TM-73

NOT-TOO-TECHNICAL MANUAL

RADIO SURPLUS A LA 73

CONVERSIONS ET CETERA

RESTRICTED. This annual catalog issue contains hobbytype projects developed expressly for radio amateurs; any other use constitutes a flagrant show of interest in 73, THE WORLD'S LARGEST INDEPENDENT HAM MAGAZINE.

NOT AFFILIATED WITH THE
WAR DEPARTMENT

MARCH 1970

73 MAGAZINE

#114, March 1970

Contents

Features

STAFF

73 Magazine is published by 73, Inc., Peterborough, New Hampshire 03458. Subscription rate: $12.00 for three years, $6.00 for one year. Second Class Postage paid at Peterborough, New Hampshire, and at additional mailing offices. Printed at Pontiac, Illinois, U.S.A. Entire contents copyright 1970 by 73, Inc., Peterborough, New Hampshire 03458. A bunch of people (listed at the left) worked far beyond the call of the almighty dollar to make this the biggest, best, most attractive issue of 73 yet published. They hope you notice. They are working on the Big April Special FM Repeater Issue which will carry the most complete and up-to-date listing of the over 300 amateur FM repeaters in the U.S. They solicit your help in getting interesting items for the Amateur News Page, the first ham newspaper of its kind. You're not on FM yet? You will be.

Amateur Radio News Page

March XIXLXX Monthly Ham News of the World 73 Magazine

Subbands Reallocated in FCC Action

Amendment of FCC Rules Adopted To Shift Frequencies and Emissions In the Amateur Radio Service

Amendment of Section 97.61 (a) of the Rules shifting frequencies and emissions in the Amateur Radio Service to the subband where A-1 emission is exclusively permitted from the 147.9—148 MHz band to the 144.0—144.1 MHz band; and shifting the subband where F-1 emission is permitted from the 29.0—29.7 MHz band to the 28.0—28.5 MHz band, has been adopted by the Commission, effective March 2, 1970 (Docket 18508, RM-886, RM-950).

The amendments were originally requested by the American Radio Relay League (ARRL). A Notice of Proposed Rule Making in the matter was released on April 3, 1969, (FCC 69-313), inviting interested persons to file comments on or before June 11, 1969, and reply comments on or before June 23, 1969.

Cl

Comments in support of the changes were filed by the ARRL, the Electronic Industries Association (EIA), Central States VHF Society (Central), and Forrest A. Bartlett (W6OWP). A comment filed by Donald R. Nelsch (K8EIW) supported adoption of the proposal in RM-886, but requested F-4 emission to be included in the 144.1 to 148.0 MHz frequency band. A comment filed by Howard McCall (W8TNF) was the only one which opposed adoption of the proposal in RM-950. No reply comments were filed.

SNOWMOBILE "MOBILE"... a first?

Bill Loeffler W1PFA Salem N.H. combines ham radio with the new popular sport snowmobiling. With a Galaxy FM 210 and Antenna Specialists 2 meter gain

CD Group Goes 2 Meters – FM

Bill Loeffler, W1PFA radio officer for the town of Salem, N.H. recently announced the RACES section of Civil Defense has planned to purchase 10 Galaxy FM 210 units of local communications. Recent tests made with the units proved the town to be neatly covered with mobile operation to base station with no blackout area whatever. Don Alexander W1UFK and Tony Coco K1ILB, communications officers for the town, feel that channelized operation on the 2 meter FM band, will greatly advance the local operation. Salem is expected to be the first RACES operation in New Hampshire to go FM.

YA Club Formed, Award Offered

Group standardizes prefixes

Since there is no licensing authority in Afghanistan, amateur operation in that country has been somewhat confused in the past. Amateurs have mere-

In its comments, ARRL pointed out that the 144.0—146 MHz band was assigned to the Amateur Radio Service on a world-wide basis, and that the 146.0—148.0 Mhz band is authorized to the Amateur Radio Service in Regions Two (Western Hemisphere) and Three (Southern Asia and Oceania), and to the fixed and mobile services in Region One (Europe, Africa, and Northern Asia); that while the 144.0—146.0 MHz band is specifically authorized for amateur satellite operation, the present 147.9—148.0 MHz, reserved for A-1 emission, cannot be used in Region One. The proposed 144.0—144.1 MHz band may, however, be used world-wide. Canada also has set aside 144.0—144.1 MHz for A-1 only operation.

The Commission said it believes that "clearing a portion of the 144—146 MHz band is desirable for continued experimentation in space techniques by amateurs."

Central commented that, although it supported the proposal, the Commission was not going far enough. It stated that "the assignment of the first 100 kHz of the 144 MHz Amateur band to A-1 emission is at best a stop gap measure . . . " and that additional protection of experimentation may be required in the future. The Commission said, however, that the evidence submitted by Central is "insufficient to persuade us that a larger subband is needed and should be authorized at this time."

antenna mounted on front of Ski Doo, Bill works into the W1ALE repeater at Concord, N.H. Power for the rig is taken from the cigarette lighter socket on Ski Doo. The snowmobile is a Bombardier Ski Doo Nordic 640E. Bill is also a member of the Salem, N.H. S-Ki-Mos snowmobile club. The 73 on front of the 'mobile is Bill's registration number in the Salem S-Ki-Mos club; there are 85 members.

In reference to the suggestion made by Mr. Nelsch that F-4 emission be included in the 144.1—148.0 MHz amateur band because of the availability of facsimile equipment of commercial quality, the Commission said that this request is beyond the scope of this proceeding. It added, however, that the matter is the subject of a separate petition for rule making (RM-1429) filed by James L. Turrin (WA8DCE) and would be considered when that petition comes before it.

C

Howard McCall told the Commission that he disagreed with the proposal in RM-950 to relocate F-1 emission in the 28.0—28 MHz frequency band because it would result in a loss of 200 kHz for this type of transmission. Although the proposed relocation would result in a reduction of 20 kHz of bandwidth available for F-1 emission, the Commission said it believes this loss is "not extensive and is outweighed by the advantage of moving radioteleprinter emission (F-1) into the CW portion of the 28 MHz band."

Finally, the Commission stated that it believed that the shift in frequencies would not affect the operation of its users significantly.

W1TNO (Ted) in Concord, N.H. reported that he worked W1PFA/snowmobile in Salem, N.H. in late January. Bill was out with the local snowmobile club, with some 90 snowmobiles, running a test to check on the emergency use of FM via the repeater. The test worked perfectly, easily turning on the W1ALE repeater in Concord, some 40 miles away. Is this the first repeater FM operation from a snowmobile?

FCC Nails Ham for "Fraud"

In a public notice issued on January 16, 1970, the FCCrevoked the license of Herbert L. Rippe W8DE. According to the report, Rippe had obtained his two-letter call by "fraudulent" means, in violation of Section 97.129 of Amateur Rules and Regulations, Part 97. His revocation was made effective as of February 16.

Allied has free classes

Allied Radio Corporation will begin its annual Novice amateur radio license course on January 19, at the main Allied store, 100 N. Western Ave., Chicago.

The free 14-week code and theory course will meet each Monday evening to help prepare would-be hams to take the Novice FCC license examination. The course will be taught by one of Allied's staff of licensed radio amateurs, with the major emphasis placed on learning the code.

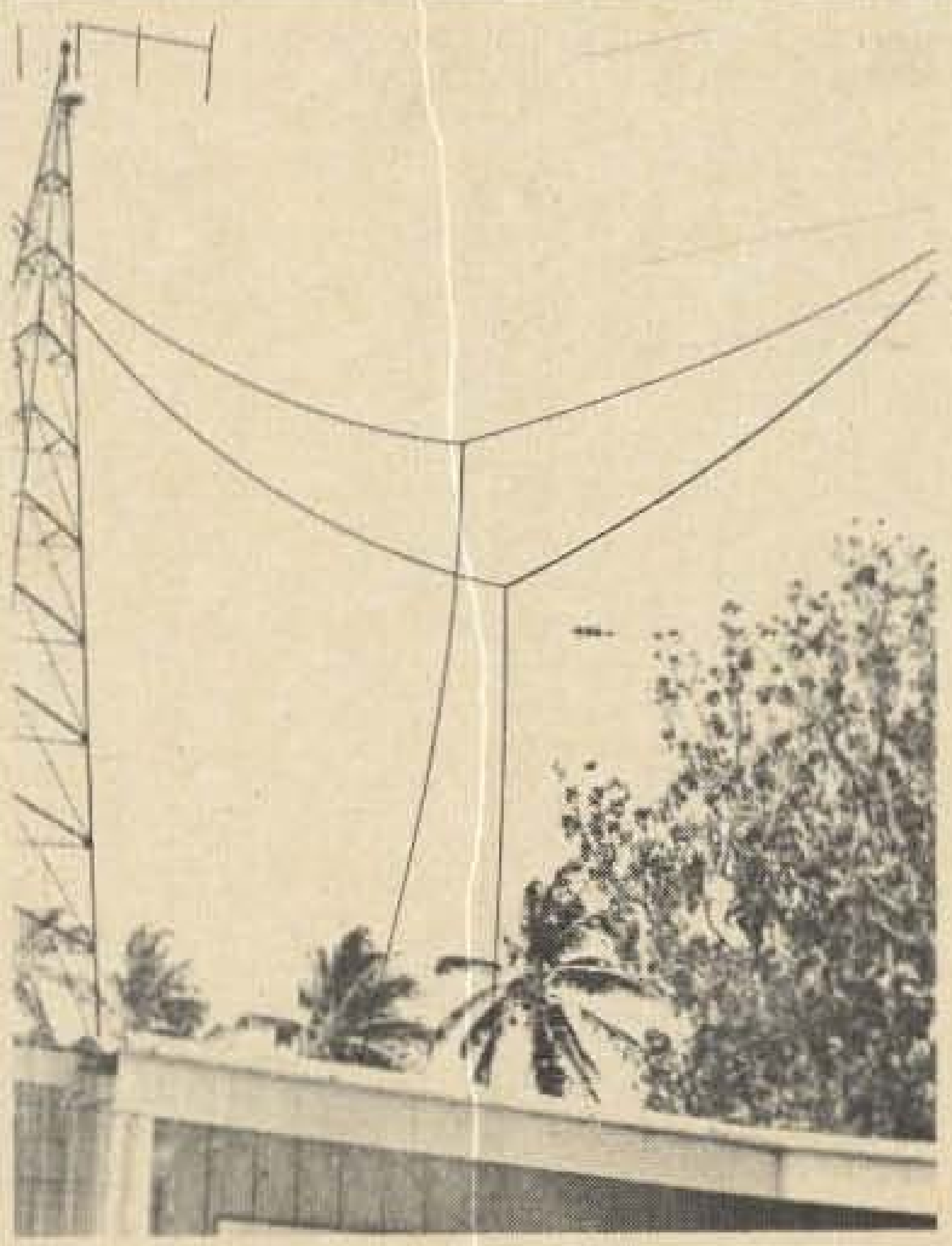
FUCHU AS, Japan — Members of the Far East Auxiliary Radio League in Japan receive a demonstration of manufacturer's performance specifications versus actual performance in electronic equipment by Mark Radke (seated) of the U.S. Army Depot Command, Japan. Watching the demonstration are (from Left) Skip Brady, KA2SB/WB6RBI, Ed Frazier, KA2ZD/WA0ZZD, and Bill Ross, KA2DK/K5LLK, league president. The league is composed of U.S. military personnel in Japan with an interest in amateur radio. The group promotes activities of KA stations in Japan and fosters goodwill in the Far East and throughout the world through the medium of amateur radio.

ly brought in their equipment, set it up, picked out a call they liked, and gone on the air, hoping that no one would get upset in the government.

A little order is appearing out of the chaos now with the formal organization of the Camel Drivers Radio Club, organized by YA5RG. The country has been broken up into nine prefix districts, and the club will endeavor to get all ops to abide by them. This may be helpful and will certainly go a long way toward preventing one op from coming to Kabul and using ten different number prefixes in order to generate more DX activity, giving the impression that he is actually moving around the country.

The club is offering the *Afghanistan Radio Award* to all amateurs and SWLs of the world. Contacts must be confirmed on at least two amateur bands and six contacts are required for YA amateurs, four for Asian amateurs (except YA), three for Europeans, and two for the rest of the world. Send QSLs and 10 IRCs (or one dollar), contacts from 1966 on count, to CDRC, Box 279, Kabul, Afghanistan. Send an extra dollar for airmail return.

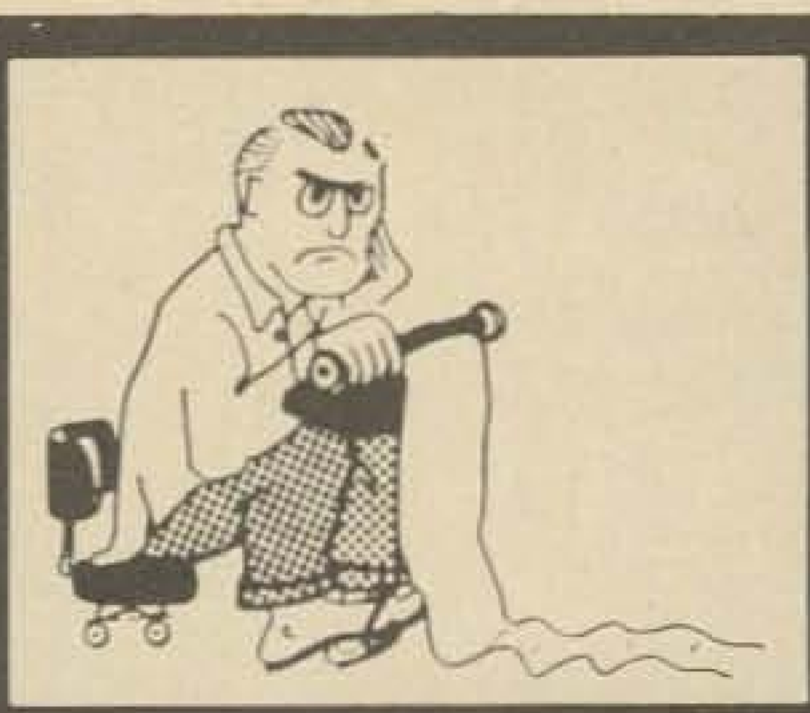
VK9KY ACTIVE FROM COCOS KEELING ISLE



One of the more remote spots in the world is Cocos Keeling Island, off the coast of Australia and south of Sumatra. The only active station on this island is VK9KY, operated by Ken Young, who is living on Cocos running the Ionospheric Prediction Service station. The tower is used for the vertical sounding of the ionosphere and the fixed beam on top of the tower is pointed at Sydney for the weekly reports to the home office.

The dipoles are used for contacts on 15 and 20 meters and are broadside to Europe, thus holding the signal down a bit toward the States. Ken is planning on putting up a groundplane, and may even be able to swing a wire beam in a stateside direction. There are, of course, no materials available on the island for building even a simple regular beam.

If you might be able to help Ken out with antenna materials, his address is Box 31, Cocos (Keeling), Indian Ocean via Perth, Australia. QSL to his manager VK2SG. He often can be worked on 20 meters around 1200Z, sideband. Stamp collectors will treasure the beautiful bird stamps from Cocos.



NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

Since I am sure that many readers must be pretty sick of reading about the ARRL in my editorials, I will ignore them completely this month except for a short answer to a letter.

The letter (from Paul Crilly WA1IND, 15 Rosewood Drive, Simsbury, CT) is quite critical of me for having bad things to say about the ARRL, which he considers a fine organization which has helped hams in countless ways. He feels that the amateurs are enthusiastic about incentive licensing and that I am afraid of progress and improvement of the quality of amateurs.

You might think, from some of my mail, that I have written editorials saying that the ARRL is run by a bunch of crooks, headed by Captain Klutz, a chap whose morals would make the Mafia blush and whose intelligence would hardly qualify him for admission to the Crotched Mountain Home for the Mentally Retarded. No matter what I may personally think, I have not written anything like that.

The ARRL was started by Hiram Percy Maxim, a genius, the son of a genius, and the grandson of a genius. It took genius to get something like the ARRL going. When Maxim died there was the usual fight for control by those of less than genius talent. Some day someone will write an honest history of the ups and downs of the ARRL, but so far all we have seen are self-congratulatory rewrites of history.

Though the League has fallen into the hands of those of less than genius calibre, the organization continues to provide many very valuable services to the amateurs it was founded to serve. Few of them, unfortunately, are completely above criticism. We have not historically seen much improvement in ARRL programs until the tide of public opinion has forced changes. In connection with this you might note that the voice of 73 is the only one not stilled by fearful publishers. I won't list the manufacturers who withhold their advertising from 73 in an effort to force us to run bland editorials, but they are large and well known, and conspicuous in their absence from the magazine.

Perhaps I am deluding myself, but I can't recall running into a fervently anti-Wayne Green amateur that has read many of my editorials. When I talk with them I find that they are mad at me for things they have heard that I have written, not for what I have actually written.

Though I think of myself as a conservative, many readers seem to feel that I am a liberal. My reaction to incentive licensing is, I think, conservative. I feel that the ARRL management should have consulted the membership before petitioning the FCC for the rules change and I also feel that the whole idea would have been infinitely better if additional privileges had been offered for advancement rather than the punitive taking away of privileges from those who chose not to advance. It is basically the concept of using the stick or the carrot, with me favoring the carrot and ARRL the stick. You get more flies with honey than with vinegar.

A recent poll asked 73 readers if they thought amateur radio should have a lobby in Washington. The response was almost 100% in favor, yet the probability of anything like this happening seems remote. Why? The ARRL management certainly recognizes that such a lobby is not only needed, but is of critical importance to our future, yet they continue to do everything in their power to keep the directors from bringing it up at Board meetings. How come? As one of the HQ small fry explained it to me, the management feels that if a lobby is started in Washington there will be no way to keep the headquarters from eventually being moved to Washington, since HQ would have to follow the action. They don't want to move. They have nice houses, friends, and are comfortable in Newington where they are. As long as they can keep the Washington lobby cooled they can live on undisturbed.

But what of amateur radio, you ask? Since few of the ARRL management have been active amateurs in many years it is not really surprising at their seeming lack of emotional involvement with the hobby. I get a strong feeling that this is strictly a business matter with them and nothing more. They try and have business interfere with their personal lives as little as possible.

You might contrast that with the involvement at 73. Mike, Ken and I spend a good part of our waking hours working at 73 (or hamming), seven days a week. You will seldom not find at least one of us on tap by 6 a.m., and the work goes on into the night when deadlines demand.

No matter how much good the ARRL does, there are bound to be some bad things and if these are not discussed and exposed, how can they be improved? Bad flourishes in secrecy and dies in the open.

When I write about the ARRL I try and differentiate *between* the 75,000 members (including me) and the management running the show at Newington. Most of the bad things that are going on are attributable to this small group, not the members. Now, do you feel that there is anything wrong about discussing the problems we are having with what can best be described as amateur radio's unelected "government?" Am I being picayune when I criticize this group?

Down through the years I have spoken out many times in my editorials in support of many of the programs run by the League. It seems to me that it would be redundant to do this in every editorial. For the most part readers of this editorial are the same readers that have endured dozens or even hundreds of my past editorials, so I try not to repeat myself too often.

When I first started in amateur radio I, too, used W1AW for code practice. Of course there were not nearly as many alternatives in those days. Few amateurs sent at less than 13 per on the air, there were no Novices yet, and about the only choice was an Instructograph tape machine or expensive 78 rpm records. Now, with inexpensive tapes and LP records available, plus thousands of Novices on the air, the need for W1AW code practice is probably not as dramatic as it was 35 years ago, but thousands of would-be amateurs still tune in W1AW every year for the service.

There has been considerable criticism recently of the W1AW practice of just coming on and sending code or bulletins with no regard for those already on the frequency, but I suspect this may be due to one tactless operator rather than headquarters policy.

The short-haul limitations of amateur radio were responsible for the beginnings of the American Radio Relay League, since relaying was the only way to cover longer distances before the short waves were discovered. This still lives on in the dozens of traffic nets spread out around the country, an activity that is basic to the ARRL. Since I have never been an enthusiastic CW operator, my own experiences with traffic handling have all been on phone or RTTY, but I certainly never put down the fellows that love traffic handling.

Are We Afraid of Progress?

Since 73 is normally months or years ahead of the other amateur magazines in bringing new technical developments to the amateurs, our marks in "progress" should be okay. The high density of technical and construction articles in 73 should acquit me on "improvement of quality of amateurs."

Might I point out, too, that only 73 has run a technical study course to help you upgrade your license. Are we doing more to help improve the quality of amateurs than the ARRL? Speaking of which, whether we like incentive licensing or not, it doesn't seem about to go away, so perhaps it is time to sit down and start plugging through our Extra Class series.

You know, I suspect that if Maxim were running ARRL we would be good friends and working together instead of the present system whereby HQ seems to be doing everything in its power to undercut 73 and ignoring as long as possible the needs and wishes of the members.

ARRL November Board Meeting

Several letters have been received complaining about the directors meeting, pointing out that they spent thousands of dollars getting together, only to discuss trivia and to ignore the major problems facing amateur radio. Since I have decided not to be critical of the ARRL in any way in this editorial, I shall say nothing about the Board meeting except that those of you who have access to the January QST will find it fascinating to read the detailed minutes of this historic Board meeting starting on page 75.

Improvement?

Now, didn't you like that editorial much better than those rotten ones where I am critical of the League? If this turns out to be popular I may write an editorial avoiding critical comments on our esteemed competitors down in New York.

New Year's Present for Wayne

A daughter was born to my wife Lin just hours before the new year. Name: Sage Anetta Green. Your wives may be interested that we used the bubble all through pregnancy and during labor. The long term results are to be seen, but labor was quite easy and the birth was quick. The bubble, if you are not familiar with it, was invented in South Africa recently and provides a way for extra oxygen to get to the baby's brain during pregnancy, theoretically helping the brain to develop better and faster than without the oxygen. It also helps greatly during birth, providing the extra oxygen at this critical time, and easing delivery markedly.

Million Dollar TVI Suit Dies

We checked with Grid W4GJO and found that the TVI suit against him has been dropped. I am sure that the impressive backing Grid got from interested amateurs who sent donations to help with the fight had a lot to do with the dropping of this suit. If you have any illusions about what a great fight ARRL puts up for amateurs that get into serious legal difficulties such as this one, difficulties that could well turn into a nightmare for all amateurs if not fought to the bitter end, then just drop in at the Ham Shack in Sarasota and talk with Grid. You will find that not one penny of the thousands of dollars Grid spent on his fight came from the League.

Legal battles like this one might never get started if the complainant knew that the amateur he was suing would be supported financially all the way to the Supreme Court by the ARRL. The Institute of Amateur Radio did furnish cash for helping amateurs in legal difficulties, because one of its tenets was the belief that one ham's fight is amateur radio's fight. If the Institute could do this, so can the ARRL. The next time an ARRL director talks to your club, ask him about this . . .or write to him and ask. Get that ball rolling. Could you personally stand the $5000 to $50,000 that a suit like this can cost?

Band Occupancy

A recent study of the occupancy of our major bands during high density hours showed that the Extra Class segments are getting a lot more use than many of the underprivileged think. The survey, run by ARRL, and using about 100 amateurs as observers, might be more meaningful if it also covered medium and low density hours when the level of interference does not keep as many operators inactive that might otherwise be on the air. I suspect that the General bands fill up first, then the Advanced, and lastly the Extra. Full is full, and when all are full, then all are being equally used . . .right?

Free Advertising

Although we realized that 73 is very popular in colleges all around the country, we are flabbergasted at the strength of the student devotion. You may note, as we have, that pictures of college students with the "73" emblem on them are appearing in papers everywhere!

. . . Wayne ■

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VOX POP

Monthly Report of Activities on our Bands

There are a lot of interesting things going on in our bands that are all too poorly reported. Starting in April we would like to devote some space in 73 to reports of doings on the bands, with a separate section devoted to each amateur band and mode. Reports should be in our hands by the tenth of the month.

What's interesting? That depends upon the band, of course. Our 160m readers would like to know about DX tests, activities in rarer spots, nets, new counties activated, and any other organized activities on that band. Heretofore, there has been no good place to report something like this or any way to organize special interest nets, etc.

On 80m we have lots doing with the traffic nets, plenty of interesting activities in the Novice band, plus DX. I don't have in mind anything like the QST Station Activities column which lists who bought what new equipment and who passed along how many messages. But if TR8MC shows up on 3565 now and then, I think a lot of fellows would like to know about it. Up in the phone band there are a number of interesting nets that could well use some publicity now and then. When the Eyebank Net gets an eyeball to the right spot at the right time, that's news. When KR6AJ comes through regularly on 3808, that's news. When DX-minded ops manage to get the DX stations to tune up into the band for them, that's news. When a DXpedition is going to give the 75m gang a workout, everyone would like to know about it. I'm sure that the RTTY group on 80 has some news now and then that they would like to pass along...etc.

DX chasers will want to know the frequency, GMT, and QSL manager of rarer DX. We will pass it along, complete with the call of the fellow reporting the news.

On the higher bands I am sure that many of us want to know what is happening around the country on FM, TV, SSTV, moonbounce, satellites, meteor scatter, and other specialized branches of the hobby.

. . .W2NSD/1 ■

Modulated Vibrator Hash

AN EDITORIAL
BY K6MVH
KEN SESSIONS, JR.

In the past several weeks I have been doing a great deal of soul searching. My position as editor of 73 requires that I give full and adequate coverage – nonpreferentially – to all facets of amateur radio. Yet my personal involvement has been almost entirely with VHF FM and repeaters. As somewhat of a prominent figure in FM circles, I feel that I am under a special obligation to make 73 take up where FM Magazine left off. On the other hand, 73 has always represented the DX'er, the sidebander, the CW enthusiast.

So you see the embryo of a dilemma that has cost me more than just a few hours of sleep. The problem became even more dramatic when Mike Van Den Branden, former publisher of FM, joined 73. With the entire *staff* of the now-defunct FM journal at 73, a commitment to heavy FM/repeater coverage seemed even more necessary.

Good ol' Father Green gave me the answer. He came into my office, closed the door; and said something like, "Okay, it can't be all that serious . . . We've got Blue Cross, your rent's paid up, and we all love you. So what's on your mind?"

I told him that I felt a special obligation – and need – to publish circuits, stories, features and news about the fast-moving and ever-changing field of FM and repeaters, but I couldn't justify slighting the other amateur modes in the process.

There would be no need to slight the other aspects of radio, he told me. And he solved my whole problem without so much as a wrinkled eyebrow. All we have to do, he said, is include more FM articles each month than the Journal did – and do it without sacrificing any of our regular content.

Simple solution . . . just make 73 a little bit thicker. So that's what we did! Is that any way to run a magazine? You bet it is!

RM–1542

One year ago last January, FM Magazine published a tentative petition with regard to repeater rulemaking, and repeater owners were invited to submit comments and recommendations for changes. The purpose was to present a comprehensive rulemaking proposal to the FCC that reflected the combined ideas of all active FM people.

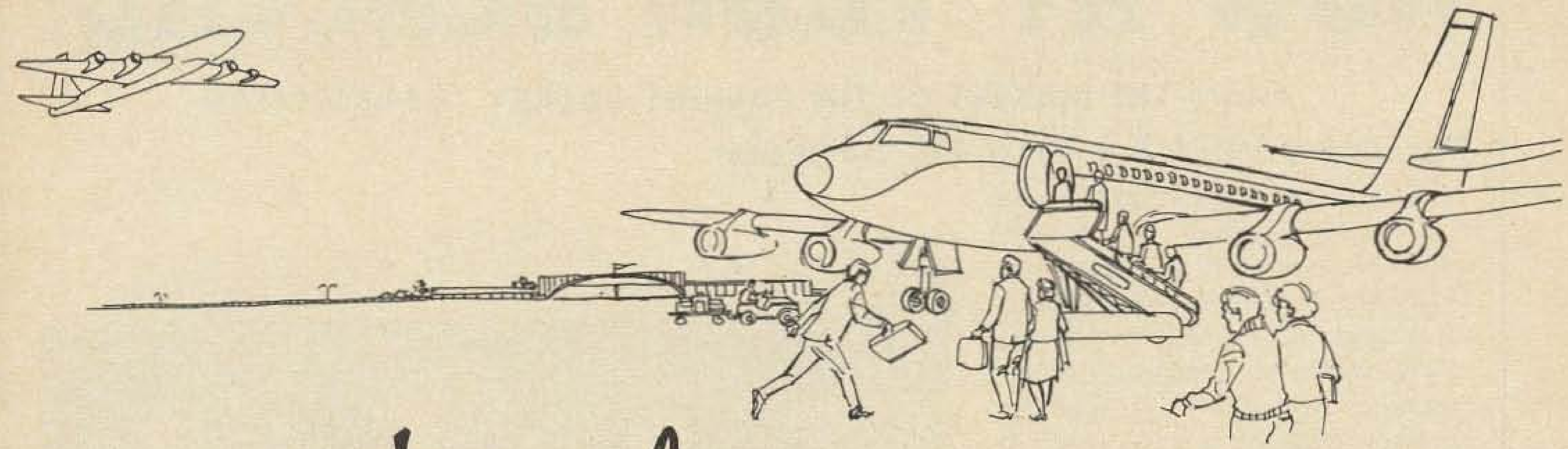
Shortly after the petition was published, suggestions began pouring into the editorial office. Then the League decided to take a hand, too. With the FM'ers going all out on the one side to get a meaningful set of repeater rules, the ARRL went off in another direction by appointing a staff of seven men to study the requirements of repeaters so that the League itself could make a recommendation to the FCC.

The League ignored the efforts already under way, and chose instead to make up its committee of staunch League members, *nearly half of whom have not participated at all* in the actions of the rulemaking group. Because of the apathy of part of the League's committee, some of the more conscientious members have become quite piqued, and are looking for a reorganization. Several members of the committee have not participated in any of the group functions, a fact that has stirred considerable controversy among the members.

One member of the League's advisory group has taken a more than passing interest in the problems, and is trying to pull the group out of its slump by actively campaigning for a set of proposed rules drafted as a result of recommendations based on comments from repeater organizations (particularly the California Amateur Relay Council) and, presumably, the original set of recommendations published in FM Magazine. That man is John J. O'Brien W6GDO, who is serving the dual role of ARRL repeater advisory committeeman and FM editor of Ham Radio. (I didn't think it was legal, since League President Denniston told me personally a year ago that I was ineligible for the committee because of my former association with FM Magazine.)

At any rate, O'Brien's rules have been reviewed by a number of active repeater groups, but they have not been adopted by the advisory committee. His recommendations are sketchy, but they appear sound and workable. The unfortunate thing is that his proposal is a long, long way from home. The advisory group must agree to accept it, following which it must be sold to League officials in Newington.

Meanwhile, hundreds of active FM'ers responded to the call for suggestions published originally in FM. These recommendations have been sifted and integrated, reworked and redrafted. Finally, one full year after the first draft was published, the final non-ARRL petition was submitted to the FCC. I personally submitted the petition, which bears identification number RM-1542, and will attest to the fact that it contains the ideas, recommendations, and constraints recommended by the collective body of active FM'ers.



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In case you're wondering what was in RM-1542, the essentials are listed in last month's "Modulated Vibrator Hash." If you're an FM'er and you *care* about recognition, licensing, and modifying the restrictions of repeaters, write the FCC now, and recommend quick action on RM-1542.

VIRGO

Probably every ham goes through the "cute phonetics" stage at some point early in his career. I started looking around frantically for something clever back in 1956 when I had a column in *Western Radio Amateur*, a west coast publication published by Don Williamson W6JRE. I wanted something snappy, like "Never Say Die," but my call, unfortunately, didn't end with "NSD." Quite coincidentally, during a late night QSO with my half converted military surplus transceiver, someone–I don't even remember who–commented that my signal was so raunchy it sounded as if I were modulating vibrator hash. The column title was born for me. It was something I was never crazy about, but it seemed reasonably apropos, so it stuck ... through several amateur publications.

It wasn't until after I got to 73 and Wayne introduced me to someone as "Mr. Virgo himself," that I became totally disenchanted with the vibrator hash bit. After overcoming my initial depression resulting from the fact that I hadn't thought of the Zodiac tie-in myself, I elected to retire the tired "Hash" for good. From now on, I'll be Mr. Virgo Himself.

SPECIAL PEOPLE

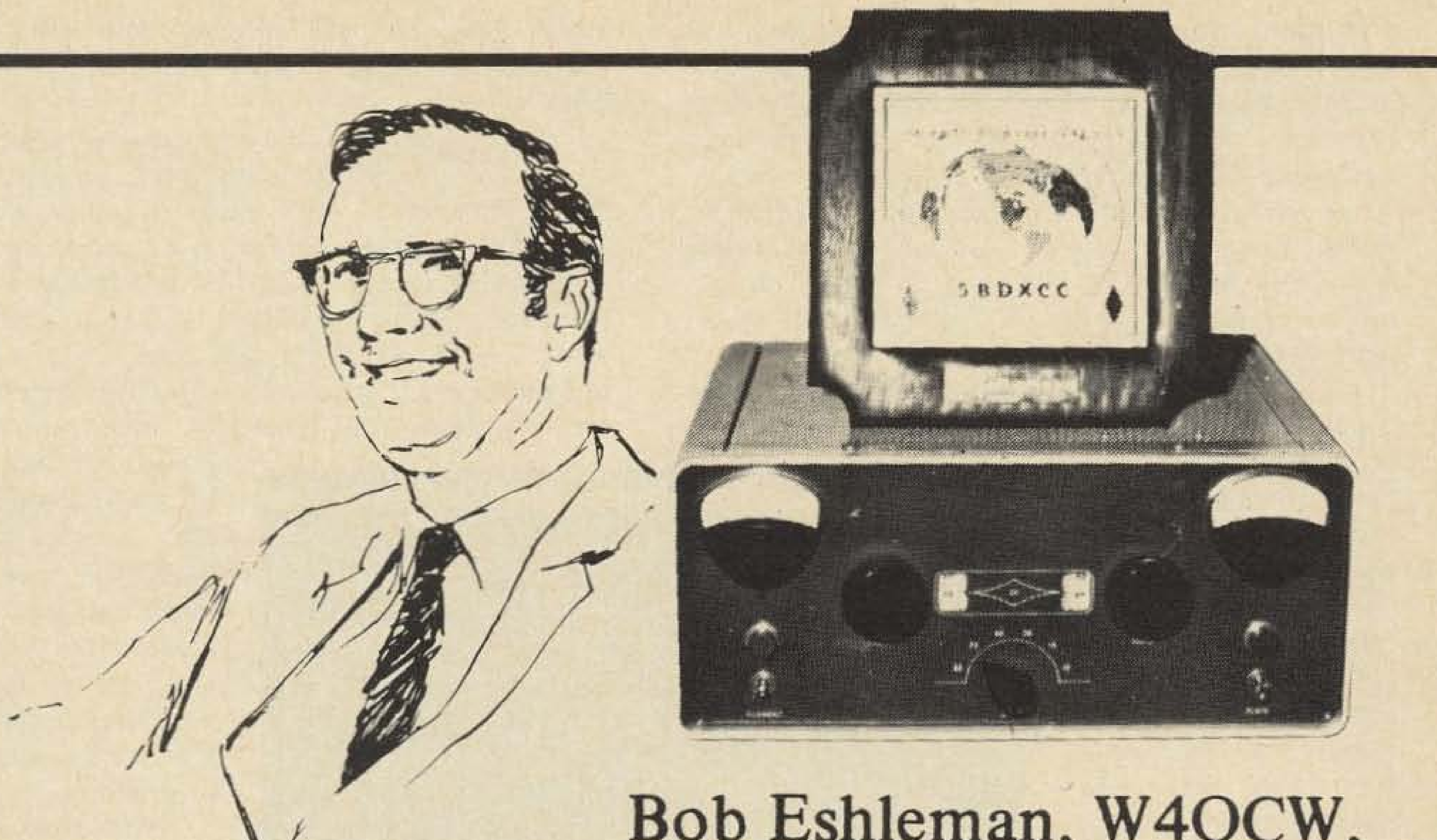
Sometimes I think somebody ought to do something special for the "special people" in the ham radio business. The special people are those who manufacture and sell the gear we use. I've been around long enough to know that no one gets rich doing business with hams. Yet, as hams, we demand more of these fine folks than we'd expect of Sears or Montgomery Ward– and we get it!

I've lost track of the times I've pestered poor old Ted W6UOU at Henry Radio in Los Angeles. This rig didn't work right, or a part was missing from that antenna kit. Never a complaint or question. Always, the Henry people would make sure I was satisfied before I left the store.

My dad (Ken Sr., K6MQB) *really* puts them through their paces. He's an active ham with interests that change with the seasons. And he lives no more than a few blocks from Henry's L.A. store. He goes from 6 meters to 75...then he gets a yen for 15 and 20 sideband...it's beams and towers and quads...something for the shack, then something for the mobile. And each change means a trip to Henry, to check in the old gear and check out the new. I'm sure half the stuff he carts out of Henry's never even gets turned on. Everybody there pretty much knows him by name, and I suspect they don't even bother to write up the paper on half his purchases, knowing he'll be back in a week or two to trade it all in.

But they're good sports at Henry's–like they are at a lot of other stores where you and I and my dad buy gear. They may flinch when they see us walk in the door, but they don't show it, bless 'em.

...K6MVH



AN EDITORIAL by DAVE MANN K2AGZ

Leaky Lines

1 DANIEL LANE, KINNELON NJ 07405

I spent this evening on the air, working old friends whom I haven't contacted in months. Now my antenna situation is cleared up I've been making up for all the time I've been struggling with limited means . . . dipoles mainly. After three or four contacts I got a call from a fellow in a nearby town. He has one of those shiny new two-letter calls, but he used to be an ordinary, garden variety K2 like the rest of us plain peasants.

"I've been reading your stuff in 73," he began. His tone was a little patronizing, as though he were at least the book reviewer of the Sunday Times. "It's pretty good," he says, "but I'd sure like to talk to you about one rock you pulled. I disagree with you completely on that one, Kid. I'm sure you didn't mean it the way it sounded, Dave."

This sounded serious and it piqued my curiosity. I asked him what part of the article he meant, but he demurred, saying he'd rather not discuss it on the air. He indicated that he would call me on the telephone, but did not wish to talk about it at present. I told him that I didn't mind his taking issue with what I had written...after all, the objective of a column like mine is to provoke thought and discussion. I never intended to write the sort of mealy-mouthed ambiguity with which everyone would automatically agree. I did not set out writing for 73 merely in order to put down on paper all those things which would justify widely held opinions, merely to bolster them. I added that sometimes an opposite opinion could serve to strengthen a reader's precepts and ideas, thus could serve two opposing viewpoints.

This particular column did not carry anything too terribly controversial, for I was merely trying to show how some topics might be handled innocuously. To be honest, the piece was written more or less jocularly, with no really serious objective in mind other than to illustrate the folly of outlawing particular subjects on the ground that they are in and of themselves unsavory and unwholesome. I thought to myself, "Perhaps he has taken exception to the part about religion. Many persons have rather thin skins on this subject, and consider it improper to discuss at all." When I asked him about this he said that it was not the part about religion.

By this time I was puzzled, and started pumping him. But he would not say anything more than he had already said. He simply changed the subject and would not "drop the other shoe."

Then I began to feel the pangs of annoyance. Why should I have to listen to what he had to say in the first place? He's not particularly qualified to do more than express an opinion, not being any sort of an expert, so far as I know. I'd gone over the column mentally in order to puzzle out what could have bugged him, but couldn't imagine what it was...unless it was the part about the pig farmer in Secaucus who ran for the Presidency so often. In my article I alleged that he could not have done worse than some of our recent Presidents, governors, and mayors. Maybe it was that apparent irreverence that annoyed him.

Now that I think of it, I tend to agree with him. I too am annoyed. I'm annoyed at myself for not saying that the pig farmer would have done better than some of our recent leaders!

• • •

The other afternoon the educational TV station programmed the new film produced and directed by Dave Bell W6BVN, entitled *The Ham's Wide World*. I was very much impressed with it, and must confess that it turned out a darned sight better than I thought it would. I don't wish to sound patronizing about it, for it needs no qualifying preface or apologetic foreword to prepare the way for some amateurish or unprofessional home-movie type stuff . . . it is a finished product in every sense of the term.

I was a little irked about its limiting the activities shown to those which are ARRL connected, thus making *non*persons of hams who don't belong to the League. While it is perfectly reasonable for ARRL to depict League activities in any film which it sponsors, it should not be forgotten or overlooked that there are thousands of amateurs, engaged in helpful spheres of hamming, thoroughly in keeping with the spirit of dedication to the public good. This is only a minor point, however, and can be dismissed in view of the overall value of the film.

The best thing about it, to me, is that there are entertainment values in it, which have been all too lacking in its predecessors. Most of the earlier efforts were marred by a certain quality of dreariness. The voice of K4LIB, Arthur Godfrey, is so familiar that any audience can identify with it readily, and he was probably the best possible choice as narrator.

You will probably have an opportunity to see the film since it has been accepted by National Educational Television for showing on all educational channels for the next couple of years. I recommend that you take the time to view it, for it is surely an excellent piece of material which should help to promote good relations between amateur radio and the public.

• • •

I've got to level with you about something that's been bothering me since I started writing LEAKY LINES. There have been letters and phone calls . . . even visits, all expressing satisfaction and enthusiasm with my position concerning ARRL's extraordinary lack of responsiveness on certain issues recently.

When this sort of response occurs, It is natural to assume that it will be followed by some sort of action. Such a response signifies a readiness to roll up the sleeves and do a job. It denotes agreeement that the League's only chance to become, in fact, what it claims to be, lies in the direction of increased membership activity.

But what have they done? Precisely nothing! That is, all excepting the members of the Atlantic Division, who elected W3EPC, who may just turn out to be the best director in years.

How are the rest of us supposed to match the Atlantic Division? If the only action a member can take is to vote in an election, a lot of people are going to be cooling their heels for a long time. If a member has to suffer the leadership to do anything it wishes, pending the only date on which he can register disapproval, election day, it seems unlikely that anything will be accomplished to effect any improvements. What are we supposed to do until then?

I think the time has come to think realistically about some structural changes in the League machinery. Is it possible, I wonder, to restructure the League, so as to be able to recall or dismiss persons who are not doing, or show no signs of willingness to be doing, the job they were elected to do? In Britain, whenever there is any sort of disagreement in which the opposing forces are unalterably unwilling to come to a position of compromise, they hold a "vote of confidence," in which the popular support and rectitude of the "ins" is tested in a general election. If the Prime Minister cannot muster support for his program, the other party takes over the reins of government, and names a new cabinet. In this way, although the parties may face periodic crises, the body politic is constantly able to renew and refresh itself, secure in the knowledge that the will of the constituency is being served and gratified.

Perhaps we could establish some similar organizational arrangement in the American Radio Relay League. It would certainly be a distinct novelty to know that the democratic (small d) institution of a two-party system, which works so well for our nation, would guarantee a more equitable situation in the ARRL.

Doubtless, this type of change would result in one thing, at least. It would compel every functionary desirous of retaining his post to pay some heed to the membership, lest he get "dumped." If they did not like what he was doing, they would simply hold an election, and the guy would either shape up or ship out.

I've always admired the British. The main reason, I think, is because of this extraordinary tremendous concept of government, geared and gaited for the benefit of the governed, rather than those who govern. Good system, that.

Till next time, 73
. . . K2AGZ

LETTERS

Leaky Lines Feedback

In regard to the Leaky Lines editorial, I found it one of the most fascinating ham radio articles that I have ever read. I saw thru that bunch of ARRL clowns way back in the 50's. I sure go along with your ideas that the commission believes the ARRL is a spokesman for all of us hams, and I fully intend to tell them that I for one am not a fond member of the ARRL; further, I know hundreds of others who feel the same way.

Kenneth Mahoney K6OPG
455 41st Ave.
San Francisco CA 94121

I think that Dave Mann's ideas are very close to the truth...but I sometimes wonder if the mass of your readers are as fully committed to amateur radio. What I'm trying to say is that I feel that your articles and critiques are causing people to think, and most people don't like to think! If I'm wrong, please correct me.

Neil Johnson W2OLU

With reference to Dave Mann's "editorial" (73, February 1970) about QRM from W1AW, I would like to point out to your readers one example of the faulty reasoning found so often in your magazine. It is true that W1AW is just an amateur station, but unlike any other club station, it represents nearly 100,000 amateurs, worldwide. As such, it has special permission to operate transmitters on seven bands concurrently. As it would be impossible to check all frequencies just before transmitting–and we know that such checks are not always accurate, anyway– I would suggest that Mr. Mann's two friends should step aside graciously in the interests of the thousands.

Al Taylor WB4CTY
5722 1st St. S
Arlington VA

I have just received and read most of February 1970 issue. As I have received and read the first issue and all issues since, I must agree the Feb 1970 issue is one of the greaters. There are numerous articles in this issue and I am glad to see that not only both sides, but most sides are represented.

I must take issue with your Leaky Lines editorial by Dave Mann. It is such articles that have brought much of the things we are not proud of in ham radio today. He says that most all technicians got their licenses by fraud. Who is responsible for this, if true? Certainly not the Tech. Why not call all of the Generals or higher in that give these tests and ask them if the Tech. has a valid license, that they signed their names under oath.

It is a sorry thing that many advanced persons today hate to see anyone less gifted get anything or anywhere. I know of many hams that would rather see a piece of Novice equipment that had gathered dust for years remain so than to help some poor kid trying to get on the Novice band and give him something that will otherwise never be used.

Harold D. Mohr K8ZHZ
5670 Taylor Road
Gahanna OH

I find that Leaky Lines stuff on said-to-be-taboo topics not very interesting in a ham magazine. I am interested in the subjects all right, but not in a magazine that I regard as a technical gold mine. Speaking for myself, I have never hesitated to discuss anything over the air, and have found plenty of other hams ready to take part.

Bob Eldridge VE7BS
8386 McGregor Avenue
Burnaby 1, B. C.

Drumodulation?

Enjoyed the January 1970 issue immensely, especially the article on SSB, AM–FM Modulator by Bill Hayes. Seems though that this article should have been in the April issue. Would like to suggest another method to obtain the same results without using an oil drum. First, the trunk lid should be properly grounded to the car body. Silver-plated finger stock should be fine for this job. Next mount a 10 in. piece of heating duct to the bottom of the trunk. The cavity could then be tuned by banging on the trunk lid with a sledgehammer.

Wallace WA8OXR
5696 Williamson Ave.
Dearborn MI

You have got to be kidding! In the "SSB AM–FM Modulation System" article, Jan 70, F9 is not kosher for ham use.

What he has got there is most probably F9– depending on how he modulates the subcarrin, either AM–FM or FM–FM as in telemetry and all those Muzak-type SCA systems on broadcast FM. Minimum bandwidth of the signal must be in the subcarrin frequencies; in this case 35 kHz deviation, plus bandwidth of the Subcarrier modulation. Not such a good idea except for the wide-open spaces of two or up. Howsomever, the article rates a nod for the idea on cavities. The idea of trying a 55 gal drum hadn't struck me–trying for a low cost Magic Tee for a one-antenna 2 meter FM repeater. A drum might work!

Fritz Hervey WB4MSJ
Rt. 1 Indian Trial NC

Comparison

I received my issue of 73 which was excellent as always. I also picked up a copy of CQ at the newstand and this is what I noticed.

Number of articles in 73: 28 technical articles not counting the excellent editorials.

Number of articles in CQ: 9 and these were not all technical articles. Strange thing too about these 9 articles: 5 were by the same two authors, giving me the impression that CQ is hard up for suitable articles and good authors. This is bad enough but the editorials in CQ are all noncommittal and don't state a positive point. CQ is just wishy-washy in its content and will not take a stand where there might be a chance of getting caught in a corner.

Keep up the good work at 73–you put to shame all the other ham publications put together. Even though I am thousands of miles away, you have my support in any way possible.

Richard J. Molby
579th Ordnance Co.
APO New York

Ham Lobby

You undoubtedly saw the article (on spectrum grabbing) in the December 5th Wall Street Journal. This publicity certainly points up dramatically the need for a PR bureau and lobby for radio amateurs.

Everett T. Plumer Wb6VVT
1244 Sixth Street
Santa Monica CA

The article, "Spectrum Scramble – Airwave Jam Worsens As More Radio Users Demand Frequencies" backed up the editorials that I have been writing about the vital importance of our having a lobby in Washington, yet the ear in Newington seems to be as deaf as ever, and nothing else much seems to be taking shape. . . . . Wayne

1984

Being relatively a newcomer to the ranks of radio amateur hamdom, having obtained my license only a year ago, I have carefully studied the situation which exists in the amateur world before plunging in with both feet. Years ago while yet in high-school, I had sensed something in regards to the ARRL which at that time I could not quite ascertain the nature of. In your battle against the undemocratic nature and scope of this organization, I believe I have been able to pinpoint the factor which gave rise to a "queasy" feeling earlier and remains with me to this day whenever confronted with this organization. In its manner of operation it resembles some of the radio societies in the Red fascist countries. It seems to serve the interests of "Big Brother" far more actively than the rights of the ham. But the, why shouldn't it *if it was set up by Big Brother* for the sole purpose of keeping control of radio enthusiasts? Instead of trying to instill democratic concepts into an organization which because of its nature can only reject them, would it not be far wiser to organize a new ham organization along the lines of the NRA, AOPA etc? Any new movement though, established while a prior despotic group is still in power, must have as a focusing point a published medium which breathes life and spirit into the soul of the new organization.

Jesse G. Korchmaros WB8CDP
331 Jackson Drive
Campbell OH

Tailored Callsign

When I write to you, it is primarily to announce the event of the year! I've got my call sign, at last.

I got it on my birthday, and it reads LA8PM. Since my name is Per Marienborg, I thought it pretty nice of Televerket (Norwegian FCC).

After having spent my two months summer holiday working, I bought a Sommerkamp FT250 transceiver for about $350. And a Mosley H-band vertical. In addition, I have a W3Dzz multi-dipole for 80 and 40.

Now, I am QRU on 10 meters almost every day. I may be identified by overmodulation, and the fact that I say Ah..., each third word and Well...about every seventh. I suffer from mike fright.

Per Marienborg LA8PM
Stovnervn. 17
Hoybraten Norway

Helping Hand

The STI Amateur Radio Club (WB9ADF) has undertaken a "Helping Hand" project to assist hams or would-be hams in solving their technical problems. We wish to extend this service to hams in all parts of the world, and particularly to those who are just getting started in ham radio or who are isolated from help. As a technical pool from which to draw solutions, the members are students working toward the Associate Degree in Electronic Engineering Technology, and are hams themselves for the most part, with a highly trained staff of instructors to back them up.

If you feel this project is of a worthy nature, we would appreciate it if you would mention it in a future issue. Inquiries and problems should be addressed to: STI Amateur Radio Club, Sams Technical Institute, Interstate Industrial Park, Fort Wayne, IN 46808.

Jeffrey Stineburg WA9TOJ
Trustee, STI Amateur Radio Club
WB9ADF

Why?

Why is it that...the only audible station on the entire 20 meter band has an operator who speaks only Esperanto and I have no way in God's world of making contact...the only 9M6 I ever heard was when the XYL gave me the supper ultimatum on the double...the one maritime mobile I really wanted came back to me when my swr bridge took a turn for the worse...the most important phone patch I ever tried was lost in band transition...the one opportunity to impress a VIP resulted in a "no propagation" day...the one last country I have looked for to make 200 was heard by the XYL while I was at work and I have been listening for 2 years while she has just learned how to tune the rig...the one piece of gear I ever bought through advertising was damaged before I got it...the QSLs were sent with an apology for being the wrong color...the YL with the most pleasing voice turned out to be an XYL...the day I was about to trade in my rig was the day I had the best contacts...my neighbor who complained about my interference admitted that his hi-fi broke down and then, when he had it repaired, he complained that he could *not* hear me: I have had no interruptions from my neighbors ever since I explained that my large antenna (beam) was for color TV...that the pink slips were an attempt to work WAFCC stations...I had failed to achieve this very simple goal.

Ian M. MacDonald DL4MI
KARLSRUHE
W. Germany

Author Talkback

This letter is in reference to my article (published in the July '69 issue) "A Simple Effective RTTY Terminal Unit." In this article it was not made clear as to the counting of the pins of the integrated circuits involved. Since I have received so many letters and phone calls from readers who can't make the unit work, and the problem, with only one exception, has been the integrated circuits in the circuit wrong, I would like to point out the correct basing diagrams.

On the μA 710C, the tab is over pin 8 and looking at the bottom view, the pins are counted clockwise in ascending order. On the MC1429G, the pins are counted in the same manner, *except* that the tab is over pin 1.

As I mentioned, I have heard from quite a few readers who have had minor problems, now I would like to hear from a few who are using the circuit.

C. Warren Andreasen WA6JMM
3737 King St.
Lemon Grove CA

RG-8 Dummy Load

"Lossy Transmission Lines" by KH6IJ/1 (Feb 70) rang a bell with me: somewhere in the pile of junque I moved down here to the land of warm (?) winters, white likker, and some of the best looking women in the wide world is a hunk of RG-8/U labeled "Federal" which has a grey-ish looking dielectric rather than the usual translucent sort. About 60 feet long, this has long been my "Don't buy surplus line" convincer. Terminated w/50 ohms, fed by any 2 mtr xmttr thru a Bird Thruline will show, say 10 watts in, NO refl pwr. Move the Bird down to t'other end, feed in same 10 watts, *NOTHING OUT!!!* Repeat Experiment with two Birds, same results. Lossy? You bet! Loss showed up above about 20 MHz, negligible, lower. Experienced same thing with new 7/8" foam line, solid OD: 42 MHz loss 100% Found water in the foam!

Fritz Hervey WB4MSJ
Box 25006
Charlotte NC

New Church

Now that the impact of this incentive license business is being felt by the majority of radio amateurs, many of us are becoming dismayed by conditions on the portion of the bands we are forced to use. Even some of the old timers have given up amateur radio as a hobby.

I can't see any hope that The Organization will ever do anything for us. Yet they have so many advantages ever over any of the other three amateur publications: They alone have the amateur's bible and sunday school pamphlets; they are the umpires of all the games (contests); they set up the rules on how the games are played. There are no other referees.

As I see it, we need a new church, a new ritual, and above all a new bunch of deacons. Perhaps then we can get back that which was taken from us.

John McFarland
Port Richey FLA

Candid Suggestion

As editor/publisher, you will of course be responsible for everything in your mag, and quite probably a lot not in it. Perhaps you could perforate the page with your comments and the people not liking same can detach and file, while enjoying the rest?

Michael R. Hanna K8UUO

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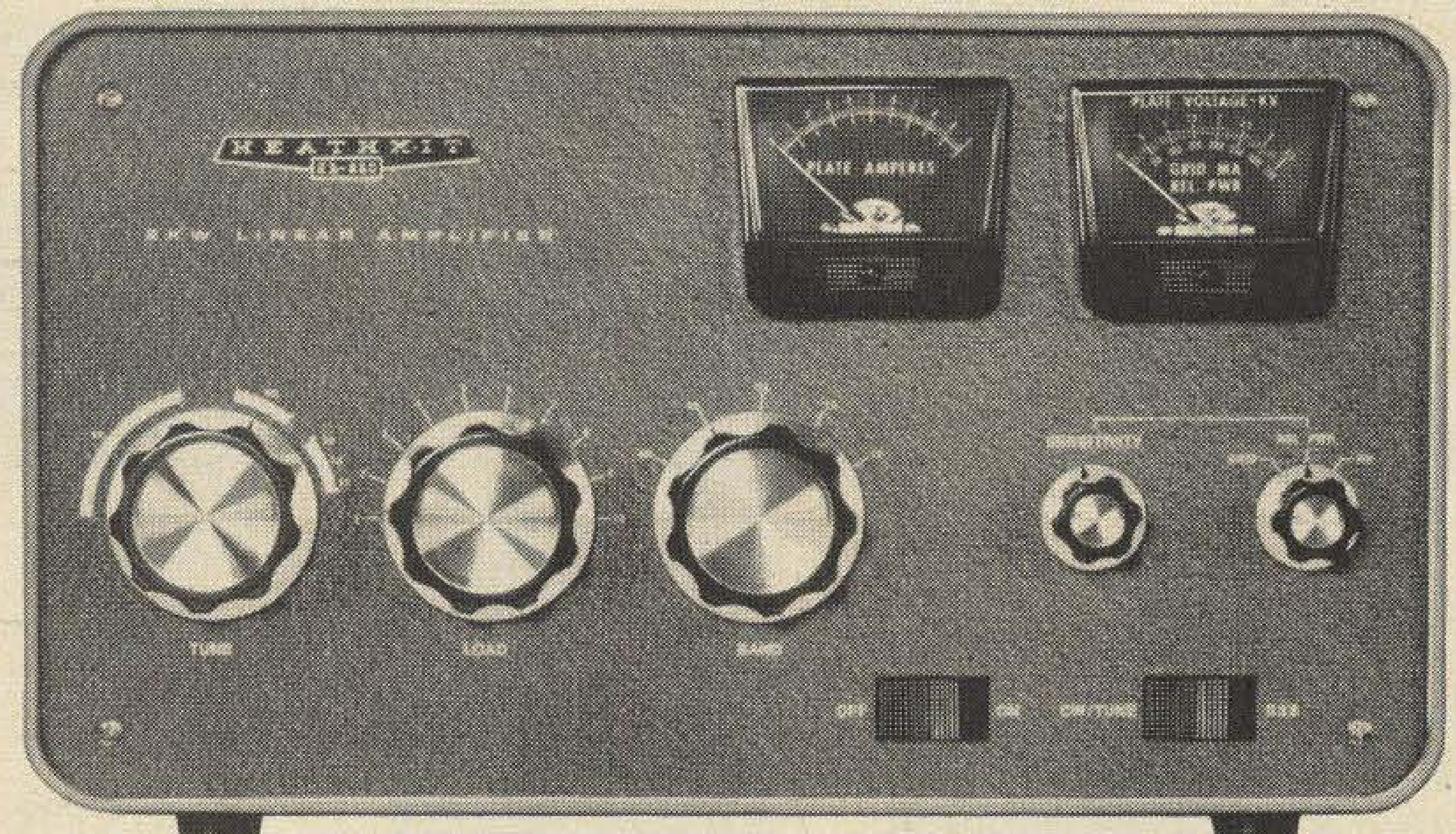

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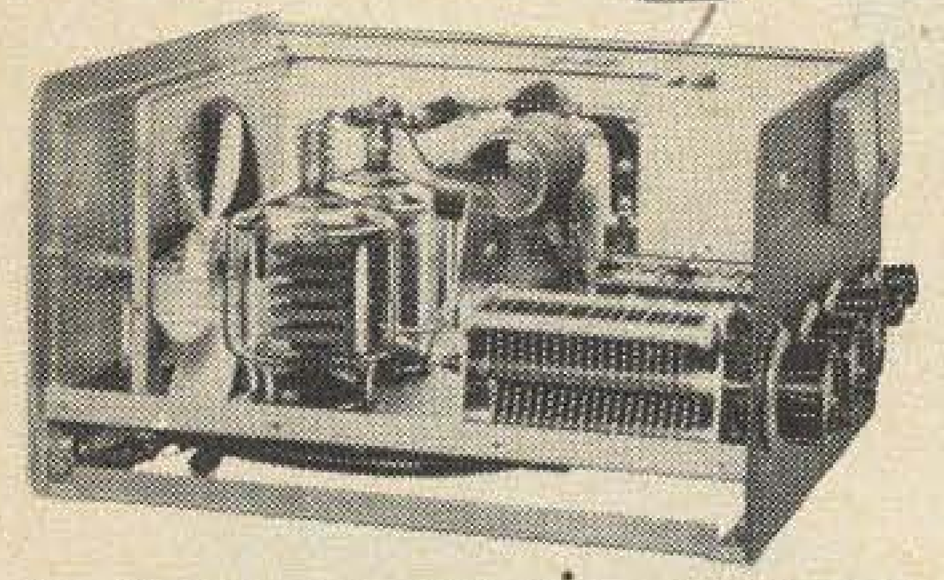

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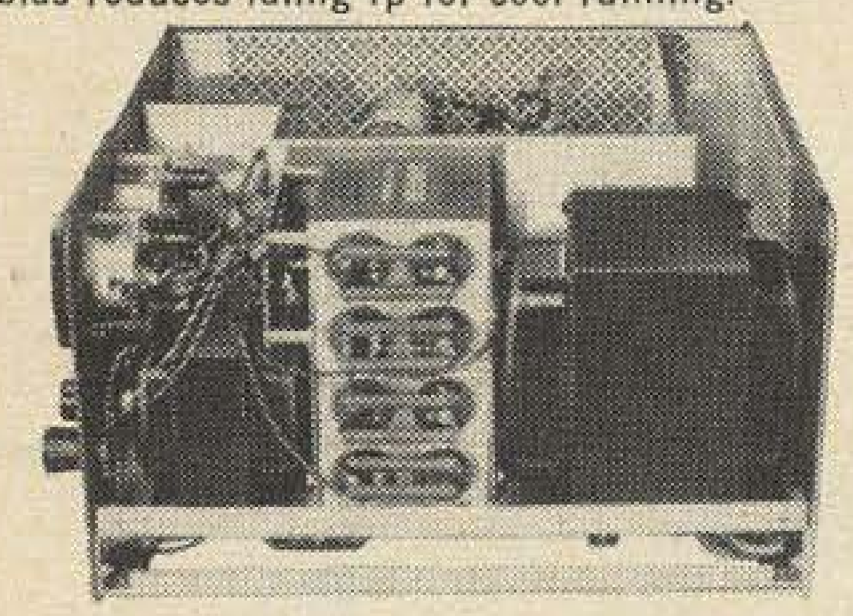

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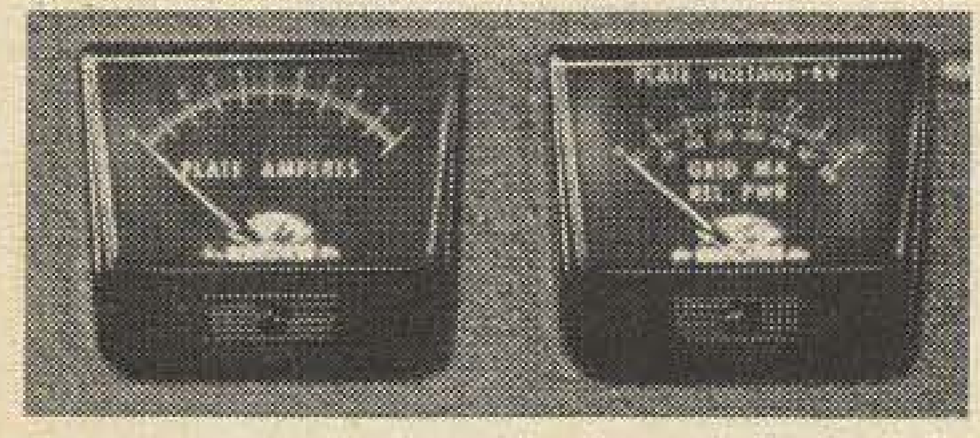

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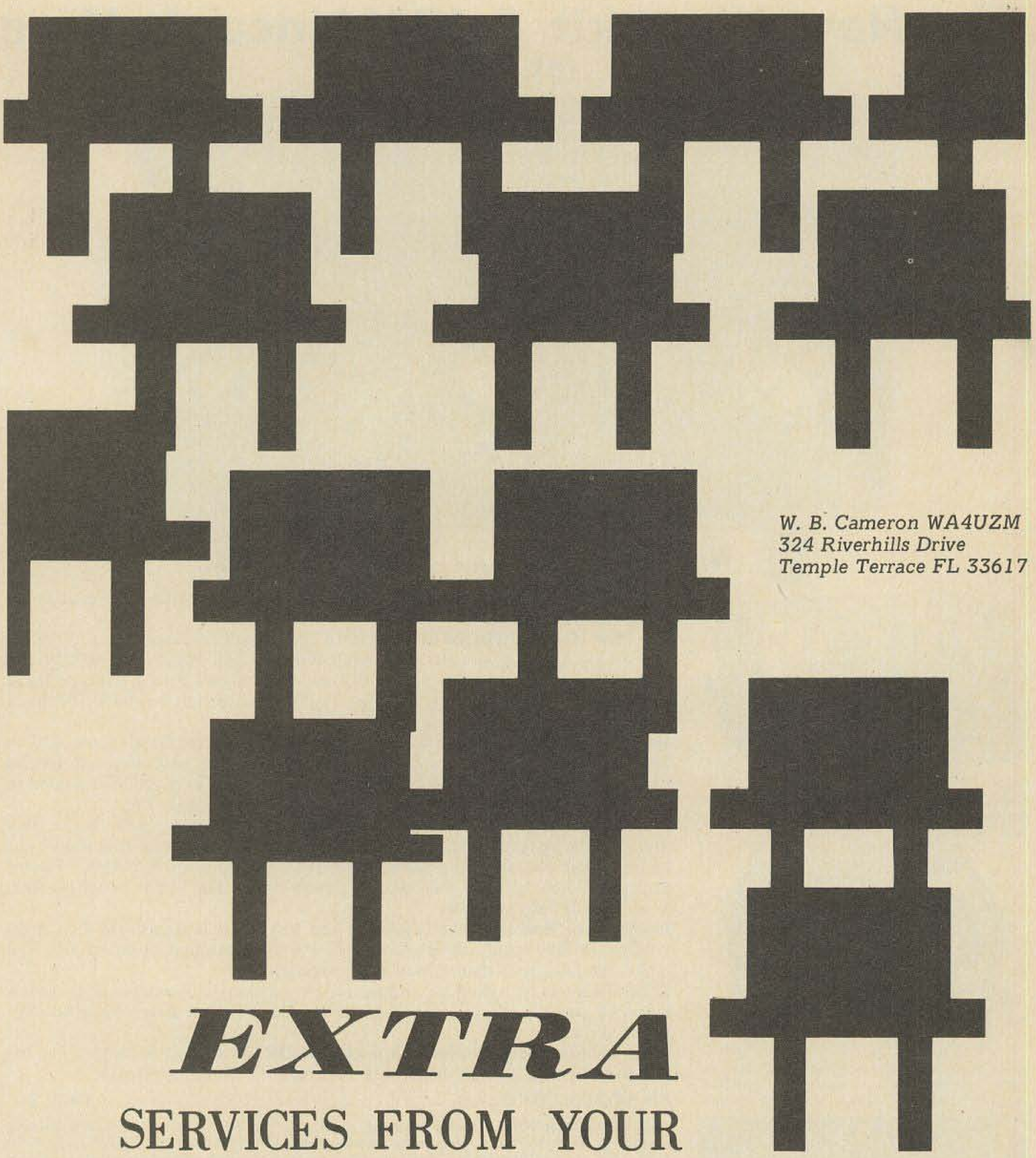


W. B. Cameron WA4UZM
324 Riverhills Drive
Temple Terrace FL 33617

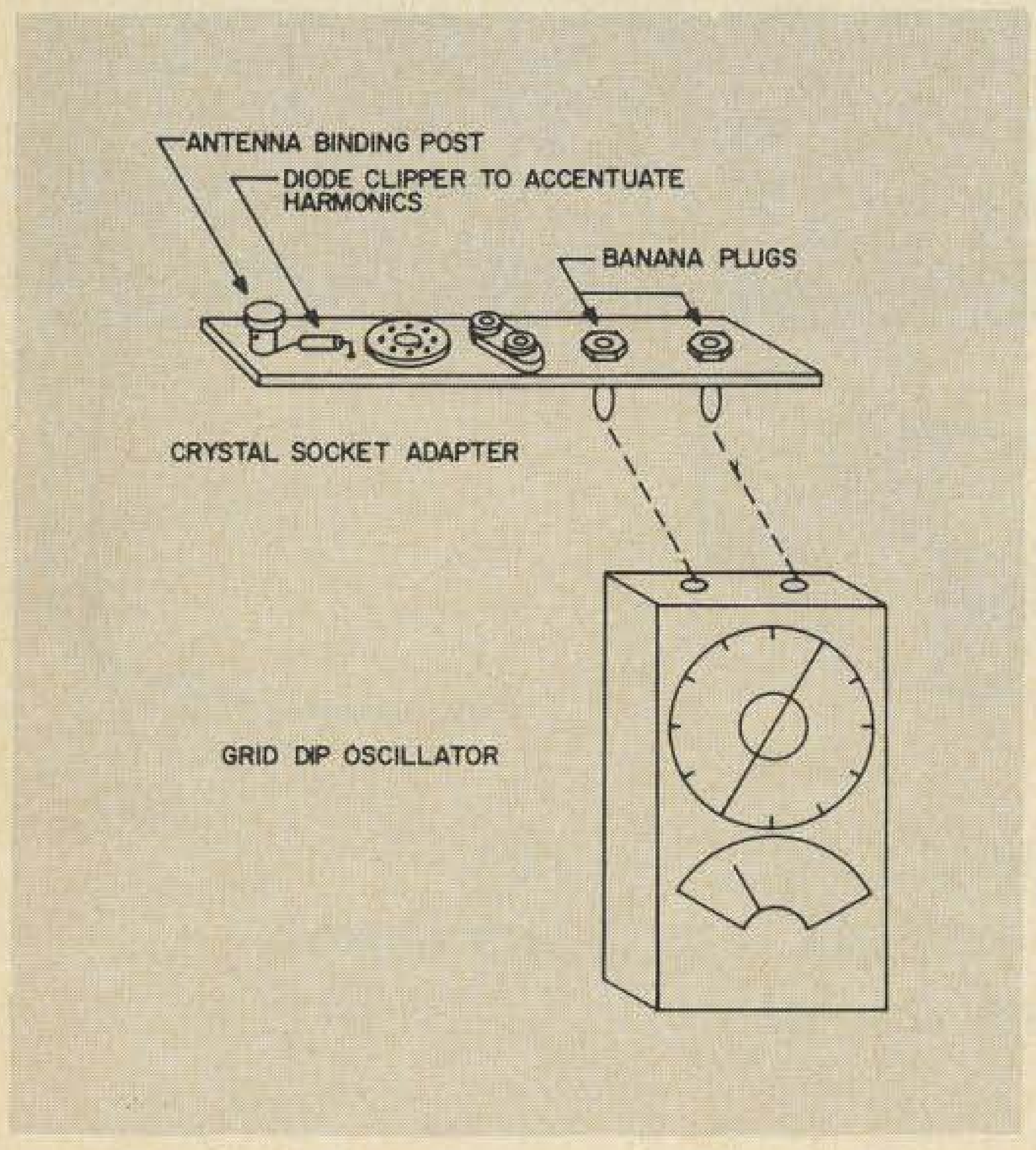
EXTRA SERVICES FROM YOUR GRID DIP OSCILLATOR

A plug-in adapter turns the oscillator into an A1 crystal calibrator . . .

