	61	124
ON4XG	A	122,774	394	47	110
ON4CE	21	1,752	65	11	13
ON4NG	14	3,050	90	5	20

Bulgaria

LZ2KBA	A	122,276	599	43	111
LZ1KKZ	A	70,929	412	31	80
LZ2ZZ	A	41,894	335	22	64
LZ1DF	A	7,776	120	12	42
LZ1CF	21	25,991	146	27	52
LZ1AG	21	24,960	161	23	57
LZ1CW	14	61,548	404	25	67
LZ1KBU	7	19,129	356	10	37
LZ2AW	7	12,726	256	10	32
LZ2KLC	7	4,290	137	7	23
LZ2FY	7	2,950	112	6	19
LZ1KID	7	153	21	2	7

Channel Is. (Guernsey)

GC3KCE	A	54,366	280	29	73

(Jersey)

GC4LI	A	31,248	191	28	56

Crete

SVØWO	A	38,280	273	28	59

Czechoslovakia

OK1BY	A	264,504	566	64	150
OK2PO	A	142,290	536	48	107
OK1BMW	A	121,992	336	58	126
OK1GO	A	97,680	418	40	108
OK1ADM	A	70,560	187	60	100
OK3DG	A	69,580	280	47	95
OK1AGO	A	44,880	240	36	74
OK3CAG	A	43,318	249	36	85
OK2ABU	A	41,292	279	28	65
OK2LN	A	40,280	254	30	76
OK2QR	A	33,762	179	36	66
OK1VK	A	29,040	156	34	54
OK1AFN	A	15,732	108	26	43
OK2BHX	A	9,296	166	15	41
OK2BCH	A	8,960	100	23	33
OK2OL	A	8,349	72	26	43
OK3KED	A	4,687	97	13	30
OK2BEN	A	4,554	76	14	19
OK3CCV	A	4,477	99	14	23
OK2BCZ	A	4,154	59	16	46
OK2BCI	A	3,478	32	20	27
OK2BEC	A	529	13	10	13
OK1VB	21	20,075	103	25	48
OK1MX	21	6,157	49	19	28
OK1MP	21	4,725	43	20	25
OK1AIR	21	2,880	37	13	19
OK3IC	21	2,673	37	10	17
OK1ZQ	21	2,516	26	15	19
OK1ZL	14	97,713	406	28	71
OK3CDP	14	58,968	282	27	77
OK3OM	14	57,870	320	26	64
OK1AOM	14	19,036	204	15	34
OK1ABP	14	16,801	113	17	46
OK1AEZ	14	13,496	109	18	38
OK1UK	14	11,500	117	15	31
OK1DK	14	10,746	91	20	34
OK2BDY	14	5,402	81	14	23
OK1KIY	14	5,364	83	11	25
OK3UI	7.0	73,152	506	25	71
OK3HM	7.0	65,268	379	26	72
OK2KOJ	7.0	23,559	180	17	40
OK1KM	7.0	11,330	150	16	39
OK3CFF	7.0	11,139	223	10	37
OK3JV	7.0	11,001	130	15	42
OK2BFX	7.0	9,888	179	10	38
OK2BBI	7.0	8,022	146	11	31
OK1HR	7.0	6,240	122	10	30
OK3CFL	7.0	4,847	105	10	27
OK3CIJ	7.0	3,040	42	12	20
OK1AKL	7.0	2,904	67	10	23
OK3CEG	7.0	1,008	40	6	18
OK1NK	7.0	779	41	4	15
OK1KKJ	3.5	27,724	476	13	45
OK1NR	3.5	22,984	403	11	41
OK1ALW	3.5	18,400	320	9	41
OK2RO	3.5	13,724	251	9	38
OK1MG	3.5	13,554	153	12	42
OK1DC	3.5	11,868	232	9	34
OK3CFP	3.5	7,920	209	7	29
OK1AES	3.5	7,490	181	6	29
OK3QF	3.5	4,515	116	6	29
OK2KGV	3.5	3,400	96	6	28
OK1AOX	3.5	3,264	102	6	26
OK1AIA	3.5	2,430	91	5	25
OK1AIL	3.5	1,775	65	5	20
OK3CGL	3.5	1,771	79	4	19
OK1AJP	3.5	480	23	6	14
OK3BA	3.5	304	18	5	11
OL1AEF	1.8	630	60	2	12
OK1AHG	1.8	390	31	2	11
OK1AKU	1.8	290	55	2	8
OK1AGB	1.8	264	29	2	10
OK1AOV	1.8	220	28	2	9
OL3ABO	1.8	209	37	2	9
OL6ACY	1.8	180	29	2	8
OL7ABI	1.8	153	23	2	7

Denmark

OZ7BG	A	73,760	233	52	108
OZ7X	A	23,460	140	31	54
OZ4H	A	14,535	99	20	31
OZ5CP	A	9,828	120	17	46
OZ4DX	A	2,812	50	11	27
OZ3Y	21	3,333	41	13	20
OZ7OF	14	25,488	198	18	30
OZ7G	14	22,372	182	15	32
OZ3FU	14	1,725	41	8	17
OZ2CE	14	774	19	7	11
OZ8E	14	530	27	5	5
OZ4GB	7.0	1,541	65	5	18
OZ5EU	3.5	8,244	221	6	30
OZ5AR	3.5	2,548	89	5	23
OZ7CF	3.5	814	32	5	17

England

G3FKM	A	246,959	505	57	142
G2DC	A	178,640	414	58	145
G3DYY	A	140,694	404	50	129
G3TWV	A	46,872	295	27	64
G6VC	A	45,152	260	23	60
G2AJB	A	35,136	186	32	64
G3SEP	A	31,832	175	32	60
G3NVK	A	17,633	159	20	55
G3MWZ	A	12,388	101	26	50
G3JKY	A	11,767	172	11	30
G3RJB	A	2,688	70	6	22
G3HCT	21	80,276	356	28	66
G3HDA	14	155,290	560	28	78
G3IRM	14	240	20	5	7
G3POI	7.0	28,161	306	17	46
G3EYN	7.0	21,948	262	15	47
G8DI	7.0	5,144	132	8	30
G3TMA	7.0	3,813	66	9	22
G3ESF	3.5	19,317	355	8	39
G3JVJ	3.5	8,580	135	8	21
G3IGW	1.8	1,760	85	4	16

Finland

OH2PM	A	241,200	635	60	165
OH5UX	A	212,160	565	55	166
OH3ZN	A	90,636	315	45	137
OH3XI	A	25,080	159	28	86
OH3YI	A	22,684	150	28	79
OH2YL	A	13,604	88	23	53
OH3MM/6	A	11,840	122	18	46
OH3XR	A	7,600	72	19	31
OH3ZD	A	6,204	73	21	45
OH1VR	A	5,657	59	21	45
OH2JM	A	5,016	56	19	38
OH5WF	A	2,312	44	14	20
OH1WD	A	812	20	9	19
OH9QL	A	756	23	6	6
OH2VZ	A	288	8	8	8
OH5RZ	21	8,235	68	19	42
OH6VR	21	6,104	60	18	38
OH3AG	21	1,032	18	9	15
OH9QV	21	988	24	8	18
OH2BAC	21	980	18	10	18
OH3XC	21	99	5	4	5
OH1TN	14	57,024	276	28	68
OH2BDP	14	36,354	237	24	59
OH2BDS	14	12,366	144	14	40
OH3MF	14	8,541	134	10	29
OH7NW	14	5,934	70	12	31
OH5OD	14	4,920	73	9	31
OH3NR	14	2,150	56	8	17
OH1ZJ	14	2,025	63	7	18
OH6RV	14	990	41	7	14
OH2BCD	14	99	7	5	6
OH1VA	7.0	49,882	376	27	71
OH1XX	7.0	31,152	291	19	47
OH5UQ	7.0	20,148	171	20	49
OH6VP	7.0	4,800	124	5	27
OH8RC	7.0	4,147	115	8	21
OH4QS	7.0	1,416	59	4	20
OH5WH	7.0	1,364	48	6	16
OH2BFN	7.0	594	27	5	13
OH2BFS	7.0	459	27	7	13
OH3LA	7.0	330	20	4	11
OH1ZK/3	7.0	170	13	4	6
OH1SH	3.5	26,000	309	14	51
OH2DI	3.5	2,808	101	5	22
OH3MU	3.5	64	9	3	5
OH5VS	3.5	35	6	2	5
OH3NY	1.8	176	22	2	6

France

F8OP	A	96,309	406	35	88
F8TM	A	94,073	333	44	107
F8RU	A	15,042	109	29	40
F3IZ	A	5,069	75	12	25
F2GO	A	4,536	68	16	20
F8JH	A	4,290	75	14	25
F2SQ	14	70	5	3	2

Germany

DJ2AA	A	461,682	875	67	167
DL9AA	A	254,259	450	73	146
DJ7IKA	A	209,017	607	58	139
DJ7LD	A	188,356	440	60	136
DJ7BQ	A	149,227	364	60	109
DJ4DN	A	111,687	321	56	121
DJ6TK	A	80,172	304	45	86
DJ4PX	A	77,000	315	43	82
DL7CF	A	55,857	207	46	83
DJ8IF	A	54,168	301	33	78
DL3CM	A	42,721	204	43	76
DJ6BW	A	38,948	255	30	61
DL8DD	A	35,908	220	29	65
DJ2SK	A	35,742	135	44	94
DJ3BB	A	34,160	156	36	86
DL8AJ	A	33,284	154	36	70
DLØER	A	19,809	145	31	62
DJ4HR	A	18,768	157	19	50
DL1AM	A	16,920	135	30	60
DJ7PB	A	14,248	122	23	29
DL1ES	A	13,440	145	22	58
DJ2FL	A	9,728	102	22	42
DJ3WD	A	7,392	83	19	25
DL1JC	A	6,097	67	19	48
DJ3YU	A	4,200	51	17	23
DJ2UU	A	2,444	49	15	32
DJ1VI	A	2,405	41	13	24
DL8IG	A	580	22	9	11
DJ2RE	21	26,112	160	23	41
DJ1ZG	21	21,158	113	25	46
DL8ML	21	20,026	117	24	38
DL2DK	14	183,022	542	32	87
DJ1PN	14	58,725	314	22	59
DJØPN	14	48,974	221	30	64
DJ6QT	14	28,826	215	17	41
DJ7RJ	14	5,780	93	12	22
DL1TH	14	3,780	66	9	18
DL2FW	14	2,860	60	9	17
DJ5BV	7.0	90,810	536	25	69
DJ5PA	7.0	56,244	363	25	61
DJ6RX	7.0	42,366	379	18	51
DJ5JH	7.0	40,950	350	22	56
DL1KS	7.0	20,770	174	17	45
DJ7XC	7.0	7,488	178	11	21
DJ3KR	3.5	46,130	416	18	52
DJ2YA	3.5	41,473	419	15	52
DJ5DT	3.5	24,766	289	11	47
DJ8FR	3.5	11,720	275	8	32
DL1FF	1.8	1,746	75	4	14
DL5FL	A	345,564	851	57	117
DL4IM	A	66,233	332	31	76
DL5AO	14	23,843	193	19	34
DL5JJ	14	14,850	125	17	33

Tony Smaker and Walter O'Neal (cigar) during a lull in the KL7JDO operation.

DM3LOG	**A**	**50,020**	**238**	**39**	**83**
DM3ZH	**A**	**37,595**	**225**	**32**	**71**
DM2AUF	A	30,086	218	27	71
DM2ATD	A	28,480	170	32	57
DM3EN	A	19,096	155	27	61
DM2AUD	A	12,000	118	24	56
DM4EL	A	8,520	92	24	47
DM3RYO	A	7,930	69	22	39
DM2BFM	A	7,260	80	18	48
DM2BDH	A	4,440	57	17	43
DM4WKL	A	3,922	72	15	38
DM4ZWL	A	3,360	88	13	29
DM2BXH	A	2,816	64	9	35
DM3VUN	A	2,112	41	14	19
DM2ANH	A	1,131	36	9	19
DM3VYO	A	840	19	10	14
DM3SF	A	342	13	8	11
DM4WPL	**14**	**29,100**	**206**	**21**	**39**
DM3YPD	14	7,831	102	12	29
DM2BBE	14	1,470	47	8	13
DM4XGL	14	1,300	45	7	13
DM2CFM	**7.0**	**13,083**	**231**	**13**	**36**
DM2CCM	**3.5**	**3,150**	**105**	**5**	**25**
DM2BLJ	3.5	1,175	50	4	21
DM2AMF	3.5	70	15	2	3

Greece

SVØWAA	**A**	**84,096**	**539**	**34**	**94**

Hungary

HA5KFR	**A**	**114,920**	**408**	**50**	**120**
HA9PB	A	25,344	202	27	72
HAØKDA	A	11,225	137	21	40
HAØKYB	A	6,930	159	9	36
HA1VE	A	6,348	93	15	31
HA8UH	A	6,102	100	20	34
HA3GG	A	2,162	97	5	18
HAØLL	A	966	36	8	13
HA1SB	**14**	**24,720**	**232**	**19**	**41**
HA1KSA	**3.5**	**31,372**	**438**	**12**	**42**

Iceland

TF3AB	**A**	**36,146**	**274**	**18**	**35**
TF3KB	3.5	315	18	4	5

Ireland

EI5B	**A**	**6,251**	**86**	**22**	**37**

Italy

I1KE	**A**	**183,280**	**539**	**49**	**109**
I1EVK	A	24,396	173	21	55
I1IR	A	1,300	25	10	10
I1SF	**21**	**47,430**	**215**	**27**	**66**
I1NU	21	29,736	180	22	41
I1PPI	**14**	**18,411**	**154**	**14**	**37**
I1VIB	**7.0**	**10,074**	**191**	**9**	**37**
I1HL	7.0	2,112	78	7	15
I1BAY	**3.5**	**23,667**	**417**	**9**	**40**
I1IZ	3.5	4,428	104	8	28

Netherlands

PAØGMU	**A**	**233,366**	**591**	**62**	**139**
PAØXPQ	A	40,793	176	36	77
PAØTAU	A	19,522	165	26	60
PAØVB	A	15,791	154	23	50
PAØWAC	**14**	**8,938**	**90**	**12**	**29**

Norway

LA8SJ	**A**	**15,914**	**165**	**18**	**55**
LA2Q	A	14,160	163	15	45
LA7H	**21**	**6,832**	**69**	**16**	**40**
LA7UH	**14**	**3,627**	**79**	**9**	**22**
LA5IH	**7.0**	**5,624**	**132**	**5**	**33**
LA8WG	7.0	3,224	115	7	19
LA6U	7.0	480	15	7	13

Poland

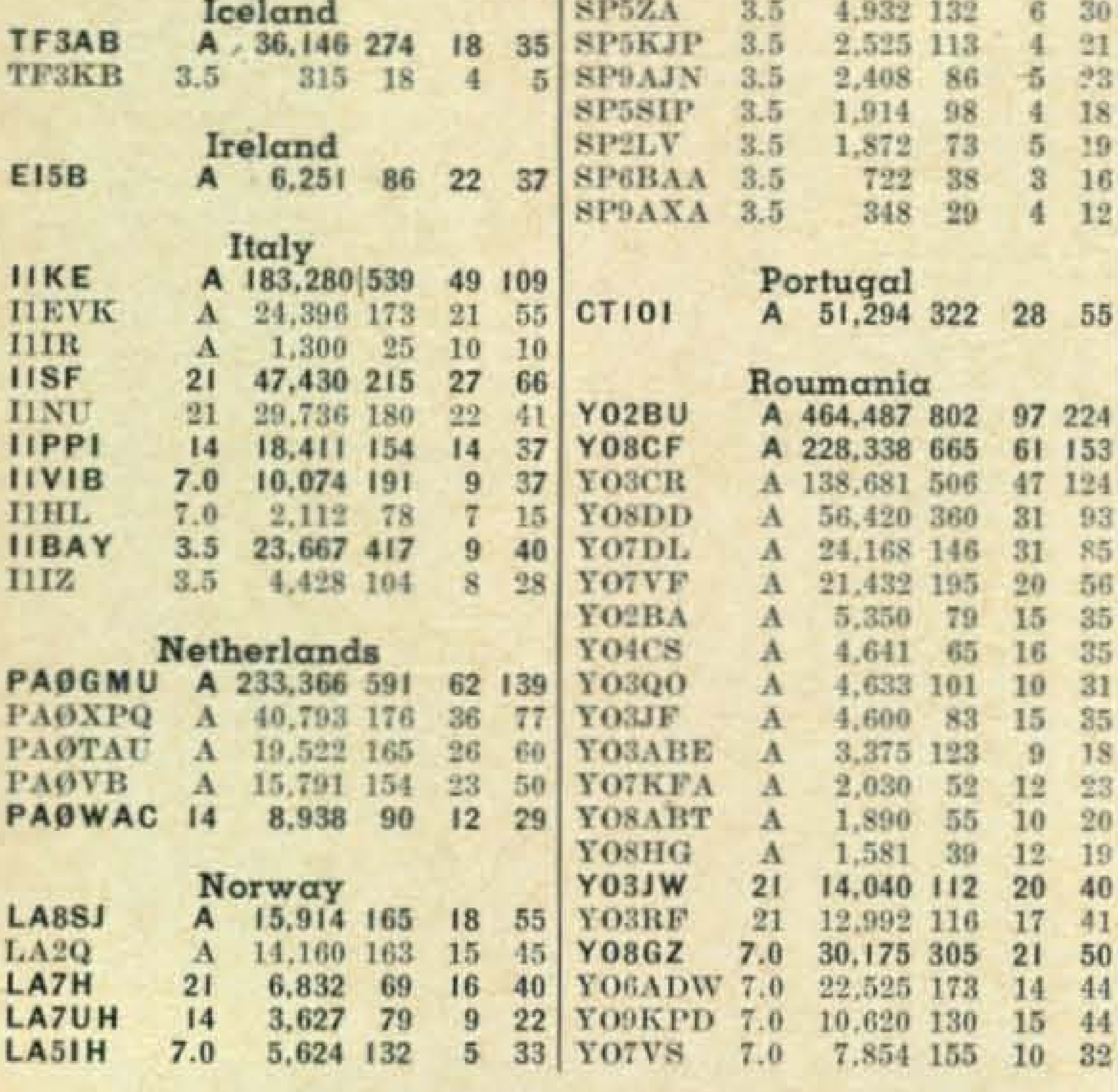
SP8CP	**A**	**128,282**	**427**	**55**	**132**
SP9ADU	**A**	**123,291**	**414**	**55**	**116**
SP2IU	A	69,690	330	63	95
SP6ALL	A	62,750	247	44	81
SP8AG	A	59,405	339	36	73
SP8SR	A	55,550	368	29	81
SP5AFL	A	53,235	336	29	88
SP9ZD	A	46,008	225	36	72
SP8AWP	A	15,614	146	22	52
SP7ASZ	A	7,493	89	17	42
SP8AOV	A	5,265	58	20	45
SP9AGS	A	4,224	72	14	30
SP9DN	A	2,100	48	12	23
SP9BCB	A	1,200	20	13	17
SP3BES	A	945	36	6	21
SP5YC	**21**	**15,624**	**94**	**18**	**44**
SP6AKK	21	2,178	23	15	18
SP3AOI	21	1,080	21	9	11
SP6AAT	**14**	**73,000**	**310**	**29**	**71**
SP8CK	14	20,022	125	21	50
SP3AIJ	14	19,768	153	19	37
SP9BDH	14	19,656	147	21	42
SP1NJ	14	15,369	149	13	34
SP5HS	14	10,348	96	17	35
SP6ANY	14	6,474	76	12	27
SP4AWE	14	3,799	71	10	19
SP6ATT	14	3,156	56	8	16
SP3PK	14	1,972	48	6	11
SP5AHW	14	851	17	9	14
SP6LK	14	110	10	3	8
SP5ARN	**7.0**	**49,680**	**417**	**20**	**60**
SP1BHX	7.0	16,968	234	15	41
SP6AWB	7.0	1,305	83	11	18
SP5BCL	7.0	1,104	45	5	19
SP6UK	7.0	156	12	4	9
SP5ADZ	**3.5**	**15,975**	**336**	**8**	**37**
SP7JX	3.5	6,278	129	9	54
SP5ZA	3.5	4,932	132	6	30
SP5KJP	3.5	2,525	113	4	21
SP9AJN	3.5	2,408	86	5	23
SP5SIP	3.5	1,914	98	4	18
SP2LV	3.5	1,872	73	5	19
SP6BAA	3.5	722	38	3	16
SP9AXA	3.5	348	29	4	12

Portugal

CT1OI	**A**	**51,294**	**322**	**28**	**55**

Roumania

YO2BU	**A**	**464,487**	**802**	**97**	**224**
YO8CF	**A**	**228,338**	**665**	**61**	**153**
YO3CR	A	138,681	506	47	124
YO8DD	A	56,420	360	31	93
YO7DL	A	24,168	146	31	85
YO7VF	A	21,432	195	20	56
YO2BA	A	5,350	79	15	35
YO4CS	A	4,641	65	16	35
YO3QO	A	4,633	101	10	31
YO3JF	A	4,600	83	15	35
YO3ABE	A	3,375	123	9	18
YO7KFA	A	2,030	52	12	23
YO8ABT	A	1,890	55	10	20
YO8HG	A	1,581	39	12	19
YO3JW	**21**	**14,040**	**112**	**20**	**40**
YO3RF	21	12,992	116	17	41
YO8GZ	**7.0**	**30,175**	**305**	**21**	**50**
YO6ADW	7.0	22,525	173	14	44
YO9KPD	7.0	10,620	130	15	44
YO7VS	7.0	7,854	155	10	32
YO4CT	7.0	5,032	114	8	26
YO8FR	7.0	4,114	107	7	27
YO6EX	7.0	4,046	99	8	26
YO2NV	7.0	3,993	115	6	27
YO2AIJ	7.0	3,683	124	6	23
YO6EZ	7.0	2,575	101	5	25
YO5TM	7.0	968	38	6	16
YO2AIX	7.0	748	45	5	12



PY1NO—All band entry from Brazil. Luiz picked up seven new countries in the contest . . . (But the *mike*, Luiz, this was a c.w. contest!)

VR2EW, Don Miller—Nuff said! The smile of confidence? He knew he had it in the bag.

Scotland

GM3JDR	**A**	**30,450**	**247**	**22**	**48**

Sicily

IT1AGA	**A**	**28,160**	**172**	**28**	**60**

Spain

EA3KT	**A**	**29,412**	**184**	**27**	**59**
EA7KE	**14**	**30,645**	**306**	**14**	**31**
EA2CR	3.5	297	15	4	7

Svalbard

LA4FG/P	14	280	20	4	10

Sweden

SM5BLA	**A**	**643,200**	**989**	**85**	**235**
SM5CCE	**A**	**195,750**	**478**	**65**	**160**
SM5BGK	**A**	**149,952**	**375**	**55**	**137**
SM5CEU	A	88,500	421	36	82
SM4AD	A	70,740	264	36	95
SM7AXP	A	50,880	220	30	76
SM3AF	A	34,404	225	26	68
SM5AHQ	A	31,950	259	19	56
SL3AF	A	30,690	238	26	64
SM3SV	A	24,411	195	23	56
SM5BDS	A	22,185	178	25	60
SM6DLL	A	20,256	136	32	64
SM7EH	A	19,872	139	24	68
SM4CHM	A	18,480	186	19	47
SM5UU	A	9,176	72	27	47
SM7PX	A	8,690	90	16	39
SM5BEI	A	7,473	100	13	40
SM6CMR	A	3,195	55	16	29
SM6CZU	A	2,278	25	14	20
SM4AZD	A	961	27	11	20
SM5DRL	A	925	29	9	16
SM5KV	**21**	**33,858**	**156**	**27**	**72**
SM4CMG	21	7,480	62	19	36
SM7CRJ	21	4,900	41	19	31
SM3CXS	21	4,050	46	15	31
SM4COK	21	3,010	43	11	24
SM5QU	21	2,752	43	11	21
SM5API	**14**	**40,635**	**310**	**20**	**43**
SM7AHW	14	26,460	186	20	40
SM2CXU	14	19,760	166	16	36
SM5BNX	14	18,189	168	16	31
SM7DVF	14	13,988	113	17	35
SM6ARH	14	10,584	87	18	36
SM5DFM	14	10,396	129	13	33
SM7TV	14	4,104	66	10	26
SM5DXE	14	3,549	44	12	27
SM6BUV	14	1,562	43	7	15
SM3TW	**7.0**	**40,716**	**320**	**21**	**57**
SM5DKH	7.0	34,344	386	16	56
SM5CAK	7.0	30,294	322	15	51
SM5DUL	7.0	8,272	161	9	35
SM5UQ	7.0	5,661	144	7	20
SM5CJP	7.0	2,484	52	7	16
SM5MX	**3.5**	**20,350**	**314**	**11**	**44**
SM3VE	3.5	1,363	42	6	23
SM3AU	3.5	285	18	4	11

Switzerland

HB9JG	**A**	**375,882**	**632**	**75**	**162**
HB9ZY	A	209,287	393	75	146
HB9MO	A	115,808	350	50	104
HB9ABB	A	33,321	306	23	64
HB9UD	A	9,130	73	27	56
HB9QA	A	2,728	61	13	31
HB9DX	**21**	**16,066**	**103**	**21**	**37**
HB9KC	**7.0**	**9,275**	**145**	**11**	**24**
HB9ADB	7.0	1,392	59	4	20

Wales

GW3MRI	**A**	**18,644**	**183**	**19**	**60**

Yugoslavia

YU3BC	**A**	**500,250**	**806**	**85**	**205**
YU3NP	21	665	13	7	12
YU2RAJ	**14**	**12,250**	**146**	**11**	**39**
YU2AKL	**7.0**	**10,368**	**188**	**12**	**36**
YU3WP	7.0	3,944	95	9	27
YU4ENS	7.0	2,376	97	6	16
YU3NBM	7.0	620	31	5	15

U.S.S.R.

Estonia

UR2CW	**A**	**30,213**	**190**	**23**	**58**
UR2LO	A	2,576	80	8	20
UR2AT	**14**	**7,227**	**134**	**11**	**22**

European

UA3UJ	**A**	**226,384**	**584**	**57**	**159**
UA4CH	**A**	**156,112**	**547**	**44**	**130**
UV3TC	A	60,552	229	30	86
UA6DU	A	47,520	339	25	71
UA3IM	A	35,568	181	35	82
UA1UD	A	31,950	270	25	65
UA4HW	A	18,180	114	28	62
UA3BF	A	17,680	116	21	59
UA3TA	A	14,186	129	24	58
UA3KTV	A	13,365	185	14	41
UA1ZW	A	12,714	169	10	16
UW3BX	A	10,508	127	16	55
UA6BV	A	7,076	86	15	43
UW6AO	A	7,009	162	10	33
UA1FP	A	2,516	48	11	23
UW3PQ	A	2,442	46	11	22
UA3GM	**21**	**13,536**	**88**	**22**	**50**
UA4PX	21	4,181	65	13	24
UA3AA	21	1,595	21	12	17
UA4KHW	**14**	**187,176**	**601**	**36**	**96**
UA1ND	14	67,158	394	26	65
UA4QA	14	55,890	326	24	66
UW4HW	14	54,900	368	24	66
UW3FH	14	30,100	237	20	50
UA4ZA	14	20,345	171	16	49
UA1IN	14	9,288	167	10	26
UA3JD	14	6,474	82	11	28
UA3SA	14	5,513	105	10	27
UW4AF	14	3,094	79	8	18
UA1ZZ	14	1,683	33	12	21
UA3KBO	**7.0**	**56,948**	**424**	**26**	**66**
UA1DH	7.0	40,896	363	19	53
UW3KAK	7.0	33,740	322	17	53
UA6GZ	7.0	10,349	151	14	37
UA3BK	7.0	3,910	97	7	27
UA1NA	**3.5**	**12,528**	**263**	**10**	**34**
UA3DV	3.5	8,440	192	8	32
UA1SW	3.5	7,215	152	6	31

Karelo-Finnish Rep.

UN1CH	**A**	**28,645**	**216**	**24**	**61**

Latvia

UQ2GQ	**A**	**26,044**	**223**	**22**	**46**
UQ2KAY	A	10,983	99	22	51

The YV9AA crew. Back row: YV5BNR, 5ATB, 5AGD, 5ANT. Front row: YV5BKA, 5AAS, 5AAQ, (YV5GO missing).

UQ2KBI	A	9,826	128	18	43

Lithuania

UP2NK	A	355,346	777	73	181
UP2NL	A	5,880	117	13	36
UP2AW	7.0	4,844	175	5	23
UP2BI	7.0	244	16	4	10
UP2KNP	3.5	30,634	483	11	42
UP2CG	3.5	6,562	179	7	27
UP2AV	3.5	169	15	4	9

Moldavia

UO5BM	A	23,760	172	28	44

Ukraine

UB5WF	A	529,038	864	85	206
UT5BP	A	134,514	485	48	111
UB5OF	A	103,086	394	44	122
UT5HP	A	99,852	385	38	121
UB5PT	A	89,712	407	36	108
UB5WK	A	74,504	366	34	105
UB5IU	A	72,930	428	30	100
UB5LW	A	66,840	336	38	82
UB5PG	A	52,272	264	35	97
UB5ZE	A	46,363	299	26	77
UT5LF	A	31,872	214	25	71
UB5ML	A	20,720	204	20	54
UB5QA	A	16,683	87	22	61
UB5WL	A	12,688	155	16	45
UB5HN	A	9,690	98	15	42
UB5IB	A	8,256	109	14	50
UB5DV	A	2,776	32	18	25
UB5EF	A	1,885	27	10	19
UB5LC	21	11,426	115	20	38
UT5BX	14	47,300	330	18	57
UB5WJ	14	40,290	217	23	56
UT5BW	14	19,380	164	13	44
UB5KBD	7.0	8,364	136	9	34
UB5PD	7.0	5,282	114	9	29
UB5PN	7.0	1,760	65	6	16
UB5VA	7.0	1,071	53	5	16
UB5CV	3.5	26,216	370	12	46
UB5HS	3.5	13,272	316	7	35
UB5TQ	3.5	10,019	210	8	35
UB5KCA	3.5	6,142	146	7	30
UT5GP	3.5	3,399	97	6	27

White Russia

UC2AD	A	89,589	283	52	97
UC2WP	A	79,665	476	26	87
UC2AW	A	13,317	81	27	42
UC2AR	A	11,440	89	28	52
UC2TA	A	4,134	78	13	26
UC2HU	7.0	5,240	105	9	31

Oceania

Australia

VK1DA	7.0	8,424	108	8	18
VK2PV	A	140,430	321	59	95
VK2VN	A	73,080	207	42	78
VK2ADE	A	42,630	146	40	65
VK2APK	14	74,706	317	32	54
VK2GW	7.0	34,800	242	20	30
VK3AXK	A	131,979	436	41	70
VK3RJ	21	20,300	147	20	30
VK3ABA	21	10,500	102	14	21
VK3ADB	14	295,596	788	35	51
VK3ABR	14	6,300	50	18	24
VK3APN	7.0	12,240	102	17	23
VK3XB	3.5	1,034	39	6	5
VK4EL	21	80,178	396	21	48
VK4UC	14	3,811	45	15	22
VK4SS	7.0	8,964	85	18	18
VK5BS	A	2,112	33	13	9
VK5KO	21	51,264	246	23	49
VK5WC	14	8,106	83	18	24
VK6RU	A	244,032	549	57	107
VK7SM	A	72,974	252	42	65

Christmas Is.

VK9DR	14	120	7	4	4

Ebon Atoll

KX6SZ	A	126,807	359	39	40

Fiji Islands

VR2EW	A	2,499,536	2215	126	268
VR2DK	A	58,564	201	52	69

Guam

K3ICK/KG6	A	11,123	155	22	27

Hawaii

KH6EPW	A	920,142	1599	83	111
KH6IJ	14	121,095	550	28	41
KH6EDW	14	20,039	242	13	16
KH6FON	14	7,644	131	9	12

New Zealand

ZL4BO	A	247,044	522	67	106
ZL1DV	14	60,515	332	21	44
ZL1HW	14	57,226	284	27	44
ZL1AYF	14	18,704	140	22	34
ZL1QW	14	2,850	51	12	14

Solomon Islands

VR4CR	14	8,705	105	12	15

Tahiti

FO8BI	A	90,090	403	35	42

South America

Argentina

LU8DQ	A	170,148	453	56	76
LU6FA	14	78,638	340	28	54

Brazil

PY2BGL	A	365,310	587	66	132
PY1ADA	A	245,364	522	63	98
PY1NO	A	88,255	326	40	55
PY2SO	14	473,156	1169	35	104
PY4OD	14	314,292	805	35	97
PY7ABY	14	41,860	180	25	40
PY2DBU	14	1,582	41	7	7
PY7AEW	7.0	1,734	35	8	9

Chile

CE4EC	A	35,712	196	31	33
CE2DI	14	14,352	119	19	27

Falkland Islands

VP8HJ	A	123,948	436	43	56

Fernando De Noronha Is.

PY7ACQ	A	58,146	306	30	33

Uruguay

CX2CO	A	1,252,275	1508	95	188
CX5DJ	14	36,729	219	22	41

Venezuela

YV5BOA	A	53,084	204	36	56
YV5BZ	A	36,654	164	37	45
YV5BMN	7	17,064	162	10	26

MULTI-OPERATOR

Single Transmitter

North America

United States

K1JGD	467,268	601	83	193
(K1JGD, W3SQX)				
W7UXP/1	112,495	259	44	107
(W7UXP, WA4RHU)				
W2PCJ	769,834	719	103	274
(W2PCJ, W2SUC, W2ZKQ, WB2CKS)				
K2HLB	625,758	748	94	223
(K2HLB, W2AGW, 2DEC, 2DNG, 2HTI, 2JT, WA2ELS)				
WB2APG	613,656	673	91	233
(WB2APG, K3JCT)				
K2SUX	241,968	395	69	144
(K2SUX, W2HZY)				
WB2FON	76,504	196	52	94
(WB2FON, 2FOV, 2MHT)				
W3HHK	459,534	580	81	197
(W3HHK, K3HTZ)				
W3GHS	215,046	331	73	161
(W3GHS, K3YUA)				
K3MBF	115,920	327	36	84
(K3MBF, K3LIZ)				
W4HOS	198,693	281	70	153
(W4HOS, W4FRO)				
W4JD	164,322	392	44	109
(W4JD, WA4HHW)				
W4ZYQ	151,709	254	67	144
(W4ZYQ, 4ZYS, WA4DQM)				
K4IIF	54,625	158	44	81
(K4IIF, K4GRD)				
WA6SBO	726,131	766	113	230
(WA6SBO, WB6EFA, W6JVA, K6SDR, K6VZA, KH6EVT)				
W6GHM	603,198	752	101	181
(W6GHM, W6ILP)				
WA6HRS	302,738	467	84	145
(WA6HRS, W6BZZ, W6CUF)				
K6EVR	213,150	511	37	108
(K6EVR, K6JIC)				
W6UED	193,680	463	37	107
(W6UED, W6VPH)				
W6UMI	151,432	297	70	114
(W6UMI, W6RGG)				
WB6NAW/6	1,798	28	14	15
(WB6NAW, WB6NKJ)				
K8KJN	308,669	414	85	186
(K8KJM, K8MFO, K8VQP)				
K8WVF	307,000	438	77	173
(K8WVF, K8VIX, K8CXM)				
WA8GUF	106,596	242	52	110
(WA8GUF, WA8GLY, WA8HHO)				
K8AJK	96,278	212	50	111
(K8AJK, WA8GUA)				
WØEZO	312,798	501	80	142
(WØEZO, WAØJRW, KØKKU)				

Alaska

KL7JDO	281,859	950	43	50
(KL7JDO, KL7EDY)				

Canada

VO2HA	19,592	319	18	13
(VO2AW, K6QYK, WA5FCX, W4DRF)				

St. Vincent

VP2SY	638,520	1384	63	141
(K1IMP, W1BPW)				

Africa

Ascension Island

ZD8AR	844,662	1308	70	151
(ZD8BC, ZD8RD)				

Ethiopia

ET3USA	1,071,312	1388	73	191
(K4FMA, K9UIW, Others)				

Liberia

EL2AE	740,691	1325	66	123
(EL2AE, EL2D)				

Asia

Japan

JA1YAY	37,312	174	41	47
(JA1KVT, JA9ADG)				
JAYAI	20,220	144	28	32
(JA1GGA, JA7SW, JA7CBD)				
JA7YAG	13,965	149	16	19
(Club Station)				
JA6YBR	3,053	42	19	24
(JA6AKL, JA6BWH)				

U.S.S.R.

Armenia

UG6KAA	272,565	731	37	98
(UG6AV, UG6WW, UG6-6829)				

Asiatic

(Club Stations)

UA9KQA	437,838	713	59	170
(UA9RJ, 9RQ, 9RR, 9-19601)				
UA9KCB	156,360	504	34	86
UA9KTE	143,412	452	22	89
UA9KJA	18,704	144	15	41
UAØKFG	630,036	1129	83	139
(UAØEH, ØFE, UWØFK, ØFM)				
UAØKKC	101,085	427	43	72
UAØKSB	74,005	398	34	61
UAØKIA	70,725	479	33	36
UAØKCA	48,872	315	34	48
UAØKKB	27,667	208	30	43

Azerbaijan

UD6KZZ	230,328	622	34	92
(UD6AV, UD6BD, UD6BO)				
UD6KAR	51,392	266	22	51
UD6KAB	29,504	167	18	46

Georgia

UF6KAF	197,904	543	35	98
(UF6GE, UF6GM, UF6LA)				
UF6KPA	5,814	59	9	25

Kazakh

UL7KAA	214,192	531	56	120
UL7KBF	169,875	509	35	90
UL7KKB	130,680	440	38	82

Tadzhik

UJ8KAA	448,350	839	68	142

Uzbek

UI8KAF	56,430	250	27	63

One of the rarer entries, EP2BQ, with Harry McQuillan at the key.

Europe

Bulgaria
(Club Stations)

LZ1KPG	397,334	1075	60	142
LZ1KAA	121,978	615	40	102
LZ1KDZ	54,846	442	26	73
LZ2KGO	18,496	261	16	48
LZ2KBI	7,334	180	8	30
LZ2KAD	6,248	166	14	28
LZ2KST	5,208	179	7	21
LZ2KRZ	2,812	64	13	24

Czechoslovakia
(Club Stations)

OK3KMS 176,490 517 63 122
(OK3CAX, OK3CEA, 3-9983)

OK2KNP	30,502	199	30	71
OK2KJU	30,160	182	32	72
OK2KOO	29,840	256	23	57
OK2KHD	16,296	132	26	58
OK1KTL	13,634	124	21	42
OK1KCD	12,744	107	17	37
OK1KDT	6,168	97	10	24
OK1KOK	2,470	55	11	27
OK1KBN	630	40	4	17
OK1KHK	176	29	2	6

England
G3SSO 530,944 881 79 177
(G2HX, 2RT, 3CNW, 3MSV, 3NHF, 3PEO, 3PYI, 6VX 8FF, 8KG)
G3TGK 20,475 186 18 45
(G3TGK, G3EBH)

Faroe Island
OY6FRA 96,746 700 30 92
(Club Station)

Finland
OH4OP 113,306 368 48 133
(OH4OP, OH4OO)
OH2TI 94,620 277 47 119
(OH2BCP, OH2BO, OH2MM)
OH3AH 50,661 282 35 82
(OH2DW, OH2PF, OH3TY, OH3XT, OH3YG, OH3ZB)
(Club Station)
OH6AF 39,347 285 22 53
OH2AC 19,845 131 31 74
OH3NE 13,041 115 26 55

Germany
DJ3JZ 570,732 975 72 167
(DL1CR, 3AO, 6KC, 7BA, DJ3JZ, 1BP, 4LI, 7AF)
DLØAA 352,458 722 72 142
(DL3AA, 3BK, 3OH, 6KB, 8XY, DJ1TL, 4XG, 5DA)
DLØITU 266,931 727 65 158
(Club Station)
DJ9HA 205,140 584 56 139
(DJ9HA, DJ9SB, DJ4SB)
DJ2XP 197,290 664 45 136
(DJ2XP, DL8AM)
DL8CM 181,104 540 55 121
(DL8CM, DL8CH)
DLØNS 103,880 423 44 96
(DJ3OZ, 4AN, DL6QV, 9VP)
DLØFT 93,732 243 50 96
(DJ5HL, 6NS, DL1HA, 1HH, 3NM)
DJ6TT 80,565 355 38 93
(DJ6LV, DJ6TT)
DLØJD 71,103 278 44 93
(DJ1CY, DJ1XI, DJ4HO)
DJ9MH 42,018 294 26 68
(DL2AW, DJ4WG)

DM4BO 42,900 218 38 72
(DM2BPO, DM4UBO)
DM6AK 30,264 200 26 78
(DM3SBM, 3XPH, 4KG, 6ZAK)
DM3UE 2,336 30 14 18
(DM3UE, DM2AGE)

DL5GK 102,960 412 46 119
(DL3BA, 5ES, DJ9CN, 9RI)

Hungary
HA5KBB 422,240 920 74 186
(HA5DM, 8WH, 5-019, 8-703, 9-007)

Italy
IØFGM 310,592 962 54 130
(I1ALU, 1LCK, 1VN)

I. T. U.
4U1ITU 14,742 135 21 33
(DL1YJ, HB9UD)

Netherlands
PI1PT 82,362 409 29 82
(Club Station)
PAØZAV 45,186 285 29 73
(PAØZAV, PMD, NFN)

Northern Ireland
GI3GAL 57,936 325 28 74
(GI3GAL, 3JXS, 3SXG)

Norway
LA1H 274,505 753 47 114
(LA1LF, 2IE, 7RB, 9JD, 9OI)
LA2J 17,536 233 16 48
(LA6IJ, 7OI, 9XJ)

Poland
SP8KAR 167,844 461 65 148
(SP8AJK, 8-029, 8-6001)
SP8KBM 33,454 207 23 63
(SP8AJE, SP8ARY)
SP2KAE 11,286 163 15 39
(SP2LU, SP2US)
SP2KAC 5,355 104 12 33
(SP2AOB, SP2RO)

Roumania
YO3KSD 241,986 854 51 135
(YO3GU, 3AAR, 3RX, 3YY)
YO5KAU 15,622 179 18 55
(Club Station)

San Marino
M1N 250,488 718 50 118
(W6JFJ, G3IRK)

Scotland
GM3GUJ 80,730 439 30 87
(GM3GUJ, GM3VBK)
GM3SFH 35,776 244 27 59
(GM3SFH, 3RNZ, 3UCF)

Multi station OH2AM of the OH-DX-Ring contest club, only European station to break a million points. Front to back: OH2BC, OH2BH, and OH2SB at the 20 m. operating position.

Sweden
SM6CKV 524,970 860 83 202
(SM6AOE, 6BJI, 6CKV & Eva)
SL5AB 75,010 389 41 89
(SM5CGS, SM5CRV)
SM7CKT 45,650 235 36 74
(SM7CKT, SM7ALA)

Switzerland
HB9AAZ 96,558 455 34 87
(HB9AAZ, HB9ADP)

Vatican
HV1CN 382,700 1316 51 121
(W9IOP, W9AC, W8DUS)

Yugoslavia
YU1BCD 216,810 664 63 135
(Club Station)

U.S.S.R.

Estonia
UR2KAC 287,640 899 46 142
(UR2FR, 2FU, 2MG, 2NN)

European
UA3KAS 990,943 1162 112 337
(UA3BA, UW3HR, UA3-27214)
UA6KAF 248,358 806 55 158
(UA6DP, UA6-14283, UA6-14303)

Club Stations

UA6KTB	196,602	634	55	162
UA3KZO	174,346	622	50	129
UA4KKC	170,748	537	49	155
UA3KFB	150,960	560	54	131
UA3KAO	148,185	509	50	135
UA4KEA	135,014	310	54	133
UA6KAE	133,940	566	54	131
UA4KEG	130,095	531	44	133
UA4KPA	115,584	498	39	129
UA3KWA	108,569	542	33	118
UA1KBB	103,680	483	35	125
UA3KMB	75,852	438	31	98
UA3KYA	52,460	270	34	88
UA4KCE	42,180	345	24	71
UA1KAC	31,059	398	12	39
UA3KRO	27,232	263	18	56
UA3KFA	18,380	199	20	48
UA1KCU	7,636	145	12	34
UA3KWI	4,902	80	14	27
UA3KOB	3,500	72	11	24
UA3KHA	2,356	36	11	20

Kaliningrad
UA2KAW 224,994 825 39 115
(UA2BO, UA2CA, UA2CD)
UA2KAP 57,776 468 26 66

Latvia
UQ2KAX 85,643 461 37 84
(UQ2AB, UQ2AN, UQ2-22375)
UQ2KCC 16,046 189 19 52
UQ2KCR 15,000 232 12 48

Lithuania
UP2KBC 248,094 736 55 143
(Alfred & Henry)
UP2KBA 118,883 532 36 107

Moldavia
UO5KAG 1,222 44 8 18

Ukraine
UB5KBA 267,444 661 62 166
(Mariam (YL) & Yuri)

Club Stations

UB5KAS	167,056	475	56	141
UB5KAI	151,424	402	58	150
UB5KLD	108,188	415	39	109
UB5KHQ	103,802	425	40	102
UB5KAU	56,916	293	33	81
UB5KGL	28,952	229	29	65
UB5KKI	22,081	215	15	56
UB5KUN	16,427	215	12	31
UB5KBV	14,927	173	17	42

White Russia
UC2KAC 91,511 538 32 87
(Boris, Valery, Vlad)
UC2KMZ 39,624 321 22 56
UC2KAA 25,500 202 16 44

South America

Colombia
HK3RQ 574,287 1208 59 102
(HK3RQ, HK1QQ)

MULTI-OPERATOR

Multi-Transmitter

North America
K2GL 2,513,448 1729 130 374
(K2GL, 2DGT, 2UYG, W1GYE, 2GLM, 2IWC, 6KFV, WB2MFX)
W3MSK 1,956,801 1467 126 347
(W3MSK, 3EIS, 3FYS, 3PZW, 6HOH, K1ANV, 3EST, 6BHM)
W3WJD 1,219,074 1096 108 290
(W3WJD, 3DQG, K3MCO, 3JJG, 6LSG)
W4KXV 1,198,512 1040 112 294
(W4KXV, 4TKR, K2UFT, 2YGR, 4MXF, 4PQL, 4VDL, WA4GHV, 4JYV, 4LNV)
W6RW 1,169,625 111 122 253
(W6RW, K2PHF, 6KOI, 6MQG, 6SUQ, 9ELT, WA6OHJ, 6TGH, WB6ENX)
VP9EU 210,500 974 35 65
(VP9EU, VP9FW, W5HWR, WB2PXZ)
W3VKD 170,544 319 49 138
(W3VKD, 3AOH, 3LMM, 3QJJ, 3UHN, K3DKD)

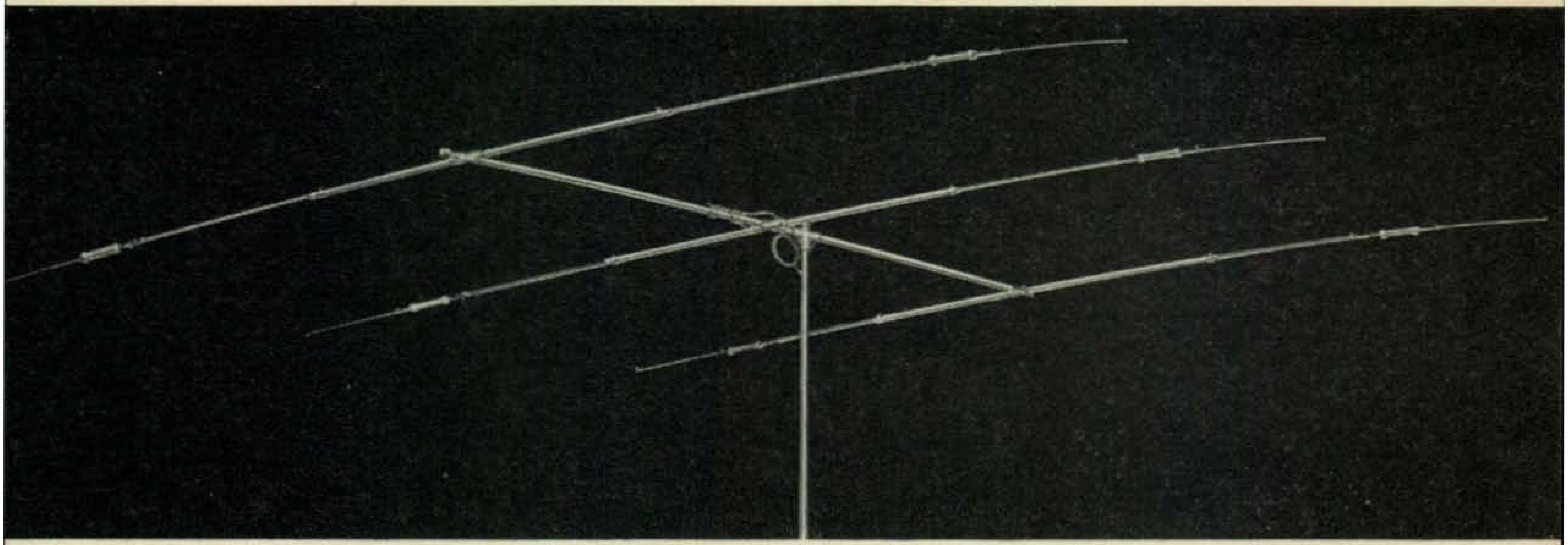
Asia
UA9KCE 655,095 975 69 186
(UA9KCE, 9CC, 9DT, UW9CC, 9EF)

Europe
OH2AM 1,010,892 1548 94 272
(OH2BC, 2BH, 2BS, 2BQ, 2KH, 2QV, 2SB, 2BBM, 2BBR)
UB5KBB 691,300 1338 85 225
(UB5LM, 5PW, 5DQ, UT5CD, 5CJ, 5TC, 5TG, 5TN, UB5KBB, 5-5970)
LZ1KSZ 624,416 1447 83 221
(LZ1DZ, 1DQ, 1DV, 1DL, 1DO, Peter, Dinko, Kosta)
OH1AA 494,320 992 72 224
(Club Station)
OK3KAG 303,696 995 59 157
(OK3BU, 3DI, 3-4123, 3-9024)
DM7L 292,896 953 65 161
(DM2AQL, 2ATL, 2BEL, 2BLL, 2CEL, 2CML, 3MEL, 3ZKL, 4CL, 4WCL, 2AKL, 2BUL, 3JML)
OH2AA 208,820 630 55 157
(OH2CF, 2ER, 2FS, 2KK, 2LP, 2WI, 2YV)

South America
YV9AA 1,865,208 2336 90 192
(YV5AAQ, 5AGD, 5ANT, 5BKA, 5BNR, 5GO)

Our thanks to the following stations and s.w.l.s. for sending in their logs for checking purposes. W1WLZ, W2APH, WN3DYT, K4QPL, W4NXE, WA4QPV/6, W5KC, WA8QYK, DL8ML, G6JF, HA5-105, LA9TG, OH3TM, OK2BDJ, OK1AEH, OK1AEI, OK1AHI, OK1AJR, OK1AKW, OK1ALZ, OK1ANG, OK1ANS, OK1AMZ, OK1APB, OK1CX, OK1KOB, OK1US, OK1PT, OK1SM, OK2DB, OK2BCN, OK2BGN, OK2KFK, OK2KGV, OK2KLI, OK2KSU, OK2KSX, OK2KOS, OK2OY, OK3CAU, OK3CES, OK3CEV, OK3CFS, OK3KEU, OK3UL, OL5AAQ, OL6AAE, OZ7KV, PE2EVO, SM3CZS, SM5BFJ, SM5BHW, SM5BXT, SM5DWL, SM6AUZ, SM6CAW, SM6CDN, SM6CKU/-MM, SM7ASN, SM7BUE, SM7MS, SM7QY, SM7TQ, SP3ARS, SP6RT, SP8ARY, TI2PZ, UA1BT, UA1FI, UA1MA, UA1KUM, UW1BA, UA3ND, UA3NG, UV3TQ, UA9CX, UA9VJ, UV9UF, UW9WI, UAØLL, UB5AE, UB5QT, UB5RS, UB5KAK, UT5NA, UC2SE, UO5WT, VE1AE.

There's a **BOLD** new look on **10 & 15** meters...



hy-gain's new 10 & 15 meter

DUOBANDER Model DB10-15

- **Takes maximum legal power**
- **Delivers uncompromised total performance on both bands**
- **Easily installs on rooftop or lightweight tower**

With 10 and 15 meters well into the comeback cycle, Hy-Gain's new Model DB10-15 is the perfect answer to maximum performance for both Stateside and DX contacts. Equipped with famous Hy-Gain Hy-Q traps, the Model DB10-15 delivers uncompromised full-size performance on both bands. Exclusive Beta Match insures maximum transfer of energy for optimum performance ...outstanding F/B ratio. SWR less than 2:1 at resonance on both bands. Terrific for short skip this Summer...the only answer for DX next Fall.

Rugged, compact construction of the Model DB10-15 makes it simple to install in minimum space...either rooftop or on a lightweight tower. Easily stacks as an ideal companion for a 20 and 40 meter duobander or with 20 and/or 40 meter beams. Rotates with TV rotator. Heavy gauge 13 ft. boom; longest element, 23 ft. Turning radius, 13.5 ft. Net weight, 38 lbs. Withstands 80 MPH winds. Model DB10-15... **$69.95** Net.

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For further information, check number 17, on page 108

Two views of the second annual Field Day sponsored by the Liberian Amateur Radio Club in Monrovia Liberia. Using the call EL2FD, the equipment was set up in a straw roofed hut about fifty feet from the Atlantic Ocean. The photo on the left shows EL2D standing center holding the mike and EL2AT seated. The other members are not identified.

PEOPLE AND PLACES

During a recent stay in Germany, Bob, WB2JGO, was able to keep in daily contact with his brother WB2IEC thru the kindness of Otfried, DL9YG shown here. DL9YG is QRV on Sundays at 1200 GMT and 2030 GMT on 14320 kc looking for Vt., Wy., Utah, and Idaho to complete his WAS. *(Tnx WB2JGO).*

This picture was taken at the ham shack of DU1TA, Ted Alberto, in Rizal just outside Manila (who is standing in the background) with his friend, Ted N. Malabanan, who is in the process of setting up his station at his QTH in Manila with a call sign DU1TNM. DU1TA's rig consists of a Swan 400 with a Swan Mark I linear amplifier. You will note also the 51J Collins receiver in the foreground. This duo are active DXers in the Philippines. DU1TA is usually on the air during weekends on 14250 kc s.s.b. and is also on c.w. *(Tnx Eddie Eustaquio).*

This is Robert Byrne, WB2JDG, who on the weekend of April 22, took part in a very difficult emergency three way QSO. It all started when a "Mayday" call from Enrique Lopera, HK5SL, in Palmira, Colombia was received by Dave Schapira, WA2BYS, as he turned on his mobile leaving work. Dave answered the call, and while Enrique held on, he tuned across the band and found Bob, who runs more power. As Dave translated Enrique's message from Spanish, it was found that a certain doctor in Ohio was needed for emergency consultation for a dying girl in Colombia. Bob located the doctor and patched him in. Quickly information sped back and forth to Colombia through Bob's rig with Dave standing by to translate for Enrique. The next day the link was remade with both doctors, and vital information was again passed with the aid of Bob and Dave. Through their effort, the girl was greatly improved by the following week. It is individual actions like this that make ham radio and hams a continuous credit to their country and community.

We're still waiting for that picture you were going to send in last month.

Home Station Performance

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LOOK INTO THE SWAN 350

The performance of the Swan 350 in your car may not quite equal your home station, but you will be amazed at how often the difference is very small. Many Swan mobile operators have established enviable DX records. QSL cards on file here at the factory verify solid contacts from all continents including stations in Antarctica.

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The 350 installs conveniently under the dash of most cars, and the power supply goes under the hood. The best location for a mobile rig is naturally up front under the dash, but if you have a car with a center console and a consequent space problem, you will be happy to learn that either the 350 or 400 can be installed in the trunk. The 406B external VFO was designed to permit trunk mounting of either transceiver, and thanks to its miniature size, the 406B can be mounted conveniently in any car, either under the dash or on top at eye level. Add an efficient 5 band mobile antenna such as the model 55 or 45 Swantenna, and you can enjoy mobile operation to the fullest. Home station performance? Well not quite, but nothing comes closer than a Swan Transceiver.

73, Dave Howard, WA6OQY

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RTTY From A to Z

BY DURWARD J. TUCKER,* W5VU

PART XXIV

It is important not only to understand the action of the selector mechanism, but also the chain of events that follow in the wake of the selector mechanism operation as these eventually lead to the printed message. Some of these subsequent functions and associated mechanisms have already been covered and more are covered below.

Type Bar Carriage Printing Mechanism

The printing mechanism on the type bar carriage consists essentially of a pull-bar bail, pull bars, type bars, and necessary mounting parts. The actual printing is done mechanically, that is, the type bars are thrown at the platen by the pull-bar bail. Located between the printing bail blades (when the type-bar carriage is mounted in place) is a plunger roller (fig. 141) which extends downward from the pull-bar bail plunger. Thus the movement of the printing bail applies a reciprocating motion to the pull-bar bail for the purpose of actuating the pull bars.

The type bar to be selected is determined by the setting of the five code bars, which are moved into position by the bell cranks (fig. 141) under the control of the vanes. The code bars are so arranged that notches on their upper sides will be lined up, permitting the selected pull bar to move down into the path of the pull-bar bail. As the pull-bar bail moves forward, it will allow all pull bars to rest on the code bars under the tension of the pull-bar springs. The selected pull bar will drop into the notch set up for it in the code bars, which will position it lower, with respect to the bail, than the other pull bars. As the pull-bar bail continues on its forward stroke, it will engage a notch on the selected pull bar, but will clear all unselected pull bars.

The forward movement of the selected pull bar will cause its associated type bar to strike the platen. Before the pull-bar bail reaches the limit of its forward travel, a stripper plate (fig. 133), located below the pull bars, cams the selected pull bar off the bail and momentum carries the type bar against the platen. As the roller on the printing-bail arm rides to the high part of its cam to complete the printing cycle, the printing and pull-bar bails will be moved to their rear position. The pull bars will then be raised clear of the code bars so that they are free to respond to a new selection.

Locking Function Lever

The locking function lever is the first on the right of the functional levers, which are mounted behind the vanes. The locking function lever (fig. 142 (A) and (B)) locks or holds the vanes in the selected position until a character is printed or a function has been performed.

When the printing bail moves forward, the function-lever bail roller moves downward off the high parts of the function-lever rear arm, allowing the locking function-lever spring to pull the lever against the rear edges of the vanes. The locking function lever engages each vane, whether in the marking or spacing position, locking the vanes in the selected position until the printing-bail cam has revolved completely. The operation of each of the remaining function levers is dependent upon the related functions. A

*6906 Kingsbury Drive, Dallas 31, Texas.

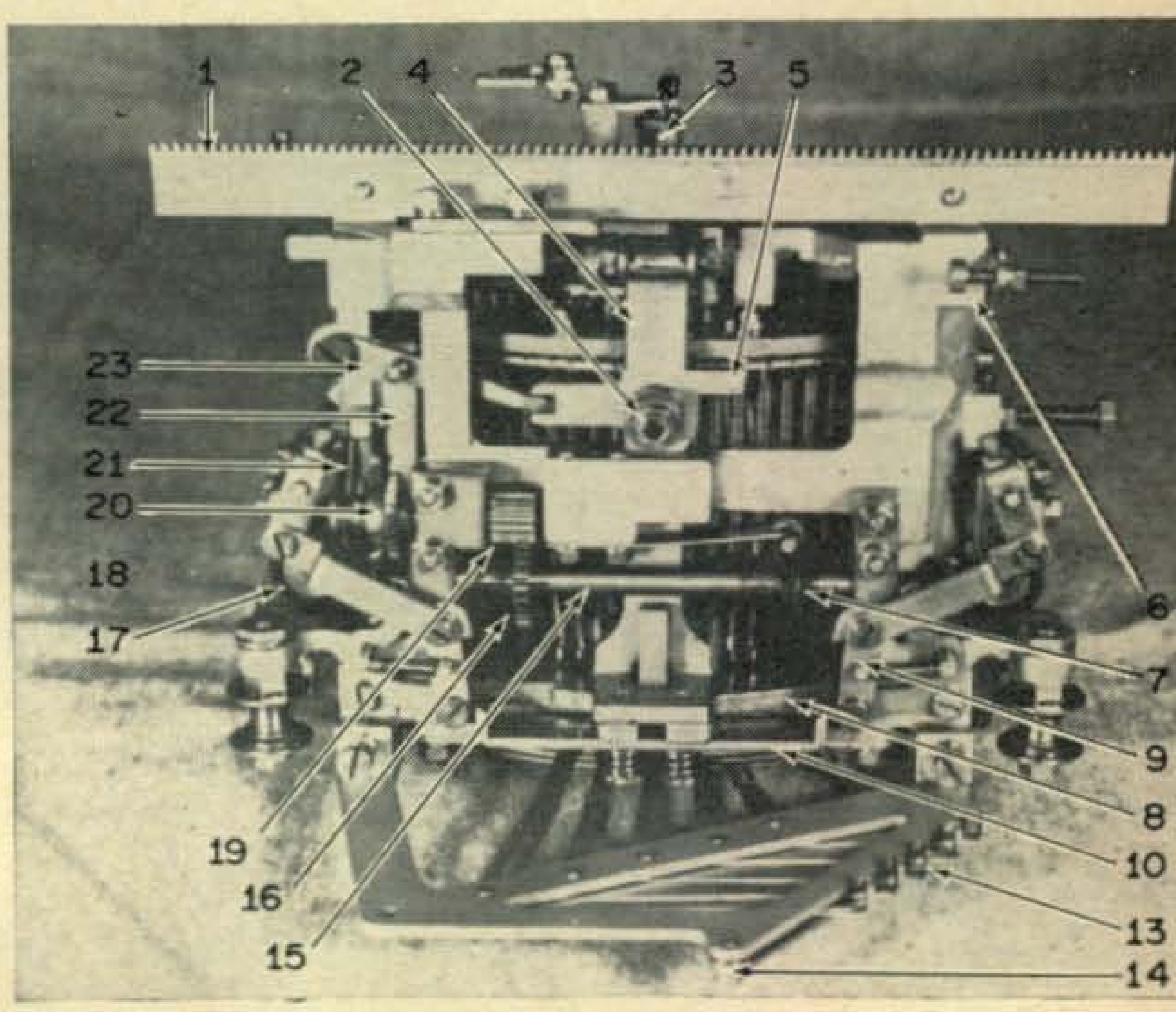


Fig. 141—Bottom view of the type-bar carriage with the major parts identified.

1. Spacing rack.
2. Plunger roller.
3. Carriage support roller.
4. Pull bar bail plunger.
5. Left plunger arm.
6. Right margin adjusting screw.
7. Detent.
8. Pull bar bail.
9. Ribbon reverse pawl.
10. Ribbon reverse bail.
11. Carriage support roller.
12. Carriage guide screw.
13. Bell crank.
14. Bracket.
15. Ribbon feed shaft.
16. Ribbon feed shaft gear.
17. Bevel gear.
18. Vertical ribbon feed shaft.
19. Ribbon feed ratchet gear.
20. Ribbon feed ratchet.
21. Ribbon reverse shaft.
22. Ribbon feed pawl.
23. Feed lever.

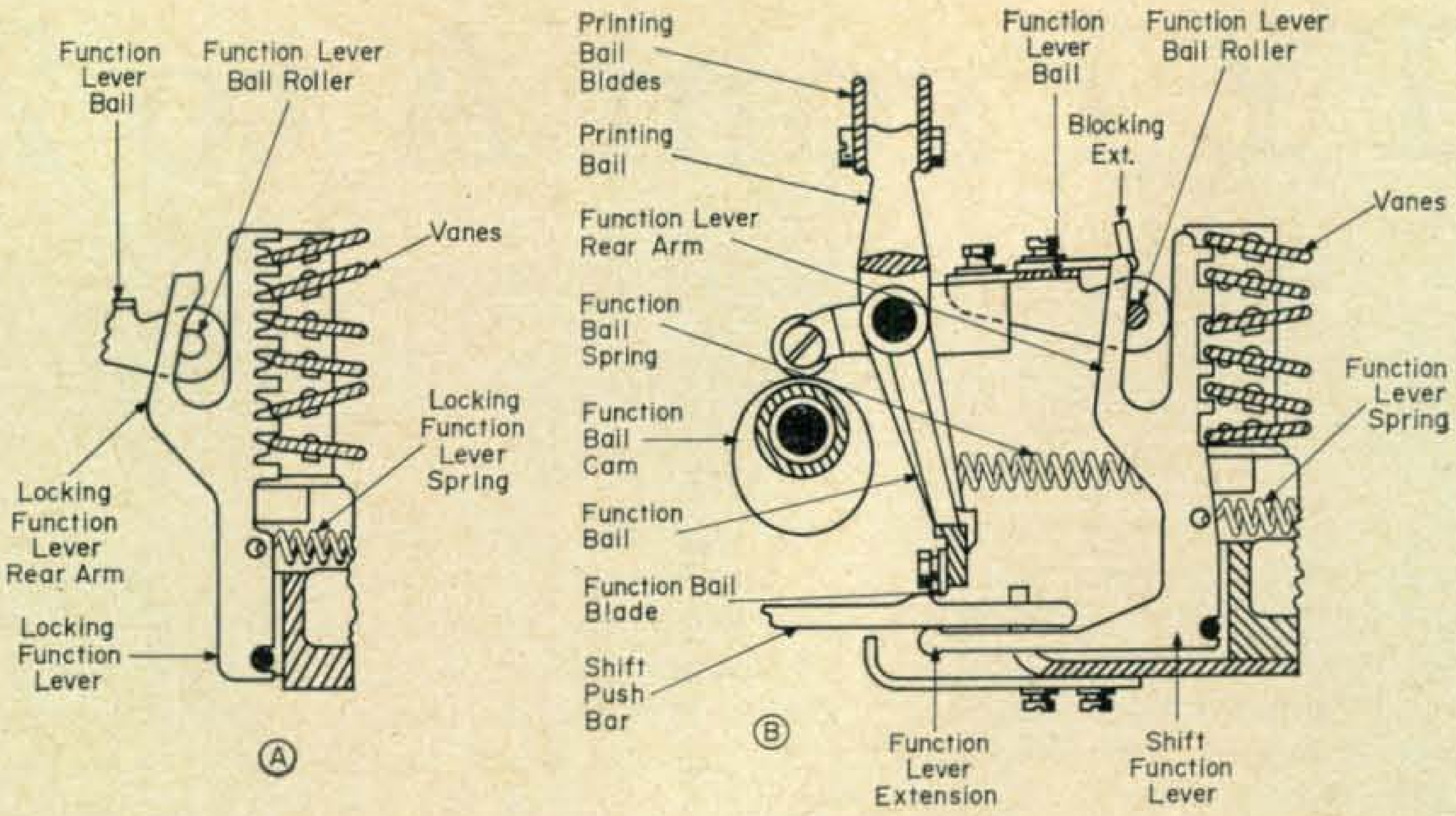


Fig. 142 (A)—Locking function lever. (B) Function lever mechanism.

No. 6 Cam of Selector Cam Sleeve Operates Clutch Throw-Out Lever
↓
Main-Shaft Clutch Members Engage
↓
Bail-Cam Unit Starts Revolving
↓
Printing-Bail Operating Arm Operates
↓
Printing Bail Moves Forward
↓
Pull-Bar Bail Plunger Roller Rides Forward Between Printing-Bail Blades
↓
Pull-Bar Bail Moves Forward, Allowing All Pull Bars to Position Against Code Bars
↓
Selected Pull Bar Drops into Code-Bar Slot and into Path of Pull-Bar Bail
↓
Continued Forward Movement of Pull-Bar Bail Engages Selected Pull Bar
↓
Selected Pull Bar Moves Forward
↓
Type Bar (Geared to Pull Bar) Forced Up and Back
↓
Stripper Plate Disengages Pull Bar from Pull-Bar Bail When Type Bar is Approximately 1 Inch from Platen
↓
Type Bar Hits Platen Under Its Own Momentun and Returns to Normal Position (Spring Return)
↓
Printing Bail Moves Backward
↓
Pull-Bar Bail Moves Backward, Positioning all Pull Bars Away from Code Bars
↓
NOTE: Locking Function Lever (Extreme Right Function Lever) Locks all Vanes in Selected Position During Printing
↓
Clutch Stop-Arm Engages with Cam Surface on Driven Clutch Member
↓
Main-Shaft Clutch Members Moved Out of Mesh

Fig. 143—Sequence chart for the printing mechanism.

sequence chart for the operation of the printing mechanism is shown in fig. 143.

Spacing

Proper spacing between characters requires the type-bar carriage to be moved with each character printed. The type-bar carriage is moved by the spacing gear which is meshed with the spacing rack (fig. 144) and is facilitated by three carriage support rollers, two of which operate on the front track and one on the rear track (figs. 144 and 145). The spacing rack is mounted on the rear of the type-bar carriage casting and the pinion is attached to the upper end of the spacing shaft. The spacing shaft, extending downward, passes through the spacing shaft gear. Just above its lower bearing the spacing shaft mounts the carriage return clutch, the lower member of which is rigidly attached to the shaft. The return-clutch members are in engagement at all times except when the carriage is being returned from the end of a line. The function of the clutch will be described later. The spacing shaft gear meshes with the spacing pinion on the main shaft as previously described. Spacing is controlled from the printing bail

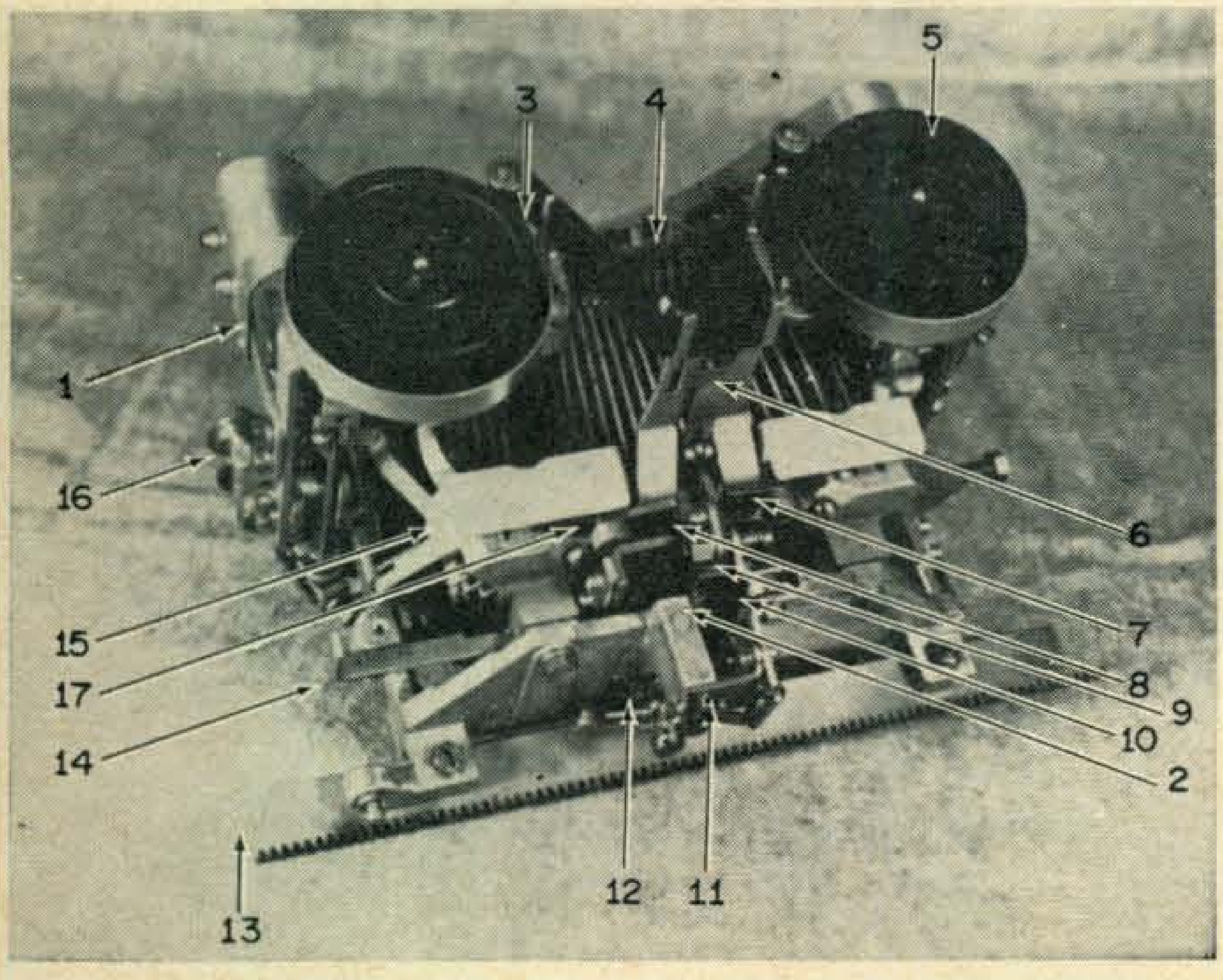
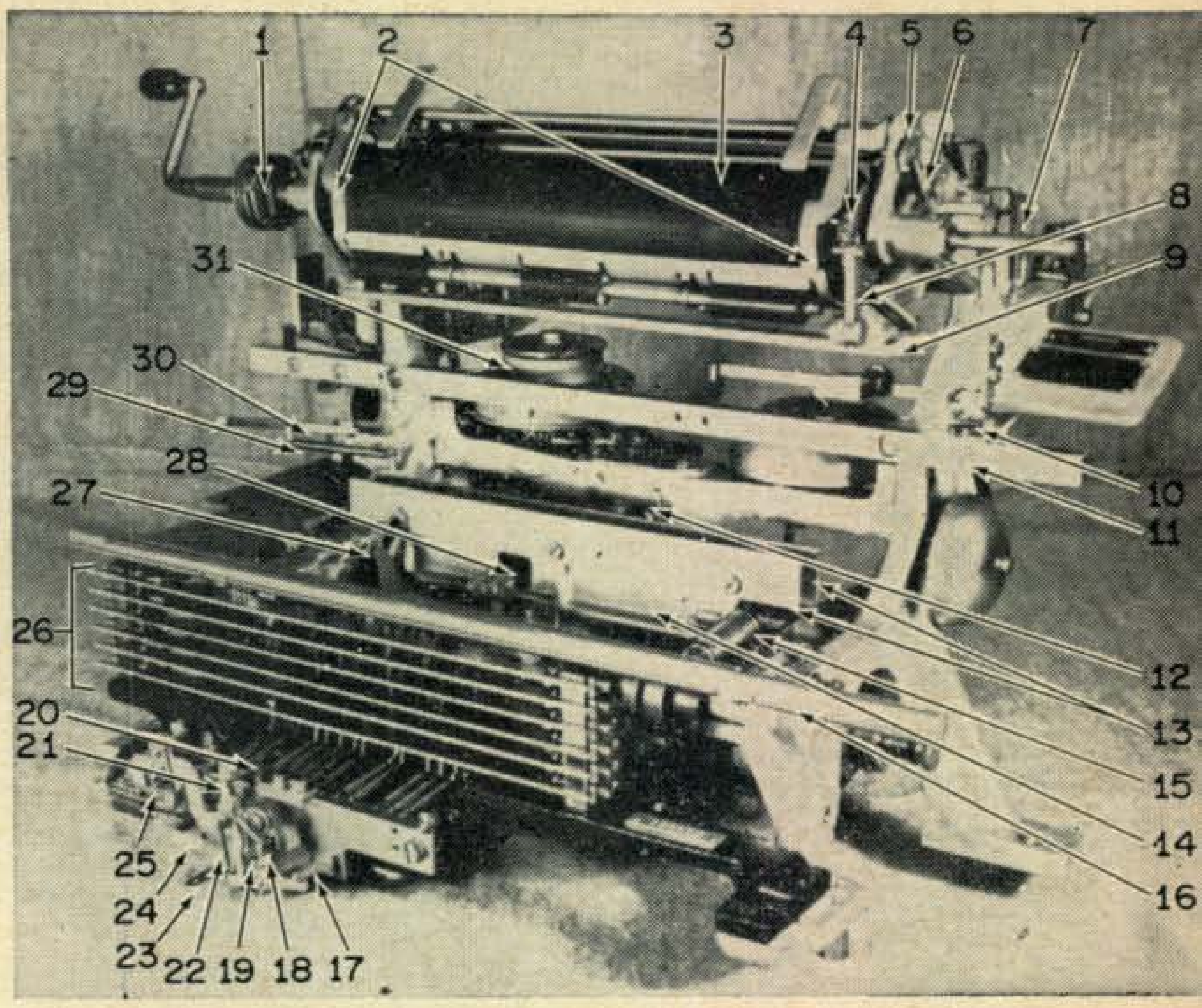


Fig. 144—Rear view of the type-bar carriage with all the major parts identified.

1. Code bars (under cover plate).
2. Ribbon oscillator extension.
3. Ribbon reverse arm.
4. Type bar.
5. Ribbon spool.
6. Ribbon carrier.
7. Adapter plate.
8. Ribbon oscillator.
9. Ribbon shift lever.
10. Ribbon shift lever roller.
11. Ribbon shift lever bracket.
12. Flanged roller.
13. Spacing rack.
14. Ribbon lockout bar.
15. Type bar segment.
16. Carriage support roller.
17. Adapter plate mounting screw.

Fig. 145—Front view of typing unit with major parts identified.

1. Friction assembly set screw.
2. Paper fingers.
3. Platen.
4. Detent ratchet.
5. Paper finger shaft stop arm.
6. Paper finger shaft spring.
7. Platen balance spring.
8. Line feed detent lever.
9. Slide bar.
10. Margin bell hammer stop post.
11. Rear track.
12. Spacing stop lever bracket.
13. Printing bail blades.
14. Printing bail.
15. Printing bail spring.
16. Front track.
17. Universal function lever ext.
18. T lever.
19. Blank function.
20. Stop bracket.
21. Intermediate lever.
22. Send-Receive reset lever.
23. Reset lever lower adj. screw.
24. Motor stop function lever.
25. Upper adj. screw.
26. Vanes.
27. Printing bail operating arm.
28. Spacing escapement pawl operating arm.
29. Dashpot lever spring.
30. Dashpot lever.
31. Carriage return spring drum.



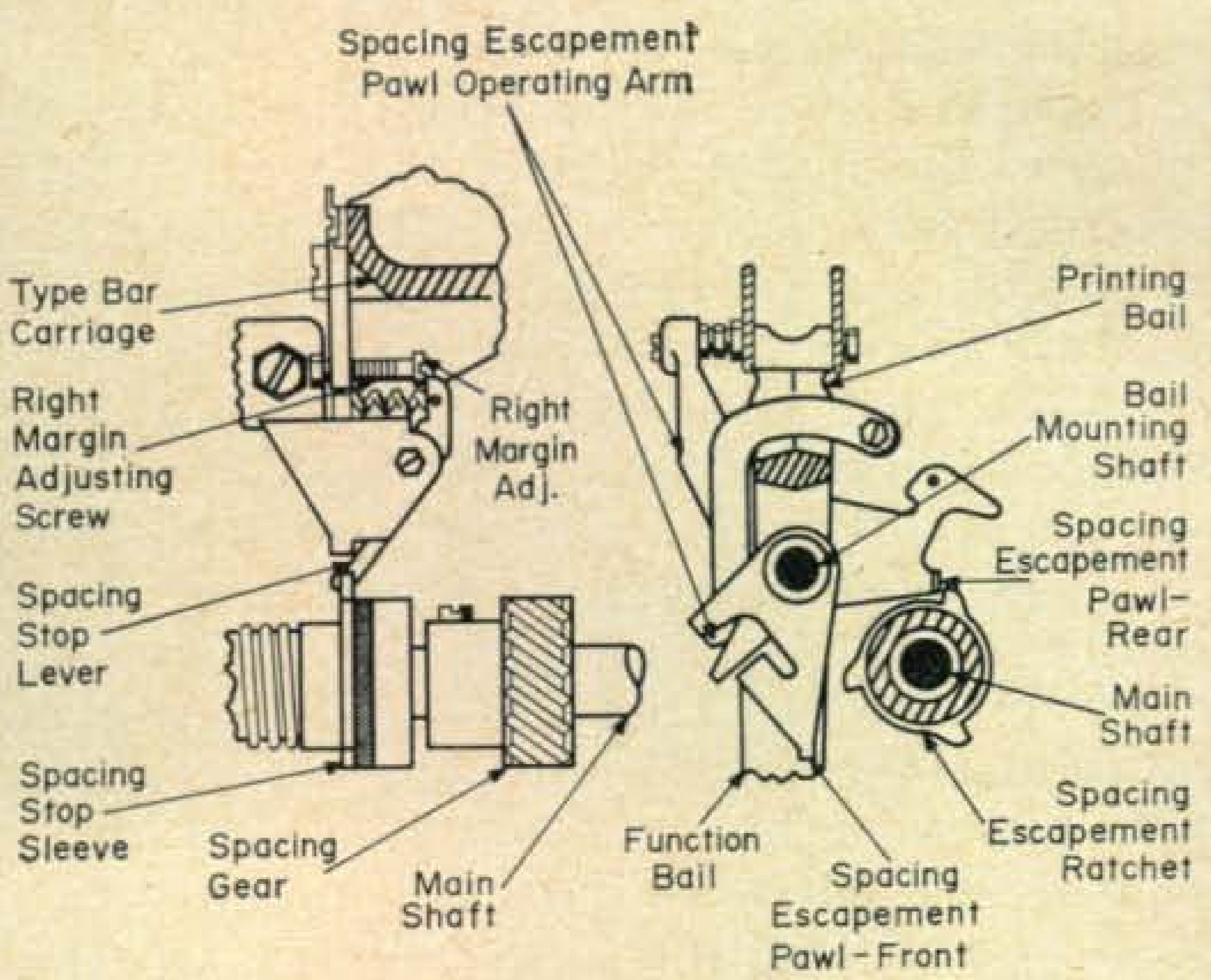


Fig. 146—Pictorial view of spacing stop mechanism with the major parts identified.

through the medium of the escapement pawls.

The spacing action is as follows: With the printing bail in its rear position, the rear escapement pawl is engaged with one of the teeth on the spacing escapement ratchet, thus holding the ratchet and spacing gears stationary (See fig. 146). As the printing bail starts to move forward, the escapement pawl operating arm strikes the lower end of the rear pawl, thereby moving it out of engagement with the tooth on the escapement ratchet. At the same time, the front escapement pawl moves against the ratchet and into the path of another tooth which it will engage after the ratchet has traveled one-sixth of a space. The printing operation then takes place.

Near the end of the return stroke of the printing bail, the operating arm lifts the front escapement pawl out of engagement with the escapement ratchet, and at the same time the rear pawl

Operation of previous selection	*Locking of previous selection*	*Impulses of next selection*	*Positioning of next selection*
Selector-cam sleeve stopped	Not locked	STOP	
Printing-bail and function-bail cams start to revolve—printing and function bails start moving.	Locking function lever starts forward to engage vanes.	START	Selector-cam sleeve assembly starts revolving for the next selection.
Pull-bar bail engages selected pull bar, or function bail engages a push bar.	Locked	1	Sword positioned and new selection stored.
Letter printed or function operation performed.	Locked	2	Same as above.
Printing and function bails start returning to normal position.	Locked	3	Same as above.
Printing and function bails nearly normal.	Unlocked	4	Vanes 1, 2, 3, and 4 are set simultaneously.
Printing and function bails normal —main shaft clutch throw-out lever engaged by sixth cam.	Not locked	5	No. 5 vane positioned.

Fig. 147—Spacing operation sequence chart. The sequences explained in each column occur in the time required to receive one selection. The third column indicates the impulses of the next selection being received and/or stored. The fourth column indicates the positioning of the next selection on the vanes, bell cranks and code bars.

moves against the ratchet. This action will allow the spacing mechanism to revolve sufficiently to space the carriage five-sixths of a space at the end of which the rear escapement pawl will engage a tooth on the ratchet. The remaining one-sixth of a space will be added preceding the printing of the next character as described in the foregoing. A sequence chart for the spacing operation is shown in fig. 147.

When the type-bar carriage reaches the end of a line, the right margin adjusting screw (fig. 146) moves the spacing stop lever into the path of a projection on the spacing stop sleeve, thus blocking rotation of the spacing mechanism and preventing further spacing of the carriage.

Selecting Cycle Overlap With Printing Or Function Cycle

It was pointed out in the beginning of this text that the normal or required speed (by the F.C.C.) is 60 words per minute (368 oper. per min.) for amateur RTTY in the U.S.

Through the use of an overlap arrangement, the teletypewriter can perform a printing or function operation while the next selection is being set up on the keyboard transmitter unit, transmitted and stored in the receiving mechanism by setting the swords in the new selection order. Tension springs on the selector levers supply the energy required to complete the selection for the next printing or function operation, when the mechanism is unlocked after a completed operation. The chart of fig. 147 shows the relationship between the operation of the previous selection and the setting up of the next selection when the teletypewriter is operating at 368 o.p.m.

Printing Bail Moves Forward
↓
Escapement-Pawl Operating Arm Raises Rear Escapement Pawl from Escapement Ratchet
↓
Front Escapement Pawl Moves Into Path of Escapement Ratchet
↓
Type-Bar Carriage Moves 1/6 Space
↓
Printing Operation Takes Place
↓
Printing Bail Moves Backward
↓
Escapement-Pawl Operating Arm Raises from Escapement-Pawl from Escapement Ratchet
↓
Rear Escapement Pawl Moves Into Path of Escapement Ratchet
↓
Type-Bar Carriage Moves Remaining 5/6 Space

Fig. 148—Spacing operation sequence chart.

Operation of Functions

There are two types of operations which can be performed by the typing unit. The first embodies those mechanical actions which are directly necessary to the actual printing of a character. The second type of operation, which embodies mechanical action supplementary to the printing of a character, or which alters the position of various mechanisms, is known as a function. Ten functions which generally are found on standard models and which may be added to as desired, are: bell, blank, carriage return, figures (shift), letters, line feed, motor stop, and space. The completion of these functions is accomplished through separate function levers located behind the vanes in the front of the typing unit.

When the printing bail is in its normal (rear) position, the function lever bail, attached to the printing bail, holds the function levers away from the vanes. As the printing bail moves forward, the function-lever bail roller moves down off the high portion of the rear arm of the function levers, permitting the function-lever springs to pull their levers against the vanes. The forward arms of the function levers are notched so that when a function combination is set up on the vanes, the selected function lever moves forward farther than the other function levers. The function lever extension then moves the selected push bar upward and into the path of the function bail.

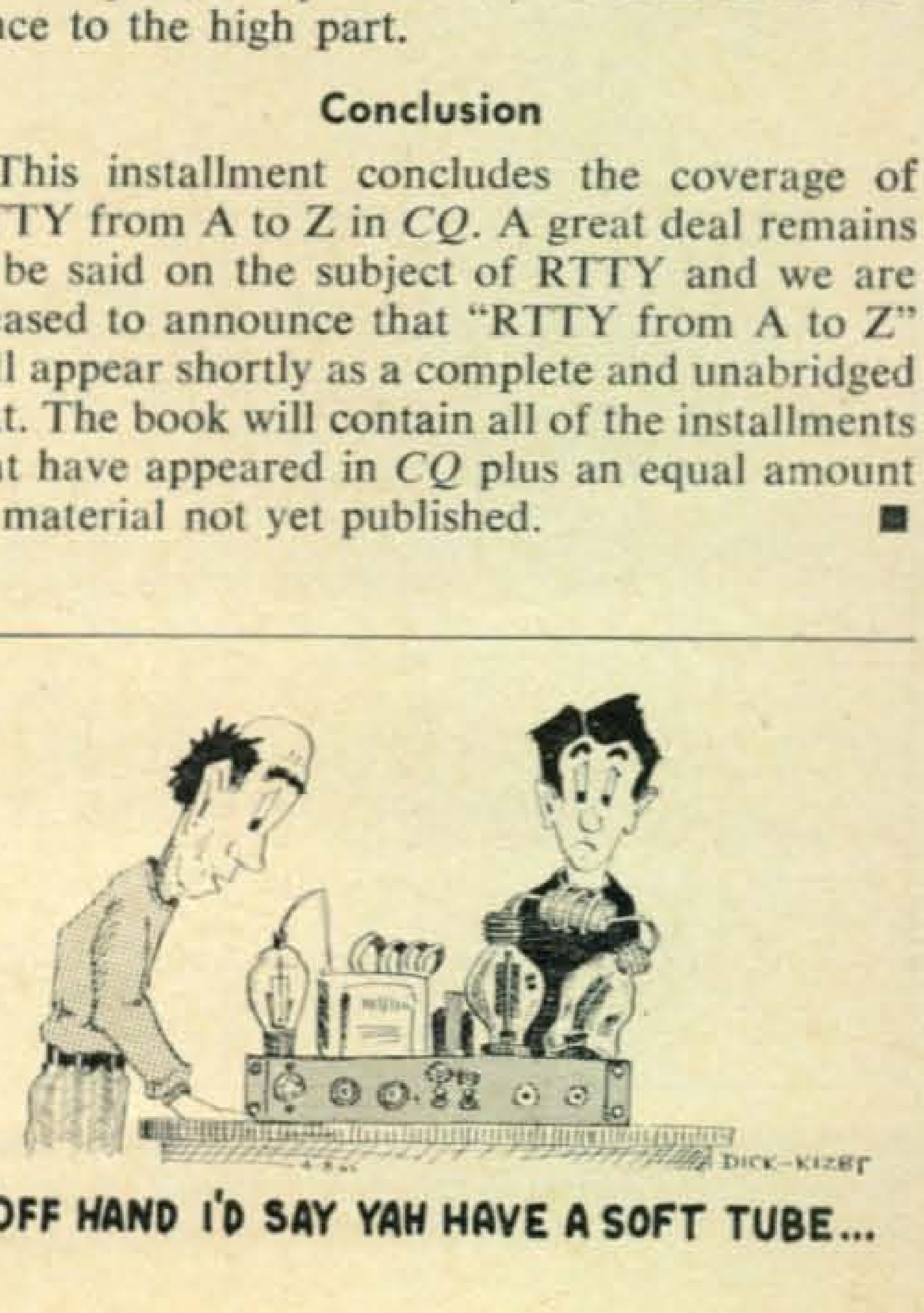
Function Bail

The function bail is mounted on the bail-mounting shaft (fig. 142(B)). It is used to operate some of the functions, and is moved by the function bail cam. The function bail has a blade attached to its lower extremity which engages the function push bars.