One of the handiest instruments around the average ham shack is the grid dip oscillator, but many hams do not get all of the advantages this little instrument can offer. Most people know that it is useful for finding the resonant frequency of an LC circuit, or for generating a signal someplace in the range, although it is not quite a substitute for a well calibrated signal generator in this respect.

Many people do not realize that the grid dip oscillator makes an excellent crystal calibrator as well. The typical grid dip oscillator uses a two-terminal coil and a two-section variable capacitor, connected in the form of a Colpitts oscillator circuit, with the variable capacitor providing the voltage division for proper feedback. This same circuit, with a quartz crystal replacing the coil, becomes a very satisfactory crystal oscillator. In this case, the variable capacitor becomes a trimming capacitor capable of putting the crystal on the proper frequency with considerable accuracy and also allowing a fairly wide latitude higher or lower for checking bandpass.

The meter reading gives an index of crystal activity. What is required is an adapter to match the pins of the crystal holders to the coil socket of the grid dip oscillator. I have made up such an adapter for my particular unit which consists of a 1½



Crystal socket adapter for grid dip oscillator extends the unit's capability by enabling it to read crystal activity.

inch by 4½ inch piece of masonite which carries two banana plugs to insert into the oscillator socket, and several different sizes of crystal holders, all connected in parallel, to accommodate any crystals I happen to have around the shack. I carry in my tool kit various assorted crystals. These give me spot frequencies for band edges and other reference points on all of the amateur bands.

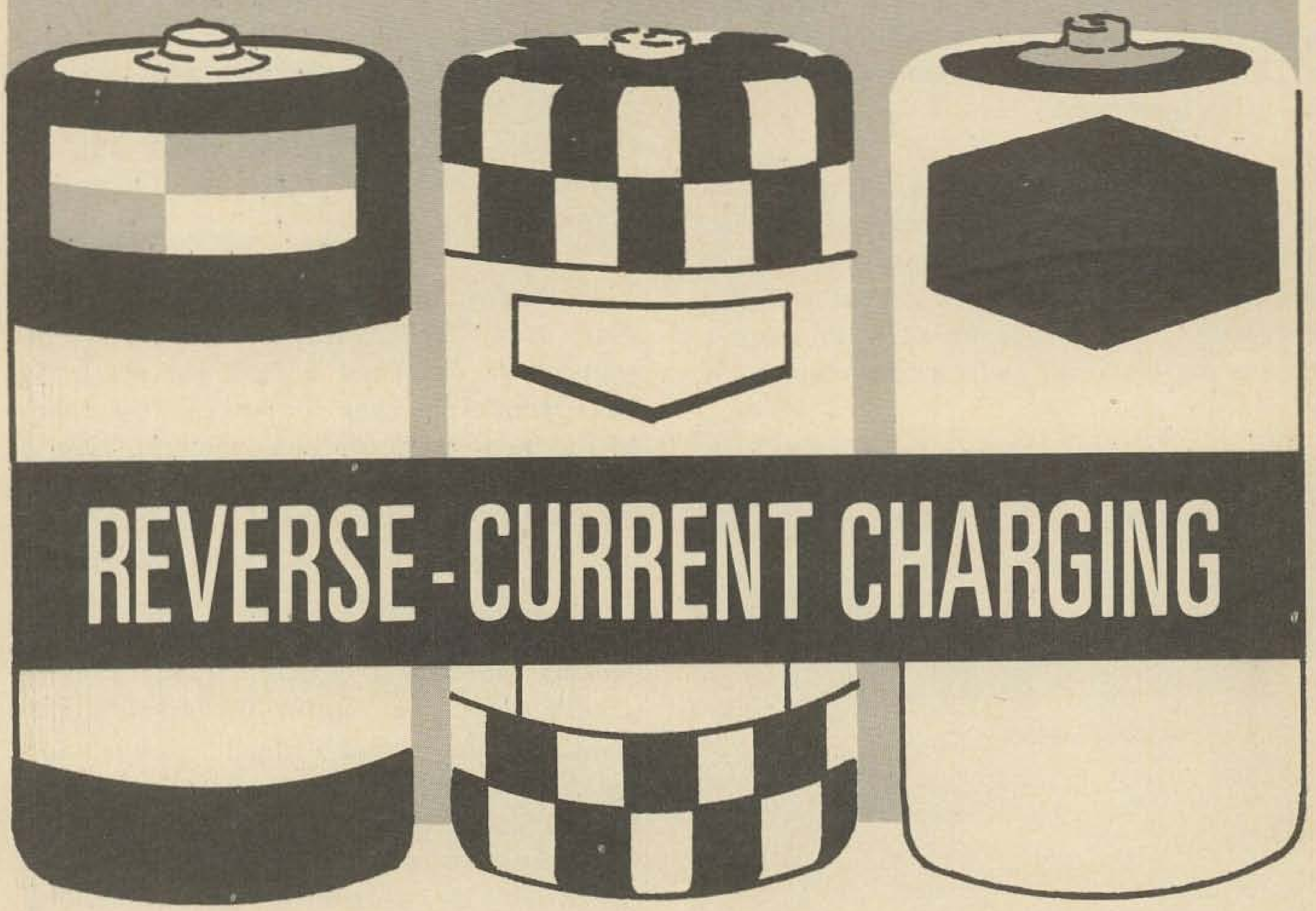
In checking the higher frequency bands, I find it useful to add a diode clipper and have one permanently wired on the same adapter board. This is a 1N69 which simply goes from one side of the crystal to a terminal point at which I can attach an antenna or a lead to the input jack of the receiver. By simply attaching a short length of wire approximating a quarter wavelength at this frequency, I can provide a strong enough signal from the shack to enable me to check out my direction finding loop in the automobile fifty feet away.

In tuning up my 2 meter FM gear, I plug in a 3061.25 crystal (which is the transmitter oscillator crystal for my Link 2m FM unit) and then couple from the 1N69 to the input of the receiver. This provides a signal stronger than most of the local signals on the band, and adequate for initial tune-up. For finer adjustment of the i-f strip, I clip the lead from the 1N69 to the chassis close to the antenna input jack and the leakage provides a signal of the order of .2 μV, which is useful for final adjustment of the critical tuned circuits, the squelch control, and others. For best results, I leave the oscillator and the receiver on for a half hour or so to warm up, and then with the variable capacitor in the grid dip oscillator, I zero-beat the incoming signal of a station generally considered to be on frequency. Once this is done, I have a signal source on the bench with which to check the receiver for passband balance as indicated on the microammeter connected to the discriminator output.

One thing which could be added to increase the utility of the instrument is some form of modulation. It would not be too hard to add an outboard modulator connected to the oscillator through pin jacks or some other means. I have not done so simply because I happen to have a modulated signal generator in the shack.

. . . WA4UZM ■

Michael Windolph K8YUC
3649 East 65th Street
Cleveland OH 44105



REVERSE-CURRENT CHARGING

With an almost foolishly simple technique you can successfully recharge ordinary dry cells – and make them hold the charge – again and again!

Do your kids continually pester you with their battery-operated toys that don't work any more because the batteries are dead? Or do you use a flashlight or other battery-operated gadget often enough yourself that you wish you could afford rechargeable cells? Maybe this article can provide the necessary relief without any extra strain on your pocketbook.

Would you believe you could make a better battery charger? How about one that can charge at twice the usual rate or more, without damage to the battery? Or one that can charge, *really* charge the ordinary flashlight battery even higher than its bought-new charge?

It can be done! The process was invented in 1954 by Ernst Beer of the Netherlands and bears patent number 2,752,550. Recently tested by Donald J. Vargo of Lewis Research Center in Cleveland, the process resulted in a better mousetrap – it really did the job better!

Although normal flashlight batteries will give, in a lifetime, about 2 or 3 A-hr of current (at 250 mA drain), with this new technique of recharging, some have given 30 to 40 A-hr and are still going strong!

Such claims sound fantastic –but try it before you decide it's impossible. It is quite a simple discovery and one that is not yet fully explained. But it works. Chemists are not really certain of all the chemical changes taking place in the normal battery. Theoretically, the chemical changes taking place when a cell is discharged should be reversed when the cell is charged. But this theory does not take into account an effect called "polarization," which tends to restrain the reaction. Besides, it has been found that with the ordinary dc charging technique the zinc of the regular LeClanche (flashlight) battery does not just migrate back to its proper place. It tends to clump up and form crystals or spikes of zinc on the negative electrode. Then further discharging thins out even more the zinc between clumps and you soon have holes in the zinc. Your cell dries out and you have a dead battery.

The discovery of Mr. Beer was a way to get the zinc to return to the negative electrode in an even layer instead of in clumps. This he accomplished by putting a small reverse current through the cell at the same time he was charging it. No one as yet has figured out just why this works but tests indicate that the reverse current seems to serve as a depolarizer. At any rate, it improves the efficiency of the charge many times.

In electroplating, this technique is used and results in much smoother, hard and even plating. Another effect of this higher efficiency in charging is that one can charge a cell at a much faster or higher rate without the cell heating up. With flashlight cells the only condition is that the cell not be already dead. Nickel–cadmium cells, of course, can be completely discharged and will still accept a charge.

It is best to recharge a carbon–zinc (flashlight) cell before it has dropped below 1.3V. After this point, the cell soon develops holes in the zinc with consequent drying out and deterioration. However, it was found that even a cell with some very small holes could be rejuvenated because the zinc is recoated so as to actually seal up the small holes! A lead–acid cell which would accept no more that a 50% charge by the ordinary technique was built up to a complete charge by alternately charging and discharging with this new circuit until it was up to full capacity.

The circuit is simplicity itself. All that is necessary beyond the diode rectifier and the resistor (or capacitor used as a reactance-type resistor) found in the cheapest recharger, is another resistor across the rectifier. This second resistor allows some ac to flow through the cell and so the technique is called asymmetrical alternating-current charging. It has been found to work best when about 10% of the forward current is allowed to flow backward in the circuit. You can easily calculate the necessary resistance.

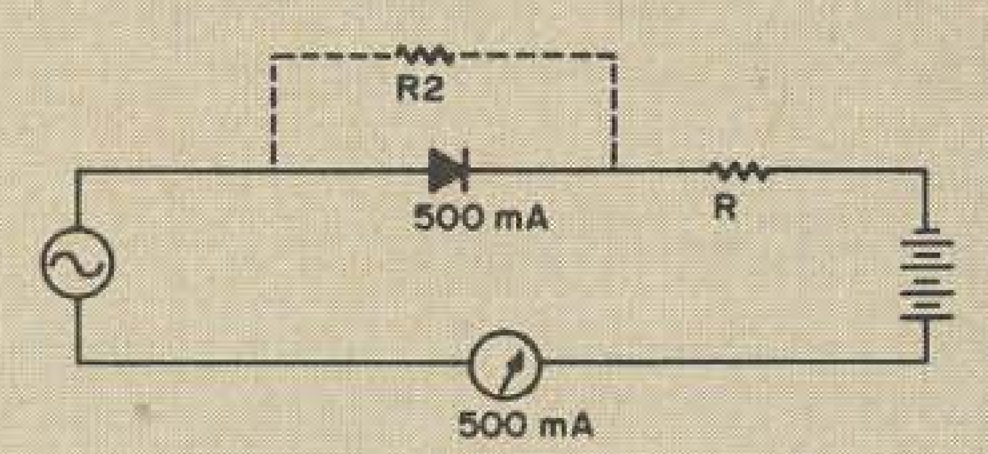


Fig. 1.

First set up your circuit as in Fig. 1. By trial and error figure out the resistance of R. Do this by deciding how much charging current you want; e.g., for a typical nickel–cadmium cell, you might choose the 100 mA they are usually rated for – or about the same or more for an ordinary flashlight cell. Begin by using a high resistance at R. This depends

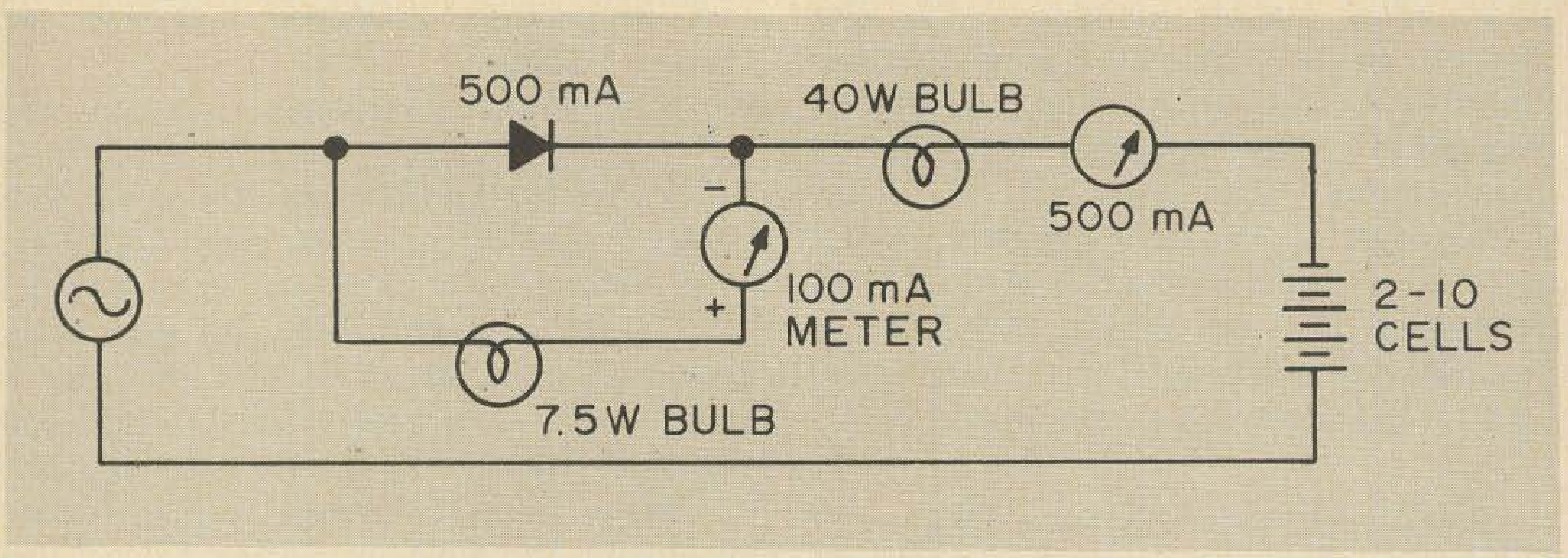


Fig. 2

on your ac source; if you use 117V you could try a 10W light bulb in series, but with only 25V or so from a transformer you could get by with a few thousand ohms to begin with. Then gradually reduce the resistance (or use a higher wattage light bulb) till the meter shows about 100 mA. Remember, the resistance has to be able to carry 100 mA, so use one of adequate rating.

Next, multiply R by 10 and place the corresponding resistor across the rectifier and you're finished. Make it big enough to carry the 10 mA of current it will be drawing in reverse. Or if you like to use trial and error, you can try different resistors at R2 also, starting with one at least 10 times greater than R and reducing it till you get the 10 mA reverse current. Remember, this is *reverse* current, so connect your meter leads accordingly.

As previously stated, this system allows recharging at a much higher rate than ordinary chargers, and without overheating a cell, I recharge my 100 mA nickel–cadmium cells at 275 mA with about 30 mA reverse current flowing. Figure 2 shows the circuit of my complete battery charger using this new technique, along with an added refinement. Due to the 117V source current and the current-dropping light bulbs, this circuit enables one to charge anywhere from 2 to 8 or more cells in series at one time without changing the circuit at all for each cell I add to the circuit This is because the line voltage with only the bulbs in series produces an essentially constant-current source for the rectifier and any number of cells. Actually, by bulb ratings one should use a 4W bulb to go with the 40W bulb, but according to actual current drawn, the 7.5W bulb proved a better match to draw 10% of the forward current.

The meters are not necessary, of course. Once you measure and obtain the current you want, or just use this circuit as is, the meters are no longer needed unless you want to be sure current is being drawn. With this circuit you will draw about 275 mA through from 2 to 8 nickel–cadmium cells. If you use ordinary flashlight cells there will be less current as carbon–zinc cells have more internal resistance than nickel–cadmium cells.

The best way to determine length of charge is to figure the normal capacity of the cell and charge accordingly; a 1 A-hr cell, for example, could be charged at 250 mA for about four or five hours. Cells have been left for days in this charging setup without any apparent damage, so don't be too concerned over a few extra hours.

Another way to check charge is to measure the voltage across the cells. Towards the end of a full charge the voltage will rise. Ordinary flashlight cells, if new, can be charged to almost 2V each. They lose the extra voltage soon afterwards but it is an increase of energy that no common charger will give.

So, dig out all your dying batteries and see which ones are capable of a lot more life.

. . . K8YUC ■

Source: "Brief Investigation of an Asymmetrical Alternating-Current Battery-Charging Technique" by Donald J. Vargo — Technology Utilization Office Lewis Research Center, Cleveland, Ohio.

NEW NCX-500 only $249.95

SPECIFICATIONS:

Frequency Coverage: 3500-4000 kHz, 7000-7300 kHz, 14000-14500 kHz, 21000-21500 kHz, 28500-29100 kHz (2 additional crystals available at $7 each to provide expanded coverage of entire 10 meter band).

Power Input: 500 watts PEP on sideband, 360 watts on CW, 125 watts on AM, D rated 20% for mobile operation.

Emission: SSB upper on 10, 15 and 20 meters; lower on 40 and 80 meters.

Output Impedance: 40-60 ohms minimum pi network.

Receiver Offset Tune: By means of a varactor controlled oscillator you obtain plus or minus 3 kHz.

SSB Generation: Crystal lattice filter 6-50 db shape factor 2.2-1, gate 2.8 kHz on 6 db, center frequency 5.202 mHz; uses stable solid state ring modulator.

Dial Calibration: 5 kHz on all bands.

Tuning Ratio: Excellent mechanical resolution with 45-1 rate.

Electrical Stability: Nominally 1500 cycles in first 30 minutes thereafter plus or minus 400 cycles for room ambient.

Suppression: Carrier minus db, rejected sideband minus 40 db, third order products minus 30 db at full output.

Sensitivity: .5 microvolt for 10 db s/n in ss mode.

Audio Output: Better than 2 watts into 3.2 ohms.

Metering: PA cathode current on transmitter. S units on receive.

Special Features: Includes side tone monitoring plus built-in code practice oscillator for Novices; incrementation toning, provision for crystal calibrator.

Dimensions: 6³⁄₁₆" high x 13⅜" wide x 11" deep. Weighs but 15 lbs.

Accessories Available: AC-500 supply, 21 lbs.; NCX-A deluxe supply, 25 lbs.; 400-12 mobile DC supply, 13 lbs.; AC supply operates on either 117 or 234 VAC 50-60 cycles; suitable for export. Mobile bracket furnished at no extra charge.

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NCX-500 w/Linear Systems 400-12	359.95
NCX-500 without supply	249.95
XC-28 plug-in solid state crystal calibrator (available 1 March)	19.95

NEW CLEGG 66'er $175.00

RECEIVER: Dual conversion with 10.7 MHz 1st IF and 456 kHz 2nd IF; sensitivity better than .35 μV for 10 dB S+N/N; selectivity 8 kHz; frequency coverage 49.9 to 52.1 MHz; drift less than 3 kHz per hour after 20 minute warmup; spurious responses down more than 60 dB; AGC provides more than 10 dB compression for 40 dB signal increase; squelch threshold adjustable; switchable ANL; audio output greater than 2 watts; speaker built in.

TRANSMITTER: 22 watts input, output 52 ohm; high talk power performance; harmonic outputs down more than 50 dB; spurious outputs excluding harmonics down more than 66 dB; exciter stages are broadband and multituned for quick QSY; ptt operation; audio response 300 to 3000 Hz ±3 dB; operated with 8.3, 12.5 or 25 MHz crystals or external VFO; spotting switch for transmitter frequency checks; built-in solid state power supply for both 115 volt AC and 12 volt DC operation; compact: 12"W x 12"D x 6½"H; 19 lbs.

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A Poor Man's Frequency Meter

How to turn a few cheap surplus sows' ears into a satin handbag.

While the FM'ers may be the only hams around who make a religion out of being precisely on frequency, virtually *all* active amateurs have a need for a frequency meter periodically. Well, this may come as something of a shock to some, but there *is* a way to measure frequency accurately without the use of expensive equipment. With a handful of parts and a few items found commonly around the radio shop, you can build the *poor man's frequency meter*, which is capable of tolerances that should amaze you.

This is *not* a substitute for a good frequency meter for commercial use, but if you have a limited number of frequencies that you want to be "dead on," this may be the answer. And it ought to be a must for the group of fellows who maintain the local FM repeater.

A nice feature of the *poor man's frequency meter* is the fact that it puts to use that old surplus military communications receiver which has undoubtedly been sitting around in a dark corner of your basement under piles of old magazines and discarded dynamotors. It also uses any old commonly available surplus wideband FM receiver, such as the types advertised in this issue of 73.

The idea is not new; hams in the two-way business will recognize it as the system that has been used for many years for the Motorola station monitor and various other common applications. Basically, it is composed of four major units:

- Receiver converter with calibration oscillator constructed on a high-band front-end deck from an old Motorola Sensicon A receiver chassis.
- Monitor receiver (any 150 MHz wideband receiver); a low i-f of 455 kHz is best.
- WWV receiver (here is where the surplus communications receiver comes in).
- Accessory items (hang a modulation meter on it).

The block diagram of Fig. 1 shows how the individual items of equipment are interconnected to form the frequency meter. Note that although a narrowband receiver can be used, a more dependable "off frequency" indication is obtainable with a wideband i-f receiver. Periodic calibration (before use) to WWV is recommended for high accuracy measurements; however, the unit will maintain its operating frequency to within 1 kHz (an error of 0.0006%) for an ambient temperature within the range of −20°C to +60°C.

Principle of Operation

The frequency converter operates on the heterodyne principle. A station frequency is

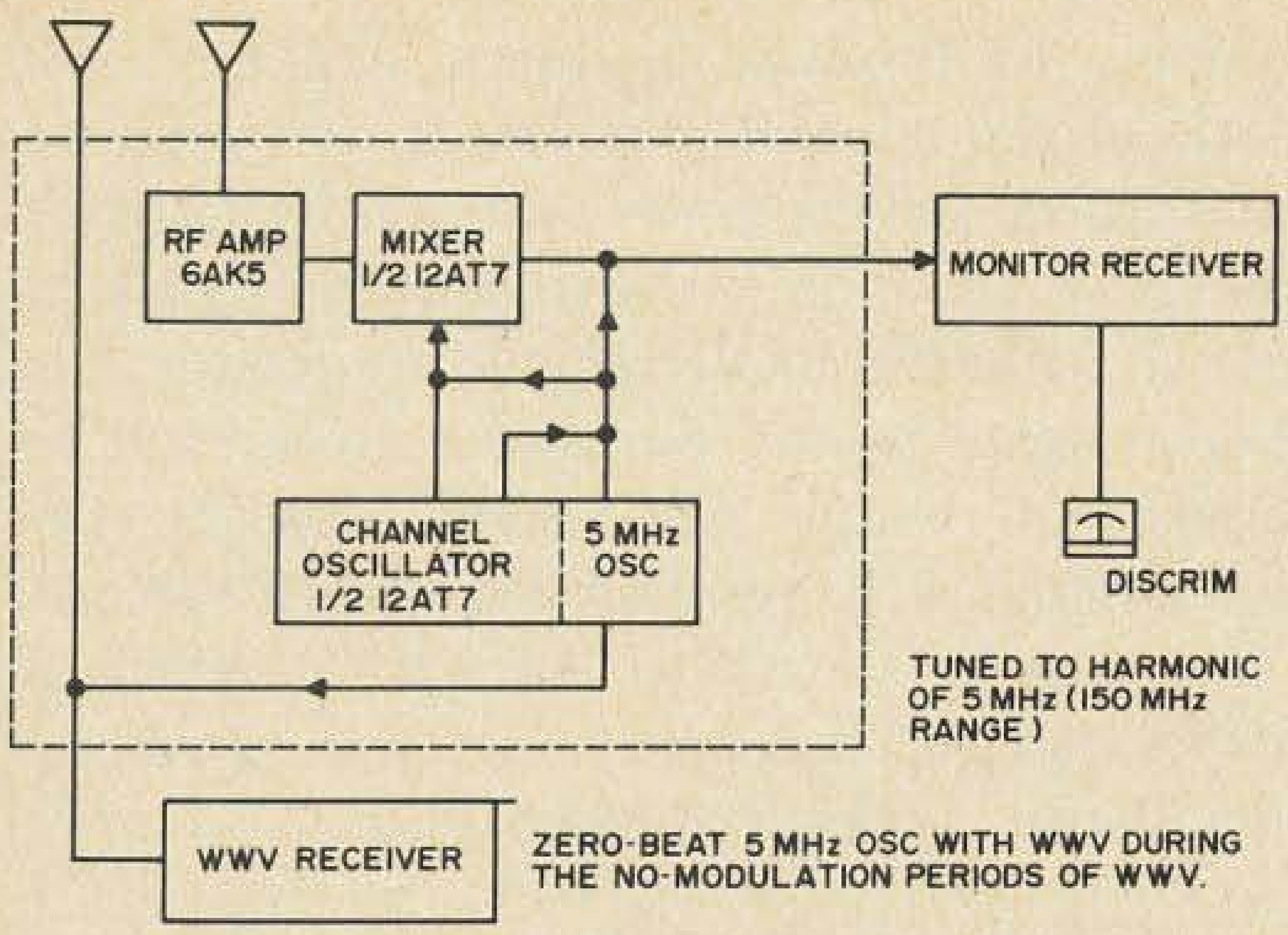

Fig. 1. This system block diagram shows how equipment should be interconnected to make the frequency meter setup.

monitored by heterodyning its carrier with the output frequency of the crystal oscillator and then feeding the resultant frequency of these two signals into the calibrated monitor receiver. If the beat frequency between the crystal oscillator signal and the monitored carrier is exactly equal to the frequency to which the receiver is aligned, the discriminator meter will indicate zero. If the beat frequency is lower or higher in frequency than the one to which the receiver is aligned, a direct indication of carrier frequency error in the monitored transmitter will be given on the meter.

The monitor receiver is aligned to a predetermined frequency. The specific frequency used will depend upon the spurious harmonics emitted by the channel crystals which will be required to monitor the specific carrier channels in consideration, plus the operating frequency to be measured.

The beat frequency fed to the control receiver may be either the sum or difference frequency of the channel crystal frequency and the monitored carrier frequency. Channel crystals for operation in the range from approximately 1.6 to 12.5 MHz may be used.

Calibration Oscillator

The calibrating oscillator consists basically of an rf amplifier stage, a mixer, and an oscillator. The calibrating crystal, shunted by a trimmer capacitor for any minor adjustment of oscillator frequency, is used for calibrating the monitor receiver.

Although the crystal is temperature controlled, a *greater degree of accuracy is obtainable without the use of the heater.* The trimmer capacitor provides *exact* calibration of the crystal frequency at any temperature by zero-beating the oscillator against the WWV signal.

The crystal heater should be used *only* when a quick check is necessary; such as, where it is desired to quickly bring the crystal to a temperature that would eventually be reached due to the heat dissipation of the equipment.

The control receiver may operate in the 145-160 MHz range; therefore, when using a 5 MHz calibration crystal, the 29th, 30th, 31st, or 32nd harmonic of the 5 MHz crystal

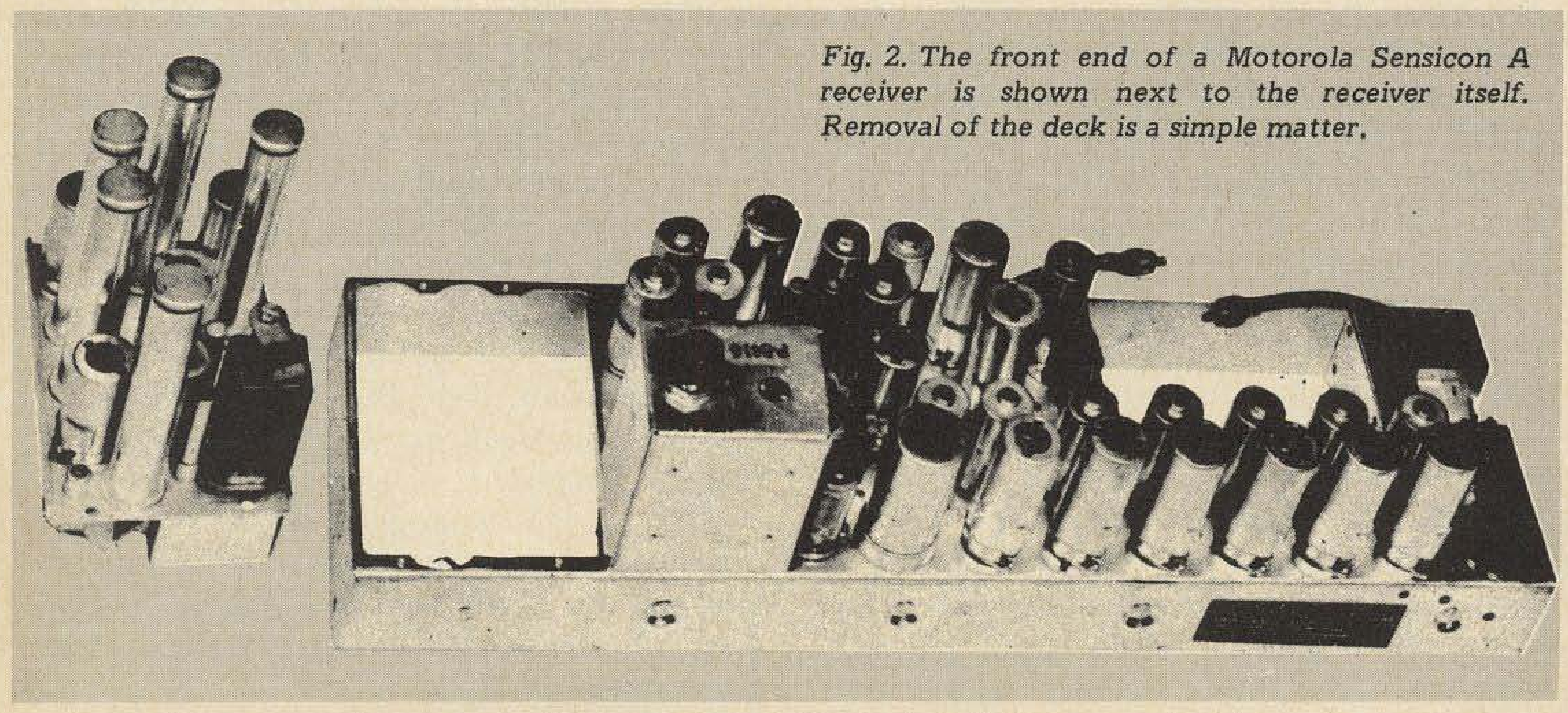

Fig. 2. The front end of a Motorola Sensicon A receiver is shown next to the receiver itself. Removal of the deck is a simple matter.

frequency is used to calibrate the receiver to 145, 150, 155, or 160 MHz.

The selector switch operates in conjunction with the calibrating oscillator. This switch may be used to select any one of several crystals as the frequency controlling element of the oscillator. These crystals include the 5 MHz calibration crystal and the five channel crystals.

One half of a 12AT7 tube is used as the oscillator while the other half of the tube quency to produce an input signal of 150 MHz at the control receiver. In this case, no indication will be given by the discriminator meter. If the monitored transmitter carrier is above or below its designated frequency, the input signal to the monitor receiver will be above or below 150 MHz, causing the discriminator to produce an output voltage. This voltage is fed to the meter, which is calibrated in kilohertz to give a direct reading of carrier frequency error.

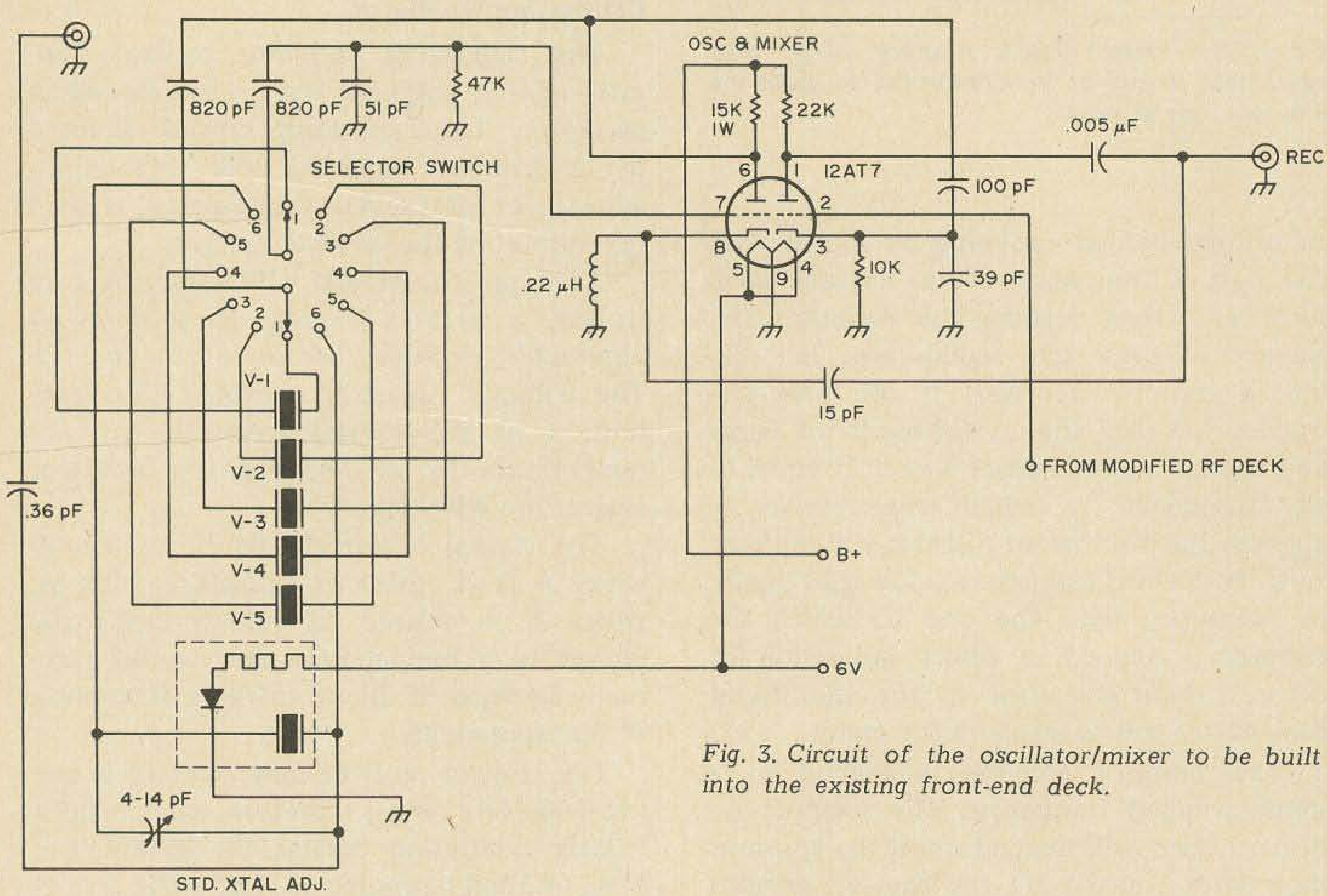

Fig. 3. Circuit of the oscillator/mixer to be built into the existing front-end deck.

functions as the mixer. The carrier frequency to be monitored is picked up by the VHF antenna, amplified by the 6AK5 amplifier, and then mixed with the selected channel crystal frequency. The output of the mixer is fed to the calibrated monitor receiver where it is determined if the transmitted carrier is on frequency.

Assume that it is desired to monitor the output of the transmitter which is operating on 146.94 MHz and that the control receiver has been calibrated at 150 MHz. The necessary channel crystal frequency will be the difference between 146.94 MHz and 150 MHz, or 3.06 MHz. If the transmitter is on frequency, the 146.94 MHz signal will mix with the 3.06 MHz channel crystal fre-

When monitoring transmitters which operate in the 420–450 MHz band, the monitor must be placed so that the monitor antenna is within a few feet of the transmitter. For this application, the frequency of the stage preceding the final tripler is monitored. This is done by selecting a difference frequency crystal for the monitor which, when beat against the frequency of the transmitter stage preceding the tripler, produces the frequency at which the control receiver is tuned.

Say that it is desired to monitor the output of a transmitter operating on 443.75 and that the monitor receiver is calibrated at 150 MHz. The channel crystal frequency is determined as follows:

$443.70 \div 3$ (tripler) = 147.90
(frequency actually monitored)
$150 - 147.90 = 2.1$ MHz
(channel frequency crystal)

If the transmitter is on frequency, the frequency of the stage preceding the final tripler will mix with the 2.1 MHz channel crystal frequency to produce an input signal of 150 MHz at the monitor receiver. In this case, no indication will be given by the discriminator meter. If the monitored transmitter carrier is above or below its designated frequency, the input signal to the monitor receiver will be above or below 150 MHz, causing the discriminator to produce a positive or negative output voltage. This voltage is fed to the discriminator meter *which can be calibrated to give a direct reading of carrier frequency error.*

Any error in carrier frequency indicated on the discriminator meter is an error in the frequency of the stage preceding the tripler; therefore, the error in the transmitter signal from the final amplifier will be three times as great. When using this method of monitoring, check the output (420–450) of the transmitter with a reliable wavemeter to ascertain that proper frequency multiplication is made.

Channel Crystal Accuracy

Since the fundamental frequency of the channel crystals is used, any error in crystal frequency is not multiplied. Therefore, the error in monitoring a frequency by this method is very small. Crystals are held to within 0.002% of the specified frequency over the ambient temperature range of –30°C to +60°C. Therefore, with the previous 2 meter example, the maximum frequency error of the 3.06 MHz crystal would be 3.06 x 0.0020%. At the frequency being monitored, the percentage error would not be discernible on the meter.

The "improvement factor" of possible percentage accuracy at the channel crystal frequency over the percentage accuracy at the carrier frequency is approximately the same ratio as the monitored carrier frequency over the channel crystal frequency, or 146.94/3.06 equals 48. This is another way of stating that the channel crystal is more than 48 times as good percentage-wise at the monitored frequency than at its fundamental frequency.

The improvement factor may be checked on any channel by the above method. It will always remain reasonably high; therefore, the possible error of the channel crystal frequency is negligible.

The front end deck of a Motorola Sensicon A receiver provides an ideal converter for the *poor man's frequency meter.* **Figure** 2 shows this assembly as a separate unit as well as in its original form installed in a Motorola Sensicon A receiver. The part numbers referred to in the modification procedures described here are those part numbers called out in the Motorola manual for the Sensicon A 150 MHz receiver. The procedure is quite simple, too. Here is all you do:

1. Replace R102 (2.2MΩ) with 3.3 MΩ and ground low side.
2. Remove C104.
3. Replace R103 (33 kΩ) with (470 kΩ).
4. Replace L101 with a 100 kΩ resistor.
5. Remove R112 (3.9 kΩ), complete B+ circuit.
6. Replace X102 with 9-pin socket (with shield).
7. Remove wire from pin 1 and connect to pin 2.
8. Connect 1 MΩ resistor from pin 2 to ground.
9. Wire 12AT7 socket for 6V filaments. (Connect 6V to pins 4 and 5, and ground pin 9.)

This completes the modification of the rf amplifier. To construct the oscillator/mixer, remove the balance of the circuitry on the deck with the exception of the crystal socket. Then build the circuit as shown in **Fig. 3** around the new X102. Be sure to use silver mica capacitors in the crystal circuits. The crystals themselves are Motorola SFMT-2 (R11, 5 MHz), and they may be obtained from Sentry or International.

The Sensicon A receiver is found in a number of the older, less expensive Motorola FM units, such as the 40V, the early 41V, and all Model series bearing the AAV and AAD suffix. These are available from Newsome (Detroit), Mann (Tarzana, Calif.), C & H (Long Beach, Calif.), and Gregory (Saddlebrook, N.J.). . . . W6YAN■

Ken Sessions K6MVH/1
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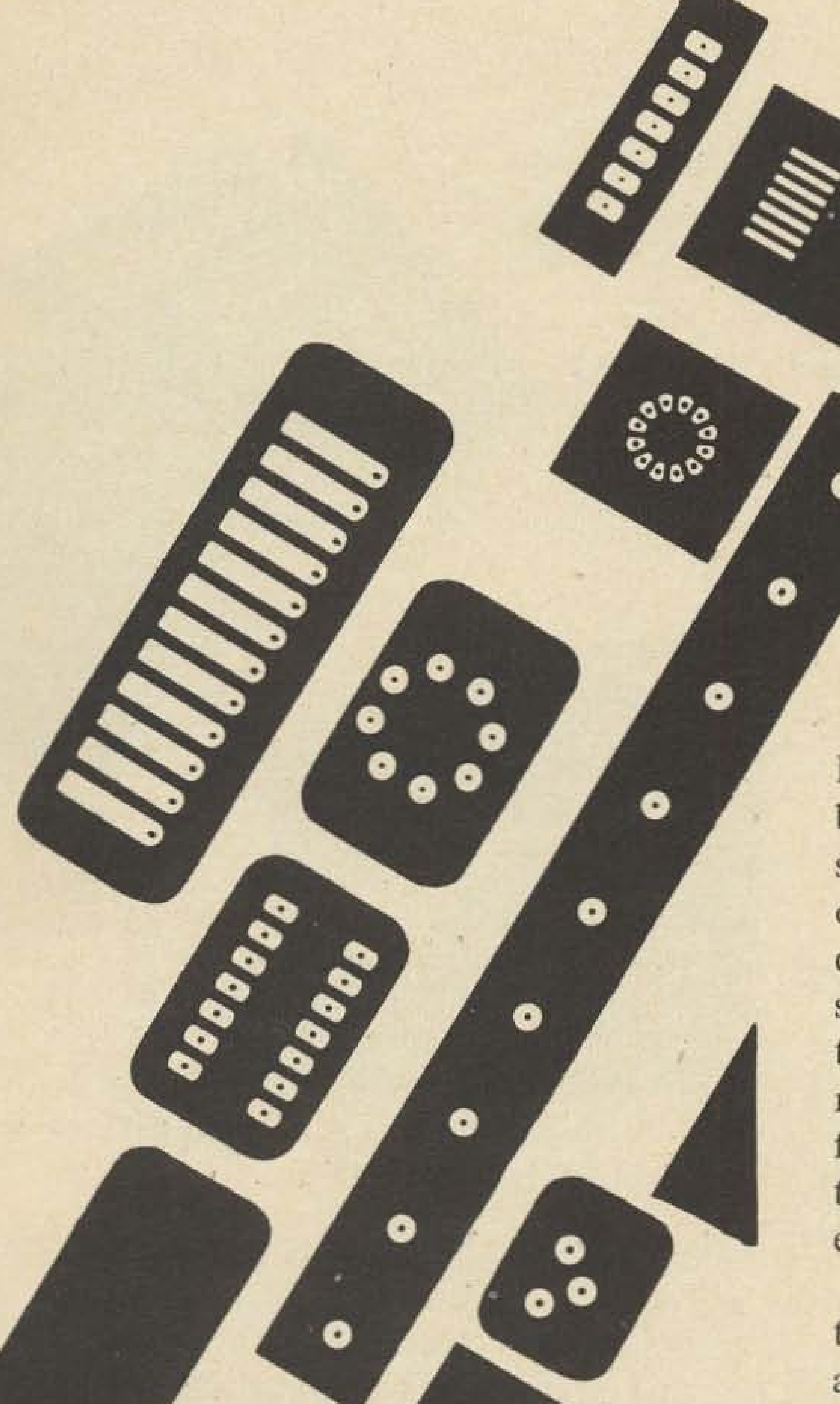
Professional PCs *from roll-your-own "negs"*



Just the thing for the next club project!

Like most other hams, I read every article I can find on how to make printed-circuit boards. The professional processes always seem to be formidable from the standpoint of complexity, equipment requirements, and detail. And the amateur methods always seem to give you a board that *looks* amateurish. Besides, amateur or professional, most all the published procedures are difficult to follow in your mind; as you read the instructions, you find it hard to know exactly what you should be doing and when.

Now, it just *could* be that I'm the dense type. Maybe other hams breeze through the articles and immediately whip up five or six boards of their favorite circuits. I began to accept the possibility of my "numbness" with great reluctance and only after digesting many treatises on the subject of preparing quick PCs.

Then one day, while I was preparing a batch of "new product" announcements for a trade magazine in Chicago, I happened across a news release from Sol Shein Advertising Agency that extolled the virtues of a simplified PC production process developed by Bishop Graphics, Inc., a California firm. The text supplied rapidly lost me as had all the previous articles I'd read, but the cagy

Step 1. Negative (B-Neg) version of a typical dual in-line IC package is laid down just the way positive configurations are handled.

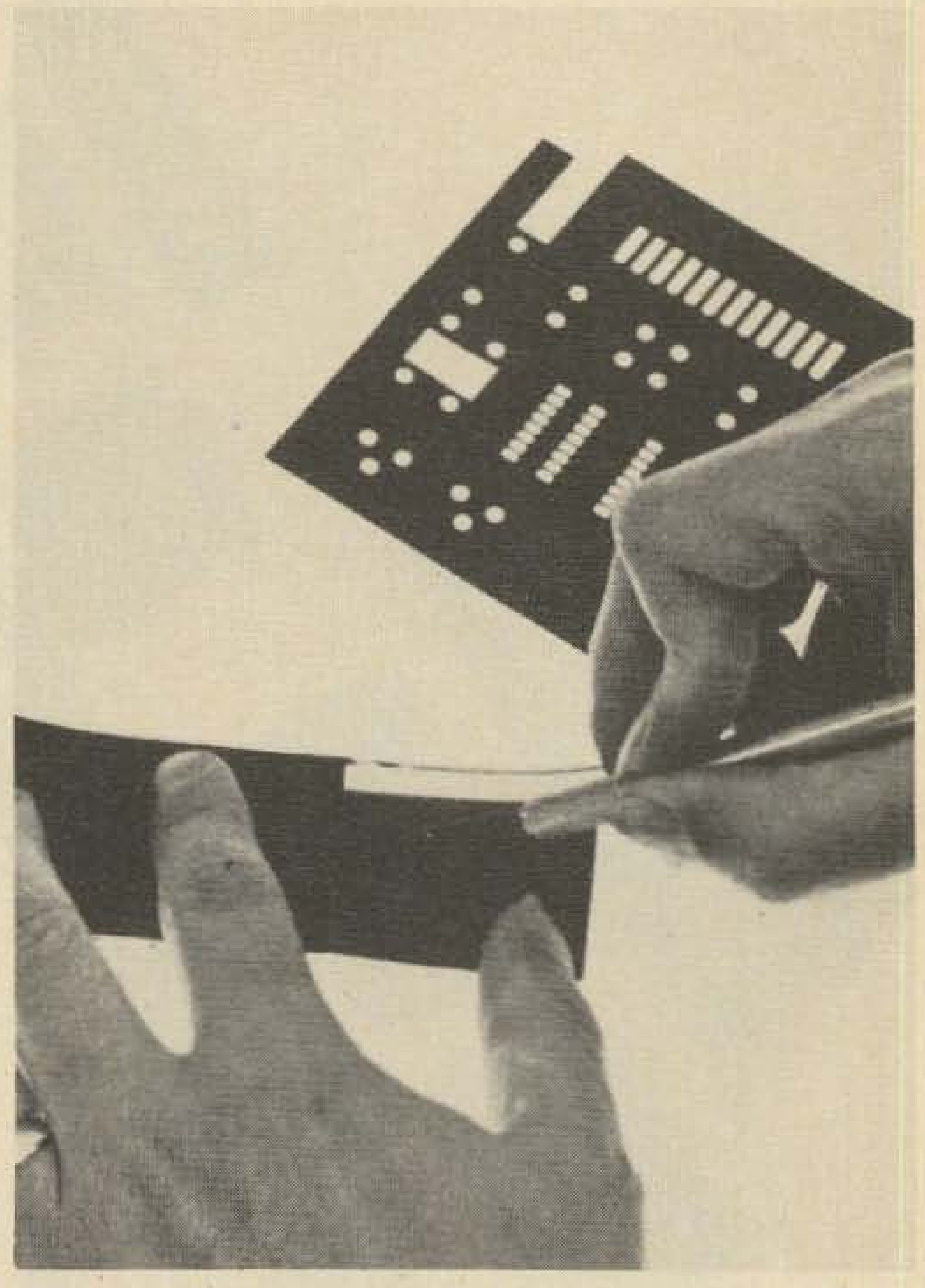
people at Shein were clever enough to foresee possible confusion, so they included a raft of photos that showed the complete preparation process, from layout to finished board.

I made a mental note at the time to write an article for 73 Magazine at my earliest opportunity; 73 readers, I reasoned, would appreciate as much as I do a truly easy way to make their own professional PC boards. The "mental notes" proved to be ill-filed, however, because I lost them as well as all of the photos when I moved from the Chicago area to Peterborough. But – as luck would have it – the Shein agency was on the ball; their press releases were also sent to 73, photos and all.

The Bishop Process

The Bishop Graphics company produces a photoresist solution that can be used to sensitize a copper-clad board for photo exposure. The product line also includes developer, etchant, and stripper; but the big thing is the technique they have for eliminating any drafting, camera work, or the necessity for darkroom processing.

The Bishop method involves the use of preprinted "negatives" which can be placed in any configuration to suit the needs of the individual. The negative patterns – including transistor layouts, dual in-line IC patterns, and a thousand and one other variations – come already printed on pressure-sensitive "B-Neg" acetate. The company also

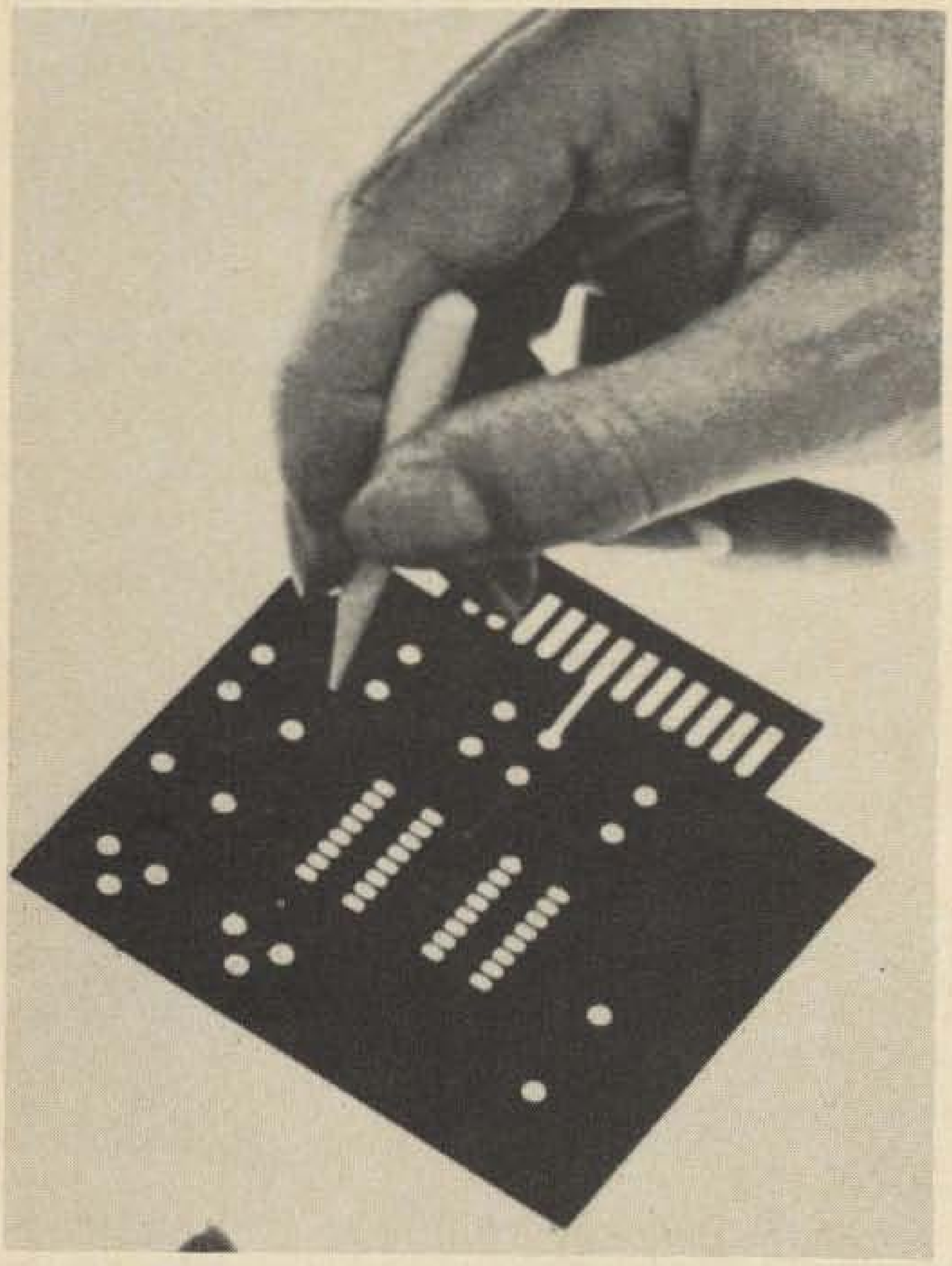


Step 2. Opaque black B-Neg "background" film fills in spaces between terminals.

supplies pure black pressure-sensitive B-Neg material so that anyone can form his own completely custom-designed negatives.

The completed B-Neg pattern can be used to produce a positive pattern on the presensitized (photoresist) copper-clad laminate or film. And the laminate, quickly etched on the spot, becomes a circuit board ready for drilling and component wiring. The whole process takes an hour or two —and the result is a *professional* job.

The steps are simple. After the B-Neg pattern is laid down on a thin transparent Mylar, acetate, or film base, the clear areas are overlaid with a mask of B-Neg opaque film. Then, with a sharpened piece of white chalk or any light marker, interconnecting circuit lines are drawn on the B-Neg mask to establish conductor paths. Corrections of



Step 3. Circuit lines are traced in white chalk or marking pencil.

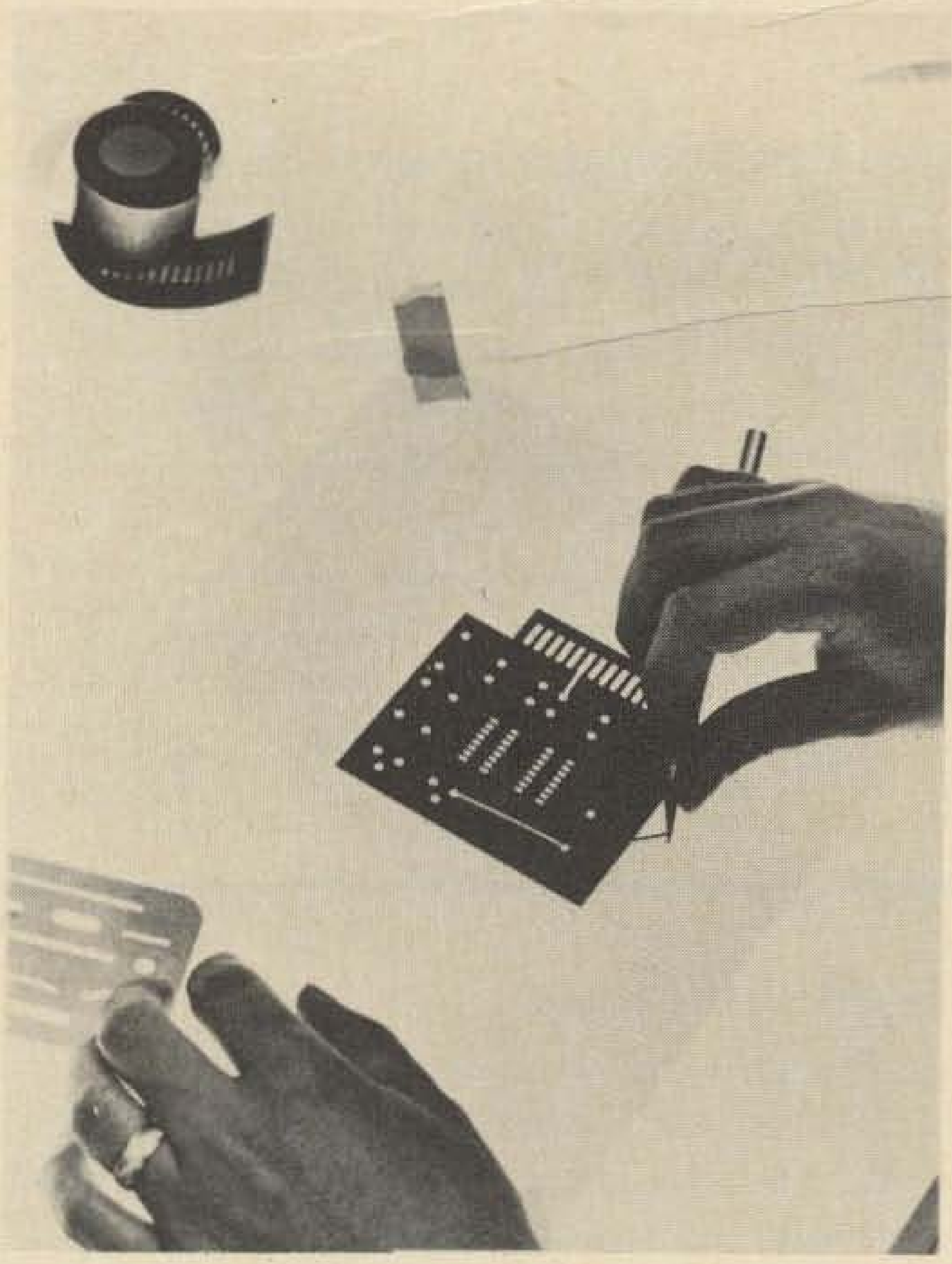
mistakes or changes are easy. Simply rub away the chalk and redraw the conductors.

The final conductor paths are established by cutting along the established chalk lines and peeling away the B-Neg material. Fine conductors may be scribed. Conductor paths can just as easily be eliminated by covering with the black B-Neg mask material.

The completed B-Neg and copper-clad laminate (which has been coated with Bishop photoresist) are placed in a contact frame or in a plate glass "sandwich." Exposure under an ultraviolet light source (or a noontime summer sun) takes no more than a few minutes, and the subsequent developing, etching and strip/rinse cycles can be completed in approximately an hour. The board is then ready for drilling and assembly.

If you are accustomed to producing your negatives with a regular process camera, you should know that existing negatives can also be changed quickly with B-Neg. Entire patterns can be relocated or conductor traces changed without retaping and reshooting original artwork.

All B-Neg pads and patterns are available in 1:1 scale. Other necessary materials are available from Bishop dealers: Mylar matte base material and grids, knife, tweezers, erasing shields (for cutting accurate conductor paths), and white charcoal pencils. If you don't know where to get Bishop's B-Neg stuff, write to the main office at 7300



Step 4. Using common eraser shield for a guide, neat circuit paths are cut and peeled.

Radford Ave., No. Hollywood, Calif. 91605. Chances are you'll even get a free sample.

Getting the Material Together

There are several ways you can go when you get on a PC production kick. You can do it the easy way by sending $28.50 to Bishop Graphics, which gets you a complete PC production kit, including an exposure frame and a couple of processing trays. Or you can scrounge and cumshaw and do everything kind of slipshod the way I do. My system differs a bit from Bishop's recommended procedure, because I am inherently cheap; as a consequence, I don't employ the trays and contact frames and other trinkets and niceties the Bishop brochures rave about. But my method is just about as effective, even if a bit more cumbersome . . . and after all, it *is* my story.

The table presented here shows the material recommended by Bishop alongside the material I recommend for the cheapskate scroungers. With care, you should get excellent results regardless of which bill of materials you use.

Step 5. Finished B-Neg and photoresist-coated copper-clad laminate are placed in contact frame.

Bill of Materials

Bishop Catalog number, description, and price.			Scroungers list and price	
	B-Neg material and patterns as necessary			Same as at left
7902	Photoresist, 7 oz. aerosol spray	$6.85	6.85	Same as at left
7904	Developer	1.50	1.50	Same as at left
7905	Stripper	1.25	1.25	Same as at left
7906	Tray set	1.25		2 shallow pans—one metal, one ceramic, plastic, or paper.
7908	Etchant	5.80	5.80	Same as at left
7909	Contact pressure frame	7.55	2.98	8 x 10" picture frame w/glass and backing
7952	4 x 6" boards (1 side copper)	4.50	4.50	Same as at left
	Ultraviolet fluorescent lamp	29.95	Free	Sunlight
		$56.65	21.88	

Preparing the Board

Prepare the copper-clad laminate *carefully*. All soil, stains, and foreign matter must be completely removed. Scrub it with ordinary household cleanser and a stiff brush. Rinse. Repeat the scrubbing. Rinse again. Wipe off thoroughly with a clean towel. Rinse *again*. Now air-dry (or oven-dry at 110° to 120°F), always handling with care and never touching the surface with bare hands or fingers. (Residual oils in the skin will reduce the quality of the end result.)

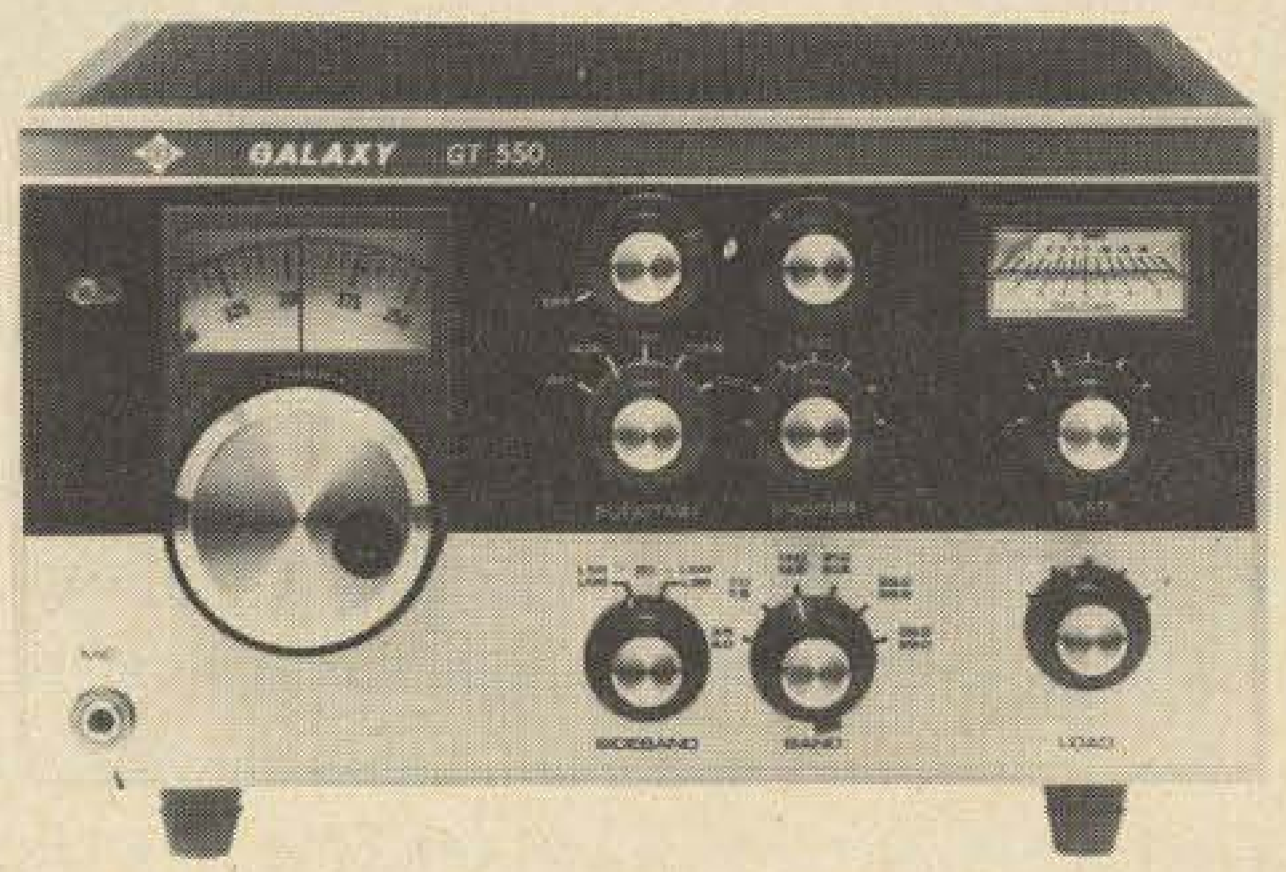
If you don't have a darkroom, wait until after dark before you prepare the board. In the dimmest light possible, place the clean, copper-clad laminate on a protective background (several paper towels) and spray on a full, even coat of Bishop photoresist, following the directions on the can. Immediately pick up the board and slant one edge toward the floor. As the 'resist runs to the lower edge and forms a bead, soak the bead off with a paper towel. Turn the board 90° and repeat (the equivalent of a slow spinning action) so that excess 'resist is removed and no longer forms droplets at the lower edge. Then place the board flat for air-drying (or in an oven at 110° to 120°F). The 'resist will flow out, leaving a very even layer. For further processing, the board must be completely dry . . . no tackiness, no solvent smell.

With the B-Neg protomaster and a contact frame close at hand, half-fill a shallow metal or ceramic dish or tray. (Don't use plastic or you'll find yourself with no dish and a big mess.)

AMATEUR ELECTRONIC SUPPLY

Make those "S" meters bounce!