The function-bail spring holds the function-bail cam roller against its cam at all times. After the printing bail and the function-lever bail move far enough to release the function levers, the function-bail roller starts to ride up on the high part of its cam. The function-bail blade moves toward the rear, engaging and operating any function push bar that may have been moved into its path by the selected function lever. The function-bail roller then rides to the low portion of the function-bail cam, and the function-bail returns to its forward position. The bail cam unit on the main shaft has not yet completed its revolution at this point, so the function-bail roller comes to rest. The roller comes to rest beyond the low part, at a point about one-half of the distance to the high part.

Conclusion

This installment concludes the coverage of RTTY from A to Z in *CQ*. A great deal remains to be said on the subject of RTTY and we are pleased to announce that "RTTY from A to Z" will appear shortly as a complete and unabridged text. The book will contain all of the installments that have appeared in *CQ* plus an equal amount of material not yet published. ■



'OFF HAND I'D SAY YAH HAVE A SOFT TUBE...

SWAN is "Big DXer's" Choice !

Shown to the left is "Butch" Greve, W9EWC (Eat Wisconsin Cheese), operating his new SWAN 400 mobile rig. Butch, who started operating in 1925, has confirmed hundreds of countries and holds many DX Contest Certificates. The W9EWC home station is located at #1 Cheddar Lane, Hilbert, Wisconsin. When Butch is not Hamming, he is busy manufacturing the famous Wispride Cheese.

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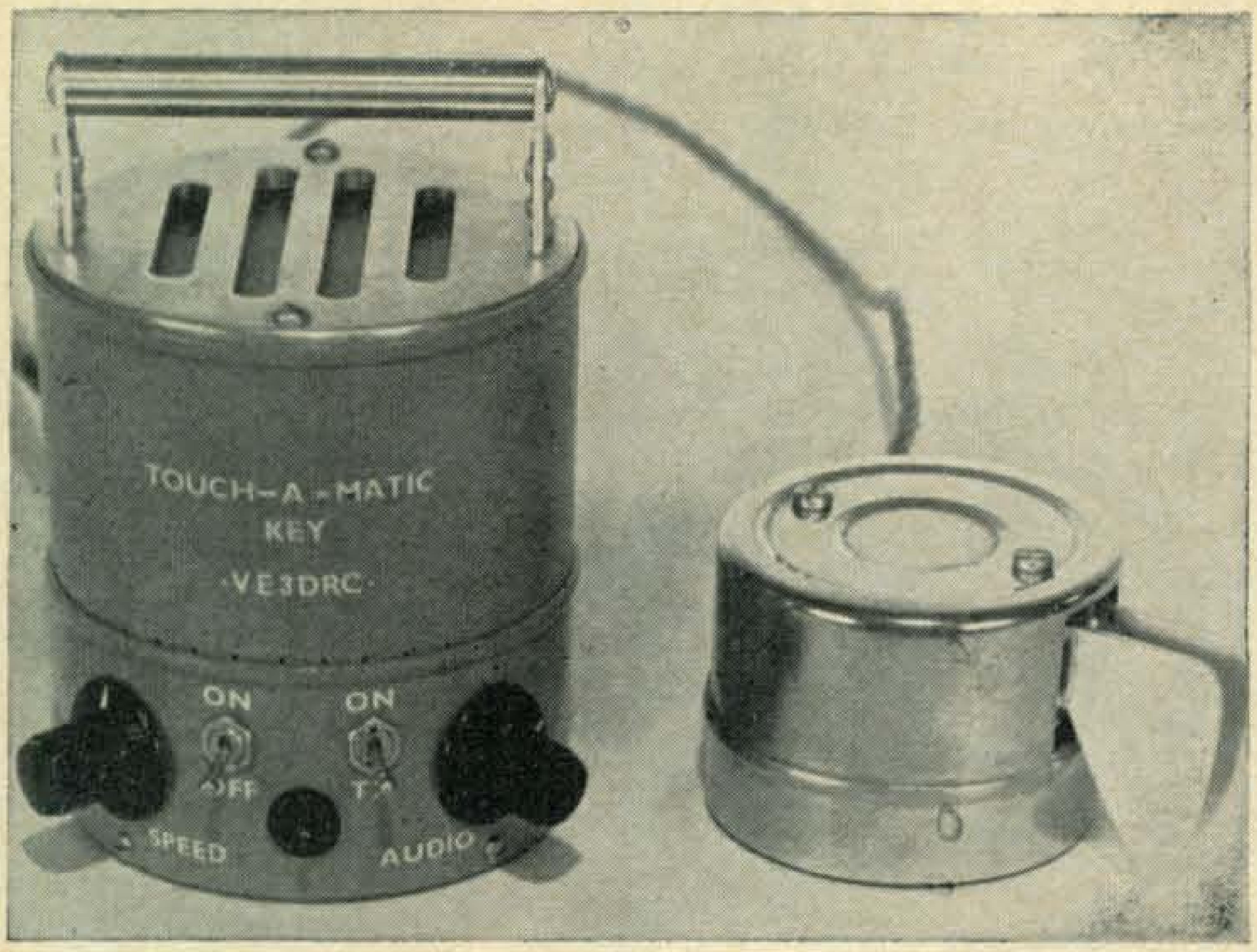


Front view of the Touch-A-Matic key with the Can-Key alongside. The speaker is mounted face up under the handle; left control is for SPEED and the right control is AUDIO volume. The two switches are S_1 and S_2 with the On Off indicator between them.

The Touch-A-Matic Key

BY ALBERT H. JACKSON,* VE3QQ

Part I

This completely transistorized electronic keyer may be operated with the Touch-Key, the Can-Key or any other dual paddle key. The output circuit may employ a transistor for control of the transmitter, or a relay. This unit, as the Touch Key and Can Key, is made from food tins with a circular parts board in a unique construction technique. Part I deals with the circuit and operation while Part II covers the construction.

As a little listening on the amateur c.w. bands will confirm, the popularity of the electronic key appears to be increasing at a very steady rate. The Touch-A-Matic key is a recent arrival on the scene, and embodies the usual keyer family characteristics plus some additional features of its own. It is fully transistorized, and examination of the schematic, fig. 1, will reveal certain similarities to the excellent electronic keys described by W3OPO[1] and by W2YM.[2] The present unit differs as to transistors used, method of speed control, audio oscillator, power supply, output circuits, provision for touch control and long-dash operation, and physical assembly.

The device shown measures 3⅜" in diameter by 3½" high, exclusive of handle, knobs, *etc.*, covers the approximate speed range of 15 to 35 w.p.m., and delivers accurately timed, self-completing dots and dashes. It is a *completely* solid-state key, from the paddles to its crystal speaker and transmitter control connector. Nevertheless, for the higher voltage blocked-grid systems and for cathode keying, a single output relay is recommended, and both alternatives are given in the schematic.

The Touch-A-Matic is intended as a companion keyer for the Touch-Key[3] described in a previous article, and its full capabilities can be realized only with this paddle section. However, all features, except actual "touch" control, are attainable with the Can-Key[4] or any other dual paddle key in which the moving contacts are insulated from ground. With a small modification, the Touch-key can be connected directly and will no longer require the additional relay unit or power supply.

Simpler Version

If touch control and long-dash operation are of no interest to you, the keyer can be built in simpler form, and a regular paddle-key, or the Can-Key with moving contacts grounded, can be

*12 Third Ave., Box 453, Arnprior, Ontario, Canada.

[1]MacFarlane, James C., "A Monitored Electronic Key and Keyer," *QST*, Dec., 1962, page 51.

[2]RCA Ham Tips, Spring, 1964.

[3]Jackson, A. H., "The Touch-Key," *CQ* Nov. 1964, page 28.

[4]Jackson, A. H., "The Can-Key," *CQ* Feb. 1964, page 36.

connected into the circuit across the diode CR_6. This is indicated by dotted lines in the schematic, and will eliminate transistors Q_{12}, Q_{13}, Q_{14}, Q_{15}, Q_{16}, diodes CR_4, CR_5, CR_7, CR_8, CR_9, CR_{10}, CR_{11}, CR_{12}, and associated capacitors and resistors which will not be needed under these circumstances.

Parts Board Assembly

As will be seen from the photographs, the "inside-out" circular parts board assembly shown is a bit unusual, but has these advantages:

(a) Good space to components density ratio.
(b) Complete and easy access to all connections.
(c) Straightforward construction technique, without turret-lugs, *etc*.

The above are offset, but only to a slight extent, by the rather burr-like outer appearance and by the necessity to heat-sink most components while soldering, even including the resistors, because the leads are short. Clip-on heat-sinks were used throughout; manufactured types are available, or you can make your own by altering copper alligator clips to fit into the narrow spaces between parts. All leads, except those of the transistors, were pre-tinned before assembly, using heat-sink clips. This greatly simplifies the final soldering operation, and guarantees a good job with minimum heat after the parts are installed.

Speaker

The speaker is a "solid-state" high impedance crystal unit of Japanese manufacture, requiring no output transformer. It measures 2½" in diameter and a little over ½" thick. While its response is apt to be peaked in the mid-audio range, it is a "natural" for this application where power and low frequency requirements are limited. Though apparently not widely advertised, this component is obtainable from: Keyes Supply Co. Ltd., Box 3501, Station C, Ottawa 3, Ontario, Canada, and perhaps others; specify Keyes catalogue #63 page 111, crystal speaker type S-25, Canadian net $2.10.

A miniature dynamic speaker could, of course, be used, but would need an additional 20K ohm to voice-coil, 50 mw output transformer. This would require careful placement to minimize hum pick-up from the 60-cycle filament unit.

Keyer Output

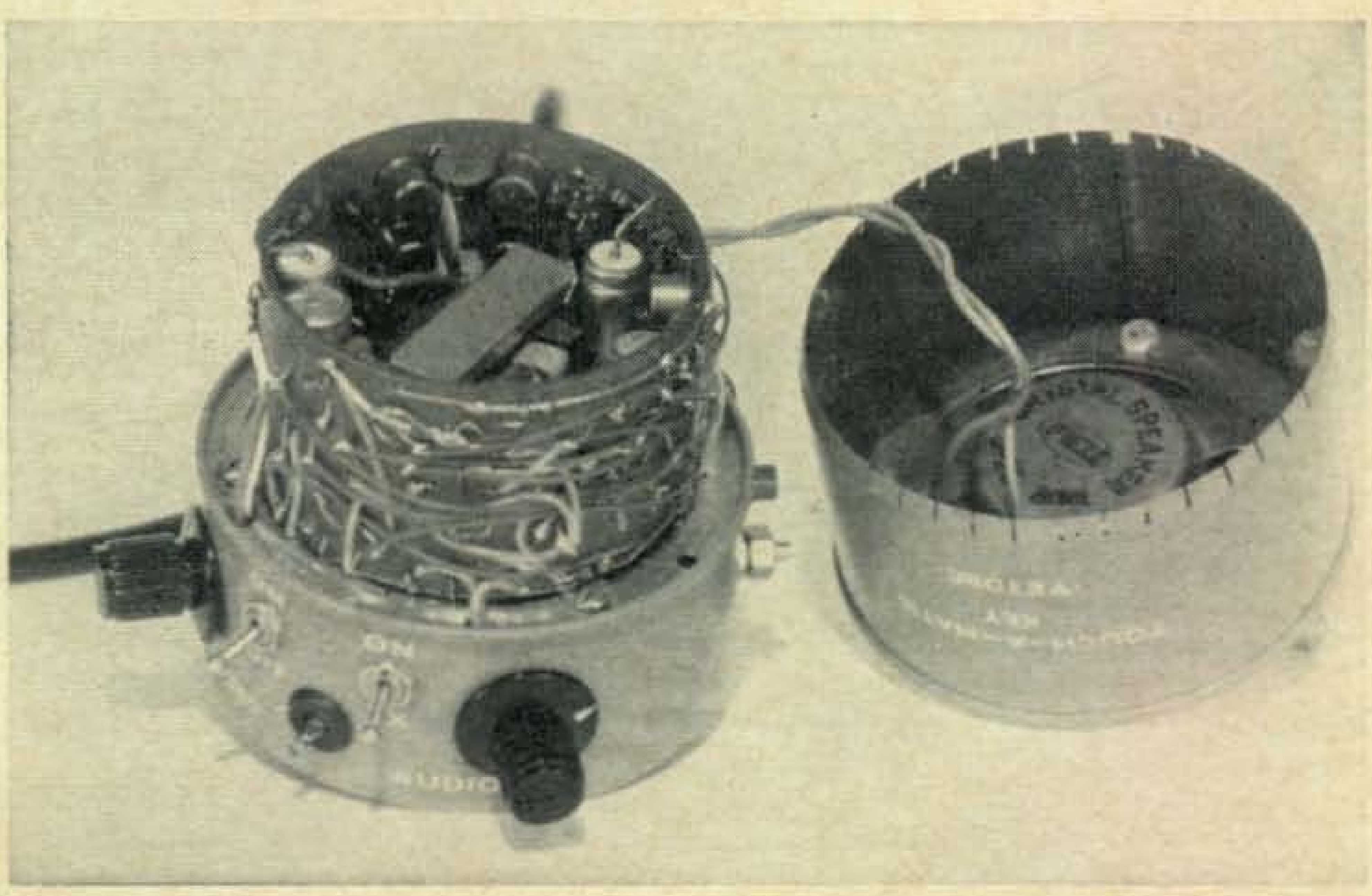
Either transistor or relay output can be employed, depending on your particular needs. The 2N398 transistor shown (Q_{17}) will be satisfactory with grid-blocking systems using negative voltages up to about 80 volts or so, and currents of a few milliamperes. For voltages above this figure, and for cathode keying, the relay provides a simple and effective control. To minimize mechanical noise, mount it on a soft-piece of plastic sponge, 3/16" thick, cut to fit its base by means of a sharp razor blade. Cement the sponge to the relay and to the inner surface of the bottom case near the center, using silicone rubber adhesive (General Electric RTV Adhesive Sealant, or equivalent). Components CR_3 and R_{28} are mounted on the relay itself, and act as transient suppressors without introducing appreciable delay.

For transistor output, cut off the relay circuit at points "X" and use the dotted line connections to Q_{17}. Resistor R_{57} will replace R_{29} on the circular parts board, and a small sub-assembly, containing the 2N398 and R_{58} and R_{59}, will take the place of the relay in the same mounting area.

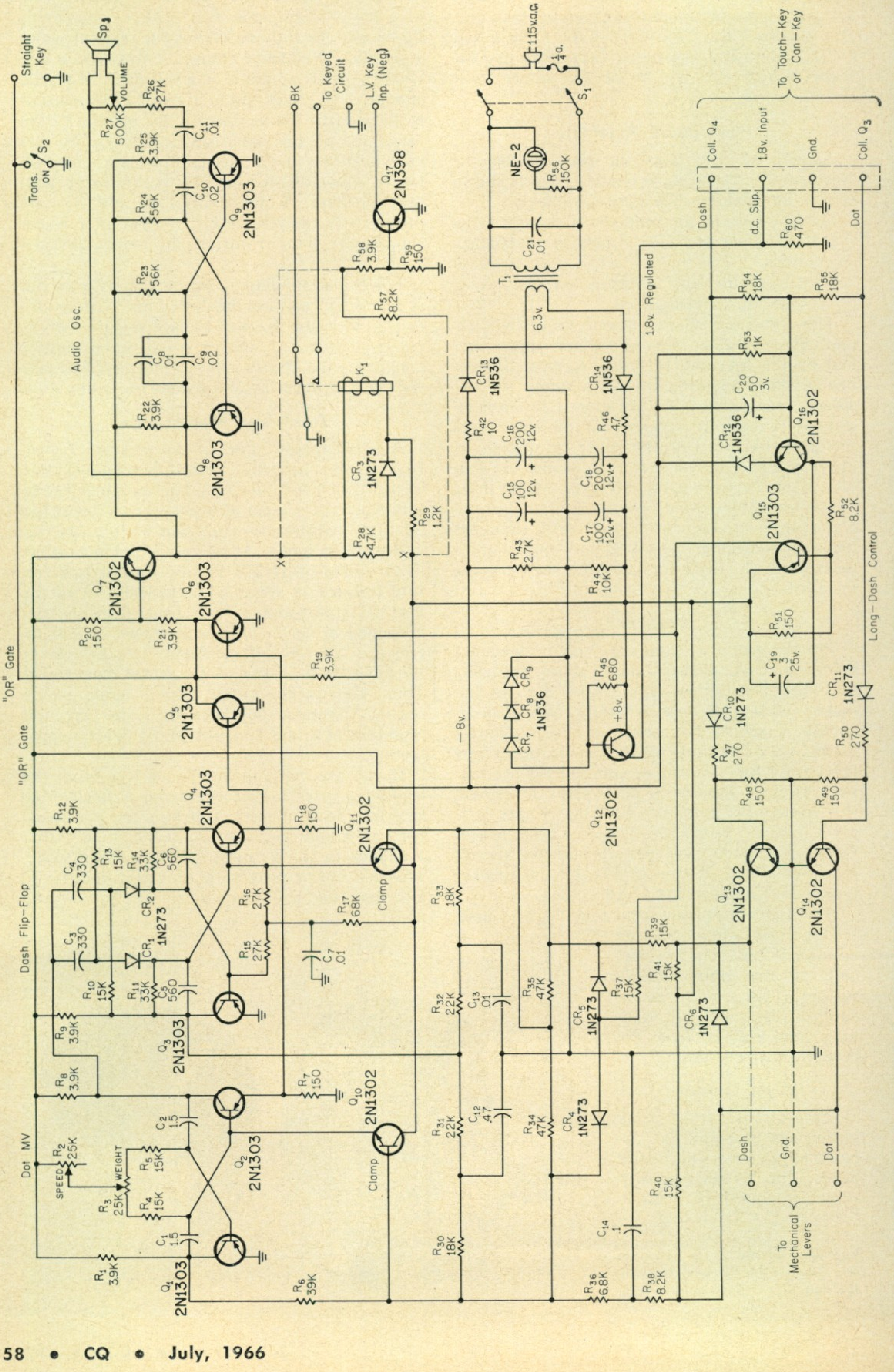
Touch-key: Modification

A small modification of the original Touch-Key circuit is needed to permit direct connection to the Touch-A-Matic key. This becomes necessary since the present all-transistor circuit is less tolerant, temperature-wise, than when output relays were included. Temperature compensation, in the form of 1N273 biasing diodes, is therefore inserted in series with the emitters of the 2N1303 transistors in the Touch-Key as diagrammed in fig. 2. This necessitates a slight increase in the low voltage supply to take care of the diode drop, and raises the power input to the Touch-Key oscillators by a small amount as a result. Allowance has been made for the new requirement in the Touch-A-Matic power supply section.

If you are building the Touch-Key from the beginning, use transistors having a fairly high beta for the oscillators. Touching the associated paddle should increase the current in either oscillator to six or seven times its idling value. This will not be possible if transistor gain is too low, and the key's sensitivity will suffer as a result.



Top view of the parts board of the Touch-A-Matic key showing the circular construction techniques.



Straight Key
Sp3
VOLUME
Trans.
ON
S2
Audio Osc.
Dash Flip-Flop
Dot MV
SPEED
WEIGHT
"OR" Gate
"OR" Gate
Clamp
Clamp
BK
To Keyed Circuit
L.V. Key Inp. (Neg)
115 v.a.c.
NE-2
6.3v.
1.8v. Regulated
−8v.
+8v.
To Touch-Key or Con-Key
Coll. Q4
1.8v. Input
Gnd.
Coll. Q3
Dash
d.c. Sup.
Dot
Long-Dash Control
To Mechanical Levers
Dash
Gnd.
Dot
Q1 2N1303
Q2 2N1303
Q3 2N1303
Q4 2N1303
Q5 2N1303
Q6 2N1303
Q7 2N1302
Q8 2N1303
Q9 2N1303
Q10 2N1302
Q11 2N1302
Q12 2N1302
Q13 2N1302
Q14 2N1302
Q15 2N1303
Q16 2N1302
Q17 2N398
CR1 1N273
CR2 1N273
CR3 1N273
CR4 1N273
CR5 1N273
CR6 1N273
CR7
CR8 1N536
CR9
CR10 1N273
CR11 1N273
CR12 1N536
CR13 1N536
CR14 1N536
K1
T1
S1

Circuit Operation

Since dot and dash formation and general keyer operation have been presented in detail in a number of published articles, only a brief outline will be given here. The dot multivibrator is the heart of the unit, and is followed by the dash flip-flop which ensures that the dashes are correctly proportioned at all speeds. Either the dot or dash sections can close the "or" gate, and their outputs are added here, in turn, during the production of a dash.

Both the dot multivibrator and dash flip-flop are controlled by their clamp transistors, Q_{10} and Q_{11}. These are normally in the conducting state, and hold the dot dash generators in the "off" condition until they are released by touching the appropriate key paddle, when the situation is reversed.

Closing the "or" gate causes Q_7 to conduct and operate the audio oscillator and output transistor Q_{17}, or the relay K_1, as the case may be. The dot paddle cuts off the clamp transistor Q_{10} only, while the dash side controls Q_{11} and, through the diode CR_6, Q_{10} at the same time.

The weight potentiometer, R_3, governs the ratio of dot to space length and therefore also the dot to dash ratio. This should be set for the usual 3:1 proportion, but may be varied according to individual requirements. Resistor R_{57} introduces a small reverse bias on the base of Q_{17}, increasing its output resistance in the "key open" condition. Capacitor C_{21} eliminates a random line switching transient, which otherwise might damage the transistors.

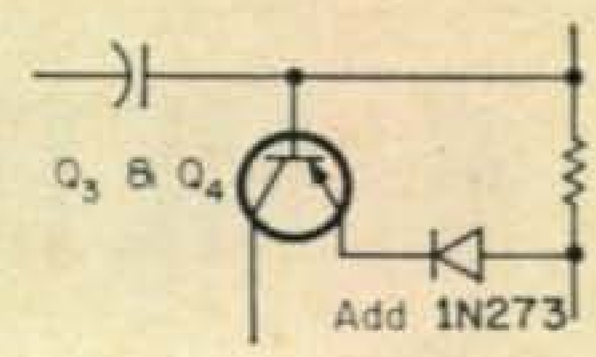


Fig. 2—Touch-Key circuit modification to permit its use with the Touch-A-Matic key. This is further described in the text.

Fig. 1—Circuit of the complete Touch-A-Matic key. When used with the Touch-Key or Can-Key connection is made as shown. To use conventional paddles wtihout the benefit of the long dash feature make the connections (dotted) as shown above plus the modifications described in the text.

- C_1, C_2—1.5 mf 25 v., ceramic plate.
- C_3, C_4—330 mmf silver mica.
- C_5, C_6—560 mmf silver mica.
- C_7, C_8, C_{11}, C_{13}—0.01 mf low voltage ceramic.
- C_9, C_{10}—0.02 mf low voltage ceramic.
- C_{12}—0.47 mf low voltage ceramic.
- C_{14}—0.1 mf. low voltage ceramic.
- C_{15}, C_{17}—200 mf 12 v. electrolytic.
- C_{16}, C_{18}—200 mf 12 v. electrolytic.
- C_{19}—3 mf 25 v. electrolytic.
- C_{20}—50 mf 3 v. electrolytic.
- C_{21}—0.01 mf 500 v. ceramic.
- CR_1, CR_2, CR_3, CR_4, CR_5, CR_6, CR_{10}, CR_{11}—1N273, germanium.
- CR_7, CR_8, CR_9, CR_{12}, CR_{13}, CR_{14}—1N536, silicon.
- K_1—Relay, s.p.d.t., 2500 ohm coil, Potter & Brumfield RS5D or equiv.
- R_1, R_8, R_9, R_{12}, R_{19}, R_{21}, R_{25}, R_{58}—3.9K, ¼ w.
- R_2, R_3—25K ohms, carbon, linear taper.
- R_4, R_5, R_{10}, R_{13}, R_{37}, R_{39}, R_{40}, R_{41}—15 K ¼ w.
- R_6—39K ¼ w.
- R_7, R_{18}, R_{20}, R_{48}, R_{49}, R_{51}, R_{59},—150K ¼ w.
- R_{11}, R_{14}—33K ¼ w.
- R_{15}, R_{16}, R_{26}—27K ¼ w.
- R_{17}—68K ¼ w.
- R_{23}, R_{24}—56K ¼ w.
- R_{27}—500K, carbon, audio taper.
- R_{28}—4.7K ¼ w.
- R_{29}—1.2K ¼ w.
- R_{30}, R_{33}, R_{54}, R_{55}—18K ¼ w.
- R_{31}, R_{32}—22K ¼ w.
- R_{34}, R_{35}—47K ¼ w.
- R_{36}—6.8K ¼ w.
- R_{38}, R_{52}, R_{57}—8.2K ¼ w.
- R_{42}—10K ¼ w.
- R_{43}—2.7K ¼ w.
- R_{44}—10K ¼ w.
- R_{45}—680K ¼ w.
- R_{46}—4.7K ¼ w.
- R_{47}, R_{50}—270K ¼ w.
- R_{53}—1K ¼ w.
- R_{56}—150K ¼ w.
- R_{60}—470K ¼ w.
- SP_1 — Speaker, crystal, 2½" dia., 80K ohms, see text.
- T_1—Transformer, filament, sec. 6.3 v., .15 a.

Long-Dash Circuit

Operation of this section is quite similar to that of the long-dash circuit described previously under the title "Touch-Key Additions,"[5] except that no relays are employed. Touching both paddles at the same time overcomes the bias developed across the diode CR_{12}, causing transistor Q_{16} to conduct and turn on Q_{15}. This operates Q_7 and closes the output circuit for as long as the paddles are held. At the same time, a re-clamping voltage is applied to the bases of Q_{18} and Q_{11} via R_{37} and $CR_{4,5}$, thus disabling the self-completing circuits and allowing accurate control of the long-dash.

Capacitor C_{20} delays long dash closure very slightly, so that no action occurs during normal keying overlap. Capacitor C_{19} prevents a too rapid return of the self-completing feature, which could make a random extension of a long-dash just as the key is opened. Transistors Q_{13}, Q_{14} and diodes CR_{10} and CR_{11} provide the circuit separation necessary to obtain three modes of operation with only two control paddles.

Break-in

Where the relay K_1 is utilized, its rear contacts can be employed with certain circuits for break-in purposes. With either relay or transistor output, delayed T-R type break-in can be provided with an s.s.b. transmitter by introducing a signal from the audio oscillator into the vox circuit. This kind of operation is very smooth, but involves modification of the transmitter to include cut-off of the microphone, modulation, and speaker anti-vox systems while on c.w. Full use is made of the normal vox delay and control circuits, but it may be necessary to increase the time interval on some transmitters. Audio output to ground may be obtained from the collector of Q_8 by means of a 0.47 mf low voltage ceramic capacitor, and phone-c.w. switching at the transmitter should be arranged to eliminate the possibility of higher voltage surges occurring during change-over, or at any other time.

Part II, to be presented next month, deals with the construction and troubleshooting procedures.

[*To be continued*]

[5] Jackson, A. H., "Touch-Key Additions," *CQ* Feb. 1965, page 59.

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For further information, check number 22, on page 108

17th YL-OM Contest Results

BY LOUISA B. SANDO, W5RZJ

CONGRATULATIONS to all of the top scorers in YLRL's 17th Annual YL-OM Contest, held Feb. 19-20 (c.w.) and Mar. 5-6 (phone). Winner among the YLs on c.w. was ARRL staffer W1YYM, Ellen White, while KØEPE, Martha Wessel, placed first on phone. (Marte earned a similar gold cup in the '64 contest.) Among the OMs, K5MDX, David Thompson, won on phone, and W9WGQ, Kenneth Bauer, earned high score on c.w.

YLRL V.P. K1EKO, Edie, reported more than 300 logs received, the greatest number coming from OMs participating in the c.w. section. In addition to the usual confusion over sections, and some unreadable logs, Edie had a new one—a bootlegged YL call. Using K2SHE (which does belong to YL Kitty Gabel of Crosswicks, N.J., but Kitty did *not* operate in the contest), some lid made quite a number of contacts giving his section variously as NYC/LI or So. N.J. As Edie comments, it may cost this character more than his wasted time!

Here are the top three in each category and the top district and country scores:

YL CW		OM CW	
W1YYM	53,346	W9WGQ*	4,046
WA4HOM*	52,480	K2EIU/5*	3,250
WA6OET*	50,540	W8AJW*	3,218

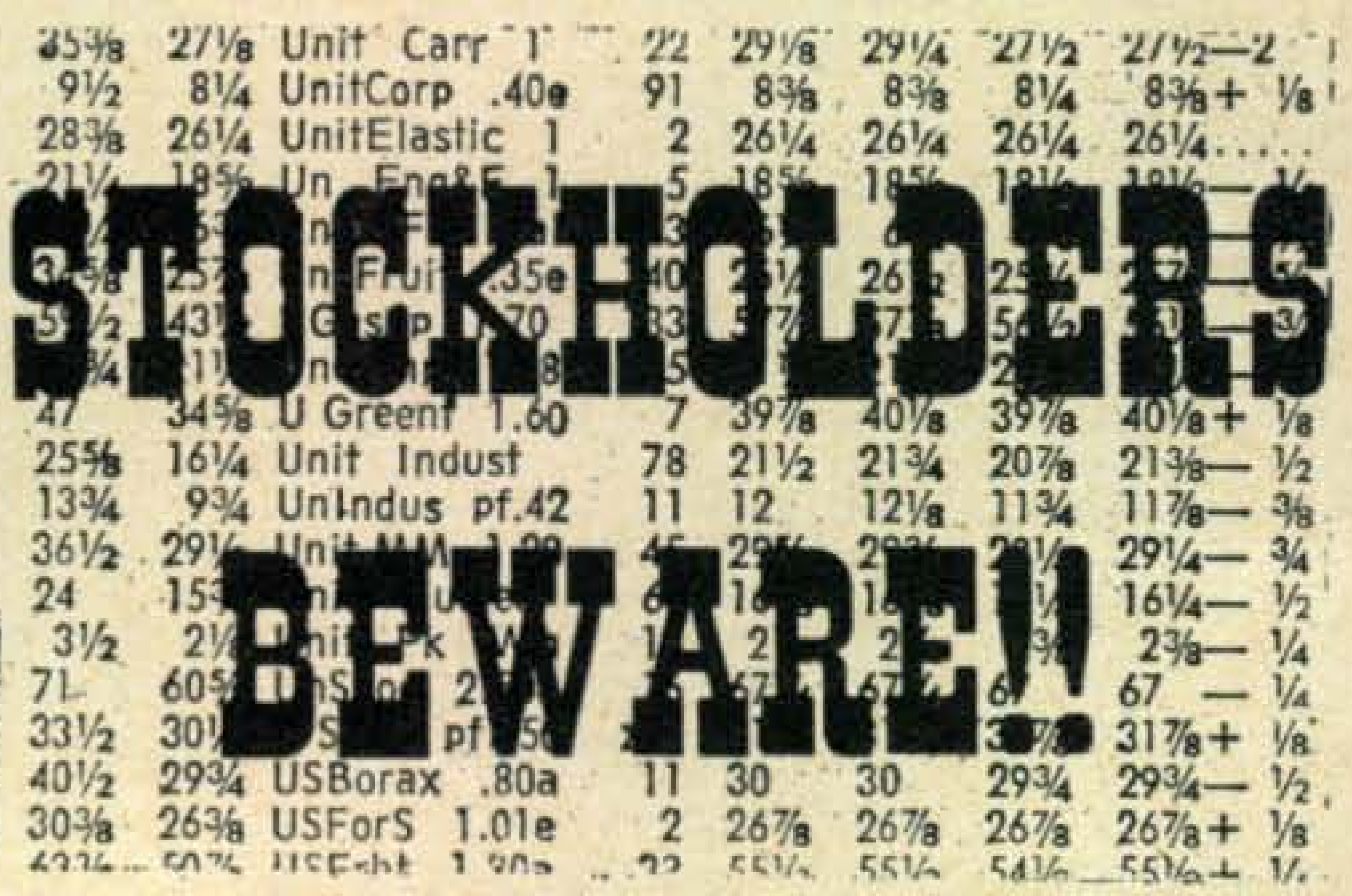
YL PHONE		OM PHONE	
KØEPE	116,896	K5MDX	7,336
WA5NVY	78,678	K2EIU/5*	5,288
WA4HOM	77,342	W9LNQ*	3,754

Top District and Country Scores

YL PHONE			
K1GSF*	1,563	KØEPE	116,896
K2KQC	7,993	KH6FQU	9,856
WA3DQG*	32,635	VE3BII*	14,773
WA4HOM	77,342	CE6CC*	9
WA5NVY	78,678	DJ2YL*	14,291
WA6OET	75,985	PY2SO	33,580
K7RAM	48,982	VK3KS*	709
K8ONV	28,724	XE1HHH*	288
K9LUI	38,994	YV1QN*	713
		ZL2JO*	23,404

[*Continued on page 105*]

*Denotes low-power multiplier.



BY ED MARRINER,* W6BLZ

JUST before the turn of the century an editor sat down and wrote this profound editorial after Mr. Marconi's recent experiments.

"The decrease in the market value of shares in cable companies is attributable to Mr. Marconi's recent successful experiments may appear ridiculous to those who understand the subject, but it is, nevertheless, fact.

"It would be unwise to say that wireless telegraphy will never be made *available for long-distance ocean work,* but it may be confidently asserted that the advance in this branch of communication like all other human progress, must be tentative and very gradual and that the difficulties to be overcome are numerous and great. On the other hand, many of the cable companies are in the strongest possible position with very large reserves; and, *even if it prove feasible to work without wires,* say between London and Paris—all such messages being carried by the British and French Governments and not by the companies—it would be a thousand pities if timid shareholders were to sacrifice their property now, only to see it, after a year or even a few months, approximate to its former market level. The investing public speak of a "fall" on the Stock Exchange, but they ought to remember that it is, in this case, only themselves who, by panic selling, can largely depreciate for a time the value of their property.

"Our earnest advice, therefore, to holders is to continue to believe that the securities of well established cable enterprises are thoroughly sound investments, and to "sit on" what they have. If they do not, they will only have to blame their credulous acceptance of ill-advised and *premature forecasts made by men who possess neither scientific nor practical knowledge of the subject.* Those on the other hand, who have worked with Hertzian wave and other systems of wireless telegraphy—men like Mr. Marconi, Mr. Preece, Prof. Lodge and Dr. Fleming—best know the difficulties, some perhaps in their nature insuperable, which have to be overcome, and are strongest in the belief that the field for this kind of communication is *not that of long-distance telegraphy for which wires will always be found to be most suitable.* Signed: Editor, The Electrician Magazine, Friday, April 21, 1899—"

Thus a moment of thought on the future of radio communications went down for posterity. It would have been embarrassing for the editor if he lived to see the development of the wireless age, which, was well underway a few years after his editorial. ■

*528 Colima Street, La Jolla, California.

PITCAIRN ISLAND GETS A VOICE

BY DOROTHY STRAUBER,* K2MGE

IN the vast world of amateur radio, no contact has been more highly prized than one with Tom Christian, VR6TC, of Pitcairn Island. Tom, who is 30 years old, is a direct descendent of Fletcher Christian, celebrated first mate of "The Bounty." The thought of working this tiny speck of an island, far off in the Pacific, with its famous history of "Bounty" settlers, has long intrigued hams all over the world.

Over the years, a strong friendship has sprung up, via amateur radio, between Tom, Bob Stark, W5OLG, of Grapevine, Texas, and John Maddox, W4TAJ, of Johnson City, Tennessee. The two Americans, at their own expense, did what they could to furnish Tom with radio parts and equipment to keep him on amateur radio. However his low power prevented him from being heard by many of the hams who wanted to contact him. It became evident that Tom would need more modern equipment and a more efficient antenna.

At the end of 1965, Bob and John asked for assistance from American manufacturers. Calls to The Hallicrafters Company for a new single-sideband station and to the Hy-Gain Company for an antenna brought generous response. Arrangements were made for Tom to receive an HT-37 sideband exciter; HT-41 1 kilowatt linear final; and an SX-117 receiver, plus a TH-3 MK2 3-element tri-band beam. Bob and John arranged for their shipment to Pitcairn. The first of the deliveries was made in April, with the balance of the equipment to follow in May.

Soon, the call VR6TC, with Tom Christian at the microphone, will be heard throughout the world with thousands of radio amateurs being given their first chance to contact this famous little island in the Pacific.

Tom, nearing the top of the tower which held a Hornet beam whose 20 meter capabilities were impaired by a broken tip on one of the elements.

After a four month sea voyage, the new Hallicrafters equipment arrives on Pitcairn. Tom's worried expression is caused by the rough handling evident in the torn cartons.

Tom, VR6TC, checking over his d.c. generator which was removed from a Texas locomotive and sent to Pitcairn by W5OLG and W4TAJ.

The Island

Pitcairn Island is just one by two miles and lies within the shipping lanes between Panama and New Zealand. The present population of 97 is a mixture of English and Polynesian and the island is now part of the British Empire. Each family has its own garden with tropical fruits and vegetables. Most keep chickens and goats. Fish abound in the surrounding waters and is another mainstay of the diet. Grocery staples must be ordered from England or New Zealand and in quantities to last between the monthly visits of the supply ship. Souvenir making is the only means of income on the island. The men get wood from Henderson Island, 100 miles away, going in open boats for a trip which lasts 18 hours! The wood is carved into different kinds of objects by the men; the women weave baskets. Sales are made to ships' passengers and by mail order to provide the inhabitants with some income.

In addition to being an expert wood carver, Tom Christian is the island's official radio operator and weather observer and also holds commercial schedules with Tonga, ships, and other islands. He is an accomplished fisherman and gardener as well as being the only amateur radio operator on Pitcairn. ■

*12 Elm Street, Lynbrook, New York, N. Y. 11563.

For further information, check number 23, on page 108

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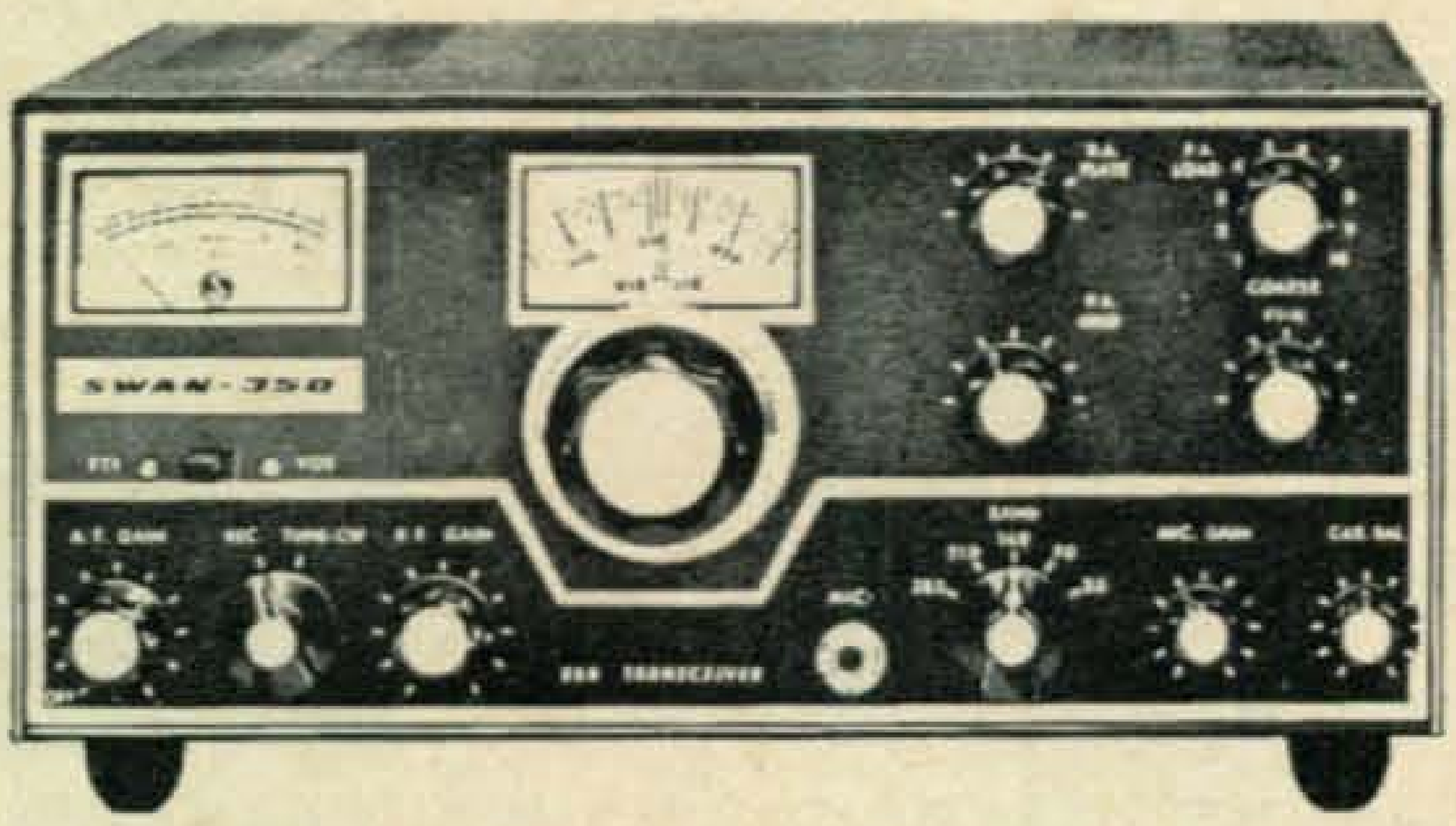

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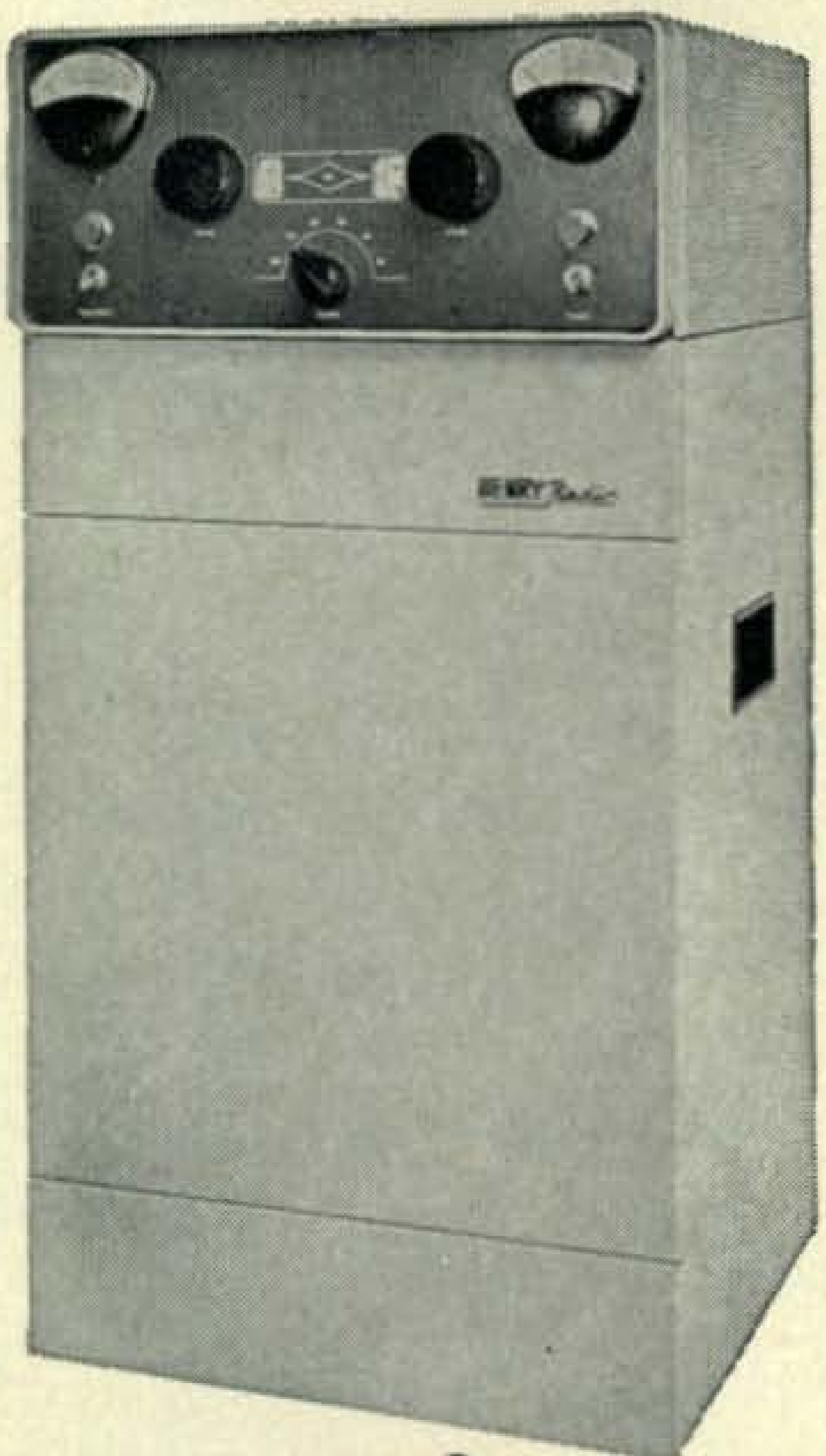

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PERHAPS the best way to begin a discussion of passive multipliers is with a definition. Simply, passive multipliers are black boxes which accept an input signal at some frequency (F_{in}) and provide an output, some multiple (n) times F_{in} at the expense of signal power. These circuits do not require d.c. power input as do tube type multipliers. Hence, they are inactive or "passive" when no signal is applied. The component commonly used for this function is a voltage variable capacitance diode.