You will with the exciting new... Galaxy GT-550



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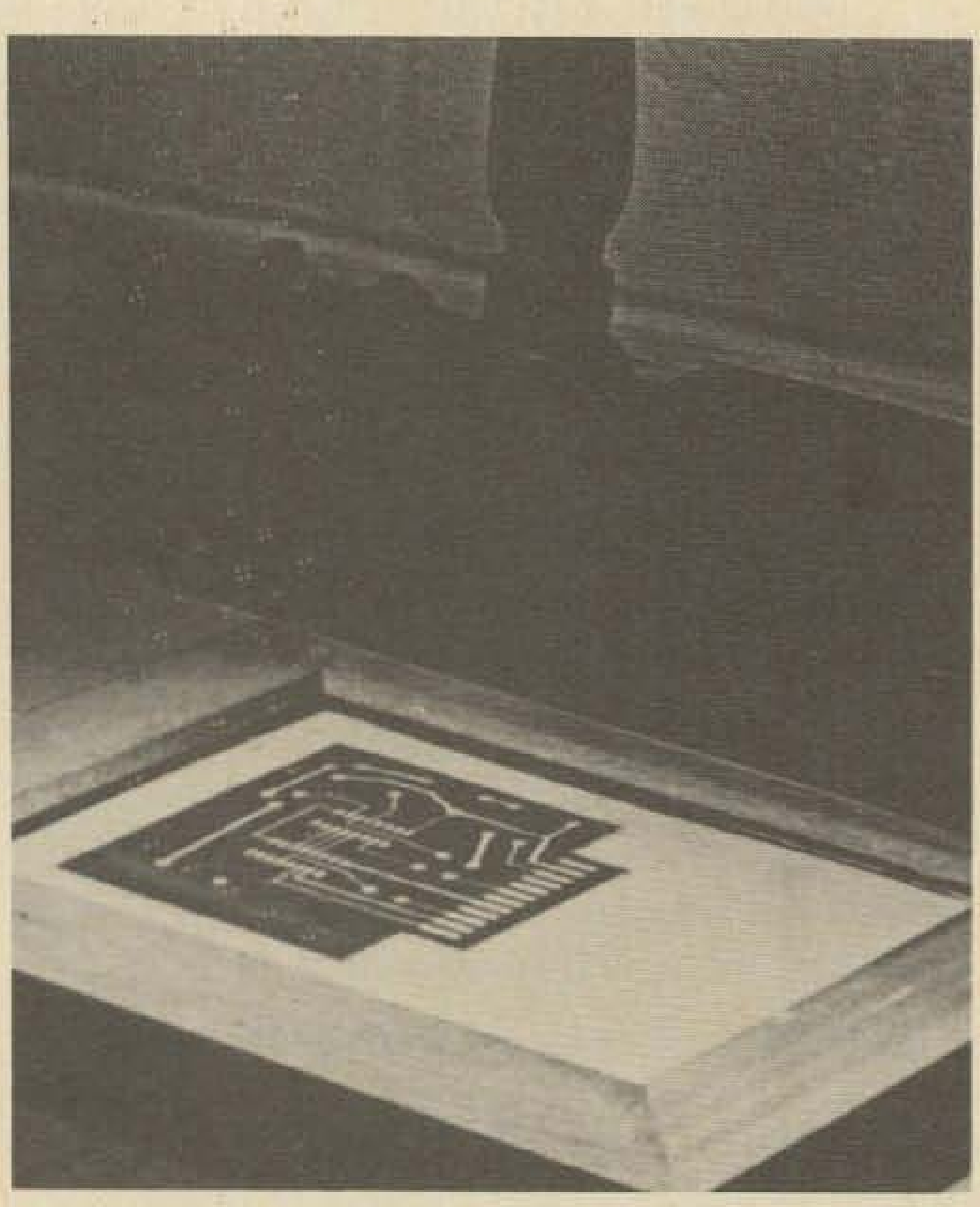
Open the contact frame (or substitute therefor), placing the B-Neg face down on the glass. Make sure the sprayed board is completely dry and place the 'resist side against the B-Neg. Close and lock the frame, and place it under the blacklight source about 3 in. from the lamps. Expose for two to four minutes (a test or two will give you a



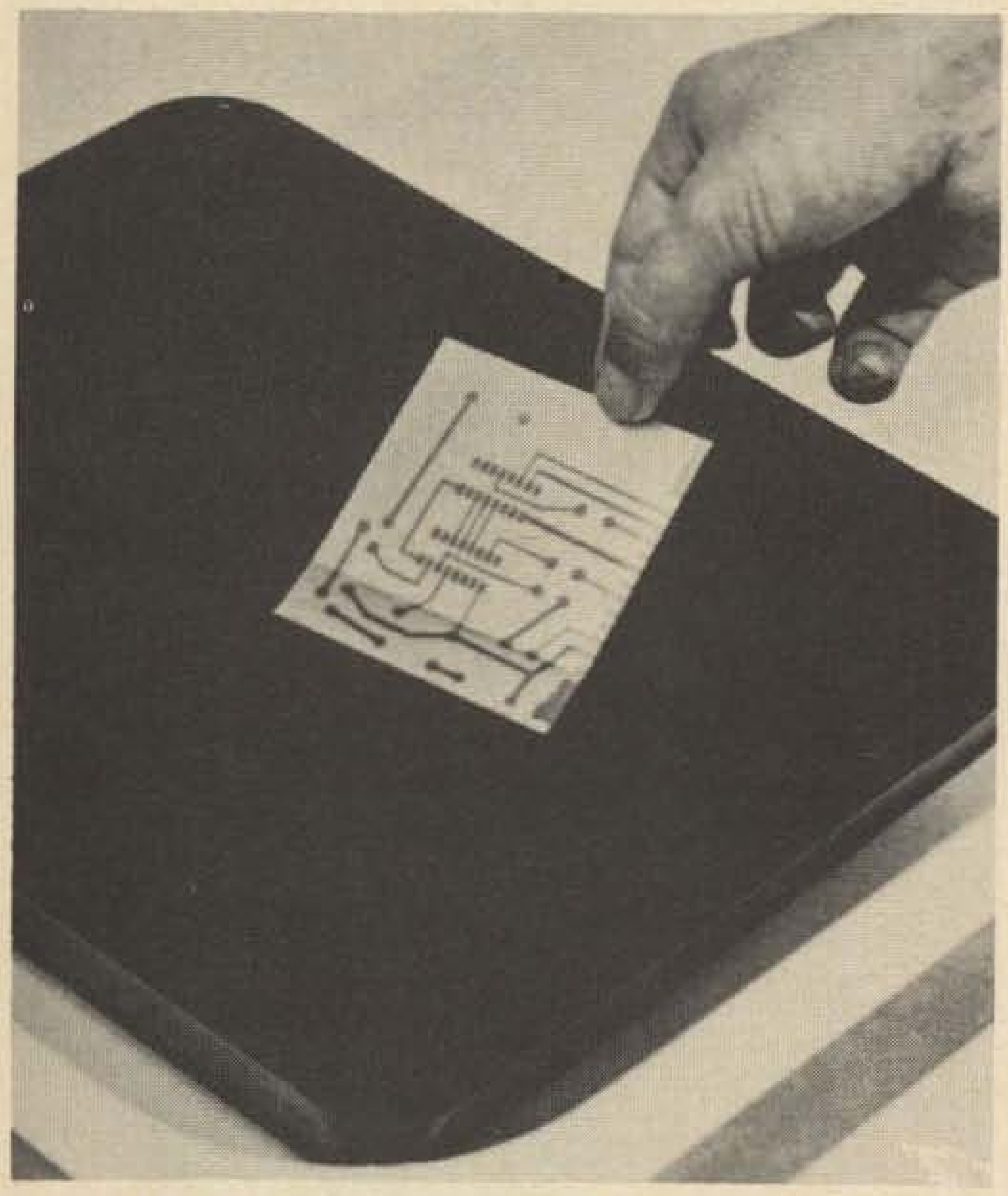
Step 6. Exposure to ordinary black-light fluorescent lamps takes less than four minutes.

Step 7. It takes only a few seconds for a crisp pattern to show in the developer tray.

reliable guide). If you use bright sunlight, allow 10–15 minutes around noon.

Immediately after exposure, immerse the board in the developer. Agitate gently; 30 sec to 1 minute should produce a bright, sharp image. Now rinse in running water at the sink, where etching and stripping will soon complete the process.

To etch the board, dissolve one packet of Bishop etchant powder in a pint of hot water in a *plastic* tray. Immerse the exposed

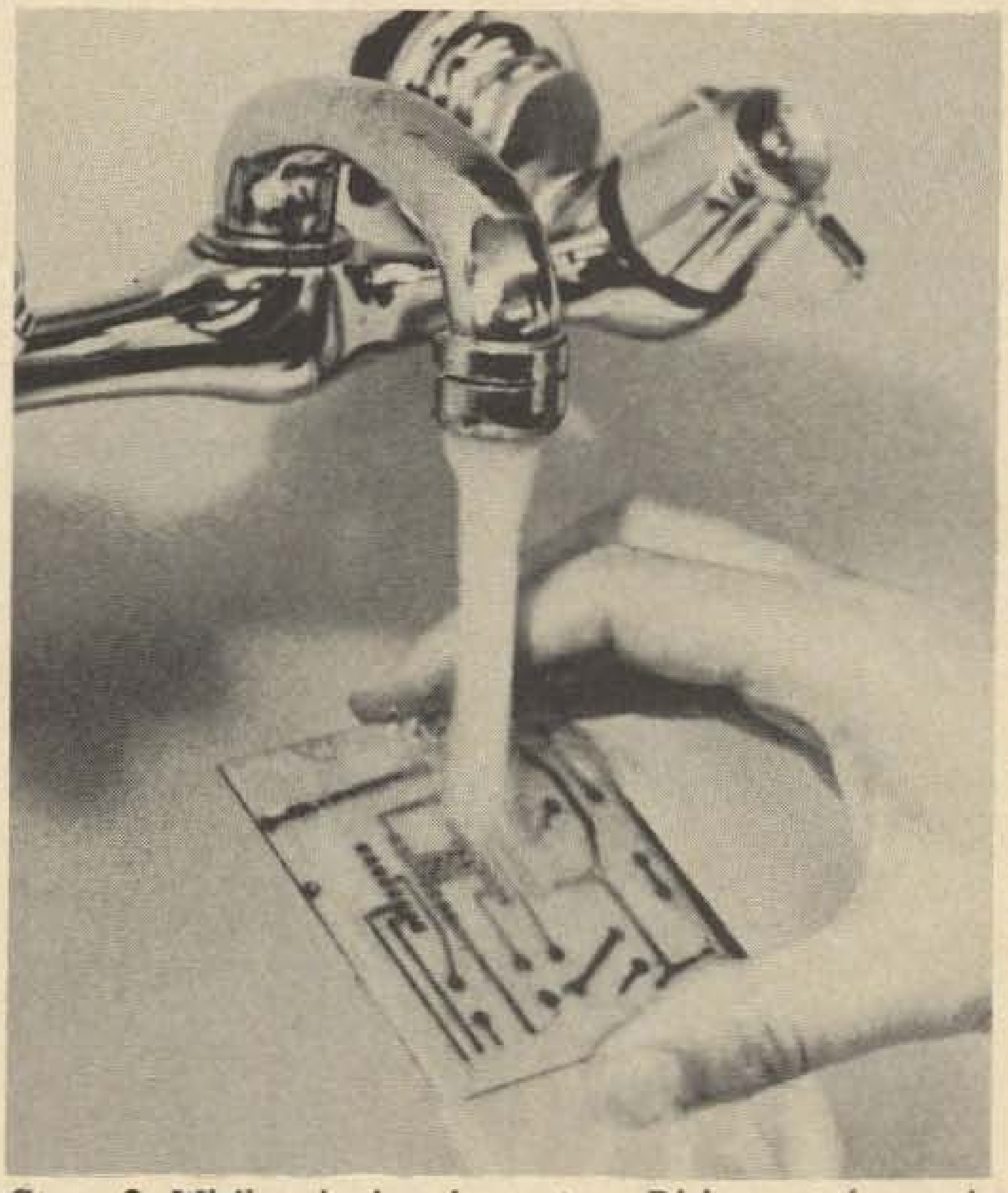


Step 8. The developed board is immersed in a solution of Bishop etchant and left for an hour.

and developed board. In about an hour, the board will be fully etched. Gentle agitation from time to time will speed the process. Hot water around the plastic tray will keep the etching solution warmer, speeding the process.

As soon as the etching process is complete, pour some Bishop stripper over the board, and, with water running over it, rub the stripper over the pattern until the copper is glossy . . . and all the dye is removed. Then dry the board and it is ready for drilling and assembly.

When you add the prices shown in the table, you may feel that the overall cost of producing your own boards is prohibitive. And of course it *would* be for a single board. But the amounts of chemicals you get are sufficient to turn out quite a few printed



Step 9. While rinsing in water, Bishop stripper is rubbed on the pattern, removing all dye and leaving a finished board, ready for drilling and assembly.

circuits. For a club project, there just *can't* be a cheaper way to get a lot of professional boards. . . . K6MVH ■

how I read the Radio Operators Handbook and found happiness

. . . and he thought a logarithm was the beat of a jungle drum

R. W. Johnson
31 Maclarnon Road
Salem NH

There are one hundred fifty-four million ham operators living on my street. Some of them sleep six to a room. Together with the thirty-two thousand at the office that I work with and socialize with every day, you can probably well imagine that for some length of time, I have felt somewhat alone if not downright black-sheepish, considering the fact that up until last Saturday evening, I didn't know the difference between a waveform and a potentiometer. For years, whether at parties or the water cooler, I felt left out.

Don't get me wrong! I'm not insinuating that the ham population has grown to unhealthy proportions or anything. All I'm saying is that when the time comes that a milkman or grocer or any other normal type of unassuming personage such as myself develops serious psychological traumas because of an inability to discuss capacitive reactance with every Tom, Dick, and Alfred, then one must do something. What one must do is largely up to oneself. I – having a very agile and analytical mind – chose to acquire an education in electronics.

So last Saturday I read the amateur radio operator's handbook –from cover to cover (minus the ads). Granted, this doesn't make me an engineer. But you wouldn't believe how it has changed my life. Things are different now. I not only feel confidence in my relationships with my contemporaries, but –and get this– I actually feel *a little cocky.* Don't laugh! I know what you're thinking. *Here's a guy who reads something and comes on like the guy who wrote the book.* Right? Isn't that what you're thinking? For my defense, I submit that all things are relative (I didn't make that up; I read it somewhere). What I mean is simply this: My knowledge on Saturday night compared to my knowledge on Friday night makes me something of a Marconi–Faraday–David Niven conglomerate. It's unbelievable how my life has changed. My confidence is not unlike that of a Karate black-belt.

Like yesterday, for instance, I went into the local Radio Shack. I didn't need a thing. It was just a place where I could feel at home –*wanted*, if you will. I asked the electronics guy if he had any microfarads, and you could tell he was really impressed because he didn't say anything for a while. He just sort of looked around and blinked a couple of times. He asked me if I was putting him on. I assured him I wasn't and he muttered something that I couldn't quite catch, and called a couple of other guys over to meet me. Their names were Chuck and Lennie, if my memory serves me right. Anyway, the four of us stood around smoking for a while and talking about this and that. Chuck and Lennie were a couple of pretty good guys. Lennie kept giving me cigarettes and lighting them for me. You could tell he wanted to keep me around for a while. Then, the first guy I had spoken to asked me how many microfarads I wanted. I told him I could use about a handful (I knew

they had to be cheaper in quantity orders). "Wouldn't use anything else," I said with a sly, knowing smile. You could tell they got a big kick out of this because Lennie kept nudging Chuck.

Now don't get me wrong. I'm not bragging or anything. That's not the point of me telling you all this. This is just to illustrate what a little erudition can do.

When I left, Lennie, Chuck, and the other guy were all hee-hawing their heads off and slapping each other's shoulders and everything. Chuck looked like he was ready to roll on the floor. Boy! You could tell that they really enjoyed electronics.

Like I say, though, life is different for me now. I can *talk* to people. I really can! New worlds have opened up to me. I feel comfortable – contented – relaxed– IN!

A few days ago, I put a dipole on my roof. It's beautiful. The ole sun reflects off that thing like there was no tomorrow. And the gleam is enough to knock your eye out (what kind of wax do you use on those things anyway?)

Hank, my next door neighbor, says I ought to get a "rig" for it. But I figure it can wait a while. First things first, you know. I'm in no hurry. I figure: today a dipole– tomorrow an ohm.

. . . WOW ■

Robert Kelty WB6DJT 2661 Carol Drive San Jose CA

A LOOK AT AMATEUR FM STANDARDS

A general survey of the VHF revolution with respect to repeaters over the past few years, and some suggestions for planning ahead.

The first eight years of amateur FM repeater operation in the United States has been a period of growth and stabilization. Today, because of the unprecedented popularity of repeaters and channelized operation on the VHF amateur bands, we are faced with such problems as:

- *Frequencies for new systems*
- *Channelizing*
- *Logical frequency pairing*
- *Deviation and bandwidth*
- *Tone frequency standards*
- *Guard channels*
- *Command methods*
- *Selective calling standards*

Many systems have grown in their present shapes because of availability of equipment, bulk availability of crystals, long-term usage on certain channels, patterning from a successful scheme, or because it seemed the thing to do at the time. In most cases, changes were made before cost prevented modification and systems developed so that members were served as necessary. But now it is 1970, we are thinking nationally—and for good reason. Travelers report that directories are inaccurate and that they have found activity not quite as reported or that the local repeaters are tone-protected. Frequencies in one area are not used in another. Interconnection presents problems in selective calling and command. Multichannel users compromise equipment performance. One area is narrowband, the other wide. So-called national frequencies are used with a variety of input frequencies, depending on area. UHF users find a wild variety of pairings and come to the conclusion that this band is haphazardly planned with frequencies confidential.

But all is not so bleak. With a little forethought, users can plan together, applying techniques known as spectrum engineering, frequency administration and conservation, or whatever name suits. It has been done with great success for the past two years in the west and I'll wager that with a little intentional planning that even in Los Angeles — that great super hodge-podge of "secret channels" and RF overlay — a measure of order will result in the next five years. Let's take a look, then, at what we can achieve and how to go about it with minimum outlay.

First there must be some form of mutual planning, whether on an agreed basis, by meetings of the repeater groups in a state or area, or by the principal repeater group taking the initiative. Acceptable standards can be determined and, though planned changeovers would meet with little acceptance, any changes could conform to agreements. Most amateur relay systems have changed enough in five years to prove they are fluid. In some concentrated areas of relay activity, coordinators, gentlemen's agreements, or adherence to accepted plans have been very successful. To my knowledge, very few systems have gone into service haphazardly and without thought. Those that ran into technical or operational problems soon changed because of opposition or impracticality.

NEW RELAYS

Where is there room for additional groups, especially in areas of intense usage? By being careful with the spectrum — that is, by channelizing and establishing standards of bandwidth — the greatest number of channels can be rendered with full compatibility. A generally accepted plan for 2-meter FM operation, for example, is each 60 kHz up from 146.04, leaving the lower portion to AM and DX'ers. Greatest activity still seems to be the upper portion of 146 MHz. A significant amount of narrowband FM equipment is available and the 30 kHz channel standard on 2-meters could within five years fit in very nicely, rendering 32 discrete channels. I see no problem in using this plan, then selecting a suitable deviation standard for one's own purposes. The equipment is made for either 5 or 15 kHz; anything else is a compromise in performance.

Six meters is less intensely used and 52.525 MHz seems to be the most popular for wideband operation. Narrowband operation does exist in some areas, from

51.0 to 52.0 MHz, on a 25 kHz channelizing plan. TV high-pass filters, though limited in effectiveness above 52.0, will help prove to TVI complainants that they often eliminate problems. AM operation stays low on 6 for reasons of self-preservation.

The 450 band is a world apart. Only the coordinators and trustees seem to know what really is in service and all admit there is more than meets the eye up there were channel frequencies are semiprivate. In Los Angeles as well as other places, for example, 50 kHz channelizing is the rule except that in L.A. ALL channels have been used above 440 and a coordinator tries vainly to keep accurate records. Those who prefer to go it alone find someone is sharing the space. Pairing is not in vogue just yet but efforts have been made to standardize, and several nets have adopted 5 MHz separation utilizing 440-444 outputs with 445-449 inputs. TV repeater experimenters have been a potential hazard, but recent concessions, after realization that FM'ers are serious, agreed to TV in the 435-440 portion of the spectrum. 450 is looking better each month as those who use this band for mobile operation see the value of planned pairing and reconfigure frequencies for better usage.

PAIRING

Armchair planning is always subject to criticism and rationalizing why it won't work. Moreover, existing nets complicate the matter. But let's look at what is being done in some areas and consider it for future planning in others.

	RELAY OUTPUT	INPUT
6 METERS	51.000	51.600
NARROWBAND	51.025	51.625
15 CHANNELS	51.050	51.650
	51.075	51.675
	51.100	51.700
	51.125	51.725
	51.150	51.750
	51.175	51.775
	51.200	51.800
	51.225	51.825
	51.250	51.850
		UNPAIRED
2 METERS	146.610	146.010
NARROWBAND	146.640	146,040
13 CHANNELS	146.670	146.070
	146.700	146.100
	146.730	146.130
	146.760	146.160
	146.790	146.190
	146.820	146.220
	146.850	146.250
	146.880	146.280
	146.910	146.310
	146.940	146.340
	146.970	146.370
	146.400-146.580	
		UNPAIRED
	146.940	(GUARD
	51.275.	51.875
	51.300	(GUARD
		CHANNEL)
	51.325	51.925
	51.350	51.950
	51.375	51.975
	51.400 - 51.575	
		CHANNEL)
450 MHz	440.050	445.050
100 CHANNELS	444.950	449.950

This arrangement aims at compatibility with other amateur operation, best utilization of the spectrum, and extension of existing FM relay systems. It is placed in nomination as a national plan.

TONE

Overlapping repeater coverage on the same channels as well as the desirability of multichannel compatibility brings us to the realization that pulse tone must be standardized where used. If pulse tone entry is planned, choose standards and hold to this plan

Touchtone is gaining popular acceptance for control and signaling in some areas and probably will dominate as ability to produce good decoders becomes more widespread. This is an excellent approach for the more talented groups.

GUARD CHANNELS

Faced with the problem of where to establish a common meeting ground for members of various groups, each operating on its own discrete frequencies, the

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If the nearest repeater is in the next county—or if the activity in your area is all "direct," you'll want the Galaxy AC-210 power booster. It doubles the output power of your FM-210 transceiver and allows operation from either 12 VDC or 115 VAC.

SPECIFICATIONS

Frequency: 143–149 MHz

Channels: Three; transmit and receive are independently controllable, giving 9 possible frequency combinations.

Transmitter: 5W in (10W with optional power booster)

Deviation: ±15 kHz max (wideband) or ±5 kHz (narrowband), with adjustable speech limiting for optimum matching to local standards.

Receiver Sensitivity: 0.5 SINAD

Power Req: 12 VDC (power booster accessory allows operation from either 12 VDC or 115 VAC)

STELLAR

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idea of guard channels has become an acceptable solution and has proved successful where implemented. 51.3 and 146.94 are logical choices here, having been sanctioned by the California Amateur Relay Council as a regional solution. By guarding these channels or using a receiver scanner which samples more than one channel, a surprising flexibility is possible. By guarding one's regularly used channels plus the common calling and working frequency, we can provide ourselves with even better systems, both at home and while traveling.

The first eight years of repeaters has taken us through a period of organizing and building. Let's let the next eight be devoted to sophistication and joint planning. With good nonrestrictive repeater regulations a good possibility within a year a fine magazine to spread the word and cement us together, and the enthusiasm we all possess, the future looks promising indeed.

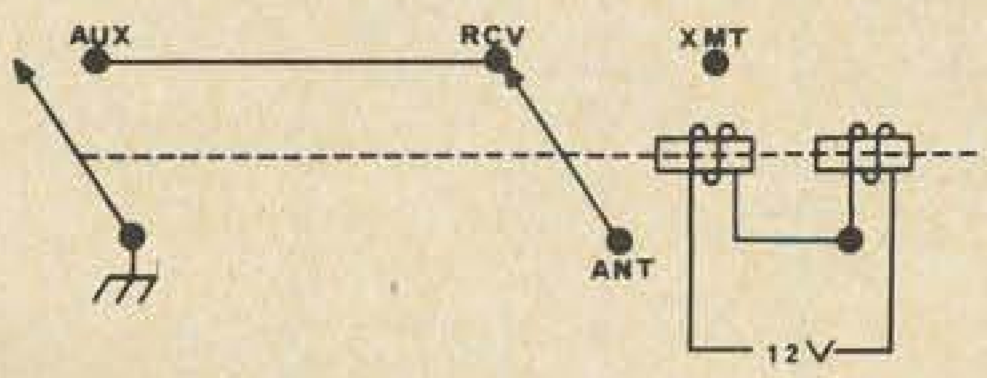
... WB6DJT ■

An Inexpensive RF Wattmeter

Walt Pinner WB4MYL
7304 Lorenzo Lane
Louisville KY 40228

While on vacation recently, I was rummaging through the various surplus outlets in the Detroit area. Among the goodies purchased was a small surplus "Antenna Current Indicator." It has a 2½ in. meter movement, three spring-loaded feedthrough connectors, and a power plug for connection to an internal antenna relay. It also includes the pickup unit and shunt necessary to operate the meter. The unit is a thermocouple-type antenna current indicator. Its nameplate states it was manufactured for the Army Signal Corps under the name of "Antenna Current Relay Unit BC442-AM."

The unit has a fitted bottom cover and ample room to install two SO-239 connectors in place of the feedthrough connectors already there. The antenna changeover relay is mounted to a plate and secured to the box with four screws. It may be removed as an assembly for use elsewhere. The rf contacts appear to be more than adequate for amateur use up to the legal limit of power. The rf contacts have an additional single-pole contact which may be



used for B+ control or grounding of the receive antenna lead during transmit, as shown in the diagram.

The relay is operated by two series-connected coils and requires +12V at 80 mA. If the coils are parallel-connected, a 6V source may be used. A single diode with a small filter on the rig's filament supply works nicely.

The meter scale reads from 1 to 10. Comparison readings of this unit, with no change other than substituting standard coax fittings, were made against a Drake W-4 wattmeter into a 50Ω dummy load. The results are tabulated below:

BC442 reading	Power (watts)
1	100
2	200
3	300
4	400
4.9	500
5.5	600
6.2	700
6.9	800

These readings remained constant over a range of frequencies from 3.5 to 30 MHz. Power levels of 25, 50, and 75 watts may be read with reasonable accuracy if the mechanical zero meter setting is adjusted with the meter in the vertical position and the power readings taken with the meter in the same position. The best part of this unit is its price. It was purchased from Bauer Industrial Supply, Redford Ave., Detroit, Michigan for $3.00, less his 15% discount (to anyone) which lowers the already ridiculous price to $2.55 plus tax. A terrific buy for your surplus buck.

. . . WB4MYL ■

Sam Craig W2ACM
5812 Tilton Road
E. Syracuse NY

A REMOTE MULTIFREQUENCY

A simple method for modernizing your surplus FM unit by adding those extra channels.

If your VHF FM gear is a single-channel type and you have been wondering how to add multifrequency capability, here is your answer. This article describes a remote crystal oscillator with switch selection of up to four crystals.

Since the original unit was intended for the transmitter of a GE pre-Progress Line ES-1B 2 meter FM unit, 3 MHz crystals were used. The circuit should work equally well with crystals of other frequencies (up to 15 MHz or so), and it can be applied to receiver local oscillators as well as transmitters. It is not designed to work with overtone crystals, however.

The circuit, Fig. 1, consists of a transistorized Pierce oscillator coupled to an emitter follower for isolation and low output impedance.

The oscillator unit may be mounted in any convenient location and coupled to the transmitter by a length of ordinary shielded cable. Neither the type of cable nor its length appears to be critical. In the original installation, a four-conductor shielded cable having a length of about 6 ft was used. The output impedance of the circuit is low enough to tolerate the shunt capacitance of 15 ft of shielded cable or coax without any drastic reduction in output voltage. Impedance matching is not necessary, since optimum power is not a requirement.

The rf output from the remote oscillator is fed directly into the grid of the former

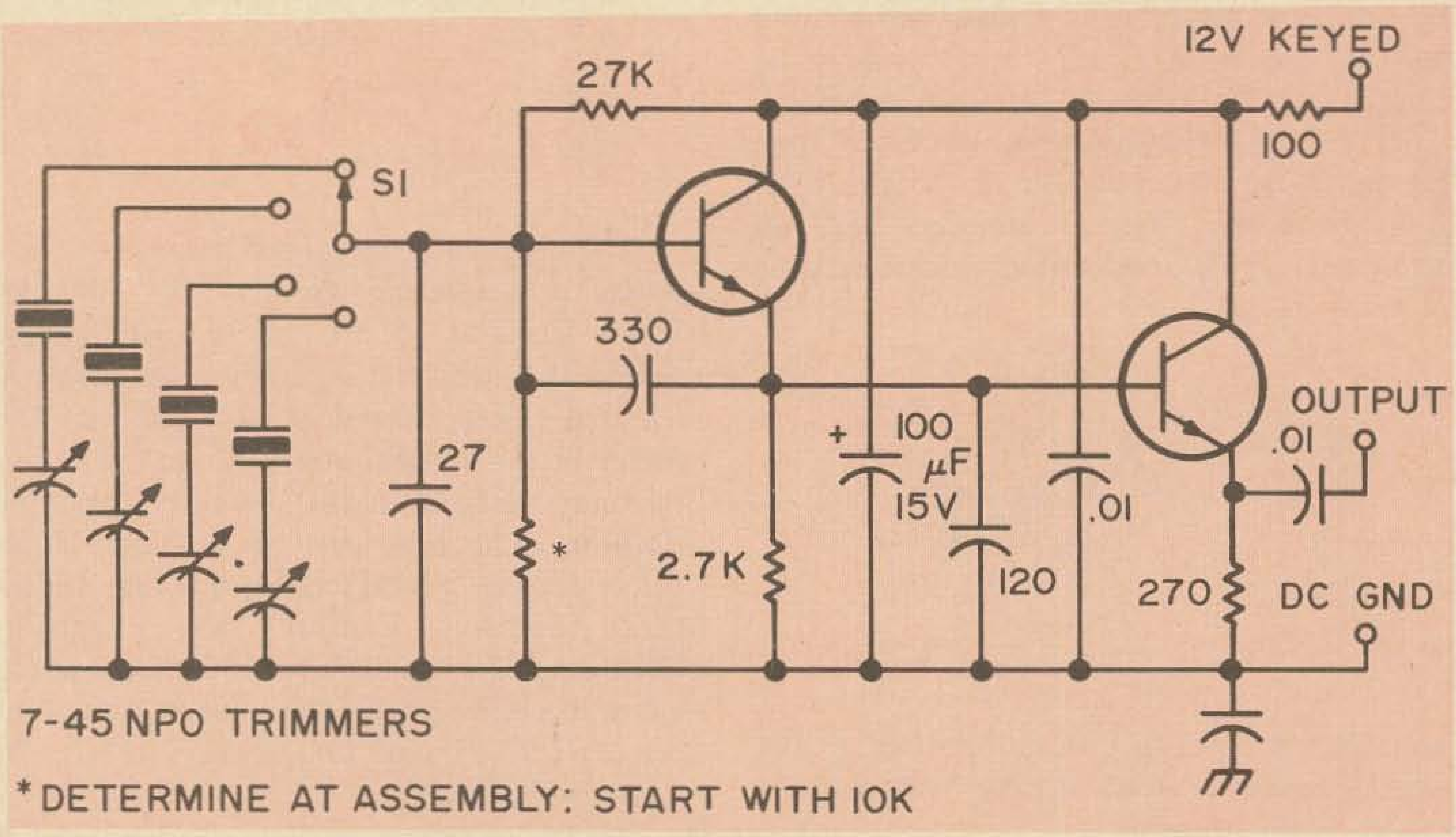


Fig. 1. Remote multifrequency oscillator schematic.

OSCILLATOR FOR SURPLUS FM UNITS

oscillator tube in the transmitter, so that this stage now becomes a buffer. The cathode of this tube (and screen, if a pentode) should be bypassed to ground for rf if not already done in the existing circuit. In my installation, the grid current in this stage was not as high with the remote oscillator as it was originally, but the drive level in the subsequent stages was unaffected.

The output frequency is not affected by the load, and changes only a few hertz when the supply is varied between 5 and 15V. Although the output voltage increases as the supply voltage is increased, the use of more than 15V is not recommended.

The oscillator consists of a two-board "sandwich" and a third board, which mounts perpendicularly to the other two, as shown in the plan view of Fig. 2. The actual size layouts of circuit paths for all three boards are shown in Fig. 3.

Once the etched circuit boards are made, assembly of the unit is quite simple. After soldering the components to the main circuit board (see Fig. 4), attach the output, power, and ground leads and mount the board in the Minibox. Be sure that leads and solder do not protrude more than 1/16 in. on the foil side of the board. Then attach and wire the connector (J1). Next, the rotary switch (S1) should be put in place and connected to the main board. The remaining two circuit boards with the crystal sockets and trimmers are fastened together and mounted last in the box. The front of this assembly is supported by the leads from the boards to the switch, so no size smaller than 20 AWG solid wires should be used for mechanical

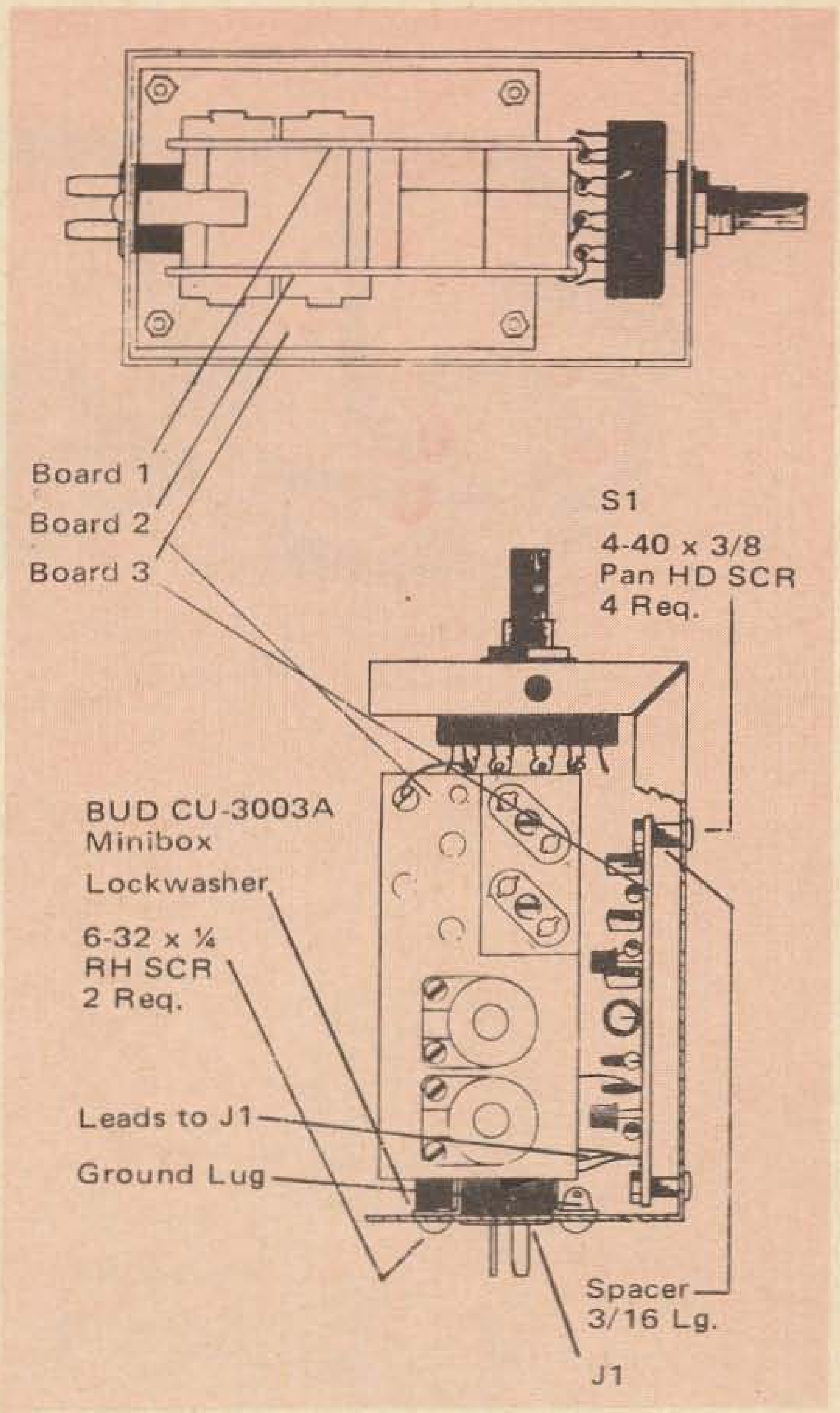


Fig. 2. Layout of oscillator.

stability. Use care when inserting or removing the crystals so as not to crack the circuit boards. Glass–epoxy board material is worth using, if available, because of its greater strength. Figure 5 shows the construction and layout detail for the two-board sandwich. When adjusting the trimmers for

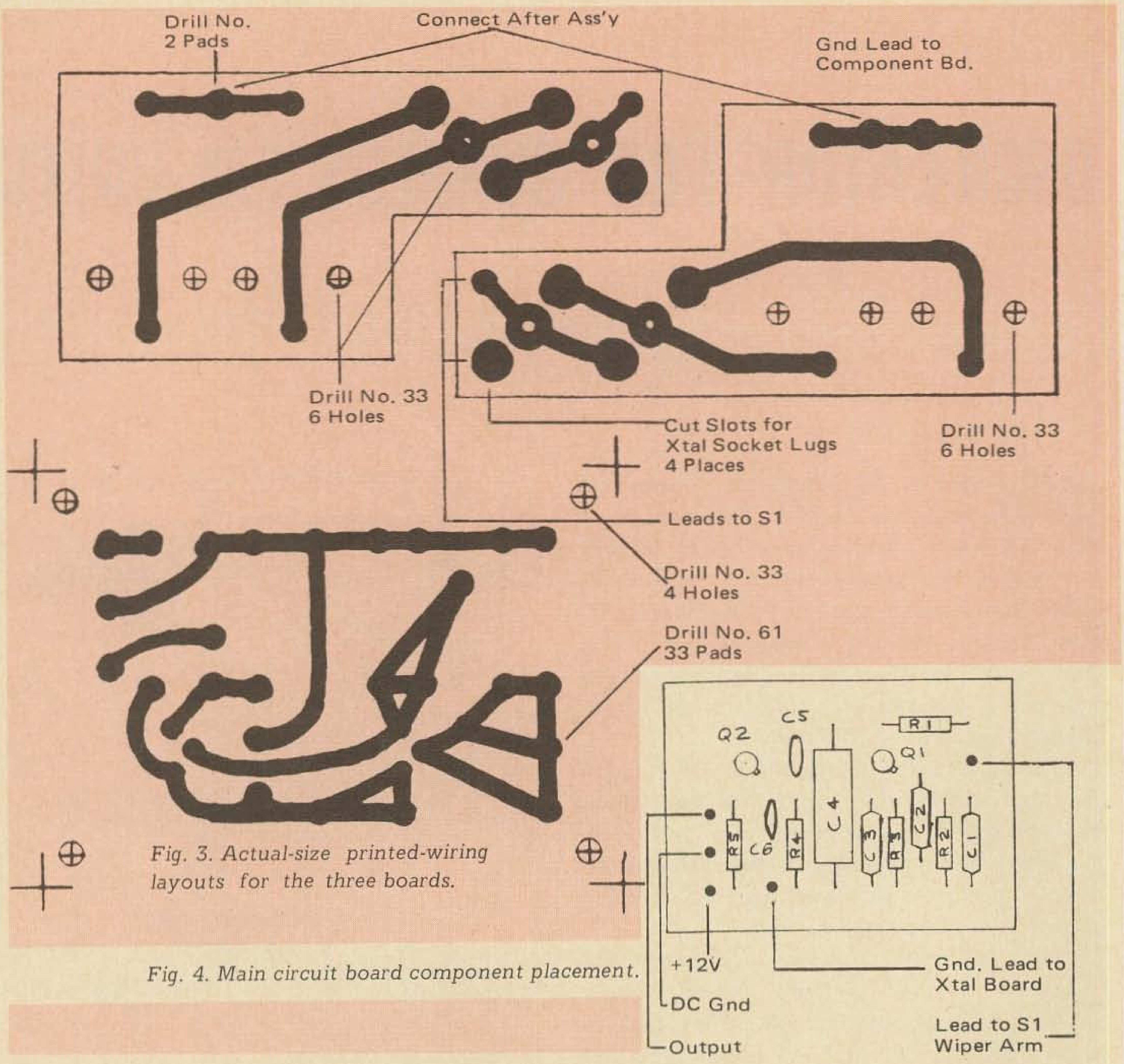


Fig. 3. Actual-size printed-wiring layouts for the three boards.

Fig. 4. Main circuit board component placement.

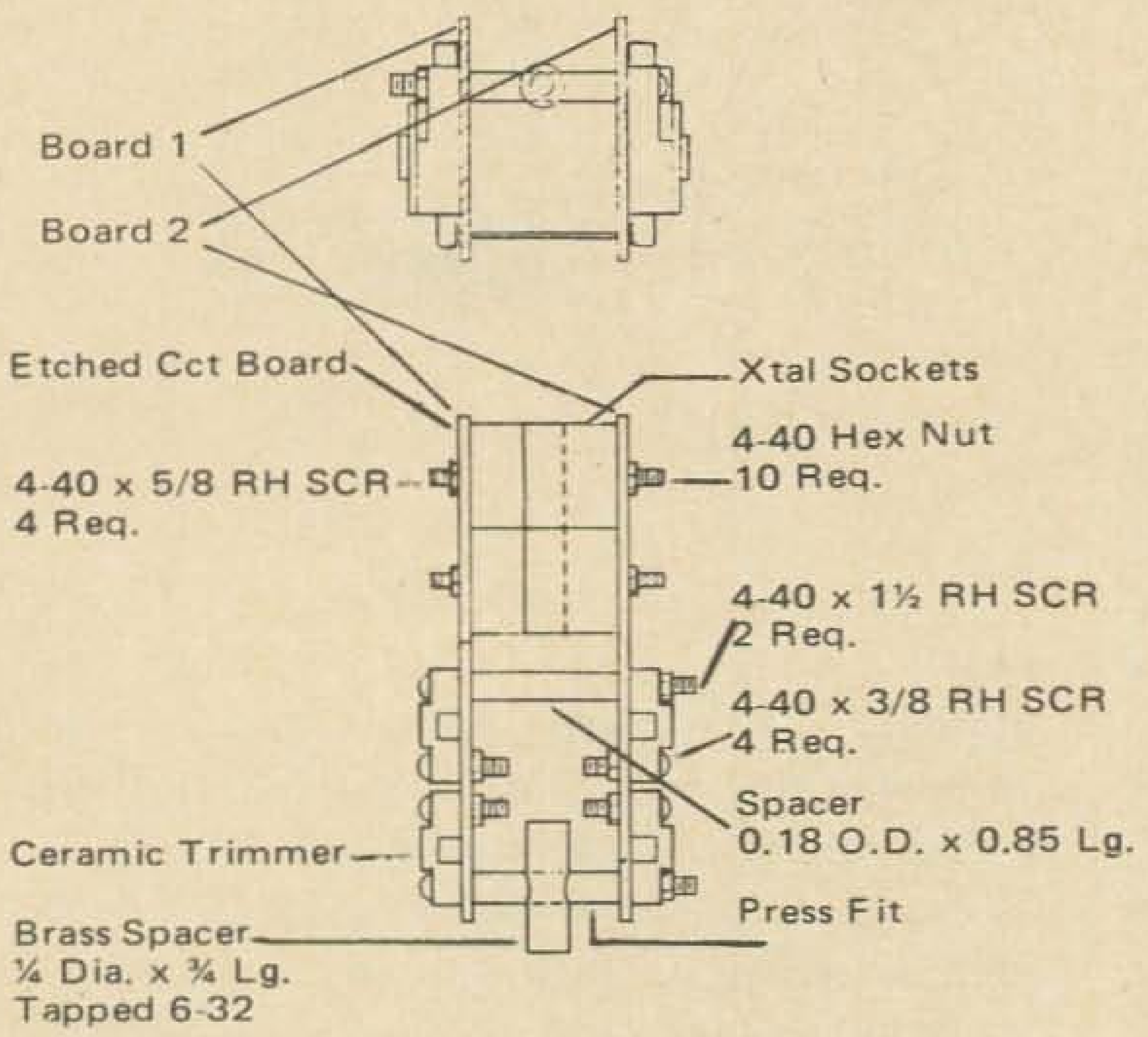


Fig. 5. Vital statistics for the two-board "sandwich."

exact frequency, remember that placing the cover on the box will lower the frequency slightly (10 to 20 Hz with 3 MHz crystals) due to the added capacitance. To avoid this problem, holes can be drilled in the cover for access to the trimmers. Because of its small size, the oscillator can easily be taken to a counter or other measuring equipment for accurate frequency adjustment.

Measurements of thermal stability have not been taken yet, but experience has shown that in the usual mobile environment the frequency does not change enough to be evident at the receiving end.

I am indebted to N. V. Friend, who furnished the idea for this device.

. . . W2ACM ■

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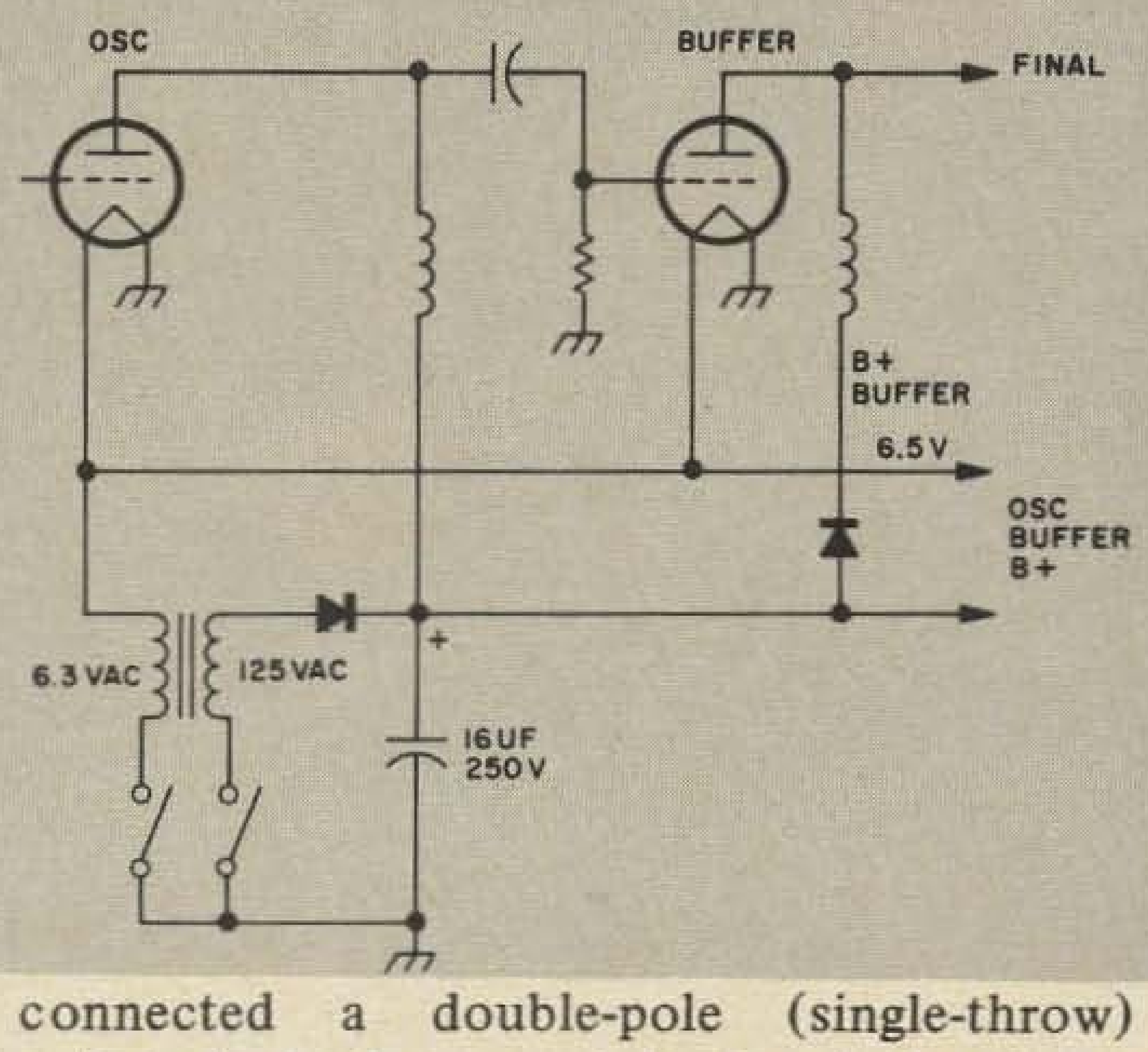


To spot my vfo on a received signal, I needed a quick and easy way to power the oscillator independently from the transmitter.

Normally the ac-driven heaters are on all the time, so why not connect a 6.3V transformer in reverse order, rectify the output, and use it for low B+ for the oscillator?

After some experimentation, I came up with the circuit shown here. As shown, I connected a double-pole (single-throw) switch in both ground leads of the transformer primary and secondary windings to prevent feedthrough when regular B+ is applied as the rig goes into the regular transmit mode.

A diode in the B+ to the buffer prevents it from operating when spot checking and still allows regular operation.

... K8BYO ■

TOWARDS AN IDEAL SOLID-STATE I-F FOR AMATEURS

PART 1 LOW FREQUENCY MODULES USING ICs

. . . and believe it or not, 455 kHz isn't it!

William Hoisington K1CLL
Far Over Farm
Peterborough, NH 03458

This article is a two-part series that deals with design methods, components, and circuits using solid-state devices leading to an i-f system that will meet the special requirements of the amateur builder who wants a reasonable-cost, selective, low-image, tunable i-f for use following converters on 6 or 2 meters, or the UHF regions above 420 MHz. This portion of the series describes design details of the 1.65 MHz and the 135 kHz i-f modules, using subminiature shielded coils and ICs.

Requirements

Selectivity and Freedom From Images. The easiest way for the homebrewer to get selectivity is to use a low intermediate frequency; however, this cannot be done without suffering from image trouble unless several conversions are used. An image is the unwanted signal on a frequency separated from the desired signal by twice the i-f. This is caused by the presence in a mixer collector circuit of several frequencies other than the desired one. For example, if the local oscillator is on 28.5 MHz and the desired signal is on 28 MHz, a beat note at 0.5 MHz will be produced, which is used for the i-f.

Unfortunately, a signal on 29 MHz will also produce a beat note on 0.5 MHz. This unwanted signal is called the image; you can see that it can cause considerable strain on the selectivity requirements of the rf and mixer stages in a 10 meter receiver in order to remove it. This is one of the main reasons for multiple conversion amateur receivers that use a first i-f of 1.65 or 2 MHz, which places the image some 3.3 to 4 MHz away from the desired signal. Here it can be handled by the selectivity of the two tuned circuits of the rf and mixer stages generally found in such a receiver. The requirement for reduction of the image is met in this fashion in our "ideal" i-f.

Tunable I-Fs. The use of converters with crystal-controlled local oscillators for stability reasons requires tuning somewhere else down the line. For the fellow interested only in a large, stay-put home station, this can be accomplished by using his 100 lb communications receiver, with switched inputs, etc. However, that does not meet our planned types of operations, such as battery-portable-anywhere, mobile, and emergency use, all of which are applications well suited for solid-state devices. A tunable, selective front end with rf stages, mixer, and tunable oscillator does the trick.

Practicability. The next requirement is for available components at reasonable cost. The J. W. Miller Co. has produced a line of shielded, subminiature adjustable rf coils (9050 series) which fill the bill for inductors. They have a threaded core of powdered iron in the center for trimming, an outer magnetic shielding cup which also helps the Q, and an aluminum case for electrostatic shielding (½ in. square by 9/16 in. high). They also are handy because you can easily add extra windings—for coupling with solid-state devices.

Resistors in the 1/8 and 1/10 watt range are available at most mail order houses, along with subminiature capacitors. Subminiature terminal pins have been described in my own previous articles in 73 Magazine.

Active devices having high gain and low internal feedback, that do not need neutralization, are available from Motorola. The HEP 590 is one of these; it is easy to use and performs excellently.

Demodulation Characteristics. These articles being mainly concerned with AM on VHF and UHF, the demodulation is important. This is given scant treatment in many handbooks, but I find that when you're actually digging those call letters (at least!) out of the mud, you need the best possible diode circuit available. It seems, from all the tests I've made, that the diode demodulates more af when connected across the entire winding of the last tuned circuit.

AF Amplification. Next in order of importance comes a good af amplifier. There is no doubt at all in my mind on this one. The Amperex TAA-300 is it. It has 1W output, a response of 20 Hz to 25 kHz, and an 8Ω transformerless output impedance, and sounds good. With bass and treble controls in front, it really does the job for voice communication frequencies for amateurs.

Single-Package I-F Pair. The last requirement (for now) is for a double-frequency i-f. This is just a handy phrase for the combination of the 1.65 MHz and the 135 kHz i-f in one package. You can put more gain—with greater freedom from feedback troubles—into the amplifier when the input is on one frequency and the output on another—a tried and proved method.

I-F Considerations

Let's face it, 455 kHz is not the best i-f for amateur communications receivers. Its use as an intermediate frequency dates from the early 1920s which is by now nearly 50 years ago, and was intended for the broadcast band. There was and still is a good reason for using it on the BC band: It is the only i-f that even partially suits a "cheapie" BC set. I say only partially because using a mixer on the BC band, without an rf stage in front, which many millions of BC sets do, you get images from 540 kHz up to about

690 on the dial. I have a $100 set that covers 540 kHz up to 54 MHz–it is an excellent set for the money and is invaluable for checking harmonics, oscillators, mixer outputs, and the like; but not having an rf stage, it does have an image on the low end of the dial.

Car radios, mostly working on the "me too" design theory, use 262 kHz for the i-f. The reason given: "greater selectivity." Sure, it is easier to get better selectivity with a lower i-f, but the image is worse also, so they use an rf stage. If this rf stage is properly made and tuned, it solves the problem on the BC band. And I'll take my hat off to most of the designers of car radios that I've had, as most of these have performed pretty well. For many years of mountain-topping on 2 meters, driving home after 2 a.m., I kept awake listening to "Grand Ole Opry" and such, and those car radios did a good job.

But what about amateurs? These bands begin at 160 meters, so up around 10 meters, with an i-f on 455 kHz, the image is only 910 kHz away! You can't really put an i-f in the middle of the BC band, so the next slot is up at 1.65 kHz, or near that point. This works out fine for the image problem, but now your selectivity has gone to pot.

Of course, you *can* use a Gonset-type i-f with selectivity of around 30 to 40 kHz. In fact, right in this article I describe a "nice little i-f" on 1.65 MHz, with just that kind of selectivity. It works fine with just a single conversion on 6 or 2 meters, but when the band opens, stay away from the low end! I was in Maine one fine evening on a little rise of 400 ft or so when 2 meters opened. I worked Washington D.C. and VE1, but I couldn't separate one signal from another on the crowded low end using my "tried and true" Gonset III.

So, it is probably best to devote the extra time and money required and try for the ideal i-f, which conquers images and provides excellent selectivity at the same time. There are two components which help the home-brewer reach this goal: the Miller Series 9050 subminiature coils and the Motorola HEP 590 communication IC.

Our ideal i-f will therefore look like the block diagram in **Fig. 1**. When designed, components selected, the circuit formed up, and packaged with its small battery supply, it should be a useful addition to amateur VHF, UHF, and microwave equipment.

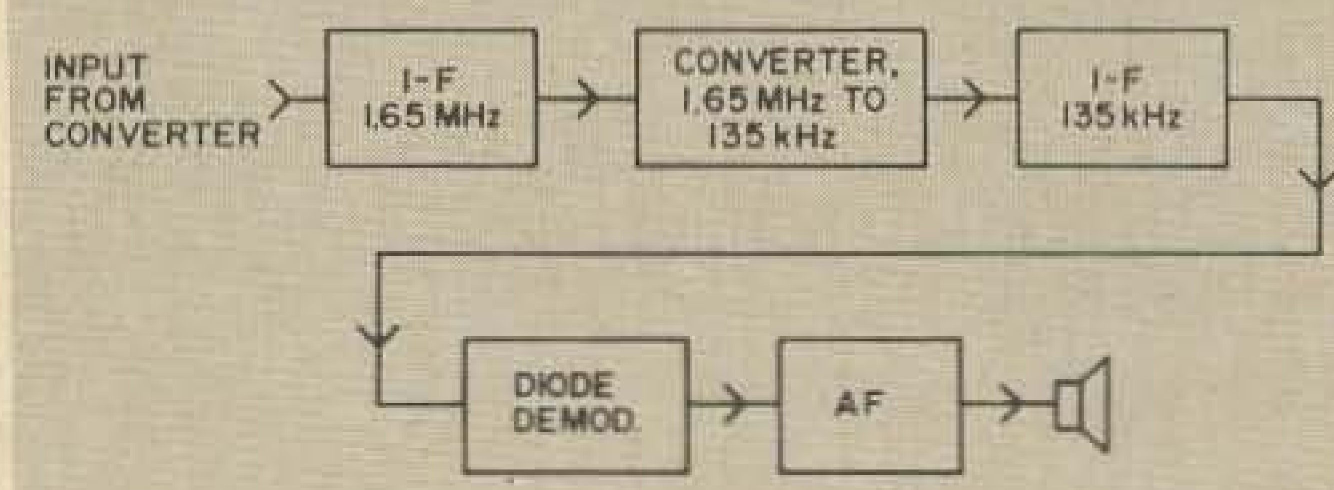


Fig. 1. Block diagram of the "ideal" i-f for amateur use.

Miller Series 9050 Coils

Here is something good, that you can really tailor to suit your needs. **Figure 2** shows the inner workings. The Bakelite base is normally supplied with two pins, but is easily drilled for four extra wires (which you need for a link-coupled base input, for example). The coil form has a neat spiral ridge inside to take the 6/32 in. threaded core. This ridge type works better than some other types of coil holders I've used. The outer powdered iron cup generally has room between itself and the existing winding for the few extra turns needed in solid-state work. The aluminum outer case comes off easily enough after you bend back the four crimped aluminum tabs on the case that hold the coil form in place.

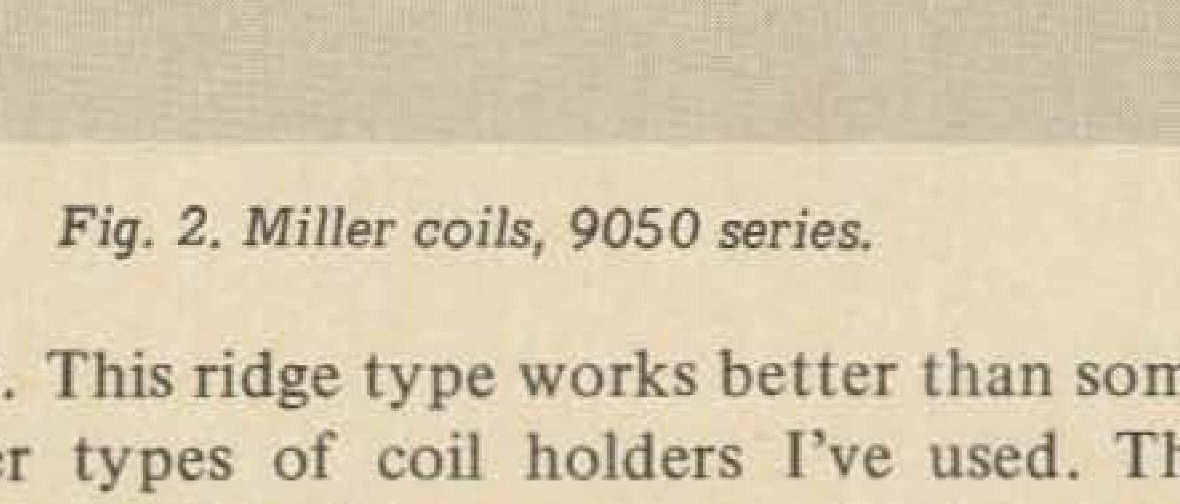


Fig. 2. Miller coils, 9050 series.

As you will see in the section on coil data, you can wind on 1-10 turns of link coupling and a 5-turn base coil, both on top of the existing winding, for a base input network. I used a small drill to make more holes in the Bakelite end piece to bring out the extra wires, and find the entire series adaptable from 30 MHz down to 135 kHz; and the good Q resulting from the use of these coils is particularly noticeable in the overall selectivity figure of the finished i-f. **Figure 3** shows one of them with an extra

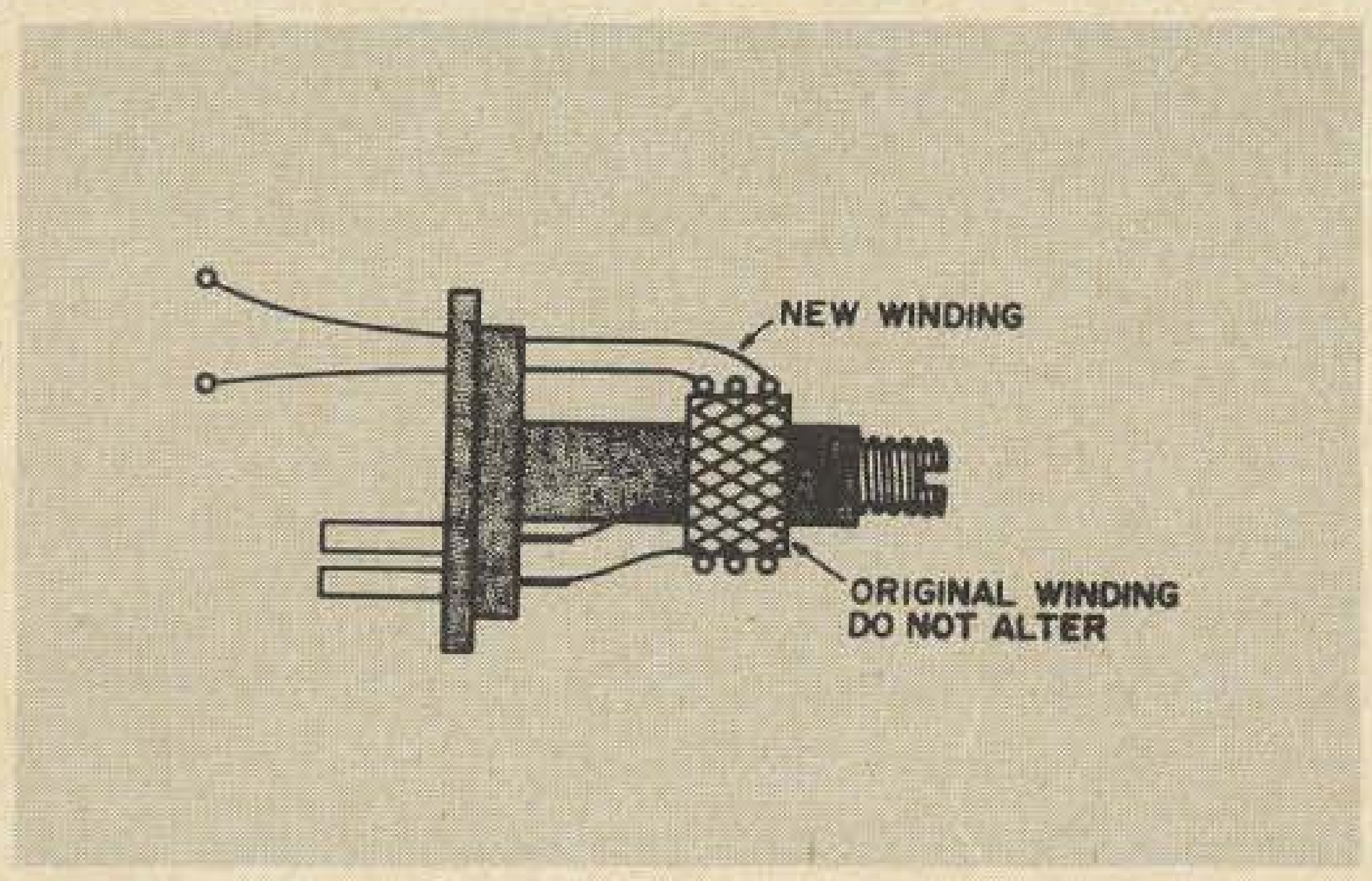


Fig. 3. Two holes at the bottom of the coil permit the two additional leads to be brought out with the original windings.

three turns installed. Until Miller comes up with something better, these are my coils.

Loaded Q vs Turns. Various sections of a communications receiver i-f have different amounts of loading, which affects the Q and energy transfer. For example, the HEP 590 input circuit works well with only a single-turn input link at 1.65 MHz, while at the same frequency a 5-turn link is required when going into the diode circuit, which is heavily loaded.

The HEP 590 output circuit, rated at 100 kΩ ac impedance, needs only 2 turns for maximum transfer of energy into a 50Ω cable or link to the next stage. Naturally, a lot depends on what impedance you're looking into, or out of, and how it is treated. The HEP 590 input circuit, rated at 1.8 kΩ ac impedance—if loaded directly onto the inductor—will swamp the Q way down.

Looking at **Fig. 1**, you can see what has to be done for this type of i-f. A winding of the correct number of turns to suit the impedance of the IC is installed over the existing tuned circuit, which is resonated at 1.65 MHz. A cable input link of only a single

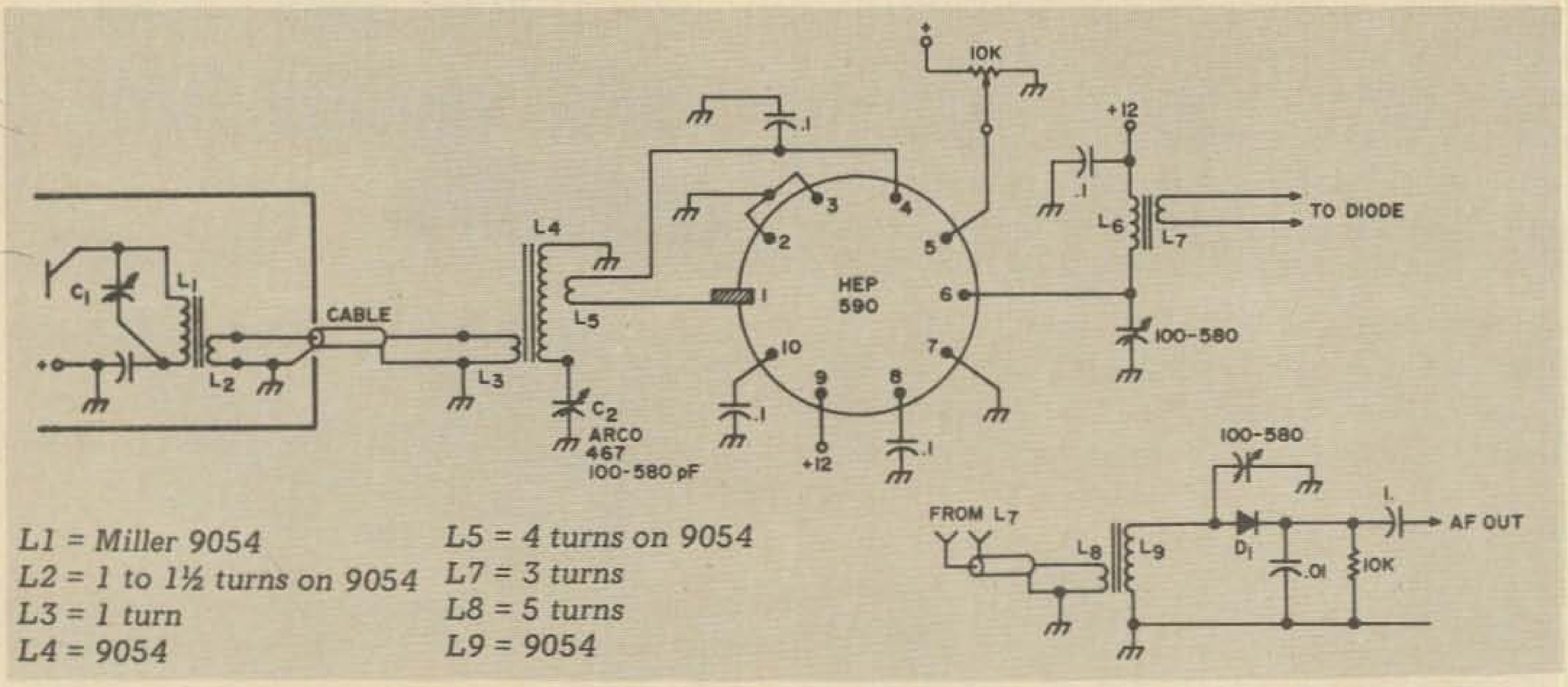


Fig. 4. Coil interconnection and winding data. At left is VHF converter (Part II). Test diode demodulator schematic is shown at lower right.

turn is also wound over the same resonant circuit. Don't forget that the presence of the powdered iron both inside and outside aids this coupling. When the inductor is heavily loaded and the Q is lowered, the number of turns required to effect a transfer of energy may be as much as five times greater. This can also be seen in the coil table in **Figs. 4** and 7. The base input is very easy to match by this method of varying the number of turns, as in **Fig. 4** (L4) and in **Fig. 7** (L3).

When using link coupling, which is very desirable at times *with modulator type units*, be careful not to couple too tightly (by the use of too many turns). This will show up as excessive detuning of one tuned circuit by the one link-coupled to it. It may also cause broad tuning. For maximum selectivity and proper handling, use slightly *less* than the coupling showing maximum energy transfer. Remember, *gain* is cheap, *selectivity* is not.

The 1.65 MHz and the 135 kHz modules will be described in the first part of this article, and the converter and avc detail in the next.

The 1.65 MHz I-F Module

This unit is what you could call a "nice little i-f." Following a 6 meter front end, it has *plenty* of gain, and selectivity of 30 to 40 kHz. It is also very easy to tune on 6 or 2 meters.

The schematic is shown in **Fig. 4**. Each of the seven windings, L1 through L7, has been the subject of considerable work and testing here, for selectivity and general handling properties. The tunable i-f or VHF converter shown at the left is the subject of other articles and is not taken up here. It does use one of the Miller series 9050 coils, though, as shown for L1, with but one turn added on to it for feeding the 1.65 MHz i-f energy over to the i-f module being described. Inductor L2 is installed on top of the existing winding of the 9054 coil. Also low in turns is L3, with only one turn being needed at 1.65 MHz, due to the high Q of the 9054 design. Coil L4 is another 9054, which has a third winding going to the base of Q1 in the HEP 590 IC. The input of the HEP 590 is rated at 1.8 kΩ.

The input tuning of C2 is very sharp due to the correct amount of coupling to L4 which has a high loaded Q. The HEP 590 communications IC and its advantages have been described several times in 73 Magaziné, so only a brief mention will be made here. Inside the IC there are three transistors and a diode. The two transistors that do the amplifying are arranged as in **Fig. 5**, in a grounded-emitter, grounded-base pair, which is a high-gain configuration with no detectable internal feedback. The third transistor is connected as an avc unit, and the diode is used for temperature control.

Another Miller 9054 is connected to the output circuit on pin 6 and tuned by an Arco 467 mica compression trimmer of 100 to 580 pF capacitance. You can also get the needed capacitance by using fixed dipped micas and trimming up to 1.65 MHz with the threaded-core tuning slug. If you do it this way, be sure to adjust the fixed capacitors so that most of the slug remains *inside* the winding for best coupling and Q.

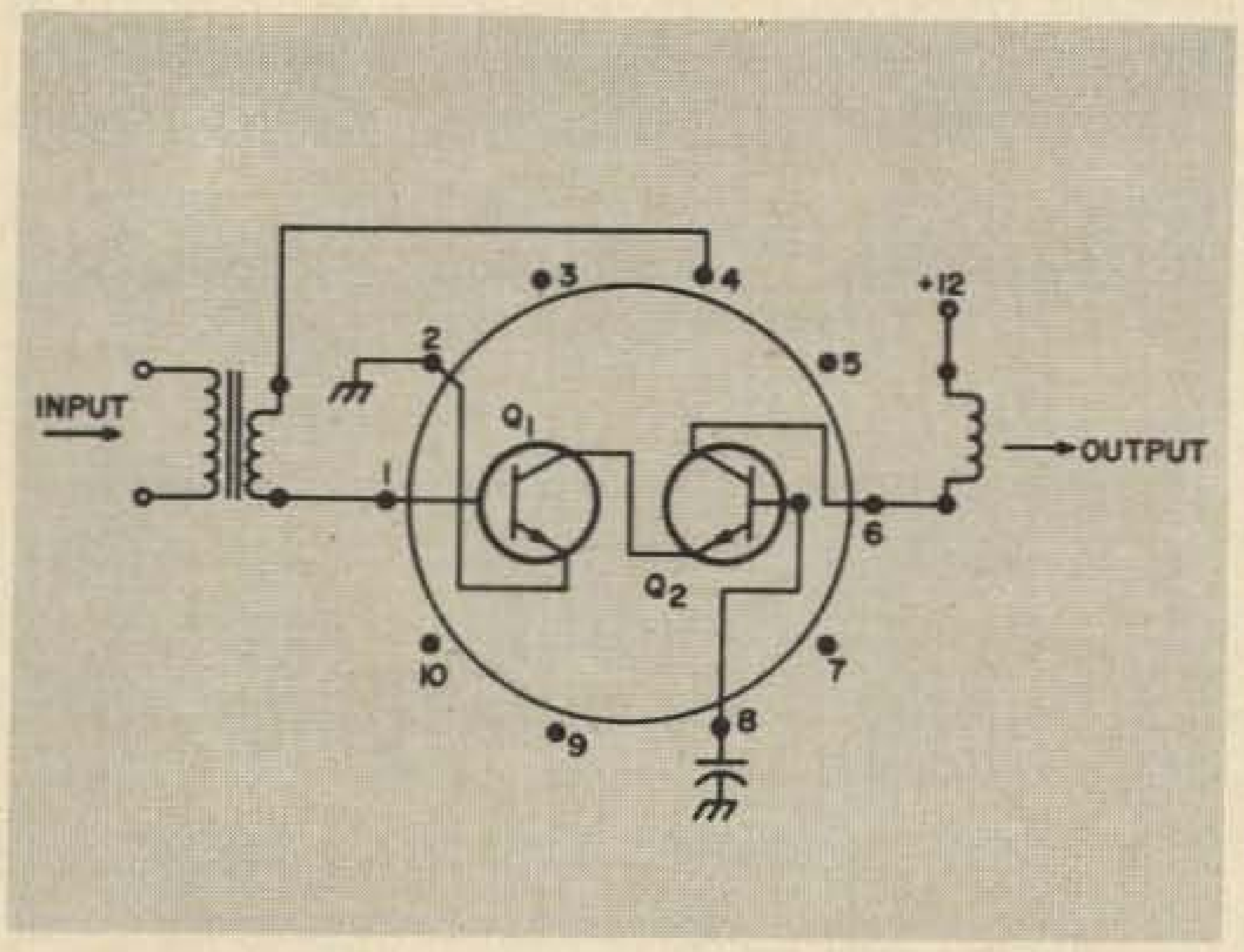


Fig. 5. Internal details, HEP 590, Motorola.

A 3-turn link winding is added to L6, which goes to an output connection. For tuning up, I used L8, L9, and a diode. When used with a tunable front end on 6 or 2 meters, this makes that "nice little i-f." Follow it with a good af and try it. You'll be surprised. It does not have ideal selectivity, but a 6 meter front end is wonderfully easy to tune with it!

Pin 5 of the HEP 590 can be used for a temporary manual gain control with just a

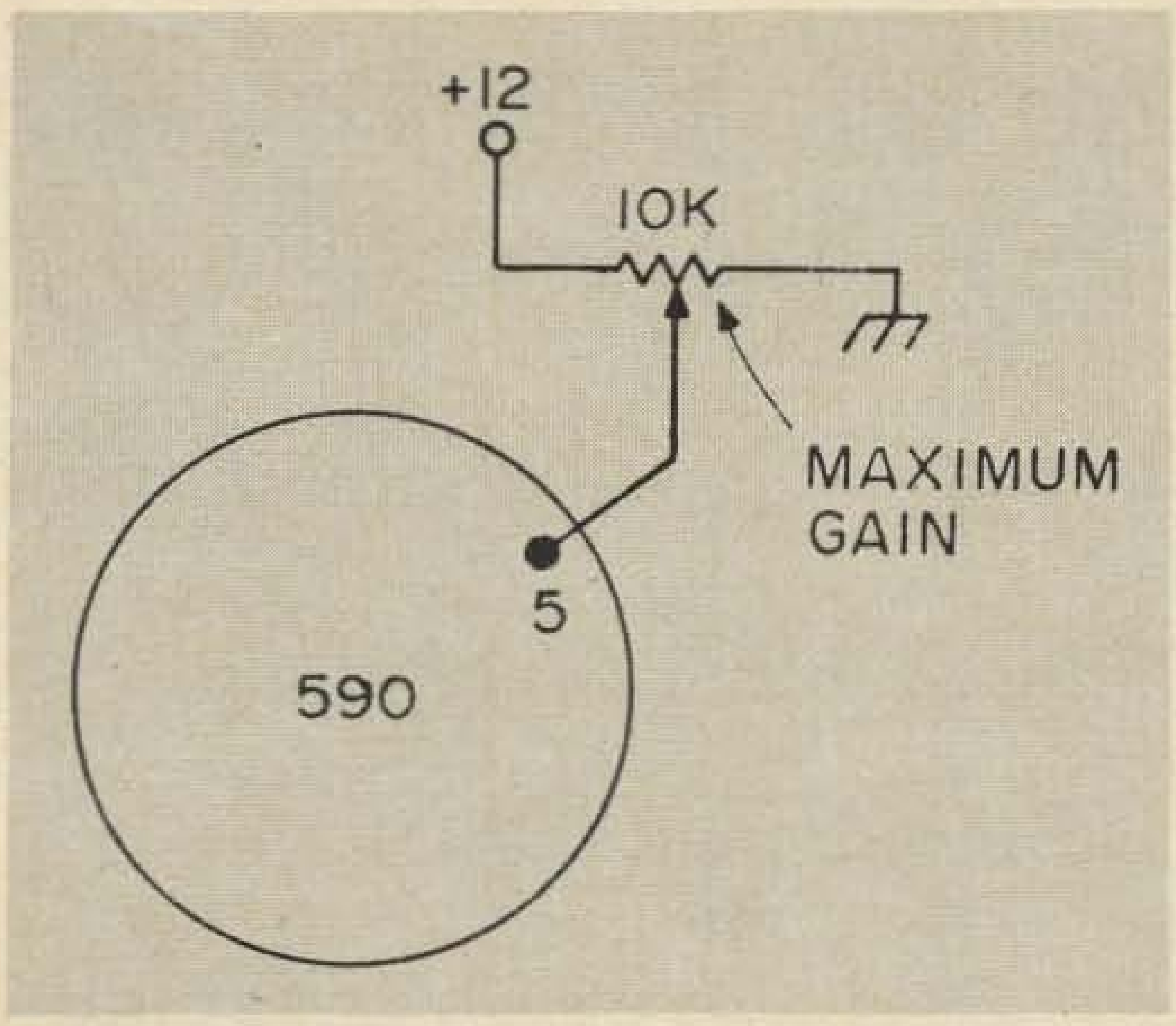


Fig. 6.

pot as in **Fig. 6**. Nothing else is needed. (The second part of this article deals with the avc circuit for use with pin 5.)

135 kHz I-F Module

My bypassing of the converter module to describe the 135 kHz i-f may seem abrupt, but the work involved with the i-f coils and the IC units makes the continuity better this way.

Figure 7 shows the schematic of this module using the Miller subminiature 9060 coils (with added windings) and the Motorola HEP 590 IC. The circuit is quite similar to the 1.65 MHz version except for the output.

The Miller 9060 tunes to 135 kHz with an Arco 100 to 580 pF trimmer, but here again you can make up the capacitor with the small dipped mica ones to bring the 9060 near resonance and trim to the exact frequency with the internal threaded slug.

The input cable from the converter module (second part of this article) goes to L1, a 5-turn winding installed over the existing winding of the 9060. I use 32 AWG double cotton-covered for this and put small tabs on the input wires of coil L1 for identification. You can also use different colored wire if you have it on hand.

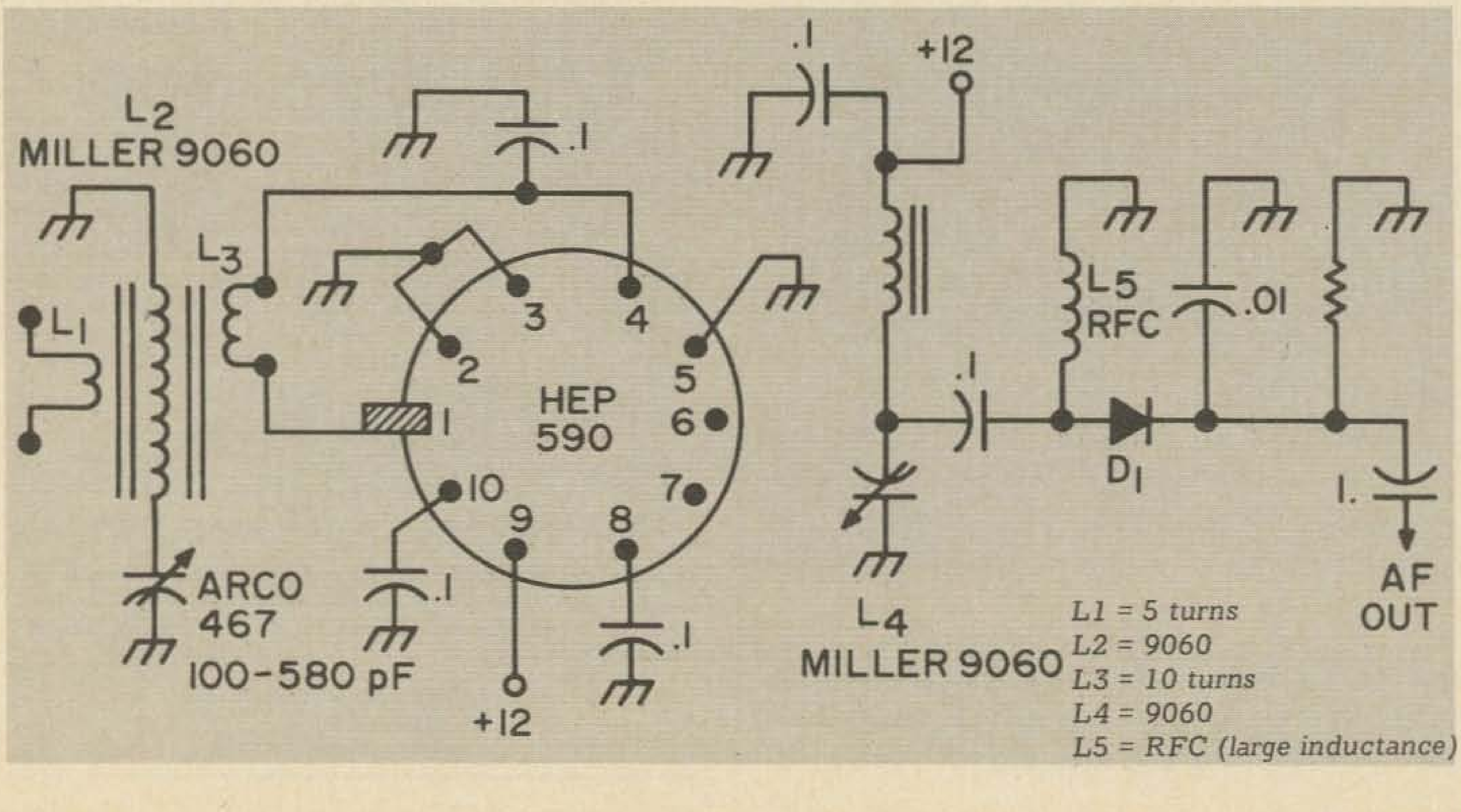
The HEP 590 was described in the first i-f section. It is treated identically, except that pin 5 is left grounded, keeping the gain full on, which is best for avc action because this is the unit that drives the avc diode and needs full gain.

The output coil is another 9060, with the diode connected to the *high* end. Some circuits call for tapping down the diode on the coil, but I have never found any connection as good as that shown in **Fig. 7** for high quality af output. Only two tuned circuits are shown here but there is a third in the converter module; the total selectivity is thus as sharp as you may want to use, because you can still recognize your friends' voices on the air. It is sharp enough so that using it on 420, for example, I have been able to separate the audio of stations that were heterodyning each other. Of course those $600 receivers can have crystals and 2.5 bandwidths, but that isn't the class of machine we're building here.

This first part of two sections on trending towards an ideal i-f system has covered the 1.65 MHz and the 135 kHz modules using modern coils and ICs. The aim is to build the best i-f possible, using reasonable-cost components and homebrew methods. The difficult requirements of an i-f with very low image characteristics and very high selectivity have been met. The second part of this article details the converter and avc systems.

...K1CLL ■

Fig. 7. 135 kHz i-f, with HEP 590 and Miller coils.



James P. Kirkgasser WA2ELA
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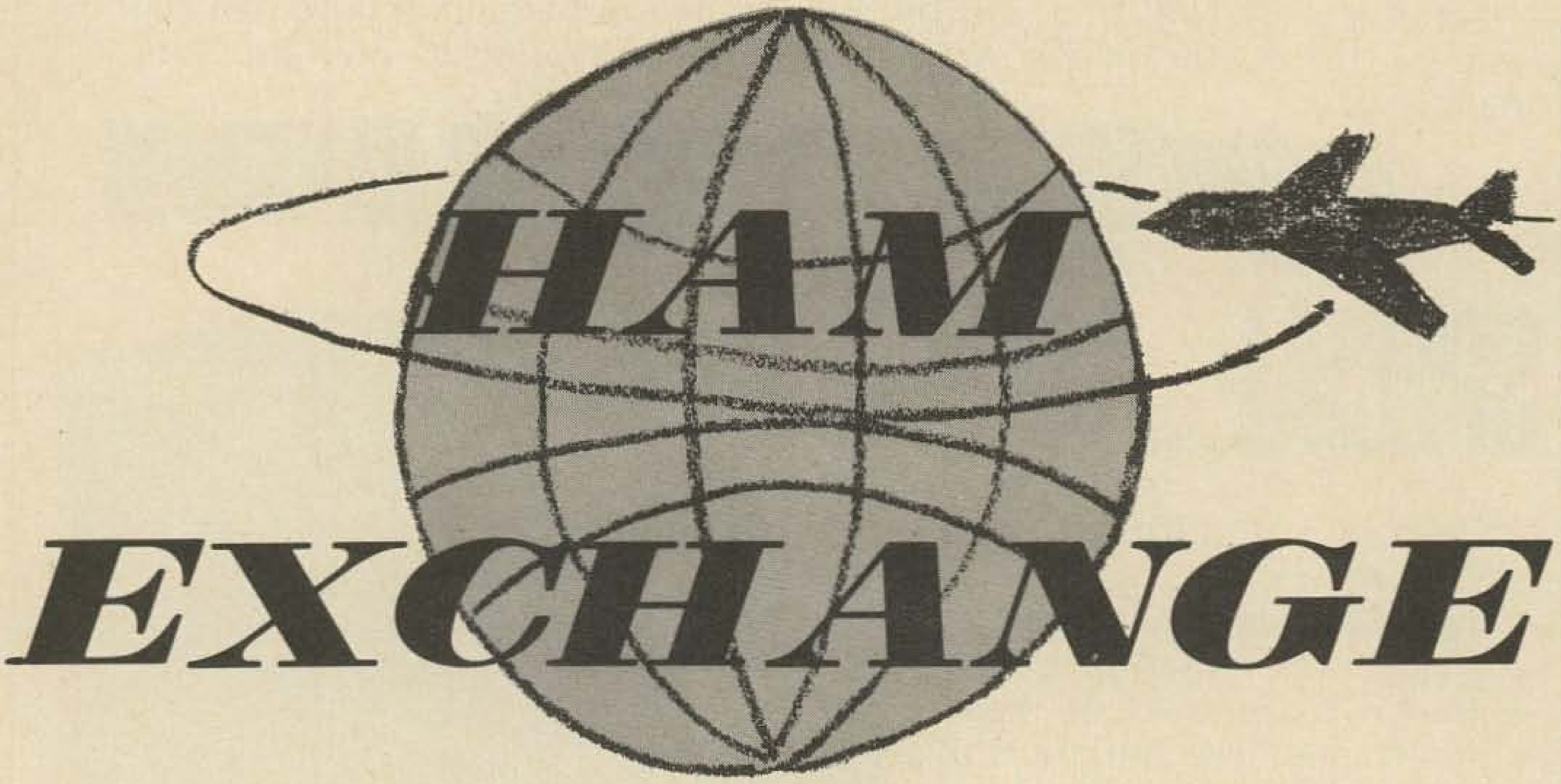

HAM EXCHANGE

The boys from Syracuse had a great time this summer doing something different. Of course, you have read about the idea put forth in 73 concerning Ham Hop, providing foreign hams places to stay when traveling about the U.S. We have already done something like this plus one better. We have set up "Ham Exchange."

This program is aimed at setting up hams going both ways, to Europe and to the U.S., with a home base that provides lodging and food at a ham's home. Thus, a traveler has a home away from home, plus the very important feature of cutting the daily living expense to the bare minimum.

The first test of the program was initiated by Fred Trode DL8VQ/W2, who enlisted the help of Uwe Rehage DL8QP to organize the DL side of the program. And we were off to our first and successful year.

Fred, my XYL, her sister, and four harmonics were the brave ones who met the charter aircraft at JFK airport at 3 a.m. on August 12 of last year. Of course there were the usual customs problems, including Eberhard (DJ9CJ) placing his passport in his luggage which went into the terminal when he needed it to get off the plane. After the normal fumbling in customs, the DL's were cleared at 5 a.m.

Fred crowded five of the hams and their luggage into his station wagon for the drive back to Syracuse where they met their hosts and the first ham exchange was off and running. My wife (Jo), with her sister and husband, took Eberhard and Ilse to see New York City and the one-time-only reception for the moon men. This was unbelievable as far as timing of the trip, etc., because our European visitors watched the Apollo XI all the way–including the walk on the moon (except Eberhard DJ9CJ), who fell asleep. I guess he had watched television eight hours straight and then pooped out at the first step on the moon).

A tour by sightseeing boat was perfect to get the feel of New York for our tired guests. Wall Street, Broadway, and the U.N. Building and two more days filled in the picture of New York City. Then we pulled the biggest goof in history–try and get through the traffic on the way to the first (hope the only one we have to go through) rock convention at Woodstock. Eberhard commented, "I have never seen so many cars boiling over in my life."

Once in Syracuse the variations on the exchange started. Some people wanted to travel, some wanted to work DX, etc. We had used 20 meters early in the summer to find out that travel was of most interest for Eberhard and Ilse. Boston, Niagara Falls, Montreal, New York City, and the local area were of prime interest. A trip was also arranged to Washington D.C. for Eberhard. Needless to say, we had a full four weeks.

I took a two-week vacation and combined it with the long Labor Day weekend to cover the areas outlined. We used a camping trailer for everyone including the children. This really cut the expenses and placed everyone in the person-to-person situation (where you can learn the most). One perfect Sunday was spent at Tanglewood, where we heard Erich Leinsdorf conduct the Boston Symphony in Beethoven's Ninth Symphony (Ilse's favorite). This is the main point about "Ham Exchange"—the people involved set up their own programs. Some traveled, some used Ham Hop, some sat home and drank beer and just got to know people.

So this is "Ham Exchange." Write your own ticket! Travel to a new land! We will help find a ham at the other end who will provide a place to live and food. The rest is up to you and your host. We hit the road and covered the northeast quarter of the

United States. Out of pocket, it cost us about $350 overall for one month, which included a vacation for our family and two additional weeks including New York City, Niagara Falls, etc. For the fun we had, and for six people, this was quite reasonable. Now we are ready for next year, and we are planning our trip to Europe with our two children.

James P. Kirkgasser WA2ELA
Fred Trode DL8VQ/W2 ■

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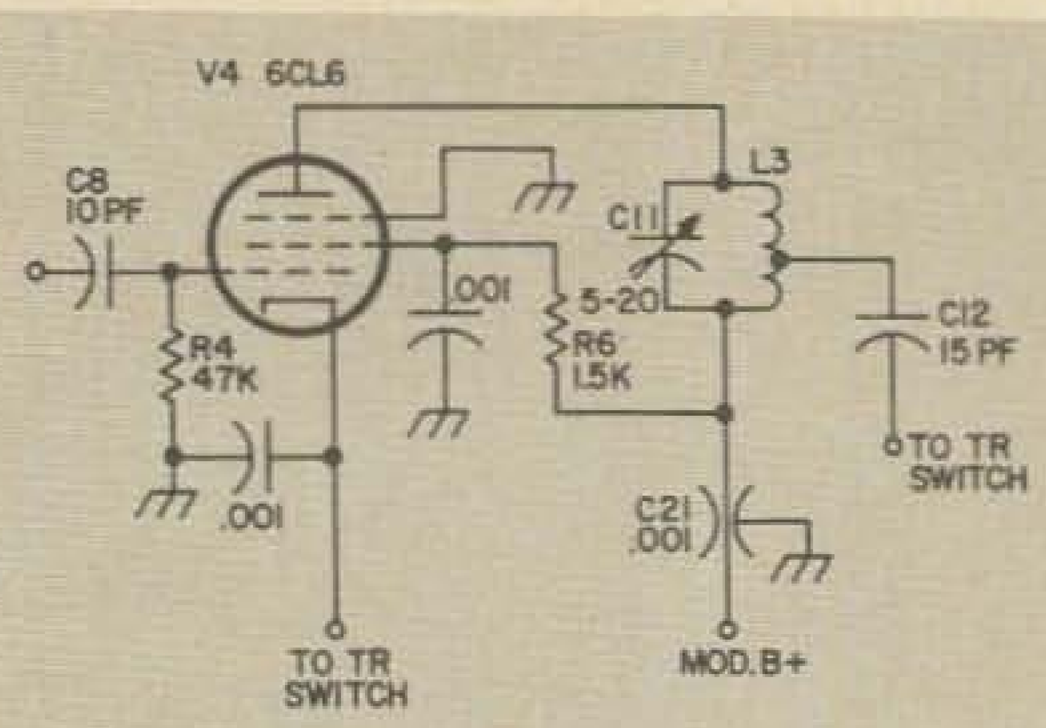
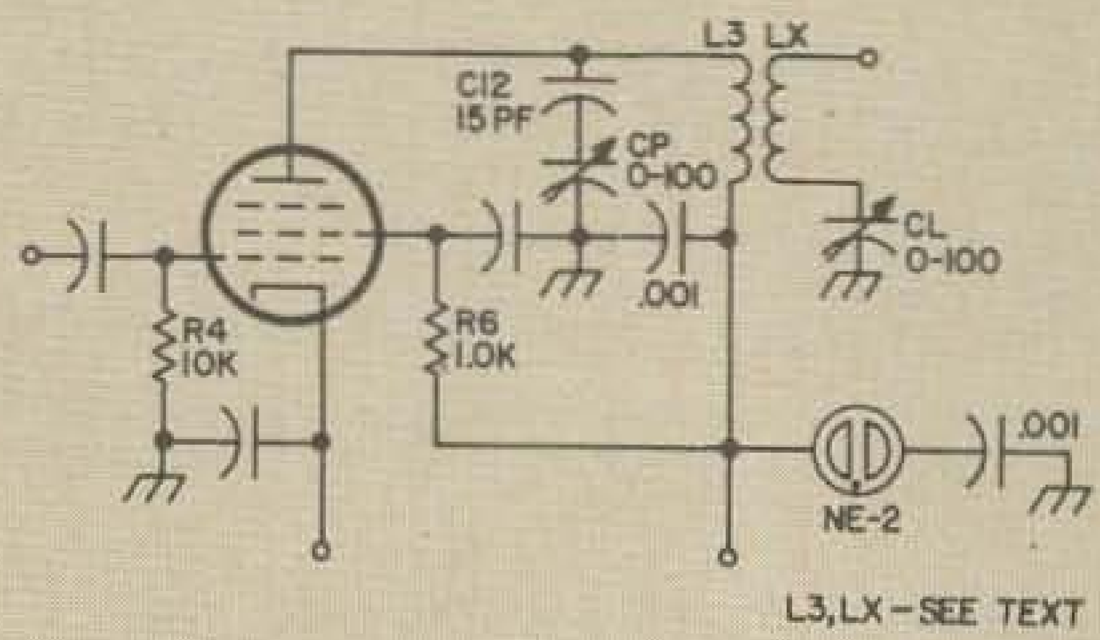


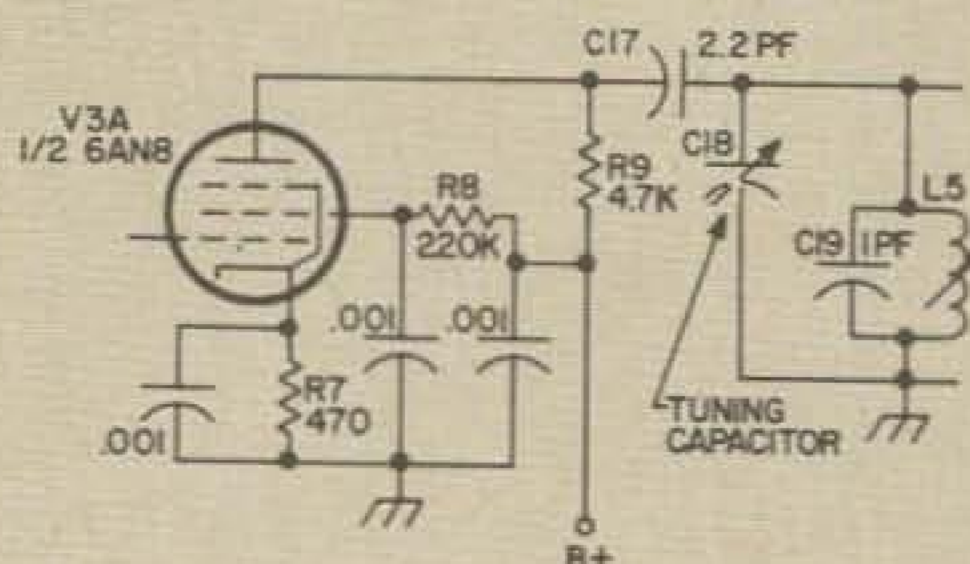
Unmodified Sixer final amplifier.

SUPER SIXER

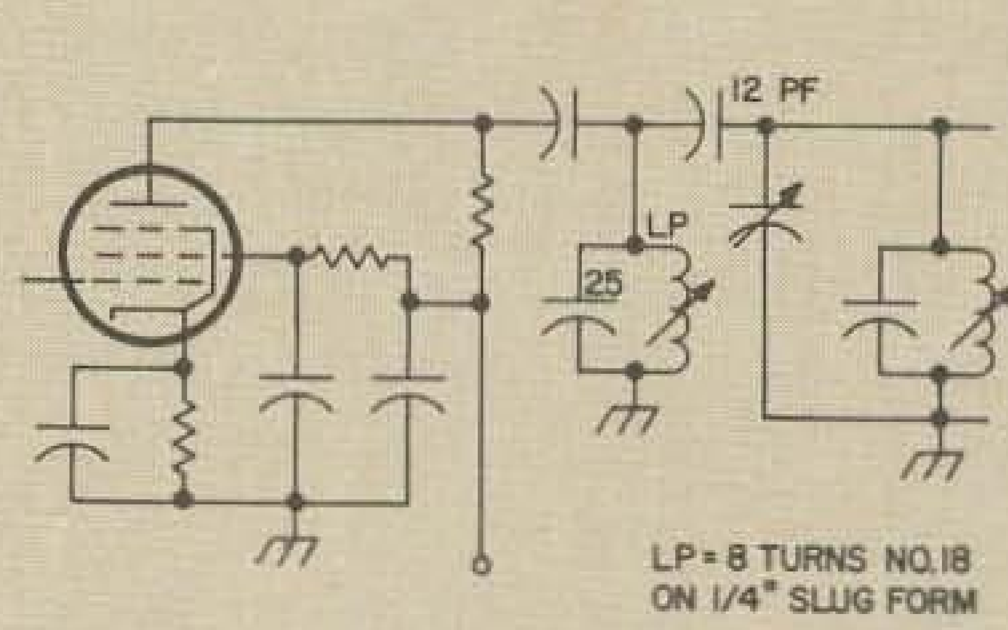
. . . to the rescue



Modified Sixer final amplifier.



Unmodified Sixer receiver, rf stage.



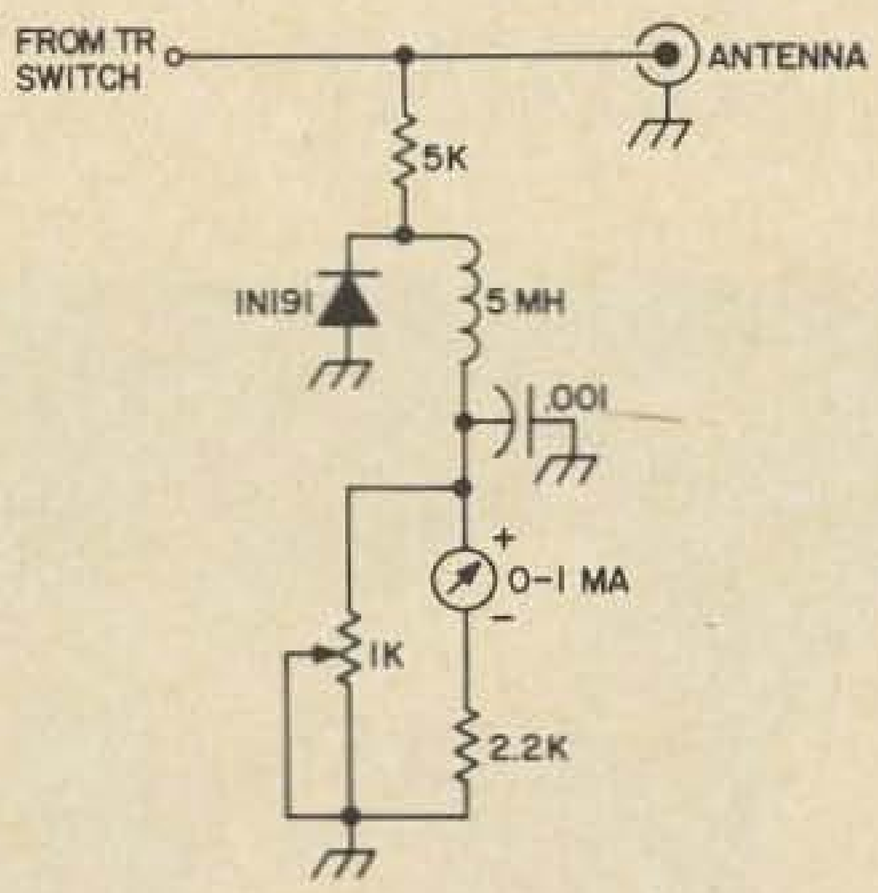
Modified Sixer receiver, rf stage.

There's just something about a Sixer that can drive a ham crazy with "modification fever." Have you ever noticed the number of improvement articles written on them? It was a touch of such a "fever," induced by TVI, that got me digging into the bowels of my Sixer.

TVI has a bad way of catching up with you, sooner or later. Naturally, it wasn't too long after the little rig was first put on the air that a flood of complaints of television interference began. The use of a lowpass filter was obvious, though I couldn't bring myself to sharing the kW filter on the sideband rig with such a peanut whistle of a tranceiver. Why, the filter looked as large as the Sixer! There must be some other quick way around the interference...

On the premonition that C12 (15 pF) in the plate tank circuit was passing something other than just 50 MHz to the antenna, I changed over to link coupling. L3 was cut down to 6 turns and another coil of insulated wire, LX, of 2 turns was wound over it.

The results were amazing. The TVI was not only gone, but in addition, the transmitter loaded into the antenna better. This was great, so other modifications were begun.



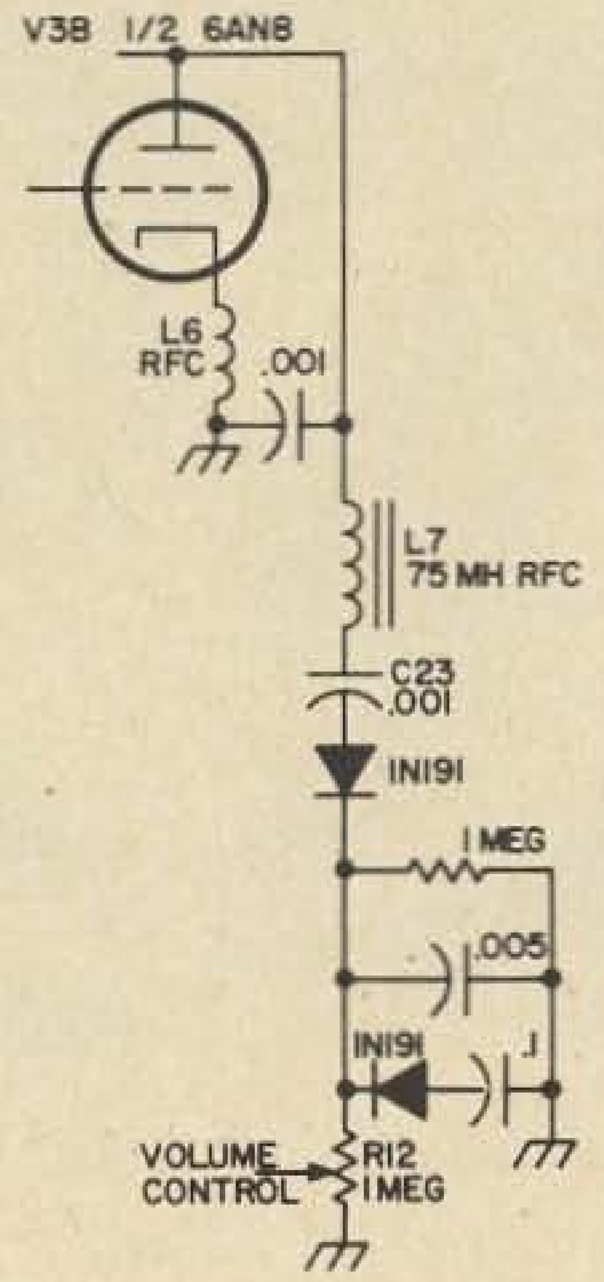
Improved tuning system.

Two holes were next drilled into the front panel, one to mount the new load control, and another for a capacitor to tune the plate of the final (6CL6). Two 0-100 pF variables were used because they were on hand at the time. The plate variable was placed in series with a 15 pF capacitor (the former C12), to make the tuning less critical at resonance.

Next, the grid and screen resistors of the final were changed from 47K and 1.5K to 10K and 1K, respectively. Input power increased two watts. Now some form of visual indicator for tuning the transmitter was needed. The original relative power output measuring arrangement of the Sixer leaves a lot to be desired. With a small light bulb as a dummy load, you can actually see a decrease in power when a meter is inserted into the circuit. A better, less lossy arrangement was substituted to sample the output rf. It is then read out on a 1 mA meter that was installed on the front panel.

Just for fun, a neon bulb was soldered in series with a .001 μF capacitor, and then to the cold side of L3. Instant modulation indicator.

The receiver section of the Sixer is its weakest spot. While the sensitivity is good, the selectivity is too broad to be usable when the band is crowded. A certain degree of selectivity was gained by adding a tuned circuit between the rf and detector stages of V3 (6AN8). How much selectivity was added, is hard to determine, but stations tune more sharply with less overload interference now.



Noise limiter.

Since the ultimate aim was to use the rig in a car, a noise limiter was tried. Even with the good limiting action inherent to a regen receiver, ignition noise was still a problem while operating mobile. From the Diode Handbook (73, Jan. 1968) came a circuit for a shunt diode noise limiter. One was installed between the detector and the first audio stage. Nothing truly spectacular resulted, for the ignition noise didn't disappear. It was reduced to a more tolerable level, however.

The crystal socket was moved to the upper right hand corner of the front panel. Instability was avoided by installing a tube shield over the 6CL6. And last, a 4PDT relay was wired in to allow PTT operation—a must when you're mobile. The Sixer was a nice rig to begin with; it's even better now.

. . . WA3AQS

Bob Manning K1YSD
Box 66
West Rye NH 03891

Bob, Bob, Bobbin' Along

K1YSD beside himself beside himself beside himself beside himself beside himself beside him

"This is K1YSD–mind if I get in on your roundtable?'

"Come aboard! What's the handle? Handle here is Bob!"

"It's Bob here, also!"

"Good enough, we got Don K1QES and Don K1NDA, and also another Bob WA1ACH on frequency."

"Oh swell. Say, Bob, what's your QTH?"

"Which Bob?"

"AOH."

"Mugwump Valley–but Don's got the best location."

"Which Don?"

"Whaaaaa me?"

"Me?"

"Who me? You call me? I was out in the sandbox."

"Who's this?"

"Don!"

"Which Don?"

"QES. Who's this?"

"Bob!"

"Which Bob?"

"YSD. Who said that?"

"Said what?"

"Said, 'Which Bob?'"

"Me, Don!"

"Which Don?"

"NDA!"

"Hey fellas, can I join the roundtable? My name is Herschel!"

"Herschel?. . .Herschel!!! You bet your sweet Aunt Matilda's hand knitted antimacassar you can join! Fact is, we'd appreciate it if you took over as the moderator of this group. Here's the situation as it now stands: We have three Bobs and two Dons on frequency. We can simplfy it if we label TFC as Bob 1, AOH as Bob 2, and YSD as Bob 3–then label QES as Don 1 and NDA as Don 2. Now, Bob 2 wants an informal with Don 1 and Bob 3 wants to talk to Bob 2–he has a message from Bob 2's son, Bob Jr. 4–Don 1 wants words with Bob 3 about what Howie 1 said to Howie 3 and Harold 2 about Don 2's meeting with Bob 1.

"Have you got all that Herschel?. . . Herschel!!!. . .Herschel???. . .Now, where the devil did he go?"

"I think I heard him mutter something like, 'Good Lord, I've tuned into the 'intra-happy-home-net' just before he pulled the plug!"

"Who said that?"

"I just told you, Herschel said it!"

"Yeah, but who are you?"

"Don!"

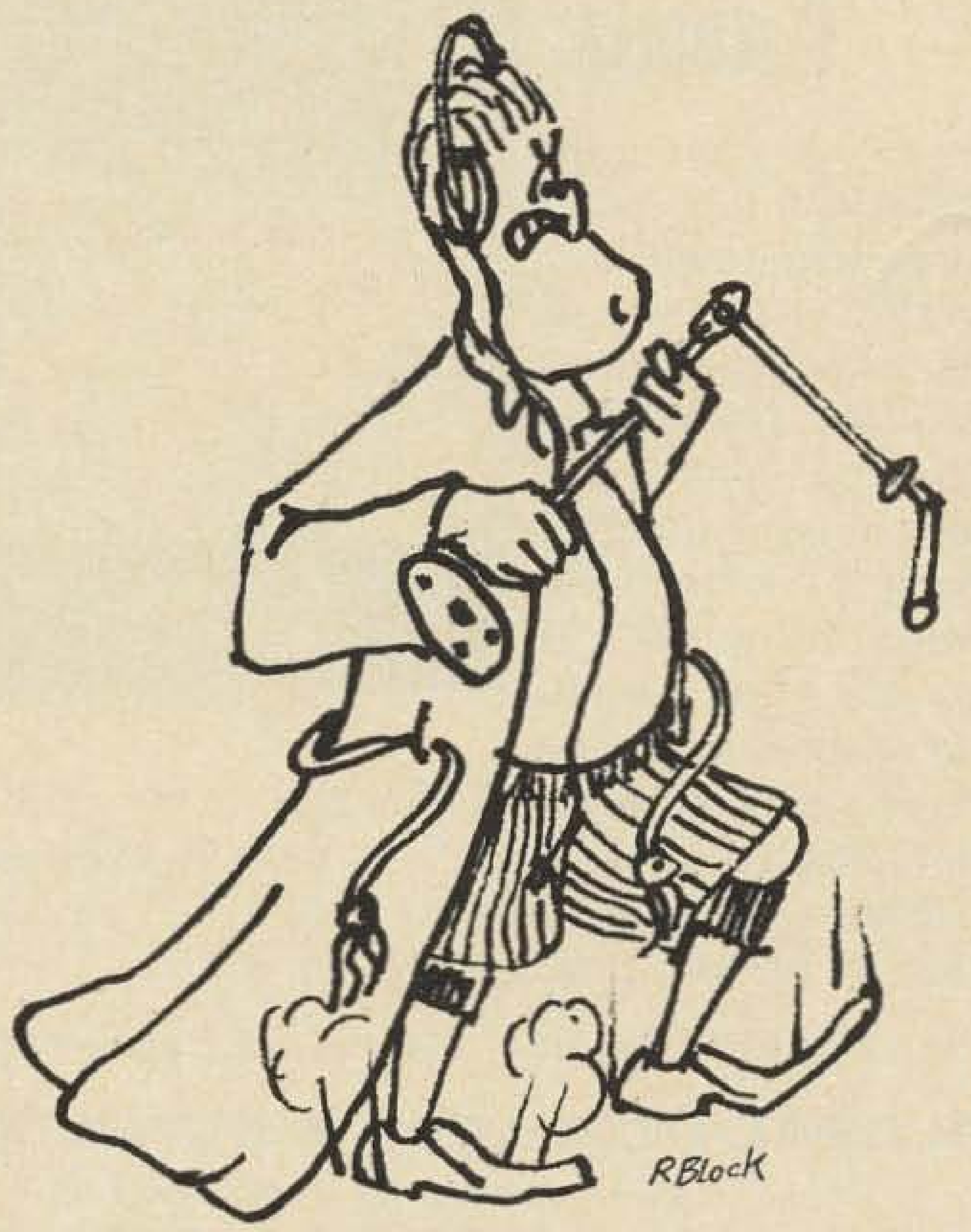
"Don who?"

"Number two—who's this?"

At this point something must have snapped, for the next thing I remember is clawing frantically through the metal and cloth grill, reaching in and disemboweling my MS-4 speaker (turning a $20 speaker into an *89¢ frisbee*). Then, standing fully erect, and with all the force of a Paul Bunyan with prickly heat, I cleaved my Drake R4 into

two equal parts with my boom mike (giving myself two R2's, a chromium W.C. Fields cue stick and a possible double hernia).

Shrieking, "GERONIMOOO!!!, I hurled myself through the screened window—straining myself—counted ten and pulled the "D" ring which, as luck would have it, happened to be the snap fastener on my sansaband trousers, and went stomping down the by-ways of our otherwise normally quiet New England town, clad only in a terry cloth robe, knee socks and boondockers with a pair of earphones clamped on my head, from which dangled, 'twixt my knees, the earphone cord and ¼" phone plug, resembling either a grotesque umbilical cord or some other potentially hysterical physical malformation . . . still clutching the misshapen boom in my hand. (I still wake up nights with the memory of a wild-eyed, horny, but impotent shepherd clomping and frolicking ungainly-not unlike a rhinoceros in heat—down the road to the tune of "Hippity Hop to the Barber Shop.')



I kept up a continuous chanting mumble of, "I'm Bob, no—you're Bob, I'm Don, he's number two, you're Don, he's Bob, I'm number one—Herschel! Herschel?? *Who the hell is Herschel??*"

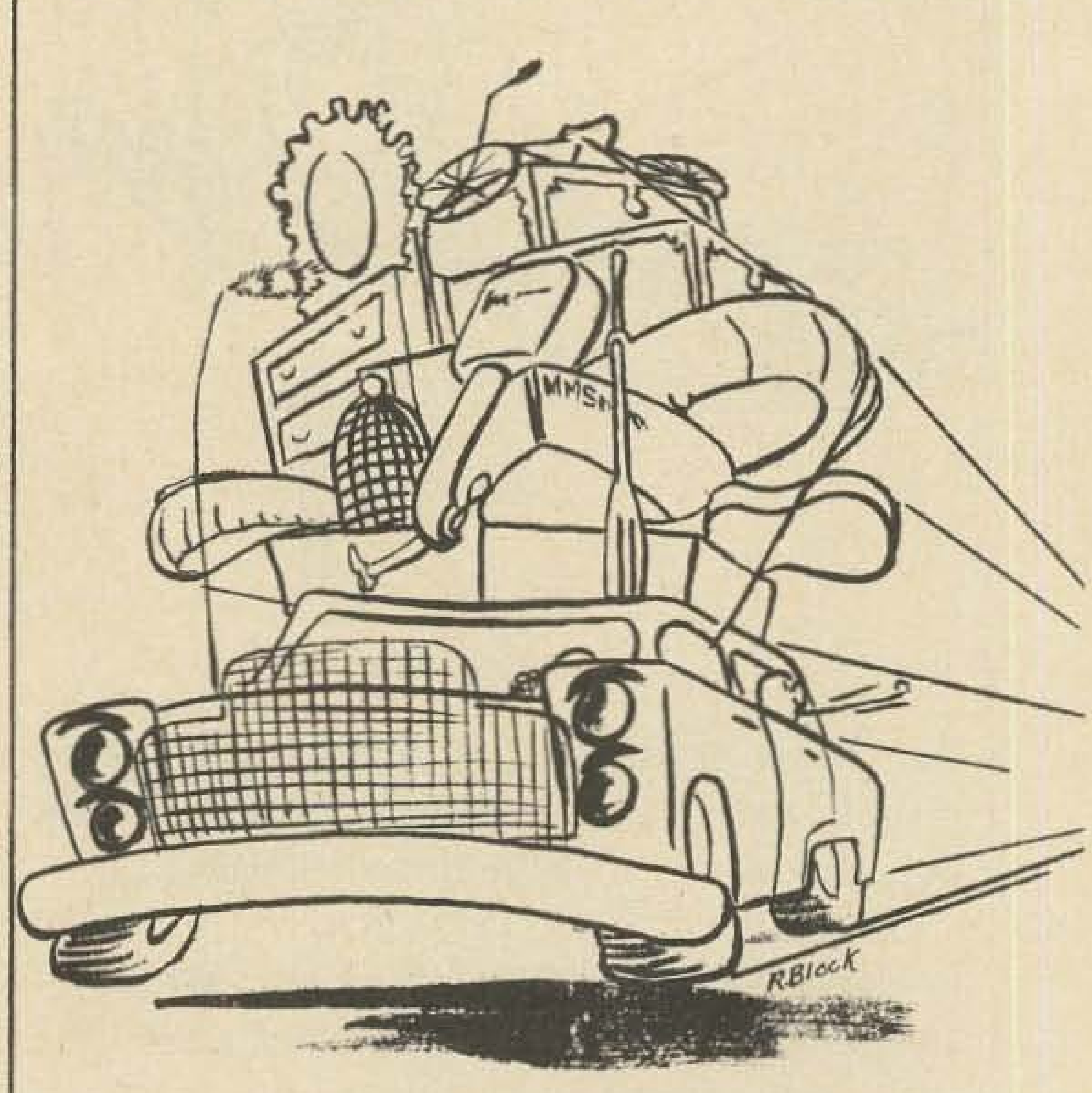
I might well have gone on like this forever and, since it was summer, there's a good chance I'd have reached route #1 (Blood Alley) and been scrunched into unrecognizable mush by some boat-hauling, arm-dangling, gum-chewing, antique-collecting kamikaze driver from Massachusetts, possibly adhering to one or more of their treadless retreads (though this would have made me a big man in concentric circles, I must confess ,that I had no real desire to become a permanent part of the Spaulding Turnpike).

Every summer, these juggernauts—with the instincts of the suicidal lemming and the finesse of a "dropped rock," burst into our State like mindless shrapnel from a fragmentation grenade.

They come, on their annual pilgrimage, like a horde of soldier ants, or locusts, firm in the belief that not only is the shortest distance between two points a straight line, but that the Massachusetts plate gives them license to disregard any and all safety precautions and that nothing should—indeed, nothing could—stand in their way.

Ensconced in a formless, unidentifiable 2000 pound mobile pig-sty, held together by Band-aids, inspection stickers, rusty wire, primer paint, ding-a-ling decals and a modified law of inertia, which, in this case, states that the vehicle—once set in motion—must not only remain in motion, but must do so with ever increasing speed mathematically proportionate with the distance covered, accidents caused and terror instilled in New Hampshirites. Failure to comply will result in instantaneous disintegration, creating either a 'Susan Spotless NO! NO!' or a new ski area complete with 200 foot bar.

Dragging a crusty, fish-tailing old boat behind, pushing a huge bug screen in front



and carrying, overhead, what appears to be next year's entire work load for the Goodwill Industries . . . at the wheel, a wild-eyed nut with at least one loose screw, a skaggy old bag and half a dozen sticky fingered, rock throwing kids with lollipops stuck in their ears and a howling mongrel dog slowly being strangled by 127 feet of 'Discover America' banners . . . they steam roll over stop signs, traffic lights, back yard fences, dogs, cows, kids, pedestrians, historical monuments and especially other mobile pig-sties. (Quite often they are fired on by irate New Hampshirites and occasionally even by the Welcome Wagon.) All this in search of a pool of stagnant water (even a backed up septic tank will suffice) in which to launch their 22 foot boat (?) with twin 50 hp motors, an antique shop from which to buy a piece of driftwood, a broken rocking chair, a two legged buffalo milking stool, some genuine Indian artifacts (made in Hong Kong) or a hand painted lobster claw with 'Souvenir of Kankgamangus by the Salt Flats' painted on it, or to find some picnic/rest area where they divest themselves of a year's accumulation of HoJo cups, napkins, straws, half eaten Texas-burgers, glad bags and other assorted garbage.

The contamination record (presently held by a family of four) is 2 minutes 19 seconds to turn a picturesque rest area into a mess that has all the charm and beauty of a blighted and deserted land fill project.

Fortunately, however, I was saved from exposing myself to this danger when I was suddenly blocked by a taxi which pulled up in front of me. The driver, noting my garb and hearing my mumbles, quipped, "Need a lift to Foam Rubber City, Buddy?"

I sped around the cab to the driver's side, reached in, grabbed the driver by both lapels, shook and twisted and shook some more while screaming hysterically, "What's your name, What's your name? Just what the hell is your ruddy name?"

"Lillian! Lillian!" she gagged, "What's yours?"

"It's Bob," I replied, "No, it's Don—no, it's Howie—no, it's Herschel—I dunno—maybe it's Lillian."

She swung her dashboard mike like a bolo, catching both my hands and causing my thumbs to become jammed, one in each ear like deer horns (if it had been winter, I'd have been gunned down by a leaky booted Massachusetts hunter carrying a modified bazooka firing 88mm flare rockets). As she careened round the corner, and out of sight, I had the final satisfaction of seeing her hair turn white.

If you're reading this, I'm assuming two things not necessarily in evidence: One, that you have some sort of interest in radio and aren't just an itinerant kleptomaniac that absentmindedly scooped up this magazine as part of your daily quota and, two, that you know what a 'handle' is.

A 'handle,' besides being the mechanical accoutrement for lifting a pot, teacup, or thunderjug, is also, for some inexplicable reason, the coloquial idiom used in amateur radio by the Neanderthal ham in-group as a synonym for the name, 'name'; i.e. 'handle' replaces the name, 'name.'

The apprentice/greenhorn ham (or 'tongue-tied jerk' as he is ofttimes unfairly referred to) just breaking in and, not wishing to sound like an idiot, which incidently, is practically an impossibility on today's bands—it has long been my contention that you could recite any arbitrary exerpt from such books as, "The Orthopedic Surgeon Looks At Your Mattress," "The Abnormal Sex Life of the African Tse Tse Fly" or the prologue to "The Cause and Effect of Rampant Fungus on the Yucatan Peninsula" backwards, in Sanskirt or Pig-Latin and no one would think it strange, probably replying, "Roger O.M. Fine Business—I agree—I got a doublet here fed by 600 ohm twin line etc, etc., C.U.L. . .anyway, not wishing to sound like an idiot, the apprentice invariably slips into the 'dead sea scroll' word, 'handle.'

However, the younger generation—as it gains confidence and wishing to show its individuality and create its own neo-radiophyte in-group—has started a crusade to substitute the word 'name' for the word 'handle' which, of course, means 'name.' Consequently, if you wish to be of the modern in-group, you'd say, "My name is Bob!" Translated into Cro-Magnon ham lingo, this would mean, "My 'handle' is

Bob!", which, translated into English, would mean, "My name is Bob!"

Logically, it should follow that when you say, "My name is Bob," you in reality mean, "My name is Bob!" but this, by antiquated League standards, is not only totally ridiculuous and ludicrous, but downright sacrilegious! (This transgression may be forgiven if you immediately yell, "Hail Huntoon et tu Hart" ten times while ingesting the first fifty pages of the Handbook, having "I LOVE I.C." tatooed on both pectoral muscles, or goosing a non-League member with a hot soldering iron.)

I might also add that the younger–or upstart–generation, as a further impiety, is attempting to do away with speaking CW phrases on the phone bands . . . damned kids. The CW advocate when switching to voice retains a lot of the CW colloquialisms such as "Q" signals. Ever try to talk in "Q" signals? At best it's like trying to pronounce pharmaceutical conglomerations while sucking three jaw breakers underwater with a split palate.

You can get away with 'cue-so' for QSO and 'Q Street' for QST and Quirt for QRT, but you're gonna rupture your larynx pronouncing QRP, QRO, QRV, QSL and QTH (Quith?).

The opening dialogue may have sounded unreal, but tune across 75 meters any evening and ye shall find the truth.

I've been net control on many occasions when there were four Bob's, five Don's, two Bill's, two Walter's, three Howie's and two Ed's. Occasionally, however, you'll run across a Vladamir or a Katrina to break the monotony and keep you from turning 23-year-old female taxi drivers into white-haired old ladies on a daily basis.

[Funny my mentioning Katrina. Poor ole Katrina–she recently ran amuck when some good intentioned neighbor, thinking that the name 'ham' applied to the male of the species only, called in an ITVI complaint and called her a 'sow.' Katrina took immediate affront to this, cornered the caller and

force fed him a mixture of 2 pints of milk of magnesia and 1 pint of vodka (the world's second largest Phillips Screwdriver).

Katrina was brought to trial, convicted and sentenced. Now, I don't know your feelings about capital punishment–in this State the maximum penalty is hanging–but, by golly, I just don't believe a woman should be hung like a man!]

Since the age span of any arbitrary group of clustered hams may range in years from 20 to 70, it is, indeed, a weird phenomenon that you'll find a sickening repetitive duplication of names. It gives one pause to wonder if, by some E.S.P. or precognition on the part of the parents that their offspring would end up being hams, they, through either a singular lack of imagination, some secret sense of humor, bestowed a seemingly endless string of common, lackluster names on all hams and hams to be.

If you were to recognize any ham by his upraised joystick or slipstick or notice him mounting his hustler, accost him and ask him–point blank–what is *the* most single important item in his shack, he'd like as not reply, "The receiver, or possibly the antenna." This is a malicious rumor spread by the same group that sponsored Edsels, slipped amateur radio the purple shaft with oatmeal clusters by turning 50% of the ham bands into a vast wasteland, and that is trying to give 10 meters to the CB'ers.

Let me assure you with a conviction born of frustration (mental constipation) that the most important item in your shack is your name and you will be saddled forevermore with the first name you give on the air.

If you've been cursed with a common name, then by all means adopt a *nom de plume* (pen name, for you illiterates).

Selecting the proper 'on-the-air name' should not be handled lightly. Television—especially late night movies—offers the most versatile virgin land for procuring a name.

Horror: Bela, Boris, Igor, Krag, Zandor, Mandrake, Luthor, Kral.

Cowboy: Wyatt, Duke, Matt, Knobby, Windy, Bat, Tex, Bret, Bart.

Ancient: Mars, Herc, Eros, Ajax, Thoth, Vulcan, Cronos, Thor.

War: Sarge, Gunner, Chief, Buck, Cap'n, Doc, Tex.

Misc: Kelly, Sully, Murph, Tab, Ty, Rip, Dash, Rock, Torn, Sue (?).

Just remember that, in real life, every Tom, Dick and Harry is named Tom, Dick and Harry, but in ham radio I've found that every Tom, Dick and Harry is named "Bob!"

One word of caution. Don't get too cute or you could end up like this:

"Name here is Spiro T."

"Spell it!"

"Spiro T—Sierra Papa India. . ."

"Whazzat last?"

"India—India November Delta. . ."

"Whazzat last?"

"Delta—Delta Echo Lima Tango. . ."

"Whazzat last?"

"Hell, I dunno—what am I spelling anyway? Who am I? What's my name? What's my name? It's Bob, no, Spiro T. I'm number one—you're Don, Quirt Quirt cue-ess-why Quirt WWAAAA—HOOOOOOO! Run for the hills, Lillian, HERE I COME AGAIN. . . GERONIMOOOOOO!!!"

"Look out for that guy wire!"

"What guy wiiiAAAWWWKKK??"

. . . K1YSD ■

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THE DIP LIGHT

Have you ever wondered how the grid dip meter got its name? I think it is self-explanatory to a certain extent, indicating that there is a meter in the grid circuit of a tube and that it measures the dip in current that occurs as the energy is absorbed when the oscillator tunes to the same frequency as the circuit under test. The name is all right as long as you think in terms of the tube circuit, but in recent years we have been seeing circuits using transistors and tunnel diode oscillators taking over. In other words, no grids.

So now the name has changed to "dip meter," which is fine as long as you have no objection to the meter part. As I see it, the meter has done a very good job in the past on this instrument, but nowadays we can come up with devices not limited by the constraints imposed on the people who first developed the grid dip meter. Think of a pilot light bulb, for instance. How much better it would serve the purpose, since you would not have to concentrate on it to see a dip as you would with the meter. Many times as I stared at the meter (which happens to be at the opposite end from the coil), I would find that I was getting no dip simply because I had inadvertently moved the coil away from the circuit under test.

A light bulb is much more obvious than a meter needle, and in this use you really would not need the precision that a microammeter gives. All you really want is a dip. A light bulb is just not sensitive enough to read microamperes. But what if you were to help it with a couple of transistors? This is the crux of the dip light shown in **Fig. 1**—the little devil that will do everything that a grid dip meter will do, only better. And it can be built more cheaply, to boot.

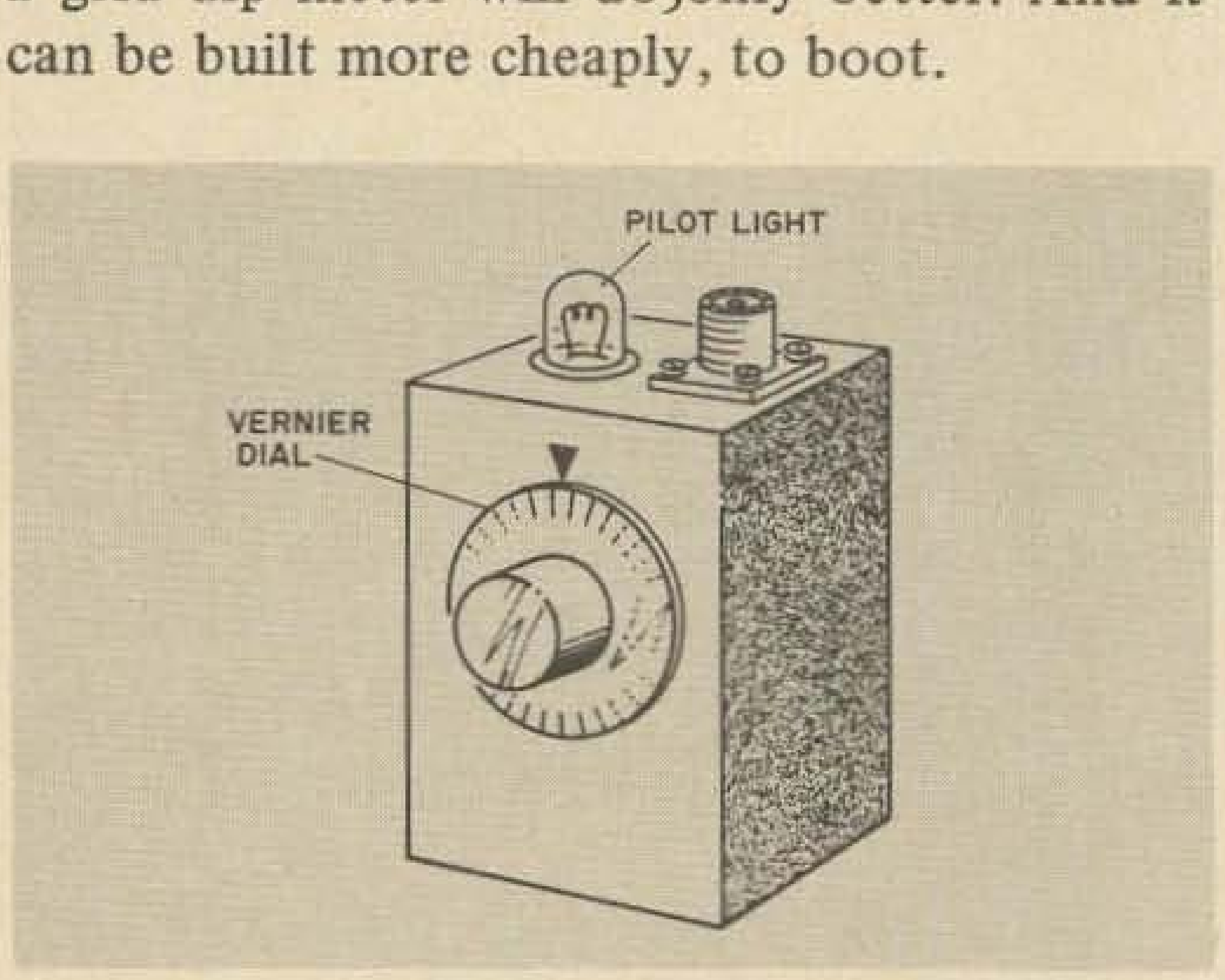

Fig. 1. A vernier dial on the front of the unit can be calibrated without much difficulty. The bulb itself can be held in place by cementing it to an ordinary grommet.

Construction

You can use regular coax connectors for the coils and build the latter on a stub of coax about 3 in. long, with the connector at one end, the outer cover and shield peeled back as shown in Fig. 2. The coil is wound on the plastic core, soldered to the center conductor and shield and then covered up with GE crude rubber cement, which is quite soft and flexible even after having cured.

The indicator lamp should go somewhere near the coil, where you can see it and the coil at the same time. For the frequency readout I used a small calibrated vernier drive. You'll find this easier than making your own dial, and you can use a chart or set of curves to correlate frequency with the calibrated increments.

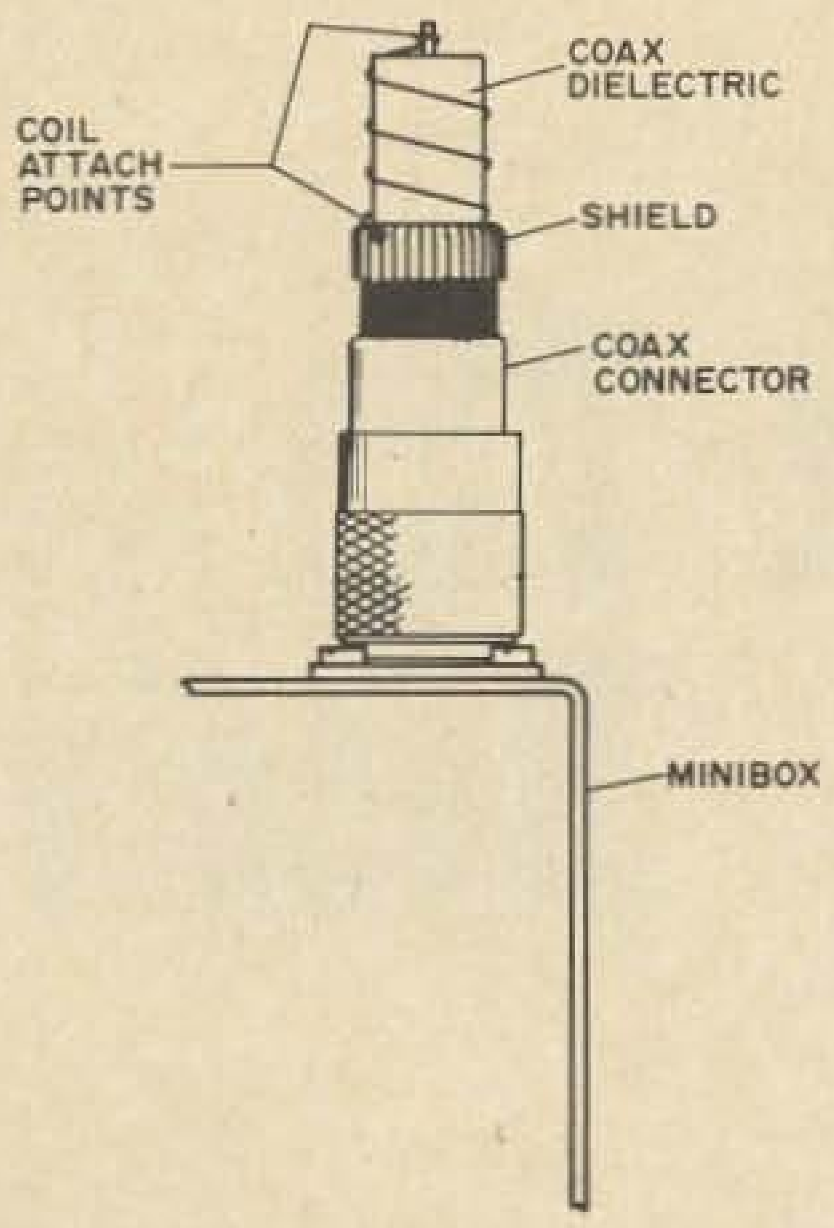

Fig. 2. Coils can be built onto bits of RG-8/U cable and terminated with UHF connector.

For the tuning capacitor, use an APC with a ¼ in. shaft. Mine had some plates removed, but I would guess it to be about 30 pF.

The oscillator circuit happens to be my pet one, but since it is not critical, you could use your own circuit. It occurred to me that one could open up one of those two-dollar modules sold as FM wireless instrument broadcasters. At least one that I know of is not encapsulated in epoxy. I built my own (Fig. 3) with GE9 transistors and have no trouble getting this little gem to oscillate up to 120 MHz.

Capacitor C1 should be chosen to oscillate down to the lowest frequency to be used. My unit worked well with a 55 pF capacitor. Resistor R1 should be 100 kΩ initially; then, when you have finished building you can replace this with a 0.5 MΩ temporarily, adjust this for a good indication on your lamp (I set mine for maximum rf, but don't know how good this might be for the transistor), and then replace with a fixed value to correspond with the setting of your pot. The lamp amplifier is a Darlington circuit to provide a better load for the diode circuit, but you could use a one-transistor circuit almost as effectively.

Be sure that you use high-gain transistors in either case though; they should be medium-power "driver" types to handle the current required to light the lamp, which should be a low-current one such as the 48 or 49 bulbs (coded with pink beads). Use two penlight cells for power and you end up having a really versatile instrument.