Since the early 1950's a great deal of emphasis has been placed upon multiplication with the Varactor, one of the voltage variable capacitance diodes. In 1962 the Step Recovery Diode (SRD) or Snap Off Diode made its debut bringing into prominence a whole new generation of multipliers which in many ways are superior to the Varactors. The SRD has been used to multiply by a factor of 50 in a single stage with an overall circuit loss of 25 db. A similar circuit using a varactor had losses in excess of 60 db or about 3000 times *less* power output than the SRD. Unfortunately, at present the SRD is limited to low power service such as v.h.f.-u.h.f. converters and low power transmitters.

V.H.F.-U.H.F. Passive Multipliers

BY ROBERT J. KOLB,* WA6SXC

Some information has been published on the use of Varactor diodes as frequency multipliers.[1,2] Presented below is some data on the use of Step Recovery Diodes as passive multipliers operating at higher efficiencies than Varactors.

Before attempting to explain the mechanism by which the Varactor and SRD are able to multiply we should review the standard semiconductor diode junction and point out how these multipliers differ in construction.

PN Junctions

Pure semiconductor material is called intrinsic material and has equal numbers of electrons and holes. At any particular temperature a given number of electrons have sufficient thermal energy to jump out of their orbits in the atoms of the crystal and become free to roam around. When they leave their orbits they create a vacancy or hole in the atoms of the material which has an equal but opposite charge. These are referred to as an electron-hole pair. When an electron from a nearby atom jumps into the newly created hole to neutralize its charge another hole is created; hence the number of electrons and holes are always equal and the net charge is zero.

When intrinsic germanium is doped with an acceptor impurity, holes are developed in the crystal structure. This is called P type material. When the germanium is doped with a donor impurity many free electrons are provided that do not lock into the crystal structure, and this is known as N type material. The net electrical charge of the semiconductor material is not changed because the donor impurity contains a proton for each electron contributed.

When N and P material are properly joined some of the electrons and holes in the region of the junction combine and disappear, leaving behind an area devoid of excess "carriers" or free moving charges. There are, however, charged donor and acceptor ions locked in place in the junction. These ions create an electric field which retards further recombination. This area is called a depletion layer. See fig. 1A. This is the normal or unbiased state. It may be thought of as a charged capacitor in a d.c. circuit. If current is to flow through the crystal, the carriers must have sufficient energy to overcome the retarding field in the depletion layer. This is supplied by an external biasing source or signal voltage.

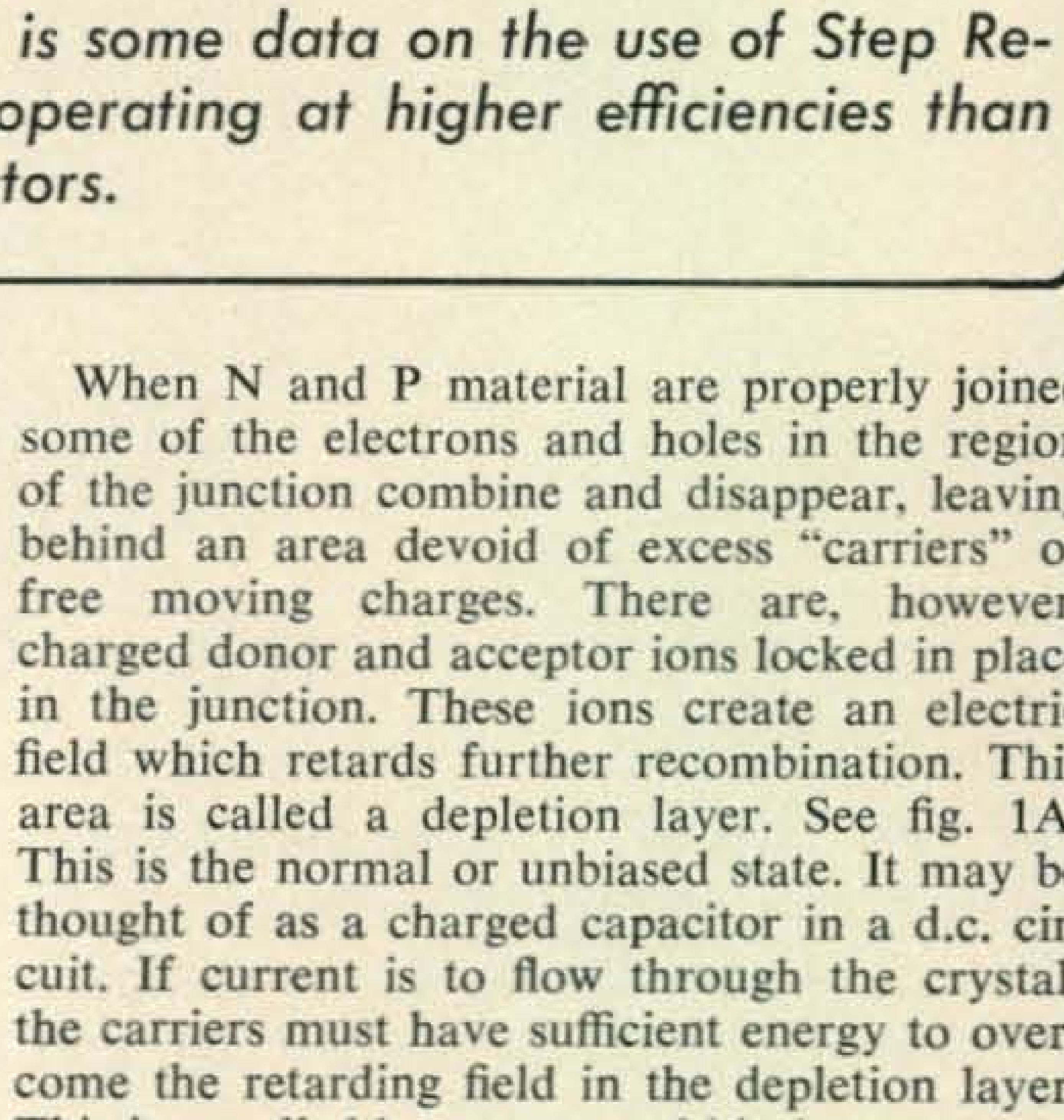


Fig. 1(A)—P-N junction permits an interaction between holes and electrons. The P type material develops a slight negative charge and the N type material develops a slight positive charge. The region about the junction is called the depletion layer, or the space charge region. (B)—In a step recovery diode the junction is separated by a layer of intrinsic material. Depletion layers appear only when the diode is heavily reversed biased.

*1300 West Oak Avenue, Fullerton, California.

[1]Thorpe, D. "Varactor Multiplier for V.H.F.," *CQ*, Jan. 1965, p. 44.

[2]Luettgenau, G. J. Williams, and H. Miyahira: *A Practical Approach to the Design of Parametric Frequency Multipliers*, Pacific Semiconductors, Ind., 1962.

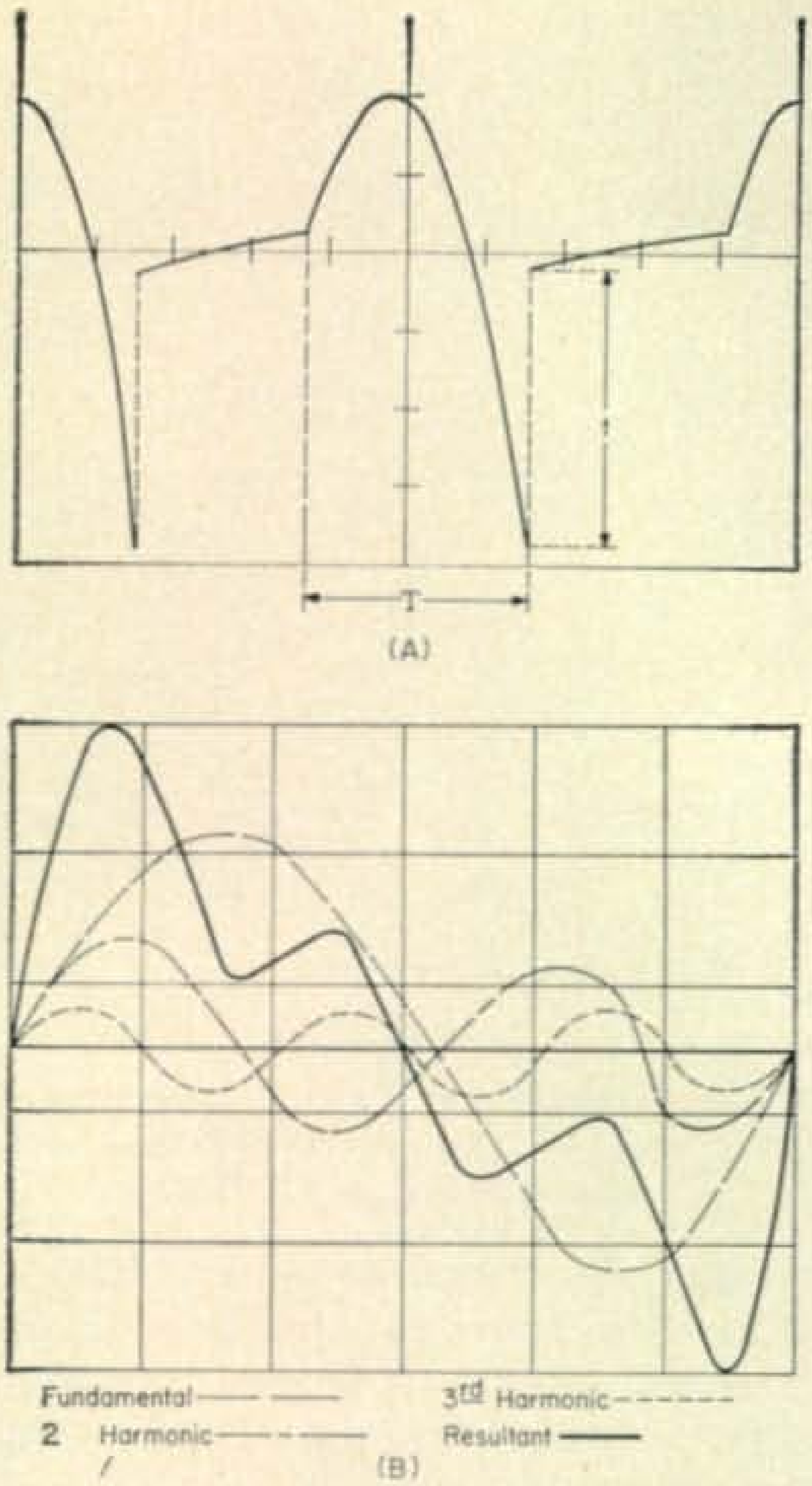


Fig. 2(A)—Waveform of current flow through a Step Recovery Diode with an applied signal of 10 mc. Period t is the transition time. Period τ is the minority carrier lifetime. (B) Current change waveform in the varactor diode is the result of the fundamental plus the second and third harmonics.

When biased in the forward direction (P side positive), current flows and the depletion layer becomes narrower resulting in an increased junction capacity. When biased in the reverse direction only microamps of reverse current flows; the depletion layer is wide and the junction capacitance is small. This reverse current is due to the electron-hole pairs thermally generated. This means that free *electrons* are present in the P material and free *holes* in the N material, and since they account for only microamps of reverse current they are called *minority carriers*. The amount of minority carrier current is dependent on temperature only and will not appreciably increase with voltage until reverse breakdown occurs. This is the type of junction used in the varactor.

Step Recovery Diode

The Step Recovery diode junction is slightly different. Sandwiched between the N and P materials is an extremely thin layer of intrinsic material as shown in fig. 1(B). No depletion layer is formed in the unbiased state. When biased in the forward direction the intrinsic material is quickly saturated with the normal or majority carriers and a tremendous retarding field is built up in a direction to prevent the flow of minority carriers. In short, the diode is back biased for reverse or minority carrier current. The minority carriers are subsequently stored in the N and P materials for the duration of the forward biased half cycle of the input signal (See fig. 2(A)). When the input signal swings negative the diode is now forward biased for the minority carriers which rush into the junction to recombine. Since the minority carriers are few by comparison with the majority carriers in the N and P regions, reverse current will flow for only a brief period. When the minority carriers are used up in recombination the diode shuts off abruptly generating a rich source of harmonics, much like a square wave. The lifetime (τ) of the minority carriers is measured from the beginning of forward conduction to the point where the diode snaps off. The time required for the current to return to zero from the point of turn off is called the transition time.

Varactor Action

Figure 2(B) shows the change in current for a single cycle of the input through a varactor diode tripler. It is important to note that the resultant current (dark line) is comprised of several components, the fundamental, second and third harmonic currents. Theoretically, output power from a Varactor at harmonics greater than the second is not possible without the use of external circuits called idlers.[2] The higher order harmonics must be supported by currents fed back in proper phase to the diode through these low impedance, series resonant idler circuits. This means that the fifth harmonic cannot exist without the presence of the second and third harmonics and so on[3]. The fundamental or input current generates the second harmonic in the diode; the second harmonic fed back through an idler mixes with the input to produce the third harmonic and the third, if fed back will produce the fourth and fifth harmonics by the same mixing process. The output current must be the sum, the difference or second harmonic of an existing frequency.[2]

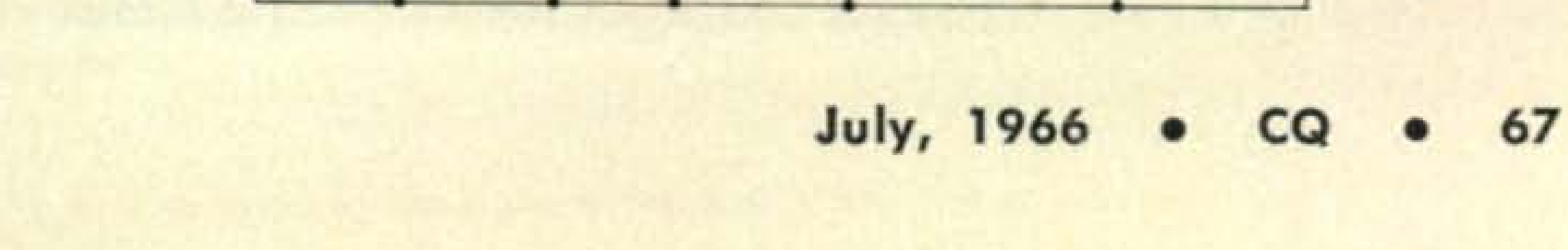
If these harmonics were not fed back for reconversion to the desired output frequency the maximum current available at the output would be 1/harmonic number squared, times the amplitude of the input signal current or

$$I_n = \frac{1}{n^2} I_{in}$$

Current at the 5th harmonic would be 1/25 I_{in},

[2]Gromer, R. D.: Efficient, High Order Varactor Multipliers, *Microwaves*, Sept. 1963, p. 19.

Fig. 3—Circuit of a Varactor tripler. The L_1-C_1 and L_3-C_3 tanks are tuned to the second harmonic. The L_2-C_2 series circuit forms the low impedance second harmonic idler circuit.



but by reconversion we can reduce losses to $-n$ in db or to about 1/3 I_{in}. Because higher order multipliers require additional idlers for each of these needed lower harmonics, the practice is to cascade doublers and triplers to reduce the number of adjustments and circuit losses.

There is another way to describe Varactor action. If we consider the depletion layer to be analogous to the dielectric and the N and P regions to the oppositely charged plates of a capacitor, we would observe a capacitor whose dielectric varies in size with the applied voltage, since the depletion layer widens and narrows with a change in voltage across the diode. This causes a corresponding change in the reactance between the Varactor and its circuits which produces the harmonic rich current waveform of fig. 2(B). Now, we can filter out the unwanted harmonics and excite a resonant circuit with the desired one as is done with Class C vacuum tube multipliers and achieve a sine wave output n times F_{in}.

A well designed Varactor tripler is shown in fig. 3. Here, L_1 and C_1 form a high impedance trap to block the fundamental from the output circuit; L_3 and C_3 similarly block the second harmonic, and L_2 and C_2 form the low impedance second harmonic idler circuit.

Referring to fig. 4 you will note that for a 20 volt swing in applied signal voltage at a 15 volt reverse bias level a typical Varactor sweeps through an 18 mmf change in capacitance (from 14 to 32 mmf) while a step recovery diode scarcely changes by 2 mmf. This accounts in part for the remarkable frequency stability of the SRD, especially when the driving signal is amplitude modulated. Some frequency modulation of the output occurs in Varactor multipliers when the drive is a.m. and in poorly designed circuits this can become a limiting factor on the amount of a.m. permissible.

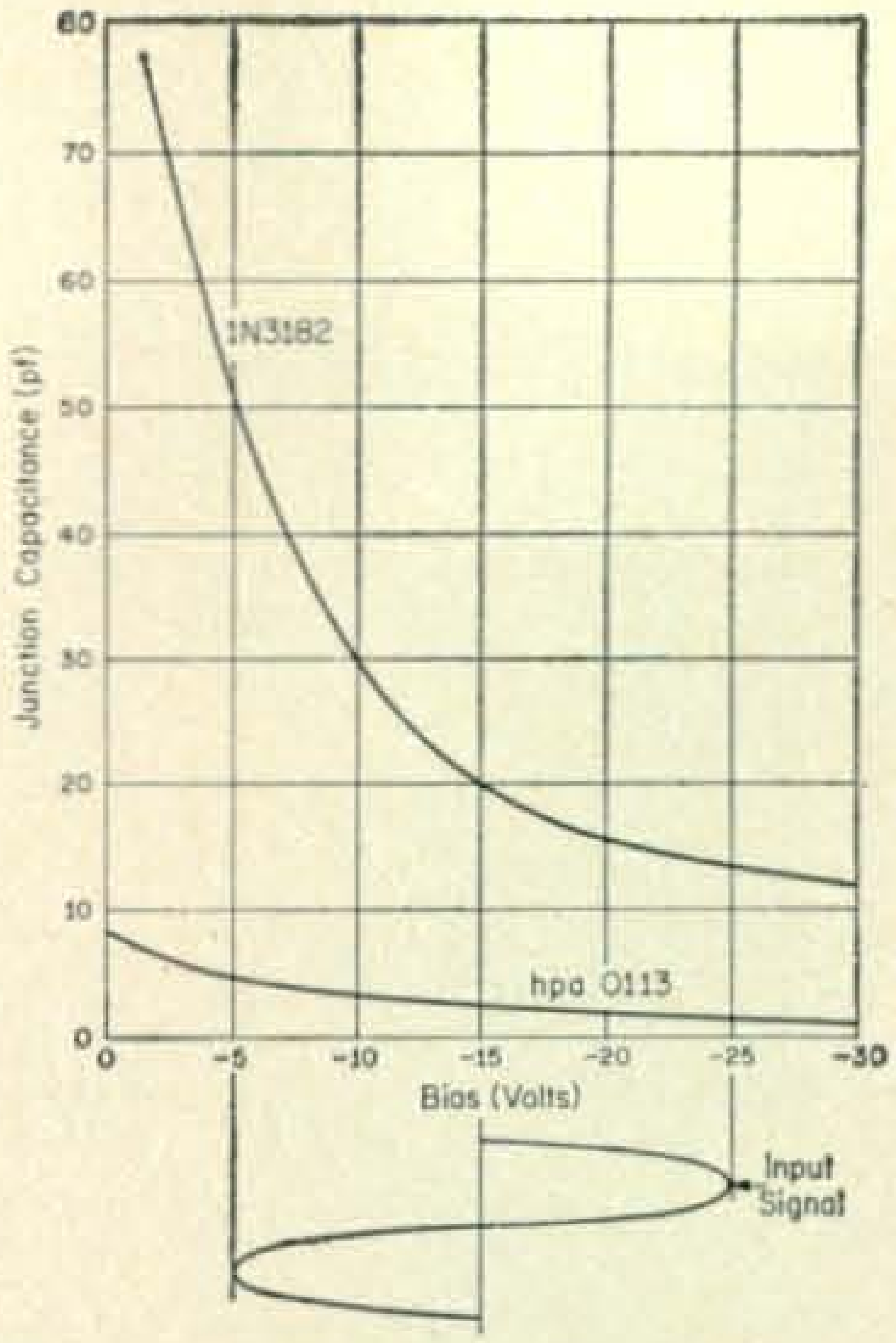


Fig. 4—Comparison of the junction capacitance change between a Varactor diode (1N3182) and a Step Recovery Diode (h p a 0113).

SRD Operation

The great efficiency of the SRD is due to the fact that it is not dependent on lower harmonics current for the generation of the nth harmonic. When the diode snaps off an extremely wide spectrum of harmonics is generated and the amplitude of each multiple is only slightly less than the next lower one. In narrow band applications where n is less than 10 it is quite possible to hold losses to $-n/2$ db or to achieve a power output of 1/3 the input when multiplying by a factor of ten.

When designing SRD circuits the important parameters are the lifetime (τ) of the minority carriers and the transition time t. The lifetime should be three times the duration of one cycle of the input signal while the transition time should be 1/10 the duration of one cycle of the output frequency.

The typical step recovery diode multiplier circuit is far more simple than its Varactor counterpart. Because of this it is also much easier to adjust. Note that the SRD multiplier in fig. 5 has a total of six adjustments. But, to make matters even simpler the output filter may be disconnected at the diode and aligned with a sweep generator or r.f. voltmeter for minimum insertion loss and appropriate bandwidth before overall adjustment is attempted. Thereafter, only the slightest adjustment of C_3 is required to match the filter to the diode. This leaves only C_1, C_2 and R_1 to be adjusted. The tap on L_1 must be optimized as in the case of the varactor tripler. Two diodes may be paralleled to obtain outputs up to half a watt, but it must be remembered that the capacitance of the diodes will be doubled and some slight circuit changes will be required. From modest investigation in this area, it appears that it is not essential that the diodes be matched.

The circuit shown in fig. 5 was used to multiply from 8 to 144 mc with an overall circuit loss of 10 db. The filter had an insertion loss of 1.6 db and an 8 mc bandwidth at the 3 db points. It provided 50 mw. which can be used to drive

[*Continued on page 105*]

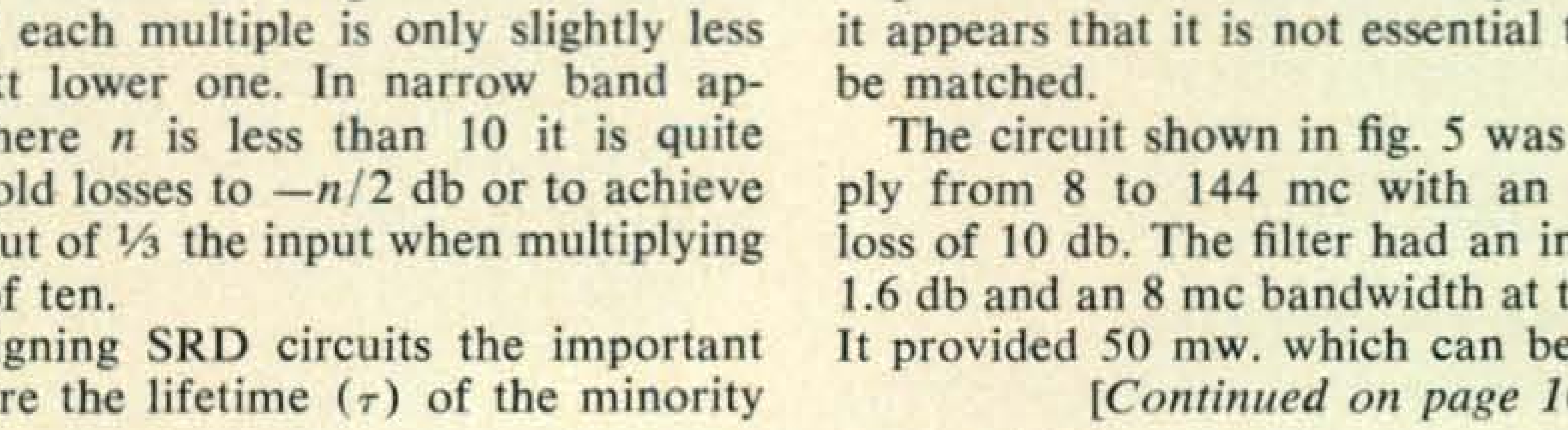


Fig. 5—Circuit of a step recovery multiplier. All capacitors are in mmf. The variables are 0.8 to 10 mmf. Rexolite is a low loss plastic bar stock available from most plastic supply houses. Any material which will hold the coils rigid is acceptable such as lucite, nylon, etc.

L_1—25t #22e, 3/4" dia., 3/4" long, wound on a Rexolite form.

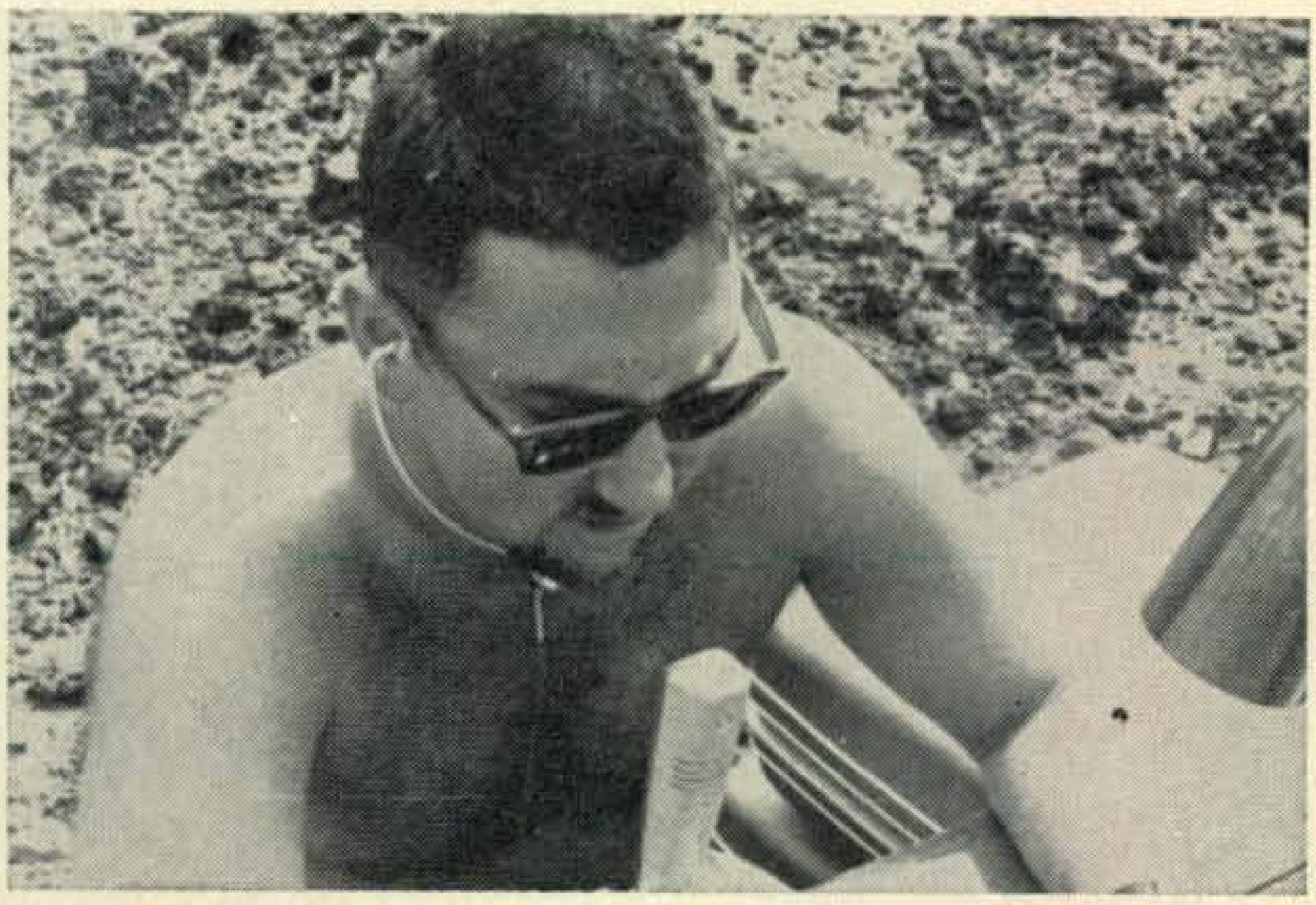
L_2, L_3—5t #16, 3/8" dia., 5/8" long, wound on a Cambion PLS-6 form with the slug removed.

L_4—5t #16, 3/8" dia., 5/8" long, wound on a Cambion PLS-6 form with the slug removed, tapped 1t. up.

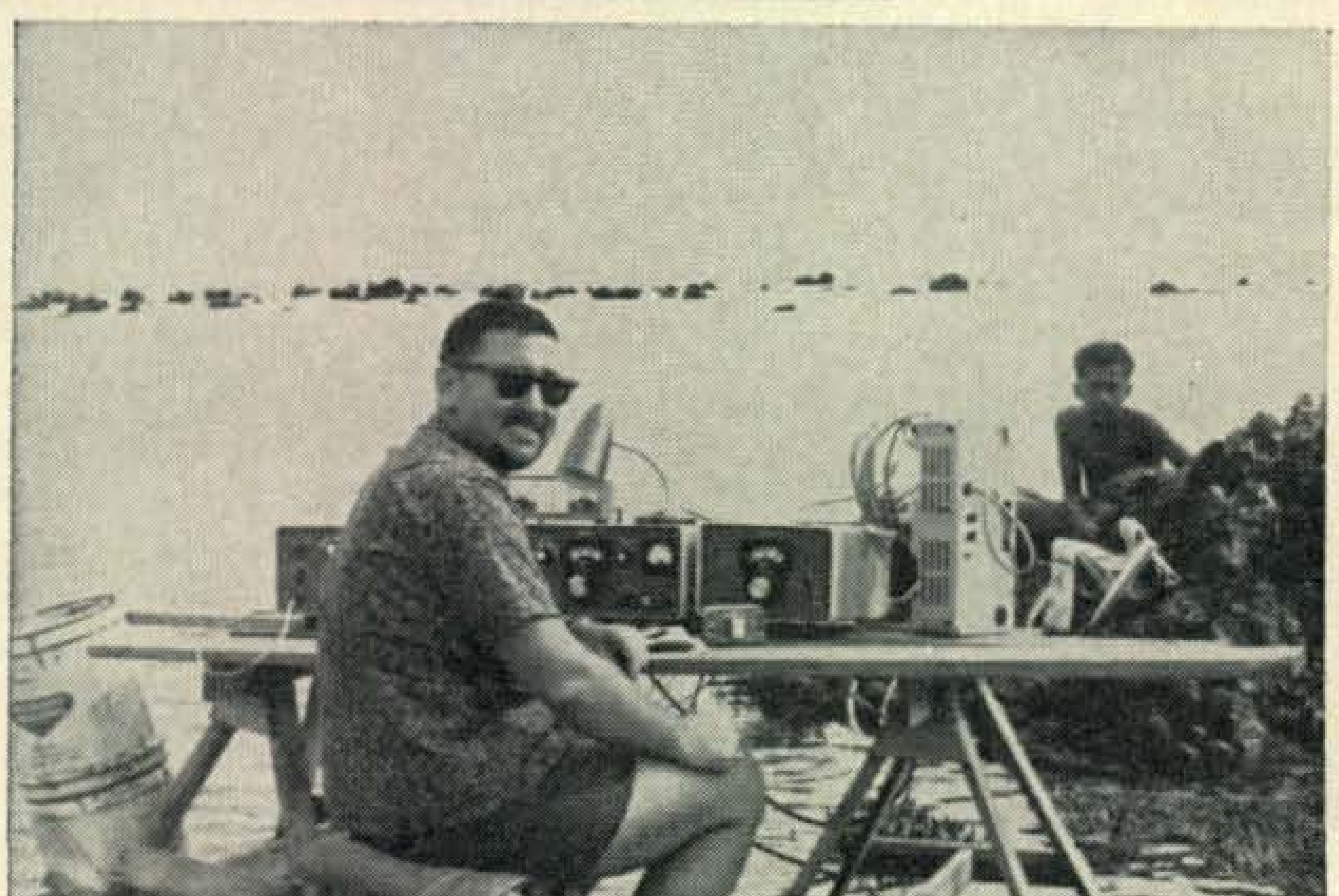
The scenery at Minerva Reef is not quite a travel agent's dream, but it looks like a heck of a good place to get away from it all (and we do mean *all*). Photos taken at 1M4A, Minerva Reef. From the looks of things, those long hours of operating must be rough on the derriere.

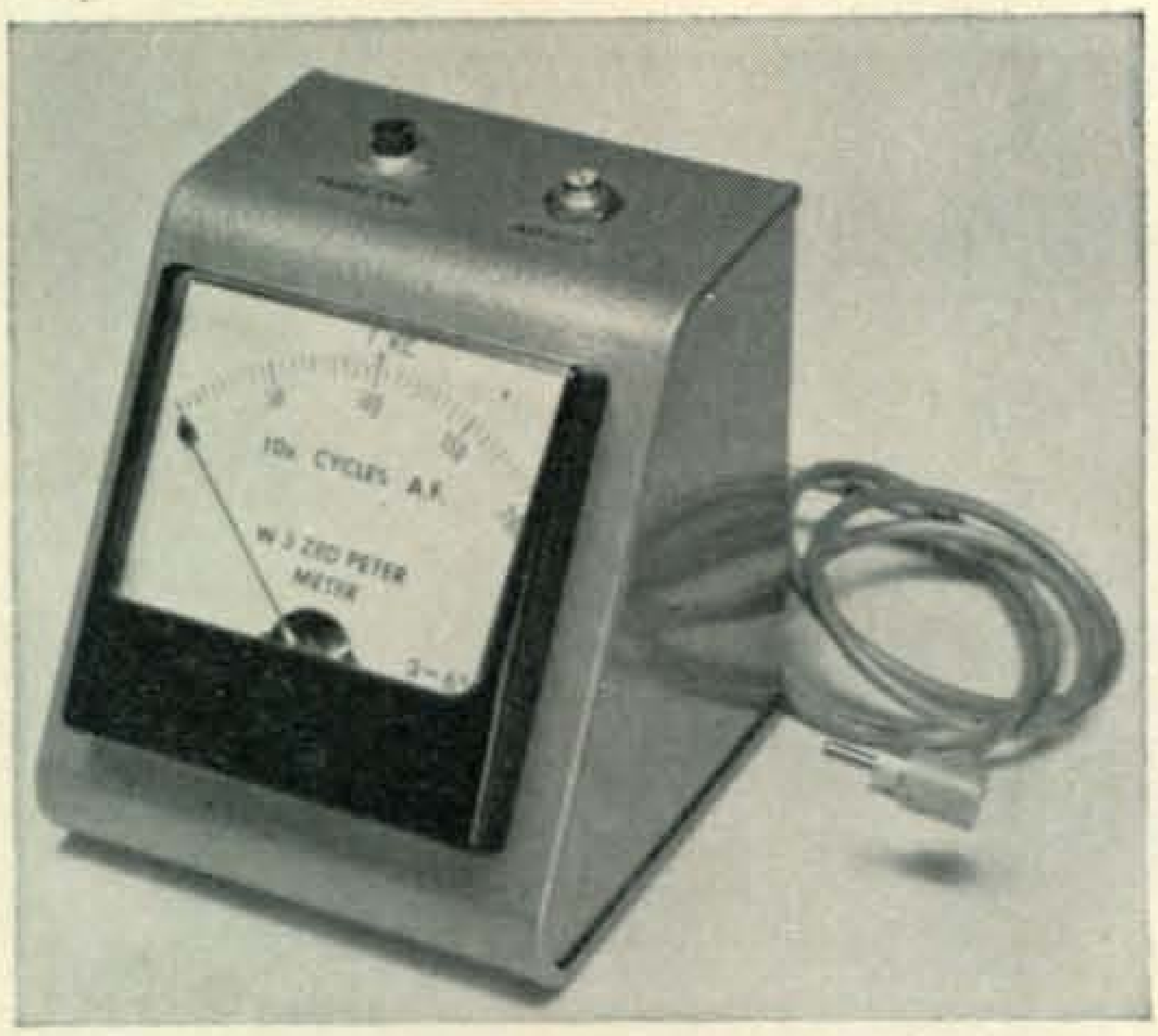
Don Miller, W9WNV, DXpeditioner

HEY! Wadyano! That guy Miller doesn't have horns and a tail after all! A few not-too-candid shots from the recent operations by W9WNV at Minerva Reef, (1M4A), and Maria Theresa, (FO8M) show that DXpeditioning can be fun (?). ■



We don't recommend that you try Don's method of keeping cool during some hot summer DXing, but in his case it was reasonably safe because of the "floating ground" on the generator (no pun intended). FO8M, Maria Theresa, was the location.





Front view of the direct reading audio frequency meter shows how the original scale calibration is used for full scale deflection at 2,000 cycles. The only operating control is the push button.

This direct reading audio frequency meter uses one transistor, four diodes and a few parts to read from zero to two thousand cycles, plus or minus 20 cycles. Simple modifications will permit the range to be changed to suit the builders purpose.

The W 3 Z_{ed} P_{eter} Meter

BY J. ALAN BIGGS,* W3ZP

There are many occasions when it is necessary to determine the frequency of an audio signal with reasonable accuracy. In our case it was necessary to determine a heterodyne to spot a signal just 1 kc inside a band edge as shown by a crystal marker. Other times, there is a need to measure the accuracy of an audio tone in RTTY applications. Unless one is a musician with a perfect ear for tone, this presents a complicated problem.

Several audio frequency meters are available with direct readout, but they are rather expensive. Also, we do not need accuracy to the exact cycle. For s.s.b., plus or minus 20 cycles is quite adequate. An oscilloscope and audio oscillator may be used to measure a.f. using Lissajous patterns, with the 60 cycle line for reference. This method, however, is bulky, crude and time consuming.

A direct-reading audio frequency meter formerly manufactured by Barker and Williamson and one by Heath was also considered. However, these used several tubes and covered much more than the single range we wanted.

Our thoughts turned to the construction of a simple transistorized direct reading a.f. meter. The circuit is shown in fig. 1. It is capable of reading 1 kc with an accuracy of plus or minus 20 cycles and has a full scale range of 2 kc. It is insensitive to the level of the input since the amplifier saturates at 0.5 volts and an increase of 30 volts in the input circuit results in a change of less than 1%.

*M. R. #2 Doylestown, Pennsylvania.

Circuit Operation

The circuit uses an inexpensive audio type p.n.p. transistor operating as a limiter-amplifier. The base-emitter circuit is saturatd by any input signal greater than 0.5 volts. The audio input signal is severely clipped by the base-emitter circuit and is amplified in the collector circuit. As long as the input is greater than 0.5 volts the circuit clips and limits presenting a constant amplitude output in the collector circuit approximately equal to the battery voltage.

The output from the collector is applied to the meter circuit through C_1. The amount of signal that arrives at the metering circuit is determined by the signal frequency and the reactance of C_1.

The reactance of C_1 varies inversely with the frequency, thus the lower the frequency the higher the reactance and the lower the meter reading. All that need be done now is to calibrate the meter scale in terms of frequency rather than current. A 0-200 microampere meter is used and a multiplying factor of 10 is used to read frequency.

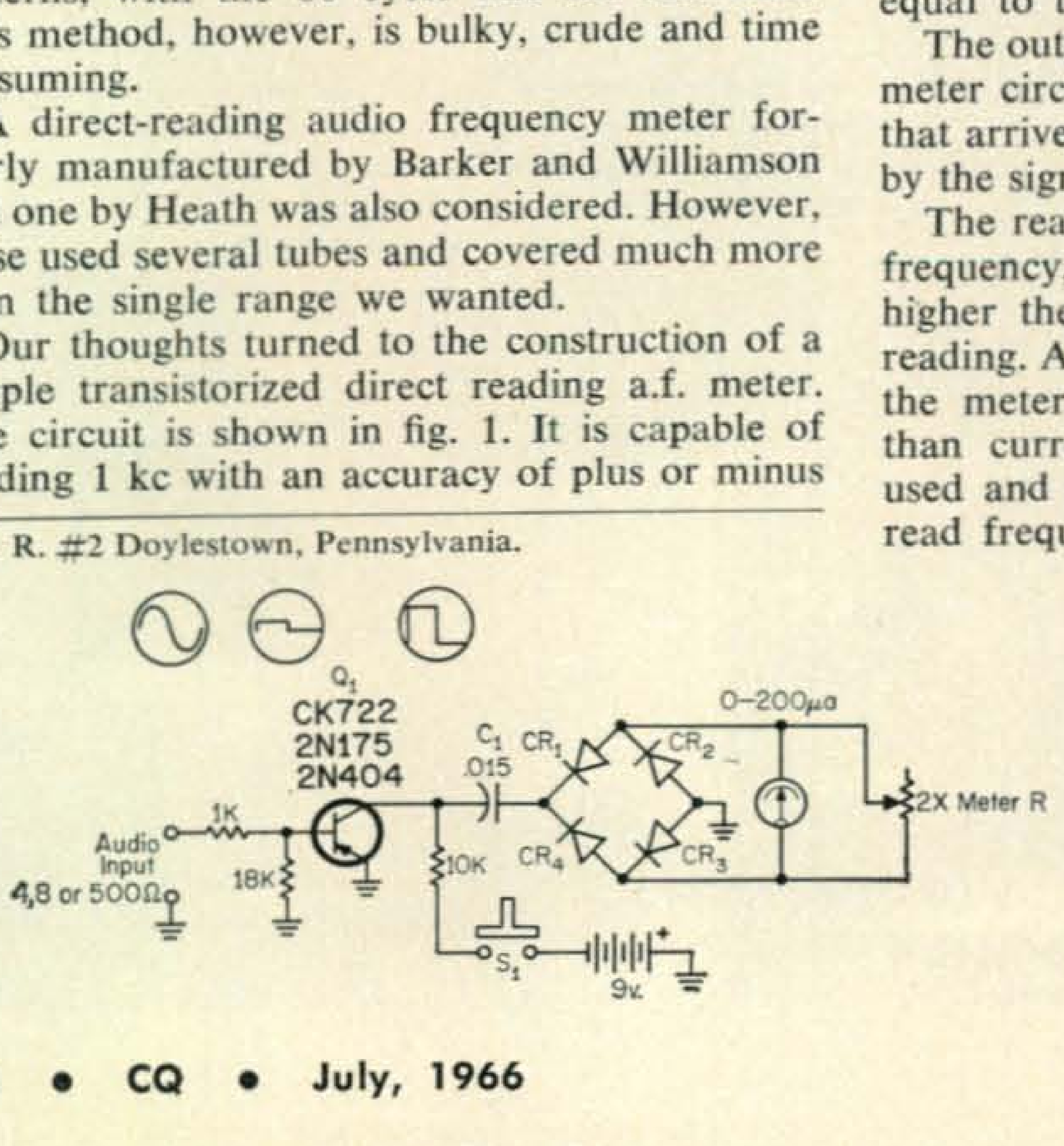
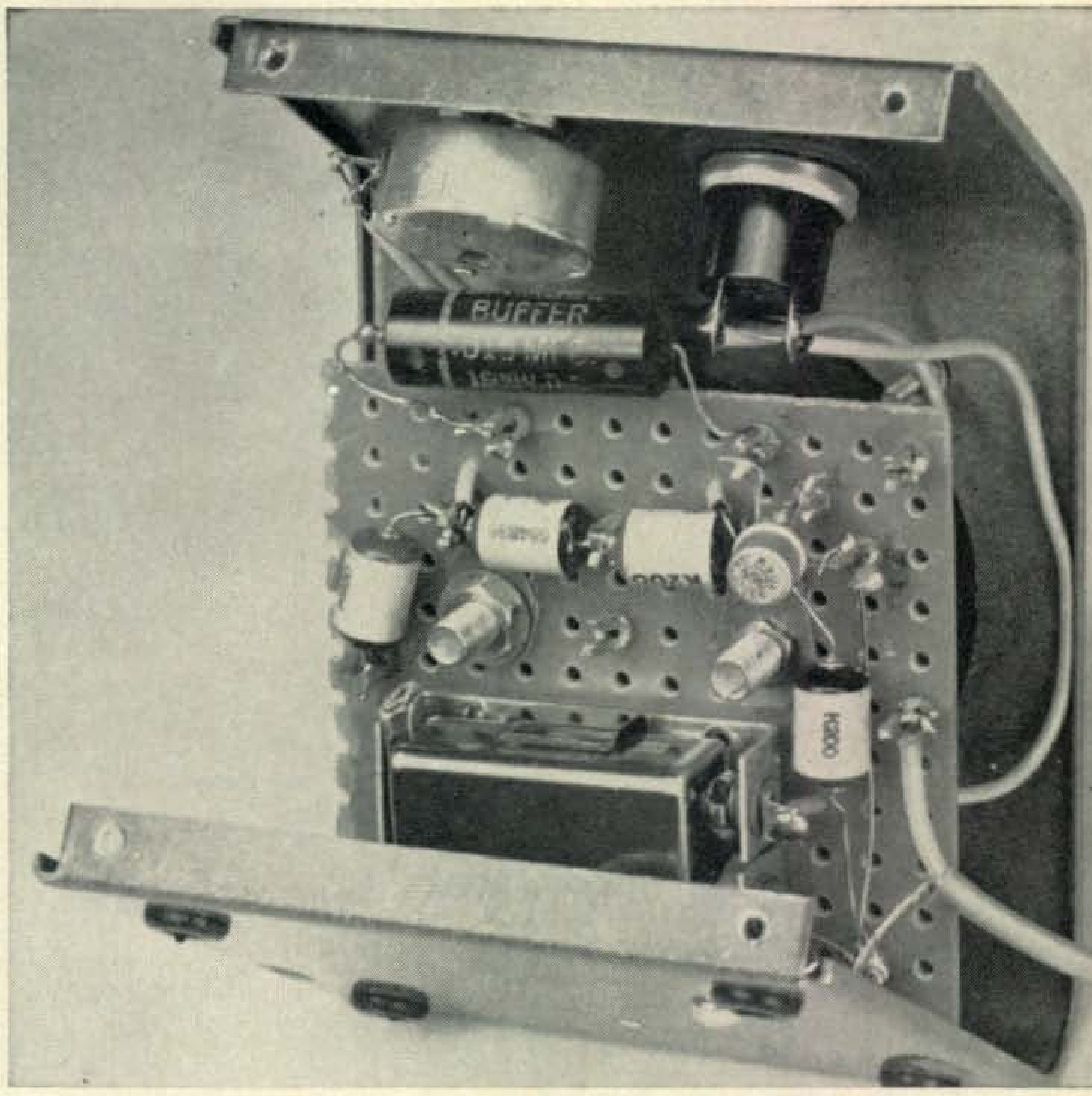


Fig. 1—Circuit of the direct reading audio frequency meter. All resistors are ½ watt, 10%. Capacitor C_1 is a good quality 0.015 mf mylar capacitor and R_4 is a linear pot about 2 times the meter resistance.



Inside view of the direct reading a.f. frequency meter shows all the components mounted on a piece of perforated board. The calibration control (R_4) and the Push-To-Read switch (S_1) are on the top of the sloped panel. The 9 volt battery is mounted in the clip below the meter studs.

Resistor R_1 is used as an isolation device to prevent the low base-emitter circuit impedance from loading down the circuit to which the a.f. meter is attached. When connected across a speaker voice coil without R_1, in the circuit, distortion, due to clipping, will occur.

Construction

The physical construction is simple and well illustrated in the photographs. The wiring technique is not critical due to the low operating frequency.

The choice of parts is not too critical either. Almost all types of p.n.p. transistors seemed to work well although there was some variation in the voltage at which some saturated.

Most silicon rectifiers worked well but a check should be made to see that the back resistances are about equal. A p.i.v. rating of at least 100 volts is required. Sarkes Tarzian K200 diodes will do very nicely for this purpose.

Calibration

Resistor R_4 shunts the meter, adjusts the sensitivity and thus acts as a calibration control. To calibrate the meter, it is only necessary to feed in a known signal and adjust the calibration control so that the meter reads correctly. The source of the accurate frequency is the problem. If an accurately calibrated a.f. oscillator is not available any a.f. oscillator may be used if checked against the line frequency with an oscilloscope, using Lissajous patterns.

Other sources of audio tones are a 1000 cycle tone frequently available from the phone companies in some areas, 600 cycles and 440 cycles from WWV. An assortment of tuning forks within the 2000 cycle frequency range may be used to measure tones generated by receiver beats. Signals close to 2000 cycles are preferable for calibration purposes, however.

The calibration will hold as long as the battery voltage is maintained and the life expectancy of the battery is "shelf life" due to the low current drain and probable short use time. The battery condition can be determined by checking the frequency calibration of the meter or measuring battery voltage output under load.

Meter Use

The meter may remain connected across the receiver output at all times if its purpose is to check how close you are to the band edge. It will only read frequency when S_1 is depressed. Caution must be exercised when measuring the beat note; be sure you are measuring the correct beat. This would be the one on the h.f. side of the zero beat when the transmitter is to be set inside the low frequency end of the band. This is reversed, of course, when setting the carrier inside the high end of the band.

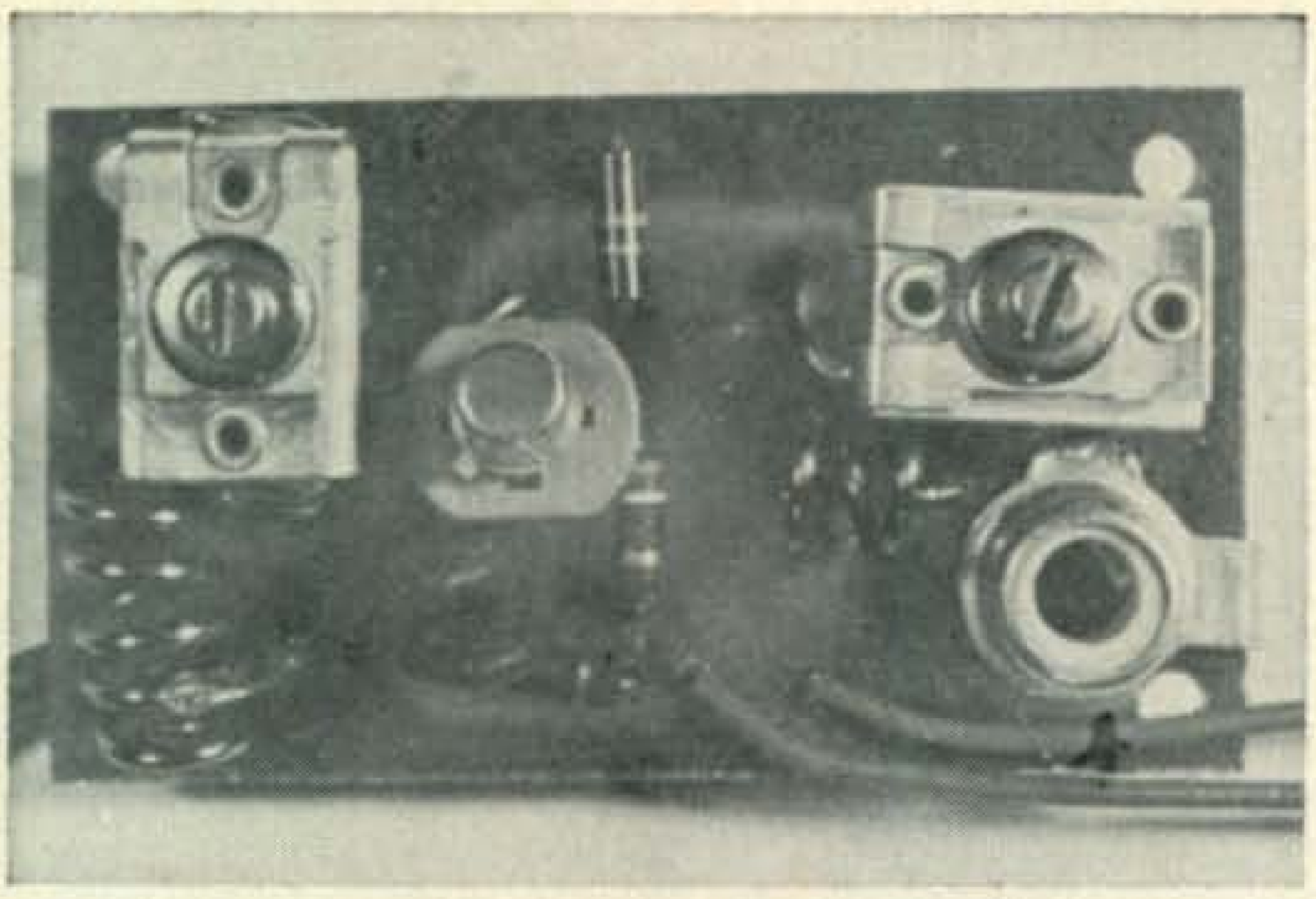
Keep in mind the fact that your frequency check cannot be any more accurate than the reference marker used. Unless the markers are accurately adjusted, considerable error might creep into the readings. I have found my 100 kc marker to be off as much as 40 to 50 cycles.

Modifications

For those who have other purposes in mind for this meter than I had, a maximum range of 2000 cycles may not be adequate, or it may even be too high. Changes in range may be accomplished by switching the values of C_1 and R_4, thus adding a new control, the range switch.

It is also possible to have a switch position on the range switch to check the battery condition.

Someone might suggest the use of a rectifier, filter and zener diode regulator to power the meter from the audio signal being measured. Well, why not? ■



View of the low noise two meter preamp. Tank circuit L_2-C_5 is on the left and the input tank, L_1-C_1, is on the right.

A LOW NOISE 2-METER PRE-AMP

BY M. D. RUBIN,* WA2STX

SINCE the introduction of the Nuvistor, the v.h.f. ham world has been turned upside down by the Nuvistor—417A controversy. While the proponents of each tube have stood firm in proclaiming their favorite as the ultimate in noise figure the vacuum tube itself is about to be eclipsed by the transistor.

Until now, almost everyone has built some gimmick or other using transistors but few hams seem to take them seriously. Transistors are electronic devices possessing their own special advantages. They will perform as well as tubes in most applications and in many applications will outperform tubes.

The following preamp is an excellent example of the capabilities of transistors. The transistor used in the preamp is a 2N3399 (made by Amperex). The device is of p.n.p. germanium mesa construction. Amperex rates the noise figure of the 2N3399 as 3 db at 100 mc and 7.5 db at 800 mc. I believe Amperex to be somewhat modest about this transistor's performance since I have *not* been able to find a tube preamp which outperforms the one described here.

The circuit draws a total of 1.8 ma from a 12 volt supply, about 1/16 the power a 6DS4 heater draws. The gain of the circuit tuned for best noise figure is 17 db and drops only 3 db (to 14 db) when the supply voltage is reduced to 4 volts. The noise figure of this preamp is better than any Nuvistor preamp I have been able to compare it with, and some of these nuvistor units have been tuned up with loving care. The transistor preamp was compared with the nuvistor preamps by measuring the amount of quieting a fixed input signal produced in a 146.94 mc f.m. receiver. The transistor preamp consistantly gave better quieting (hence had a better noise figure) than the Nuvistor preamps. If the transistor is beginning to sound too good to be real take a look at the price, \$2.55 or about 32 cents more than a 6CW4.[1]

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Circuit Description

The preamp was designed to be used with f.m. mobile gear on 146.94 mc but can be used in any 2 meter receiving set-up. The circuit is a common emitter amplifier which has been adapted to negative ground operation. The most striking feature of the circuit is the lack of neutralization. Amperex gives the feedback capacity of the 2N3399 as 0.18 mmf. At the impedance level that the circuit works, this feedback is negligible. After much experimenting with the input matching (both step-up and step-down) I found the transistor gave best noise figure when the base was driven from a 50 ohm source. Provisions have been made for tapping the input coil for the inevitable skeptic who has to adjust the "front end." A transistor socket allows transistors to be interchanged for comparison.

Construction

The preamplifier is built on a printed circuit card shown in fig. 2. Any of the usual methods for making printed circuit cards is acceptable. Jack J_1 is assembled on the card first. Remove the parts of the jack from its fiber board mount, solder the shield of the connector to the card first (after cutting off the inboard mounting arm). Place a plug into the jack before carefully soldering the center pin of the jack to the card. This will insure good alignment. Next install the jumper from the collector of Q_1 and C_5. Mount C_1 and C_5 by passing a wire through the lugs of the capacitors and then soldering both ends through the printed circuit. Mount

[1]As of January 1966.

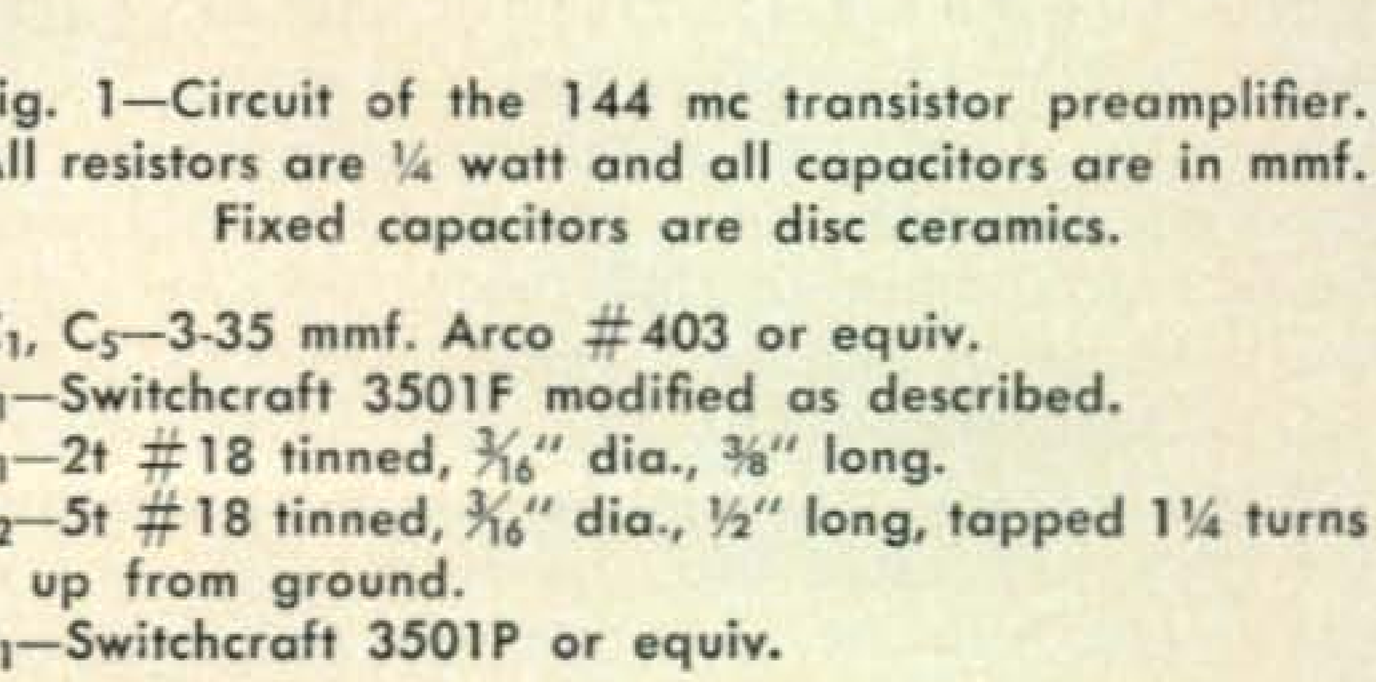
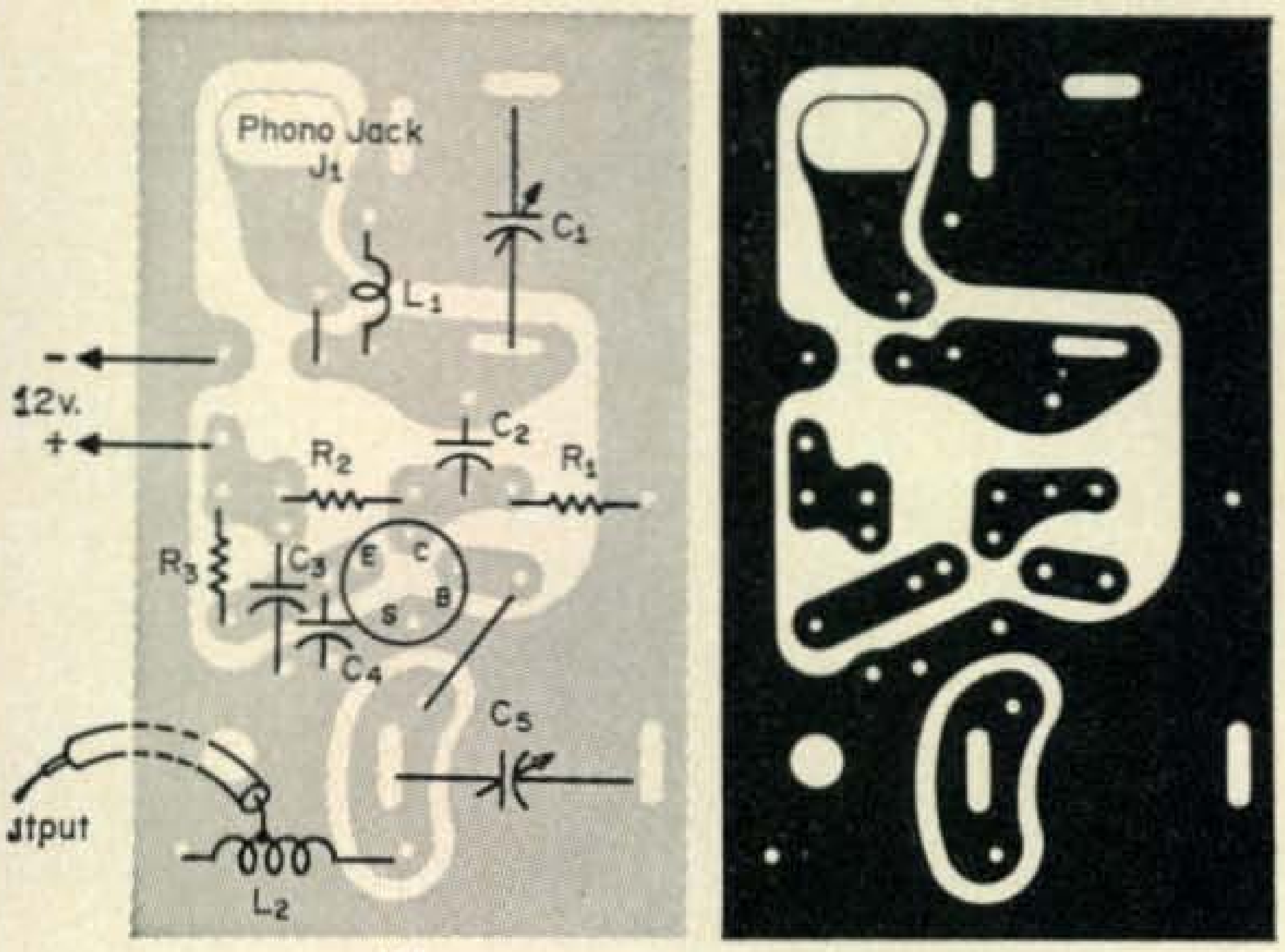


Fig. 1—Circuit of the 144 mc transistor preamplifier. All resistors are ¼ watt and all capacitors are in mmf. Fixed capacitors are disc ceramics.

C_1, C_5—3-35 mmf. Arco #403 or equiv.
J_1—Switchcraft 3501F modified as described.
L_1—2t #18 tinned, 3⁄16" dia., ⅜" long.
L_2—5t #18 tinned, 3⁄16" dia., ½" long, tapped 1¼ turns up from ground.
P_1—Switchcraft 3501P or equiv.



(A) (B)

Fig. 2—(A) Layout of parts shown on the foil side of printed circuit board. Components are inserted from opposite side. (B) Full size layout of circuit board, foil side. Drill lead holes at all white dots. Cut slots as shown for C_1 and C_5 lugs, and J_1 ground lug. Large holes are for J_1 (top oval) and output coax (bottom round.)

the rest of the parts as shown. The last step in the construction is to strip the outer covering of 6" of RG-174/U coax back about ½ inch from the braid and tin it. Pass the center conductor through the hole next to L_2 through the bottom of the card. Solder the braid to the ground and the center conductor to L_2, 1¼ turns from the cold end. Put P_1 on the end of the cable; this completes the construction.

Alignment

Insert the transistor into its socket. Be sure to get it in properly! Connect the preamp in front of the receiver it will be used with. Set C_1 and C_5 one turn from max. Apply 12 volts to the preamp. (Remember, negative ground.) Adjust C_5 first then C_1 to maximum gain. At this point C_1 and C_5 may now be adjusted for best noise figure by any of the usual methods. Capacitor C_1, of course, has the greatest effect on noise figure.

For those who want to adjust the input match, the jumper between the input jack and L_1 is removed. A piece of wire is soldered in the hole on the jack side of the trace. The other end may now be tapped any place on L_1.

Precautions

Transistors are highly reliable devices. There is no known degradation and, transistors, if not mistreated, will last longer than the gear they are used in. Transistors however are very easy to burn out. The various elements which compose a transistor are almost microscopic in size (especially v.h.f. receiving transistors). Whenever the device ratings are exceeded excessive heating occurs.

Because the transistor is so small critical temperatures are reached in a matter of milliseconds and damage to the device occurs. Two of the most hazardous mistakes are reversed

[*continued on page 106*]

A Clipper-Preamp For A. M.

BY GARY BLAKE JORDAN,* WB6MOC

The use of this clipper preamp with an a.m. transmitter can raise the average percentage of modulation to as high as 90% as compared to 40% without the unit. The clipper also limits audio bandpass to 500 to 2500 cycles.

Although s.s.b. is rapidly replacing a.m. as a major mode for amateur voice communications, a.m. remains a dominant force. Often the full benefits of a.m. are not realized; many amateurs acknowledge that s.s.b. is, technically and practically, a superior method of communicating without attempting to obtain the best possible benefits from "ancient modulation."

It is an established fact that a properly modulated s.s.b. signal enjoys a 9 db greater signal information power over a 100% modulated a.m. system with carrier (for signal radiated power in both systems). Nothing can be done to an a.m. system to overcome this inherent disadvantage; however, many a.m. transmitters used by amateurs are not 100% modulated more than a small percentage of the time during voice peaks. This factor leads to a further disparity between the two systems.

For years it has been recognized that the human voice characteristic contains many high amplitude voice peaks (more or less dependent upon the particular human voice) which can be omitted from the voice waveform with small loss in intelligibility. In an a.m. system, these voice peaks cause the transmitter to reach 100% modulation. However, the average value of the voice waveform is considerably below the peak value. A transmitter hitting 100% on peaks may be modulated only 40 to 60% on the average.

It has been shown[1] that clipping the voice waveform ahead of an s.s.b. system increases the peak-to-average value of the r.f. output. Obviously, a preclipper should not be used for s.s.b. For an a.m. system, however, if the peaks of the modulating waveform are clipped off, the ratio of average-to-peak amplitude at the modulator increases. This means, in essence, that the modulating gain can be increased. Where previously the unclipped waveform produced 100% modulation on peaks and average 40 to 60%, a preclipped modulator can be adjusted to hit 100% on peaks because the peak-to-average amplitude ratio of the input is lower; however, the average modulation can be made 80 to 90%.

With the preclipping amplifier shown here, the average modulation value for most transmitters will be nearly doubled. On the average, there will be twice as much energy in the information sidebands as before. Therefore, by using voice clipping, the same information channel signal strength increase is obtained as would be obtained by doubling the transmitter power.

Circuit

The semiconductor circuit shown here, although apparently simple, is carefully designed to perform two functions. First, it is a variable depth clipper which increases the average-to-peak ratio of the input by shunting the high voltage, low energy portions of the applied wave. Secondly, the circuit acts as a bandpass filter with considerable gain. The measured bandpass has its 3 db points at 500 and 2500 cycles, the voltage gain is about 20, and the result is spectacular.

At the input, a simple *LC* filter effectively removes any r.f. which might stray into the audio. The capacitor to ground also helps attenuate

*21018 Stagg Street, Canoga Park, California.

[1]Squires, W. K., Clegg, E. T., "Speech Clipping for Single Sideband," *QST*, July 1964, p. 11.

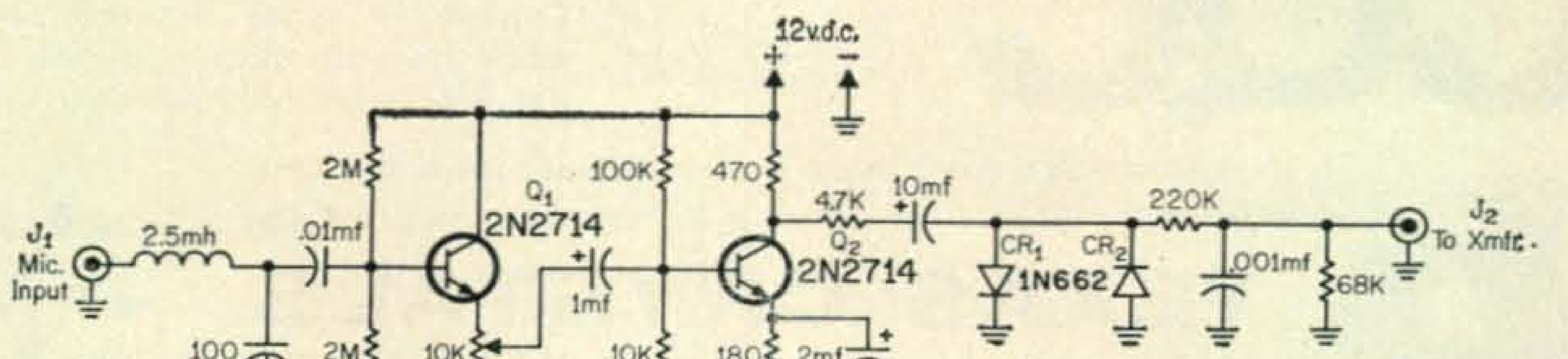


Fig. 1—Circuit of the clipper-preamp for use with an a.m. transmitter. Connectors J_1 and J_2 are selected to mate with the existing equipment. All capacitors greater than 0.01 mf are tantalum units rated at 15 volts. Capacitors .01 mf and smaller are disc ceramic. All resistors are ½ watt.

high audio frequencies at a 6 db/octave rate. Following the filter, the audio signal is lightly coupled (to remove low audio frequencies) to the base of a emitter follower. The input impedance here is fairly high, being approximately the value obtained by taking the parallel equivalent of the two base bias resistors in parallel with beta times 10K, the emitter resistor. The resultant 500K value matches the output impedance of crystal or dynamic microphones.

The first stage (although it has less than unity voltage gain) has an appreciable current gain which can be used to drive the second stage. The variable resistor in the emitter serves as a clipping depth control essentially by varying the current available to the second stage.

The input of the second stage is designed to more or less approximate the midrange output impedance of the first stage for maximum power transfer (this is not absolutely essential). The emitter bypass capacitor, base input capacitor, and the output coupling capacitor are chosen so that, when operated in conjunction with other circuit components, there is a theoretical 18 db/octave rolloff beginning at 500 c.p.s. This rolloff further attenuates the low and unproductive audio frequencies. The measured value is very close to this theoretical value.

The second stage operates as a high-gain (measured value $\geqq 20\times$) voltage amplifier. The output is fed through a resistor whose value is high compared to the collector resistance so that maximum available voltage swing can be approached. About 90% of the voltage that would be developed with the collector unloaded will be seen even if the output resistor from the collector is grounded. In effect, this is what happens, because any voltage over 0.5 volts causes the back-to-back diode pair to conduct. Hence, the voltage waveform at Q_2 is clipped when it reaches D_1-D_2.

Because the waveform is effectively clipped at 0.5 volts by D_1-D_2, a peak amplitude clipper with bandpass limiting is obtained. The depth of clipping of the speech waveform is controlled by the variable emitter resistor. Because the clipped waveform will have considerable high-frequency distortion, it is filtered once again by an *RC* network at the output to remove most of the spurious responses (with a calculated rolloff of 4 db at 2500 cycles).

Construction

The circuit should be built in a completely shielded enclosure, such as a Minibox, to keep all r.f. out of the high-gain circuitry. Because power levels are low (as is the frequency), no precautions are necessary in layout, except to employ standard shielding processes. A two-inch cube could easily contain all the components. Input and output connectors to match individual equipment should be used.

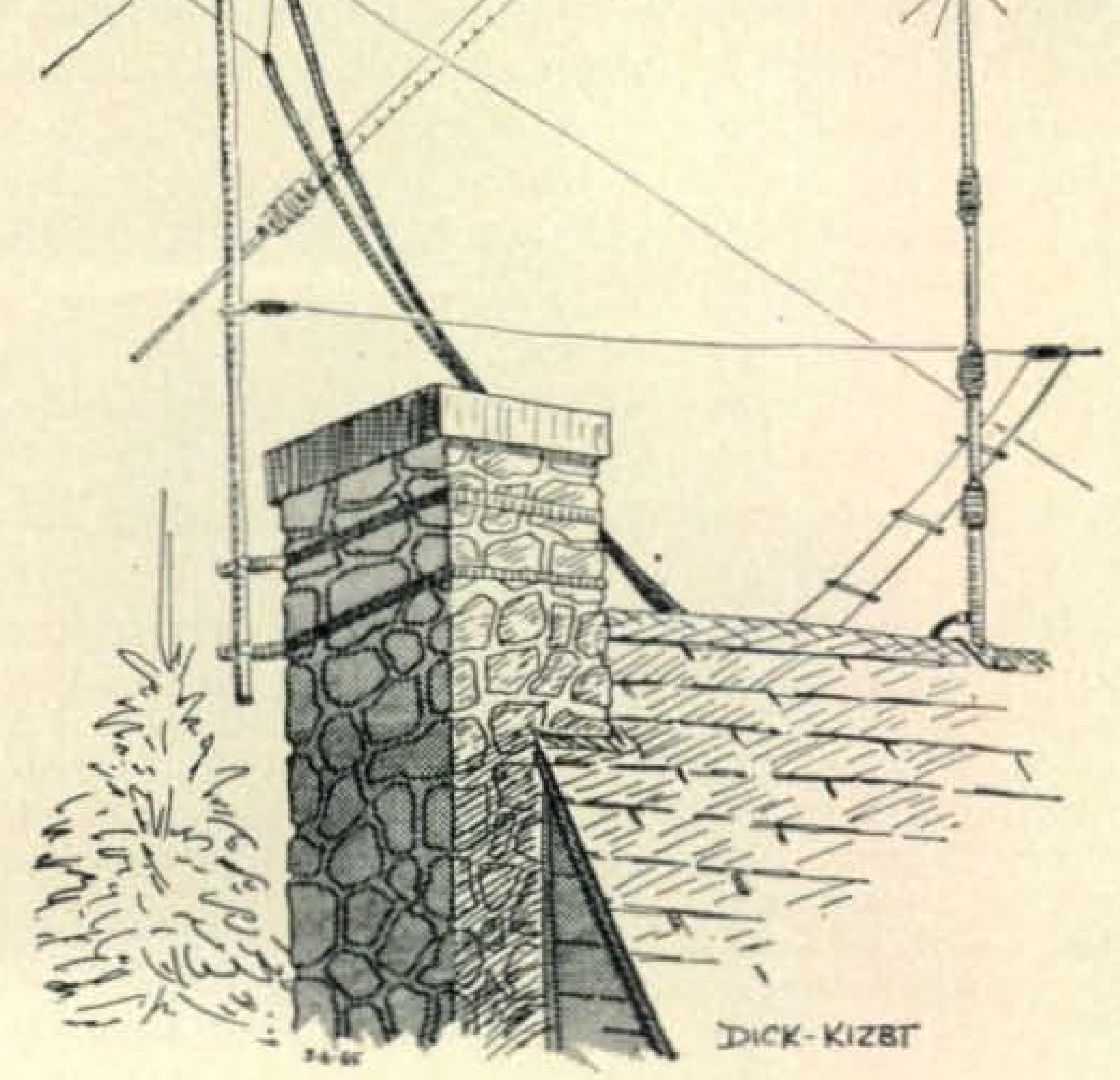
Use

In transistor circuits, especially high-gain audio such as this, it is imperative that a well-filtered and regulated B plus supply be used. If a power supply other than a battery is used, the builder may want to include a 100 ohm resistor between the supply and the clipper and include a large filter capacity from B plus to ground.

To operate, simply connect the unit between the microphone and transmitter. Set the clipping depth control to maximum gain, and while talking into the microphone, adjust the transmitter audio gain control to give 100% modulation. Then back off the clipper gain control to the point where an on-the-air or scope check shows less than 10% distortion. Then simply forget both controls.

Do not attempt to run the transmitter gain control over the 100% modulation point. Once set, simply leave that control alone and adjust all audio gain with the clipper control. You will notice that past a certain point, the transmitter audio peaks will stay at the same value, but the average energy contained in the wave will increase tremendously. Too much clipping, however, will reduce intelligibility, so don't use more than 10 to 15 db. Measuring clipping depth is covered adequately in the amateur handbooks.

Several models of this clipper have been used at various stations (W3AEX, KIFPM) with encouraging results. On-the-air checks confirm what laboratory analysis has proven. Taking the clipper out and modulating at 100% on peaks gives a mediocre RST. With the clipper in, the transmitted signal which previously averaged 50 to 60% modulated now averages 90%, and although S remains the same, the R in RST at least doubles. QSO's which were in the mud at the other end suddenly were R-5 when the clipper was switched in. Consequently, it has been left permanently connected here at W3AEX and no a.m. takes place without it. This is probably the best recommendation that can be given. ■



Noisemanship

Understanding Receiver Sensitivity Specifications

BY WILL HERZOG, K2AHB

This dissertation is intended to help the reader understand sensitivity specifications, or at least enable him to detect how engineers sometimes arrive at desired numbers in the event of weak designs. There is little new information contained herein; but most of these fundamentals have frequently been overlooked by people who should knew better. Some receiver designers seem to belong to a mystic clan that develops new methods as soon as the old ones become acceptably specified. Here the "standards" used for compatible a.m.[1] are reasonable extensions of accepted conventional a.m. definitions, and are used by Collins Radio Company.

How Much Sensitivity?

For practical h.f. communications use, the ambient atmospheric noise is strong enough so that most often it is the actual limiting factor, not the noise figure of the receiver. This is especially true below 13 mc. The ambient atmospheric noise is least in arctic zones, at daytime, and during winter. Conversely, the highest ambient noises are found in the tropics, during summer nights. There is considerable atmospheric noise data in the CCIR Reports[2], given in terms of db above thermal noise.

From examination of the CCIR Reports, one can deduce that a 10 db noise figure implies sufficient sensitivity to allow adequate reception over the 2-30 mc range anywhere in the world 99.9% of the time. For 50 ohm antennas with a 4 kc bandwidth, this corresponds to an s.s.b. or c.w. sensitivity of 0.54 microvolts. This usable sensitivity number must be reduced to make up for antenna and antenna coupler losses in estimating how much sensitivity can be used in practice. The rule of thumb, replacing your antenna with a resistive dummy antenna to see if there's a change in output, is still useful.

The overall reception noise figure $= 10 \log (F_a - 1 + F_e F_k F_r)$ where:

F_a = atmospheric noise factor. (From the CCIR averages).

F_r = receiver noise factor.

F_e = transmission line-loss (expressed as an attenuation ratio, not db).

F_k = antenna overall efficiency (including directivity).

When the operating frequency is above the critical frequency,[3] one has predominantly galactic (and local man-made) noise. When the operating frequency is below the critical frequency, there is mainly atmospheric noise; the galactic noise is effectively shielded out by the F_2 layer. It all comes to this; below 30 mc 0.54 microvolts or 10 db is good enough if your receiver is matched to the antenna. Above 30 mc the galactic and man made noise are the only criteria setting the usable sensiivity.

Why Hard Microvolts?

Sensitivity cannot be specified meaningfully in terms of an input voltage to the receiver terminals unless the impedance is also specified.[4] Both are necessary to get a real evaluation of the input power required. Actually, this is not useful in practice because receiver input impedances vary quite wildly. Ranges of 5 to 400 ohms for a 50 ohm receiver, are not unusual extremes. Therefore, an honest sensitivity specification uses "hard" microvolts by convention.

In a Thevenin equivalent circuit, fig. 1, the generator output, E_g, is the hard microvolt. The source impedance, Z_o, is set equal to the specified nominal input impedance, Z_{IN}. Therefore the maximum available input power is that computed by considering that the voltage into the receiver antenna terminal is actually one half the hard microvolts specified, developed across the nominal input impedance. That is, a "hard" microvolt is defined as the open circuit voltage from a Z ohm signal generator, where Z is the nominal specified input impedance of the receiver.

Thus, the actual input voltage to the receiver is 6 db (one half) less than the hard microvolts used when talking of sensitivity, if the receiver's input impedance, Z_o, is on the nose. If it's high or low, the receiver's sensitivity is properly penalized, as it would be in practice. So don't ever again even think of a soft microvolt; use the hard microvolt; it's 6 db worse sounding to the uninitiated, but it's honest.

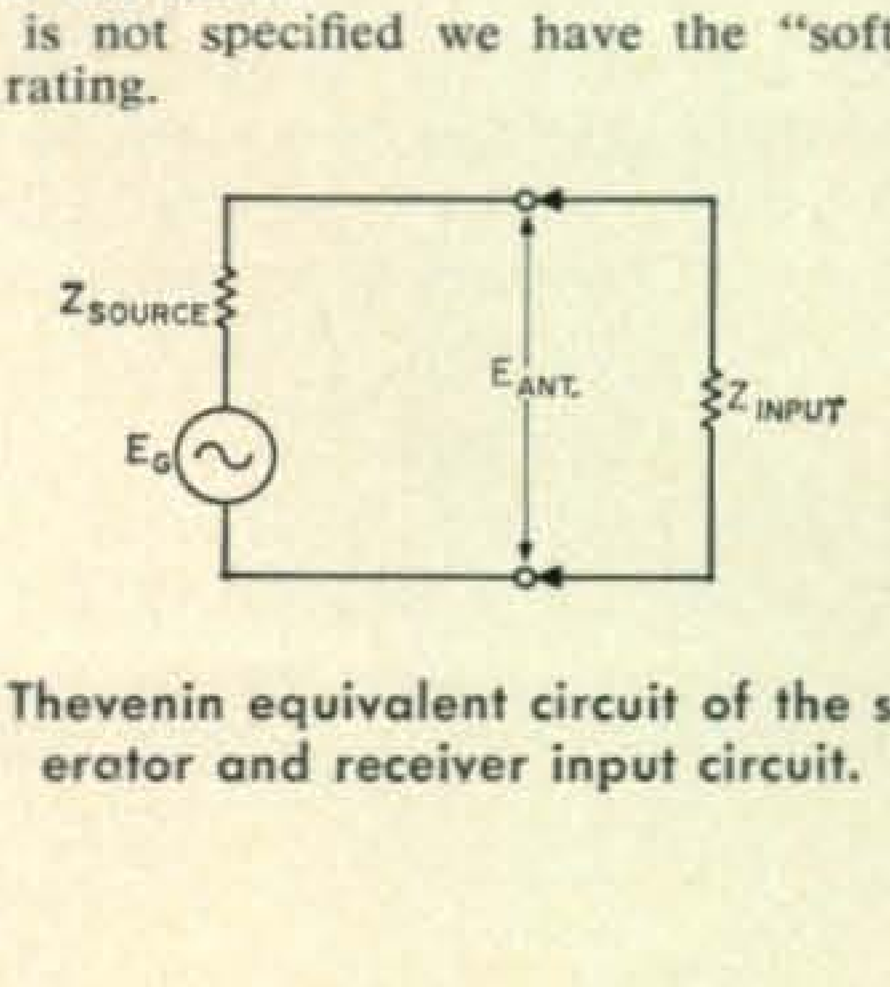


Fig. 1—A Thevenin equivalent circuit of the signal generator and receiver input circuit.

[1]CAM is a single sideband signal but with the carrier transmitted equal in strength to the peak envelope power of the sideband, so it may be received on conventional envelope detectors.

[2]The CCIR Reports are French alliterations for the International Radio Consultative Committee.

[3]The critical frequency is that frequency which just penetrates the F_2 layer of the ionosphere, rather than reflecting back to the earth.

[4]When Z_0 is not specified we have the "soft" or easy microvolt rating.

Why The Dummy Antenna?

In practice a dummy antenna is required to ensure that the signal generator's output calibration may be counted upon, since their meters only indicate the output voltage correctly when they are terminated in a specified load, usually 50 ohms. Their actual output impedance can range typically from 5 ohms to 100 ohms but their attenuator's calibration is accurate as long as the generator sees a 50 ohm load. To ensure this 50 ohms, we take a loss, usually 20 db (in addition to the 6 db loss we take by using hard microvolts).

A typical dummy antenna is a 26 db T pad consisting of two 47 ohm series resistors and a 5 ohm shunt resistor. See fig. 2. The coax to the receiver is kept as short as practical so s.w.r. won't fool you. (Remember that receiver probably is *not* 50 ohms.) When using this pad, the signal generator's output reading is divided by 10 (to allow for that 20 db loss) to read hard microvolts directly. Of course, other dummy antennas may be used if it is known that the receiver is to be used with a specific antenna-feed system rather than a 50 ohm coaxial feeder. These might be balanced lines, auto-whip antennas, *etc.* But the principle of using a dummy antenna to produce a known maximum available power, remains.

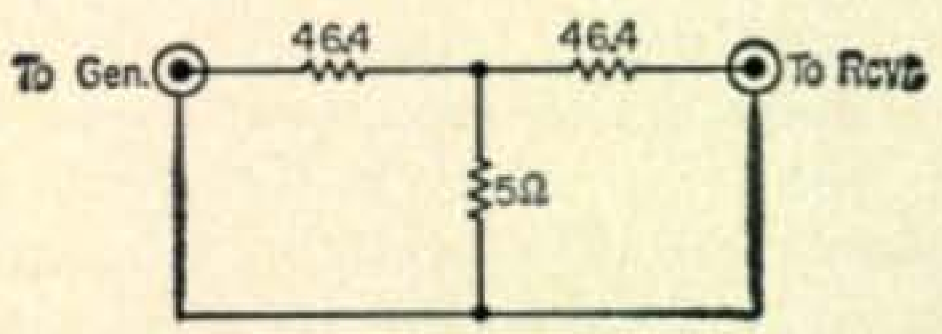


Fig. 2—Circuit showing a 26 db T-pad used as a dummy antenna.

S.S.B. Sensitivity Defined

S.s.b. sensitivity is defined and measured the same way as c.w. sensitivity, and is simply the hard microvolts required from an unmodulated signal generator (with dummy antenna) to produce a 10 db signal-plus-noise to noise ratio out of the receiver. This is measured by detuning the signal generator, or turning its output down if it is well shielded, (or even substituting a 50 ohm resistor across the receiver) to get a reference noise output, and then increasing the input carrier usually at a 1 kc beat frequency) to read a 10 db rise in output.

Strictly, a true r.m.s. meter (such as a Ballantine 300) must be used. If a v.o.m. (such as Triplet 620 or Hewlett Packard 400D) or other average detecting, r.m.s. calibrated meter is used, it will rise 11 db for the same input signal. You are prevaricating if you use an average reading meter without going for an 11 db rise, instead of 10 db.

A peak-detecting type of meter is practically useless for sensitivity work. It won't even lie reliably because the peak of a noise signal is hard to define because it's infinity in theory. If you must use a peak value for noise, consider it 4 or 5 times the average. Most people consider it fair play to "shop around" for the actual generator frequency and audio beat note used. The passband shape is considered as a separate specification item.

A.M. Sensitivity Defined

Just as s.s.b. or c.w. is a carrier-on-to-carrier-off measurement, a.m. is a modulation-on to modulation-off measurement. The "noise" measurement is taken with an unmodulated carrier input. The signal-plus-noise measurement is taken by switching on the signal generator's modulation. Thirty percent modulation (at 1 kc) is used to approximate the nominal output level that an equal "carriered" voice signal would have, and to facilitate signal generator modulation design. Again, generator carrier and modulation frequencies may legitimately be adjusted for best answers.