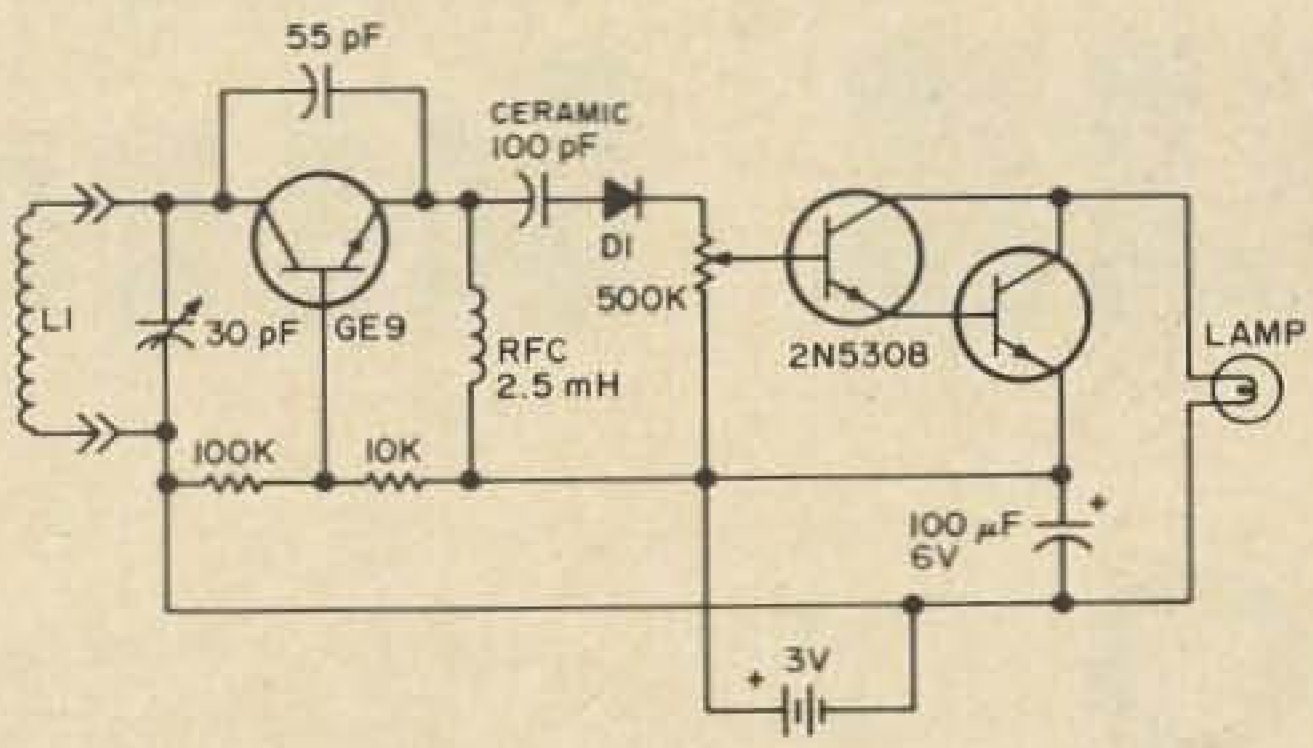

Fig. 3. Dipper is nothing more than a simple oscillator and a Darlington amplifier pair.

Plotting the Frequency

Making the frequency curves should be a simple enough matter using "science" graph paper and an accurately tuned receiver. Simply tune the receiver to the frequency that you need then find it with the frequency control of your dipper. First find the highest and lowest frequency that the instrument will cover, and mark this along the side of your graph. Mark the maximum number of divisions of your dial along the bottom of the graph. Then spot a few frequencies more or less evenly spaced between the maximum and minimum, and draw your curve to touch all the points. Voila! You have a curve for one coil. Repeat this for the others. This method is good because if you ever wish to make an extra coil, you simply make an extra frequency curve for it and do not have to alter your instrument at all.

. . . VE3ECU/WØ ■

73 Checks Out The KRIS Scanning Receiver

One of the most interesting technological innovations in recent ham radio history has been the "scanner"–a transistor FM receiver that has the capability of monitoring a multitude of crystal-controlled channels by sequentially scanning the frequencies at a high rate then stopping and "locking on" to a frequency where a signal is present.

The idea of scanning is not new; there were a number of military "autoscan" receivers in use during the second world war–but these were large and cumbersome, they used mechanical contrivances for slewing, and they tuned at a rate so slow that short-duration transmissions could take place without being spotted. Today, with more and more frequencies being "standardized" for repeater operation in the VHF bands, the scanning receiver takes on more the stature of a necessary part of a truly "mobile" mobile setup, and less that of a conversation piece.

In the New England area, for example, where repeaters stud the hilltops, a user who wants to get the optimum use from his equipment will have to be prepared to transmit and receive on as many as four repeater frequencies–in addition to those frequencies established as "point-to-point." The problems of monitoring for activity can become trying when you pass through areas where several repeaters–on different frequencies–are operational. I found myself monitoring 146.94 MHz for signs of action on the W1ALE repeater while the Mount Snow and Concord machines (146.88 and 146.76, respectively) were hopping. A scanning capability, I felt, would serve as a "funnel" and allow monitoring of all the repeaters and point-to-point channels at once.

So that I could check out the practicability of monitoring with a scanning receiver, I invited the manufacturer of the Kris scanner to lend me a unit for a while for test purposes. I had seen Kris' ads and was frankly impressed with the specifications. The people at Kris were accommodating, and provided a receiver that was tuned up, crystaled, and ready to go.

I was in for a few surprises when I opened the box. The ads I had seen on the Kris units had been for the "Snooper," a

$139 unit with an "automatic–manual" switch for mode selection. But what I received was the top of the line: a $149 receiver with a built-in switching capability that permits the operator to "lock out" any channels he does not wish to monitor. Also, I discovered that the unit is not restricted to mobile use; it comes with a built-in power supply to permit use from either 115V house current or the 12V power from a car battery. It also comes with a removable telescopic whip antenna that attaches through a grommeted hole in the cabinet top.

On the negative side, the regular antenna connector on the back of the scanner is made to accept the plug that comes standard on automobile BC radio antennas. This might be great for someone who wants to forego his mobile BC listening in favor of monitoring the local FM nets, but for most of the hams I know, it would be an annoyance. The ideal connector, in my estimation, would be a conventional UHF connector suitable for matching with regular RG-8 or RG-58/U coax. It is probably safe to assume that the unit was originally developed for use by off-duty civil employees and other nontechnical people who would be stopped by so strange a beast as a PL-259 or its mate. At any rate, the required adapter is an Antenna Specialists M46; and the Kris people indicated they would supply the adapter if the request is made at the time of order.

Operationally, the Kris scanner is a wonder. It sits there silently and does exactly what it was made to do—quickly, efficiently, and rhythmically. The receiver scans at the rate of 20 samples per second, so that each channel (there are seven of them) gets "visited" every 0.3 second. The scanning rate remains the same whether some channels are skipped (locked out) or not. Each of the seven channels has a numbered indicator lamp that glows during each "sample-taking" period. When a signal appears and the receiver locks on, the lamp for that channel stays on so the operator can identify the active channel.

I checked the unit out in the 73 Magazine office where the sophisticated test equipment complement consists of a voltohmmeter and a pair of pliers—so there was little in the way of measurements that could be done. But I did have a receiver of known sensitivity for comparison, and all indications were that the Kris performed in consonance with the manufacturer's specs; signals that quieted the known receiver by 20 dB did the same on the Kris scanner. Since the "control" receiver was rated for a sensitivity of 0.5 μV for the 20 dB quieting factor, it is safe to assume that Kris' specs (identical to those for the control receiver) are accurate.

With respect to bandwidth, it should be noted that the Kris is a "good" receiver—and, like any good receiver, it is reasonably selective. But a highly selective receiver can't have a broad bandwidth without some compromise. Thus, the Kris scanner should be tuned for the frequency in the center of its range. The performance tends to degrade gradually off either side of the center frequency of interest. Since the degradation is insignificant over a range of several megahertz, this little tidbit of information will be inapplicable to most users. But if you plan on monitoring the local repeaters as well as the police frequencies in the 155 MHz region, try to plan your channels so that the top frequency is no more than 8–10 MHz from the lowest frequency of interest. And even then you'll have to compromise the sensitivity on the low end if you want acceptable performance on the top. For the conventional repeater frequencies, however—between 146 and 148 MHz—you'll find no deterioration in performance over the whole range.

All things considered, I think the scanning receiver will find a home with the FM crowd. Even if you don't have a lot of active channels in your area, it's always nice to monitor the more popular frequencies for transient mobiles, DX, or blossoming FM activity. The scanner is really great . . . easy to get used to . . . easy to get dependent upon. But what I can't figure is why nobody has ever made a scanning transceiver?

. . .K6MVH ■

TWO CONVERSIONS FOR THE MOTOROLA 41V

PART 1: AC POWER SUPPLY

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This power supply was designed to provide the voltages necessary to operate the 41V Motorola mobile as a base station. The idea behind the supply was to make it possible to convert a unit for ac operation without removing any parts necessary for dc use. This adds considerably to the utility of the unit. An operator can use it at home on ac, but when he wishes, he can reinstall it as a mobile by the simple addition of a jumper plug.

The supply uses a common TV transformer in a full-wave circuit to provide a B+ potential of 325 to 350V, and a divider network for the low B+ stages of the rig. You may have to adjust the divider resistor values to come up with the exact values of low B+ called for.

The relays are supplied by a small filament transformer and a full-wave bridge rectifier. The diodes here can be most anything over a 500 mA rating and 100 PIV or better.

Please note that the diagram shows a supply for a 12V dc rig. If your rig is for 6V, either convert it for 12V or be sure to use a 6V relay supply transformer, and use only one 6V winding on the power transformer (the heaviest, of course).

With this conversion, control connections are made through the normally used 19-pin connector on the front panel. If the rig is a front-mount unit, you are really in business.

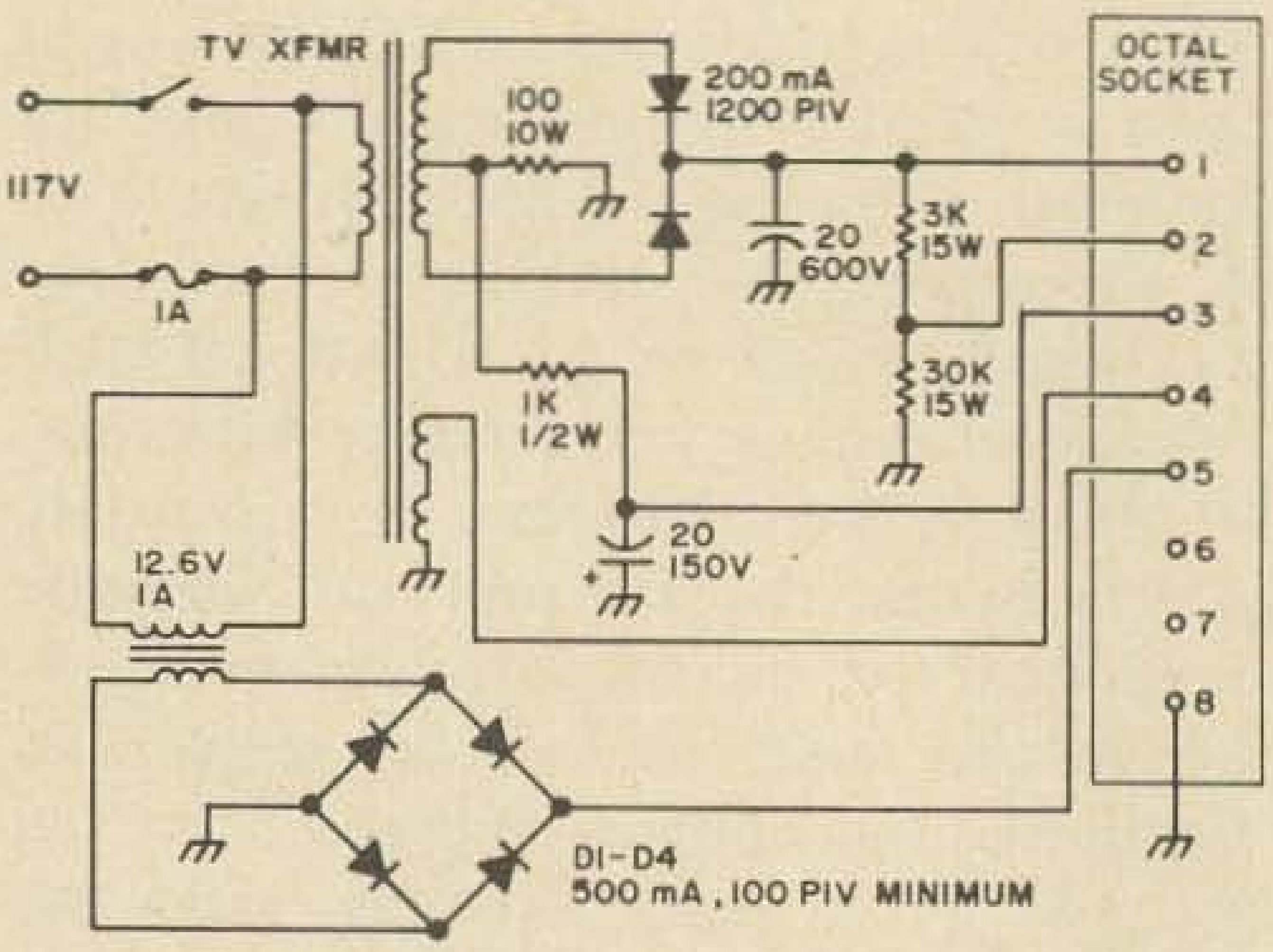

Fig. 1. Ac power supply for Motorola FMTRU-41V. (Original supply is shown in companion article.)

Step-by-step modification:

1. Remove RED lead from C10A and connect it to power socket pin 7.
2. Connect power socket pin 1 to C10A.
3. Connect power socket pin 2 to C9A.
4. Connect power socket pin 3 to terminal 10 on transmitter power supply strip.
5. Connect power socket pin 8 to ground.
6. Remove yellow lead from fuseholder and reconnect it to power connector pin 6.
7. Connect power socket pin 4 to fuse.
8. Remove relay lead from pin 2 of driver tube (2E26) and run to power socket pin 5. This step is for 12V units only.

Table I. Power plug connections.

Pin	Voltage	Current	Mode	Notes
1	350	150 mA	transmit	
2	200	55 mA	receive	
	150	50 mA	transmit	
3	-20		transmit	Bias
4	12.6 ac			6.3V ac in 6V equipment
5	12 dc			Relay supply
6	N/C			
7	N/C			
8	Gnd			

NOTE

If the unit being converted is a 6V model, change step 8 as follows: Remove the lead between E2-9 (transmitter supply tie strip) and K1-9/K1-10 (relay). Connect K1-9/K1-10 to power socket pin 5. Supply filament voltage to pin 6

The octal chassis connector plug is mounted on a small aluminum plate on the metal extension above the 19-pin control connector (top side of the power supply chassis).

Note that there is very little filtering in the ac supply. The capacitance in the rig has been found to be adequate to take care of ripple. It is possible, however, that the filters in the unit may have deteriorated and lost some of their ability to filter. In that case, replace 'em. Many units of this type have been subjected to considerable heat, which is rough on electrolytics.

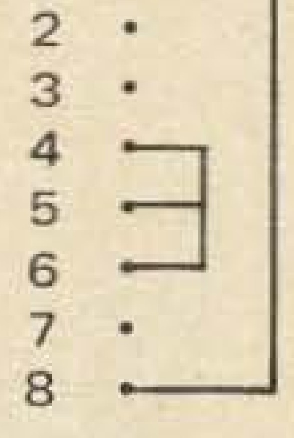

Fig. 2. DC jumper plug wiring.

The jump plug for dc operation can be wired up and then tied to the rig with lacing cord. Then it's there when you want it. Jumper wiring is shown in the shcematic.

. . .K9PKQ ■

PART 2: 6 TO 12V FILAMENT CONVERSION

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Setting up the 41V to operate on two meters is too simple to warrant a complete article on the subject. After a few preliminary value adjustments, the tuneup procedure is perfectly straightforward. This article deals primarily with changing a 6V unit to 12V; but, in the interest of completeness, here is the frequency conversion information:

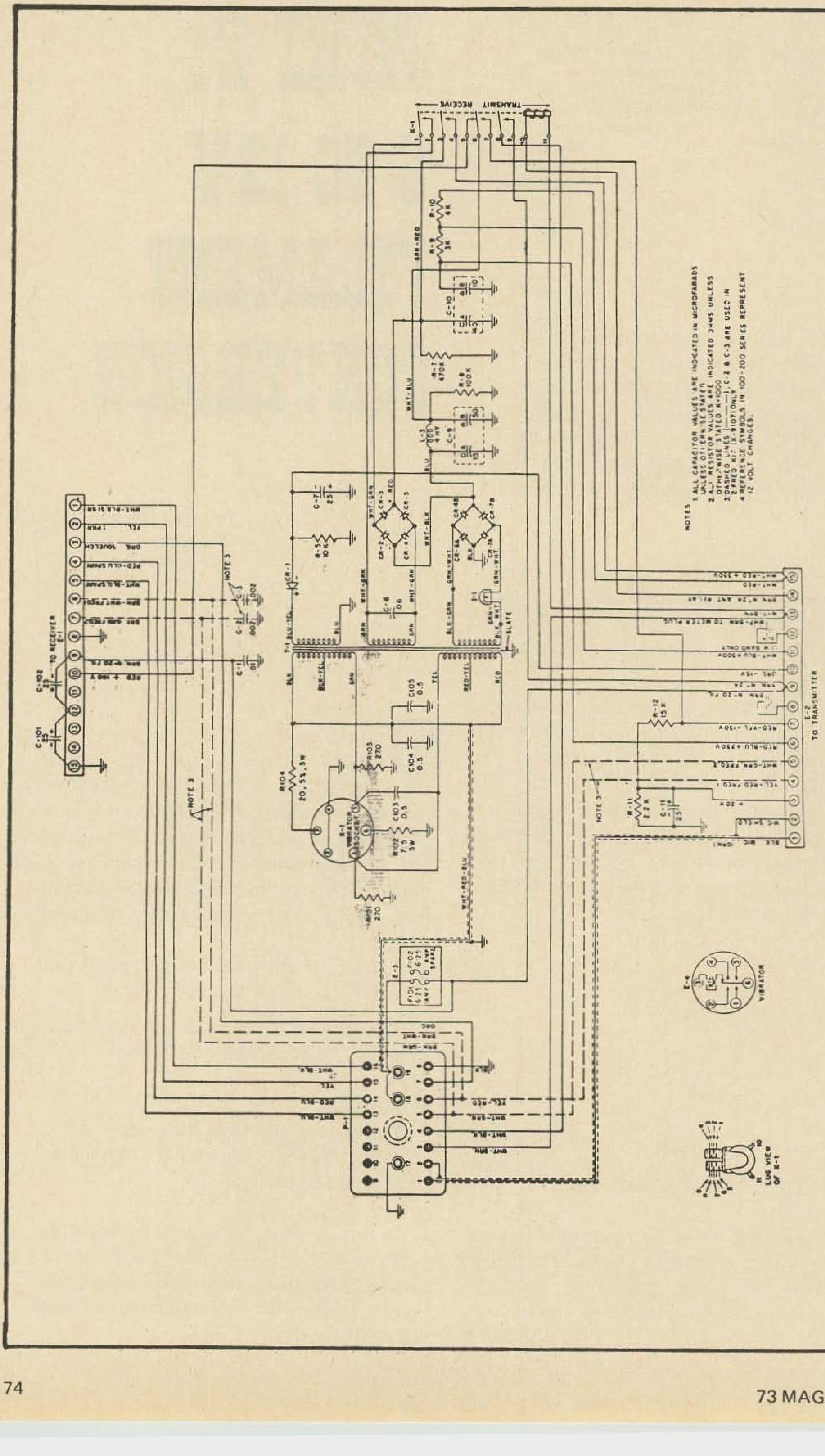
1. Add 2-5 pF from pin 1 to pin 3 on L1, L2, L3, L4, and L5 of receiver.
2. Add 4 or 5 pF from pin 1 to pin 3 on L7, L7A, and L8 of receiver.

Crystal data:

Transmit – Motorola Type R09, 85°C oven. Specify operating frequency; Sentry will correlate.

Receive – Most common is Motorola Type R21 (85°C oven). Specify operating frequency; Sentry will correlate.

Sentry address is: Crystal Park, Chickasha OK 73018.



41V POWER SUPPLY AFTER MODIFICATION TO 12 VOLTS

6 to 12V Conversion Transmitter

a. Doubler driver (V106)
   (1) Disconnect and remove the jumper between pins 7 and 8.
   (2) Disconnect the brown-white lead from pin 2 and connect it to pin 7. This connects tubes V106 and V107 in series.

b. Tube V105: 3rd doubler (25–50 MHz) 2nd doubler (152–174 MHz)
   (1) Disconnect and remove the ground lead from pin 3.
   (2) Disconnect and remove the jumper between pins 2 and 3.
   (3) Connect a jumper between pin 2 and the center shield (gnd).
   (4) Disconnect the brown-white to pin 3. This connects tubes V101 and V105 in series.

c. Audio Amplifier (V108)
   (1) Disconnect and remove the ground lead from pin 9.
   (2) Remove the jumper between pin 9 and the center shield.
   (3) Connect a jumper between the center shield and ground.
   (4) At the V108 tube socket, disconnect the brown lead (running from tube V109) from pin 4 or pin 5, depending upon which is used, and connect it to pin 9. This connects tubes V108 and V109 in series.

d. Tubes V102 (modulator), V103 (buffer and 1st doubler), and V104 (2nd doubler – 25 to 50 MHz tripler – 152 to 174 MHz

   Replace the three 6AU6 tubes (V102, V103, and V104) with 12AU6 types.

e. Antenna Relay
   (1) Remove the three screws that hold the antenna relay cover to the chassis. Unsolder the relay cover from the shield around the rf section.
   (2) Remove the solid bus which connects the relay coil to ground.
   (3) Connect the brown-white lead between the relay coil lug, from which the ground bus was just removed, and pin 2 of tube 106.
   (4) Replace the antenna relay assembly on the chassis by means of the three screws. Resolder the relay cover to the rf shield. This connects the relay in series with the transmit-receive relay on the power supply chassis.

f. Crystal Socket (Single-Frequency Models)
   (1) Mount two 15Ω resistors near the crystal socket by using existing holes in the chassis. Place one lockwasher, one eyelet, and one fiber washer at each end of the resistor. Connect the resistors in parallel.
   (2) Disconnect and remove the ground connection from the crystal socket.
   (3) Connect one end of the paralleled 15Ω resistors to the crystal socket terminal from which the ground connection was just removed.
   (4) Connect the other end of the paralleled resistors to ground.

g. No. 2 Oscillator V201 (two-frequency models only)
   (1) Disconnect and remove the jumper between pins 2 and 3 of the V201 tube socket.
   (2) Connect a 39Ω resistor between pin 3 of tube V201 and the grounded lug on the crystal socket (X202). This connects the filament of tube V201 in series with the 39Ω resistor across the 12V source.

h. Crystal Assemblies (two-frequency models only)
   (1) Make a note of the frequency of each crystal and remove the two crystal assemblies from their sockets. The crystals must be removed from each 6V assembly and inserted in the new heater and base assembly as outlined in the following steps. Use care so that 6 and 12V assemblies are not mixed.
   (2) Remove the housing cover by releasing the ring clamp.
   (3) Remove crystal from the 6V base

(continued on page 93)

A CW MONITOR

How to get a 98¢ oscillator module to key on and off with your rf

J. A. Houser WB2GQY
23 Washington Street
Rensselear NY 12144

It seems that selfishness, next to greed, is the greatest incentive to invention – to want some device to accomplish some desire; and when such is not available, the selfish man will create it, if possible.

I found myself in this position with regard to a desire to be able to monitor my CW transmissions on any band – *without* touching the monitor other than to turn it on when required and shut it off when not, without any connections whatsoever to the transmitter, as I detest modifications of equipment.

After scanning handbooks and catalogs, I could find nothing like what I wanted, so I decided I would just have to build one. I felt this could not possibly be a complicated device. Live and learn!

The untunable, nonresonant quality I wanted appeared perhaps to be the most insurmountable obstacle. Transistors seemed to be the most feasible devices to use in view of the fact that self-power was also an objective.

Did you ever try to pick out a particular transistor for a particular application – with the thousands, nay, maybe tens of thousands of transistors to choose from? If you did, perhaps you might do as I did – use what you have! Somehow, you always seem to find something that will work.

But to get on with the project: Of necessity, you have to have an audio oscillator and a speaker. I saw a cheap audio oscillator module in the Lafayette catalog for 98 cents and I figured I couldn't make one for less, so I bought that along with a small steel-encased speaker with a universal bracket (see parts list). This module is designed to work with anything from 1.5 to 6V, but 3V is recommended. One of those battery holders which hold two size D flashlight cells side-by-side seemed ideal for the power. Everything was swell so far; it worked well, with two pieces of hookup wire for the key, as I didn't intend to key it anyhow. An instruction sheet came with the module showing hookup. The note is about 1 kHz with 3V applied.

Now the sticky part of the design started to erupt. You have to have something to switch the module on and off with the CW signal. Seemed like a power-type transistor should work, but how much power? What current does the module draw from 3V? Nothing like measuring it – here is the result:

V	mA	R (load)	W
1.5	19	75	0.030
3.0	32	93	0.096
4.5	38	119	0.18
6.0	45	133	0.27

So you will need a transistor that will handle 96 mW, and this eliminates any of the small audio output transistors such as used in the little BC radio receivers, because most of them put out only about 20 mW. An audio power output transistor such as used in the auto radios will handle 100 to 200 mW, so it is ideal. Since I just happened to have one of these on hand, I hooked it up as in Fig. 1 to find out what control voltage I would need to fire it.

Now I had to decide whether to do a lot of research to determine whether all the parameters were correct or whether just to hook it up and see if it worked. I decided on the latter. I hooked it up per Fig. 1 and started with 1.5V between X and Y, then 3.0, then 4.5 and 6V. Finally, with 9V, it fired, and the audio oscillator switched on. Now I was almost certain I could not get 9V dc out of rf rectified from a small whip antenna to fire this directly, so I figured I would have to put another control switch (transistor) ahead of this one to control the 9V needed to switch it on. Perhaps I could pick one out that would take about 1.0 to 1.5V dc from rectified rf to switch it on and off – sort of a double switch, if you will.

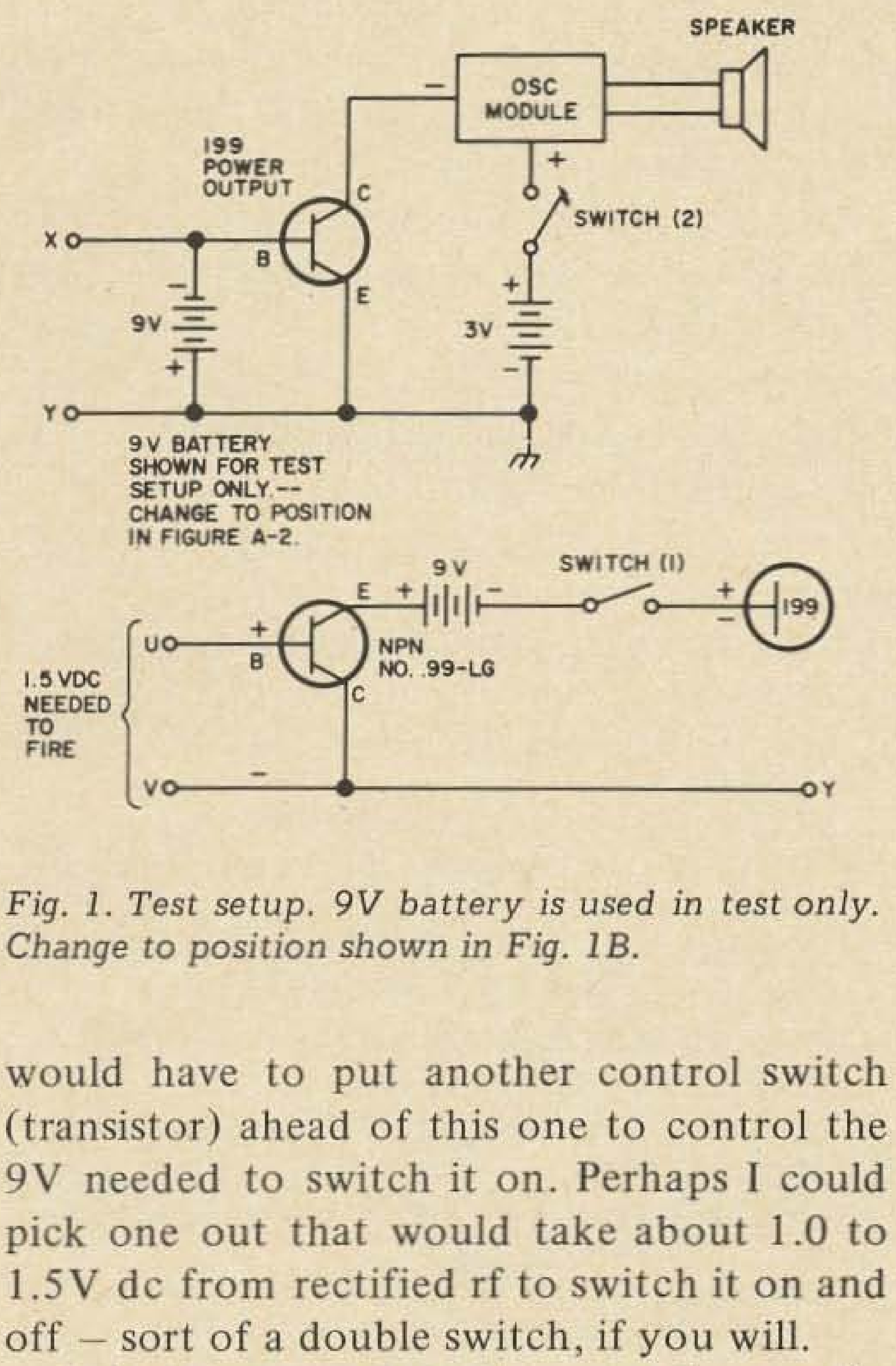


Fig. 1. Test setup. 9V battery is used in test only. Change to position shown in Fig. 1B.

I just happened to have another audio driver and output transistor such as used in miniature BC receivers on hand, so I tried this. It was an NPN type. I hooked it up ahead of the power transistor to see what voltage dc I would need to fire it, which would then fire the power transistor, which would then turn on (and off) the audio oscillator module. I found I needed 1.5V at the base to fire this one. It fired the power transistor, which turned on the audio oscillator, and I got a fine 1 kHz note. Everything so far was fine.

Now all I needed was 1.5V dc from rectified rf, and everything would be cooking. I tried a single IN34 diode hooked to a piece of hookup wire for an antenna, and the best dc I could get from this arrangement was about 0.3V.

Well, why not an rf voltage doubler? After all, these work at 60 Hz and are used in many receivers and some low-power transmitters. So I hooked up a voltage doubler as in Fig. 2.

Sure enough, up went the rectified dc voltage. In the 40 meter band it even went as high as 12.0V dc; and in the 80 meter band it was about 1.8 to 2.5V dc, which should be more than enough. However, in the 20, 15, and 10 meter bands, I could get only about 0.3 to 0.9V, which would not fire the first control transistor.

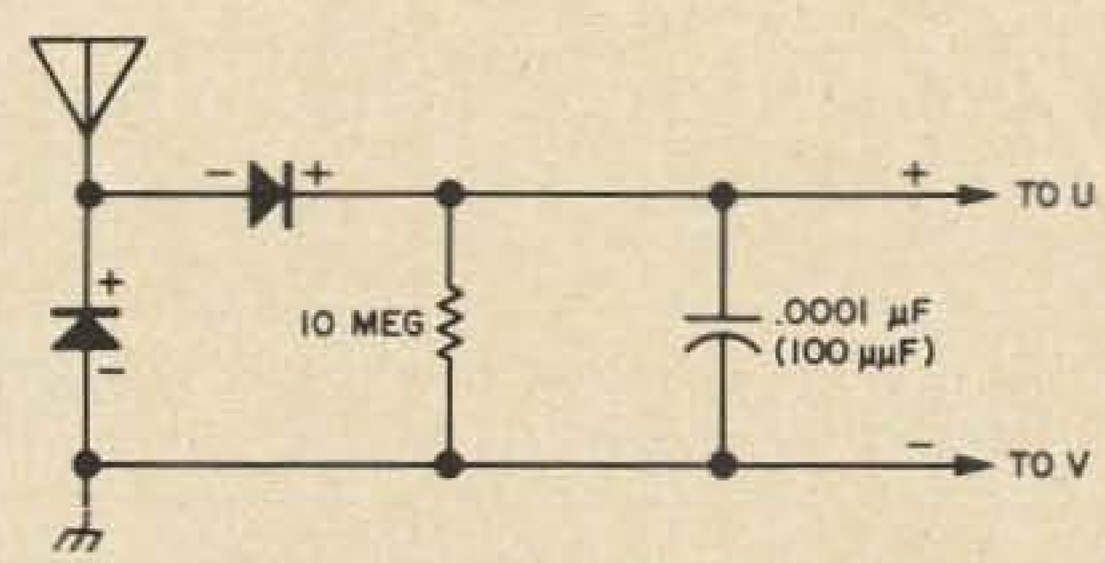


Fig. 2. Voltage doubler rf pickup. 1N34s.

I thought maybe I could improve the antenna pickup to acquire the additional voltage required. I tried all kinds of loops, from 1 turn to 100 turns, figuring the electromagnetic pickup might be predominant over the electrostatic pickup from a unipole antenna, only to find out that no loop at all would work. The pickup just has to be from a unipole! Then I tried a counterpoise along with the antenna, figuring I might end up with a pair of rabbit ears. Nothing except a single unipole would work. I had been working with GE IN34 AS type germanium diodes, so decided to try some surplus ones removed from old IBM computers. All seemed to work about the same,

PROPAGATION CHART

J. H. Nelson

Good O Fair (open) Poor □

March 1970

SUN	MON	TUES	WED	THUR	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	$\boxed{17}$	18	19	20	21
22	23	$\boxed{24}$	25	26	27	$\boxed{28}$
29	30	31				

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	7	7	7	7	7	7B	14	21	21	21
ARGENTINA	21	14	14	14	7	7	14A	21	21	21	21	21
AUSTRALIA	21	14	7A	7B	7B	7B	7B	14B	14	14	21	21
CANAL ZONE	21	14	7A	7	7	7	14	21	21A	21A	21	21
ENGLAND	7	7	7	7	7	7B	14	21	21	21	14	14
HAWAII	21	14	14	7B	7	7	7	7B	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	14	21	14	7B	7B	7
JAPAN	14	14	7B	7B	7	7	7	7	7B	7B	7B	14
MEXICO	21	14	14	7	7	7	7	14A	21	21	21	21
PHILIPPINES	14	14	7B	7B	7B	7B	7B	14B	14B	7B	7B	7B
PUERTO RICO	14	7A	7	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	7A	7A	7	7B	14	21	21A	21	21	21	21
U. S. S. R.	7	7	7	7	7	7B	14	21	21	14	7B	7B
WEST COAST	21	14	14	7	7	7	7	14	21	21	21A	21

CENTRAL UNITED STATES TO:

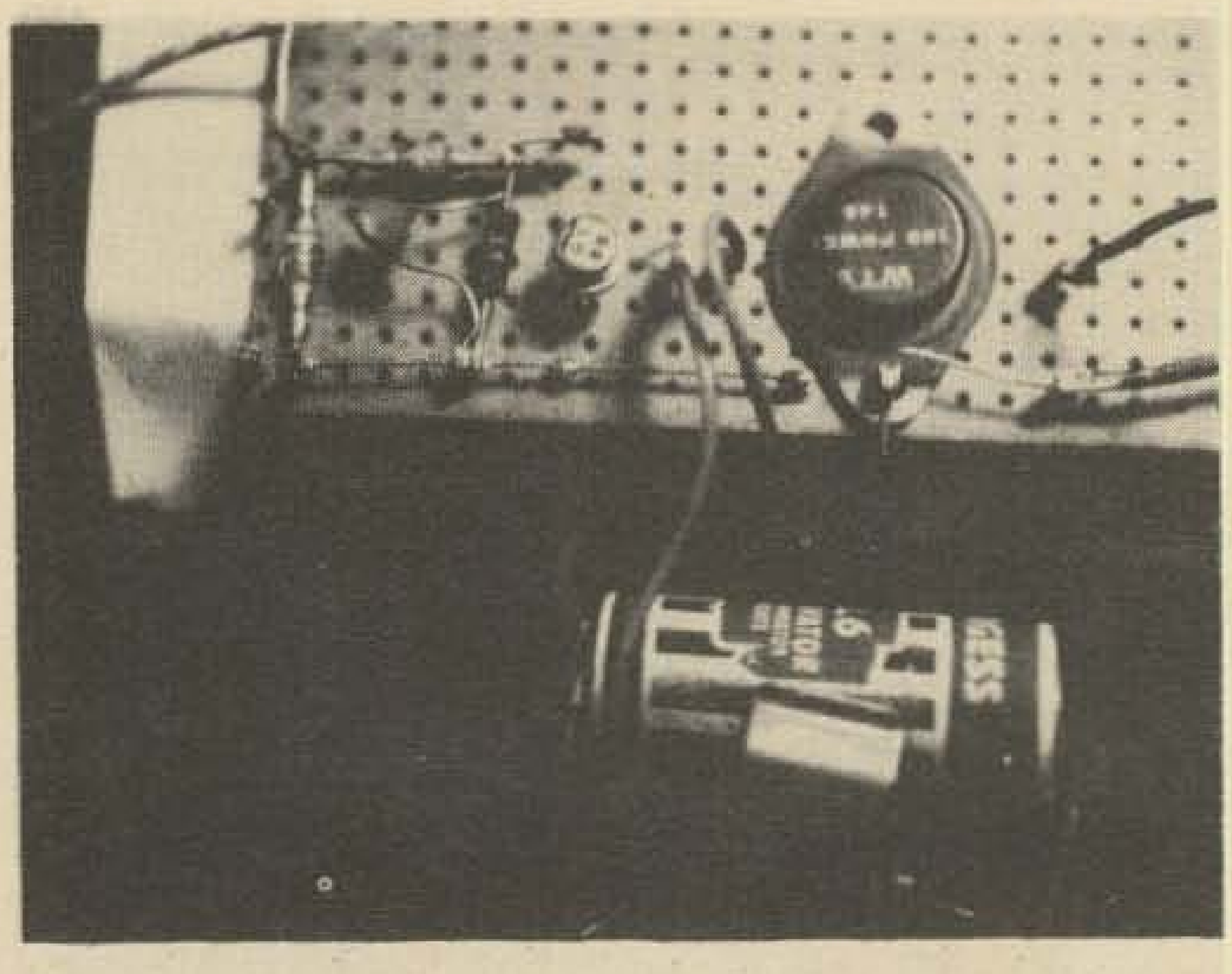
ALASKA	21	21	14	7	7	7	7	7	14	21	21	21
ARGENTINA	21	14	14	14	7A	7	14	21	21	21	21	21
AUSTRALIA	21A	21	14	7A	7B	7B	7B	7A	14	14	21	21
CANAL ZONE	21	14	14	7	7	7	14	21	21A	21A	21	21
ENGLAND	7B	7	7	7	7	7	7B	14	21	21	14	14
HAWAII	21A	21	14	7A	7	7	7	7	14	21	21A	21A
INDIA	7B	14	14	7B	7B	7B	7B	14	14	7B	7B	7B
JAPAN	21	21	14	7B	7	7	7	7	7	7B	7B	14A
MEXICO	21	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	14	7B	7B	7B	7B	7	14B	7B	7B	14
PUERTO RICO	21	14	7A	7	7	7	14	21	21	21A	21	21
SOUTH AFRICA	14	14	7A	7	7B	7B	14	21	21A	21	21	21
U. S. S. R.	7	7	7	7	7	7B	7B	14	14	14	7B	7B

WESTERN UNITED STATES TO:

ALASKA	21	21	14	7	3A	7	7	3A	7	14	21	21
ARGENTINA	21	21	14	14	7A	7	7B	14	21	21	21	21
AUSTRALIA	21A	21A	21	14	7	7	7	7	14	14	21	21
CANAL ZONE	21	21	14	7A	7	7	7	14	21A	21A	21A	21
ENGLAND	7B	7B	7	7	7	7	7B	7B	14	21	14	7A
HAWAII	21A	21A	21	14	7	7	7	7	14	21	21A	21A
INDIA	7B	14A	14	7B	7B	7B	7B	7	7	7	7B	7B
JAPAN	21A	21	14	7B	7	7	7	7	7	7	7B	14A
MEXICO	21	14A	14	7	7	7	7	14	21	21	21	21
PHILIPPINES	21A	21	14	7B	7B	7B	7B	7	7	7B	7B	14
PUERTO RICO	21	14	14	7	7	7	7	14	21	21A	21	21
SOUTH AFRICA	14	14	7	7	7B	7B	7B	14	21	21	21	21
U. S. S. R.	7B	7	7	7	7	7B	7B	7B	14	14	7B	7B
EAST COAST	21	14	14	7	7	7	7	14	21	21	21A	21

A - next higher frequency may be useful
B - difficult circuit this period

and I could not get the rectified dc higher on the higher frequency bands. Next I minia-



Monitor can be set up simply on a piece of perforated board. It's a lot easier than a PC board.

turized the breadboard layout. Nothing changed, and now it was small enough to put into the speaker case on one side, with the code oscillator module on the other side, and the antenna coming out the top.

So I now have a nice little miniature CW monitor on 80 and 40, which are the two bands I work CW on most. Anyone who wants to use this on 20, 15, or 10 may, with a little more research and development, get it to work on the higher bands.

Here is the parts list with approximate prices:

- 2 diode rectifiers, GE 1N34AS or equivalent ($1.50)
- 1 pkg. (100) T-28 terminals, Laf. 19-8302 ($1.55)
- 1 P91 terminal inserter, Laf. 19-8306 ($.50)
- 1 2" x 4" PC Vector, phenolic punched board–for no. 28 terms. ($.25)
- 1 3" speaker and case, Laf. 44-5201 ($6.45)
- 1 9V battery holder–Keystone 173 ($.35)
- 1 Cordover solid state oscillator module, Model CPO-4, Laf. 19-1513 ($.98)
- 1 Workman TV transistor NPN, 99-L6, audio output ($1.00)
- 1 Workman TV transistor, power, WTV-199-140 ($1.50)
- 1 100 pF capacitor ($.15)
- 1 5 meg ¼W resistor ($.12)
- 1 old antenna rod from TV rabbit ears or old auto antenna
- 1 5/16" rubber grommet
- 1 9V transistor battery
- 2 1½V D flashlight batteries; hookup wire, solder, etc. as required
- 1 DPST slide switch ($.35)

. . . WB2GQY ■

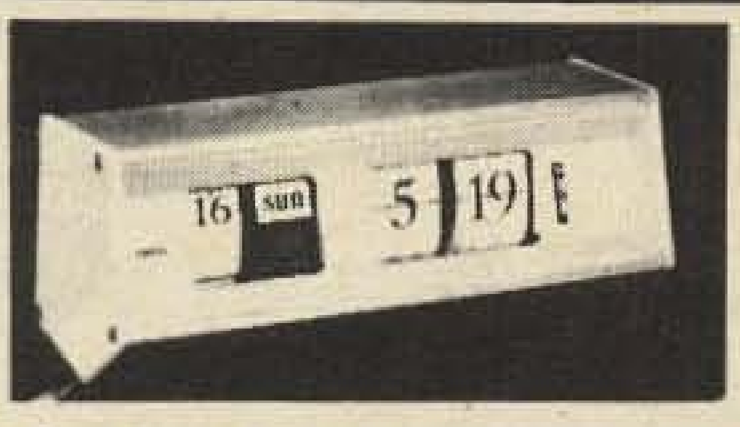
SHOP-BY-MAIL SPECIAL VALUES!

RF Field Strength Meter 1-400 mhz

Comes with 5-section antenna and earphone for modulation checking. Invaluable for tuning any transmitter. Magnetic base for mobile use.

Model FL-30 **ONLY $8.95**

24 HOUR CALENDAR CLOCK



Your operating desk will stand out with this day-date clock. Great for the office too. Set the 24-hour model on GMT and never make a time or date mistake again. 8" x 3½" brushed aluminum case, self-starting, 110 v 60 cy. Please specify 12 or 24 hour clock. SPECIAL Calendar Clock ONLY $40.00 postpaid.

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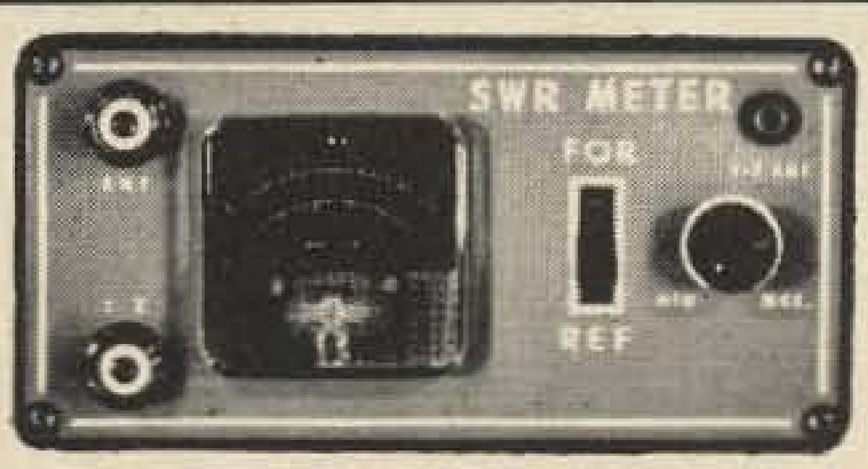
This clock can be read from 15 feet in a dense fog. Available in charcoal gray, coral red, light blue, white or brown. Please specify 12 or 24 hour clock. They are beautiful. ONLY $24.95 postpaid.

DESK NAME PLATE

We sold a boodle of these at the last big hamfest. You can order your name and call on this handsome desk plate in up to 20 letters and spaces. Immediate delivery on all orders, too. The plates are brown walnut stained and a real value at only $2.00 pp.



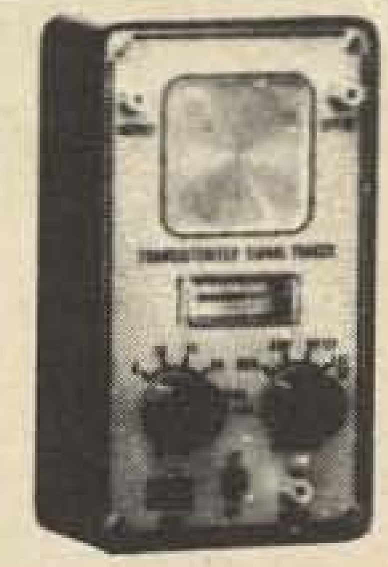
52 Ohm 1 KW SWR Meter
Simple
Inexpensive
Effective
$14.95
Model SE-405

MINIATURE TEST LABORATORY

AC Voltmeter	DC Voltmeter
Ohmmeter	Milliammeter
RF Signal Generator	AF Signal Generator
Resistance Substitution	Capacitance Substitution
9V DC Supply	RF Field Strength
Self Powered	7½" x 3¾" x 3¾", 1¾lbs.

Thanks to transistors and printed circuits you can hold this complete lab in one hand. Not long ago this would have been a whole shelf full of test equipment. 455 khz generator for aligning if's, 400 hz generator for audio circuits. Plus a normal VOM and R&C substitution. Field Strength meter for tuning transmitters. Everything in one small box!

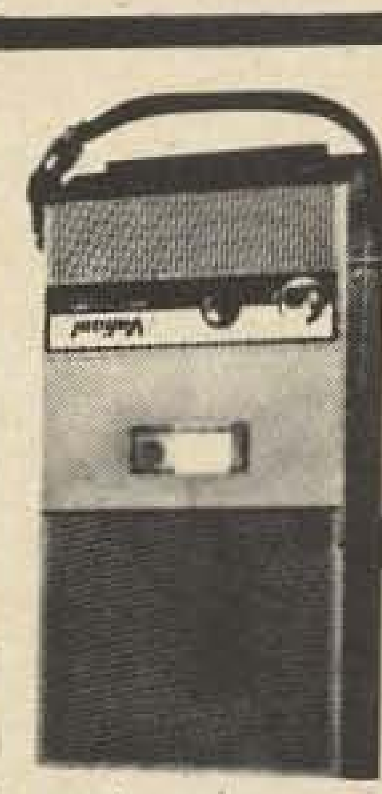
Model SE-400 Mini-Lab **ONLY $25.00**



This is by far the single most valuable piece of test equipment. Built in meter for measuring gain of each stage under test. Easy to find weak or defective stages. Output speaker built in or to VTVM or scope. No line cord since it is self powered. ONLY

Model SE-350 Signal Tracer $22.50

CASSETTE TAPE RECORDER



REDLINE presents the Valiant. This neat little cassette tape recorder has excellent fidelity and an easy push button system that means everyone in the family can use it and have fun. It has a battery level meter, recording level meter, a jack for feeding hi-fi or your receiver (or tv), and operates from a switch on the mike. Record those rare DX contacts as well as your regular friends off the air. The price is ridiculously low. SPECIAL, ONLY $33.00 postpaid.

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○ SE-405
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Send order to:
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Please allow a little extra for postage charges.

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The Logical Approach to Surplus Buying

Jim Kyle

All that's surplus is not military . . . or FM.

Take a look at the surplus ads in this issue—and you may be a bit surprised by what is turning up on the market these days.

For instance, a random sampling of a recent issue shows one ad featuring a "6,400 memory drum," faced by another which offers "brand new RTL integrated circuits." Elsewhere in the same issue we find "universal logic circuit cards," and a potpourri of "dual 4-input *nand* gate," "quad 2-input *nand* gate," and "J/K flip-flop master slave" IC chips. That's all a far cry from the decoherer, spark gap, and Alexanderson alternator—or even from the push-pull 304TL's or war-weary ART-13's which used to be the mainstay of the surplus market.

It's probably an insult to most of you to assume that you don't know that all these strange new items in surplus come not from military communications channels, but from the computer industry— and so it won't be assumed.

But the question just may remain open, as to what earthly (or spacely, either, for that matter) use such gadgets could be in ham radio. And the purpose of this parcel of prose is to attempt to provide a route toward finding some answers to that question.

Now that we have assumed that everybody knows these strange things come from the computer industry, we'll be a bit more specific and point out that it's the *digital* computer industry which provides most of the goodies. Analog computers are still with us, and will be for a long long time because for some purposes, they're better machines—but the big money, and the big market, is for digital computers, and Detroit has nothing on the computer sciences. After all, if you buy a new car you can expect it to run for at least three years, and maybe even until it's paid for—but the average life of a large-scale computer system is more like two and a half years. By that time, the state of the art has advanced so far that your "brand-new" machine is obsolete.

This rapid obsolescence cycle is what's putting so much computer surplus onto the market now. While most hams are still a bit puzzled by the whole idea of integrated circuits (sort of like we were by transistors way back in 1959 and 1960), the computer people have moved through two whole "families" of IC designs and are now well into the third generation. The obsolete stuff has to go somewhere, and that's where the "surplus" comes from.

"Fine," you may be saying, "but I don't want to build a computer. What good is this stuff to me?"

Patience. It may turn out to be a gold mine for you. And it may not. Only you can decide that, but in the pages which follow we're going to try to give you enough information to let you make the decision, and to let you use these things for purposes their original designers never had in mind.

Logic Elements

Right here at the outset it would probably be a good idea to define some of the words and phrases used in the computer industry for these circuits, because the ads cited earlier reveal some lack of understanding—and when the sellers are mixed up, then the buyer who knows what the words mean has a chance to get even better bargains than usual.

Computer designers tend to think in terms of *logic elements*, which can best be thought of as little black boxes which do one and only one job. The most common types of logic elements are flip-flops, gates, and a third type variously called a buffer, a driver, an amplifier, or sometimes an inverter.

Flip-flops are logic elements which have at least one and sometimes as many as four input terminals, and usually two output terminals. The signals at the input terminals determine the "state" of the flip-flop, but once the state has been either "set" or "cleared," the input signals can be removed and the output terminals will continue to indicate the state without change. The major purpose of a flip-flop is to "remember" a transient signal level or condition; several flip-flops, of some special subtypes, are often connected in cascade one after the other to serve as a counting circuit.

Gates are logic elements which have two or more input terminals, and usually a single output terminal. The presence or absence of signals at the input terminals, and especially the combinations of signal levels simultaneously present at all input terminals, determine the signal at the output terminal. Gates have no memory capability; when the input signals change, the output signals change also.

The third class consists of logic elements which normally have only one input terminal and one output terminal. The names buffer, driver, and amplifier mean the same in the computer world as they do in ham radio. This logic element provides isolation between more active stages in a design, and also helps provide driving power (because digital-circuit input terminals represent fairly heavy loads upon their driving circuits). The inverter is a special subclass of this type of circuit, which produces an output signal of opposite value to its input signal.

We'll go into these types of logic elements in more detail a little later, but before we do there are several other terms which are not exactly everyday phrases in amateur radio —which are, still, important in understanding how these circuits work.

Digital circuits are, almost without exception, designed to operate with "binary" signals. A binary signal is one which can take on only one of two possible values. For instance, it may be a +2V level, or a ØV level, with respect to ground. In practice, the actual circuit will be built to interpret any voltage above some specific value as being the higher of the two levels, and any below that value as being the lower. This voltage level, which separates the *high* from the *low* binary signal value is known as the *threshold* of the circuit, and the exact voltage values which are the two values of the binary signal are known as the *logic levels*. Often, one of the logic levels is zero volts, and then only the other logic level is specified.

We mentioned a bit earlier that digital

circuit input terminals represent quite a load to their driving circuits. When we get to the actual schematics, you'll see why. Because of this, digital circuits are rated for *fan-in* and *fan-out*. The units used for rating fan-in and fan-out are usually arbitrary. One type of gate, for instance, might represent a 2-unit load and be rated for a fan-in of 7 and a fan-out of 12.

This would mean that such a gate could accept at any one of its inputs, then, connections to three identical gates, and could drive from its own output terminal six other gates.

If more than 6 gates need to be driven to make the circuit do what the designer intended, he would have to add a buffer as one of the loads on this gate. The buffer might represent a 3-unit load, and that would leave only 9 units of fan-out available so that only 4 other gates and the buffer could be connected.

The fan-in and fan-out ratings are meaningless unless you know the number of units of load represented by each logic element you want to include in a circuit, but they still give you an idea of the relative power output of different elements in the same family. The higher the fan-out rating, the more power is available at the output terminal.

The Logic of Switches

Before we can make much practical use of the digital circuits available in surplus, we need to know how the circuits work. And to do that, we must know a bit about electronic logic circuits. Fortunately, it's not very complicated. What makes a computer circuit so complex is not the individual circuits– each circuit is about as complicated as a diode detector, and far less difficult to understand than an audio amplifier – but the vast numbers of them involved, and the hundreds of feet of interconnecting wiring hooking them all together.

You can't get much less complicated than a simple switch – but that's just what the basic digital logic circuit amounts to. If the switch arm is in one position, current flows one way; if the switch arm is in the other position, the current flows to the other terminal. The "live" pole indicates the position of the switch –but we usually think of it in a different way, and believe that the position of the switch tells us which way the current's flowing.

This is fine if it's *us* who has to do the remembering, but in a computer it's the circuit which must remember something. And it may be overstating things to point out that the "up" or "down" position of the switch handle *does* remember for us what we did there last. This small fact is never fully appreciated until you work with equipment which uses "alternate action" switches which you push once to turn on, again to turn off, and after they're pushed you can't tell by looking whether they are on or off.

Let's take that SPDT switch and connect a couple of them to form a logic gate. **Figure 1** shows the circuit. Electricians among the readers may recognize this as the "three-way switch" circuit for turning a light either on or off from either of two locations, but it's a logic gate circuit as well, because the output signal (the fact that the light is one, or off) depends upon both input signals (the positions of each switch individually). If switch A is up and switch B is down, or vice versa, the lamp is off. If both switches are up, or both down, the lamp is on.

In logic, a *truth table* is often used to describe the actions of any logic element. **Figure 2** is a truth table describing the circuit of **Fig. 1**. The important thing to note here is that every possible one of the switch positions is included in the table, and the output condition for each of these possible input conditions is also included.

The truth table in **Fig. 2** uses words to describe the input and output conditions. Truth tables used to describe the functions of various logic circuits usually use either the initials T and F, for *true* and *false*, or, more often, the numerals 1 and Ø, to describe the two states of the signal level.

Remember that these circuits operate only with binary signals. If we name one logic level 1 and the other logic level Ø,we can then relate the actual voltages at the input and output terminals of any circuit to the 1 and Ø entries in the truth table for that circuit, and the truth table will tell us what output the circuit will produce for any possible combination of input signals.

To illustrate the point, **Fig. 3** is a redrawn

Fig. 1. This simple circuit, known to electricians as a three-way switch, for controlling a light from two separate locations, is also a rather exotic digital logic circuit. No gate used in digital logic is any more complex than this circuit, though it may have more control points.

Switch Positions		Lamp
S1	S2	
down	down	on
down	up	off
up	down	off
up	up	on

Fig. 2. Truth table describes all possible conditions of a three-way switch circuit. Left two columns show switch positions and right column shows lamp condition which results from each combination of switch positions. Systematic tabulation of switch positions insures that all possible combinations are included; positions for S2 alternate from down to up to down to up, changing at each line, while positions for S1 change only when a position of S2 is repeated. If the circuit had three switches, 8 lines would be necessary to describe all

version of **Fig. 1** with the switch positions labeled as 1 and Ø, and also includes the truth table in 1 and Ø terms. In this table, an output of 1 means the light is on, and a Ø output means the light is off.

If we think only of two-input gates, we could design circuits to fulfill any of 16 truth tables. **Figure 4** shows all 16 of these possible truth tables for two-input gate logic circuits. In practice, only a few of these 16 are used to any degree. The most common gate circuits found in surplus are those known as *nand* and *nor* gates. **Figure 5** shows the truth table of both the *nand* and the *nor*. The three-way switch circuit of Figs. 1 through 3 is known in logic as an *exclusive or* circuit; you're not likely to find one of these in surplus, because when a logic designer needs an *exclusive or* gate he usually builds it up from several *nand* or *nor* circuits.

Back in the earlier days of computers

S1	S2	OUT
Ø	Ø	1
Ø	1	Ø
1	Ø	Ø
1	1	1

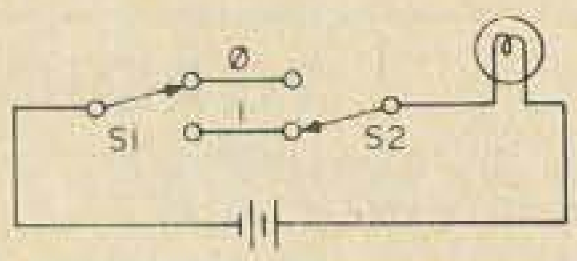

Fig. 3. Redrawn schematic and revised truth table show operation of three-way switches entirely in terms of digital logic and binary signals. Substitution of **1** *and* **Ø** *for* **on** *and* **off** *or* **up** *and* **down** *standardizes the description of circuit action.*

IN1	IN2	OUT	IN1	IN2	OUT	IN1	IN2	OUT	IN1	IN2	OUT
Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	ØØ	Ø	Ø
Ø	1	Ø	Ø	Ø	O	Ø	1	Ø	Ø	1	Ø
1	Ø	Ø	1	Ø	Ø	1	Ø	1	1	Ø	1
1	1	Ø	1	1	1	1	1	Ø	1	1	1
ALL Ø			AND			3			DRIVER 1		
IN1	IN2	OUT	IN1	IN2	OUT	IN1	IN2	OUT	IN1	IN2	OUT
Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Ø	1	1	Ø	1	1	Ø	1	1	Ø	1	1
1	Ø	Ø	1	Ø	Ø	1	Ø	1	1	Ø	1
1	1	Ø	1	1	1	1	1	Ø	1	1	1
5			DRIVER 2			X OR			OR		
IN1	IN2	OUT	IN1	IN2	OUT	IN1	IN2	OUT	IN1	IN2	OUT
Ø	Ø	1	Ø	Ø	1	Ø	Ø	1	Ø	Ø	1
Ø	1	Ø	Ø	1	Ø	Ø	1	Ø	Ø	1	Ø
1	Ø	Ø	1	Ø	Ø	1	Ø	1	1	Ø	1
1	1	Ø	1	1	1	1	1	Ø	1	1	1
NOR			NOT X OR			INVERT 2			12		
IN1	IN2	OUT	IN1	IN2	OUT	IN1	IN2	OUT	IN1	IN2	OUT
Ø	Ø	1	Ø	Ø	1	Ø	Ø	1	Ø	Ø	1
Ø	1	1	Ø	1	1	Ø	1	1	Ø	1	1
1	Ø	Ø	1	Ø	Ø	1	Ø	1	1	Ø	1
1	1	Ø	1	1	1	1	1	Ø	1	1	1
INVERT 1			14			NAND			ALL Ø		

Fig. 4. All 16 possible truth tables for 2–input gates are shown here. Tables 3, 5, 12, and **14** *have no names, while* **ALL Ø** *and* **ALL 1** *have no practical uses. The rest are all used in logic circuitry, but only some of them are available as actual gates; those which are not available as gates must be synthesized by combining actual gates to produce the desired truth table.*

(that is, in the dim dark ages of some three to five years ago), the most common logic circuits were the *and* and the *or* arrangements. **Figure 6** shows an arrangement of switches which produces the *and* function, together with its truth table, while **Fig. 7** shows switches to create an *or* gate.

The names are almost obvious from the circuits. In the *and*, both (or all, if there are more than two) inputs must be at the **1** logic level in order to produce a **1** output. If any input is at **Ø** level, the output is **Ø**. In the *or*, either input **1** or input 2, or input 3, or . . . being at the **1** level is enough to produce a **1** output, and a **Ø** output results only if all the inputs are at **Ø**.

Figure 8 shows both the *and* and the *or* circuits redrawn to substitute transistors for the switches. Notice that the transistor is virtually an exact substitute for the switch—but a transistor can switch from on to off in a microsecond or less, while actual switches take considerably longer.

Let's move back to actual switches one more time, though, to examine the *nor* circuit. This name is a contraction of *not or*, because, as you can see by comparing truth tables, the only difference between an *or*

IN1	IN2	OUT	IN1	IN2	OUT
Ø	Ø	1	Ø	Ø	1
Ø	1	1	Ø	1	Ø
1	Ø	1	1	Ø	Ø
1	1	Ø	1	1	Ø
NAND			NOR		

Fig. 5. Truth tables for nand *(left) and* nor *gates show striking similarities. These two types of gates are the kinds most often found in surplus digital ICs. If all* **Ø** *entries in truth table for the nand are replaced by* **1** *and all 1's by* **Ø**, *the result will be the truth table for the nor. Because of this similarity, sometimes an identical pair of circuits carries different names—and sometimes the same circuit is used to perform both* nand *and* nor *functions, by reversing polarity of all signals at both the input and output for one use, and leaving polarity unchanged for the other.*

S1	S2	OUT
Ø	Ø	Ø
Ø	1	Ø
1	Ø	Ø
1	1	1

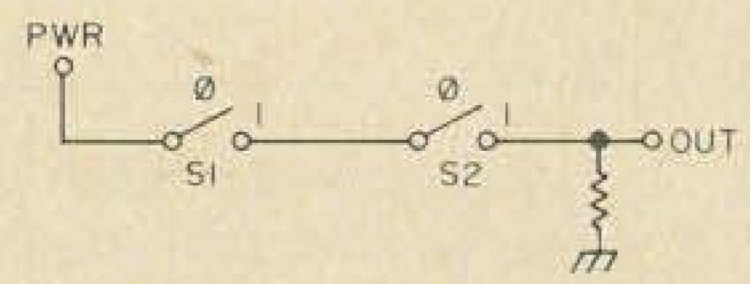

Fig. 6. Schematic and truth table for toggle-switch version of **and** *gate. Both switches must be in* **1** *position for power to appear at output terminal and produce output of* **1**; *either switch being at* **Ø** *holds output at* **Ø** *also.*

S1	S2	OUT
Ø	Ø	Ø
Ø	1	1
1	Ø	1
1	1	1

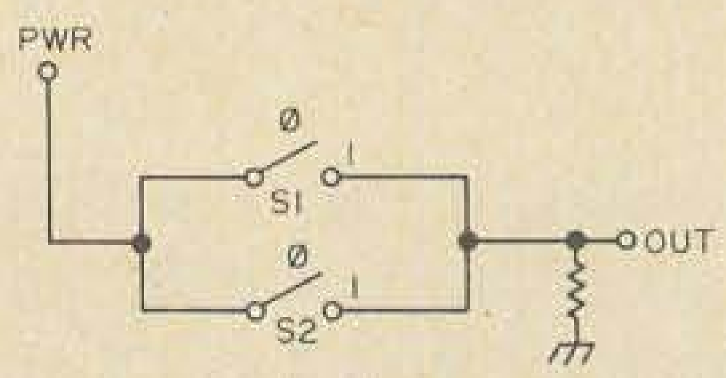

Fig. 7. Schematic and truth table for switch version of **or** *gate. Since switches are in parallel, either switch being in* **1** *position produces a* **1** *output, and a* **Ø** *output occurs only when both switches are open.*

and a *nor* is that the output of a *nor* is 1 under the input conditions which would make an *or's* output Ø, and vice versa.

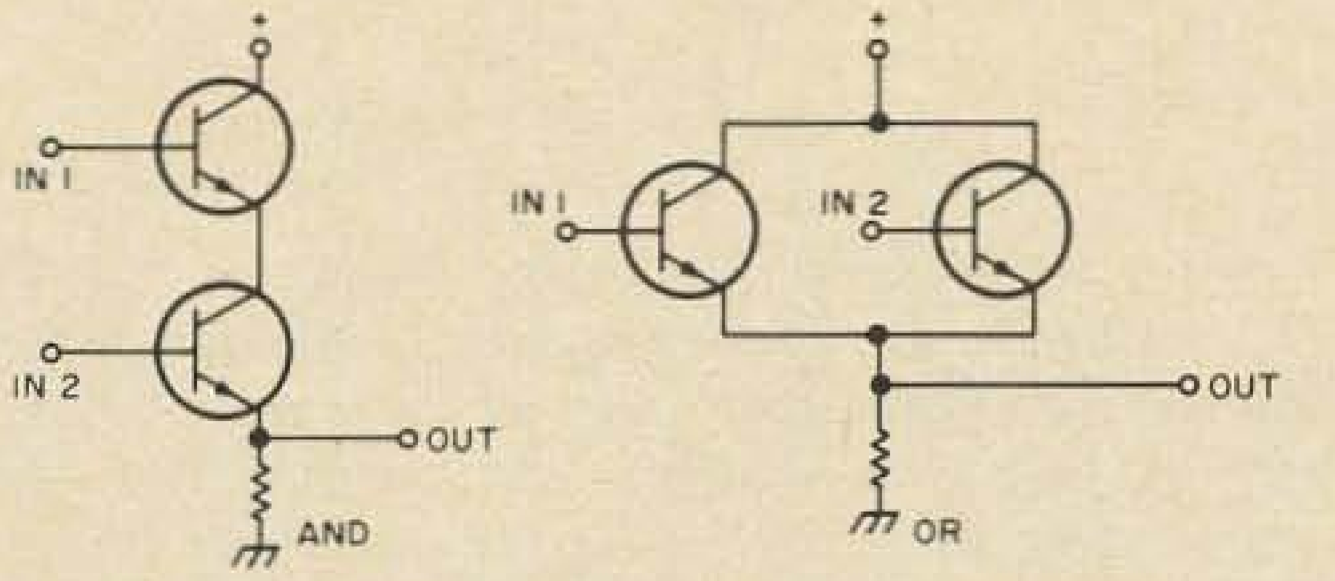

Fig. 8. Substituting transistors for the switches in Figs. 6 and 7 produces these circuits, which are workable transistor-logic versions of the **and** *and* **or** *gates. These exact circuits are seldom used in practice because the input logic levels must swing over a greater range than the output levels. Before IC usage became common, most logic circuits used diode gating; with the advent of ICs, the* **nor** *and* **nand** *circuits became the preferred versions.*

The circuit of **Fig. 9**, which is simple enough, produces a *nor* gate. If either switch is closed (the **1** position), the output signal is shorted to ground to become Ø level. If both switches are open (the Ø positions), the output rises to the level of the supply voltage and becomes a logic level of **1**.