A compatible a.m. receiver, that is, reception of s.s.b. with carrier reinserted at the transmitter, does not pass the "undesired sideband." So for testing purposes, conventional d.s.b.-a.m. signal generators are set to 60% modulation to achieve the equivalent sensitivity measurement. (Notice that such a c.a.m. receiver has ½ the audio output voltage, (¼ the power) as a conventional d.s.b.-a.m. receiver when listening to a conventional d.s.b.-a.m. signal.[5])

Since even the better signal generators (HP 606) have enough f.m. or p.m. to cause the sidebands to be *quite* unequal (even though their trace on a scope and measured distortion are impeccable), it is better to set the carrier to the middle of the passband, and use a modulation frequency low enough so that both sidebands are received. This also allows the conventional a.m. definition, 30% modulation, to be used.

S.S.B. and A.M. Sensitivities

In some "ideal comparison" of sensitivities in an s.s.b.-a.m. receiver, the ratio of a.m. to s.s.b. sensitivity would be constant and equal for measurements in either mode. But due to the accepted terminology, (and the innate superiority of s.s.b., if you'll let my bias show) the a.m.'s effective signal is only 30% of the carrier value (for 30% modulation) so the ratio would be 3.3. Several effects act to further change this ratio, mostly upward. One is the difference in detector operation; an s.s.b. "linear-product" detector does not degrade the signal-to-noise ratio, while an a.m. linear envelope or square-law-envelope detector does, for signal to noise ratios below 3 or so. For 10 db ratios, this is a negligible effect.

The peaks and valleys in the selectivity curve of the receiver will either help or hurt apparent sensitivity, depending upon their location with respect to the sidebands and carrier. The noise bandwidths may be different for different modes. Therefore, great care in defining terms must be used when comparing quoted sensitivities. ■

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[5]Another difference between c.a.m. and d.s.b.-a.m. is in the use of a square law detector. For d.s.b.-a.m. it has more distortion than a linear-envelope detector. But for c.a.m. this distortion cancels out the inherent c.a.m. distortion, to give less overall distortion. Since many a.m. detectors are add-on-diodes to s.s.b. product detectors, they run at low levels, which give "squarish" operation "free."

Practical Tips on Operating Abroad

BY CHARLES J. SCHAUERS,* W6QLV

CQ's "man in the Alps" gives some useful suggestions to American amateurs who will be lucky enough to vacation in Europe this summer. Other globe-trotters take note, too.

Now that it is possible for U.S. radio amateurs to operate in other countries because bi-lateral reciprocal operations agreements have been concluded between them and the U.S., some advice to those U.S. hams now operating or who contemplate operating in foreign countries should be of interest.

The advice given here is based primarily on conversations held with foreign hams as well as some officials; and it would be well for those foreign hams operating in the United States to remember that the points made are quite universal in application.

Above all, U.S. hams should not forget that they are truly "extraordinary ambassadors" when in other countries whether they are residents or merely on a short visit. It has been said that actions speak louder than words, but for the ham because he uses the airwaves his words cannot only be heard in his home country but abroad as well—he is judged more by what he says than how he acts.

Plan Ahead

First of all, when contemplated hamming abroad, follow standard licensing or permit procedure in obtaining permission to operate. You can obtain full information on how to file your application in a specific country with which the U.S. has a reciprocal agreement by writing to the American Embassy in *that* country. Plan far enough in advance so that you will have received your license prior to your departure; the possession of a paper permit will make it easier for you to pass through customs with your equipment.

Remember that you may be required to post a bond for your equipment in some countries. Do not fail to declare your equipment or you may have it taken away from you, especially if you don't have an operating permit.

If you plan to operate from a hotel make certain that you have the manager's permission—in writing if possible. Do not operate your station in unauthorized locations. This means sticking to the letter of your permit. If you intend moving around within a country, make certain that the licensing authorities have been notified (if they permit this sort of operation).

Before installing your station (especially in a hotel) make certain that sufficient power is available and also that the lines feeding your electric outlets *are* fused. You certainly do not wish to be liable for an entire hotel or other building in case you are to blame for a fire!

"Do's" and "Don'ts"

Here are some more "Do's" and "Don'ts" that should be considered.

Don't use more power than authorized for transmissions; **don't** forget to keep your log properly; **don't** communicate with unauthorized stations; **don't** fail to clear up TVI when reported; **don't** turn down calls for assistance from local hams; **don't** operate off frequency; **don't** discuss your host country or its people unless what you have to say is favorable—remember you are a guest; **don't** pass unauthorized third person traffic or attempt phone patches if these are forbidden; **don't** allow a local national who has no license to operate your station; **don't** give your host country any reason to "call you on the carpet" for anything connected with your ham activities; **don't** neglect to advise U.S. hams abroad (if you are a U.S. ham) when they are unknowingly breaking operating regulations or giving U.S. hams a "general black-eye." Also, *do not* sell your equipment to local hams if this is not permitted by customs regulations or without checking with customs. Finally, keep your religious and political views and views on other controversial subjects to yourself—do not discuss them on the air.

Do join the local radio club if you are a semi-permanent resident and the national ham radio society—this is good for you and for them; **do** offer to help local hams with their technical problems; make your U.S. ham magazines, call and handbooks available to hams in your area; **do** obtain permission from your landlord to install antennas; **do** make your station and logs open for inspection at anytime; **do** report suspicious activities on the bands if they are continuous—but do *not* try to assume the role of "official monitor" or "investigator;" **do** try to learn enough of the local (national) language so

[*continued on page 106*]

*4 Lutzelmatte Strasse, Luzern, Switzerland.

50 Watts on 50 mc S.S.B.

BY CHARLES W. COPP,* W2ZSD

THIS project was undertaken to get the author on six meters s.s.b. and c.w. with a transmitter that had many of the operating features and conveniences of the commercially available s.s.b. exciters.

Block Diagram

Figure 1 shows a block diagram of the transmitter that finally evolved. It is of the crystal filter type with the capability of upper and lower sideband operation or c.w. It contains a v.f.o., vox and anti-trip circuits, solid state voltage rectification and an electronically regulated low voltage power supply.

The 6146 final has an input of 70 watts p.e.p. and uses a pi-network in the plate circuit for good harmonic reduction and matching to a 50 ohm load. A spotting control allows exact zero beating of a received signal without causing QRM. A spot level control allows the level of the spot signal to be varied but not to cause the final to draw more than a few ma.

Vox delay, for various vox hold times, is adjustable from the front panel, as are all operating controls. Receiver muting bias is provided automatically during transmitting for receiver quieting, and can also be used to drive additional circuitry if automatic antenna relay switching is desired.

Referring to fig. 1, the single sideband signal is generated at 9 mc using a self excited 7360 balanced modulator and a 9 mc crystal filter. Following the crystal filter, is a 35.8 mc crystal controlled local oscillator and mixer with its output at 44.8 mc. The next mixer combines the 44.8 mc s.s.b. signal with a 5.2 mc v.f.o. signal for an output at 50 mc. At this point, the signal level is low and must be amplified by the 6CL6 voltage amplifier before proceeding to the 6146 output stage. A 12AX7 and 12AU7 are used as the audio and vox voltage amplifiers while a 6BV8 and a 12AT7 complete the vox circuitry and provide for anti-trip and relay control.

The power supply provides 600 volts d.c. for the 6146, 150 volts d.c., and 200 volts d.c. from a solid state bridge rectifier module.

The 200 volts d.c. is obtained from an electronically regulated power supply consisting of a 6AS7, 6AG5 and 0B2. This provides a stiff 200 volt source for the 6146 screen and makes the v.f.o. and crystal oscillators immune to changes in B plus due to fluctuating line voltage. A bias supply is provided to take care of all negative voltage requirements within the transmitter and provides receiver muting bias.

S.S.B. Generator

The s.s.b. generator consists of a self-excited balanced modulator using a 7360 beam deflection tube. The 7360 generates a double sideband signal with the carrier suppressed. A McCoy 9 mc crystal filter removes the unwanted sideband so that the output of L_2 is an s.s.b. signal centered at 9 mc. Sideband selection is accomplished by using the two crystals supplied with the filter. When the 9.0015 mc crystal is switched into the oscillator circuit by S_{1a}, the lower sideband is generated. The 8.9985 mc crystal generates the upper sideband signal. For c.w. operation, switch S_{1b} places a 3-13 mmf trimmer across Y_2. This

Front view of the s.s.b.-c.w. transmitter. The controls in the left group are, top row l. to r.; SPOT LEVEL, VOX DELAY, ANTI-TRIP GAIN, VOX GAIN. Bottom row; MODE, CARRIER BALANCE, MIKE INPUT, A.F.GAIN. The lower center control is V.F.O. TUNING. Grouped around the meter are TUNE, LOAD and METER FUNCTION. The FUNCTION control is in the bottom row between the key jack and the ON-OFF indicator.

*337 Jamaica Boulevard, Carle Place, New York.

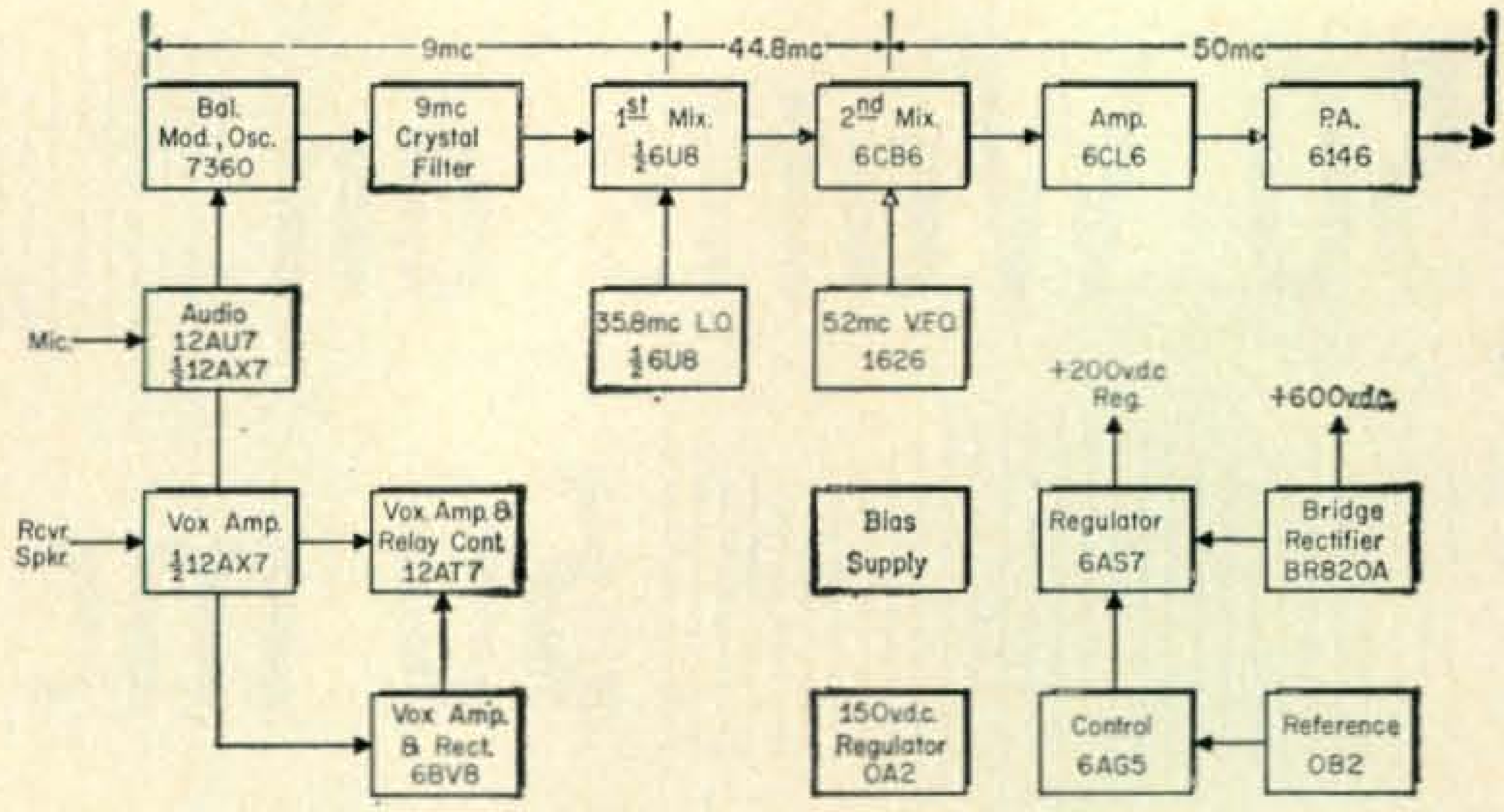


Fig. 1—Block diagram of the 50 mc s.s.b.-c.w. transmitter.

lowers the frequency of the 9.0015 mc crystal so that it operates closer to the center of the crystal filter response.

At the same time, switch S_{1c} connects one deflection plate of the 7360 to ground through a 100K resistor. This unbalances the modulator and supplies the r.f. signal needed for c.w. operation.

Switch S_{1d} places −25 volts on the grid of the second audio tube V_{6b}, thereby biasing it beyond cut-off so that no audio will appear on the c.w. signal.

Transformers L_1 and L_2 are modified 10.7 mc i.f. units. They are modified by opening the cans and disconnecting the secondary wire from terminal 3 (see fig. 4). A 68 mmf mica capacitor is now connected between terminal 3 and the lead that has been removed from terminal 3. If the capacitor leads are kept short and dressed neatly, the capacitor will act as a rigid support for the secondary lead. To complete the modification, a 330 mmf mica capacitor is placed between terminals 3 and 4.

Frequency Conversion

Frequency conversion takes place in two steps. The first combines the 9 mc signal with a 35.8 mc crystal controlled local oscillator (V_{2B}) in the pentode section (V_{2A}) of a 6U8, with its plate tuned to 44.8 mc. It is important at this point to have a high Q coil (L_3) and have as much isolation between L_3 and L_5 as possible. If these precautions are not heeded, the 35.8 mc signal may appear in the 6U8 pentode output. A careful check with a grid-dip oscillator should indicate if any 35.8 mc is present at L_3.

The second frequency conversion takes place in the 6CB6 (V_3) mixer. Here the 44.8 mc s.s.b. signal is combined with the 5.2 mc v.f.o. signal. The plate coil (L_4) of V_3 is tuned to 50 mc. Inductor L_4 should have its axis perpendicular to the axis of L_6; this will minimize the chances of oscillation in V_4. However, a shield should also be placed across the base of the 6CL6 (V_4).

V.F.O.

In this transmitter the complete v.f.o. section was removed from the BC-458 and the mounting dimensions carefully measured. If the measurements are transferred directly to the new chassis no difficulty should be experienced in the layout or operation of the v.f.o. The 1626 (V_5) is a tube with very stable characteristics and this v.f.o. will give a rock-steady s.s.b. signal on 50 mc.

Final

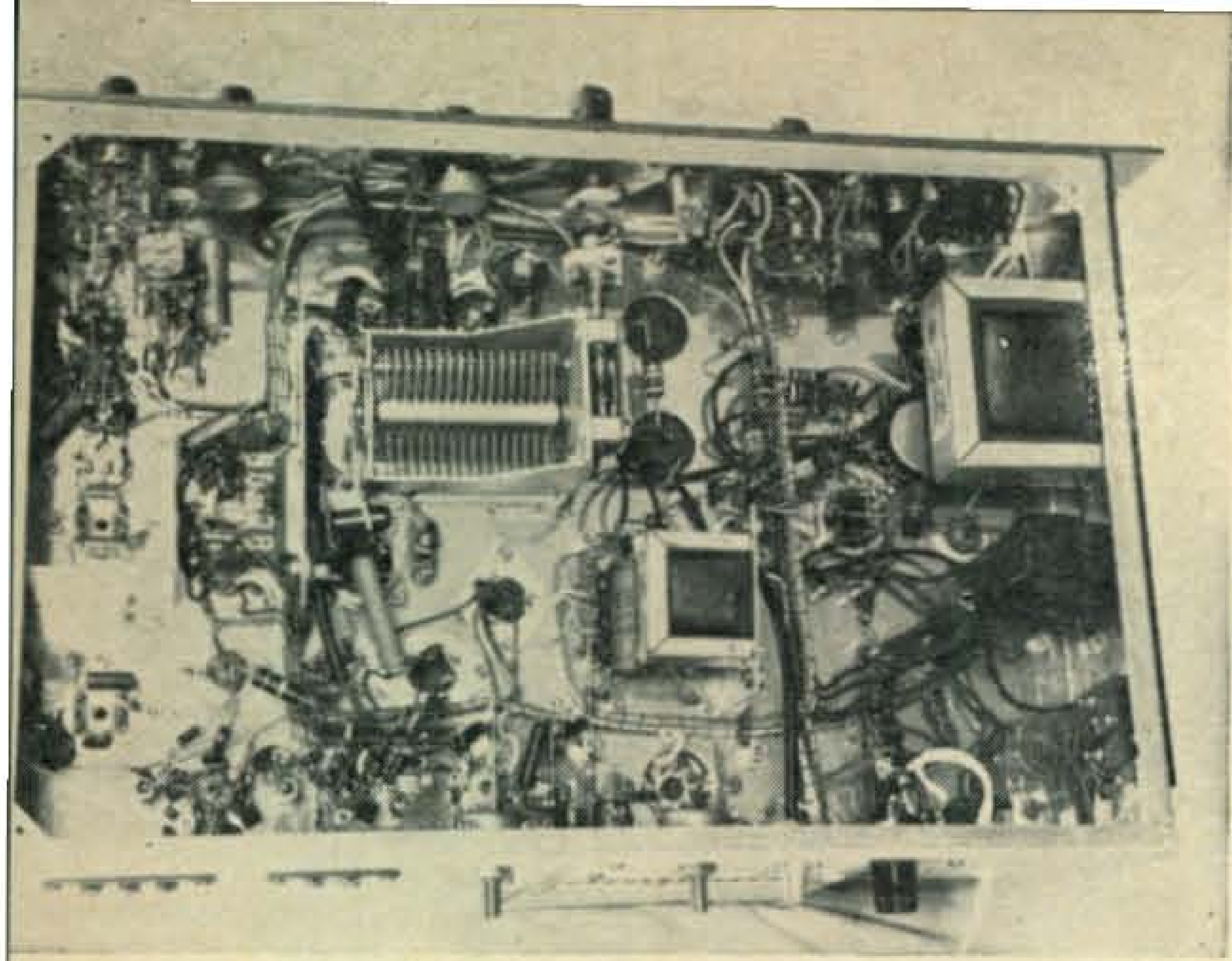
The final consists of a neutralized 6146 (V_{10}) operating in Class AB¹. Approximately 600 volts is supplied to the plate and a well regulated 200 volts is supplied to the screen grid. A bias supply gives a voltage for the grid that can be adjusted for approximately 15 ma of plate current.

A 3 mmf capacitor couples some of the voltage to a 1N34 detector. The d.c. voltage from the detector is read on meter M_1 when it is switched to OUTPUT by S_3. This allows the operator to null out his carrier without any additional equipment. When a good null is reached, S_4 is depressed. This increases the meter sensitivity and allows for a more exact null. Switch S_3 also allows meter M_1 to be switched to measure final plate and grid currents. Since no grid current should flow in Class AB¹ operation, meter M_1 can be used to indicate overdrive when switched to read grid current.

Audio And Vox

The audio amplifier consists of an rc coupled amplifier using a 12AU7 (V_6) and one half of a 12AX7 (V_{7A}). Values for the coupling capacitors and load resistors were chosen to limit the frequency response to between approximately 300 and 3000 c.p.s. An audio gain control allows the operator to vary the audio voltage reaching the balanced modulator.

The vox circuit shares its first two stages with the audio section (V_{6A} and V_{7A}). Following V_{7A} is a vox gain control and voltage amplifier using the triode section of the 6BV8 (V_{9A}). The output of V_{9A} is capacitive coupled to the plate of one of the 6BV8 (V_{9C}) diode sections. Tube V_{9C} rectifies the audio signal and provides a positive voltage to the grid of the relay control tube 12AT7 (V_{8B}). This positive voltage causes V_{8B} to conduct, actuating relay K_1, turning on the transmitter. The combination of a 0.2 mf capacitor, 820K resistor and the 7.5 meg potentiometer in the diode cathode circuit of V_{9C} provide the vox delay. This control allows an adjust-



Bottom view of the 6 meter transmitter. The v.f.o. tuning capacitor may be seen in the center of the chassis.

ment of the vox hold-in time. The delay time is adjustable from almost zero to three seconds.

The vox anti-trip uses half of a 12AX7 (V_{7B}) and half of a 12AT7 (V_{8A}) as voltage amplifiers. The receiver loudspeaker is connected across the ANTI-TRIP GAIN CONTROL. When a signal is being received, the voltage across the loudspeaker voice coil is amplified and applied to the second diode of 6BV8 (V_{9B}). This diode is connected so that when an audio signal is present, a negative voltage is obtained from the rectified audio. By placing this negative voltage upon the plate of V_{9C}, it is possible to back bias the vox diode so that any vox voltage generated by the loudspeaker audio reaching the microphone will not trip the transmitter on.

The anti-trip gain control is adjusted by first turning it fully counterclockwise and allowing the receiver audio to trip the transmitter. The ANTI-TRIP GAIN is then increased until the receiver no longer trips the transmitter. One set of contacts on relay K_1 shorts out the loudspeaker during transmission to insure complete receiver quieting.

Power Supply

Power for the transmitter is obtained from a surplus TV power transformer. These transformers provide excellent sources of power for low-powered amateur transmitters. The solid state rectifier module used in this transmitter is manufactured by Diodes Inc.[1] It is rated at 1400 volts r.m.s. input, and will carry 1500 ma if kept below 50 degrees C. The complete bridge is an epoxy package, 1⅜ × 1⅜ inches with a machined mounting surface for good heat sinking. However, during operation of the transmitter, no heating of the rectifier module was noticed. One word of caution when using solid state rectifiers; they don't stand up under short circuits, so be very careful when testing with the power on. With care, they will last indefinitely.

The bridge rectifier supplies approximately 600 volts d.c. to the 6146. If a transformer with at least 700 v.c.t. is used, no trouble should be experienced in obtaining the 600 volts under full load. A choke input filter using a swinging choke, provides better regulation of the 600 volts than would otherwise be obtained from a smoothing choke.

B+ voltage is taken from the center tap of T_1. This voltage will be about half the voltage output of the bridge. In this power supply, the voltage is +290 volts under load. If this voltage is used unregulated, it will fluctuate with variations in the load on the bridge rectifier. In the case of the 6146, plate current varies from 15 ma to 115 ma. The changes in the +290 volts with such a load variation can not be tolerated if a stable signal is desired. The only solution lies in a voltage regulator. Because v.r. tubes can only regulate 40 ma and the transmitter needs approximately 80 ma at 200 volts, an electronically regulated circuit is used.

In this transmitter, it was decided to supply all low B+ voltage at 200 volts. This value was arrived at when the 6146 tube was chosen for the final, since in Class AB^1 with 600 volts on the plate, the 6146 screen wants a stiff 200 volts supply. A 6AS7 (V_{11}) was picked for the regulator because it operates with a 90 volts plate voltage (+290 volts from the center tap minus the +200 volts Output) and was readily available. A 6AG5 (V_{12}) control tube is used to sense variations in the output voltage and compare it with the voltage across the 0B2 (V_{13}). These variations are amplified by the 6AG5 and control the bias of the 6AS7 in such a way that any

[1]Diodes, Inc., 9261 Independence Ave., Chatsworth, Cal.

Fig. 2—Circuit diagram of the 50 mc s.s.b.-c.w. transmitter. All capacitors one or greater in value are in mmf. Capacitors less than one are in mf unless otherwise noted. All resistors are ½ watt unless otherwise noted. The power supply, an integral part of the transmitter is shown in fig. 3 for simplicity.

C_1, C_2, C_3, C_4—All obtained from the oscillator circuit of the BC-458 as explained in the text.

C_5—15 mmf. Hammarlund MAC-15 or equiv.

C_6—20-20 mmf differential capacitor, Hammarlund MAC-20-20 or equiv.

C_7—15 mmf, Hammarlund APC-15 or equiv.

C_8—35 mmf, Hammarlund HF-35 or equiv.

C_9—100 mmf, Hammarlund HF-100 or equiv.

K_1—8K, d.p.d.t. relay.

L_1, L_2—10.7 mc i.f. transformers modified as explained in the text. Miller #1463 or equiv.

L_3—7 t #24 e. closewound on ¼" slug tuned form.

L_4—4 t, ½" dia., 16 t.p.i. Air-Dux T-416.

L_5—7 t #16 e. closewound on ¼" slug tuned form.

L_6—4½ t, ½" dia. 8 t.p.i., Air-Dux T-408.

L_7—4 t, ¾" dia. 8 t.p.i., Air-Dux T-608.

L_8—Obtained from BC-458 as explained in text.

PC_1—5 t #20 e. wound on a 100 ohm 1 watt carbon resistor.

Y_1, Y_2—8.9985 mc and 9.0015 mc crystals supplied with Z_1.

Y_3—35.8 mc crystal.

Z_1—Mc Coy 9 mc filter, Silver Sentinal.

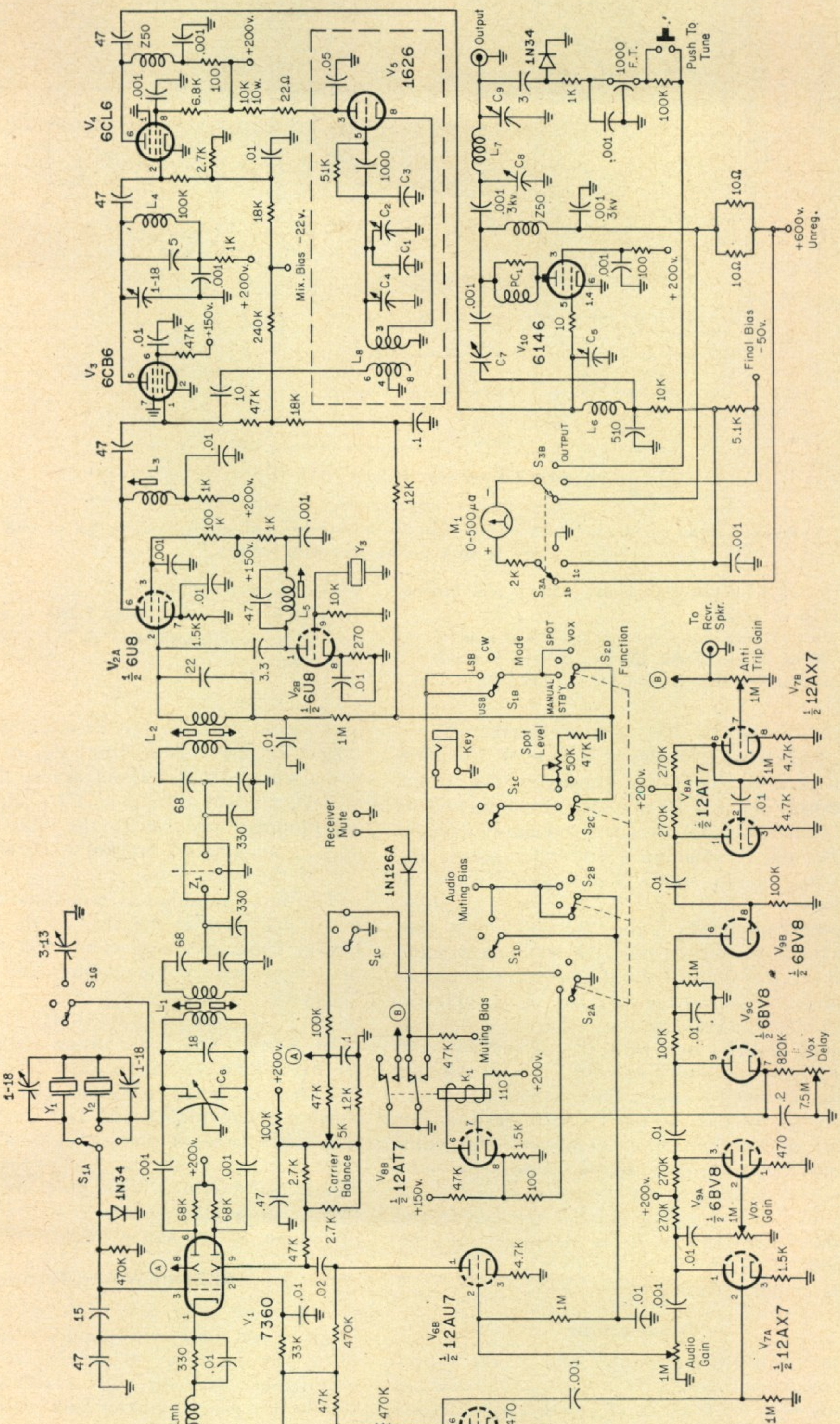


Fig. 2—Circuit of 50 mc s.s.b.-c.w. 50 watt transmitter. See page 82 for parts identification.

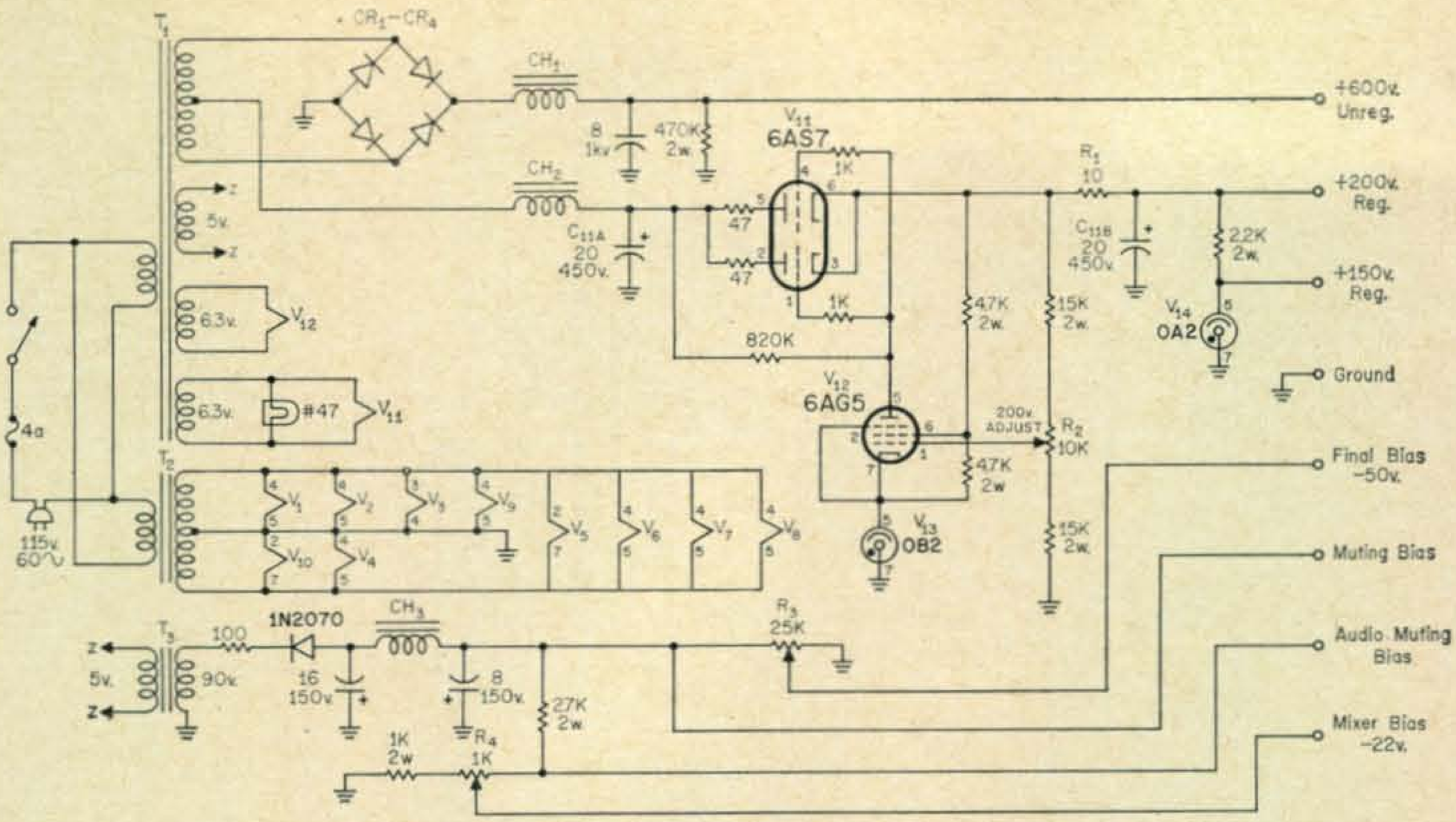


Fig. 3—Power supply circuit for the 6 meter s.s.b.-c.w. transmitter. All capacitors are in mf and all resistors are ½ watt unless otherwise noted.

CH_1—3.5-13.5 hy swinging choke 150-15 ma. Stancor C-1718 or equiv.
CH_2—7 hy 110 ma choke. Stancor C-1710 or equiv.
CH_3—20 hy 15 ma choke. Stancor C-1515 or equiv.
CR_1—Bridge Rectifier, Diodes Inc., #BR820A.
T_1—TV power transformer.
T_2—12.6 v.c.t. at 2.5 a. Triad F-26X or equiv.
T_3—6.3 filament transformer at 1.2 a. Stancor P6134 or equiv.

fluctuations of the 200 volts are corrected.

A 0A2 (V_{14}) provides a source of 150 volts from the 200 v. supply at approximately 20 ma.

Resistor R_1 is a 10 ohm ½ watt unit and its only function is to provide a means of current monitoring. By placing a voltmeter across R_1, a reading of one volt will represent 100 ma of current.

Potentiometer R_2 is the 200 volt adjust control. It allows setting the 200 volt line exactly. Once set, this control should not have to be adjusted again, unless the 0B2 has to be replaced.

All bias voltages are derived from a 6.3 volt filament transformer with the secondary connected to the unused five volts filament winding on the TV transformer. This provides approximately 90 volts a.c. to the 1N2070 rectifier. The output of the bias filter is about −60 volts. Potentiometer R_3 is connected across the −60 volts and is used to set the grid bias for the 6146 final to give a plate current between 15 and 20 ma. Potentiometer R_4 is the mixer bias adjustment and should be set to give −22 volts on its center terminal.

Construction

The complete transmitter and power supply are constructed on a 17″ × 11″ × 3″ aluminum chassis with an 8¾″ front panel. Layout is not critical in most cases. However, the 7360 (V_1) and transformers T_1 and T_2 should be placed as far apart as possible, since the 7360 is sensitive to magnetic fields. Also crystals Y_1 and Y_2 should be close to switch S_1. With this in mind, V_1 and T_1 were put in opposite corners of the chassis.

A shield must be put between the input and output of the crystal filter, Z_1, to prevent the 9 mc signal from leaking across the filter terminals. Chokes CH_2 and CH_3 along with T_3 are mounted underneath the chassis with CH_2 and T_3 on a small bracket so as to keep them out of the way.

The final amplifier is contained in the small perforated cage at the rear of the chassis. The tuning capacitors are connected to the front panel with two flexible couplers and a rigid shaft. Capacitor C_5 is mounted on the chassis close to the 6146 socket and its shaft extends into the cage. A small hole is cut in top of the cage cover so that a long screwdriver can be used to adjust C_5. The 6146 socket is mounted on ½ inch metal spacers above the chassis and a 1⅛ inch hole is directly beneath the socket to allow connections to the 6146. Screen bypass capacitors should be mounted with very short leads between the screen terminal and a ground lug under one of the metal spacers.

Alignment And Testing

Alignment of a filter type s.s.b. transmitter is not as complicated as the alignment procedure of a phasing type. A general coverage communications receiver with a 100 kc frequency standard, a grid dip meter and a v.o.m. are three basic pieces of equipment needed. An oscilloscope and an audio oscillator were also used for aligning the generator crystals, but are not absolutely necessary.

The first step that should be performed if it has not already been done is to adjust the 200 volts using R_2. A visual check of V_{14} will tell

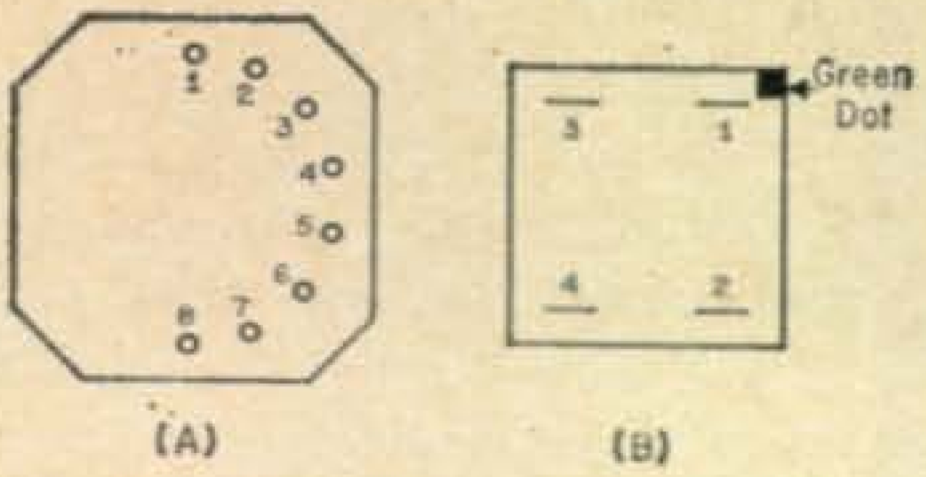


Fig. 4A—Bottom view of L_8, the v.f.o. coil taken from the BC-458. B—Bottom view of T_1 and T_2, Miller #1463, 10.7 mc i.f. transformers or equiv.

if it has ignited to provide the 150 volts. With the function switch in STANDBY, adjust R_3 to give between 15 and 20 ma of final plate current. Resistor R_4 is then adjusted to give —22 volts at its center terminal.

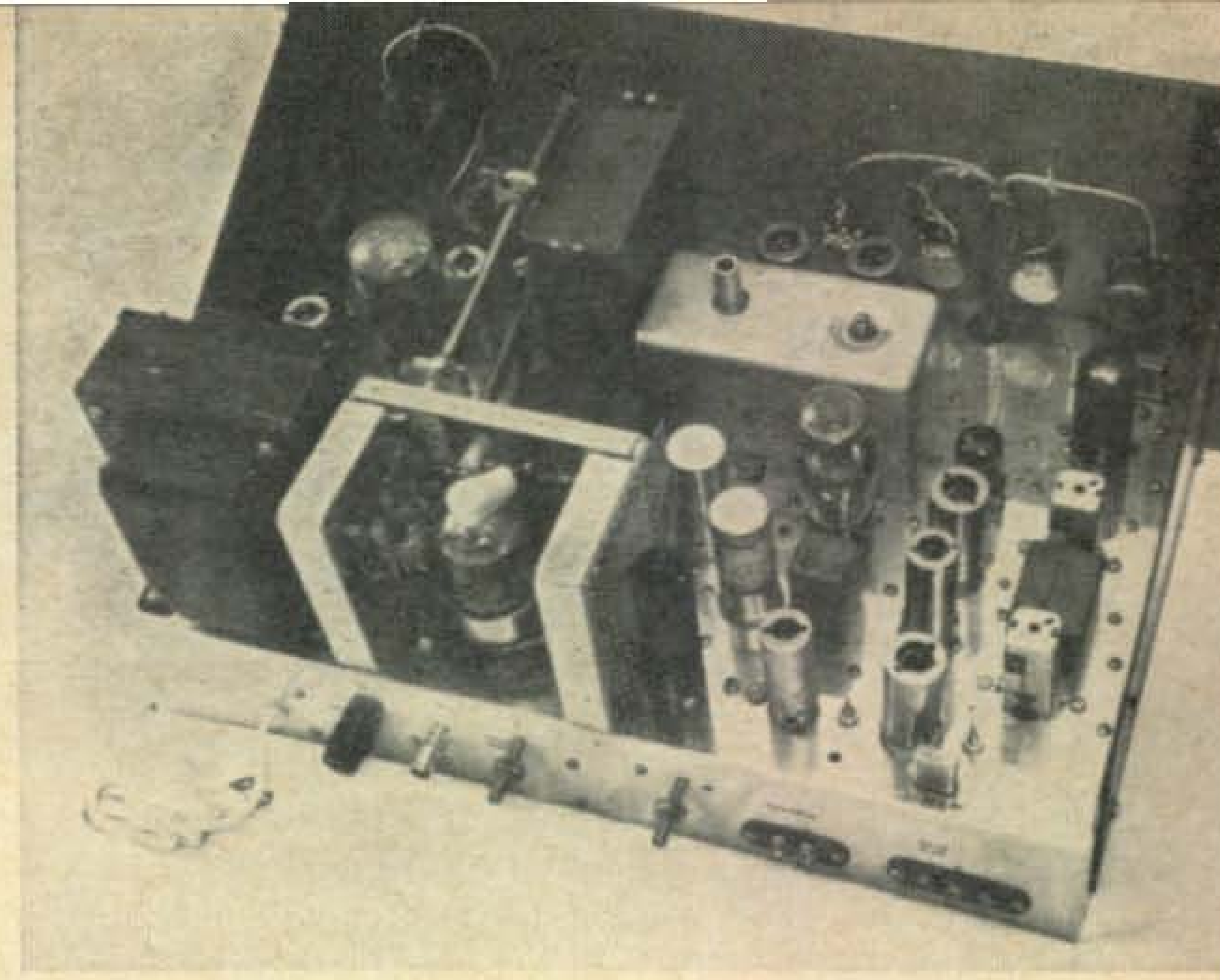
Now, with the power turned on, and all equipment warmed up for at least 30 minutes, put the MODE switch in the UPPER SIDEBAND position and FUNCTION switch in STANDBY. Tune the receiver to 9 mc to check for oscillation of the 9 mc oscillator. Connect the oscilloscope vertical amplifier across the receiver speaker and the horizontal amplifier input to the audio oscillator. Set the audio oscillator to 1500 c.p.s. Switch the receiver 100 kc frequency standard on and switch the b.f.o. to off. Adjust the vertical and horizontal amplifier gain controls to give a convenient size pattern on the oscilloscope. Adjust the trimmer capacitor across Y_1 until a circular pattern is obtained on the oscilloscope. When this is done, crystal Y_1 will be 1500 c.p.s. below 9 mc.

Now place the MODE switch to LOWER SIDEBAND and repeat the above procedure for Y_2, which will put it 1500 c.p.s. above 9 mc.

Loosely couple the receiver to the output of L_2 with the MODE switch on UPPER SIDEBAND and the FUNCTION switch in STANDBY; tune the receiver for maximum S meter reading. Now decrease the r.f. gain of the receiver and peak L_1 and L_2 for maximum S meter reading.

When both the primary and secondary of L_1 and L_2 are peaked, the differential capacitor, C_6, and the CARRIER BALANCE potentiometer should be adjusted until maximum carrier balance is obtained. This is indicated by a decrease in the S meter reading and the r.f. gain may have to be increased in order to detect the maximum carrier null. At this point a microphone can be connected and the AUDIO GAIN increased to see if the balanced modulator is operating properly. The FUNCTION switch must be in the MANUAL or VOX position before checking the balanced modulator with audio. Remember, the receiver is very sensitive and it may appear that good carrier suppression has not been achieved because the receiver may be picking up a signal directly from tho oscillator.

Once the balanced modulator is operating, the next step is to align the first local oscillator and mixer. Using the grid dip meter tuned to 35.8 mc, and set for diode operation; adjust the slug of L_5 for maximum oscillator output. Unbalance the balanced modulator using the CARRIER BALANCE control; put the FUNCTION switch on MANUAL and tune the grid dip meter to 44.8 mc. Couple the grid dip meter to L_3 and adjust L_3 for maximum output. If the grid dip meter is not sensitive enough the receiver can be used in conjunction with a six meter converter. This is done by tuning the receiver 5.2 mc below the normal intermediate frequency that corresponds to 50 mc.



Top rear view of the 6 meter s.s.b.-c.w. exciter-transmitter. The parts locations are identified in fig. 5.

In the case of a 14-18 mc i.f., tune the receiver to 8.8 mc and adjust L_3 for maximum S meter reading.

Next, tune the communications receiver to 5.2 mc, turn the 100 kc frequency standard on and connect a short antenna to the receiver. Adjust the v.f.o. to a frequency of 5.2 mc with the plates of the variable capacitor fully meshed. This will prevent operation outside the lower band edge.

Connect the receiver to a six meter converter and listen for a signal around 50 mc. At this time, it would be wise to connect a dummy load to the output connector if it has not already been done. Since we should now have a 50 mc signal, the remaining r.f. circuits can be peaked up using the receiver S meter and finally the output meter of the transmitter. After all stages are peaked, it would be a good idea to start with the balanced modulator coils L_1 and L_2 and proceed through all stages again.

To neutralize the final, the plate and screen voltages should be removed. Under no circumstances should the plate voltage be removed without also removing the screen voltage, as the 6146 can be permanently damaged. The receiver can now be connected directly to the output connector and C_7 adjusted for minimum feed-through with the carrier unbalanced and the FUNCTION switch in MANUAL.

The transmitter is now ready for on-the-air tests and should provide many good s.s.b. and c.w. contacts. The tuning is broad enough so that the lower 200 kc of six meter can be covered without the need of further adjustments. When properly loaded, an output of approximately 50 watts p.e.p. can be expected, and will provide a good signal barefoot or ample drive for a linear. ■

the USA-CA PROGRAM

BY ED HOPPER,* W2GT

AWARDS and endorsements up to May 10 were: Carl, WØVFE earned a USA-CA-2500 award endorsed mixed and received endorsement of All 7 mc A-1 for his USA-CA-500 award. Earl, W7KOI received a USA-CA-1500 award, the first issued to the 7th district. "Red," W1EIO won a USA-CA-1000 award endorsed All A-1, and endorsements of All 7 mc A-1 and All 14 mc A-1 for his USA-CA-500 award. Mixed USA-CA-500 awards were issued to Geo., W7ENA; George, WA8AZB; Dave, WA8KAN; and LeRoy, WAØLMK.

USA-CA HONOR ROLL

2500		1000		500	
WØVFE	14	W1EIO	98	W7ENA	567
1500		**500**		WAØLMK	568
W7KOI	47	WA8AZB	566	WA8KAN	569

SPECIAL USA-CA HONOR ROLL
Top Twenty-Five County Hunters

K9EAB	3079	WA9AJF	2900	WØGYM	2231
WØMCX	3079	K8IWI	2780	K8VSL	2180
K8CIR	3068	K8KOM	2700	W5NXF	2080
W9ICF	3050	VE3-9301	2679	WA5AEB	2062
WØJWD	2977	WØKZZ	2591	W2JWK	2050
K5SGJ	2961	WØVFE	2527	K9UTI	2000
K5SGK	2960	W8UPH	2368	W5EHY	2000
K4VOF	2944	W9CMC	2368	WA8EZW	2000
		K3LXN	2331		

County Hunter Nets

By the time you read this, every effort will be made to have the following County Hunter Net schedules:

1200 to 1800 GMT on 7,223 kc
1800 to 2400 GMT on 14,295 kc
0200 to —— GMT on 3,947 kc

all county hunters are most welcome.

On May 2, a *CW* County Hunters Net was started by K3WWP and WA8EOH. Sessions will be on 7.035 mc on Mondays, Wednesdays, and Fridays from 1700 to 2000 GMT with K3WWP as net control; and on Tuesdays and Thursdays from 2300 GMT until skip goes out, with WA8EOH as net control. *ALL* County Hunters and/or stations in rare counties are welcome to QNI. *(This sounds like a fine start and I am sure it should soon spread to 14 mc and 21 mc—Ed.)*

New USA-CA Award

After some prodding by Carl, WØKZZ and others who thought it be a fine idea to issue a new card for working *fixed* stations in US counties, I have figured how this could be done without changing rules. Oh, yes, some of the reasons behind this would be to give many or all of the old time county hunters a new goal to work for, and also create a new interest and a real challenge for others. This idea could also apply to those who normally operate exclusively on fone, a new award could be issued to them for working US counties on c.w. and a new award could be issued to stations who normally operate c.w. for working counties on fone. To assist where there are no resident amateurs, *fixed* portable stations could count, *if* their antenna was tied to ground so that they could not easily become mobile.

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

County Identification

A nice letter from Scott Wilkerson, K3FKU, 2519 Mason St., Wheaton, Maryland with the information that the Americana Encyclopedia is a great help in identifying counties and most libraries have them. Scott also offers anyone needing such help, to help with county identification. Others who have made such offers are: Bertha Farr Eggert, WA4BMC, 1510—17th Ave., N., Lake Worth, Florida 33460; Raymond A. Forman, W5EMZ, 706 Comer St., Carthage, Texas 75633; Alfred Vasko, W8FRD, 208 S. Main St., Swanton, Ohio 43558; and Dick Hade, K9HSK, 132 South Euclid Ave., Princeton, Illinois 61356. *(So, what other problems do you have?)*

Letters

Walter, DL9PF, writes: "As you know, I am one of the boys looking for more counties. I got the #1 USA-CA-500 award for Europe and am working hard for the 1000 sticker. It is most difficult for us over here and some of our special problems are: *CQ* arrives here about the 20th of the month and most QSO party announcements are too late. I realize you have your deadline 2 months in advance, but please find a way to have these announcements in *CQ* in time for us. Also in many QSO parties, the scoring does not count stations outside the US, so there is no incentive for the rare counties to work us. This also applies during ARRL field-day, multipliers are based on ARRL sections, so there is no incentive for the portable in a rare county to work us. It would seem that scoring could easily count a foreign country for a multiplier. I hope to spend part of August and September in the US and will be sure to visit *CQ* and meet you all and take pictures and write a story about *CQ* HQ for our magazine, the DL-QTC. I also hope to drive to the west coast."

Silvio, WPE4110, writes: "Let me compliment you on the FB job you are doing with the column. Time was when I thought that anything which didn't count as a country, zone or prefix was just a waste of time and money. However, since I first caught your column in '65, I've been about 95% county-hunter and 5% DXer! Hi! I'm an avid award hunter, and *more* awards

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- **"Sharpest"** of all transceivers—special McCoy 6 crystal filter.
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☐ Remote VFO—$69.95 ☐ D.C. SUPPLY—$89.95
☐ Enclosed is my Money Order ☐ Check ☐ Charge it
☐ Specifications & Package Information
☐ Quote me on Attached Letter.
☐ FREE WRL 1966 Catalog

Name________________ Call________

Address________________________

City____________ State______ Zip______

For further information, check number 53, on page 108

New awards. At left, the St. Louis Bi-Centennial Award. Next, the SPARK Award, and at the right, the County Hunters Mobile Service Award.

are to be had for counties than any other single type of hunting. Being a 'lowly' s.w.l., I certainly have my trouble with non-confirmers. I ALWAYS enclose an s.a.s.e. and even a prepared QSL-form and all the guy has to do is check it against his log and sign it and put it in the envelope and drop it in the nearest mailbox. But many won't even do that."

Roger White, WB2SIJ, writes: "I will be operating from Cape May county, N.J. from 24th to 30th June and from Saratoga county, N.Y. from 2nd to 28th of August and I'll operate on 40, 20, and 15 and will be pleased to make schedules for any stations needing these counties. Write to 10 Marlboro Lane, Colonia, N.J. 07067."

James, WAØJIH, writes: "Just sent my book for USA-CA-500 and it has been a most enjoyable experience. Lots of hams fail to realize what a *real thrill* county hunting is. Always check and read your column monthly. Always glad to give out Platte county."

Bill, WB6OAV/3, writes: "On my transfer from Camp Springs, Md., to Albuquerque, N.M., we will make it a sort of county expedition via the northern route through W. Va. Ohio, Indiana, Illinois, Missouri, Kansas, Texas, and New Mexico. We will be operating 6 meter mobile out of two cars on the trip but on all stops we will operate on 40, 20, 15 a.m. and c.w. We will leave on the 28th of June."

Awards

The St. Louis Bi-Centennial Award: Sponsored by The Northwest St. Louis Amateur Radio Club, Inc., is issued to celebrate St. Louis' 200th Anniversary. Requirements: Only confirmed contacts after January 1965, with St. Louis City and St. Louis County stations count. Any band, any mode. Stations outside St. Louis City and County, 15 required. DX stations, 10 required. Stations in St. Louis City and County, 25 required. Send log data signed by one other amateur stating he viewed the QSLs and 50¢ or 5 IRCs to: The Northwest St. Louis Amateur Radio Club, Inc., c/o Paul Haefner, KØJPL, 1939a East Warne, St. Louis, Missouri 63107.

S.P.A.R.K. Award: The Southern Penninsula Amateur Radio Klub of Hampton, Virginia is issuing this award for contacts with stations in the cities of Hampton and Newport News and in the counties of Charles City, James City, New Kent and York. Local stations in these cities and counties must work 10 other stations; stations in the rest of the continental U.S. must work 5 stations in these areas; and all other stations must work 3 stations in these areas. U.S. stations are required to pay $1.00 handling charge but no charge to others. Send log information only, to Southern Peninsula Amateur Radio Klub, c/o Awards Chairman, 71 Pine Chapel Rd., Hampton, Va. 23366.

County Hunters' Mobile Service Award: For having given so freely of time, energy and resources to U.S. County Hunters, The Neighborhood Electronics Club of Oak Park, Illinois is issuing this nice award to *MOBILE* stations operating in U.S. and giving county contacts to others. Requirements: Furnish proof of having given a certain number of different U.S. county contacts to other amateurs by requesting the "receiving" station(s) (or in the case of controlled nets, NC's concerned) to confirm receipt in writing to Awards Manager. List to include: mobile station call, date of contact, state and county given, Awards Manager will notify station qualifying. Basic award—50 different counties; endorsement D—100 different counties; endorsement C—150 different counties; B—200 different counties; A—250 different counties. Basic award is $1.00, subsequent endorsement seals for s.a.s.e. or 10¢. No date or band/mode limitations. NO AOMB/M endorsements. TCR and MER apply. Awards Manager: Hector Otero, WA9CNN, 201 North Harvey Ave., Oak Park, Illinois 60302.

I'm sure by now you realize I do not have a feature story this month, hope you did miss it. The story was left out to try to catch up on interesting letters, award data and other important information and still keep the column within a reasonable size, so send your complaints to Dick Ross. Another problem that is always with us is—the *QSL PROBLEM*. I am constantly receiving letters from overseas hams telling me that our U.S. is such a prosperous country and anxious for good will, world wide, and they wonder *why* U.S. hams do not even answer their QSLs. Letters are also arriving from U.S. hams who claim they can not get QSLs from overseas hams even when they send IRCs, but they also complain of other U.S. hams who do not QSL. So, send that QSL, it could be the ONE needed for an award! Keep your eyes on CONTEST CALENDAR by Frank Anzalone, W1WY, because, at present, I do not have available space to duplicate data on QSO Parties.

Thanks to W8GIU for offering to send a POD 26 to LA3UF, I still have unfilled requests from overseas amateurs for POD 26. Another point I would like to get across is that my deadline for material is the 10th of the 2nd month prior to publication, that is, material for September *CQ* must be in my hands by 10th of July. I greatly appreciate all your wonderful letters. How was your month? 73, Ed., W2GT

Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

July	2-3	Venezuela Contest
July	2-3	Alabama QSO Party
July	16-17	Colombia Contest
July	23-24	Indiana QSO Party
August	6-7	Illinois QSO Party
August	6-7	*CQ* VHF Contest
August	13-15	WAEDC C.W.
September	10-11	WAEDC Phone
September	17-19	Washington QSO Party

Venezuela Contest

Starts: 0000 GMT Saturday, July 2
Ends: 2400 GMT Sunday, July 3

This is a phone *only* contest, a.m. and s.s.b., all bands 10 thru 80.

Do not pass up ths one, the certificate is a beauty and you do not have to be a top scorer to qualify for an award.

Complete rules were in last month's CALENDAR.

Mailing deadline is September 15th. Logs go to: Radio Club Venezolano, Independence Contest, P.O. Box 2285, Caracas, Venezuela.

Alabama QSO Party

Starts: 2100 GMT Saturday, July 2
Ends: 0300 GMT Monday, July 4

Rules appeared in last month's CALENDAR.

Mailing deadline is August 1st, and your logs go to: Huntsville Amateur Radio Club, c/o Richard Rodkin, WA4TID, 4030 Medford Dr. SE, Huntsville, Alabama 35802.

Colombia Contest

Starts: 0000 GMT Saturday, July 16
Ends: 2359 GMT Sunday, July 17

Rules for this one also appeared in last month's CALENDAR.

Logs must be in the hands of the Committee before September 30th. They go to: L.C.R.A. Colombia Independence Contest, P.O. Box 584, Bogota, Colombia.

Indiana QSO Party

Starts: 1400 GMT Saturday, July 23
Ends: 2300 GMT Sunday, July 24

Extensive coverage of the state by portable and mobile stations is promised for this one.

You can use c.w. or phone or both, on all bands 10 thru 80.

There seems to be no scoring system. Work as many Indiana stations as you can. It is assumed that the same station may be worked on different bands for scoring credit.

A Trophy will be awarded to the highest overall scorer, and a certificate on each band as follows: 1. Indiana to DX. (KL and KH considered DX) 2. Indiana to U.S. 3. DX to Indiana. 4. U.S. to Indiana.

Suggested frequencies: C.w. – 3540, 7050, 14075, 21080, 28110. Fone–3890, 3947, 7260, 14340, 21430, 28690. Mobile–7223. Also Novice & v.h.f.

Logs go to: Wm. G. Bradburn K9KCQ, 5030 West Vermont, Indianapolis, Ind. 46224, and must be postmarked no later than August 31st.

Illinois QSO Party

Starts: 1600 GMT Saturday, August 6
Ends: 2200 GMT Sunday, August 7

Rules essentially same as last year and will appear in next month's CALENDAR.

Summer CQ VHF Contest

Starts: 1:00 P.M. Local Time Aug. 6
Ends: 8:00 P.M. Local Time Aug. 7

This is the big one for you mountain-topping v.h.f.ers. All bands above 50 mc can be used. There are three major categories: Single Band, Single Operator; Multi-Operator, and/or Multi-Band; and Novice. A club aggregate scoring is also provided (club members should indicate if their score is to be applied to a club total).

The exchange consists of a serial number, (Signal report followed by 3 digits beginning with 001—new sequence on each band), county, state, operator's name.

Logs and cover sheets are available from *CQ* for a self-addressed, stamped envelope. Use local time when logging contacts. You must compute your own score.

Contacts on 6 and 2 meters count 2 points; contacts above 2 meters count 4 points. Multiply points × total counties worked (add totals on each band) × total hours worked (at least 1 contact per hour) × power multiplier (1 for 30 watts or more; 1.25 for less than 30 watts).

Awards will be made to top scorers in each state, in each category. Trophy to highest score in U.S. in each category. Logs go to *CQ* VHF Contest, 14 Vanderventer Avenue, Port Washington, L.I., N.Y. 11050. Deadline: Sept. 1, 1966.

DARC WAE DX

C.W.—August 13-14 **Phone** September 10-11
Starts: 0000 GMT Saturday, Ends: 2400 GMT Sunday in each instance.

This is the 12th annual WAE contest sponsored by the DARC, with its well known QTC feature.

The object of the contest is for non-Europeans to work as many European stations as possible on all bands. (Note the WAE country list.)

Rules: 1. Use all bands, 3.5 thru 28 mc.

2. The usual five and six digit serial number, RST/RS report plus a progressive three figure QSO number starting with 001.

*14 Sherwood Road, Stamford, Conn. 06905.

3. Each exchange will count 1 point, except on 3.5 mc where it will count 2 points.

4. Same station may be worked once per band.

5. The multiplier for non-European stations is determined by the number of European countries worked on each band. (WAE list)

6. Europeans will use the latest ARRL country list for their multiplier. In addition each call area in the following countries will be considered a multiplier. JA, PY, VE/VO, VK, W/K, ZL, ZS, UA9 and UAØ.

The final score is the total QSO points, plus the QTC points if any, multiplied by the sum total countries from all bands.

QTC Traffic: Additional point credit can be realized by making use of the QTC traffic feature.

A QTC is a report of a confirmed QSO that has taken place earlier in the contest and later sent back to a European station.

It can only be sent from a non-European station to a European station. The general idea being that after a number of European stations have been worked, a list of these stations can be reported back during a QSO with another station. An additional 1 point credit can be claimed for each station reported.

1. A QTC contains the time, call and QSO number of the station being reported. ie: 1200/DL1FF/123. This means that at 1200 GMT you worked DL1FF and received number 123.

2. A QSO can be reported only once and not back to the originating station.

3. Only a maximum of 10 QTCs per station are permitted. You may work the same station seevral times to complete this quota. Only the original contact however has QSO point value.

4. Keep a uniform list of the QTCs sent, ie; QTC 3/5 indicates this is the 3rd series of QTCs sent and that 5 QSOs are being reported.

Classifications: 1. Scoring will be determined on all band operation only.

2. Both single and multi-operator divisions.

3. There is also a power classification. Class A up to 50 watts, B up to 150 watts and C over 150 watts. Its important you indicate your power.

Awards: Certificates to the highest scorer in each classification in each country and country/district in Rule #6. A minimum of at least 4 hours of operating is required for an award.

2. Continental leaders will be additionally honored and 2nd and 3rd place certificates will be given in areas of sufficient participation.

3. Contest contacts can be used for WAE certificate endorsement providing that the log of the requested station is also received. These endorsements cannot be considered before the publication of the results of the contest.

It is strongly recommended that you use the official DARC contest log form. A self-addressed envelope with 1 IRC (3 for Air Mail) will get you a supply from the DARC.

Address your request and your contest report to: Dr. H. G. Todt, DL7EN, Chlodwigstr. 5, 1 Berlin 42, Germany. Mailing deadline, September 15th for c.w. and October 15th for phone.

WAE Country List

CT1, CT2, DL/DJ/DM, EA, EA6, EI, F, FC, G, GC, GD, GI, GM, GM Shetland Islands, GW, HA, HB/4U1ITU, HBØ/Liechtenstein, HV, I, IS, IT, LA, LA/Bear Island, LA/P Jan Mayen, LA/P Spitzbergen, LX, LZ, M1, OE, OH, OHØ, OK, ON, OY, OZ, PA, PX, SM, SP, SV, SV Rhodes, SV Crete, TA/European part, TF, UA/UW/UV1-6, UB/UT/UY, UC, UN, UO, UP, UQ, UR, UA Franz Josef Land, YO, YU, ZA, ZB2, 3A, 9H.

Editor's Notes

We held up the printing of the Phone results as long as possible, waiting for Don Miller's XW8BF log, but unfortunately it arrived after all copy had gone to the printer for the final printing. It was impossible to include Don's fine effort on 14 mc in the final results, and it would

[*Continued on page 102*]

Propagation

BY GEORGE JACOBS,* W3ASK

With long hours of daylight and the sun high in the northern sky, h.f. propagation conditions during July are generally more stable than during any other month of the year.

Twenty meters is expected to be the optimum band for long distance propagation during the month. The band is expected to remain open around-the-clock to one area of the world or another, with peak conditions forecast for several hours after sunshine, and during the late afternoon and early evening hours. Fifteen meters is forecast to open fairly frequently on north-south paths, especially during the late afternoon hours. The band should also open to other areas of the world, but less frequently. Some good 10 meter DX openings are predicted for July, mainly on north-south paths during the afternoon hours.

During the hours of darkness, 40 meters is expected to open to several areas of the world, but seasonally high static levels may often make DX reception difficult. High static levels are also expected to result in somewhat poorer DX conditions on 80 meters, although some DX openings are forecast during the hours of darkness. Not many DX openings predicted for 160 meters during July, because of seasonably high levels of static and solar absorption.

Short-Skip

This month's column contains Short-Skip Propagation Charts for July and August. Short-skip conditions are expected to be optimum during July, mainly as a result of the seasonal peak expected for sporadic-*E* propagation. During the hours of daylight, considerable short-skip openings are forecast for 10 and 15 meters over distances ranging between approximately 500 and 1300 miles, with some openings extending out to 2300 miles. Frequent short-skip openings on 20 meters, ranging between 300 and 2300 miles, are expected almost around-the-clock, with conditions peaking during the late morning hours and again during the late afternoon and early evening hours.

Good daytime short-skip openings on 40 meters are predicted for distances between approximately 100 and 750 miles, with good nighttime openings between 250 and 2300 miles. Good 80 meter short-skip openings are expected during the daylight hours for distances up to approxi-

[*Continued on page 104*]

*11307 Clara Street, Silver Spring, Md. 20902.

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for July

Days	Forecast Rating and Quality (4)	(3)	(2)	(1)
Above Normal: 1, 10-11, 16, 24, 29	A	A-B	B-C	C
Normal: 2-4, 6-7, 9, 12-14, 17-18, 21-23, 25-27, 30-31	A-B	B-C	C-D	D-E
Below Normal: 5, 8, 15, 19, 28	C	C-D	D	E
Disturbed: 20	D	D-E	E	E

How To Use These Charts

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

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

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

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

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

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

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

6—These Propagation Charts are valid through Aug. 31, 1966. These Charts are prepared from basic propagation, data published monthly by the Institute For Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado.

CQ Short-Skip Propagation Chart

JULY—AUGUST, 1966

Band Openings Given In Local Standard Time

At Path Mid-Point
(24-Hour Time System)

Band (Meters)	*50-250 Miles*	*250-750 Miles*	*750-1300 Miles*	*1300-2300 Miles*
10	*Nil*	07-09 (0-1) 09-13 (0-3) 13-17 (0-1) 17-21 (0-2) 21-23 (0-1)	07-09 (1) 09-13 (3) 13-17 (1-2) 17-21 (2-3) 21-07 (1)	07-09 (1-0) 09-13 (3-1) 13-17 (2-1) 17-21 (3-1) 21-07 (1-0)

15	*Nil*	07-09 (0-2) 09-13 (0-3) 13-17 (0-2) 17-19 (0-3) 19-21 (0-2) 21-07 (0-1)	07-09 (2) 09-13 (3) 13-17 (2) 17-19 (3) 19-21 (2) 21-23 (1-2) 23-07 (1)	07-09 (2-1) 09-13 (3-2) 13-17 (2-3) 17-19 (3) 19-21 (2) 21-23 (2-1) 23-07 (1-0)
20	09-00 (-1)	06-09 (0-2) 09-15 (1-4) 15-20 (1-3) 20-00 (1-2) 00-06 (0-1)	06-09 (2-3) 09-16 (4) 16-21 (3-4) 21-00 (2-3) 00-06 (1-2)	06-09 (3-2) 09-15 (4-2) 15-16 (4-3) 16-21 (4) 21-00 (3-2) 00-06 (2-1)
40	07-11 (1-2) 11-16 (2-4) 16-20 (3-4) 20-22 (1-2) 22-07 (0-1)	07-09 (2-3) 09-11 (2) 11-16 (4-2) 16-17 (4-3) 17-20 (4) 20-22 (2-4) 22-07 (1-3)	07-09 (3-1) 09-16 (2-1) 16-17 (3-1) 17-20 (4-3) 20-22 (4) 22-05 (3-4) 05-07 (3)	07-17 (1-0) 17-20 (3-2) 20-05 (4) 05-07 (3-1)
80	06-11 (3-4) 11-15 (4-3) 15-21 (4) 21-04 (3-4) 04-06 (3)	07-09 (4-1) 09-11 (4-0) 11-15 (3-0) 15-17 (4-1) 17-19 (4-2) 19-21 (4-3) 21-04 (4) 04-06 (3) 06-07 (4-2)	07-09 (1-0) 09-15 (0) 15-17 (1-0) 17-19 (2-1) 19-21 (3-1) 21-04 (4) 04-06 (3) 06-07 (2-1)	07-17 (0) 17-19 (1-0) 19-21 (1) 21-03 (4-3) 03-04 (4-2) 04-05 (3-2) 05-06 (3-1) 06-07 (1)
160	17-18 (1-0) 18-19 (1) 19-21 (3-2) 21-23 (4-3) 23-05 (4) 05-07 (3-2) 07-08 (1) 08-09 (1-0)	18-19 (1-0) 19-20 (2-0) 20-21 (2-1) 21-23 (3-2) 23-03 (4-2) 03-05 (4-3) 05-07 (2-1) 07-08 (0-1)	20-21 (1) 21-00 (2-1) 00-03 (2) 03-05 (3-2) 05-06 (1) 06-07 (1-0)	20-22 (1-0) 22-00 (1) 00-05 (2-1) 05-06 (1-0)

ALASKA
*Openings Given In GMT**

To:	*15 Meters*	*20 Meters*	*40 Meters*	*80 Meters*
Eastern USA	01-03 (1)	12-15 (1) 22-01 (1) 01-03 (2) 03-05 (1)	07-10 (1)	*Nil*
Central USA	02-04 (1)	13-16 (1) 23-01 (1) 01-03 (2) 03-05 (1)	08-12 (1)	*Nil*
Western USA	16-23 (1) 23-06 (2) 06-08 (1)	14-23 (1) 23-01 (2) 01-03 (3) 03-05 (4) 05-06 (3) 06-08 (2) 08-10 (1)	08-10 (1) 10-13 (2) 13-15 (1)	10-13 (1)

HAWAII
Openings Given In Hawaiian Standard Time†

To:	*15 Meters*	*20 Meters*	*40 Meters*	*80/106* Meters*
Eastern USA	11-14 (1) 14-16 (2) 16-18 (1)	02-05 (1) 05-07 (2) 07-13 (1) 13-15 (2) 15-18 (3) 18-19 (2) 19-20 (1)	18-20 (1) 20-00 (2) 00-03 (1)	20-21 (1) 21-23 (2) 23-01 (1) 22-00 (1)§
Central USA	08-12 (1) 12-16 (2) 16-19 (1)	04-05 (1) 05-07 (3) 07-09 (2) 09-13 (1) 13-16 (2) 16-18 (4) 18-19 (3) 19-20 (2) 20-22 (1)	18-20 (1) 20-02 (3) 02-04 (2) 04-05 (1)	20-22 (1) 22-02 (2) 02-03 (1) 21-02(1)§
Western USA	08-11 (1) 11-14 (2) 14-16 (1) 16-18 (2) 18-19 (1)	04-05 (1) 05-08 (2) 08-11 (3) 11-15 (2) 15-18 (4) 18-19 (3) 19-21 (2) 21-23 (1)	18-19 (1) 19-20 (2) 20-02 (4) 02-05 (3) 05-06 (2) 06-07 (1)	19-21 (1) 21-23 (2) 23-03 (3) 03-04 (2) 04-05 (1) 23-03 (1)§

*GMT or Z Time is 5 hours *ahead* of EST; 6 hours *ahead* of CST; 7 hours *ahead* of MST; 8 hours *ahead* of PST and 9 hours *ahead* of Alaskan Standard Time in the zone between Skagway and 141 degrees west longitude, etc.
†Hawaiian Standard Time is 5 hours *behind* EST; 4 hours *behind* CST; 3 hours *behind* MST; 2 hours *behind* PST and 10 hours *behind* GMT.
§Possible 160 meter openings from Hawaii.

DX

BY URB LE JEUNE,* W2DEC

The following certificates were issued between the period from April 6th, 1966 to May 5th, 1966:			
CW-PHONE WAZ			
2167	W6OAQ	2175	DJ6NS
2168	W6GVM	2176	CR6CZ
2169	WØNGF	2177	DL7HZ
2170	WAØKDI	2178	W2GQN
2171	F7DO	2179	OK1GA
2172	CE5EF	2180	OK1AFC
2173	W6FAY	2181	OK1MX
2174	KR6BQ	2182	OK1ADM
ALL PHONE WAZ			
336	W6GVM	338	OK1ADM
337	W2GQN		
TWO-WAY SSB WAZ			
392	W6GVM	395	W1DGJ
393	ZL1AGO	396	W2GQN
394	SM5FE	397	OK1ADM
CW WPX			
721	K1BOM	724	VK4SS
722	OH5VF	725	OK1IQ
723	SP3AIJ		
SSB WPX			
242	OK3EA		
MIXED WPX			
121	JA1BN		
100 TWO WAY SSB			
487	YO3ZA	488	OA4PI

Here and There

FB8WW Crozet Island: Marcel, FB8WW, active daily between 1300 and 1230 GMT on 21130/140. Will go to phone on request. *(Tnx LIDXA).*

FB8ZZ Amsterdam & St. Paul: FB8ZZ occasionally on 14050 kc at 1130 GMT. *(Tnx LIDXA).*

FR7 Reunion: Guy, FR7ZD, on 14115 kc s.s.b. listening 14210 kc between 0300 and 0400 GMT. Also FR7ZN on 14056 kc c.w. *(Tnx LIDXA).*

GC Jersey Island: GC2AAO on 14220 between 1600 and 1700 GMT weekends. *(Tnx NEDXA).*

HKØ San Andres: HKØAI daily between 2200 and 2300 GMT on 14 mc c.w. or s.s.b. *(Tnx Veron).*

KG6I Bonin & Volcano Island: Lee, KG6IG, on 14250 at 1200 GMT. Also John, KG6IC, at the same time on 14255 kc. *(Tnx LIDXA).*

KJ6 Johnston Island: KJ6CE and KJ6DA active daily between 0700 and 0800 GMT near 14300 kc s.s.b. *(Tnx Veron).*

OHØ Aland Island: Ed, OHØNF on 14238 kc at 1930 GMT. *(Tnx LIDXA).*

OY Faeroes Island: The rare OY6 prefix is available on s.s.b. for the first time with OY6M operating on 14220 kc at 1300 GMT.

MP4B Bahrain: John, MP4BFU, active daily between 2300 and 2400 GMT. He prefers 14230/240 kc. *(Tnx LIDXA).*

MP4T Trucial Oman: Roger, MP4TBO, 14199 s.s.b. working 5 up about 2200 GMT also 21358 at 1600 GMT. *(Tnx LIDXA).*

SVØ Greece: Dick, K1VWJ, passes along word that he is operating SVØWV on 14150 kc or 14250 kc daily between 1400 and 0000 GMT.

TA Turkey: TA2BK is active on 14 mc c.w. Try 14011 around 0600 to 0800 GMT. *(Tnx Veron).* Also, K5CEL is now in Yalova, Turkey and awaiting final approval to operate. He already has a NCX-5 and beam in the air and will be ready to go as soon as permitted. QSL Manager will be K1IYD, Oscar Hilbert, 100 Westport Dr., Chicopee Falls, Mass *(Tnx NEDXA).*

TR8 Gabon: TR8AG is active on 14015 c.w. and 14115 a.m. between 2000 and 2400 GMT. *(Tnx Veron).*

TT8 Tchad Republic: Hubert, TT8AE, on 14207 kc s.s.b. at 1930 GMT. *(Tnx LIDXA).*

TY Dahomey: Jack, TY3ATB, is active on 14 and 21 mc s.s.b. around 1900 GMT. He runs an S-line into a TA-33. *(Tnx VE2ANK).*

VK9 New Guinea: VK9JK, Joe, 14227 kc at 1200 GMT. Also VK9GN on 14197 kc at 1300 GMT. *(Tnx LIDXA).*

VK9 Papua: Graham, VK9DJ, on 14212 or 14232 around 1200 GMT. VK9CJ on 14162 kc c.w. at 1100 GMT. *(Tnx LIDXA).*

VR4 Solomon Islands: VR4CR on 14088 at 1200 GMT. *(Tnx LIDXA).*

VP8 Falkland Islands: The following VP8's are no longer in the Falklands and should be QSLed c/o RSGB. VP8's FJ, HF, HK, IC, CW, ID, GJ, HU, BO, BK, CI, AD, GX, HR, BY. *(Tnx CX2AM/K4YYL).*

VS90 Muscat & Oman: VS9OC, Jim, on 14197 at 2200 GMT working 5 up. *(Tnx LIDXA).*

VU2/A Andoman Islands: VU2DIA on 14015 kc at 0130 GMT almost daily. *(Tnx LIDXA).*

XV5 Viet Nam: Dick, K1RAW, is now in Vietnam and hopes to be active as K1RAW/XV5. Until he gets a permit, he will try to operate from K1YPE/XV5. QSLs for K1RAW will go to WA1AZW, Carl Mascott, 37 Foster Dr., Framingham, Mass. Dick says that he will try to clear up the pileups and get all who desire a contact with Vietnam. His frequencies will probably be 14270 and 14195/200. *(Tnx NEDXA).*

YA Afghanistan: YA1AW almost daily on 14212 at 0200 GMT. *(Tnx NEDXA).*

ZD5 Swaziland: ZD5D on 14270 at 1130 GMT. *(Tnx LIDXA).*

ZD9 Tristan Da Cunha: ZD9BE daily between 1800 and 1915 GMT on 14 mc c.w. or a.m. *(Tnx RSGB).*

7X2 Algeria: Henry, 7X2AH, on 14248 at 1900 GMT. *(Tnx LIDXA).*

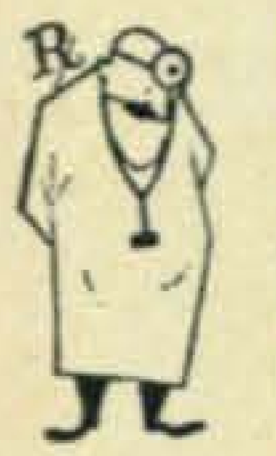
New Japan Prefix: Starting about July of this year, JH1AAA should be QRV from Japan. The license series starting with this call and ending with JH1XZZ is now being issued to private stations with JH1YAA thru ZZZ reserved for club stations. The existing JA series follows the

[*Continued on page 104*]

*Box 35, Hazlet, New Jersey 07730.

HAM CLINIC

CHARLES J. SCHAUERS,* W6QLV



THANKS to R. W. ("Bud") Drobish, W9QVA, he has sent us the information so many hams have written HAM CLINIC about—this is the modification of the Hallicrafters SR-42 2m. transceiver and HA-26 v.f.o. for f.m. operation.

As many DX net and local repeaters using the two meter band operate only on f.m. and having a desire to be able to talk to these stations, rather than just listen, Bud made the following modifications in the SR-42 and the HA-26 to accomplish this type of operation.

Referring to fig. 1, you will see that a voltage variable capacitor (1N3182) is used as the element for injecting capacitance into the HA-26 tank circuit. The modulator shown in fig. 2 was constructed on a piece of perforated phenolic board, but because only a few holes are actually required, it could easily be built on a small piece of bakelite or other insulating material.

The simple flip of the d.p.d.t. switch puts the combination on f.m. or a.m.

The 12 volt Mallory mercury battery (which is directly tied into the circuit without a switch because so little current is drawn) is mounted on the rear of the HA-26 v.f.o.

With the addition of the new circuitry, the v.f.o. frequency will shift so it will be necessary to recalibrate the HA-26. However, there will be a little interaction between the setting of the AUDIO GAIN control and the transmit frequency resulting in a small amount of additional shift in transmit frequency, but this is not troublesome. When going from a.m. to f.m. there will also be some noticeable shift.

The main difficulty encountered with the unit was getting the transmitted signal exactly on the desired frequency but this problem was eliminated by using a simple crystal controlled oscillator on the desired frequency and zero beating the HA-26 against it. The unit was tested on one of the Chicago repeaters with excellent results.

*c/o *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y.

HAM CLINIC is a free technical question and answer service provided exclusively by *CQ*. Every attempt is made to answer each reader's question as promptly and accurately as possible. Occasionally, even HAM CLINIC is stumped, but it rarely happens. Readers are requested to enclose a stamped, self addressed envelope with their questions, to facilitate fast replies. For *extra* fast service, write directly to: Ham Clinic, c/o Chuck Schauers, W6QLV, 4 Lutzelmatte Str., Luzern, Switzerland. Enclose two IRC's. Normal inquiries: Ham Clinic, c/o *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.

Questions

Swiss Reciprocity—"Four other hams and I are planning a trip to Switzerland in connection with our schoolwork. Tell me, has the reciprocal agreement between the U.S. and Switzerland been concluded; Also, can you give me any information of interest?"

Negotiations for an agreement between the U.S. and Switzerland have been going on for sometime. At this writing (May 1966) I do not know when they will be concluded. I have been advised *officially* that if and when the agreement is made, U.S. hams will be required to pass an international morse code examination and an examination on regulations. These are not required by the U.S. but each country can make its own rules. Currently, a fee of 30 Swiss francs (about $8.00) must be paid when applying for the examinations and the license. Presently living in Switzerland, you can appreciate my position. We U.S. hams here are patiently waiting for the diplomatic wheels to turn so that we can finally go on the air. I have been waiting nearly 4 years to operate here, but all good things take time. On my trips to the U.S. I can and do operate.

When you come to Switzerland you will find a clean democratic country, beautiful scenery, fine educated people and a high level of technology. Let us hope that when you arrive here for your activities you will be able to operate your ham station. If you are in Belgium, England, Luxembourg, Portugal and some other European countries, you can as a U.S. citizen operate your ham station upon proper application. Good luck!

Putting the BC-455 on 10 Meters—"Would you please direct me to information relative to putting my BC-455 on 10 meters? I'd like to be ready for 10 meters when it opens up."

Yes. See the September 1948 issue of *CQ* for the article covering this. (Reprints from the

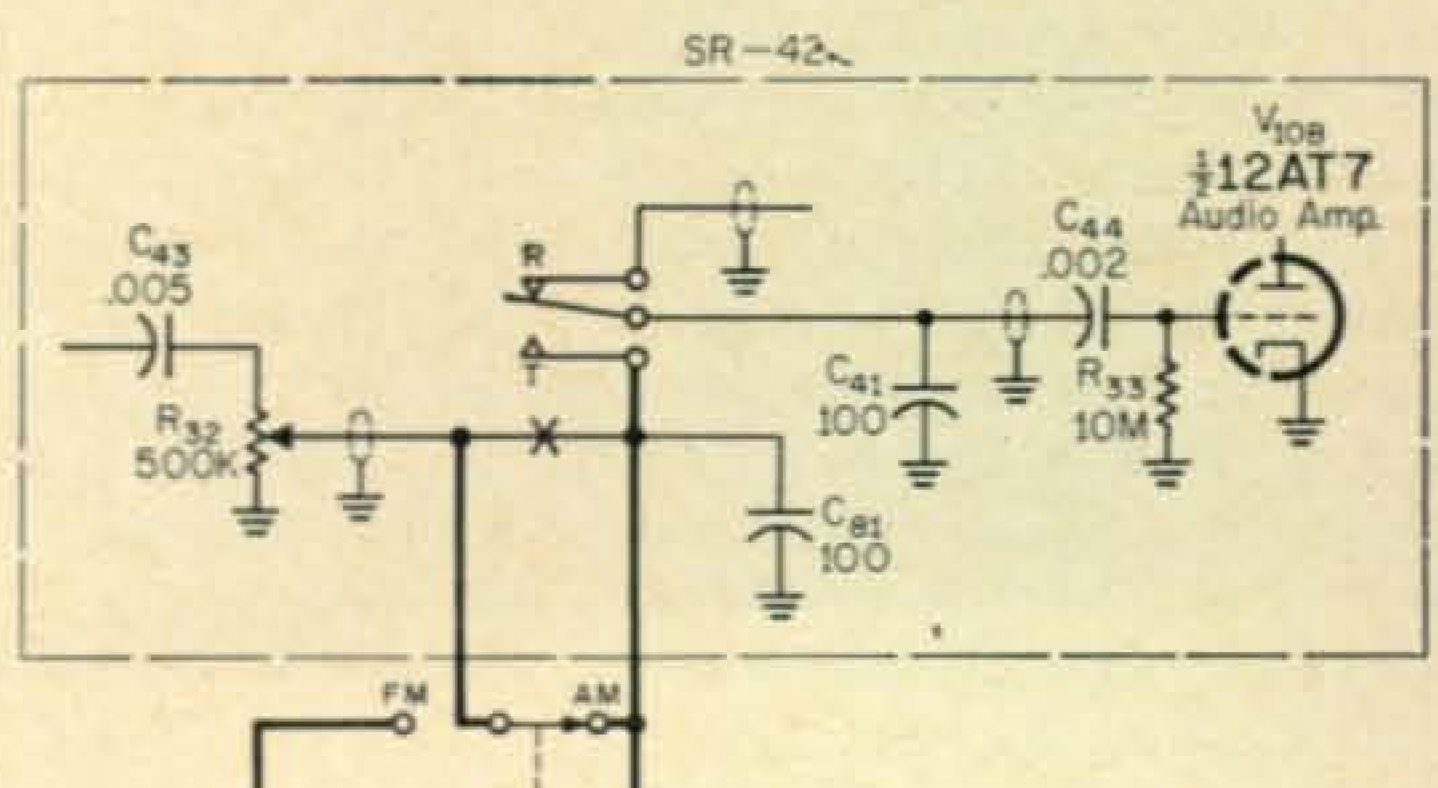


Fig. 1—Modification of the Hallicrafters SR-42 2 meter transceiver and HA-26 v.f.o. for f.m. operation.

CORRECTION

Space Electronics Co., Div. of Military Electronics Corp. ad appeared on page 96 of our May issue. The correct telephone number should read 212 CY 9-0300.

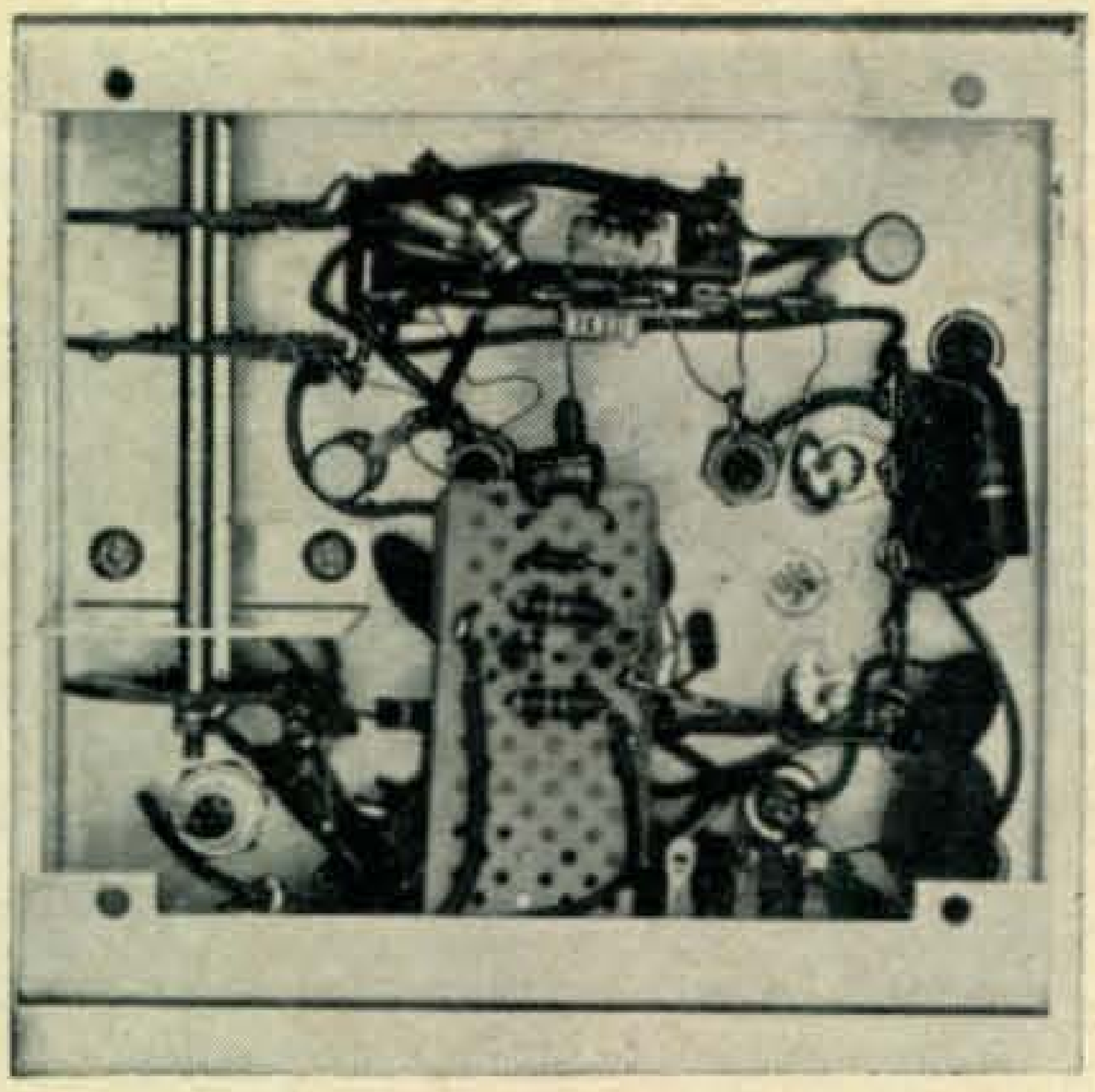


Fig. 2—This shows the mounting of the modulator in the HA-26. The board is mounted with an "L" bracket to the rear of the chassis.

editor of *CQ* for $1.00—*not* HAM CLINIC).

Converting 28 Volt Relays—"I have obtained a number of 28 volt surplus relays. Can you tell me where I can find information for converting these for 12 volt operation?"

Sure. See the article "Converting 28 Volt Relays to 6 and 12 Volts" by W7GRG in the January 1956 issue of *CQ*. Reprints $1.00.

SB-34 Improvement to r.f. Stage—"I have a new SB-34 and would like to know if I can improve its sensitivity by replacing the receiver r.f. stage transistor with a field effect transistor (FET). I also would like to know if there is any way of installing a variable a.g.c. time constant control on this set. Can you help me?"

If I were you I would leave well enough alone. This set has excellent sensitivity and selectivity and wonderful a.g.c. action. In fact I would go as far as to say that there is no comparable transistorized transceiver on the market today for the money. You of course can install an a.g.c. control on this set for various a.g.c. delay periods, but why? It is not an a.m. set. The values chosen are as good as can be obtained. I tried out the set and I was truly impressed by the a.g.c. action (among other things). On this one I can't help.

6 Meter Transceiver—"I would like to know if anything has appeared on making a 6 meter s.s.b. transceiver? If not, do you have any suggestions? I'm looking for something that has at least 100 watts input."