Just by switching the names of the logic levels and switch positions, so that closed switches mean logic level Ø and ground voltage is an output level **1**, we can change this same circuit to a *nand*. If you disbelieve this apparent contradiction, check it out against the truth table. Sketch the circuit four times, setting the switches to each of their four possible combinations, and check the output voltage by name. It will follow the *nand* truth table when closed switches indicate Ø and ground output indicates **1**,

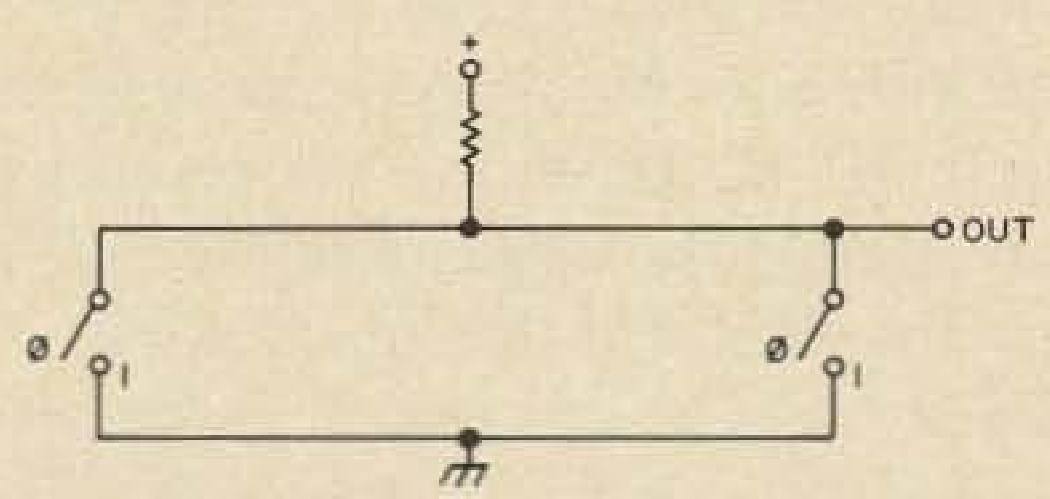

Fig. 9. Two switches and a resistor suffice to form a **nor** *circuit, which as you can see by comparison with Fig. 7 is simply an "upside down* **or**.*" Turning the circuit upside down inverts the output, making it "***not or***," which was contracted by busy engineers to* **nor**. *With switches this circuit offers no advantages over the plain* **or**, *but when transistors are substituted, a major advantage appears (Fig. 10).*

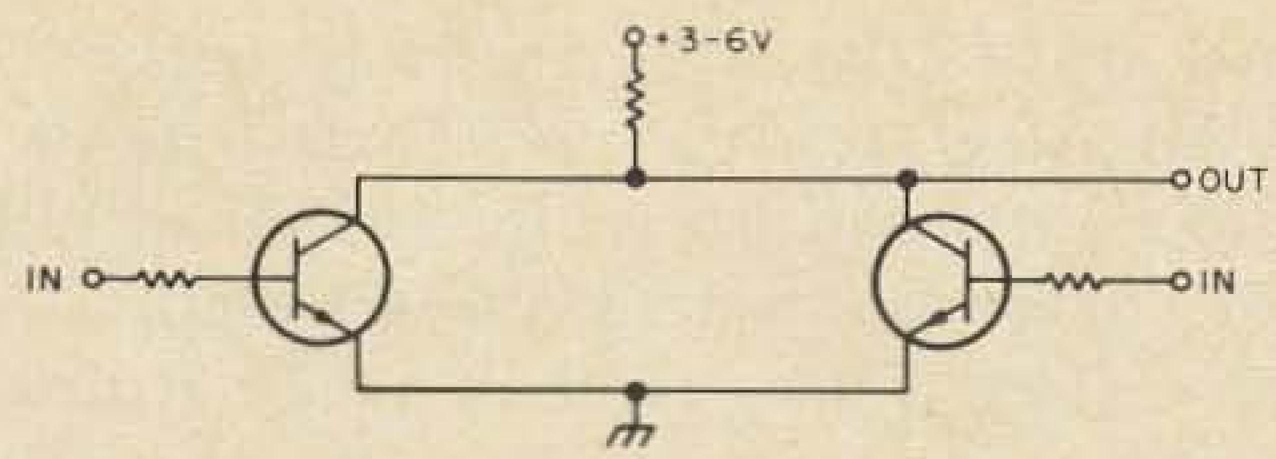

Fig. 10. Schematic of transistorized nor *gate obtained by replacing switches of Fig. 9 with type 2N706 transistors, and adding series resistors to limit base current. This is the circuit used for each gate element in Fairchild Micrologic type 914 ICs, and any RTL* nor *gate will have similar schematic. Each input requires its own transistor, with all collectors connected together. When any transistor is on, output is at ground level; output is at supply level only when all transistors are off.*

and will follow the *nor* truth table if the closed switches indicate **1** and ground output is Ø.

In actual digital logic circuits, the usual difference is that one circuit uses NPN transistors and positive supply voltages, while the other uses PNPs and negative supplies. Sometimes, designers actually do use the trick of changing logic levels in mid-circuit, so that physically identical circuits may be *nands* here and *nors* there, with no way to tell the difference.

But we're a bit ahead of ourselves, because we haven't converted the switch-operated circuit of **Fig. 9** into its transistor equivalent yet. **Figure 10** does so –and takes us one step further.

In **Fig. 10**, a positive or **1** voltage applied to either base resistor will turn that transistor on, which is the same as closing the switch. The output will drop to Ø. You can build the circuit of **Fig. 10** using 2N706 transistors, or you can buy it in surplus as a Fairchild Micrologic type 914 integrated circuit. If you buy a 914, you'll actually get a pair of these circuits, completely independent of each other except for the power and ground connections. The 915 is the same except that it has three transistors per logic element instead of two, which makes it a dual 3-input gate (the 914 is a dual 2-input).

Some similar circuits known as quad 2-input gates simply have four independent 2-input circuits similar to **Fig. 10** inside.

You may run into circuits called "quad 3-input gate extenders" or words similar to this. The key word in this is *extender*. Beware of them for most purposes, because they do not include the load resistor or power supply connection. Their purpose is to be connected across the output of some other gate to provide additional inputs. The gate extender does come in handy at times, though, should you want to use some value of collector resistor other than the 640Ω which is typical of a 914 or 903.

Flip-flops

In the sometimes illogical world of logic circuits, a flip-flop isn't always. You may meet R-S flip-flops, J-K flip-flops, type D flip-flops, and delay flip-flops. You might even meet a British import here and there which isn't a flip-flop at all but bears the name of one.

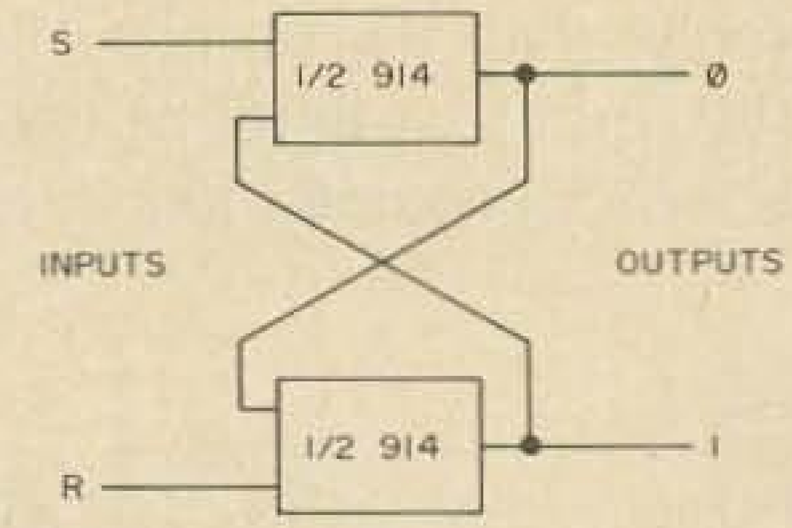

Fig. 11. By cross-coupling two halves of a type 914 IC, a type R–S flip-flop can be constructed. Two inputs for each gate are at left side of box representing gate element, and output is at right. Application of **1** *level to either the* **S** *or* **R** *input makes corresponding gate output a* **Ø***, and if other input is also* **Ø***, then the opposite gate's output must be* **1***. This* **1** *feeds back to original gate to maintain a* **1** *input, and holds output conditions constant until flip-flop is switched to opposite state by applying a* **1** *to the other input terminal.*

The circuit most people think of when they hear the name flip-flop (if they think of a circuit at all) is the counting flip-flop which flips to one of its two states when a pulse arrives, and flops back to the opposite state when another pulse comes in. This one is more accurately called a trigger, or type T flip-flop —but you won't find it in surplus.

In computers, another kind of flip-flop, known as the R–S flip-flop, is often found. This one has two input terminals, and two output terminals. A **1** applied to the **S** input causes a **1** to appear at the output terminal labeled **1**, and a **Ø** level to appear at the **Ø** output terminal. Both output signals remain even if the input **1** is removed.

Applying a **1** input to the R input terminal reverses the state of the flip-flop. The level at the **1** output becomes **Ø**, and the level at the **Ø** output becomes **1**.

The **R** and the **S** at the inputs stand for *reset* and *set*. Some designers use **S** and **C** instead of S and **R**, to mean *set* and *clear* and thus avoid confusion between the act of resetting or clearing, and the act of re-setting or setting again.

An R–S flip-flop cannot count as does the type T; it merely remembers what the most recent signals applied to its inputs were. You won't find many R–S flip-flops in surplus either, but if you want one you can build it easily by connecting the two halves of a type 914 dual *nor* gate as shown in **Fig. 11**. A **1** applied to terminal **S** causes the output of that half of the 914 to drop to **Ø**, and this makes both the inputs to the other half **Ø**. With both inputs at **Ø**, this other half produces a **1** output at the **1** terminal. The **1** output is cross-coupled back to the other input of the first half, to hold conditions in case the **1** at terminal S is removed. The *reset* or *clear* condition works the same way, but the roles of the two halves are reversed.

The reason that you won't find either type T or R–S flip-flops in surplus is because a single integrated circuit was developed which can serve either purpose, as well as several additional ones. It is known as the J–K flip-flop. The name comes from IBM names for some of the signal wiring in its computers.

Like the R–S flip-flop, the J–K has two input terminals and two output terminals. However, in addition to these two pairs of terminals, the J–K always has a fifth terminal known as the *trigger* terminal, and often has either one or two additional terminals known as *unconditional set* and *unconditional clear*. The block diagram symbol for a complete J–K flip-flop, as set forth by military standards, appears as **Fig. 12**, and in this article we'll use the labels shown in **Fig. 12**. These labels are not actually as standardized as all that, though, and you may find authors using other words to refer to the same terminals.

In particular, any IBM literature you may happen to come across will refer to the S terminal as the **J** terminal, the **T** terminal as the **Q** terminal, and the **C** input as the **K** terminal. IBM uses the symbol **Q** for clock-

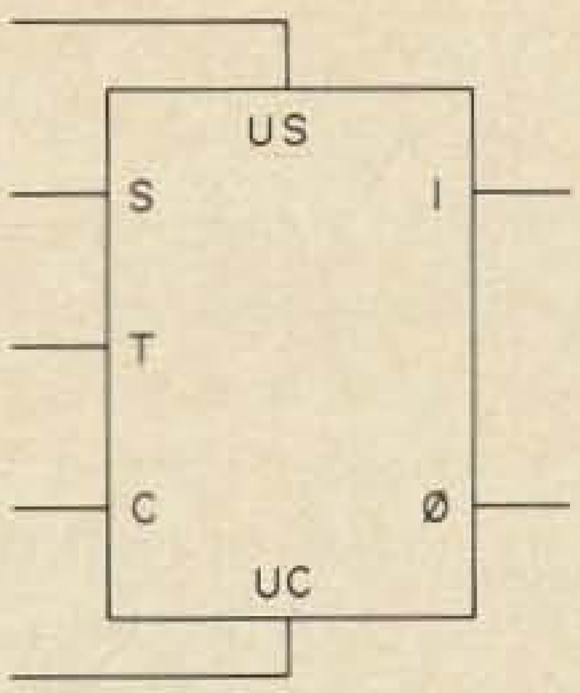

Fig. 12. Military standard symbol for J–K flip-flop, as set forth in MIL-STD-806B. Meanings of letters are explained in text.

pulse signals, while **J** and **K** are names for logic level lines to the giant of the industry.

But the military has standardized on other names: **S** for *set*, **T** for *trigger*, **C** is for *clear*, **US** for *unconditional set*, **UC** for *unconditional clear*, and **1** and **Ø** are the outputs.

The J–K flip-flop is a bit difficult to describe by a truth table, since what happens at its outputs depends on the levels present at the **S** and **C** inputs *at the instant* of a pulse transition at the T input. We'll describe action of the Fairchild Micrologic 923 series, which is typical of J–K flip-flop action.

The 923 has six terminals; **S**, **C**, **1**, **Ø**, **T**, and **US**. The **UC** terminal is omitted. If a positive logic level is applied to the **US** terminal, the **1** output terminal will go to ground level and the **Ø** output terminal will rise to nearly the dc supply voltage (which should not exceed 5V). This action occurs regardless of the conditions at the **S**, **C**, and **T** terminals, and is why the **U** in **US** stands for *un*conditional. This terminal is used for setting the flip-flop to a known condition when equipment is turned on, or whenever you want to clear it.

For the **S**, **C**, and **T** terminals to have any effect, the **US** terminal must be at ground level, ØV.

Under this condition, the levels at the output terminals will depend upon the levels present at the **S** and **C** terminals at the instant the voltage at **T** drops from positive to ground, and also (in some cases) upon the previous condition of the flip-flop.

If both the **S** and the **C** terminals are at high voltage, the negative-going transition at **T** will have no effect; the state of the flip-flop will remain unchanged.

If **S** is at high voltage while **C** is at ground when the voltage at **T** drops from high to low, then the **Ø** output terminal will go to ground and the **1** output will climb to the positive level. That is, the **1** output will mirror the level at the **S** input, and the **Ø** output will follow the **C** input.

If **S** is at ground and **C** is high at the transition, the reverse occurs; **Ø** goes high while **1** goes to ground.

If *both* **S** and **C** are at ground when the transition occurs, the flip-flop will reverse its state. If **1** was high before the transition, it will be low afterward and **Ø** will be high. If **1** was low before, it will be high afterward while **Ø** will be low. This is the counting action of the type T flip-flop; all that's necessary, then, to turn a J–K into a counting or type T unit, is to strap both the **S** and the **C** inputs to ground.

We aren't showing you a schematic of this unit, because it's almost unbelievable. The type 923 comes in a TO-5 can or epoxy blob, the same size as most entertainment transistors; the circuit contains 15 transistors and a rather large number of resistors as well. In addition, the way in which the transistors are used to obtain desired circuit action leads directly to mass confusion upon quick study of the schematic. Some of the connections appear impossible; the designers made use of, among other things, differences in switching speed between two almost identical transistors side by side on the microscopic chip, to obtain the action of a capacitor!

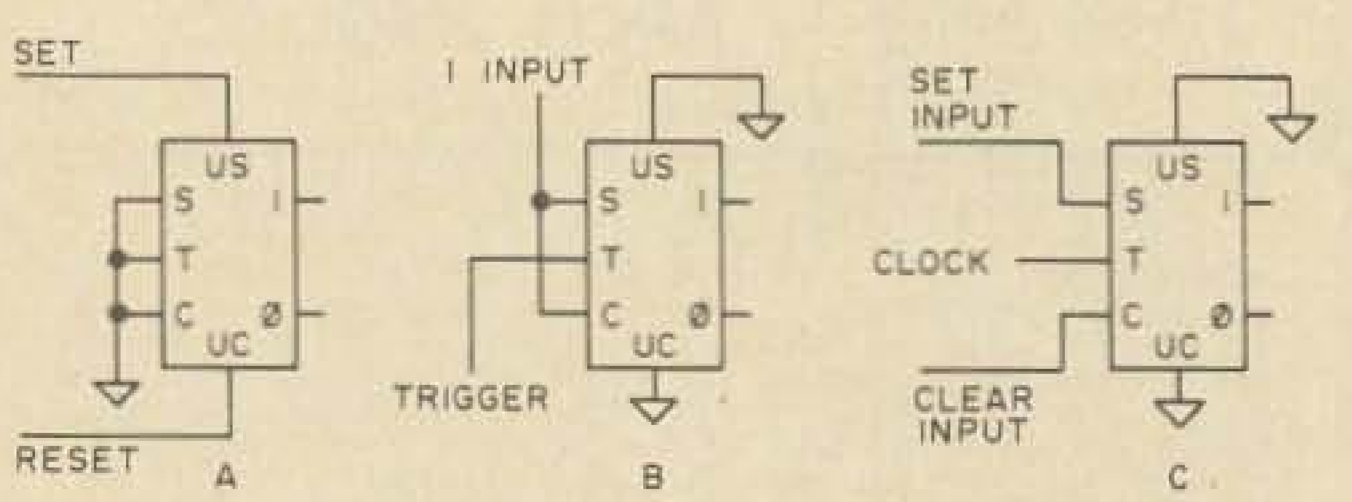

Fig. 13. Hookups for using J–K flip-flop as (A) type R–S flip-flop, (B) type T (trigger, or counting) flip-flop, and (C) delay flip-flop. Hookup A acts just like circuit shown in Fig. 11; outputs retain conditions set in by signals on set *or* reset *lines. Circuit B reverses output conditions with each pulse applied to trigger input. Circuit C is slightly more complex. Conditions at* set *and* clear *inputs when* clock *pulse occurs are reproduced at outputs, until next clock pulse occurs.*

Figure 13 shows the connections for using a J–K flip-flop as (a) an R–S flip-flop, (b) a trigger or counting unit, and (c) a delay flip-flop. The delay unit repeats at its output the conditions which existed at its inputs one trigger pulse time ago; it sometimes has a use in construction of electronic keys, and is the basis of such computer subassemblies as ring counters and shift registers. the situation is similar to that at the cutoff

What Have You Got?

Assuming that by now you've become sold on the whole idea and sent off for a package of ICs, you probably are in somewhat of a quandary attempting to find out just what you have on hand. Many of the surplus IC units have no identification markings which make any sense.

This comes about because most of the units available (other than those purchased directly from factory distributors) come from industrial surplus, and any identification marks on them are probably the part numbers assigned by the manufacturer who intended to use them, rather than being the type numbers put on by the semiconductor plant which made them in the first place.

Most ICs come in one of two distinct package styles. One is the multilead TO-5 can or epoxy configuration; the Fairchild 914 and 923 are good examples of these. The other is the DIP (for *dual in-line package*) which may have a varying number of connections. This is a small *flatpack* with the connections coming out on the two long sides. Many of them have 14 connections (including power and ground), with 7 coming out on each side.

If you're extremely lucky, the surplus house you bought your units from will have furnished you with a base diagram so you know which pin is which. Otherwise, there's some tedious detective work in store. It's not impossible, though.

It helps, in case you're having to figure it all out with no help from the dealer, to know whether the unit in hand is a flip-flop, a buffer, or a gate. It's also nice to know how many independent units are in the same package, because then you can get some idea of how many pins to test. But you can do without these aids.

The first thing necessary is to connect

power to the unit. Low voltage, with a current-limiting resistor of at least 1000Ω per volt of supply voltage is safest. A couple of D cells are ideal, with a 2.2 kΩ series resistor. This will give you 3V at just under 1 mA – enough to check out most circuits and not enough to harm very many. If you know which pins are power and ground, just connect them. If not, pick any pin at random as the ground and try each of the others, in turn, as the hot side. If you can't get any readings in subsequent tests which make sense, move to another pin with the hot side of the power source; after going all the way around, move to another pin and try again.

Sometimes it's handy to have a milliammeter in series with the power source. If you get nearly a 1 mA of current flowing, the circuit must be full on in the IC, and you probably have your power source connected to a pair of input terminals, or to an output terminal with reversed polarity.

With a 14-pin DIP unit, you might have to run through the whole series of identification tests 196 times to come out with an identification –but the odds favor getting one sooner. From this, you can see just how much it does help to know where the power goes in the first place.

With power connected, measure the voltage from each of the other leads to ground. Some of the leads will undoubtedly measure nearly full supply voltage, and others will measure at ground. Leave the meter on one of those showing high, and short each of those showing ground, in turn, to the supply (at the IC side of the current-limiting resistor; it won't hurt to use another 2.2 kΩ resistor in series, if you're the cautious type). If any of these causes output voltage to drop to ground, make a note of the pins involved.

After all the no-voltage pins have been tried, try shorting the other high-voltage pins to ground, one at a time. If one of them brings the meter to zero, make a note of it.

When all of the pins which originally showed voltage have been checked out, move the meter to one of the pins which showed zero volts originally, and try the same thing again with all the other pins, noting any which cause voltage to appear, and what was done to each. Go all the way around with this series of tests, too.

By now, your notes will present a complete truth table for the unknown unit. The next step is to study it carefully to see if it falls into any of the patterns of **Fig. 4**. Any combinations of pins which produce such a pattern probably form an independent gate element within the IC; they should be checked out carefully by connecting the meter to the apparent output pin, and applying the appropriate high or low levels to all the input pins at the same time.

A Few Helpful Hints. Most of the gate functions cannot be detected by single-input-pin tests such as those described here. If you find apparent "inverter" action from several input pins to the same output pin, the apparent output pin is probably the actual output pin of a gate element of some sort, and the apparent input pins are probably the actual gate element input pins. Try combinations of high and low levels at all the input pins simultaneously while reading level at the output pin, to find any similarities to the truth tables of **Figs. 4 and 5**.

If any of the single-input-pin tests cause an output voltage level to switch and stay in the opposite condition, you probably have a flip-flop; gates do not stay in alternate states, but hold their output levels only so long as inputs are supplied, while flip-flops "remember" inputs and do not need to keep them applied to have a changed output. If you find a suspected flip-flop, try multiple-pin tests by connecting all pins except the one you're testing and the output pin you're measuring from, to ground. When you find the single pin which causes output to reverse when the contact is either made or broken, under these conditions, you know the **T** input terminal and one of the two output terminals. From there, it's trial and error to find the rest of the connections.

After a little experience with this type of detective work, you'll probably develop a feel for it which may defy explanation. If you want to develop the feel without all the trial-and-error headaches, invest in a few units which come with connection diagrams (if you can find such), and practice with them.

Using Logic Elements Illogically.

While it's possible that you may become so fascinated with the possibilities inherent in logic circuitry, as such, and forget all about radio, that's not very likely. It's much more probable that you're only messing with all this Boole (to steal a good pun) because you want to make use of the ICs in some circuit that has nothing to do with electrical logic machines.

In that case, you'll probably welcome this portion of our discourse, because the rest of this article is devoted to some typical ways of using digital IC elements in ham radio.

The most versatile of the ICs for such uses is probably the 2-input *nor* or *nand* gate, of which the 914 is typical. A glance back at the schematic of this gate, **Fig. 10**, will show the resemblance between the *nor* gate and a *long-tailed-pair* differential amplifier circuit. All that you have to do to turn a 2-input *nor* or *nand* into a long-tailed-pair is to add the "tail," a resistor, between the IC's ground terminal and the actual circuit ground. The resistor value is not particularly critical; anything from 47Ω to 1 kΩ might do it, depending upon the signal levels involved and so forth.

You may also find it necessary to provide some forward bias to each of the two bases, by connecting a voltage divider to each of the input terminals. The complete circuit is shown in **Fig. 14**, but parts values must be determined by experimenting for each application. This circuit has been used as a mike preamp, and might also have other uses. High-frequency response is not particularly good, because the series resistors inside the IC (see **Fig. 10**) act with the junction capacitance to form a lowpass filter.

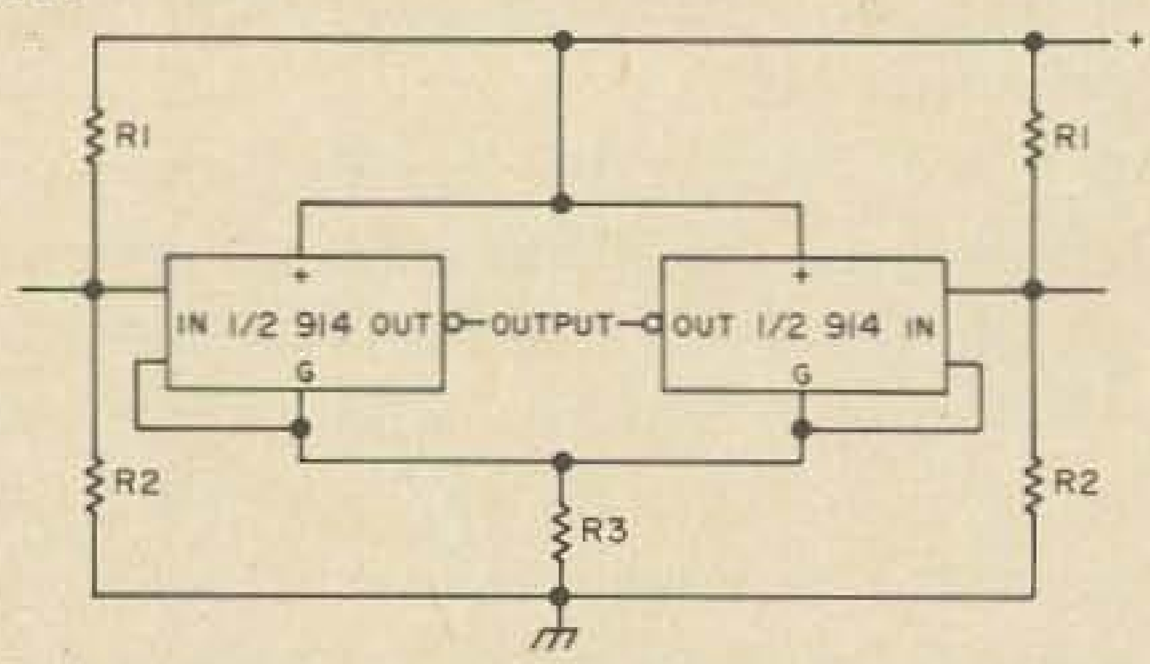

Fig. 14. Use of type 914 RTL logic element as differential amplifier is shown here. Values for R1, R2, and R3 must be determined by trial and error, but one such application has successfully used 1.8 kΩ at R1, 1.3 kΩ at R2, and 330Ω at R3. These values may be used as starting points. Output is taken directly from output pins of IC.

We already saw, in **Fig. 11**, how to cross-connect one of these gates into an R–S flip-flop, otherwise known as a *bistable multivibrator*. If we simply duplicate that hookup, but put one capacitor and appropriate resistors in place of one of the direct wires, as in **Fig. 15**, we have a *one-shot* or *monostable multivibrator* which performs nicely as the frequency divider in a frequency standard. The frequency adjustment depends upon both the capacitor size and the resistor values. Vary the capacitor until you're in the right ball park, and then use the resistance as a "trim" adjustment.

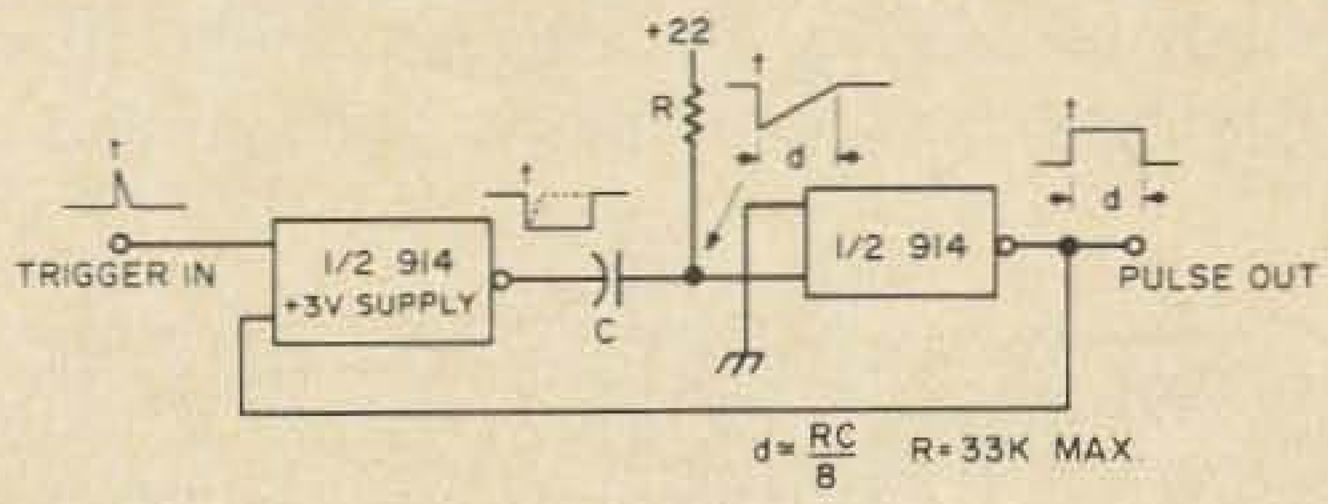

Fig. 15. One-shot circuit is easily built from 914 IC by adding single capacitor and external resistor. If 3V supply is used for IC, and 22V supply to drive external timing resistor, duration of output pulse will be almost exactly 1/8 the RC time constant, with R in ohms and C in farads. Maximum resistance usable for R is 33 kΩ to permit turn-on current to flow. Capacitance C, however, may be any value desired to achieve required output pulsewidth.

By substituting a crystal for the other cross connection, as **Fig. 16** shows, we can turn the dual *nor* gate into a crystal controlled oscillator with a high-harmonic waveform. It makes a fine frequency standard, especially if one or two dividers similar to the **Fig. 15** circuit are added.

If you want a free-running oscillator, you can get it by using capacitors on both sides. The circuit is just like **Fig. 16** except that another capacitor replaces the crystal. Frequency will depend upon values of both capacitors, and both sets of resistors.

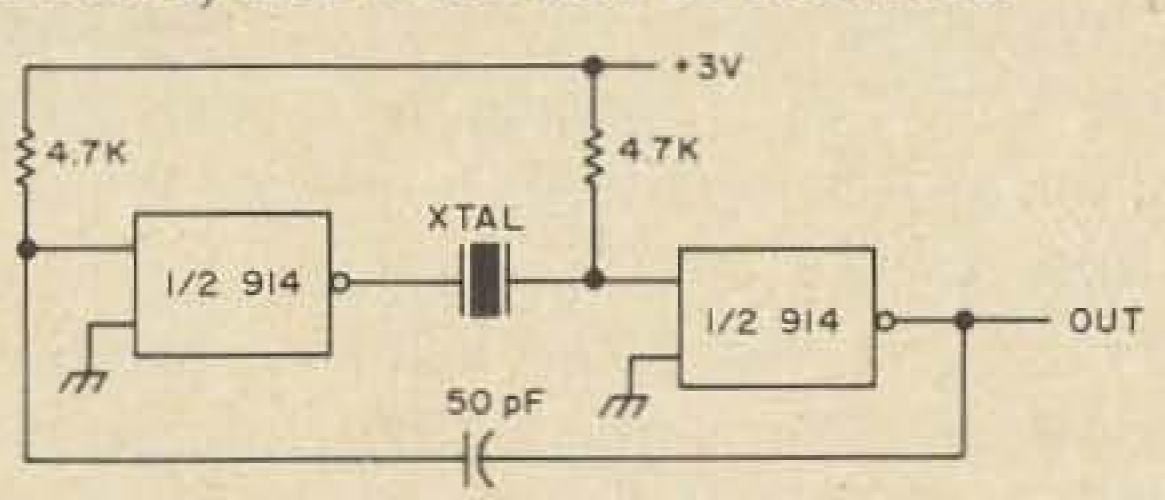

Fig. 16. Minor modifications to one-shot circuit, including substitution of a crystal for the timing capacitor and insertion of a capacitor in the dc feedback loop, turn it into a crystal-controlled oscillator which may be used for a frequency standard. Output is rich in harmonics, and this circuit is not recommended for transmitter use for that reason.

The *synchronous detection* technique for reception of AM, FM, and DSB signals has long been of interest to many of us, but too many transistors or tubes have been necessary in most circuits for synchronous or phase-locked detectors. Surplus ICs may, at long last, make phase-locking practical for ham receivers. (See W2EUP's frequency synthesizer description in 73, February 1970.) **Figure 17** shows a voltage-controlled oscillator (VCO) designed several years ago by a Motorola engineer using the Motorola MECL dual *nor* gate. Frequency varies over a 10-to-1 range as control voltage is varied from 1–7V. Both capacitors are the same value, and they control center frequency. Minimum value is about 110 pF, which provides a center frequency of about 2 MHz; maximum is 100 μF, which provides a center frequency of about 3 Hz (lowest frequencies with these two values are 750 kHz and 0.5 Hz respectively). For a 455 kHz i-f strip, 470 pF values would be about right.

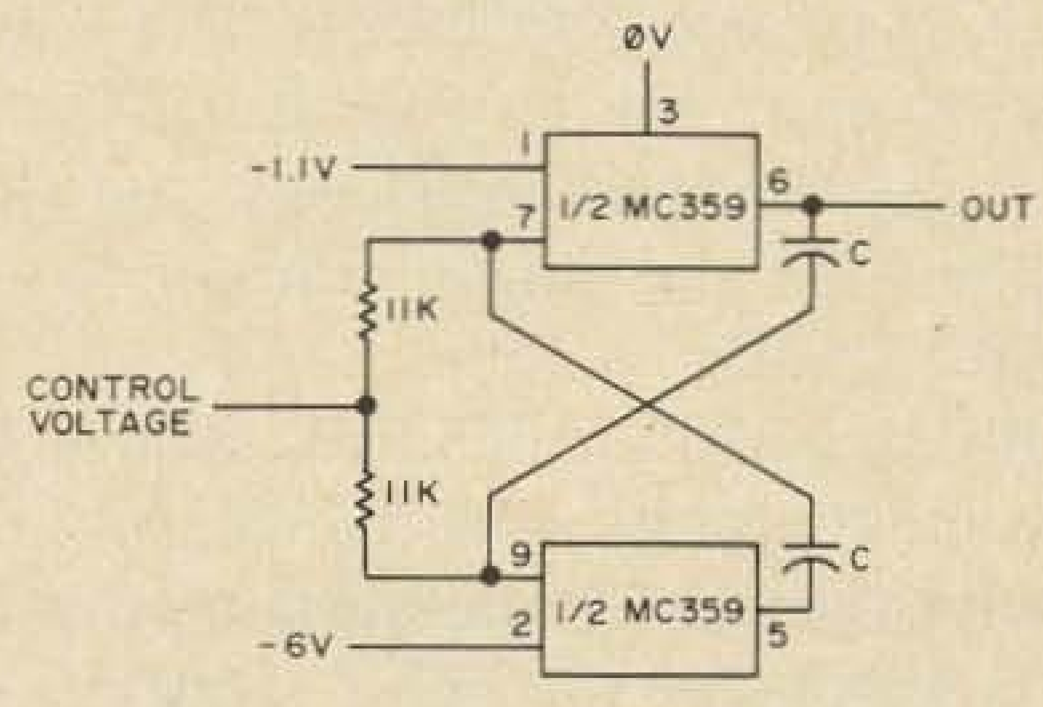

Fig. 17. Voltage-controlled oscillator can be varied over nearly 10-to-1 frequency range simply by varying control voltage. This circuit may be used as part of phase-locked detector.

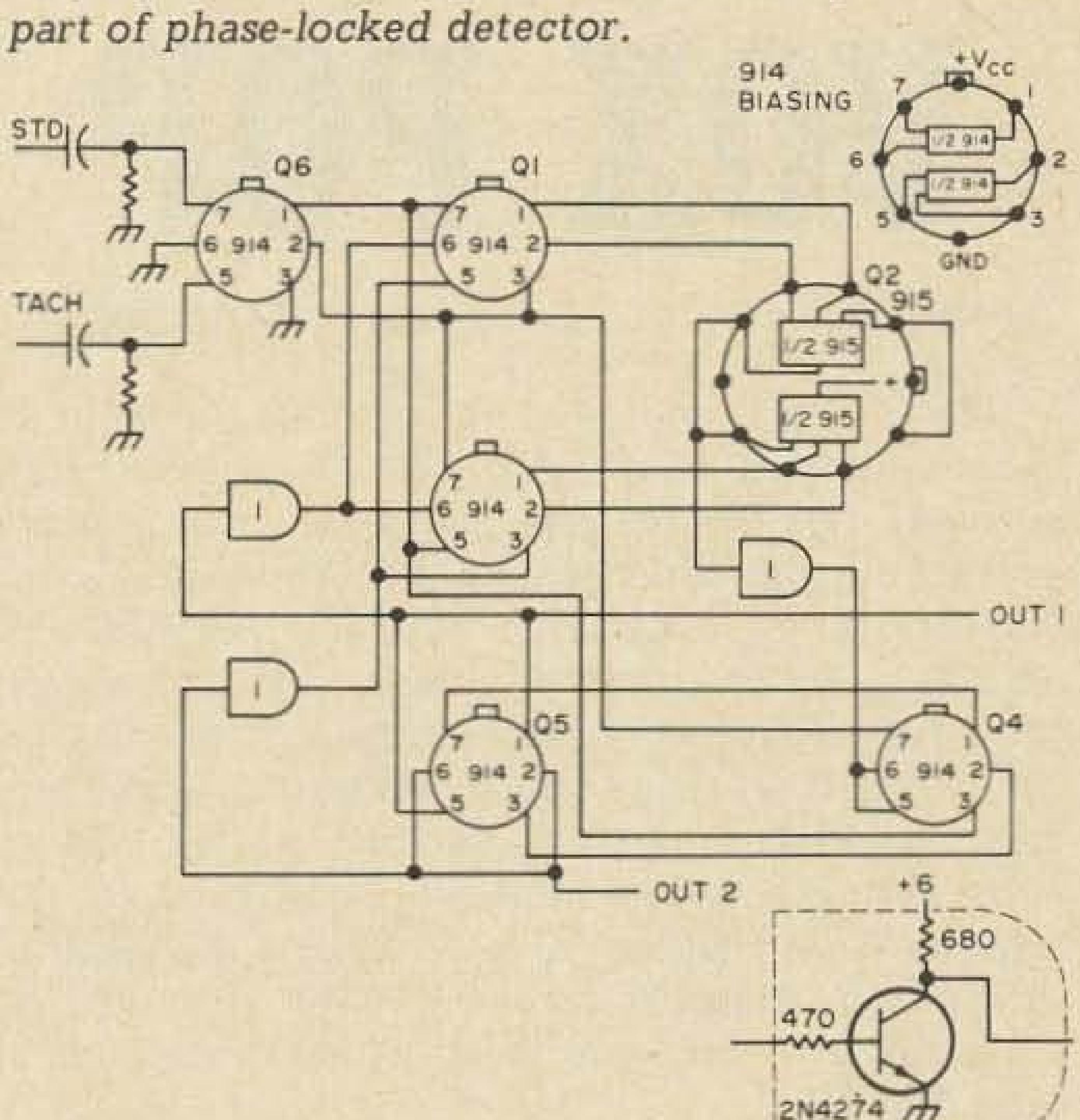

Fig. 18. This rather complex arrangement of ICs is a frequency comparator and phase detector. The unknown frequency is fed into the TACH input and the standard to which it is to be compared goes to the STD input. Output level indicates whether TACH is higher or lower in frequency than STD. OUT 1 and OUT 2 are of opposite polarity. Type 915 IC (Q2) is same as 914 but has 3-input gates rather than 2-input elements.

Figure 18 shows the frequency comparator or phase discriminator which goes with the VCO to provide half of a synchronous detector. This circuit was developed at Fairchild, and is not necessarily directly compatible with the VCO, but it should be possible to blend them together with a little trial and error.

The circuit of Fig. 18 accepts input signals at two connectors, labeled *REFERENCE* and *SIGNAL* in the drawing. It produces a single dc output. If the *SIGNAL* frequency is lower than that of the *REFERENCE*, the dc output level will be low. If the *SIGNAL* frequency is above the *REFERENCE*, the dc output level will be high. If both *SIGNAL* and *REFERENCE* are at the same frequency, the dc output level will be between the low and high levels, and will be determined by the phase relation between the input signals.

Unlike phase discriminators which make use of tuned circuits, this one has no humps in its response curve. The output will follow phase variations of the input faithfully, and can be filtered and used to drive the VCO in the classic phase-lock detector arrangement.

A somewhat less complex circuit which has nothing to do with radio but which may be of interest to the sports-car fanatics among us is in Fig. 19. This is a combination tachometer and dwellmeter, built around a single quad dual-input *nor* (Motorola MC724P). The gates at terminals 1-2-3 and 12-13-14 form a one-shot flip-flop timed by the 0.5 μF capacitor and 20 kΩ resistor. The gate at 5-6-7 is used simply as a driver, and the remaining gate (8-9-10) is the meter driver. Power is furnished by a pair of dry cells. In switch position 1, power is off. In position 2, the circuit acts as a tach, and resistor R1 should be adjusted to produce a 900 rpm reading when 60 Hz voltage is fed in. In position 3, it's a dwellmeter, and R2 should be set so that full-scale reading on the meter is obtained with the input terminals shorted. This will be 45 degrees of dwell for an eight-cylinder vehicle, 60 degrees for a six, and 90 degrees for a four. The meter can also be read as indicating percentage of time that points are closed, but most specs for tuneup give dwell readings in degrees.

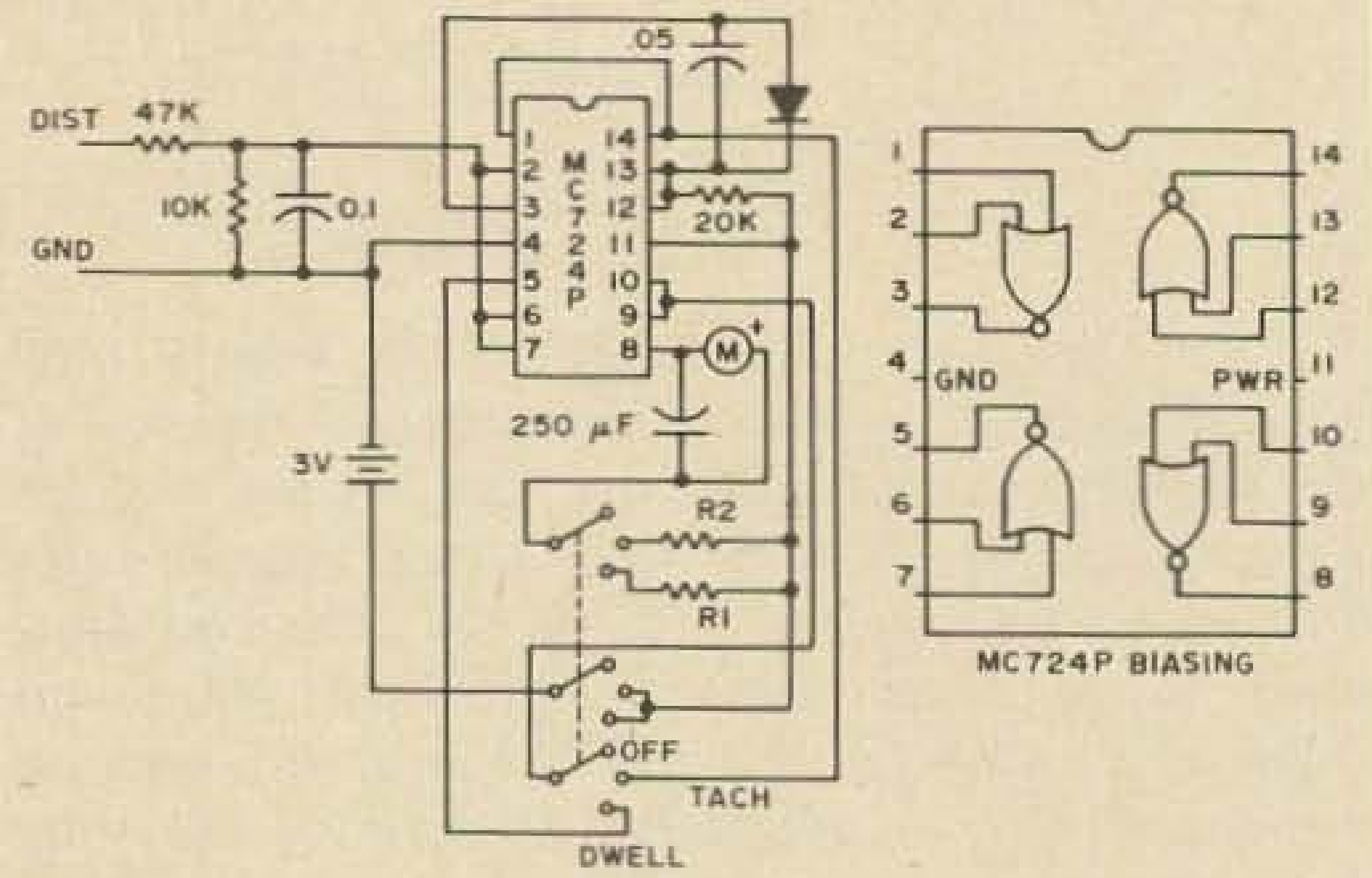

Fig. 19. Single IC chip provides tachometer and dwellmeter for auto enthusiasts. Tachometer uses one-shot formed by gates at terminals 1-2-3 and 12-13-14, with 20 kΩ timing resistors and 0.05 μF timing capacitor. Dwellmeter is driven by gate at terminals 5-6-7. Gate at terminals 8-9-10 is used only as meter driver, and capacitor across meter serves to damp individual current pulses. Power is supplied by 3V battery. Calibration is adjusted by R1 and R2.

This is, of course, only a sampling of the various uses which you can make of digital ICs. A little experimentation will probably result in several new ways – and now that they're in surplus, they're cheap enough to permit such experimentation. **. Jim Kyle**■

VOX POP

Monthly Report of Activities on our Bands

Please send reports of interest on the band of your choice to Vox Pop, 73 Magazine, Peterborough, NH 03458. Use a postcard and indicate on the top the band being reported. Any news of interest will be considered grist for the mill...DX reports (including time, frequency, QSL manager), new FM repeaters, nets, emergency operations, contest high scorers, county operations, skip openings on VHF's, aurora, meteor scatter, moonbounce, anything you think will be of good general interest. The deadline for each issue is the tenth of the month. Material received April 10th will be scheduled for the June issue, which comes out in early May.

REPORT FORM

Please send all your reports to VOX POP on a postcard or QSL card, keep them as short as you can so we don't have to wear out our blue pencil. At the top of the card print clearly the band that the report is for. All reports will be listed by band, so if you are reporting on more than one band use more than one card.

(continued from page 75)

assembly and install in 12V base assembly.

NOTE:

The letters A and B are stamped on the bottom of the base assembly. Plug the crystal into the socket on the A side.

(4) Place the spacer plate between the crystal and the heater element and replace the cover. Make sure that the polarity of the cover and base agree.

(5) Insert the crystal assembly in the proper socket.

6 to 12V Conversion Power Supply

a. Vibrator Connections

(1) Disconnect the shielded lead from the two 2.9 mH choke coils located near the center of the chassis (Fig. 1).

(2) Disconnect the other ends of the two chokes from the two 0.5 μF capacitors (C4 and C5). These two choke coils are not used in the 12V circuit.

(3) Disconnect the black-yellow transformer lead from capacitor C4(0.5) and disconnect the red-yellow transformer lead from capacitor C5(0.5). Tape each lead separately and dress it out of the way.

(4) Disconnect the sleeve-covered lead from pin 3 of the vibrator socket. Use this lead to connect capacitors C4 and C5 in parallel. Do not solder the connections to C4 and C5 until completing step 15.

(5) Disconnect the black, yellow, and red leads from pins 1, 2, and 4 of the vibrator socket.

(6) Remove the lead between vibrator socket pin 6 and ground.

(7) Remove the 100Ω resistors connected between vibrator socket pins 1, 2, 4, and 5 and ground.

(8) Connect the red and black leads to the ungrounded terminal of C4 or C5 (changed to C104 and C105 on schematic).

(9) Connect pins 2 and 4 of the vibrator socket and then ground pin 4 at the ground lance near pin 5.

(10) Connect a 270Ω resistor from vibrator socket pin 1 to ground.

(11) Connect a 270Ω resistor from vibrator socket pin 5 to ground.

(12) Connect a 7.5Ω resistor from vibrator socket pin 6 to ground.

(13) Connect the yellow transformer lead to vibrator socket pin 1.

(14) Connect a 20Ω resistor from vibrator socket pin 3 to the ungrounded terminal of capacitor C4.

(15) Connect the shielded lead, which was disconnected from the 2.9 mH choke coil in step 1, to the ungrounded terminal of capacitor C5.

b. Push-to-Talk Relay Modifications

(1) Remove the white-black lead connected between terminal 8 of relay K1 and terminal 14 of transmitter terminal strip E2.

(2) Remove the white-black lead which connects between terminal 14 of terminal strip E2 and pin 4 of power plug P1.

(3) Connect a black-white lead from terminal 8 of relay K1 to terminal 4 of the power plug.

(4) At terminal board E1, disconnect the 24 AWG brown lead (running from the relay coil lug) from terminal 9. Reconnect this end of the lead to terminal 14 of terminal board E2.

c. Fuses

(1) Remove the two 15A fuses from the fuseholder.

(2) Paint out or use tape to mask over the markings on the fuseholder. It is recommended that 6.25A now be marked on the fuseholder to insure that oversize fuses are not used.

(3) Place two 6.25A fuses in the fuseholder.

d. Terminal Strip E1 Modifications

(1) Connect a 25 μF capacitor from terminal 9 to terminal 12 of receiver terminal strip. Connect the negative side of the capacitor to terminal 9.

(2) Connect a 25 μF capacitor from terminal 12 to terminal 15 of the receiver terminal strip. Connect the negative side of the capacitor to terminal 15.

That's all there is to it. The worthless old 6V surplus mobile is ready to go in your 12V auto.

. . . W6YAN ■

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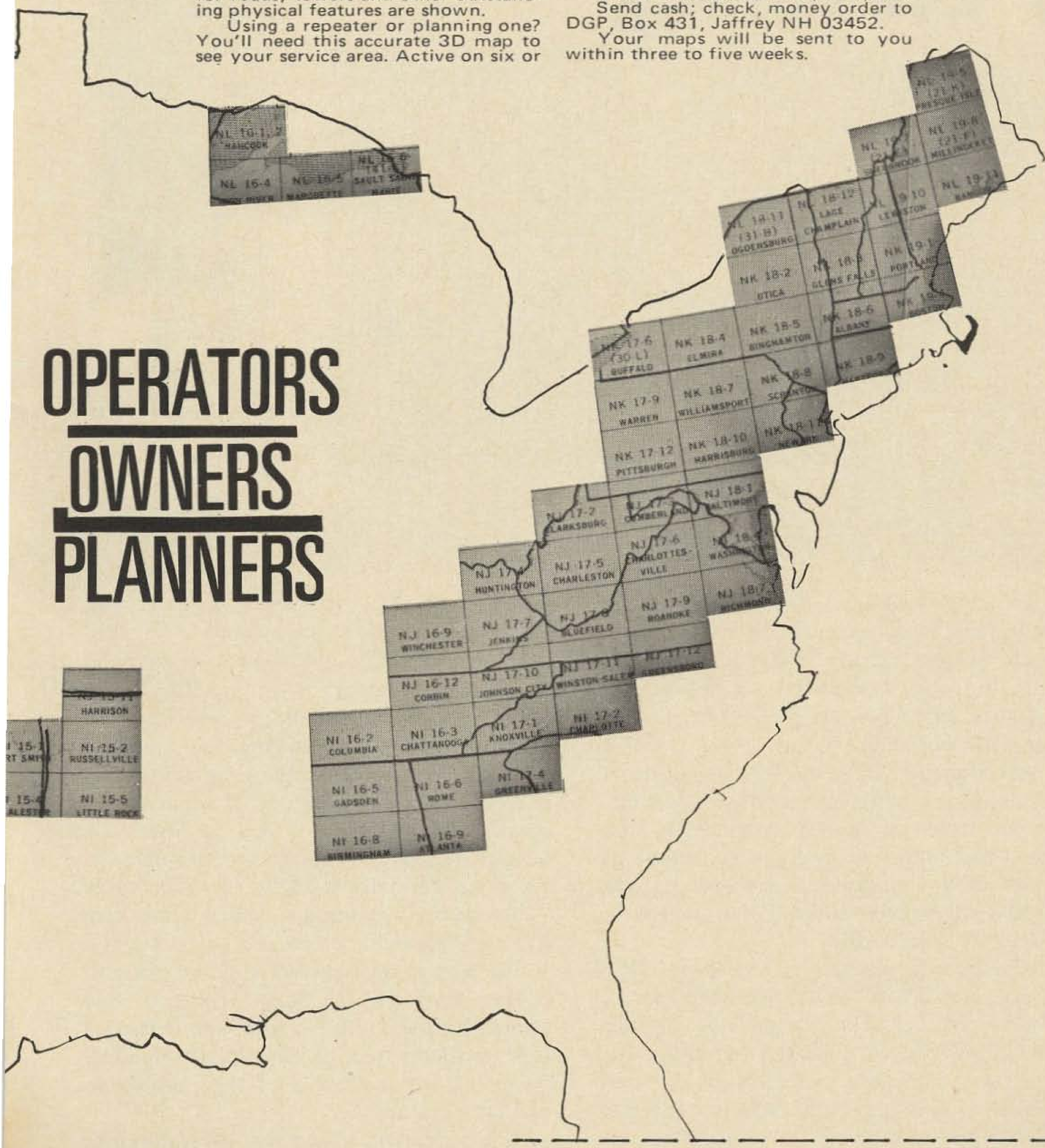

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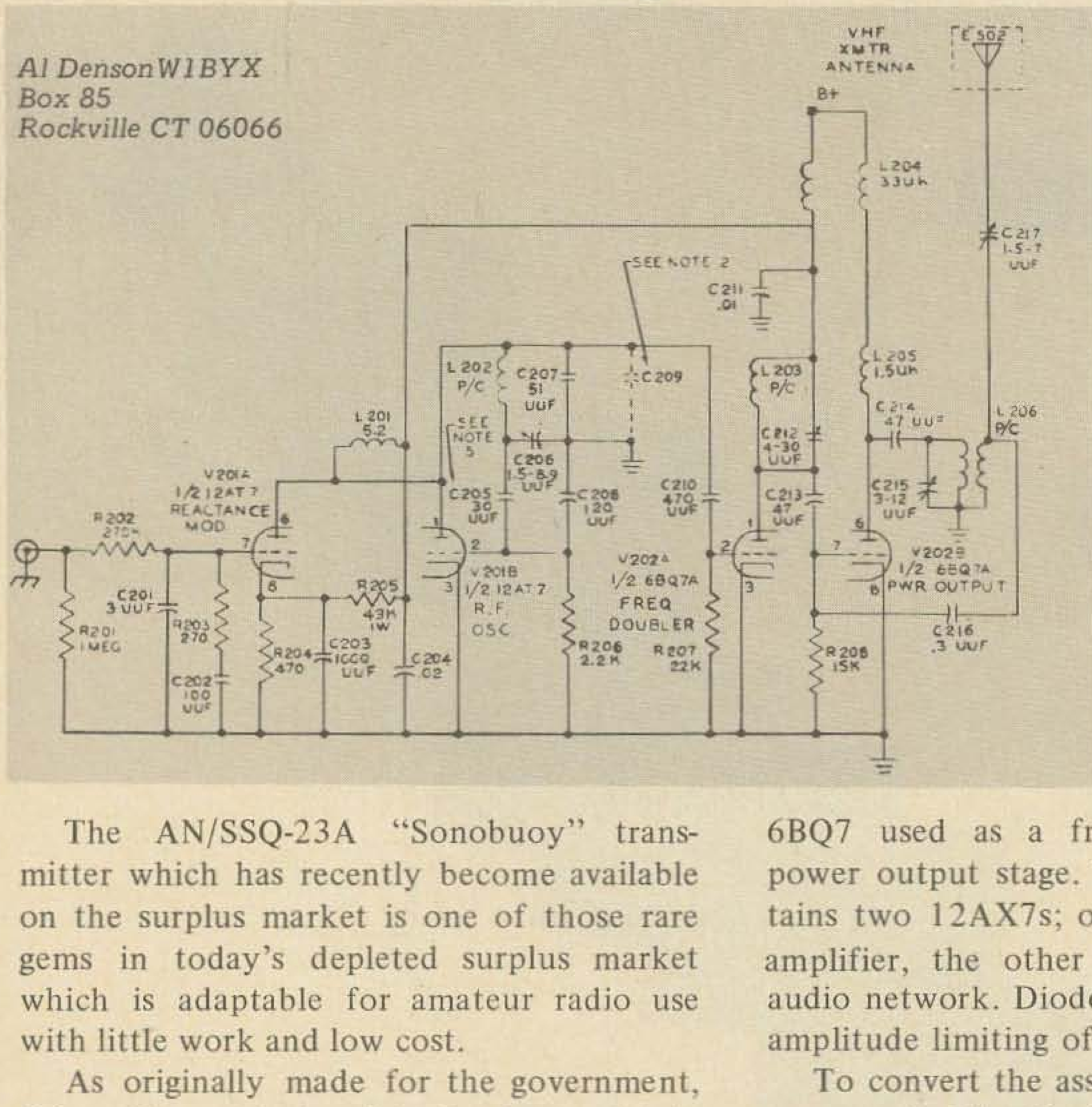
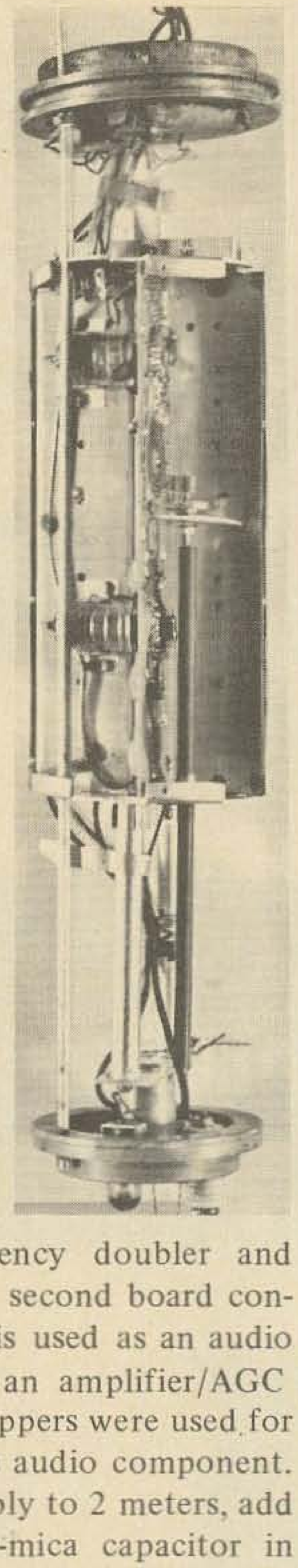
Converting the AN SSQ-23A Sonobuoy to a 2W FM Rig

Al Denson W1BYX
Box 85
Rockville CT 06066





The AN/SSQ-23A "Sonobuoy" transmitter which has recently become available on the surplus market is one of those rare gems in today's depleted surplus market which is adaptable for amateur radio use with little work and low cost.

As originally made for the government, this unit was designed to be dropped into the sea from an aircraft as an expendable unit which detected underwater sounds by means of an underwater microphone. The original frequencies covered the range from 162.25 to 173.50 MHz.

A self-contained battery supply of 13V is tapped at 6.5V to feed a transistorized dc power converter. The normal battery drain was 2.25A total for both 6.5V sections. The dc power converter assembly is a small transistor switching unit which converted the 13V to 160V B+ for the transmitter.

The entire transmitting assembly consists of two printed circuit boards, the first of which contains a 12AT7 tube used as the rf oscillator and reactance modulator with a 6BQ7 used as a frequency doubler and power output stage. The second board contains two 12AX7s; one is used as an audio amplifier, the other as an amplifier/AGC audio network. Diode clippers were used for amplitude limiting of the audio component.

To convert the assembly to 2 meters, add one small 18 pF silver-mica capacitor in parallel with C206 as a pad to lower the output frequency. Connect a microphone to the input formerly used by the underwater "microphone" transducer and connect two 6V batteries in series to the power supply. Voila! You're on 2 meters FM, and ready to operate through the local repeater. And toned repeaters are no problem either; a tone oscillator may be very simply added by means of the built-in neon-tube relaxation oscillator circuit.

The schematic shows the 2W transmitter board only. The poor quality of the schematic is attributable to the fact that it was reproduced from a xerographic print of the original manual.

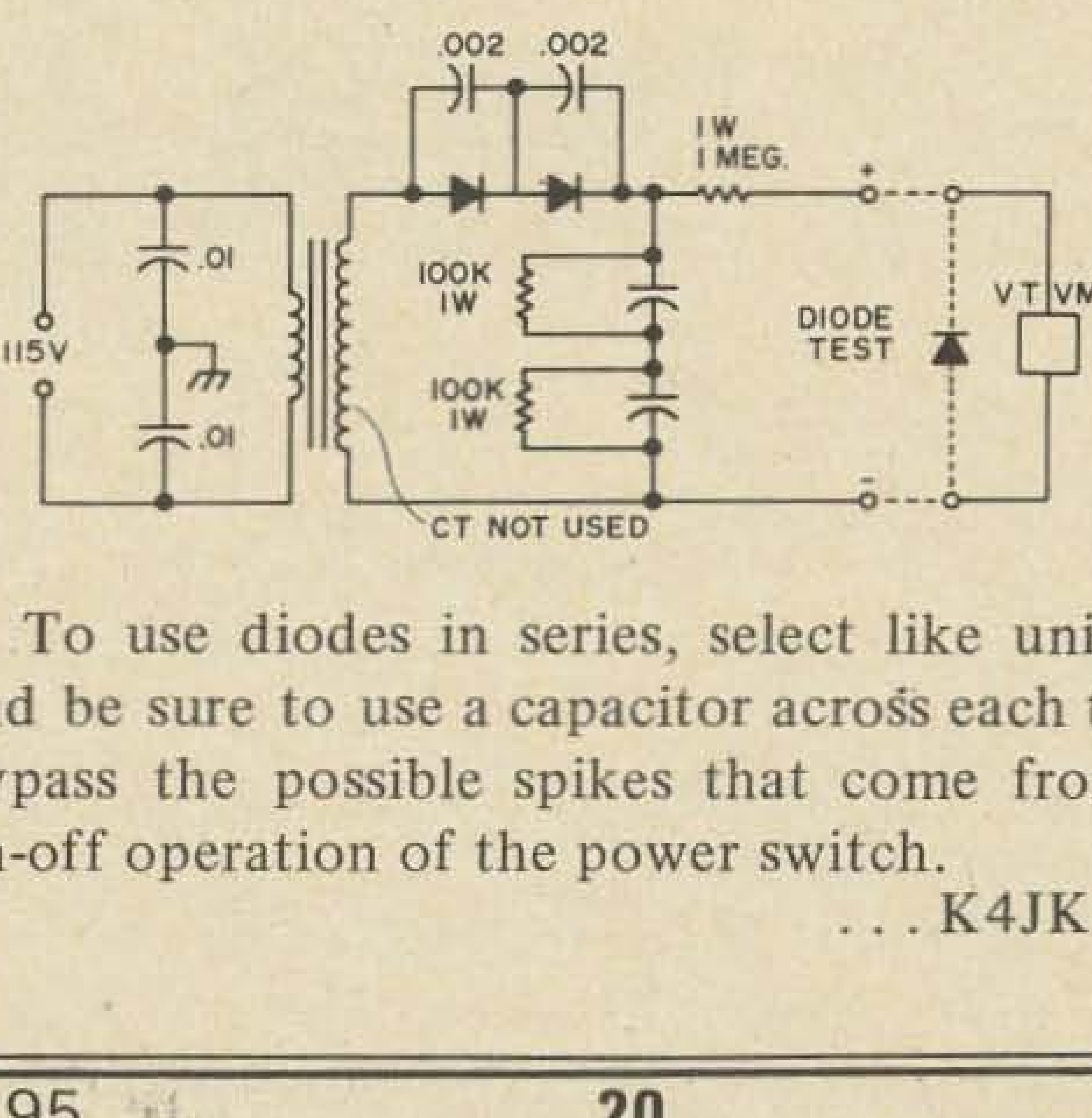
. . . W1BYX ■

EASY DIODE TESTING

Edwin Kirchhuber K4JK
2804 Broadview Drive
Huntsville AL 35810

With the advent of "bargain" diodes, we must test before using, especially if they are to be used in series (what else). The simplest method I have found is to use the good old vtvm and a power supply capable of providing 1000V. I used a 40 mA transformer (275-0-275V) in a half-wave circuit. The filter is a couple of 450V electrolytics in series. Any value from 8 to 80 μF is okay. The hot lead coming from the power supply has a 1 MΩ, 1W resistor in series to limit the current. The vtvm is placed across the diode test points and the readings are taken.

To check the characteristics of the "mystery" diode, put its cathode to the positive test point, and the anode to the negative test point. Read the voltage on the vtvm. If, for instance, it reads 300V, a safe PIV working voltage would be 2/3 of that – or 200V. To test for forward characteristics turn off the supply and reverse the diode. Set the vtvm to the 3V scale, turn on the power and read the voltage drop across the diode. It should not exceed 3V. Over that it is no good (open). No voltage indicates shorted diode.



To use diodes in series, select like units and be sure to use a capacitor across each to bypass the possible spikes that come from on-off operation of the power switch.

. . . K4JK ■

Samuel Kelly W6JTT
12811 Owen Street
Garden Grove CA 92641

TURNING THE AN/GRC-9 INTO A NOVICE RIG

. . . and it puts out a husky 15W on CW.

The surplus situation out here has been pretty bleak for quite a while, so I figured my luck was bound to change. While wandering through a local junkyard I noticed a small olive-drab box on the scrap pile. Inside was a compact transmitter–receiver covering 2 to 12 MHz! The junkie had decided not to melt it down because it had too little copper in it! After brief negotiations I parted with ten bucks and brought home the set. Since then I have run across others. They are apparently being phased out by the army. The sets I have seen have all required minor repairs, but the performance is well worth the effort.

The AN/GRC-9 is a small five-tube transmitter and seven-tube receiver designed for infantry packset use and for installation in vehicles. The receiver has a built-in 200 kHz crystal calibrator. The actual tuning range is from about 1.8 to 12 MHz so you can cover 160, 80, and 40 meters. The transmitter can be either crystal controlled or vfo. Full break-in is provided and there is a CW sidetone and provision for netting.

The set was designed for CW, MCW, and AM operation. The MCW mode is illegal, and the suppressor grid AM feature is practically worthless. However, CW performance is quite good. Power output is 15W, but can be increased. One of the best features is an ingenious antenna matching system that will match anything from a short whip to a dipole.

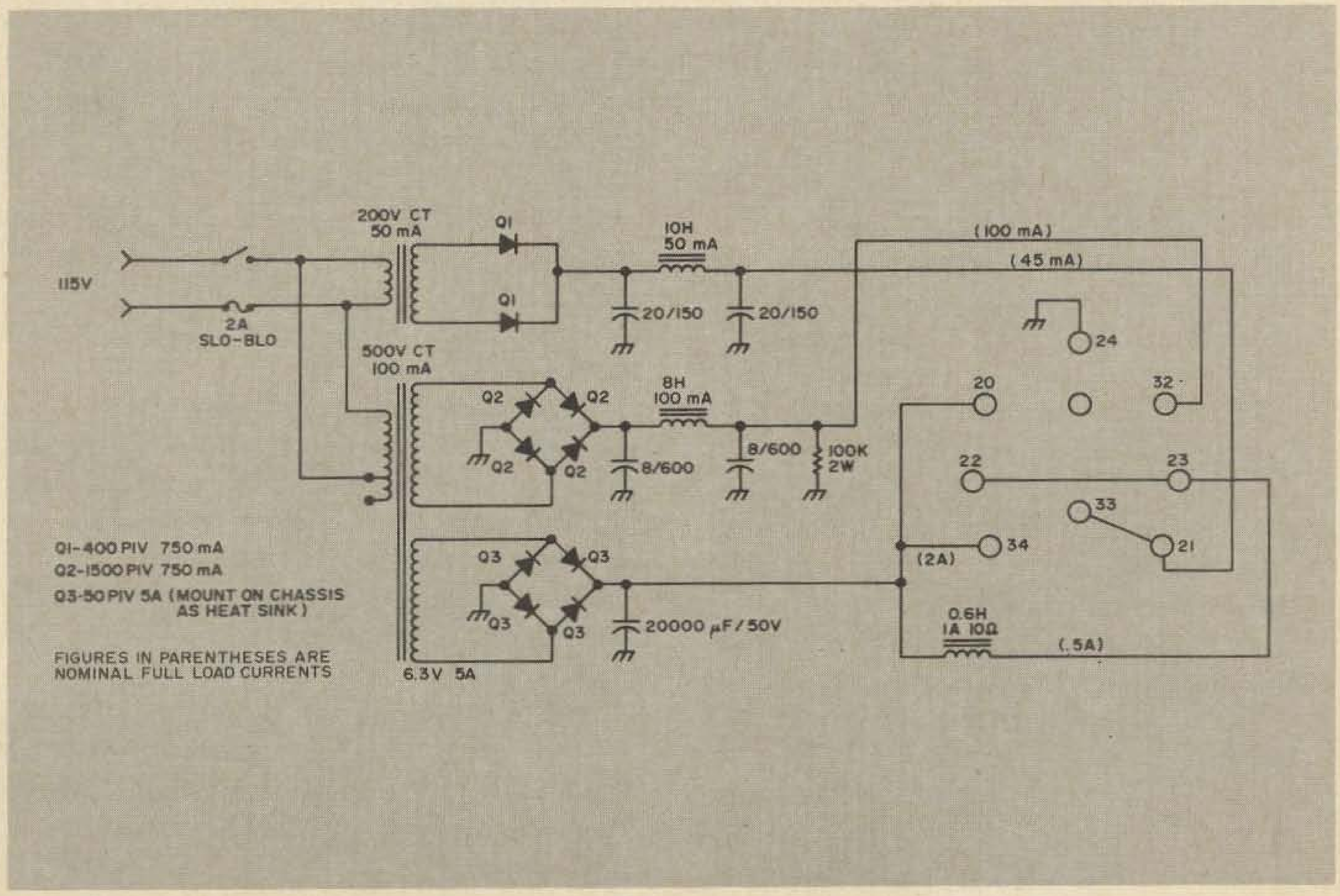
The first step in getting the set on the air is to supply power. For mobile or portable use the army used the PE-237 vibrapack, GN-58 hand generator, or DY-88 dynamotor. The PE-237 is available in quantity, but is useless. Reliability is terrible; it's bulky and the big vibrators are hard to find. The DY-88 is good and will operate from 6, 12, or 24V; but it, too, is quite bulky. The GN-58 hand-crank generator is fun for field portable use, but soon you run out of friends to turn the crank. The supply shown in Fig. 1 provides all necessary voltages and is easily run from a dc-to-ac inverter for portable operation. Incidentally, it will also operate the BC-1306, which is similar to the AN/GRC-9 but covers only 3.8 to 6.1 MHz.