A number of small transistorized 6 meter transceivers have been described in the literature, but none in the 100 watt range. I suggest that you consider buying a Swan 250 6 meter transceiver. This is a relatively new Swan product and I predict that it will be mightly successful. This set is rated at 240 watts p.e.p. input and can be used at a fixed station or mobile.

Product Detector Questions

During the last two years more questions have been received on adding product detectors to the older receivers than any other. For some unknown reason there seems to be a "mystery" connected with the product detector and most of the writers requesting information want step-by-step design and/or installation instructions, and these we do not have for every set ever manufactured. A product detector actually is nothing but a good mixer-demodulator, there is nothing complicated about it. The signal (s.s.b.) comes from the i.f. strip is fed into the product detector *along* with a good steady b.f.o. signal, the result is of course output audio. Now there are detectors and *detectors!* Some introduce distortion; some are not configured to permit using a S meter; others work at high signal levels, and a few work very well. We have already described (a number of times) in this column the product detector's that will work with most sets. The smart ham leaves his old a.m. detector in his set and uses switches to cut in a product detector—but it takes a little ingenuity and cut-and-try. The simple solid-state ring demodulator described in HAM CLINIC in the June 1965 issue or the product detector with a.g.c. shown in the February 1965 column can be used in nearly any set. It is important only to try different signal and b.f.o. injection levels in either. If you want copies of the June or Feb. 1965 columns send $1.00 to the *CQ* editor.

Thirty

As this is written, our letter back-log is the lowest it has ever been . . . we only have about 65 letters to answer and answer them we will. For over eight years now we have *not* missed a column and we do not intend to. Helping out hams has become second nature to us and we enjoy doing it. However, we do appreciate it very much when you drop a line to the editor or a card to us telling us that you enjoy HAM CLINIC. Your letters keep the column going. So drop us a line will you? We'll try to help you with your problems although we cannot guarantee that we can answer them all. Remember to enclose two IRC's or 25¢ for airmail return postage from our current QTH: 4 Lutzelmatt St. Luzern, Switzerland or for somewhat slower service drop your mail in the box addressed to *CQ*. For this month then,

73 and 75, Chuck, W6QLV

SURPLUS sidelights

BY GORDON ELIOT WHITE*

THE Boehme model 5-C frequency shift converter has begun to appear in the MARS depots and on the surplus market in reasonable numbers this year. The unit is an excellent RTTY terminal unit for amateur use, providing diversity reception if two receivers are available, but useful as well for single channel operation.

The 5-C is a little bulky and weighs 67 pounds, but it is one of the most convenient converters to operate and the size is no handicap if you can mount it in a standard 19 inch rack.

Boehme is an old-line electronics company that used to build Wheatstone Perforators and other automatic Morse equipment. The firm is one of the few companies that take an interest in users of its older gear. Parts and some technical information on the 5-C converter, the perforators, and the Boehme model 6-E tone keyer may be obtained by writing Ralph Reinhardt at H. O. Boehme Inc., 200 Shames Drive, Westbury, Long Island, N. Y. Ralph tells me that Boehme plans to reprint the 5-C manual and reissue it, also possibly the manual on the Wheatstone Perforator. Parts for all of the older equipment may also be bought from Boehme through Ralph.

The 5-C is about ten years old now, and is being retired from government service chiefly with the Army Security Agency. I have seen surplus converters from such classified locations as Vint Hill Farms, Virginia, and Kagnew Station, Ethiopia, where they were undoubtedly used to monitor signals from Cuba, the U.S.S.R., China, etc. The 5-C can accept an unusually wide range of frequency shifts, from 200 cycles to 15 kc, plus make-and-break keying of automatic Morse, thus covering almost any interesting signal the intelligence boys might discover.

Inputs are audio, 500 or 5,000 ohms impedance, to terminals on the rear of the unit. The converter contains its own loop power supply, thus the teleprinter needs only to be attached to the output terminals for operation of the selector magnets.

A polar/neutral switch under the back of the converter should be set on neutral to operate the printer. (Polar operation would be necessary only if a polar relay was used in the local loop for keying a transmitter or other special purposes.) The TONE KEYER terminals could be used to re-transmit a received signal, but are not normally used in amateur operation.

I would recommend that if a single receiver is used that it be hooked to the #2 terminals. A front panel switch can be used to cut the #2 input on or off, a convenience, occasionally, in making adjustments.

On the front of the converter are located the monitor scope tube, output current meter, SHIFT RANGE, TUNING, and other controls. For operation turn on the local power switch, set the channel #2 switch "in," adjust the output level for proper magnet current of 20 or 60 ma, put the signal balance control in the center of its range, the F.S.-A.M. control on F.S., and the NOISE REJECTOR fully counterclockwise.

The various controls are shown in fig. 1 and should be easily understood. Assuming single-receiver operation to Channel #2, turn the monitor switch just to the left of the scope to Ch. 2. For normal 850 cycle shifts set the FREQUENCY SHIFT RANGE-KC switch to the left on ".2-1" (200 to 1,000 cycles). With at least some sort of signal coming through the receiver adjust the focus and intensity controls on the scope.

With a good FSK signal from the receiver, set the b.f.o. to provide the maximum width horizontal line on the monitor scope. Turn the tuning control in the center of the front panel until a vertical line of maximum height is produced on the scope in the familiar "+" pattern. Since receiver tuning, b.f.o. tuning, and converter adjustments interact to some degree, it may be necessary to juggle back and forth a bit to get the best signal indication.

Once a good "+" pattern is observed, the printer should be operating. If it puts out garble try reversing the OUTPUT REVERSE switch. There are a lot of signals on the air that sound like RTTY but won't print at all, on any speed up to 100 words per minute. For test purposes you might try tuning 5937 kc, which is WBR,a Navy weather station at Miami, Florida. It must have a really powerful transmitter, for it puts a booming RTTY signal into much of the U.S. mainland almost 24 hours a day.

After the printer runs right there are very few adjustments on the 5-C. The SIGNAL BALANCE control can be used to vary the bias from *mark* to *space* for best printing range. A distortion set might show the zero bias point for a particular signal, but generally eyeball calibration is as good as any.

If you are lucky enough to own two receivers feed the second audio input to the appropriate rear terminals and adjust the tuning with the

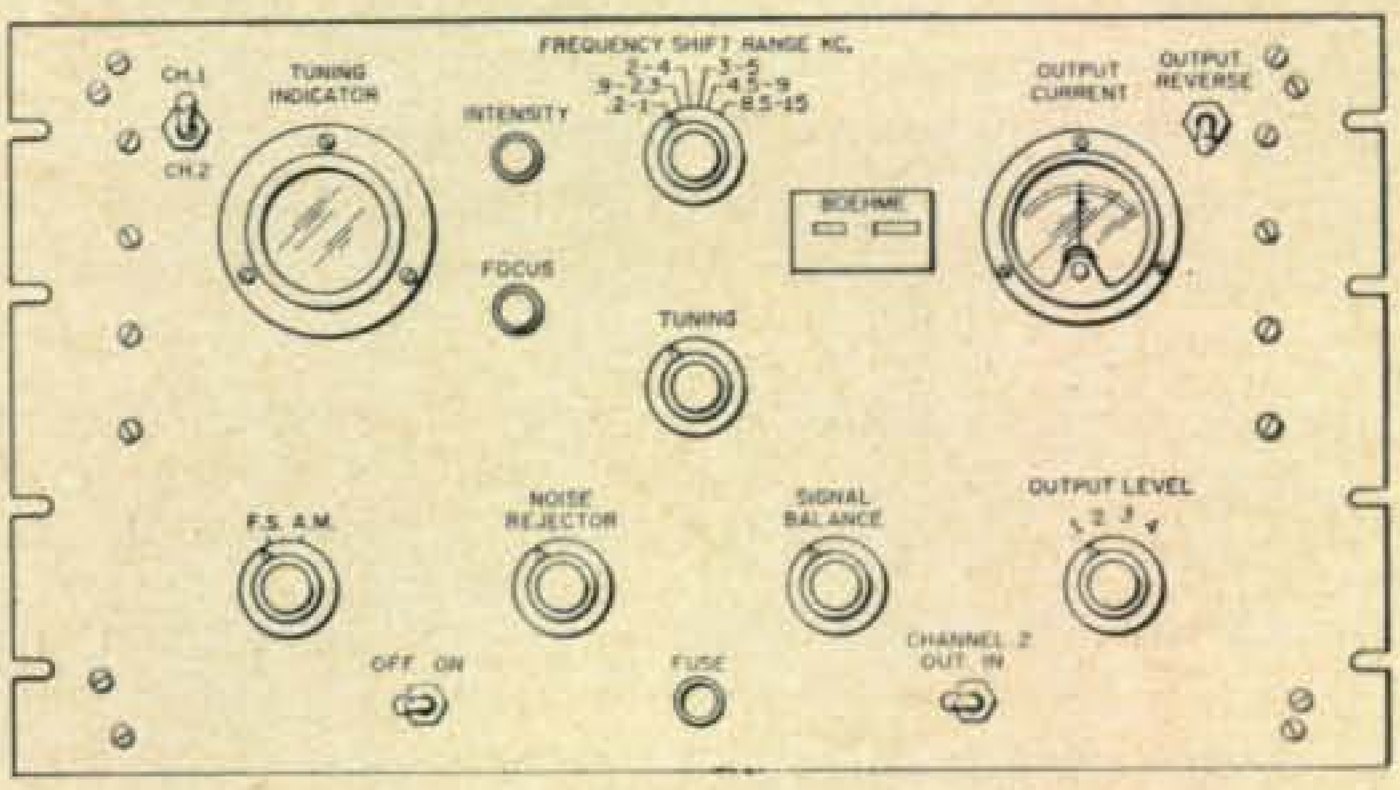


Fig. 1—Front panel view of Boehme model 5-C RTTY converter.

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

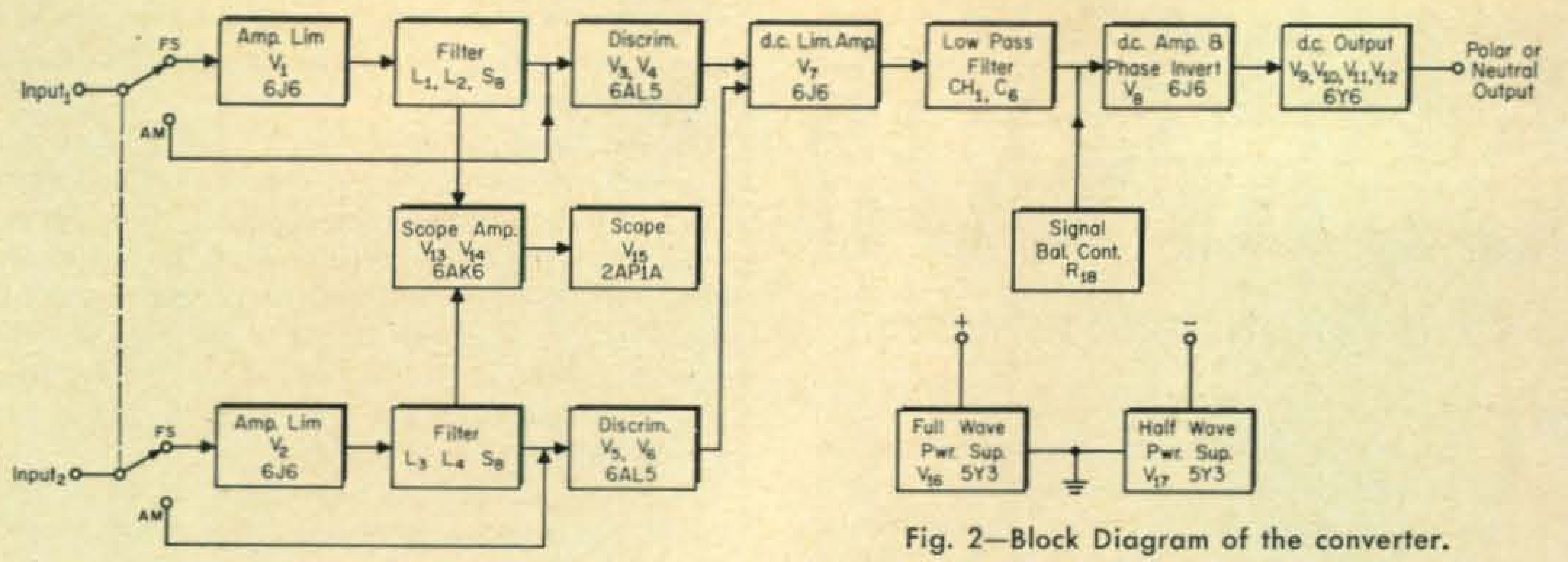


Fig. 2—Block Diagram of the converter.

monitor selector switch in the indicated position. The real problem in diversity work is the receiver tuning. For an amateur contact that is hard to copy you will probably find it difficult to tune the second receiver before the signal fades out entirely. Under poor conditions tuning is a slow and tedious process, particularly through noise, fading, or QRM, precisely the time when diversity would help the most. Once you get tuned in you often find that receiver #2 is receiving "upside down" with *mark* and *space* in the opposite sense from receiver #1. This condition may be checked by switching Channel #2 in and out and by flicking the output reverse switch to either position. Obviously only garble results from diversity operation of this sort, so retuning of one receiver is necessary.

Where you are working a reasonably steady signal, amateur or otherwise, diversity can be a great help, usually with space separation of the receiving antennas to counteract fading. In fact, I find that the addition of even as simple a receiver as one of the AN/ARC-5 Command Sets adds a great deal of reliability to my R-390-A Collins for RTTY.

The only "conversion" needed with the 5-C in my view, is a front panel jack or two. I have put in two input jacks and an output receptacle to allow patching strictly from the armchair rather than via the screwdriver route in the rear-rack cable jungle.

The a.m. position of the F.S.-A.M. SELECTOR switch is used for reception of make-and-break keyed Morse, a mode little used by amateurs for automatic reception. C.w. hounds could find a Boehme model 4-G inking recorder capable of copying up to 500 words per minute if they were interested in really fast operation! The NOISE REJECTOR control is a make-and-break keying adjustment. It is really a noise-limiter threshold pot that might be tried if ignition or other pulse interference bothers RTTY. I find that it can be advanced about a quarter-turn to the right during FSK reception before it drops out the signal.

The 5-C is, as I have intimated, wired for operation from ordinary 117 volt a.c. lines. It uses 17 tubes, with two 6AK6's in the tuning monitor section, four 6Y6 keyers, and a quartet of 6J6's and 6AL5's in the input and detector stages. The scope tube is a 2AP1A. Rectifiers in the power supply are 5Y3's.

The circuit is a limiter-discriminator f.m. design, relatively straightforward in operation, as the block diagram shows. The interesting features are the tuned audio filters, L_2, L_4, which are controlled by a gearing arrangement behind the tuning knob, giving a very wide range of continuous shift coverage. The upper control changes shifts by steps, within which the tuning control provides vernier adjustment.

The only problem I have had with my 5-C is reliability of the 6Y6 keying tubes, which run quite hot and seem to pop out every 20 or 30 hours. Maybe I just use tired tubes. The problem is not serious.

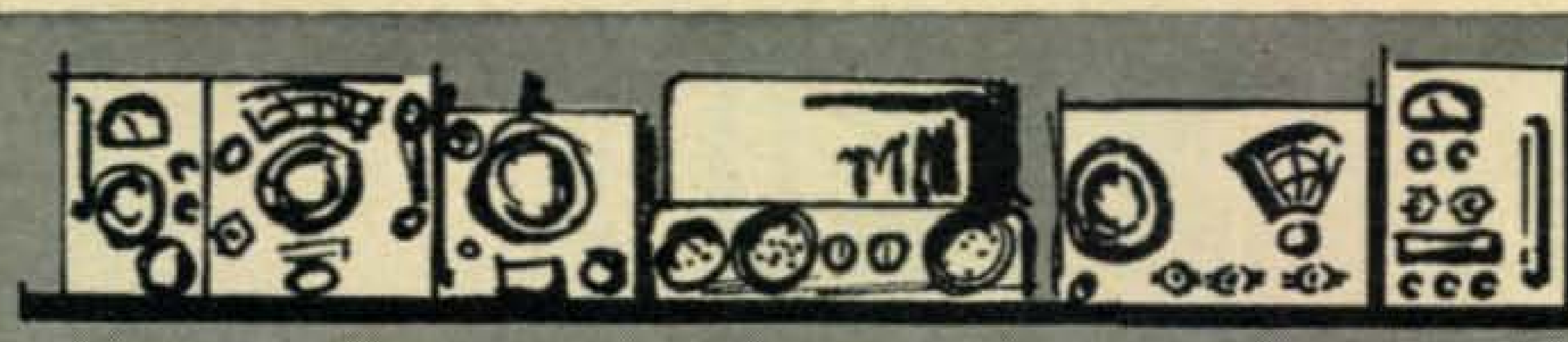
The specs show that the 5-C is 10½ inches high and 15 inches deep, in addition to weighing in at 67 pounds. Input may be as low as 15 db below 6 milliwatts, with a 35 db limiting range. There are -A and -B models, but the differences are very slight. Taps on the input transformers provide the different impedance values (500 or 5,000 ohms).

The SIGNAL BALANCE control, by the way, lengthens the mark pulse when turned clockwise from the center position.

In addition to the already mentioned equipment, Boehme made tape reels, Wheatstone Morse keyers, a keying relay used on those old A-N low frequency airway ranges; tape recorder driving units (inked tape); automatic keyers, etc. High-speed morse is still used, particularly by certain governments, but it is now "read" by computers instead of human operators, so most of the old Boehme material is in the antique class except for the RTTY units.

With the risk of overemphasizing RTTY material, I plan to go into some other converters and RTTY transmitters now coming on to the surplus market, and right now I want to warn the amateur gang about some of the complex diversity sets, particularly the huge six-foot rack monsters. Unless I have overlooked an oddball unit somewhere, none of the *time-division diversity* sets (AN/FGC-5; AN/FGC-29, etc.) is of any use whatsoever for amateur RTTY. The FGC-5 has a very nice monitor scope in the top position of each rack. The scope is self-contained, with a 117 volt a.c. power supply. Take it out and forget the rest. It won't work on single-channel signals, even with all 5,000 pounds in your shack.

SURPLUS CORNER



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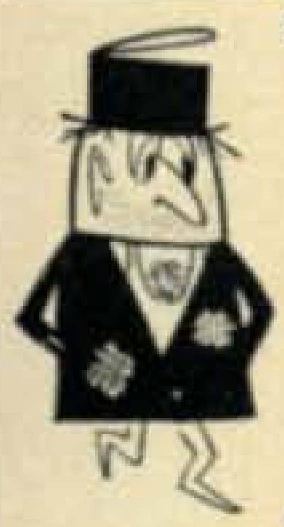

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TEST EQUIPMENT: AN/URM-25, AN/URM-26, SG-1A/ARN, AN/URM-80, AN/URM-81, SG-2A/GRM, AN/URM-32, AN/ARM-8, SG-13/ARN, AN/URM-48, AN/ARM-25, AN/ARM-22, AN/ARM-65, AN/ARM-5, SG-66/ARM, AN/USM-26, AN/UPM-98, AN/UPM-99, AN/UPM-4A, MD-83A, AN/USM-16, AN/URM-43, AN/APM-66, AN/APM-68, TS-723/U, TS-757, AN/UPM-32, TV-7/U, TV-2/U, AN/PRM-10, ME-11/U, AN/ARM-51, TS-710, TS-330, TS-683, TS-382, TS-621, AN/URM-52, TS-510A, AN/URM44, AN/PSM-6B, AN/URM-7, AN/TRM-3, SG-24/TRM, ME-6/U, AN/URM-14, AN/GPM-15, ME-30A/U, AN/USM-24, AN/USM-50, IP-111/ART-26, TS-497B, TS-403B, TS-186D, TS-505D, TS-537, SG-12A/U, ETC.

RECEIVERS: AN/APR-9, 13, 14, R-388/URR, R-388A, R-390, R-390A, R-391, R-392, R-274, R-220, SP-600JX, 51J-2, 3, 4, 51S-1, ETC.

AIRCRAFT EQUIPMENT: AN/ARC-34, 44, 38, 52, 58, 27, 73, 84, ETC., AN/ARN-14, 21, 59, 67, AN/APN-70, 81, 84, 22, AN/APS-20E, 81, 100.

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***Note: This phone number is correct. Our apologies to those who called the incorrectly listed number in last month's ad.**

For further information, check number 35, on page 108

Some of the gang have been misled by the Teletype Corp. nameplates and the designation "CV-71, CV-94 telegraph converters"—forget them.

So much for time-division multiplex. *Frequency Division multiplex* is a horse of another hue. I have put some drawers from the big AN/FCC-3 beast to amateur purposes with excellent results. The FCC-7, FCC-8 and FCC-60 ought to be equally adaptable.

Frequency division involves combining many narrow-shift channels into a single a.m. carrier using filters on each end to separate the signals. Most such units use 85 cycle and 170 cycle shifts in the 500 to 3500 cycle audio range. For appropriate amateur narrow-shift signals the receiving units can be used as is. For wider shifts the bandpass filters can be eliminated, as the discriminators are reasonably wide. Tuning indicators can be added with ease.

The transmitter sections make excellent audio frequency shift oscillators. In at least the FCC-3, -7 and -8 sets, each rack-mounted drawer has its own a.c. power supply and loop power. You can plug them in and go. Don't bother though, with the so-called frequency converters in these racks. They are multiplex/diversity heterodyne converters, *not* teleprinter converters.

Finally, I want to say a word to the hundreds of amateurs and others around the world who have written me about the column, or for assistance. I have heard from readers from Bangalore, India to Iselin, New Jersey. As far as I could, I have answered their questions, or referred them to someone who could. A few though, have needed help I could not readily give. I have a small stack of letters still waiting to be answered because I could not find the answer. To those readers I want to say I am still working on your problem, but I cannot promise how soon I can help you.

If anyone can give me information on the RT-53-B/TRC-7 transceivers; on the RCA AVT-23 transmitter; on the OS-8U oscilloscope; the CY-1181/TT field telephone; the T-27/ART-28 transmitter; the BC-406 receiver; the BC-452-F transmitter; the T-132/UPT-T3 transmitter; the AN/ARR-27 receiver; the RCA MI-8119-1A noise meter type 312-A; the PE-197 power units; AN/SRT-14, 15 and 16 transmitters; Rex Bassett GC-75 base station; the AN/FRR-48 receiver; the TDQ transmitter; the AN/PRC-36 radio set; the AN/FRR-10 and -24 diversity set, and the BC-1807, BC-1398 and OAP-1 sets, I'd like to have it in order to pass it along to interested amateurs.

One more note on manuals: Jim Cooper, W2BEV, 834 Palmer Avenue, Maywood, New Jersey, has a listing of almost every Teletype Corp. book ever printed, including the FRXD, MXD, #26, #28 and later machines. His prices are quite reasonable.

I have a late letter here from Tom Allen, of Tallen Electronics, 300 7th Street, in Brooklyn, N. Y., to the effect that he has quite a stock of AN/ARC-3 units at under $10 each. ■

For further information, check number 39, on page 108

Lafayette HA-650 Review [*from page 19*]

One thing that was first found annoying was that if the set is used with an external antenna with the unit place in a normal table-top position, the folded-over whip antenna obscures the S-meter and the tuning dial, and swinging it away from the panel places it in the way of the operator. Happily though, it was found that this interference could be eliminated by screwing the antenna off its base and setting it aside.

The HA-650 is manufactured in Japan; nevertheless, you need have no fear about transistor replacements, inasmuch as Motorola type 2N2951 and 2N2949 are used in the transmitter driver and final amplifier respectively, and American equivalents, such as the Fairchild 5006, are available as replacement of the Japanese types used in the other stages.

The set is neatly built on a printed-circuit board mounted in a sturdy chassis framework. The entire assembly is housed in a heavy-gauge metal case in which a removable plastic battery holder also is contained.

The HA-650 is priced at $119.95 complete with p.t.t. microphone, carrying case, external battery cable and all mounting hardware. It is available from Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, L.I., N.Y. 11791.

—*W2AEF*

Announcements [*from page 10*]

New QRP Club Award

The QRP Radio Club wishes to announce that they intend to present an award to an outstanding amateur in the "2" call area for 1966. For further information contact Joseph Tiszka, WA2JKX 64/12 Gate Ave., Ridgewood, N.Y. 11227.

Pittsburgh, Pa.

The Greater Pittsburgh VHF Society is holding its Annual Corn Roast and Transmitter Hunt at South Park, Mercer Grove, Penn., Sunday, August 14, 1966, all day.

Stolen Equipment

A Knight-Kit VTVM and a Galaxy V Transceiver S.N. 6602 V 2241 was taken from the Keesler Amateur Radio Club Bldg. between May 7 and 11. Any information concerning this should be sent to Lawrence H. Molitor, K9VBS/5, CMR #4 Box 14796, Keesler AFB, Miss. 39534.

Corrections

In fig. 4 on page 32 of April '66 *CQ* and in fig. 1 on page 27 of May *CQ*, the polarity for the meters in the control grid-return circuit should be reversed.

At fig. 2 page 31 of Feb. '66 *CQ* the rectifier circuit is called a full-wave type. Although this may be the case inasmuch as both halves of the cycle are rectified, output voltage is produced only during each half cycle and thus it appears to the load as that from a half-wave rectifier.

In the June 1966 issue of HAM CLINIC page 85, fig. 1 should show the secondaries of the transformers used as 500 ohms *not* 500,000 ohms.

Contest Calendar [*from page 90*]

not be fair to make any adjustments after the results have been officially announced. Don found the log among some things Chuck had left behind at Pago Pago, Samoa. The original

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was sent to Ack and QSLs are already on their way.

Highlights of the past month have been the presentation of the Potomac Valley Trophy to Jim Lawson, WA2SFP at the North Jersey DX Ass'n Roundup in Newark, and visits by Bruce Henke, M1N/W6JFJ and Tony Gomez, YV5AGD of the YV9AA crew. Bruce entertained a group of W1/DXers with slides of his San Marino trip and Tony did likewise with slides from the YVØAA DXpedition of a few years ago. Two most enjoyable evenings. Now to sit back and relax (?) for a couple of months.

73 for now, Frank, W1WY

DX [*from page 93*]

same pattern—AA thru XZZ being private calls and YAA thru ZZZ club stations. *(Tnx JA1BN).*

QTH's and QSL Managers

ZB2AM—via W1GHT.
ZD8J—via K4LJV.
HC1GC—via W2CTN.
ZD5D—via WB6CWJ.
VK9CJ—via W2GQN.
MP4TBO—via VE1AKZ.
CX9AAK—Box 27, Montevideo, Uruguay.
CR6IF—Box 261, Benguela, Angola.
MP4BFT—via KØSZY.
ZF1RD—via K8LSG.
KS4CA—via WA9OVE.
7Q7PS—via W1MRQ.
K1YPE/XV5—via W4UWC.
CN8—QSL Bureau Box 299, Rabat, Morocco.
PJ5ME—via W2CTN.
VR5CR—A. Carter, c/o Weather Office, Honiaro, Solomon Is.
7X2AH—via WA4STL.
5W1AX—via KS6BT.
TY3ATB—via VE2ANK.
KW6EK—via W2CTN.
ET3AC—via W4NJF.
SVØWV—via K1VWJ.
VP8IY—c/o British Antarctic Survey, Port Stanley, Falkland Islands.
ZB2AM—via W1GHT.

Propagation [*from page 92*]

mately 300 miles, and up to 2300 miles during the hours of darkness. While no 160 meter short-skip openings are forecast during the daylight hours, some openings are expected to occur over distances up to approximately 2300 miles during the hours of darkness.

DX propagation charts for July appeared in last month's column.

VHF Ionospheric Openings

Intense sporadic-*E* ionization expected during July is likely to result in some 6 meter short-skip openings between distances of approximately 900 and 1300 miles and occasionally as great as 2300 miles. There is also the possibility that an occasional short-skip opening over a distance of approximately 1200 miles may also occur on 2 meters as a result of sporadic-*E* propagation.

Some meteor-type v.h.f. ionospheric openings are likely to occur during the last week of July when the *Perseids* and *Aquarids* meteor showers are in progress. The *Perseids*, one of the major meteor showers, usually extends well into August.

Auroral disturbances sometime occur during July. V.h.f. short-skip openings resulting from auroral ionization are often possible during such disturbances. Refer to the "Last Minute Forecast" appearing at the beginning of this column, for periods that are expected to be disturbed during July.

Sunspot Cycle

The sunspot cycle continues to increase slowly. The monthly Zurich sunspot number reported for April 1966 was 47.5. This is the highest monthly level recorded since September 1962, and results in a smoothed sunspot number of 19 centered on October 1965. A smoothed sunspot number of 34 is forecast for July 1966.

73 George, W3ASK

Results of YL-OM Contest [*from page 61*]

YL CW

W1YYM	53,346
K2JBX	25,670
W3UTR	7,650
WA4HOM*	52,480
K5FXX*	20,475
WA6OET*	50,540
WA7BAB	23,253
K8ONV	36,675
W9KSE	17,258
WA2WBA/Ø*	39,655
VE1AQI*	6,100
VE3EZI*	47,970
VE6ABV*	6,960
VE7BPM*	36,660
DJ9SB*	10,850
LA6ZH*	110
OH2YL	144
PY2SO*	32,544
SP6AZY*	3,565
VK3KS*	4,830
ZL2JO*	4,869
VE8BB	456
DJ8EN*	70
OZ5EU*	3
PY2CQ	56
VK3XB*	1

OM PHONE

W1FDW*	2,868
K2PXX*	1,148
W3BVL	1,536
K4JIG*	2,681
K5MDX	7,336
WA6TKQ*	1,760
W7ULC	1,995
W8WUO*	2,364
W9LNQ*	3,754
WØGNX	1,305
KH6BIH	285
WA4MFS/PK4*	380
VE2CK*	356
VE3BJK*	609
VE4ZX	182
VE7AKB*	1,125

OM CW

W1ECH	2,574
W2AAU	2,680
WA3EEQ	2,432
W4JUJ	2,030
K2EIU/5*	3,250
W1PYM/6	2,418
WA7CAQ*	2,779
W8AJW*	3,218
W9WGQ*	4,046
WAØKDS*	2,228
KH6BIH	513
VE1AE*	467
VO1AW*	333
VE2AQJ*	720
VE2AQO*	1,463
VE3BJK*	2,538
VE4ZX	858
VE6UP	1,734
VE7BDJ	980
VE8BB	932
DL1QT	255
G3WP*	20
IT1AGA*	553
LA1H*	546
OH3MF*	105
OK2QX*	138
PAØVB*	38
PY2CQ	224
SM3CNN*	88
SP8MJ	195
UR2DE*	11
VE1AFD/SU	12
VK3XB*	20
YU1MV*	113

Passive Multipliers [*from page 68*]

a 2N1692 to approximately ½ watt. Care should be taken to assure that the self resonant frequency of RFC_1 is not harmonically related to input frequencies but is less than the output.

Conclusion

The author has constructed and evaluated a number of circuits using both types of devices. The varactor remains the superior device where high power is required, but higher power SRD are being developed. Experimental units have been operated successfully with 8 watts drive in 2000 mc range. Where high orders of multiplication at low power levels is required the step recovery diode is far superior to the varactor in stability with large variations in input power and bias voltage. Similar units to the one shown in fig. 5 are available to amateurs at low cost by sending a QSL card to Milt Liebhaber, District Sales Manager, hpa Associates, 3939 Lankershim Blvd., No. Hollywood, California.

Operating Abroad *[from page 78]*

that you can tell local hams who you are, where you are located *etc.;* **do** help the nationals to learn English, they will usually appreciate this; and **do** abide by any special regulations affecting your license.

If you are authorized to operate mobile in a specific country, you no doubt will be stopped by the police from time to time. You should have your license with you as well as a "paper of explanation" (in the national language)—the latter prepared by someone who can write the explanation of your activities. If you speak the local language then you will have no trouble.

Proceed With Caution

Reciprocal operating agreements between the country in which you are located and *other* countries usually do *not* provide for operating privileges for alien hams in these countries. This means, that you, as a U.S. citizen authorized to operate in country "A" with which it has a reciprocal agreement with country "Z" does not necessarily mean that *you* can operate in country "Z." So before you leave country "A" for country "Z" make sure they will allow you to operate, otherwise you will find on trying to get into country "Z" that you either must remove your radio equipment (unless in transit) or have it sealed. This is important. Do check mobile operating regulations thoroughly and check with the authorities of the countries through which you will pass if you are transient.

There is no doubt about it, reciprocal operating privileges do engender international goodwill and contribute to better understanding. Further, they encourage people-to-people visits which are so essential in this modern day and age, but the ham need not travel any further than his operating position to talk to people in all walks of life all over the world. It is my opinion that the radio ham world-wide does more for his country than he is sometimes given credit for. ■

2-Meter Pre-Amp *[from page 73]*

supply (or plugging in the transistor backwards) and excessive supply voltage (do not exceed 20 volts on this preamp, even for an instant). If these two rules are observed and there are no accidental shorts on the printed circuit card the transistor should never need replacing which is one of its greatest advantages.

Conclusion

The preamp described will give as good or better noise figure as any nuvistor or 417A and provide excellent gain. The power drain is so small that an external battery will give many months of operation. The best feature of this preamp is that you will never have to worry about a tube going soft, or the *Gm* falling off, or the filament burning out because, barring accidents, the performance of the transistor preamp will not change. The author would like to thank W2EUP and K2GUG for their help in evaluating the performance of the preamp. ■

Ham Shop

Advertising Rates: Non-commercial ads 10¢ per word including abbreviations and addresses. Commercial and organization ads, 35¢ per word. **Minimum Charge $1.00.** No ad will be printed unless accompanied by full remittance. **Closing Date:** The 10th day of the second month preceding date of publication.

Because the advertisers and equipment contained in Ham Shop have not been investigated, the publishers of CQ cannot vouch for the merchandise listed therein.

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QSL-SWL-WPE cards. Samples 10¢. Log sheets, QSL cards, Decals, Rubber Stamps, Certificates. MALGO PRESS, Box 375, Toledo, Ohio 43601.

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QSL's, 100 4-color $3.99. Free Samples. ED's PRESS, W9BPJ, 3232 LeMoyne, Chicago, Illinois 60651.

EMBOSSED QSL cards. Free samples. ACE PRINTING SERVICE, 3298 Fulton Road, Cleveland, Ohio 44109.

100 two-color QSL's, 100 letterheads, 100 envelopes $2.95 postpaid. Merchants Press, Taylor, Texas 76574.

HUNDRED QSL's. $1.00. Samples, dime, Holland, R3, Box 649, Duluth, Minn. 55803.

QSL's: Moyers Printing, 846 Rising Son, Telford, Penna. Samples Stamped envelope.

CB, SWL, QSL, WPE CARDS. Free Samples. ABCD Printing, P.O. Box 658, Edgewater Branch, Cleveland, Ohio 44107.

QSLs, samples 10¢. Samco, Box 203, Wynantskill, N.Y. 12198.

QSLS—100 3-color glossy $3.00; silver globe on front report form on back. Free samples. Rusprint, Box 7575, Kansas City, Mo. 64116.

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COLLINS telescopic antenna, HF, 120′ extended height, model #237Q-2A, freq. range 2-30 MC, 50 ohm, omni directional radiation pattern, blast protected, shock insulated. Gov't. surplus, from Atlas "F" missile sites . . . like new! (10) avail . . . first come, first served! Perry Equipment Corp., 1421 N. 6th St., Phila., Pa. 19122.

NOW! A publication devoted entirely to Government Surplus electronic equipment. Many schematics and other interesting data each month. Sample copy 25¢. 12 month subscription $3.00. National Surplus Digest, P.O. Box 36Q, Sweet Valley, Pa.

WHOLESALE: Microphones 89¢, 4-transistor amplifiers $4.95, Speakers 56¢. Hundreds of items. Catalog 25¢. Refundable. ROYAL, Box 2591, El Cajon, Calif.

NOVICE CRYSTALS 80-40M $1.05 each. Also other freqs. Free list. Nat Stinnette W4AYV, Umatilla, Fla. 32784.

LEARN GUITAR FAST! Get Chordogram! $1.50. CROSSWIND MUSIC, Box 3240, Huntsville, Ala. 35810.

RTTY GEAR for sale. Write for list-issued monthly. 88 or 44 Mhy toroids. Five for $1.75, postpaid. Elliott Buchanan W-6-VPC—1067 Mandana Blvd., Oakland, California 94610.

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NEW TOOOOOBES: 6146B—$4.00; 6CW4—$1.40; 417A—$3.95; 6360—$3.45; 6146—$2.55; New, boxed, guaranteed. NO pulls, seconds or JAN. Free catalog. VANBAR Dist., Box 444Y, Stirling, N. J. 07980.

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TELETYPE TEST SET I-193C. Government rebuilt, still crated. Tests RTTY transmitters, converters, relays. $14.95 each. F.O.B. Harrisburg, Pennsylvania. Satisfaction guaranteed. Telemethods International, P.O. Box 18161, Cleveland, Ohio 44118.

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For further information, check number 27, on page 108

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37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
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Non-commercial ads only

"HAMFESTERS RADIO CLUB" Chicago, Illinois, proudly announces its 32nd Annual Midwestern Hamfest, Sunday August 14th at Santa Fe Park, 91st Wolf Road near Chicago. The Hamfest features manufacturer and distributor exhibits, swappers row, contests, awards and a variety of activities for all. Clowns and games for the children, activities for the XYL while you enjoy amateur radio with friends and acquaintances. The Hamfest climaxes "Illinois Amateur Radio Week August 8-14th," by proclamation of Governor Otto Kerner. For complete details and a map of the location write: Gregory Purteck WA9MRE, 2916 West Marquette Road, Chicago, Illinois 60629.

MUST SACRIFICE mint HT-37. Original owner, purchased new. First certified check for $275. takes it. Ship express collect. W8EWP, 7229 Saratoga, Reynoldsburg, Ohio 43068.

FOR SALE: Clegg 22er A1, Mint $160.00. UHF Resonator 32 elem. 2 meter beam $20.00. Art 28, $45.00. H. Wright, 3857 No. 86th St., Milwaukee, Wisc. W92FT.

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APACHE AND MOHAWK Heathkit gear in very good condition. Factory checked, $325.00 or best offer. R. Milasich K9ECK, 405 Price, Calumet City, Illinois.

ELMAC AF-67 with James C-1050 mobile supply—$70.00/DX-100—$50.00/SX-99—$67.50. All with manuals. K5RVB—Box 133—Mt. Pleasant, Texas.

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AMECO TX-62 with Co-ax relay, xtals, home brew VFO-voltage reg. Self cont'd. Supply and EV-727-S.R. Mike. All for $140.00. Used very little, poor activity area. W9HEM, 2004 Golfview Dr., Urbana, Illinois.

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PROFITS FROM coins in your pocket or piggy bank! Send any 1955 half dollar and receive $3.00 in return. Send any penny prior to 1934 and get back 3¢. Any plain 1954 penny will get 3¢ back. All mercury dimes prior to 1934 can be worth up to double your money back. If it has a little "D" or "S" it's worth 20¢ and 15¢ if no letter. No bent, drilled or mutilated coins accepted. Postage refunded upon receipt of your coins. Send any amount, mixed or singles. Robin Cowan, Dept. 5J, 73-62 Bell Blvd., Bayside, N.Y. 11364.

Last month I was asking $200.00 for my excellent condition Gonset G-50 and $175.00 for same condition 2 meter Communicator IV. This month I'll accept any reasonable offer for either or both, and throw in a bunch of crystals. Ship express collect anywhere, or will deliver anyplace on Long Island. Tom Kneitel, K2AES, 6 Netcong Place, East Northport, N.Y. 11731.

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WANTED . . . Silver dollars. Any condition, will buy or trade. Drop a line if you have any other coins for sale or trade. Scott Cowan, Dept. J5, 73-62 Bell Blvd., Bayside 64, N.Y.

LONG ISLAND HAMFEST AND PICNIC sponsored by the Federation of Long Island Radio Clubs will be held Sunday July 17th. at 9 AM. COME ON DOWN with the entire family for a pleasant day. Picnic Pavilions, Swimming, Playgrounds, Charcoal Grills, Technical Talks, Manufacturers Displays, Prizes, Mobile Judging Contest, Auction and more.

WANTED: GOLDKIT thriller transceiver or NORSEMAN transceiver box 107 Wilmington, NC.

NEED copies of old RADEX (Radio Index) magazine from 30's and 40's for personal collection. Want single copies or complete collection. State condition and price first letter. Tom Kneitel, K2AES, 112 New Highway, Commack, N.Y. 11725.

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For further information, check number 37, on page 108

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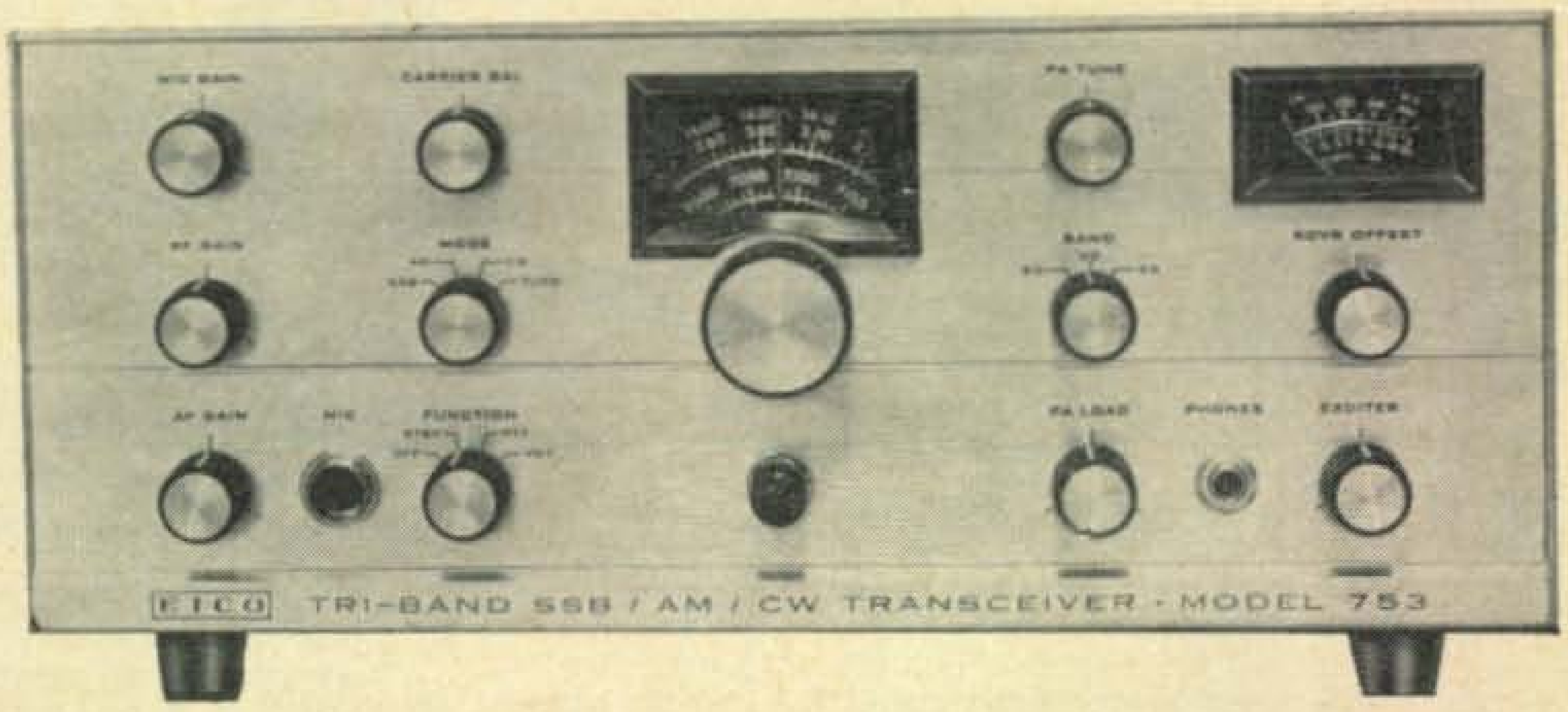

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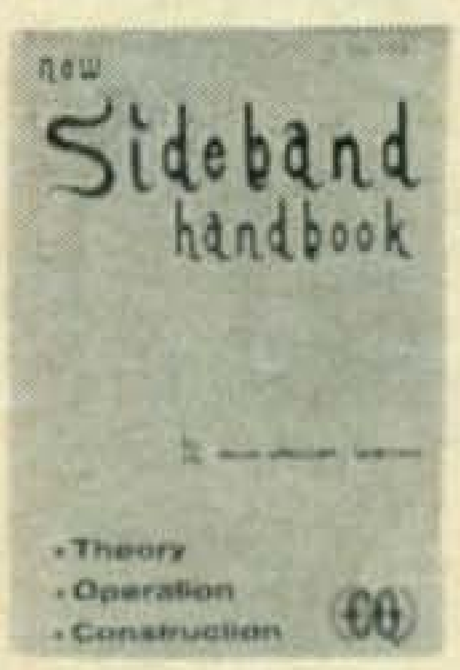

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