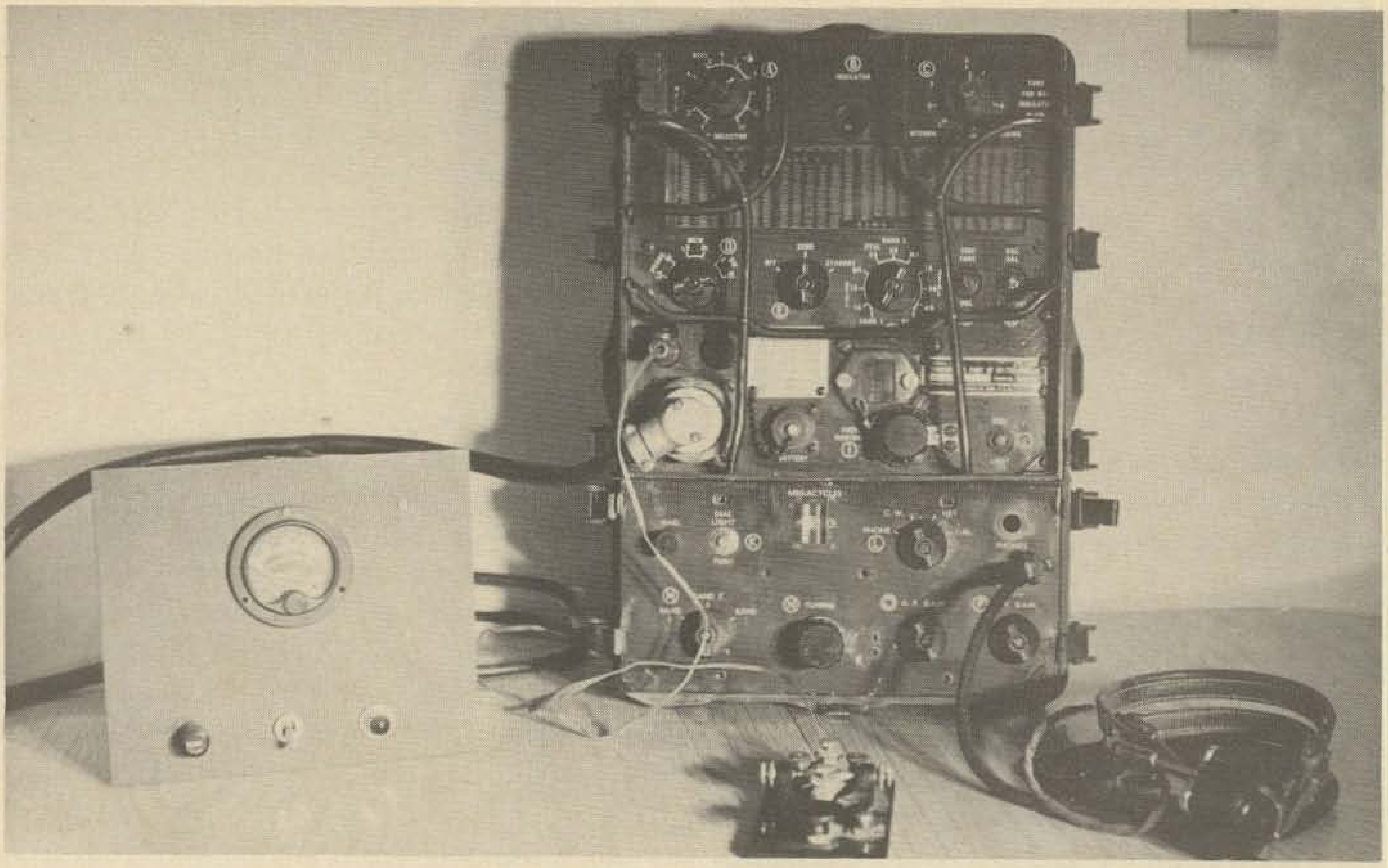
Don't try to change the connector on the transmitter. Get a CD-1086 cable or a PL-279 connector. Watch out for the CD-435 cables. They are quite common and are identical in appearance to the CD-1086. If you get one it will have to be rewired as the pin for the +500V is jumpered to the 1.4V filament pin!

After completing the supply, carefully check your wiring and connect the supply to the set. Plug in phones (be sure the impedance switch at the back of the receiver is in the correct position), key, and antenna. The phone jack is also the switch for turning on the receiver filaments. Turn the power supply on and set control E to STANDBY or SEND. Set control A for the type of antenna in use. Set control D to CW–HI. Now measure the voltages. The metering socket, X-110, provides a convenient point for measuring the 6.3V filament and plate voltages. Pin assignments are stenciled on the back plate of the transmitter. The 2E22 plate voltage should be between 425 and 600V. Receiver plate voltage should be 105V, and the 6.3V filament shouldn't be less than 6.0V. The receiver filament voltage is measured on pin A of the BATTERY connector. It should be between 1.2 and 1.4V.

The controls are well marked and self-explanatory; the "net" provision turns on the receiver bfo and the transmitter vfo for zero beating. The calibrate position activates the 200 kHz crystal oscillator which is used

Fig. 1. Power supply for AN/GRC-9 and BC-1306 transmitter/receiver.





You can save yourself a lot of grief by using the connector already provided on the AN/GRC-9. In the photo here, the homebrew power supply (left) feeds the unit through its original mating connector on the front of the unit. After minimal conversion, all you need to do is add a key and a set of headphones as shown, and you're on the air.

for calibrating the transmitter vfo using the screwdriver-adjusted OSC/CAL adjustment (control H).

The transmitter's crystal oscillator always operates into a doubler stage, so the crystals must be chosen to be at half the desired operating frequency. Standard FT-243 types can be used. Provision is made for two crystal controlled channels per band.

With the power supply of Fig. 1, the transmitter will operate break-in in either the SEND or STANDBY positions. After a suitable warmup, tune in the desired signal on the receiver. Switch control L to NET and adjust the vfo for zero beat. Now switch L to CW. Set control A to the highest number for the type of antenna in use. Close the key and adjust control C for maximum brilliance on the indicator (which is an NE-16). This will coincide with maximum plate current. If no peak is observed, change A to the next lowest setting and repeat until a peak is observed.

As with all low-power sets, special consideration must be given to the antenna system. For really portable operation, be sure to have a good ground or get the counterpoise sets (CP-12 and CP-13) that were designed for use with the set. A doublet antenna made with 72Ω twinlead is recommended. Antennas AT-101/GRC-9 and AT-102/GRC-9 are specially designed longwires having jumpers for adjusting the frequency. These are desirable accessories.

In the PHONE position, the 2E22 filament is turned on by the transmit relay so there is a delay of about 3 sec after you press the push-to-talk switch. The 2E22 is a rare bottle to come by.

You can substitute an 807 by replacing the plate cap connector, clipping the lead going to pin 4 of the socket, and connecting pin 4 directly to the chassis. But the set will operate in the CW mode only now.

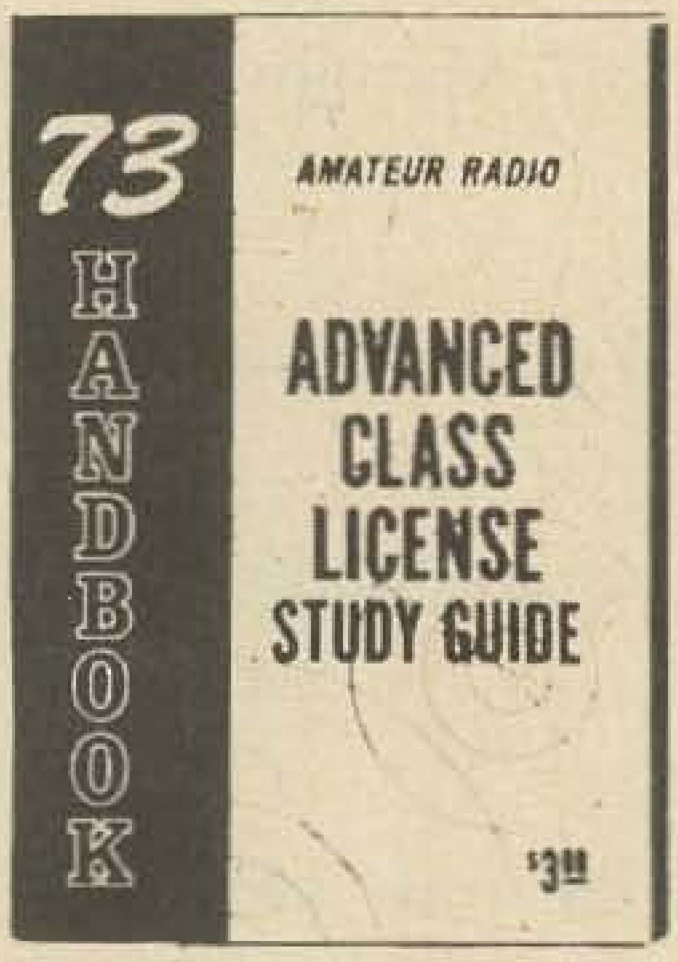
Don't jack up the plate voltage for the final amplifier over 600V as the rf components won't take it.

This set is excellent for the Novice as well as the portable CW enthusiast. Detailed troubleshooting information is contained in Technical Manual TM 11-263.

. . . W6JTT ■

73 Books for Hams

ADVANCED CLASS STUDY GUIDE



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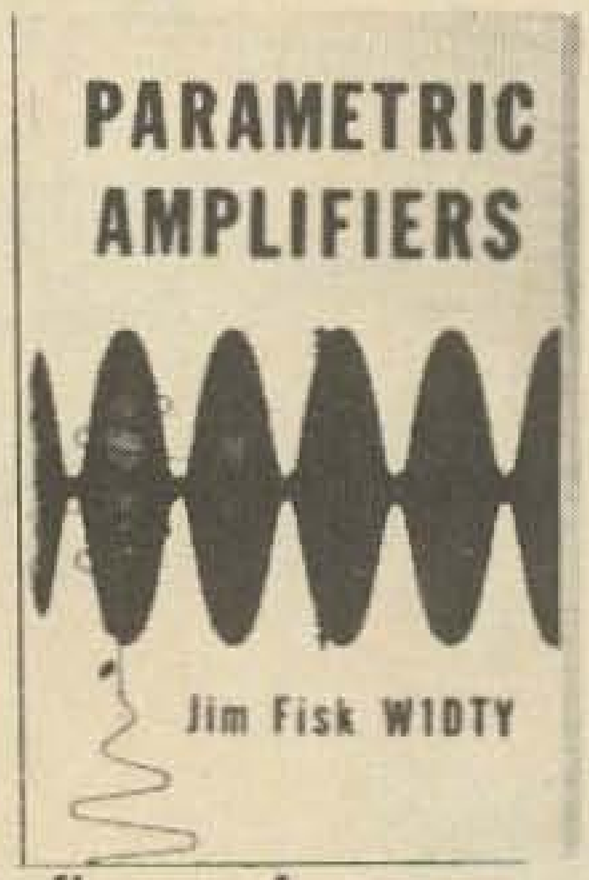

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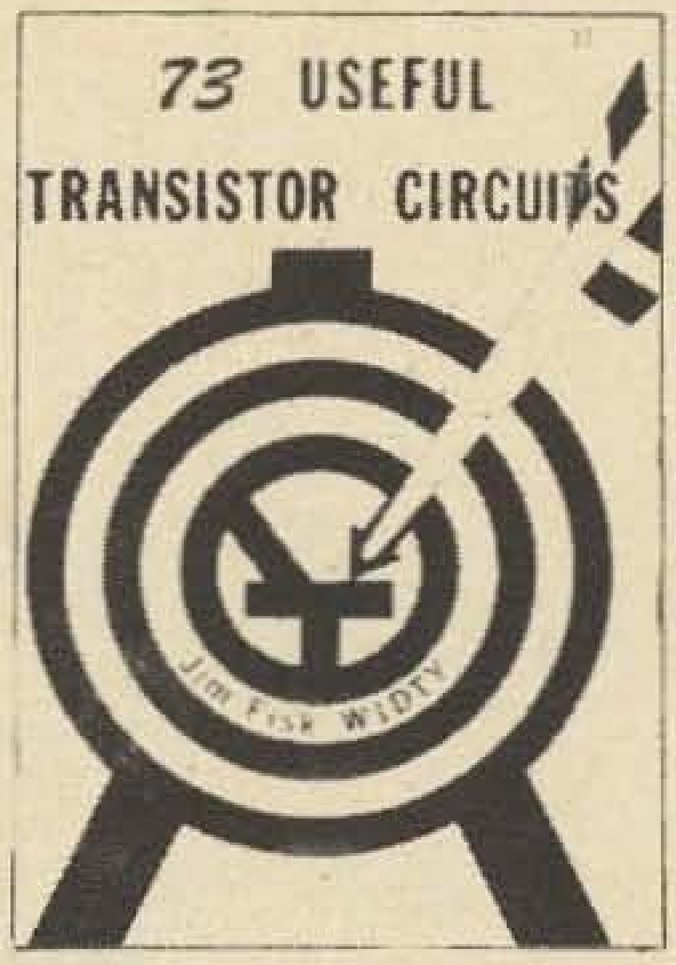

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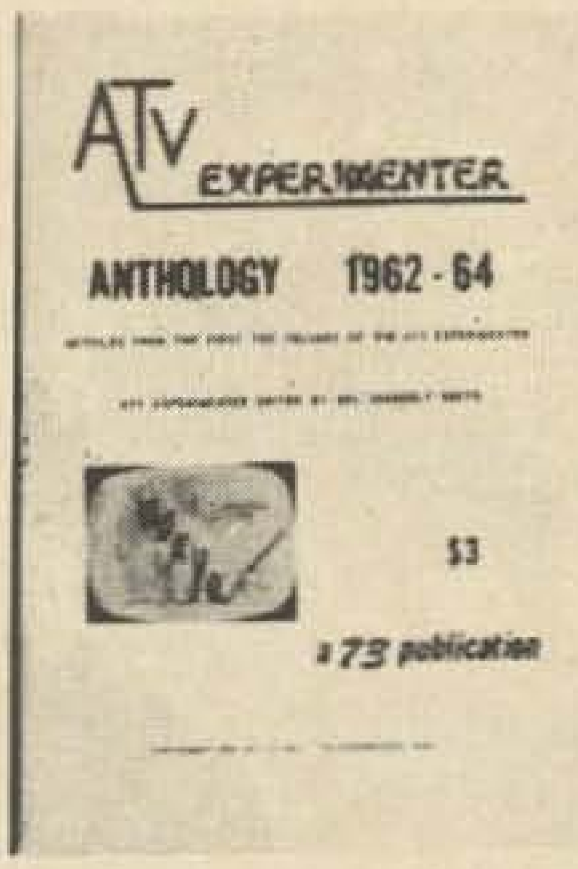

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STAFF

Getting Your Extra Class License

Part XIV: Measurement

Most of our discussion, so far in this Extra Class study course, has revolved around the theory of things—the "why" of the subjects covered on the FCC examination.

But you're undoubtedly aware that when theory and practice agree, at least one (and usually both) is probably in error—at least, so one of Murphy's famous laws would have us believe.

Actually, a properly framed theory must agree with what actually happens. If it doesn't, then it's not properly framed. There's just one rub—before you can compare theory and "what actually happens," you have to know what's "actually" happening. And that's where the fine art of making measurements comes in.

Measurements are an essential part of all electronics, for exactly this reason. They are the link between theory and practice. What's more, in ham radio measurements provide the assurance that your operation is within legal limits, both in the amount of power you use and the part of the rf spectrum your signal occupies. Since measurements are so essential, they are included in the Extra Class examination—and this time, we're going to concentrate on several aspects of the measurement problem which we haven't examined before.

We'll be covering the following questions from the FCC study list (as always, the numbers are those in the study list):

4. What precautions should be taken when measuring the rectified grid voltage in an oscillator with a dc voltmeter?

12. An oscilloscope is used to study the relationship between the input and output of an amplifier produced by a voice signal. How would the scope pattern display a linear relationship between the input and output signals?

35. How may an amateur check his transmitter for spurious sidebands?

37. Define the term decibel. How is the decibel used for voltage and power calculations?

60. How does a cathode-ray tube operate? What magnitude of voltage is normally used to bias the plates of a cathode ray tube? What purpose does this magnitude of bias voltage serve?

65. What means may be employed to measure low frequencies? High frequencies? VHF and UHF?

Rather than attempting to provide specific answers to these specific questions, we'll follow our usual practice of rephrasing the questions into more general terms covering the same subjects.

For openers, let's find out "How can we make accurate measurements?" Then we'll turn to rf measurements in particular by asking "How can we measure rf without lab equipment?" Having eliminated lab equipment, we will next turn our attention to an instrument which was considered only as lab gear up until a few years ago as we find out "Why use an oscilloscope?" and finally we'll tackle a bit of unavoidable (but, we hope, not painful) mathematics by asking "What are dB?" All set? Let's get with it.

How Can We Make Accurate Measurements? In order to make accurate measurements, it helps to have a clear idea of just what "measurement" amounts to. We went through this in extensive detail in our earlier Advanced Class study course (now available as a book; order it!) and we won't go through it again, except to point out that any measurement is actually a comparison between an unknown quantity and a standard.

As it happens, only three basic causes of inaccuracy in any kind of measurement exist. If you can get rid of all three, you can't help but make accurate measurements. Unfortunately, we can never escape one of them, and so no measurement can ever be completely accurate. The best we can hope for is an *acceptable* degree of accuracy in our measurements. Just how accurate we must be to be acceptable is determined entirely by the purpose for which the measurement is being made. That is, if we only want to know whether our transmitters are generating output in the 80 meter band or on 40 meters, an accuracy of several dozen kilohertz is acceptable. But if we're hugging the band limit just as close as we dare in hopes of getting a better shot at some DX prize, then we need accuracy measured in hertz or even tenths of hertz.

The three basic causes of inaccuracy in measurement are: 1) improperly calibrated standards and/or instruments; 2) using the wrong instrument for the job; and 3) using the right instrument in the wrong way.

The inescapable inaccuracy in any measurement stems from the fact that perfect calibration is impossible. Even our "standards" have some small degree of built-in error. For most practical purposes this doesn't matter too much, but every now and then it fouls things up rather smartly. One example is in the measurement of frequency. Most of us take it for granted that WWV is an absolutely accurate standard of frequency. In point of fact, it is not. The accuracy of WWV is only about one part in 10,000,000,000,000. For almost any ham purpose, this is adequate, and our assumption is safe. When measuring time intervals of a microsecond or so, however, cumulative error can creep in from this source.

The more important side of our WWV example is that the signal has that accuracy only at the WWV transmitters! As soon as it leaves the transmitting antenna and is propagated several hundred to several thousand miles, often by way of one or more ionospheric jumps, the varying distance over which it travels introduces additional inaccuracies—and these cannot be compensated for by any techniques now known.

The problem was sufficiently serious, in this day of fractional-microsecond accuracies required for space probes, that a special low-frequency service was established to provide ground-wave propagation of the WWV signal on a global basis. This takes much of the propagation error out of the standard—but not all, and the standard isn't precise to begin with.

On a more practical level for us, any instrument which we use for measurements must be calibrated to some kind of standards, and the accuracy of the measurements made cannot be better than that of the instrument's calibration. Fortunately, for most ham purposes an accuracy of 2 to 5% is more than adequate. The only major exceptions are the measurement of frequency and of time, and for both of these far more accurate standards are readily available.

Mention of using the "wrong instrument" for any measurement may bring to mind immediately visions of an elaborate lab filled with exotic test equipment. However, for our purposes most of it is totally unnecessary. The ham who knows what he's doing and how to use the equipment he has can make almost any measurement he's ever likely to need with nothing more elaborate than a good vom, his regular station transmitter and receiver, and a moderately stocked junkbox from which to build any special adapters for special jobs.

It's a little easier if the list of test equipment includes a vtvm capable of reading both ac and dc voltages as well as resistance; in this case the quality of the vom can be considerably less since its primary purpose then will be the measurement of dc. A scope helps too, but that's another question on our list so we'll ignore it for now.

Even with this restricted list of test equipment, it's not too difficult to use the wrong instrument for the job. A classic example, which has probably happened at least once to anyone who has ever used a voltmeter on both ac and dc voltages, is that of leaving the meter set for ac while measuring dc. The needle will still indicate, but the calibration is way off because the rectifiers necessary to measure the ac voltage offer some resistance to dc, and the scale calibration usually includes an automatic conversion from peak-to-peak or average readings (which is what the meter actually measures in almost every case) into rms readings, which are the values we usually use to refer to sine-wave ac voltage or current.

It's also spectacularly easy to leave the meter set on a resistance scale and attempt to measure high voltage; in this case, you usually have no doubt about the fact that something went wrong. Rather than attempt to straighten the bent needle, it's usually best to purchase a new meter!

But a little forethought and caution (and, let's face it, some bitter experience too) will help you avoid this cause of inaccuracy. By far the largest source of inaccuracy in most electrical and electronics measurements comes from using the right instrument, but using it in the wrong way.

The list of examples of using the right instrument in the wrong way is almost endless; we can show only a few. One of the more obvious is to attempt to measure a high value of resistance (say, a couple of megohms or more), using a vtvm on the highest scale. So far, so good. But just to make sure that the test probes are in good contact with the resistance being measured, let's grasp one in each hand and press it firmly against the terminal or lead it's supposed to touch.

Surprise! No matter what the actual resistance, the meter reading will usually be around half a megohm. For some people, especially on a hot and humid day, it will be much much less. After all, the human body has resistance too, and it varies from as little as 10,000 ohms up to two or three megohms (for dry skin). Putting this resistance in parallel with the resistance being measured plays hob with the measurement.

A more subtle error in the use of measuring instruments occurs whenever we forget that any meter requires *some* power out of the circuit being measured. In other words, the meter will load the circuit. This becomes most apparent when you attempt to measure the voltage between a hot chassis and ground, especially if the chassis is hot because of a very-high-resistance leakage path through supposedly good insulation. The "circuit" we're measuring in such a case is the series circuit from power line through several hundred thousand ohms of leakage resistance to the chassis itself, through ground, back to the grounded side of the power line. If a 25-megohm (input resistance) vtvm is used to measure voltage between the chassis and ground, you'll probably read about the same voltage as you would get from simply measuring the power-line voltage itself.

But a 20,000 ohm-per-volt (Ω/V) vom is adequate to make this measurement, if it's used properly.

Setting it to the 150-volt or even 300-volt ac scale, however, is not proper use. On those scales, the average hot chassis will measure out at only 30 to 50 volts—from ¼ to ½ the actual voltage present. Because on the 300-volt scale, the meter's total resistance is only about 1.5 megohms (a 20 kΩ/V meter typically has only 5 kΩ/V sensitivity on its ac ranges) and this, in series with approximately equal quantities of leakage resistance, cuts the voltage *at the meter* way, way down.

The proper technique, in this case, is to set the vom to its highest ac voltage scale and then make an educated guess about the reading. After all, if you measure anything over 80 to 100 volts you know something's wrong; absolute precision isn't necessary in this case. And on the highest scale, the meter's resistance is highest so that circuit loading is least.

The same principle applies to measuring avc voltages in receiver circuits, and frequently to the measurement of screen-grid voltages (if they are obtained via series dropping resistors). The series resistance of a typical avc circuit is in the megohms; even a vtvm loads such a circuit slightly, and an ordinary vom will impose such a load that the measurement will not only be inaccurate but the circuit will fail to work properly so long as the meter is connected.

This whole business of "loading," incidentally, is the reason that the vtvm was invented in the first place. By using a dc amplifier between the test probe and the meter, less power need be taken from the circuit and so less load is imposed by the measurement.

When attempting to measure dc voltages in the presence of rf voltage, things get even trickier. Then an rf choke needs to be connected between the test probe and the measurement point, as close to the measurement point as possible, to keep the rf out of the meter and let only the dc through. At the same time, the possibility of loading the circuit down by too low an input resistance of the meter is present. A typical vom on the 50-volt scale offers only one megohm input resistance; many oscillators, for example, use 470,000-ohm grid-leak resistors. Shunting this with a 1-megohm load will cut the actual resistance in the circuit down to about 300,000 ohms, which amounts to a 33% reduction of the intended resistance. This may cause circuit malfunction.

If the need is to measure rf in the simultaneous presence of dc, the problem is even trickier. RF voltage measurements are usually made by use of an "rf probe" which is simply a crystal diode detector mounted at the end of a test probe. These usually include a blocking capacitor to keep dc out of the diode, but are also usually limited to voltages smaller than about 20 volts peak. If the rf voltage to be measured is greater than that, then a capacitive voltage divider needs to be rigged up to reduce the voltage applied to the probe into the 20-volt range. This, however, increases circuit capacitance—and would undoubtedly detune any oscillator.

The vom and vtvm, between them, will take care of just about any measurement of voltage, current, or resistance you normally need to make, except for the measurement of very small rf voltages (such as those present on the antenna lead-in from received signal). For these, we can use the station receiver—but not in the customary manner of just reading the S-meter. We'll look at this in a little more detail in our next question—for right now, the hint is this: remember that measurement is simply a process of comparison, and almost any indicating instrument has high accuracy when it's used to compare two quantities (in contrast with its undetermined accuracy as a measuring device all by itself).

To measure time, the station receiver comes into play again. Tuned to WWV, it provides a precise source of 1-second timing "ticks." For measuring much longer times, a clock or watch is a little handier—but the measurement of time is not, in the usual course of events, a normal electrical measurement.

To measure power, some professionals use a special wattmeter. We can achieve the same result by measuring voltage and current at the same time, and plugging them into the power formula. If the power we're measuring is rf, we simply use rf instruments. But these aren't on our list, so to manage with the instruments we have, we can rig up an rf probe to permit measurement of rf voltage and then measure the voltage present across a known resistance. Then we square the voltage and divide the product by the resistance, to get the power in watts.

To sum up, we can use the vom and vtvm, when we take the proper precautions to avoid loading down the circuit under test and to assure that only the desired power gets into the meter, to find out almost anything we want to know about dc, or about any qualities of ac which can be converted meaningfully into dc levels to drive the meters.

But we cannot use these instruments, directly, to make measurements of those qualities of ac which do not convert readily into dc levels. Some qualities of this type are the frequency, the waveform, and the distortion level of an ac signal. Another is the frequency distribution of a complex signal such as the output of an AM or SSB transmitter.

How Can We Measure rf Without Lab Equipment? Any mention of rf measurements, for most people anyway, stirs up immediate visions of highly specialized test gear such as spectrum analyzers, frequency counters, and the like. And let's face it, such equipment is nice to have if you can afford it—but most of us find it hard enough to keep a kilowatt in the shack, and would consider a 5–10 kilobuck outlay on one or two items of seldom-used test gear a needless extravagance.

If one has a spectrum analyzer, a sensitive rf vtvm, a wide-range frequency counter or EPUT (events per unit time) meter, and a good impedance bridge accurate over the entire rf spectrum, and also knows how to use all this gear, measurement of rf (and the special qualities of ac which are difficult to measure with common test instruments) is a snap. Just connect the right gadget in the right way, and read the result off the indicators.

But it's not exceptionally difficult to get the same or even better accuracy in rf measurements with no more test gear than we've already listed as being adequate for dc measurements—a good vom, the station receiver and transmitter, and a well-stocked junkbox.

To show the truth of this statement, let's go down the list of fancy equipment we just set forth and find out what each instrument does, then figure out how to do the same with our restricted set of test gear. We'll start with the spectrum analyzer.

The spectrum analyzer is a device which displays on a cathode ray tube a literal picture of some part of the rf spectrum, as it appears at the input terminal. The horizontal axis of the display represents frequency, and the vertical axis indicates signal strength. If only one signal is present in the band the instrument is set for, the display will be a horizontal line with a single vertical pip on it representing that single signal. If many signals of differing strengths are present, each will be represented by a vertical pip, and the height of the pip will show the relative strength of that signal.

The display looks exactly like the familiar graphs of the spectrum which appear in almost any textbook or magazine article which discusses it, and that's the main thing that makes the spectrum analyzer so convenient to use.

What the gadget actually amounts to, though, is a highly selective receiver with a circuit in it which automatically sweeps the receiver across the selected portion of the spectrum, while sweeping the beam across the crt face at the same speed. The receiver's output drives the vertical deflection plates of the cathode ray tube.

And there's the clue to our cheap-and-dirty version. We don't have to have the tube display. All we really need is to tune a selective receiver across the spectrum, noting down the relative strengths of every signal we encounter. Then we can take pencil and paper, and draw a graph which shows the same thing as the display would.

One of the major ham uses for this type of measurement is to check a transmitter's output for spurious emissions. The spurious emissions may be unwanted sidebands, splatter out of the desired channel, harmonics, or parasitics.

To make such a measurement on a transmitter, using the station receiver set to its most selective condition, the major problem is preventing overload of the receiver. The transmitter should (initially, anyway) be operated at minimum power, and be connected to a well-shielded dummy load rather than to an antenna. Even so, the chances of overloading a sensitive receiver are rather good. To test for possible overloading, disconnect the antenna cable from the receiver. Theoretically, you should not then be able to even detect your transmitter's signal—but few if any transmitters or receivers have this much shielding or filtering included in them. If you find the desired signal, but no others, you can proceed with the measurement; if you find spurious signals even under these conditions, they may be due to receiver overload—and they may actually be present in the transmitter output.

The simplest way to determine whether they are actually present in the transmitter output is to move the receiver to another location, leaving the transmitter operating into the dummy load. Alternatively, enlist the aid of another ham a half-mile or so away. *His* receiver shouldn't be overloaded by your signal, if your dummy load is a good one (although the chances are fairly good that he will be able to find it). Increase power until his S-meter gives a comfortably high reading on your main signal, but not higher than S9. Then have him search the regions where your receiver indicated spurious signals. If the signals you found were the result of overload in your receiver, he shouldn't be able to locate them. Similarly, if they were actually present in your transmitter's output, they should be equally detectable to him.

If the spurious signals were due to receiver overload, then incase the shielding and filtering of your transmitter, receiver, or both. Most modern transmitters, in these days of potential TVI, have reasonably adequate shielding and filtering. Few hams do. The shielding and filtering required are the same as that required to TVI-proof a transmitter. Details, of course, will vary from receiver to receiver.

In order to describe the measurement technique, let's assume that your receiver passed this initial test and has adequate shielding and filtering so that the only signal you detected was your own carrier. Adjust transmitter power level to provide a convenient reference level on your receiver's S-meter with carrier alone. It need not be high, since it is merely a reference point. The level should be considerably higher than that at which you made the initial test, though, so that if any spurious signals are present in the output they will now be strong enough to be detected.

Now search the regions of the spectrum in which you suspect the spurious outputs might be present. If you find one, keep the receiver tuned to it and increase the transmitter's output until the strength of the spurious signal is equal to the reference level at which you set the carrier initially. Keep track of how much you had to increase the transmitter power to do this. The ratio of new transmitter power to original transmitter power, when converted to dB, will give you an accurate measure of the strength of the spurious signal.

The measurement of strength will be accurate, despite inaccuracies in your S-meter's calibration, because the S-meter is used only as an indicator or reference point, and not to make the measurement itself. To put it another way, the S-meter only tells you when you have increased power enough to make the spurious signal as strong as the carrier was originally. The *measurement* is the comparison of transmitter power in the beginning and transmitter power necessary to bring the spurious signal up to the strength of the original carrier.

Checking across a wide stretch of the spectrum by this technique is a tedious business—but we never claimed it would be quick. It *is* a practical way to check for spurious output, with little test equipment. It can also be used to check the modulation index of an FM signal (by locating the point at which carrier disappears as modulation index is increased), and with minor variations to check both carrier and sideband suppression of an SSB signal.

The station receiver can also double as a sensitive rf vtvm. The rf vtvm is, essentially, an instrument for measuring rf voltages which are very small to begin with. If an accurate measurement of the voltage is desired, an accurate standard for comparison will be necessary—but most uses of rf vtvm are more concerned with the presence or absence of rf voltage at some specific frequency, or its relative strength as some adjustment is varied, and for these no standard is needed.

The procedure for using the receiver as a vtvm is essentially the same as that for making a spectrum analyzer of it. You tune in the signal, and use the S-meter as an indicator of signal strength.

If your receiver has no S-meter, don't let that stop you. Simply connect your vtvm to the avc line (most easily located at the cold end of the first i-f transformer, where a bypass capacitor and isolation resistor should be connected) and measure the relative voltage there. If you have no vtvm, it's still possible to get a fair indication by connecting the vom to measure screen voltage on any controlled i-f tube; unless the screens are fed from a regulated source (and in a well-designed receiver with avc, they won't be, because the variation of screen voltage with avc level helps smooth out the avc action of the receiver and compensate for some nonlinearities inherent in the design of the tubes) this will give you the desired measure of signal strength. Screen voltage will rise with increasing signal strength, as the avc voltage reduces the tube's cathode current.

The frequency counter or EPUT meter is a bit more complex to simulate with a restricted list of test gear, because its purpose is to measure frequency of an ac signal over a very wide range, and the cheap-and-dirty techniques cover only limited ranges.

A frequency counter consists of several different kinds of circuits. One actually counts the individual cycles of the signal and tallies them up on the visual indicators. Another provides an accurate time reference. Still another acts as a gate, to apply the input signal to the counting circuits for a specified period of time and then to shut it off.

All together, the circuits actually count the number of cycles of the input signal which occur during the time the gate is open, and display the resulting count on a set of indicators. If the input signal is ordinary 60 Hz ac power and the selected time interval is one second, the resulting count may be 59, 60, or 61, depending upon what fraction of a cycle happens to get cut off at the beginning or end of the one-second measurement interval.

Setting the time base to 10 seconds provides an extra digit of accuracy. The indication now will probably be 59.9, 60.0, or 60.1. Going up to a 100-second base adds still another digit, but your power company probably doesn't keep the frequency any more constant than 0.1 Hz either side of the nominal 60.

Most commercial frequency counters offer at least 5-digit readings, but few of them offer time bases longer than 100 seconds. The frequency range usually runs from 1 Hz or so at the low end, up into the VHF region, with time bases as short as a microsecond for measurement of very high frequencies.

To measure frequency in the ham shack, it's not very practical to attempt to duplicate the frequency-counter approach. Instead, we usually divide the ac spectrum into three or four different ranges, and use different techniques for each. For everything except VHF and above, the basic technique is that of comparing the unknown frequency to a known standard.

At audio frequencies, our standards can be 60 Hz ac from the power line, tuning forks, or the 440 Hz and 600 Hz signals broadcast by WWV. Another standard sometimes used is a well-tuned piano.

The ear can be used as a comparison device with surprising accuracy; while few persons have perfect pitch, most of us can tell when two tones differ in pitch—so if enough standards are available, at least one is likely to be fairly close in frequency to the unknown signal.

A variable-frequency audio oscillator can be calibrated by comparison against several standards, and then used as a secondary standard for comparison to the unknown, with the ear still serving as a zero-beat indicator.

Yes, we know a variable-frequency audio oscillator wasn't on our list of equipment—at least, not under that name. But the bfo of the station receiver, together with any source of steady-frequency rf such as the transmitter's oscillator, provides a most handy source of audio tones, and is usually continually variable throughout the audio range!

To increase accuracy of such measurements, a scope can be used as an indicator of zero-beat rather than trusting the ear. Just connect the scope's vertical input leads across the variable audio oscillator's output, and the horizontal input leads to the unknown signal. If the two signals differ in frequency, the tube will display a pattern of varying complexity. When the frequencies become identical (zero beat), the pattern will be either a straight line, a circle, or an ellipse. If it's an ellipse, it may appear to be rotating, and shift through the circle and straight-line conditions as it rotates. This indicates a very slight difference in frequency; the difference in cycles per second is equal to the number of times per second the pattern rotates. Keeping this in mind, it's easy to measure a *difference* of as little as 0.01 Hz in the two frequencies; whether the final frequency measurement has this accuracy will be determined entirely by the accuracy of the standard you're using.

When the unknown frequency is above the audio range, the same basic technique is still used but the source of frequency standards differs. A standard-frequency crystal oscillator is handy to have in this case; refer to your junkbox and rig one up. Zero-beat it against WWV, using the af measurement technique to get as much accuracy as you can. You now have a source of rf of known frequency—the usual standard is 100 kHz.

The frequency of the unknown signal is first approximated by comparison to other signals of known frequency. Then you turn on the frequency standard, and count harmonics of it from some known point. An easy point for most of us to locate in any ham band is the lower band edge; this is also, always, a harmonic of 100 kHz, and so when the receiver is tuned approximately to the lower limit the harmonic of the standard will mark the exact band limit. Other known points in the spectrum may be located in the same manner—if necessary, by counting multiples of 100 kHz from the nearest ham band.

The 100 kHz standard permits the unknown signal to be bracketed between two points 100 kHz apart, and it's usually not too difficult to determine which of these two it's closest to. This locates the frequency of the unknown signal to someplace inside an area 50 kHz wide; for many purposes this is close enough. If not, we call upon a second frequency standard. This is a multivibrator or frequency divider, slaved to the 100 kHz unit, which provides a 10 kHz signal as accurate as the 100 kHz original. By switching it on, and counting harmonics as we tune up from the known 100 kHz harmonic, we can bracket the unknown signal between two 10 kHz harmonics of known frequency.

If even this isn't accurate enough, we're not done. The 10 kHz frequency is within the audio range, and we've bracketed our unknown between two of these points so the error in our measurement this far cannot exceed 5 kHz. All we need do is measure the beat frequency between our unknown and the nearest 10 kHz harmonic (that is, the lowest frequency in the receiver's output), using audio measurement techniques, to locate the unknown frequency to an accuracy limited only by that of our standard.

This technique for measuring rf frequencies works equally well from the bottom of the rf region up to the VHF area; as frequency increases, the number of 100 kHz harmonics becomes a bit large so that VHF workers customarily use still a third standard oscillator set to 1 MHz to obtain a good starting point, but the technique remains basically unchanged.

By the time we get to 50 MHz or so, however, the strength of the 10 kHz harmonics is getting a bit weak. Somewhere in this region, most of us switch to a completely different measurement technique which depends upon the constant relationship between frequency and wavelength. Rather than measuring frequency in terms of time, it becomes easier to measure wavelength in terms of distance.

For this, we use what are known as Lecher wires. The term presumably has nothing to do with dirty old men. A set of Lecher wires consists essentially of a parallel-wire transmission line which is at least one wavelength long. For 50 MHz use, that's just under 20 feet. One set will suffice for all measurements. In addition to the two taut parallel wires of the transmission line, which must be uninsulated and supported only at their ends, we have a shorting block which shorts the two together and which can be moved the length of the wires, and a connector at one end to connect the wires to the transmitter output. Often, the shorting block includes some indicator of rf current such as a pilot lamp. In another version of Lecher-wire technique, the short is left permanently in place at one end of the wires and the transmitter is connected to the other end; in this case, an indicator of rf voltage is arranged so that it can be moved the length of the wires to measure voltage between the two conductors at any point along their length.

The idea behind the Lecher wires is that every condition which exists on a transmission line will exactly repeat itself every full wavelength down that line, and many conditions such as peak absolute voltage (without regard to phase) will exactly repeat every half-wavelength.

Thus if a transmitter is coupled to a set of Lecher wires with the shorting bar set at the far end, and adjusted for a specific amount of plate current at resonance, and then the shorting block is moved closer to the transmitter, the conditions under which the transmitter's output stage operates will change as the shorting block moves. When the block has been moved exactly a half wavelength, however, the conditions will have returned to the exact duplicate of those at the start, and the plate current will again be what it was at the beginning. Simply measuring the distance through which the block was moved and multiplying by two tells us the wavelength; converting wavelength to meters and dividing the result into 300 gives us the frequency in MHz.

As described, the Lecher wires can be used only to measure frequency of a transmitter, and that is their most usual use. They can, however, be used as a tunable trap to trap out the signal, and thus can be used to measure frequency of signals other than those produced by a transmitter—if you have a receiver capable of detecting the signal being measured. The technique is similar; the signal being measured is coupled to the receiver, and the Lecher wires are connected in parallel with the receiver input. The receiver S-meter, or a similar indicator rigged up as we discussed earlier in connection with rf vtvm's, is used to indicate signal strength. At some positions of the shorting bar, signal strength will reach maximum, and at other positions of the shorting bar, signal strength will be minimum. The distance between two points of either maximum or minimum strength will be a half wavelength; you can use whichever is easiest to detect.

The impedance bridge is a device for measuring the impedance of any circuit at any specific frequency, and this is the hardest of all the lab-type instruments to duplicate in a cheap-and-dirty version with limited test gear. Fortunately, its major use for ham purposes is in the matching of antennas to transmitters and feedlines, and this application can be simulated by simple measurement of swr on the feedline.

To measure swr on a feedline, locate a point on the feedline at which the rf voltage is at a maximum. This is simple with open-wire feedlines and not too difficult with twin-lead, but coax poses a difficult problem not easily solved. When the rf voltage maximum is located, if the frequency is known you can find the voltage minimum point a quarter-wavelength in either direction from the maximum point. The vswr is simply the ratio of maximum voltage to minimum voltage.

At sufficiently high frequencies, a variant of the Lecher wires can now be used to adjust the swr to unity. This consists of a length of open-wire transmission line with an adjustable short, at least a half wavelength long, which is connected across the load (or, alternately, at some multiple of half a wavelength back from the load). By moving the short along this line, the swr can be changed to anything from unity to infinity. The principle is that the impedance of the "tuning stub" changes from zero to infinite as the shorting stub moves through a quarter wavelength distance, and is either capacitive or inductive, depending on whether the stub's effective length is greater or less than a quarter wavelength.

When the stub is adjusted to bring swr to unity (1.0 to 1), then the impedance of the stub is exactly canceling any reactance in the load itself, and the resistive element of the stub's impedance is bringing the load's resistance to a match as well. The impedance of the stub can be calculated from its length, and a bit more calculation will reveal the impedance of the load.

This technique is actually that employed in most microwave labs; instead of a "tuning stub" they call the adjustable element a "slotted line," and they perform the calculations graphically by means of a "Smith chart." The result is the most accurate measurement now possible of rf impedance at very high frequencies—but it's more trouble than most of us find convenient.

Why Use An Oscilloscope? You may recall that our list of minimum test equipment did not include an oscilloscope, yet the scope is one of the most convenient of all test instruments to use and many hams working with RTTY or sideband feel that the scope is as indispensable as a receiver or a transmitter. Let's examine the instrument in detail and find out why it's so convenient.

An oscilloscope—any oscilloscope—is built around a cathode ray tube. In addition to the tube itself, the scope includes power supplies. Most scopes also include amplifiers to drive both the vertical and horizontal deflection plates of the tube, and a horizontal-sweep circuit of some type to provide a "time base."

The differences between scopes are, for the most part, differences in the deflection amplifiers and in the horizontal sweep circuitry. An inexpensive "general-purpose" or "service" scope typically has a vertical deflection amplifier with frequency response from the subsconic up into the low rf region (5 Hz to 500 kHz, frequently), a horizontal amplifier with more restricted bandwidth, and a sweep oscillator which provides a sawtooth waveform from 15 to 20 to 200,000 pulses per second.

More expensive "service" instruments often provide a vertical-amplifier frequency response from dc up to 4 or 5 MHz, to provide the capability of viewing all key waveforms in a color-TV chassis.

"Lab-type" scopes are more elaborate; they may provide amplifiers with frequency response from dc up to 50 or 100 MHz, with much more accurately calibrated "triggered-sweep" or even "delayed sweep" timebase circuits. The "X-Y" scope has identical vertical and horizontal amplifier circuits. There are almost as many variations as one can imagine.

But while the variations among scopes lie mainly in the associated amplifiers and time bases, the heart is the cathode ray tube itself; it provides the characteristics which make the scope useful.

Like any other vacuum tube, the cathode ray tube (crt) contains a heater, a cathode, and a grid. But there the similarities end. Instead of a plate, the crt contains several additional electrodes known as "focus" electrodes, and an "accelerator" electrode. In addition, the crt's used in most scopes contain two pairs of "deflection plates." And finally, the "face" of the tube is coated on the inside with a "phosphor," which is a substance that glows when struck by rapidly moving electrons.

The heater brings the cathode to a temperature which permits electrons to boil off its surface, and these electrons are attracted toward the focus and accelerator electrodes, passing through the grid structure en route.

However, the shapes of all these electrodes are such that the electrons—at least, most of them—never reach either the focus electrode of the accelerator directly. Instead, the same electric forces which attract the electrons away from the cathode shape the stream of electrons into a tight beam, which passes through appropriately shaped openings in the focus and accelerator electrodes and goes on to strike the phosphor at the tube's face.

Once the electrons hit the phosphor, they can bounce back in all directions inside the tube and thus make their way to the accelerator, completing the electric circuit. When the electron beam strikes the phosphor, though, it creates a glow where it hit—and that's the whole purpose of the crt in the first place.

The intensity of the glow depends on the number of electrons which hit the screen (phosphor), and this is in turn controlled by the grid-cathode bias of the crt just as in a conventional vacuum tube.

The physical size of the beam depends upon the balance of the forces which shape the beam in the first place, and so is affected by many things. The beam intensity, the speed at which the electrons are traveling, and the relative voltages between focus electrode and cathode and between focus electrode and accelerator all have some effect upon beam size. The major control of beam size is the voltage present between focus electrode and cathode. If the other factors are in the right general area, the voltage on the focus electrode can be adjusted to shape the beam into the smallest possible physical size—or, by analogy with optics, to "focus" the beam to an apparent point.

The speed at which the electrons in the beam are traveling is determined by the voltage between accelerator and cathode. The greater the voltage, the faster the beam.

Since the electrons are packing more energy when they move faster, this will also affect beam intensity. Most crt's operate with voltages of 1 to 25 kV between accelerator and cathode; typical values for a 5-inch crt would be about 2000 volts. The high voltage is required because of the physical distance between cathode and accelerator, and also in order to establish the proper "electron ballistics" to permit focusing action. While the voltage is high, the current is very small, normally being in the microampere range.

The combination of heater, cathode, grid, focus, and accelerator is known as an "electron gun." The electron gun supplies a steady stream of electrons in a nice tight beam, but all that does on the screen is produce a single intense dot of light. For the tube to serve any useful purpose, that dot must be moved about on the screen and that's the purpose of the deflection plates.

The two pairs of deflection plates are arranged at right angles to each other, so that the beam passes halfway between the two plates of each pair on its way from electron gun to screen (some crt's use "postdeflection acceleration," with an additional accelerator between deflection plates and screen, but this is a complication we won't go into here; the principles are similar).

The electrons in the beam are, of course, negative charges, and are subject to the laws of electrostatic attraction and repulsion. Thus, if one plate in a pair is made positive with respect to the beam, the beam will be attracted toward that plate. If the other plate goes negative at the same time, the beam will be repelled from the negative plate and attracted toward the positive one. By independently adjusting the voltages on each pair of plates, the beam can be moved to any desired location on the crt screen.

In practice, both plates of each pair are usually kept at approximately the same voltage, which is usually 150 to 300 volts more positive than the accelerator. To keep things within reasonable limits, many scopes have the crt hooked up so that its cathode is 2000 volts negative with respect to ground, its accelerator is at ground level, and the deflection plates are 200 to 300 volts positive to ground. This permits direct connection from the deflection amplifier plates to the deflection plates of the crt for better low-frequency response, and all the high-current voltages are kept to moderate levels. In such a hookup, the deflection plates are still around 2200 volts positive with respect to the crt cathode, however. The exact ratio of voltages between one plate and the other of each pair is adjusted as necessary to put the electron beam in the center of the screen with no signals applied; this is the purpose of the "centering" controls on the scope.

The signals to be displayed on the scope are then applied to the deflection plates, and thus move the spot around the crt screen in a manner determined by the waveform and intensity of the signals. If a sine-wave signal is applied to the vertical plates while a sawtooth signal is applied to the horizontal plates, the resulting spot movement will trace a conventional "picture" of the sine-wave on the screen.

Like the more conventional dc meter movement, the scope changes an electrical force into visible movement of something. Where the ordinary meter moves a pointer which has considerable weight and limited speed of response, however, the scope is moving an electron beam which has, for all practical purposes, no weight or inertia at all and so is capable of almost unlimited response speed. An ordinary dc meter cannot follow the fluctuations of a 20 Hz signal rapidly enough to be read conveniently; an ordinary scope can easily display variations in a 50 MHz signal, if its deflection amplifiers are bypassed and the signal connected directly to the deflection plates.

This rapid response, and the ability to draw waveform pictures which correspond to the way most of us imagine waveforms, are the two features that give the scope its chief value. There's something about actually *seeing* a signal that no amount of indirect measurement can provide.

We've already mentioned the use of the sawtooth or "time base" horizontal sweep for waveform viewing, but the scope is equally useful as a direct comparison instrument. If one signal is applied to the vertical plates and another signal to the horizontal plates, the resulting display on the screen will be an instantaneous comparison of the two signals. If one signal is an unknown frequency while the other is the known standard (or, better yet, an adjustable-frequency secondary standard), the screen display will provide an indication of the relationship between the two frequencies. If the display is a stationary pattern, the unknown is an exact harmonic of the standard or vice versa; at any rate, one of the frequencies is an exact multiple of the other. If the pattern moves, the relationship is not exact.

The signals being compared do not have to be completely separate signals. A signal can be compared against itself. If the same signal is applied to both the horizontal and the vertical plates, the screen display will be a single line inclined at a 45 degree angle from the horizontal. If the vertical plates are fed by the signal from the output of an amplifier's input, the display will show the effect of the amplifier on the signal. Since the amplified signal is stronger than the input signal, the vertical deflection will be greater than the horizontal and the display will be moved nearly vertical. If the only thing the amplifier does to the signal is to amplify it, this will be the only difference in the displayed signal. If the amplifier also introduces distortion, though, the vertical plates will get the distortion components of the signal and the horizontal plates will not—and the display will no longer be a straight line! Instead, it will show "squiggles" indicating the presence of distortion.

If the amplifier changes the phase of the signal, the display won't be a straight line either—instead, it will be an ellipse or a circle (which depends upon the amount of phase shift introduced by the amplifier).

Since this comparison is essentially that of a signal against an amplified version of itself, it can be used at any frequency to which the deflection plates can respond. In practice, this means any frequency below the UHF region.

If linearity of an rf amplifier is being checked by this method, though, it's often more convenient to modulate the rf, then use detectors at both the input and output test points to convert the modulated rf to audio and make the actual comparison on the audio components rather than the rf itself. When this is done, the scope's internal amplifiers can be used, and the effects of the amplifier's gain canceled out by amplifying the input-side signal a corresponding amount more than the output-side signal. This often makes the distortion easier to see, since it is normally very small in comparison to the original signal level.

What are dB? It's almost impossible to do anything in radio any more without running into "dB," the abbreviation for "decibels." It's also almost impossible to find anyone capable of giving a brief yet clear and accurate description of what these beasties really are. Let's give it a try, anyway.

The word "decibel," itself, is the standard metric-system indication for a unit of measurement which is one-tenth of a "bel." This doesn't help much, because even fewer persons are familiar with "bels."

The "bel" is the unit of power ratio, and simply indicates a 10-to-1 power ratio. A 100-watt amplifier is one "bel" more powerful than is a 10-watt unit, and similarly the 10-watt unit is one "bel" more powerful than a 1-watter.

This makes it appear that a 100-watt rig would be only two "bels" more powerful than a 1-watt outfit—and that's exactly right. Each "bel" indicates an additional 10-time increase in power, so that two "bels" means 10 times 10 or 100 times as much power.

It only takes six "bels" to make a million-time power increase. Sailors who are used to the expression "eight bells and all's well" would be floored if they were talking about "bels" instead of "bells," because that's a power ratio of 100 million to 1.

Obviously, the "bel" is far too large a unit for comfortable use. That's why "decibels," which are only one-tenth as large, are the unit in common usage.

It might appear that, since a decibel is 1/10 of a bel and a bel is a 10-to-1 ratio, a decibel would be 1/10 of 10-to-1 or simply a 1-to-1 ratio. However, that's *not* the case, and the reason is far from obvious. It comes about because of the way in which the ratio is converted into a number to make the "bel" unit in the first place. To get one "bel" from a ratio of 10, or two "bels" from a ratio of 100, what we really did was simply count the zeros in the ratio. The number "10" has one zero, so that's one bel. Similarly, 100 has two zeros, so it's two bels. A million is written as "1" followed by six zeros, and so it's six bels. And so forth.

This business of counting the zeros is the first step of the mathematical process called "taking the logarithm" of a number. If the number happens to be an even multiple of 10, it's also the last step of the process as well—but if it's not, there's much more to it. The "bel" is thus defined as the *log* of the power ratio.

When we stepped down from the massive "bel" to the more conveniently sized "decibel" we applied our factor of 1/10 to the *unit* itself, not to either the ratio of the log of the ratio. The bel is still what it always was; it just takes 10 times as many decibels to make a bel. Since the bel is the log of the power ratio, this means that 10 dB = log (P1/P2). One dB, then, would be 1/10 of log (P1/P2); we usually write this equation a little differently. We turn the ratio upside down so that the log gets multiplied by 10 rather than divided, and come out with the formula you'll find in all the textbooks: dB=10 log (P2/P1).

We've made this brief excursion into "logs" and equations just to show where the formula came from. In actual practice, you don't need slide rule or log tables to work with dB to as much accuracy as is ever needed in any radio work.

All you need is the knowledge that an additional 10 dB is a 10-time power increase, 100 dB is 100 times, etc., plus a knowledge of the ratios indicated by each dB value from 0 through 9. Even of these 9 ratios, you'll normally use only a couple.

The ratio for zero dB is 1 to 1. If an amplifier is rated for 0 dB gain, its gain is exactly one. To see this most easily, convert the dB back to bels for a moment. Ten times zero is still zero, so 0 dB equals 0 bels. The number of bels, we recall, is equal to the number of zeros following the "1" in the power ratio. One followed by no zeros remains one, so the ratio is 1 to 1.

The most important dB-to-ratio number to remember is that for 3 dB. This is a 1.995-to-1 power ratio, which is so close to being 2-to-1 that nobody ever pays any attention to the difference. Remember it as 3 dB equals twice the power.

Back at the beginning of this question, we saw that *adding* dB (or bels) is the same as *multiplying* the power ratio. It follows, then, that 6 dB should be just barely less than a 4-to-1 ratio. The actual ratio is 3.931 to 1, but 4 to 1 is close enough for any practical work again.

A single dB is a ratio of 1.259 to 1; the easiest way to remember this is as 5-to-4 ratio, or 1.25 to 1. You don't really need to remember it, except that it gives you the ability to figure out the ratio for any other number of dB.

For instance, working from the 5/4 ratio for 1 dB, we would get ratios of 25/16 for 2 dB and 125/64 for 3 dB.

Let's see what happens when we use both the 3 dB and 1 dB values this way to calculate the ratio for 10 dB (which we already know is really 10 to 1): To tally up 10 dB from our 3 and 1 dB figures, we get 2x2x2x(5/4). This comes out to 40/4, or exactly 10 to 1. The small errors in both the 2-to-1 figure and 5-to-4 figure have canceled each other out.

If we did it with nothing but the 1 dB figure, we would multiply 5/4 by itself 10 times. This comes out to be 9765625/1048576, or a ratio of 9.3+ to 1. In this case, our error has accumulated a bit. The moral is clear; when you figure out the other values, use both the 3 dB and 1 dB values to keep the error to a minimum.

Now let's use these facts we have memorized to find out the power ratio indicated by 37 dB. First, we dissect the number "37" into its components, 30+3+3+1. The "30" gives us a ratio of 1000/1. Each "3" gives us a ratio of 2/1, and the "1" gives us a ratio of 5/4. The total "37" must, then, mean a ratio of 1000/1 times 2/1 times 2/1 times 5/4, or 4000/1 times 5/4, which works out to be 20,000/4 or 5000/1. An amplifier rated for 37 dB gain would, then, produce a power ratio from output to input of 5000 to 1. A hundredth of a watt at the input would produce 50 watts at the output.

You may have noticed that we've only looked at positive dB figures. Often, ratings are expressed in negative dB. While it's just as easy (or difficult, as the case may be) to work the math for negative as for positive logs, the simple way out is to always think in terms of dB without sign, and then read the sign as meaning "gain" or "loss." Positive dB indicate gain and negative dB indicate loss. An attenuator rated for −37 dB from input to output still involves a 5000/1 power ratio, but now it's in the other direction and the output power is only 1/5000 as great as that at the input.

"Great," we can hear you mumbling, "but what about dB of voltage or current? All you've mentioned yet have been *power* dB, and most of the time we use the other kind!"

Relax. There *is* no other kind. Decibels, *any* decibels, always indicate power ratio. Granted, the textbooks show you a different formula if you're dealing with voltage or current measurements–but that's just to keep you from having to convert the voltage or current into power by using Ohm's law before making the dB conversion.

And since that "other" formula–the one that says dB=20 log (E2/E1)–*is* a combination of the dB formula, the power equation P=E x I, and Ohm's law all wrapped up in one package, it can get you into big trouble with the kinds of questions the FCC puts on its exams.

If, on the other hand, you fix firmly in mind that dB are measures of power ratio and nothing else, you can't go wrong. If the problems fails to mention power and gives you either current or voltage instead, just convert the current or voltage to a power by plugging it into the power equation. Then use the decibel relationships we've already examined.

Many times, both on exams and in practical work, you may find that only a voltage or a current is given; there's only half the information you need to figure out the power. What then?

If the two voltages being compared are both being measured across the same (or equal values of) resistance, you can get the power by squaring the voltage and dividing by resistance. This is just a combination of the power equation and Ohm's law; Ohm's law tells you the current given the voltage and resistance, while the power equation tells you the power when current and voltage are known.

As a matter of fact, this can be done even when the resistance values differ! And when the resistance values are equal or the same, you don't even have to know what the resistance is, because when you take the ratio of the two power figures, the resistance will cancel itself right out of the calculation.

That means that all you have to do is use the *square* of the voltage in place of the power figure, and everything we've said about dB will still hold true. But this will work *only* if both voltages are measured across the same resistance value; if the input voltage is measured across one value of resistance and output voltage is measured across some other resistance value, then all bets are off. For example, you might measure 1V at the input of an amplifier across a 1-megohm resistor, and find 1V at the output across a 10-ohm load. If you simply work with the voltage ratios, you have 1/2 or 0 dB ratio. But 1V across one megohm is just a microwatt (1/10000000 watt), while 1V across 10 ohms is 1/10 watt, so the amplifier itself must have a power gain of 100,000–which is 50 dB!

In the one very special case of identical resistances, however, the ratio of the squares of the voltages can be used in place of the power ratio; now as it happens, one of the nice properties about log-type numbers is that the log of the square of any number is just two times the log of the number itself. Similarly, the ratio of the squares of two numbers is exactly the same as the square of the ratio of the two numbers–you can take the ratio either before or after squaring, so long as the end result gets both the input and output voltages squared. That means all we have to do to the "power" or universal version of the dB formula is plug in "E" instead of "P," and multiply by two–which is where the "other" formula applies only to a single special case, while the "power" version applies to everything.

. . . Staff

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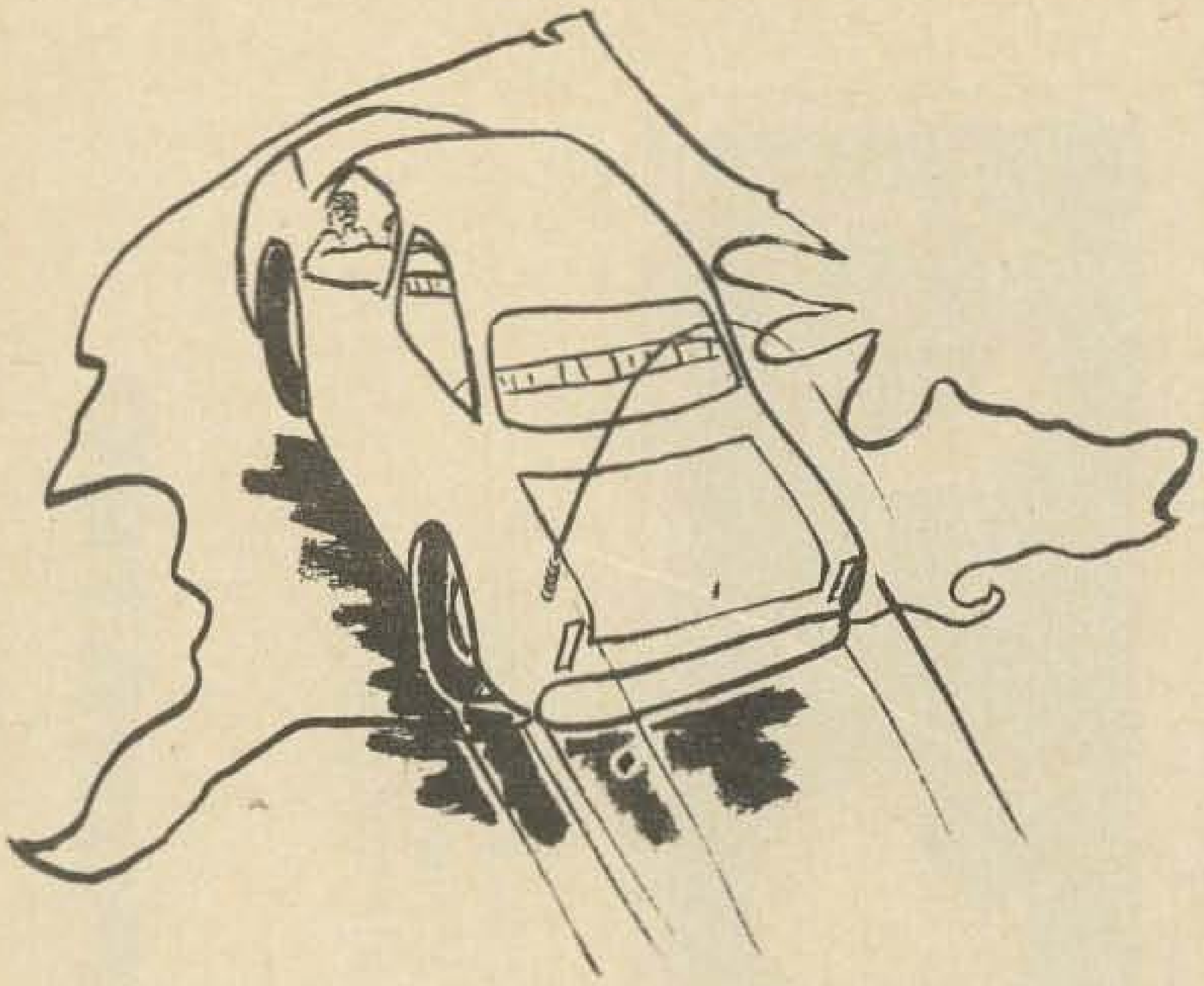
VHF FM & ...YOU

Why has this mode made such a sweeping impact on amateur radio?

The past few years have shown a marked increase in the number of amateurs operating on the 50 MHz, 144 MHz, and higher frequency bands. Many of these amateurs are using surplus or obsolete commercial FM equipment. This rise in FM activity is due to several factors, including the availability of equipment and the need for reliable single-frequency communications. The availability of equipment is due to two prime factors: The "splitting" of commercial FM channels has rendered many older units unsuitable for commercial use. Also, recent trends in miniaturization have made many units obsolete in terms of size, reliability, and battery-power consumption.

The need for a reliable single-channel system stems from several factors: The

average American is much more "mobile" than ever before. In previous years of amateur radio operation, people in certain



The average American is much more mobile than ever before.

areas monitored specific frequencies. Since almost everyone was using AM, close receiving and transmitting tolerances were not required. Today, with the accuracy needed for monitoring and transmitting on specified SSB frequencies, it is becoming less and less popular to do so. Of course, there are a few frequencies that are monitored in certain areas, but these are relatively rare. Also, the congestion on the lower frequencies is increasing, thus requiring more and more power in both mobile and fixed-station equipment.

The trend is thus towards a universal fixed-frequency type of operation in cases where reliability and performance are required. This has been met by using certain specified frequencies and fixed-frequency FM equipment. The most popular of the universally accepted VHF frequencies are 52.525 and 146.94 MHz.

Operating on VHF FM

Operation of VHF FM is very much like operation on the lower frequencies, and yet it is very different. It is like AM, SSB, and even CW in that there is much ragchewing, many technical discussions, and even emergency and traffic nets. You can call your buddy, check out equipment, and handle traffic and emergency situations. It is quite unlike SSB, AM, and CW in that there is no need to retune the transmitter and receiver every time you operate; there is usually no background noise whenever the frequency is not in use (almost every piece of commercial FM gear has a noise-stopping squelch); high power is not needed for general use; and the frequency is almost constantly monitored.

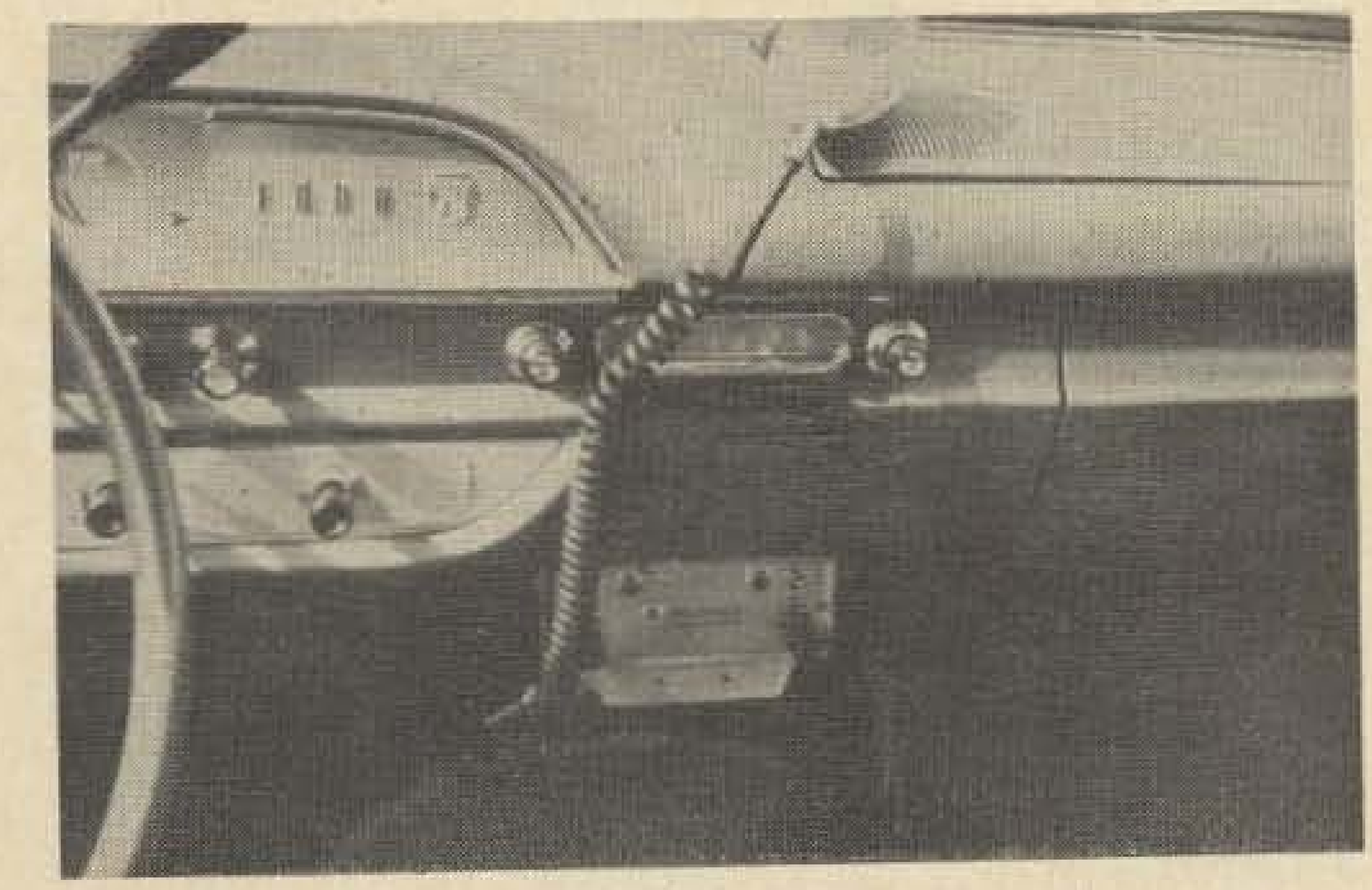
Although the sudden popularity of FM and the increasing availability of specially designed gear threaten to change the picture, the equipment used by the average FM'er has typically been obsolete commercial equipment previously used by police, fire, taxi, utility, and other groups. This equipment has a power *output* of from a few milliwatts to nearly 100 watts, and a frequency selection of from one to four crystal-controlled channels. The design of the equipment is excellent. The receivers often have sensitivity figures of 0.5 μV (for 20 dB of noise quieting) or better. Operation of the equipment is quite simple, for it was originally designed to be used by nontechnical people in business or emergency situations. The controls usually consist of an on-off-volume control, a squelch control, and a push-to-talk microphone.

Many amateurs operate using "wideband" or ±15 kHz deviation. Some amateurs in certain areas are gradually shifting to "narrowband" or ±5 kHz deviation. This poses no real difficult problems, for narrowband signals can be received on wideband equipment (with an apparent loss of audio volumeand subsequent decrease in signal-to-noise ratio). Wideband signals can rarely be received on narrowband equipment without adjustment of the transmitting or receiving equipment, however.

Almost every metropolitan area now has at least one repeater system which will pick up and rebroadcast signals. In most cases, the input of these repeaters is 146.34 MHz and the output is 146.94 MHz. But in areas of extreme spectrum congestion, other frequency pairs are used.

The range of units (without using a repeater) varies with terrain and power output, as well as the type of antenna used. It has been my experience that the average unit now in use by the amateur FM'er (10W output with a quarter-wavelength whip) has about a 15-mile range of communication.

FM equipment is generally reliable, and when it does become necessary to either repair or service, it is relatively easy to work on. Many units use common tube types in both the receiving and transmitting portions, thus eliminating a parts scarcity problem. Most units are divided into three distinctive portions: transmitter, receiver, and power supply, with interconnecting cables. These "strips" are often interchangable between units, from base station to mobile and from mobile to base station. Trunk mount units are usually "wife approved," for the control



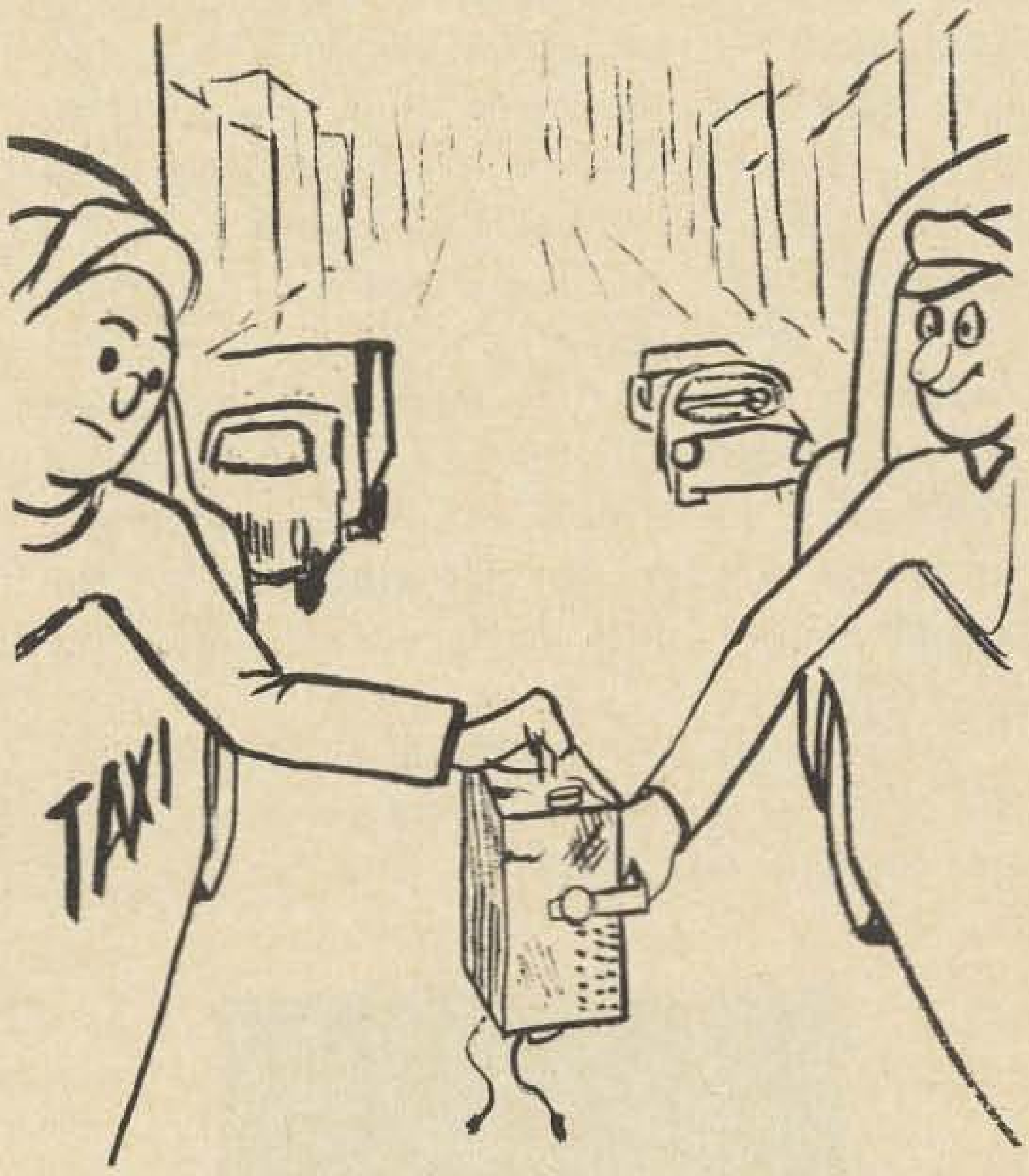
head and speaker take up very little room in the car. However, there is very little difference in performance of trunk mount and dash mount units of the same type.

Acquisition of Equipment

The old Bugs Bunny cartoons used to start with Elmer Fudd reading a recipe for rabbit stew. He would quote the first instruction as "First, catch a wabbit." Well, the first instruction in the recipe for good, amateur FM'ing is to first catch the unit.

Local sources of equipment vary. The best place to start is another amateur who is already active on VHF FM. Many FM'ers keep spare units around for trading and helping out newcomers. If you don't know any active FM'er in your neighborhood, then you will have to start looking elsewhere. In some localities the police and fire forces are possible sources. However, many departments either trade in older equipment on newer models, or they sell the units to the members of the department for monitor receivers and for auxiliary squad work.

Another possible source is taxi companies. The two-way radio is the life-blood of the taxi driver, so most cars are usually equipped. Herein problems also lurk. Many taxi companies trade in older units or sell them to the individual drivers. The units sold to the drivers often get resold to other



Many taxi companies trade in older units or sell them to individual drivers; but the units often get passed along more than once, and they come out the worst for wear in the shuffle.

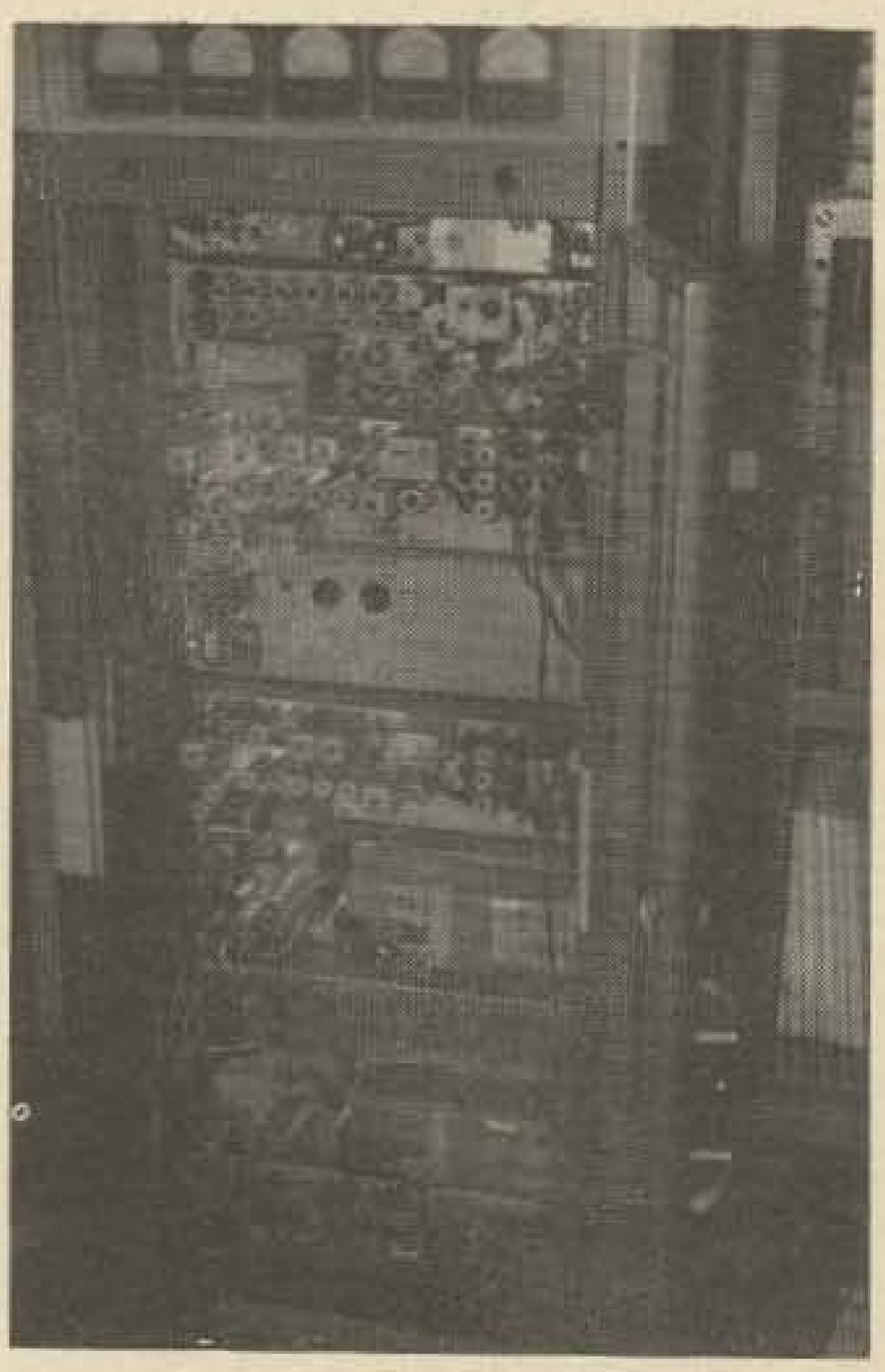
drivers and so on until the unit is either so old or so beat up that it is good only for a boat anchor.

The modern railroader is quite dependent upon communications, so FM gear is found around rail yards. Railroading is hard business, and the equipment often sees rough service. However, many amateurs have been able to obtain obsolete equipment from railroads. If there is a repair center in your area, check with the purchasing agent there. If not, talk with someone who works for the railroad and find out who takes care of the radios in your locality.

Sometimes two-way radio repair shops are subcontractors to the major manufacturers and some even buy and sell two-way equipment. However, many of these shops have a market for monitor receivers, system spares, and the like, and do not like to dispose of any extra pieces of equipment at low prices. There is always a chance, though, and even if the personnel do not have any units to dispose of, they often have information as to where such units can be obtained.

Utility companies usually buy equipment from the two-way manufacturers on an outright basis and seldom trade in older equipment. Often entire fleets of equipment are retired at the same time. Some companies will sell one or two units at a time while others will only sell in lots of 5, 10, 15 or more units. In these cases it is necessary for a group or club to purchase the units in order to meet the minimum purchase requirements. Of course, some utility companies have been known to give the units to a club for distribution to the membership – but such cases are the exception.

It is possible to purchase either portions of units or complete systems from companies who specialize in the surplus FM



market. These may be found by looking through the pages of this issue of 73. However, the prices are usually higher than would be paid if obtained locally. One advantage of dealing with a surplus house is that you have some recourse if you're not happy with your purchase within a reasonable period. Several of the surplus FM suppliers offer money-back equipment guarantees. Also, these companies often have a supply of schematics and other information on the equipment.

If you have a selection, always pick a mobile with a transistorized power supply over a vibrator (and a vibrator over a dynamotor, if in the same power output class). Always remember that power output is the measure of FM gear, not power input as in other equipment. If the unit is intended for fixed-station use, pick out the highest powered unit in best condition. If a choice is available between several units pick the newest type.

General Conversion Techniques

The first step in conversion is to determine the frequency range of your unit. If the source is known, it is a simple matter to check the operating frequency. If the source is not known, a look at the final tank will usually give a clue. Of course, the major manufacturers have a definite system of marking the frequency ranges of the equipment.

The first step in the actual conversion is to acquire a set of crystals on the proper frequency. This is best accomplished by ordering commercial grade crystals from a crystal company that typically supplies crystals to the two-way industry. I highly recommend International Crystal for several reasons: They can supply crystals of the correct cut and frequency for multiplication when given the manufacturer of the equipment and the manufacturer's crystal type; International guarantees crystals for correct operation; and they give excellent service in terms of turnaround time and warranty replacement. Regardless of the source of the crystals, it is important that they are of the correct cut. If the crystal was not designed for the oscillator circuit used in the equipment, it may not "pull" onto the correct frequency if it oscillates at all.

The next step is getting the heater strings on the correct voltage. If the unit is to be used as a base station with an external ac supply this step is unnecessary, for the correct heater voltage can be supplied from the ac supply.

Many 6V units have the heater strings divided into two 6V sections with approximately the same current requirements for each section. If this is the case, conversion to 12V involves merely lifting the ground side (if any) on one half of the heater strings and forming a series–parallel arrangement. It is necessary, however, to retain a balance in current requirements. That is, do not put a section requiring 5A of heater current in series with a section requiring 6.5A, etc. A small difference can be tolerated, but the better the match, the better the performance. In units where the "strings" do not exist, it is necessary to calculate the heater current requirements and then develop the necessary series–parallel arrangement.

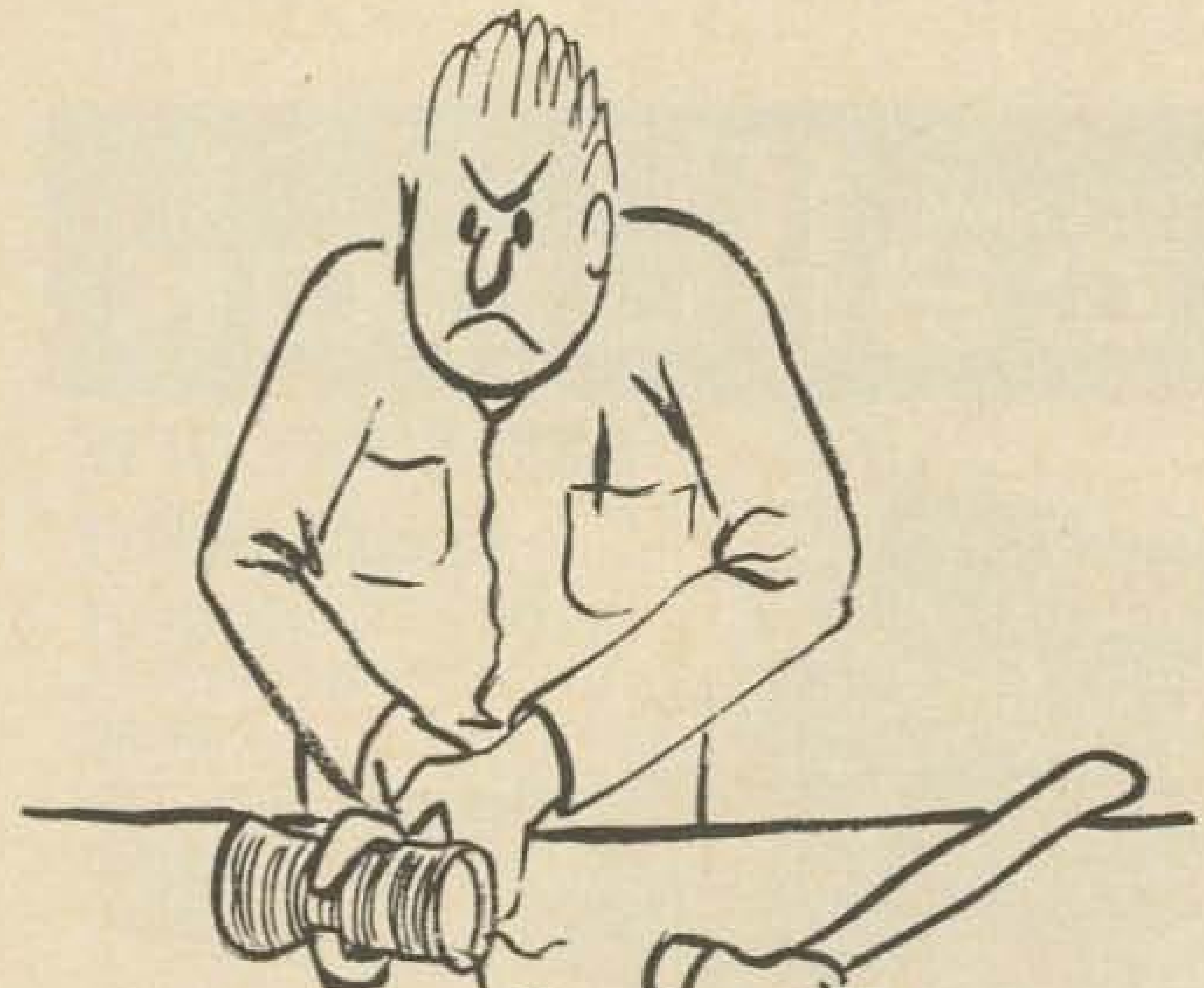
The power supply is the next area of conversion. Fortunately, most transistorized power supplies are found in either 12V only or 6/12V combination units. Thus, I will not attempt to cover them here. Dynamotor units may or may not prove to be difficult to convert from 6 to 12V operation. The cheapest method is to replace the dynamotor with a 12V surplus unit. The DM-35 works very well in higher powered units (50–60W), and other units may be used for lower powered equipment.

The receiver power supply is almost always a vibrator supply, even in dynamotor units. The simplest modification for this supply is to pick up 6V across one of the filament strings. A 2W dropping resistor of 20–47Ω will have to be put in series with the vibrator coil if the vibrator itself is driven directly from 12V.

Vibrator units are generally of two types: Lower powered units (<15W) use a single transformer to provide voltage for both receiver and transmitter B+ lines. Higher powered units use two transformers, one for low B+ and one for high B+. In the case of the single transformer unit, the power supply may be connected across the lower leg of the heater string. In this case, allow for the current required by the power supply when setting up the heater strings or place a resistor of the correct size across the other heater string. In the case of two transformers, each one may be placed across separate heater strings. Make sure that the circuitry formerly grounded goes to the 6V point in the section which is connected across the "high" heater string (the string which is not grounded).

The rectifiers used in older FM equipment are usually of the selenium type. If higher voltage is required, or if any one of the rectifiers is defective, replace the entire rectifier with the silicon type. This usually results in higher transmitter output and lower power supply heating.

Low-band conversions. Units which were originally designed for the 25–30 MHz range will, of course, work on 10 meters without any modifications. The only thing which needs to be done is to put in the necessary crystals and keep the deviation below the maximum allowed by the FCC. Units designed for the 30–40 MHz range will also usually work on 10 meters without modification. If the receiver will not tune down to 29 MHz, it is usually necessary to place small capacitors (a few picofarads will usually do) across the coils in the rf section. The transmitter final grid and tank coils may be slightly squeezed together to lower the frequency.

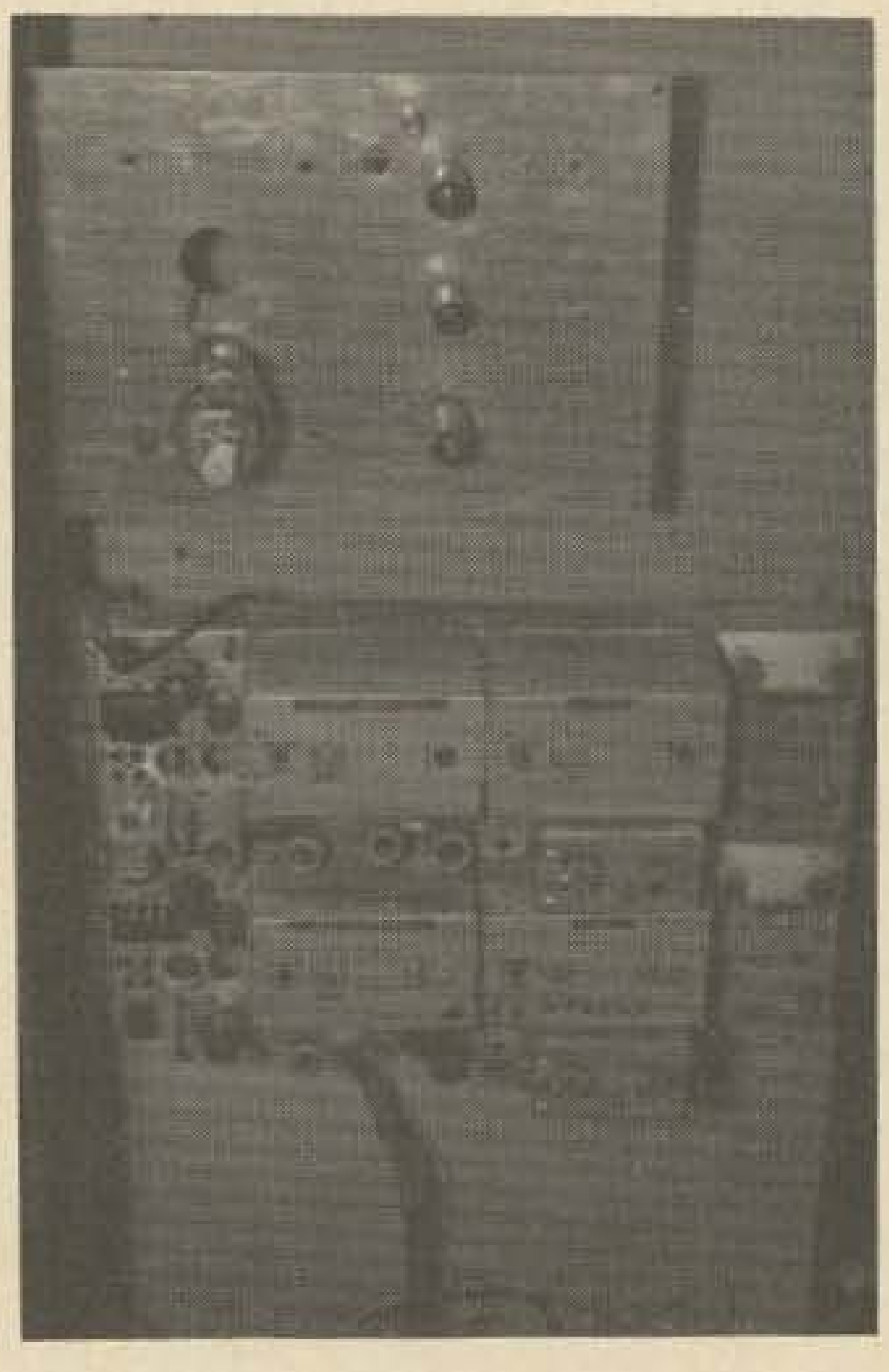


The transmitter final grid and tank coils may be slightly squeezed together to lower the frequency.

Use of the 30–40 MHz units on 6 meters sometimes requires a substantial amount of modification. Fortunately, only the rf and first mixer sections need modification in the receiver. These coils must be reduced by either removing turns or decreasing the capacity across the coils. A grid dip oscillator is a must. The entire transmitter section must be modified. Each coil must be reduced in size until it will tune to the correct frequency.

The 40–50 MHz units can be used on 52.525 MHz without modification. All that is required is the proper crystals. If, for some reason, the unit will not tune up to 52 MHz, it may be necessary to reduce the capacity across the receiver rf coils and slightly spread the turns of the final tank coil to bring them within the tuning range.

High-band conversions. Units in the 144–170 MHz range will usually tune up on 146.94 MHz without modification. Units that require modification can usually be brought within range in the following manner: The receiver rf coils may be padded within range by putting small Mylar capacitors of 2–5 pF across each section. The receiver oscillator coil may require as much as 20 pF across it. (Try for proper operation without this capacitor before adding it.)



The only transmitter stages usually requiring modification are the driver and final sections. The driver may be brought within range by either squeezing together the turns of the coil (if a coil is used) or by the addition of approximately 5 pF across the tuning capacitor (if parallel lines are used). In the cases where there is not enough capacity in the final tank circuit or where adjustable plates do not exist, it is necessary to add capacitance here also. The simplest manner is to make a capacitor from about 3 in. of RG-58/U coax. This coax is attached with the shield side to one line and the center to the other. The coax may be trimmed about ¼ in. at a time until the final tank is resonant with the tuning slider about ¼ in. from the end.

General tuning instructions. For the most part, the FM unit is tuned in each stage for maximum output. Most equipment has either a central metering point or a test jack for each stage. In all cases a VOM may be used as a visual indication. Normally a 0–3V scale is sufficient. The Motorola units may be measured with either a VOM or a 50 μA meter. Generally, the only exception to the "maximum output" rule is the discriminator frequency, which is adjusted for a zero reading.

The receiver should be tuned starting with the meter at the second limiter test point. As the tuning progresses, it will become necessary to first reduce the signal input to the receiver and then to switch to the first limiter test point. As the second limiter approaches saturation, the reading will begin to decrease, thus giving a false reading. That is why it is necessary to reduce the signal input. The same thing holds true for the first limiter, but it does not go into saturation as easy as the second limiter and is therefore a better indication at higher signal levels.

When starting from scratch it is usually necessary to begin receiver tuning with the low i-f stage. In almost every Motorola FM unit this stage is at 455 kHz. The low i-f coils are adjusted for maximum reading at the second limiter test point (make sure to keep the signal level low enough to prevent saturation). At this time also adjust the discriminator secondary for zero reading at the discriminator test point.

The next stage to be tuned is the high i-f stage. This stage may be first tuned by injecting a signal at the i-f and adjusting for maximum reading at the second limiter test point. These adjustments may be "touched up" when the carrier frequency is being received.

The rf stages can usually be adjusted by inserting a signal at the antenna jack at a fairly high level and adjusting the coils for maximum reading at either the second limiter or first limiter test point (taking care not to saturate the stage being measured). In cases where a signal cannot be forced through from the antenna jack, it is necessary to use an injection probe of some type and start at the final rf stage and work towards the antenna.

The carrier frequency may be adjusted by metering the discriminator test point and adjusting the crystal warp capacitor or coil until a zero reading is obtained.

The first step in tuning the transmitter is to put the high–low switch located near the final amplifier section in the low position. Or, if the unit does not have such a switch, disconnect the plate connections to the final amplifier tube. This is to protect the final from damage from prolonged periods of tuneup.

Actual tuning begins with the oscillator section and works toward the final. Each stage is tuned for maximum output. A metering point is usually provided at each stage. If the unit has been modified, especially if modified from 30–40 MHz to 6 meters, it will be necessary to check the output frequency from each multiplier stage. After every stage (except the final and driver) has been tuned, replace the final tube if it was removed. Tune the driver, final grid, and final plate circuits for maximum output. Next, go back through the unit and touch up the various stages.

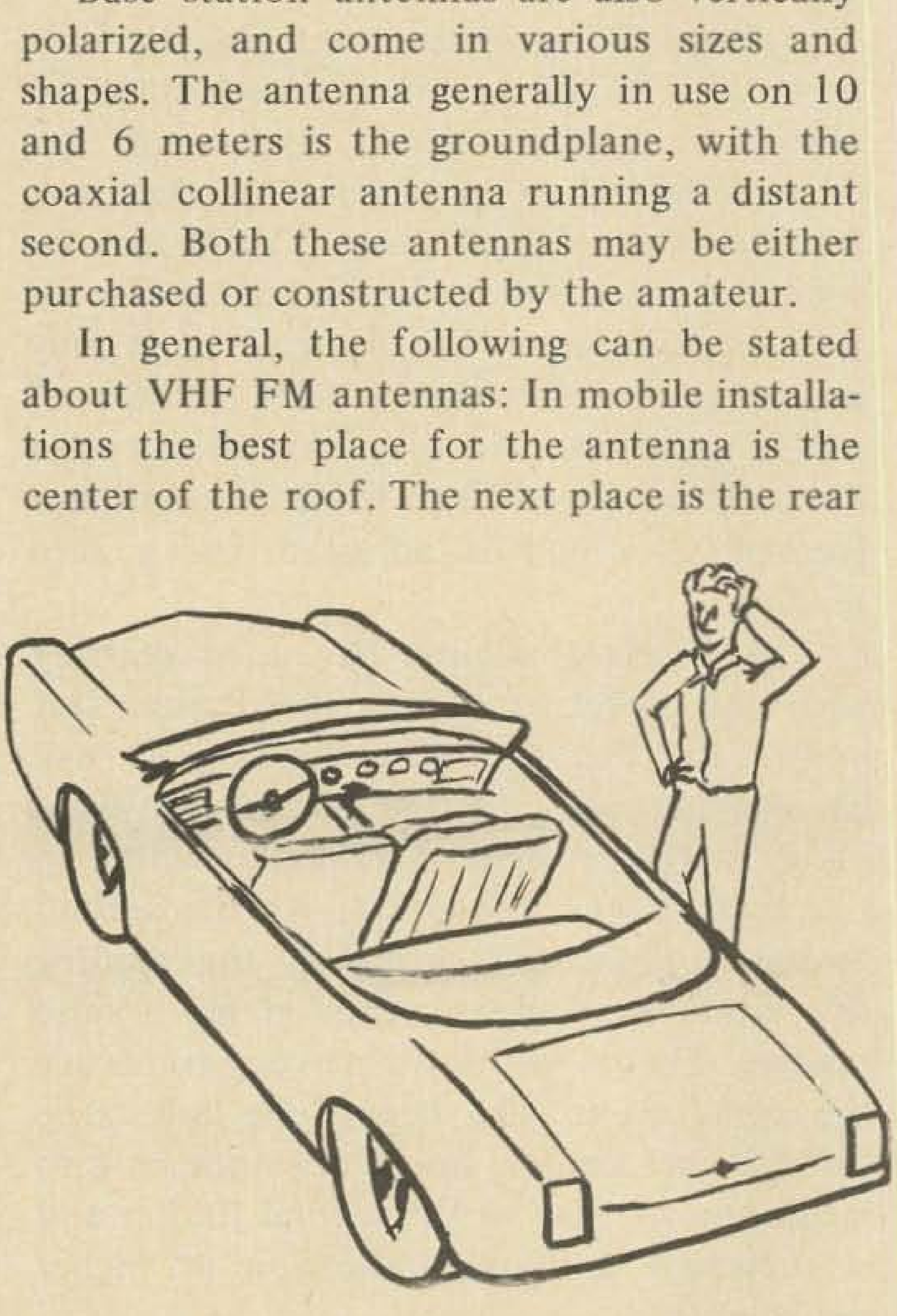
Antennas

The vast majority of FM operation is with vertically polarized antennas. These range from the simple quarter-wave whip to corner reflectors and yagis. The most popular mobile antenna for both 10 and 6 meter FM activity is the stainless steel whip with spring base. Next in popularity are the shortened antennas made by Antenna Specialists Company and others. The latter type may be mounted in the center of the roof or on the rear deck for better isotropic radiation.

Three types of antennas enjoy popularity with FM amateurs operating on 2 meters. They are the quarter-wave whip, the coaxial antenna, and the 5/8-wave, 3 dB gain antenna manufactured by Antenna Specialists and others. The quarter-wave whip can usually be purchased for under \$5. The coaxial antenna can be purchased for around \$20. The 3 dB gain antennas cost about \$25, but they will effectively double the output power.

Base station antennas are also vertically polarized, and come in various sizes and shapes. The antenna generally in use on 10 and 6 meters is the groundplane, with the coaxial collinear antenna running a distant second. Both these antennas may be either purchased or constructed by the amateur.

In general, the following can be stated about VHF FM antennas: In mobile installations the best place for the antenna is the center of the roof. The next place is the rear



In mobile installations the best place for the antenna is the center of the roof.

deck or trunk lid; next comes the fender, and finally a bumper mount. In base stations, the rule is the higher the better while keeping line losses down. Remember that even the best coax has a great deal of loss at 2 meters and higher. If possible, use a very good grade of foam coax. Of course there are lines available with extremely low losses, but these are quite expensive and extremely hard to work with.

Glossary

Whenever an amateur first starts out he must learn the jargon used on the bands. The same is true when starting out on VHF FM. As an aid, twenty of the more common terms and their usual meanings are listed below.

Channel Guard: A registered trademark of General Electric for a system of *continuous tone squelch.*

Coffin units: FM units manufactured in the late 1940s and early 1950s such as the Motorola 30D which consisted of separate receiver and transmitter units housed in cabinets with rounded tops which resembled coffins.

Control heads: The small box-like unit containing the off-on-volume control, squelch control, and microphone connections of a trunk-mounted mobile unit. The control head connects to the unit via a multiconductor cable.

Continuous tone squelch (CTS): A system wherein a low, subaudible tone is transmitted continuously with the voice transmission. This tone activates a reed in the receiver which, in turn, allows the squelch to operate. If the tone is not present, the receiver remains muted. This system allows only the desired stations (those with the correct tone frequency) to be received. Provision is normally made to use either conventional squelch or an unsquelched monitor position.

Deviation: The amount the modulated carrier varies from the center frequency. During half of the modulating cycle the deviation is positive and during the other half the deviation is negative. Commercial standards now call for ±5 kHz (narrowband). Most amateur operation is ±15 kHz (wideband).

Discriminators: The discriminator serves to convert the FM signal to AM and then demodulate the AM signal into audio. It is analogous to the diode detector in AM gear and the product detector in SSB gear.

High band: The slang term applied to the commercial band from 148 to 172 MHz.

IDC (Instantaneous Deviation Control): Motorola tradename for the potentiometer which acts as an "audio gain" which in turn controls the level of peak deviation.

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Limiter: A circuit i-f which saturates with a fairly low incoming signal, keeping the audio output from the discriminator at a constant level (similar to AVC in an AM unit). This circuit is needed because the audio output from a discriminator is directly proportional to the signal input, thereby varying with any change in signal level.

Low Band: The commercial band from 30 to 50 MHz.

Motrac: A registered trademark of Motorola for its series of mobile equipment utilizing transistorized receivers and hybrid transmitters.

Permakay: A Motorola trademark for its line of selective i-f filters. These are of two types, wideband (marked with a type number ending with the letter "W") and narrowband (marked with a type number ending with the letter "S").

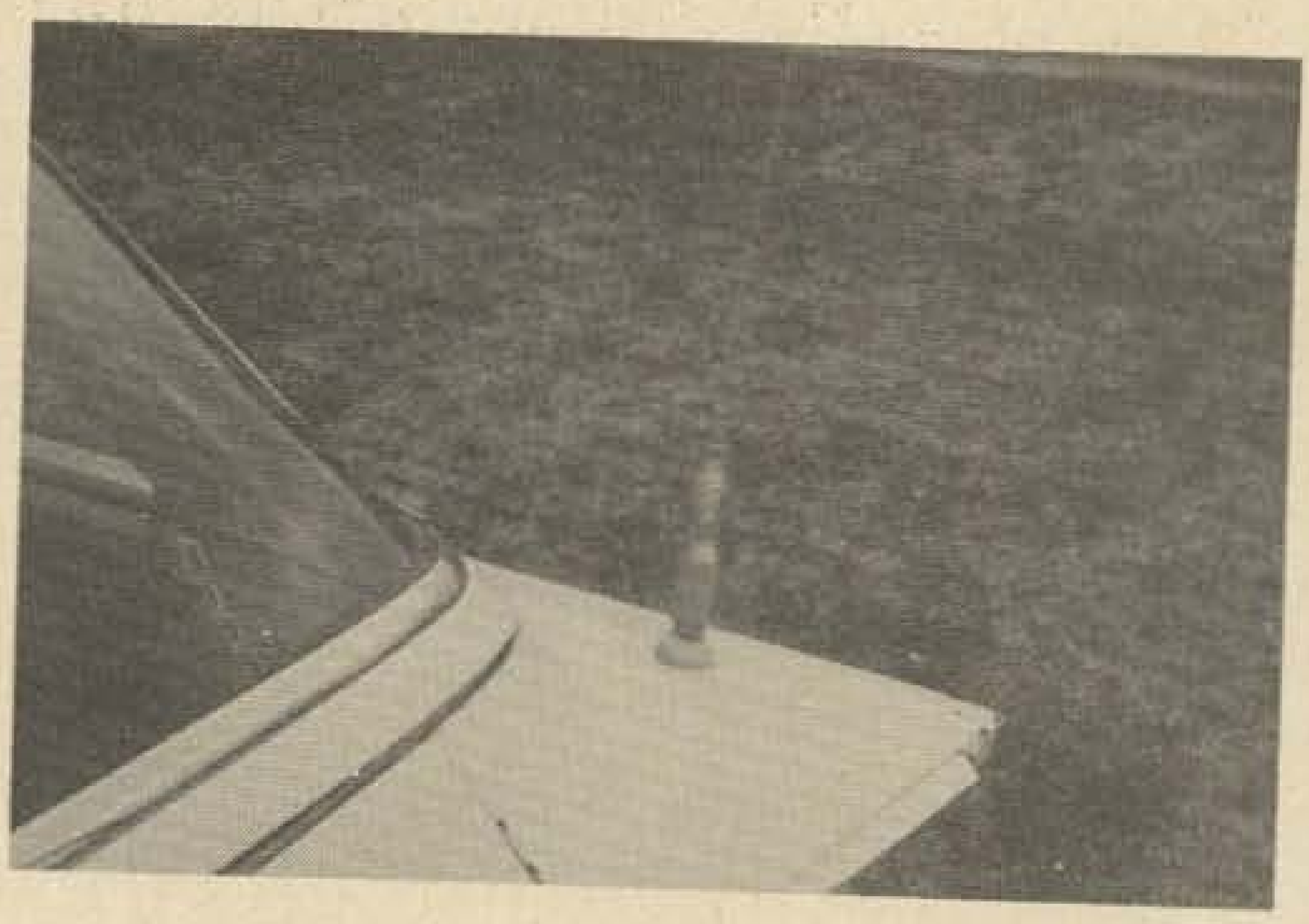
Pre-Prog: Slang term usually applied to General Electric units manufactured before the "Progress Line." Often this term is used to apply to units immediately preceding the Progress Line which are similar in appearance.

Private Line: The registered trademark for Motorola's version of CTS.

Single tone: The use of a high-pitched tone for control of remotely situated functions. This differs from CTS in that the tone lasts for only a short period of time. These circuits are often used in amateur repeater applications to restrict unauthorized use of the repeater and to reduce intermodulation effects.

Progress Line: A General Electric trademark for its pretransistor line of units. These units normally have vibrator power supplies. Newer types, with transistorized power supplies, are called "TPL."

TPL (Transistorized Progress Line): A trademark of General Electric used for their line of equipment utilizing transistorized receivers and tube type transmitters. The rear mount versions of this unit have the majority of the receiving circuitry located in the control head.



Twin V: A registered trademark of Motorola originally applied to mobile units capable of operation from 6 or 12V sources.

Warp: The pulling of the operating frequency by either inductance or capacitance changes being introduced in the oscillator or i-f circuit. This technique is also called "rubbering."

. . . K9STH ■

SURPLUS CATALOG

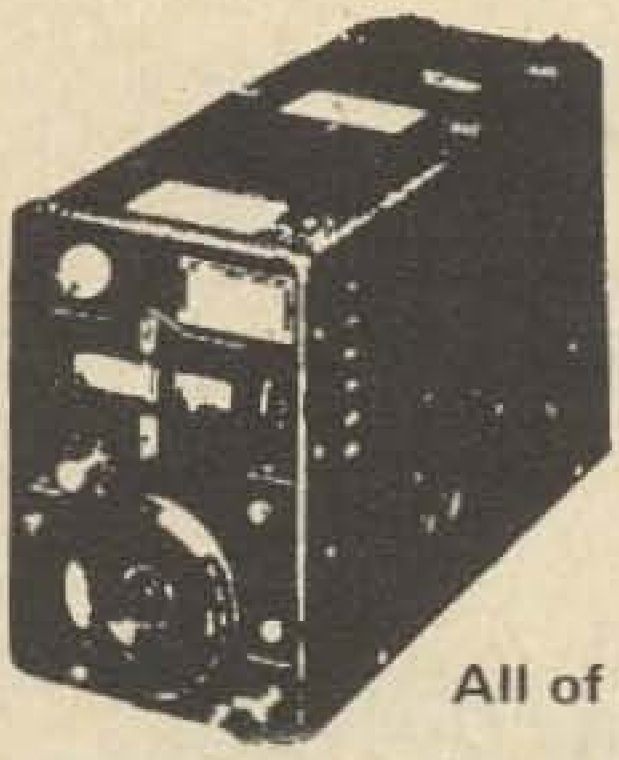
A few years ago the word "surplus" was almost synonymous with military. But not today. The day of the government being the only big spender is over forever. And surplus is a natural byproduct in a world of heavy spending and innovative, advancing technologies. The heavy dollar volume pouring out of the computer industry, the concentrated spending of industry for better communications, the necessary cyclic improvement in military systems development—all contribute to the new world of Surplus.

As you look over the ads and articles in this issue of 73, you will see how the surplus field has changed. The amateur's legacy is still the obsolete AN/GRCs and such of the government. But it also includes the myriads of integrated circuit and semiconductor assemblies and components that have been replaced by the computer industry's bid for smaller, more reliable counterparts.

Contributing also to the surplus market was a decision by the FCC to make certain restrictions to commercial two-way radio users that would disallow use of all the older, tried-and-true radio transmitter—receiver units. As established radio users reluctantly parted company with their old wideband mobile units and base stations, the surplus outlets began to bulge with bargains. Since the amateur bands were not affected by the FCC ruling, the hams made excellent targets for the still-quite-usable gear.

All this has worked to the advantage of you and me, the amateurs. We can buy *good* gear—extremely well designed, well built, rugged, and field-tested—for *peanuts!* Whether your mode is FM, AM, VHF, or HF, SSB or CW, there should be a lot of available items you'll want. Just remember . . . the surplus issue comes out but once a year. If you muff this opportunity to browse the surplus catalog section, your second chance will be a long time coming.

ARC-5 REVIVAL



Transmitter:

3-4 mc	$17.00 recond.
4-5.3	15.00 new
5.3-7	15.00 new
7-9	17.00 recond.

Receiver:

190-550	17.00 recond.
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TRANSISTOR MOUNTING PADS

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#A-3 50/$1.00 300/$5.00

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2 METER ARC-3

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BLISS-FULL PAK #1 $5.00

Kit # 2 includes all of the above but more fibres, longer lengths, fatter bundles and also includes light source, heat shrink tubing, a 5 ft. light pipe, a longer coherent bundle (image transmitter) & more experiments.

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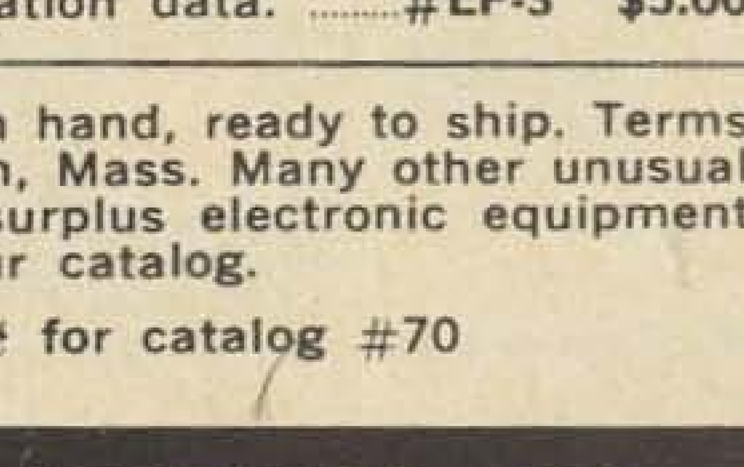

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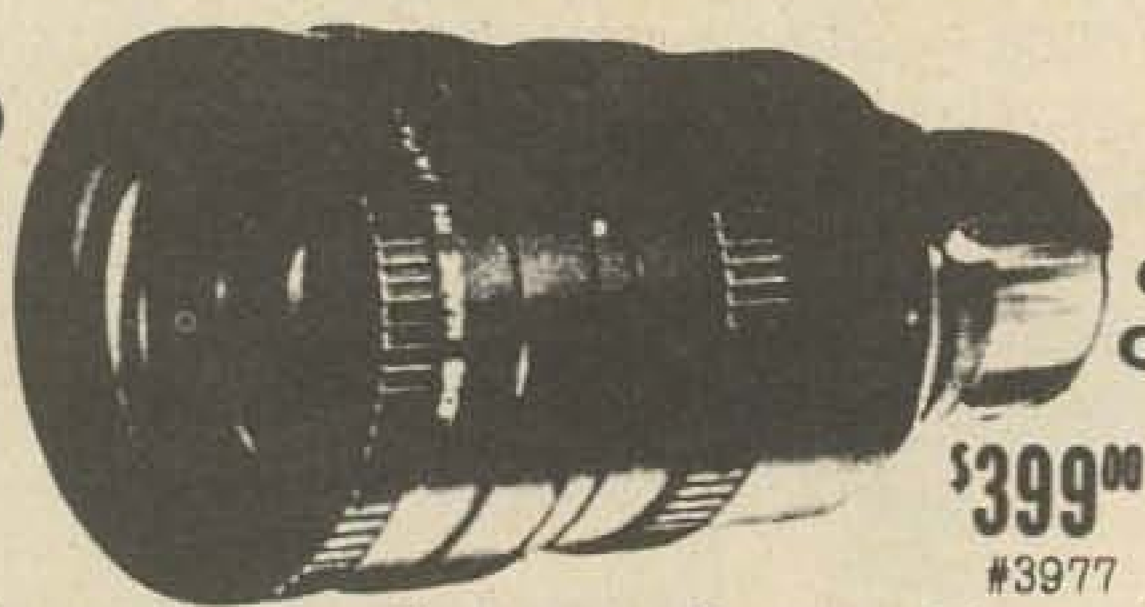

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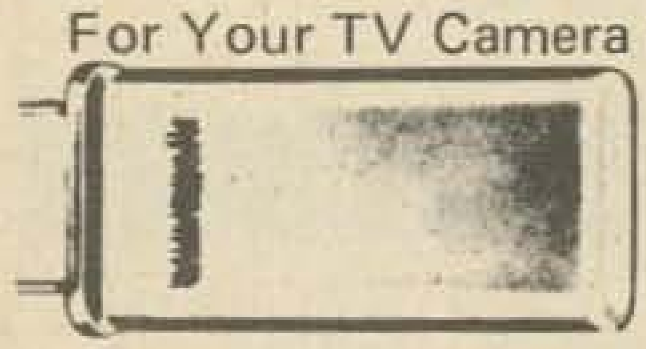

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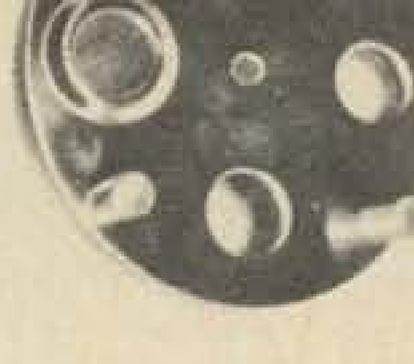

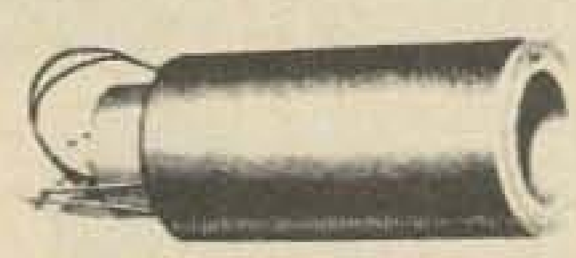

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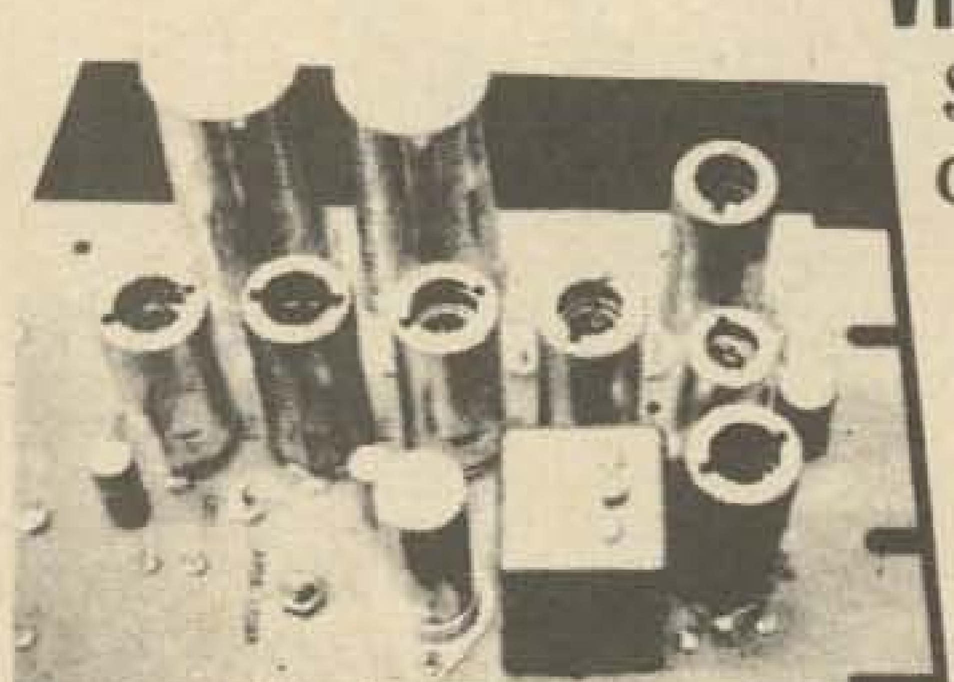

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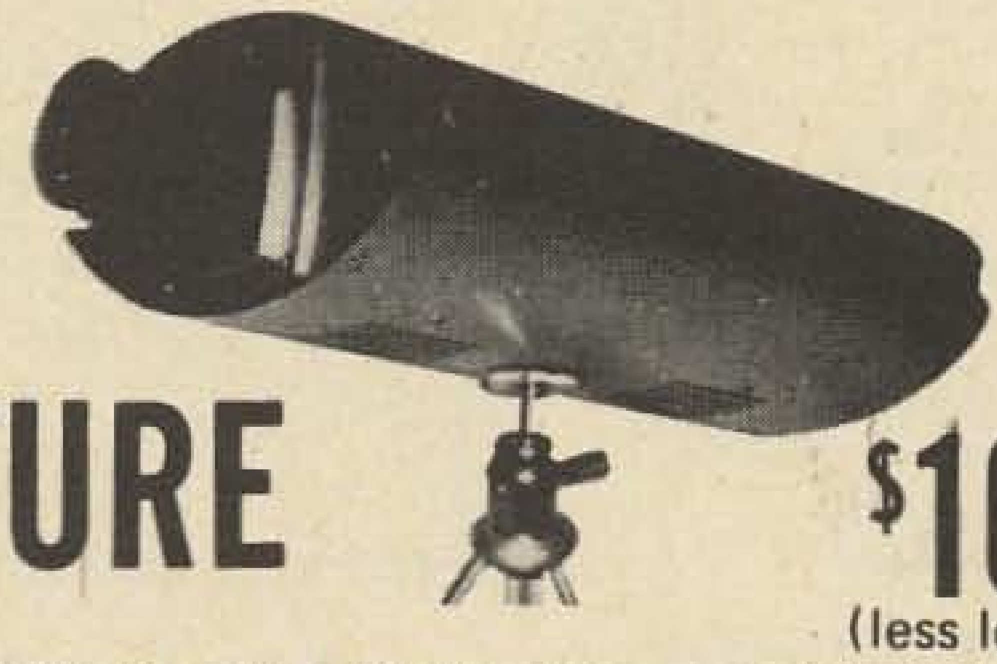

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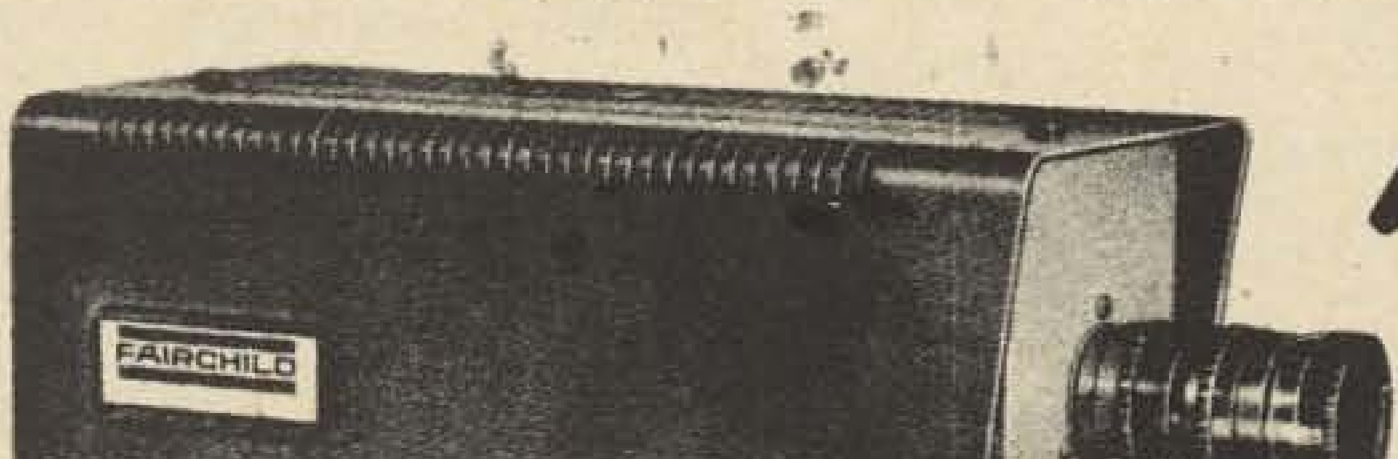

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27.065	27.075	27.085	27.105	27.115	27.125	27.135
27.155	27.175	27.185	27.205	27.215	27.225	27.255
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1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	3025	3035	3040	3055	3060	3070	3075	3095	3105	3110
2005	2010	2015	2020	2030	2035	2040	2050	2055	2060	3115	3125	3130	3135	3140	3145	3150	3155	3160	3165
2065	2070	2075	2080	2085	2090	2095	2100	2105	2110	3510	4300								
2115	2120	2125	2130	2135	2140	2145	2150	2155	2160										
2165	2170	2175	2180	2185	2190	2195	2200	2210	2220										
2225	2230	2240	2245	2250	2255	2260	2265	2270	2275	5675	5700	5720	5725	5750	5775	5800	5825	5840	5850
2280	2285	2295	2300	2305	2310	2315	2320	2325	2330	5875	5900	5925	5950	5975	6000	6025	6050	6075	6100
2335	2340	2345	2350	2355	2360	2365	2370	2375	2380	6125	6150	6175	6180	6200	6225	6250	6275	6300	6325
2385	2390	2395	2400	2405	2410	2415	2420	2425	2430	6340	6350	6375	6400	6425	6450	6475	6500	6525	6550
2440	2445	2450	2460	2465	2470	2475	2480	2485	2490	6575	6600	6625	6650	6675	6677.77		6700	6725	6750
2495	2500	2505	2510	2515	2520	2525	2530	2535	2540	6775	6800	6825	6850	6875	6900	6925	6950	6975	7225
2545	2550	2555	2560	2565	2570	2575	2580	2585	2590	7250	7275	7300	7325	7350	7375	7400	7425	7450	7460
2595	2600	2605	2610	2615	2620	2625	2630	2635	2640	7475	7500	7525	7550	7575	7600	7625	7650	7675	7700
2645	2650	2655	2660	2665	2670	2675	2680	2685	2690	7725	7750	7760	7775	7800	7825	7850	7875	7900	7925
2695	2700	2705	2710	2715	2720	2725	2730	2735	2740	7950	7975	8032	8064	8225	8236	8250	8275	8300	8325
2745	2750	2780	2785	2790	2795	2815	2830	2835	2840	8350	8375	8400	8420	8425	8450	8475	8500	8525	8550
2845	2850	2855	2860	2865	2870	2875	2880	2885	2890	8523.7		8560	8575	8600	8620	8625	8650	8670	

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BC-348 Receiver, tunes 200-500kc and 1.5-18mc, 28 vdc, unmodified ..... $ 65.00
BC-639 VHF Receiver with AC power supply, tunes 100-156mc ..... $ 65.00
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APX-6 Transpondors, famous moonbounce set ..... $ 18.50
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T-67/ARC-3 VHF Transmitter, tunes 100-156mhz, 28vdc, popular on 2 meters ..... $ 18.50
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R-5/ARN-7 ADF Receiver, tunes 100-175khz, 115V/400cy & 28vdc, a good VLF receiver ... $ 12.50
RUQ Collins VHF Fixed-Tuned receiver, 118-136mhz, single channel, 115V/60cy ..... $ 19.50
T-23/ARC-5 VHF Transmitter, tunes 100-156mhz, 28vdc, a lot has been written on this one . $ 15.00
BC-645 Transceiver, tunes 460-490mhz, complete with control box, antenna, dynamotor and mount, 12/28vdc input, excellent for conversion to 420mhz ham band ..... $ 21.50
RT-19/ARC-4 VHF Transceiver, 100-156mhz, 28vdc, good for 2 meter use ..... $ 15.00
R-19/TRC-1 FM Receiver, 70-100mhz, 115V/60cy, see conversion articles ..... $ 19.50
Bendix RA-10 RDF Receiver, tunes 150-1100khz & 2-10mhz, use for transmitter hunts ..... $ 16.50
URC-4 VHF-UHF Emergency Walkie-Talkie, less batteries, good for 2 meter use ..... $ 18.00
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BC-733 Receiver, 108-110mhz, 24vdc, a well built set to play with ..... $ 6.50
TCS-12 Receiver-Transmitter, complete with CMX-46159 receiver, COL-52245 transmitter, COL-21881-A 12vdc dynamotor power supply & COL-20309 115V/60cy power supply, tunes 1.5mhz to 12mhz ..... $ 69.50
R-81/ARW-20 Receiver set, 28vdc ..... $ 15.00
AN/DRN-11 Transpondor set, has good UHF possibilities ..... $ 14.00
BC-659 Transceiver, FM, 27-38.9mhz ..... $ 18.00
IP-69A/ALA-2 Panoramic Indicator, 30mhz IF input, 115V/400cy, see 73 conversion ..... $ 27.50
RBW-2M Panadaptor, 5.25mhz IF input, 115V/60cy ..... $ 32.50
R-316/ARR-26 FM Receiver, 162-173mhz, less case ..... $ 45.00
RT-86/APW-1 Radar Set ..... $ 18.00
CPR-46ACJ Radar Receiver ..... $ 20.00
CV-216/URR SSB Converter, requires 200kc IF input, 115V/60cy, goes with Navy receivers . $ 65.00
BC-1032A Panadaptor, 5.25mhz IF input, 115V/60cy ..... $ 32.50
TBX-5 Transmitter-Receiver Unit, 2-8mhz, less power supply ..... $ 12.50
RT-157/APN-68 Transpondor Set, 214-234mhz, 80&115V/400cy ..... $ 15.00
ARC R-15 VHF Receivers, tunes 108-135mhz, complete with 28vdc dynamotor ..... $ 19.50
Collins 17E-2 Transmitter, soon to be a collector's item ..... $ 12.50
ARN-5 Glideslope receiver, 332-335mhz, 24vdc, has a lot of good components or use it in an aircraft ..... $ 9.50
Hammarlund SP-600JX-17, tunes 0.54khz to 54mhz, 20 tubes, 19" rackmount receiver with dust cover. The best of all models $285.00
ARC-1 VHF Transceiver, 100-156mhz, less 832A and 24 volt dynamotor ..... $ 9.95
BC-1000 Transceiver, 18 tube portable, 40-48mhz, can be converted for 6 meters ..... $ 14.50
URC-11 Walkie-Talkie, ideal for 220mhz, see May '69 CQ conversion ..... $ 14.50
Motorola T-416/GR FM transmitter, 152-174mhz, 2 channel, part of VRC-19, 25 watts output, easy to convert for 2 meters ..... $ 18.50
ARC-2 Transceivers, 2 to 9.050mhz, 30 watts out, superhet receiver, autotone ..... $ 47.50

Teletype Equipment:

Teletype Corp. Model REC-30 power supply ..... $ 12.00
Northern Type 111 IF Monitor ..... $ 10.00
Northern Type 105 Frequency Shift Keyer ..... $ 15.00
Limiter for RSA-1 Frequency Shift Receiver, rackmount ..... $ 12.00
Model 14AS Tape Printer, Western Union Teletype machine ..... $ 16.00
C-808/GRC-26A Radio Teletypewriter control ..... $ 22.00
RA-54-A Teletype Power Supply ..... $ 17.50
Model 15 KSR Teletype Machine, good condition, synchronuous motor ..... $ 60.00
TT-107B/FG Teletypewriter-Reperforator, 60 or 100WPM, 115V/60cy $125.00
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CV-57/URR Frequency Shift Converter, use with any 455kc IF receiver, a popular teletype converter ..... $ 65.00
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Radio Part and Associated Equipment:

Jennings ECS 3-30mmfd, 15KV vacuum variable capacitor, new ..... $ 17.50
Jennings UCSX 1000, 20-1000mmfd, 12.5KV vacuum variable capacitor, new ..... $ 24.50
RA-84 AC Power Supply for BC-779 Super-Pro receiver, rackmount ..... $ 18.50
J-37 Code Key, a very good surplus key ..... $ 3.00
Brush Dual Channel DC Amplifier BL-530, complete in cabinet ..... $ 24.50
AM-40A/AIC Interphone amplifier, 4W output, 28vdc ..... $ 4.00
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EE-8 Field Telephones, less batteries, price per pair ..... $ 15.00
Carter Rotary Converter JR1010CW4, 28vdc input, 115V/60cy at 9.6amp output ..... $ 65.00
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Cold Cylinder Test Indicator, has beautiful 0-400uadc meter ..... $ 2.00
BC-709C Interphone amplifier, uses standard batteries, good for plane, car, camper, etc. ..... $ 3.00
Bendix AN-5851-1 Sextant, Bubble type, used good condition, ideal for navigation, in case ... $ 24.00

Transformers for Surplus Conversion:

Transformers are with 2-18 volt center tapped windings. Connected in series delivers 36 volts as rated; connected in parallel 18 volts at twice rated current through rectifier bridge will give 12 or 24 volts DC. Primary on below transformers 115V/60 cycle.

1 amp	wt. 3	$ 6.20	12 amp	wt. 16	$23.90	30 amp	wt. 27	$52.00	50 amp	wt. 38	$61.20
4 amp	wt. 6	$11.70	24 amp	wt. 25	$42.25	50 amp	wt. 38	$61.20			

Junk Box Nightmare:

For this special 73 Surplus Issue, we have put together 50 lbs. of small valuable electronic components consisting of surplus resistors, capacitors, switches, connectors, circuit boards, transistors, small screws, knobs, variable capacitors, tube sockets, etc. etc. All small components, no heavy transformers, etc. Each box is different, guaranteed to satisfy you.

Special postage paid deal $16.50, two for $30.00. A once a year bargain.

Aircraft Pilots:

Bendix RT-221A/CNS-220, 118.00 to 135.9mhz, 50khz spacing, 360 channel VHF communications transceiver, weight 4½ lbs., size 3¼" x 2½" x 12", all solid state, 1968 models, 12 or 24 volt, $345.00, sells new for $945.00.

Test Equipment:

OS-8/U Portable O'scope in carrying case, excellent for the ham shack, 115V/60cy	$ 45.00
TS-413/U Signal Generator, 75khz to 40mhz, 115V/60cy, good low frequency generator	$175.00
TS-175/U Frequency Meter, 85-1000mhz, less batteries	$ 60.00
TMC Variable Frequency Oscillator Model VOX, 2-64mhz, stable as a rock	$ 85.00
TS-375/U AC-DC Voltmeter, complete with all probes	$ 20.00
BC-221 Frequency Meter, 125khz to 20mhz, less batteries	$ 60.00
TS-125/AP Precision S-Band Power Meter, 2mw sensitivity	$ 12.00
I-196B Signal Generator, 150 to 235mhz	$ 18.00
IE-36, SCR-522 test set, contains 0-1madc meter, control, cables, nice wooden case	$ 9.50
ME-29/U Portable Ammeter, range 0-1, 5, 10, 50, 100, 500madc	$ 10.00
TS-328B/U Portable Electrical Frequency Meter, 380cy to 420cy	$ 15.00
BE-67 Portable Milliammeter, range 0-1madc, uses 9vdc battery	$ 7.50
TS-15B/AP Flux Meter, 1.2 to 4.5 gauss	$ 18.00
TS-268D/U Crystal Rectifier Test Set, checks 1N-21, 1N-23, etc.	$ 18.00
URM-30, URC-4 Walkie-Talkie test set, for alignment & testing, also checks battery	$ 15.00
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Ideal #41-001 Portable Insulation Tester, 500-2500V, complete with prods	$ 20.00
ME-30/U Voltmeter, rackmount, 0-300V in 12 ranges, frequency range 20cy to 2mhz	$ 18.00
IE-17-E, BC-611 Walkie-Talkie test set, used for alignment and testing	$ 15.00
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TS-10A/APN Radio Altimeter Test Set	$ 18.50
TS-16/APN Altimeter Test Set, used to check and align radio altimeters	$ 24.50
Microline Model 123B Wattmeter-Bridge, .1 to 10mw, -10 to +10DBM, 115V/60cy	$ 18.00
Supreme Model 599 Tube Tester, Portable, checks the old time tubes	$ 15.00
I-177B, a popular surplus tube tester, complete with tube data charts	$ 17.50
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General Radio Model 813B Audio Oscillator, 400 cycles, a good freq. standard	$ 20.00
Weston Model 311 Potential Transformer, ratios 4600 and 2300	$ 20.00
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Lambda Model C-281 Regulated DC P/S, 125-325vdc at 200ma & 6.5vac at 10 amps output	$ 16.00
OS-34/USM-32 Portable General Purpose O'scope, 10cy to 4mhz, 115V/60cy	$ 80.00
Sorensen Model 1000S AC Voltage Regulator, input 90-130vac, output 117V/50-60cy at 1kva	$ 20.00
TS-226A/AP Power Meter, range 405-425mhz, power range 0-1000 watts, 115V/60cy	$ 27.50
TS-92/AP Alignment Amplifier, frequency range 15-500mhz, 115V/60cy	$ 24.50
Lavoie Model 105SM Portable Microwave Frequency Meter, 375-725mhz	$ 19.50
URM-32A Heterodyne Frequency Meter, 125khz to 1000mhz, with orig. calibration book	$ 95.00
General Radio Pulse Generator Model 869-A, .3 to 70 microseconds	$ 29.50
Measurements Model 79-A Pulse Generator, 60 to 100,000 cps	$ 21.50
Berkeley/Beckman Expanded Scale Meter Model 101R50-6, rackmount	$ 19.50
Measurements Model 82 LF Signal Generator, 20cy to 200khz and 80khz to 50mhz	$175.00
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Hycon Model 627-R Oscilloscope, rackmount, general purpose, 3 inch	$ 60.00
Hickok Model 640AF General Purpose Oscilloscope, 5 inch	$ 60.00
Hickok Model 695 VHF Television-FM Alignment Signal Generator	$ 35.00
TS-418 Signal Generator, 400 to 1000mhz	$175.00
TS-419/U Signal Generator, 900 to 2100mhz	$175.00
Tektronix RM-125 Power Supply for Type 122 Pre-Amplifier	$ 19.50
Tektronix Type K Plug-in, fast rise .05-20u/cm	$ 65.00
Tektronix Type 162 waveform generator	$ 19.50
TS-230C Frequency Power Meter, Radar X-Band, for un-modulated and pulsed signals, a popular radar lab item	$ 29.50
TS-170/ARN-5 Glideslope test set	$ 17.50
TS-155 Signal Generator, 2400 to 3750mhz, a popular unit	$ 49.50
Stoddart 90329-4 Power Supply for NM-50A	$ 65.00
UPM-6B Transpondor test set with probe	$185.00

ATTENTION: KW Linear Amplifier Builders:

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Eimac 3-1000Z, fresh yellow factory boxed with guarantee	$ 79.00
Eimac SK-510 socket, 3-1000Z and 4-1000A	$ 10.50
Eimac SK-516 chimney for 3-1000Z	$ 12.00
Eimac SK-506 chimney for 4-1000A	$ 12.00
Eimac HR-8 Heat Dissipating Plate Cap for 4-1000A and 3-1000Z	$ 2.85
Eimac 3-500Z, fresh yellow factory boxed with guarantee	$ 32.00
Eimac 3-400Z, fresh yellow factory boxed with guarantee	$ 26.00
Eimac SK-410 socket for 3-400Z and 3-500Z	$ 10.50
Eimac SK-416 chimney for 3-400Z and 3-500Z	$ 7.00
Eimac SK-650 socket for 4X150A, 4CX250B, no screen bypass	$ 12.00
Eimac SK-626 chimney for SK-650 and SK-620	$ .75
Eimac SK-620 socket for 4X150A, 4CX250B, has screen bypass	$ 13.25
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SN-12/APA-16 Range Marker Unit (bombsight)	$ 17.50
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AM-837/APS-20 Amplifier, Radar	$ 19.50
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AM-674/APA-57B Wind-Servo Amplifier, Radar	$ 18.00
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MD-110/APT-16 Radar Modulator	$ 12.00
MX-284/APN-12 Videogate, Radar	$ 10.00

Boat Owners:
APN-9 Loran Systems with 12 volt transistor power supply, go back to your favorite fishing spot or navigate world wide with this Loran A set. Price $225.00, send for detailed information.

All equipment excellent condition, FOB Ellenton. Satisfaction guaranteed or money refunded. Immediate shipment. Write or phone (813) 722-1843, Bill Slep, W4FHY.

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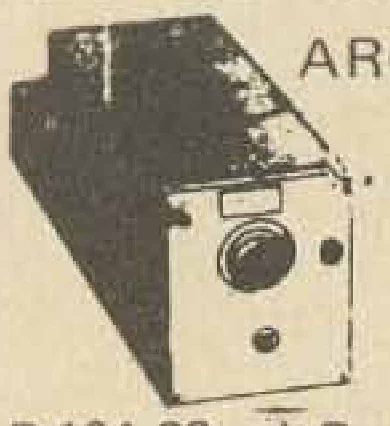

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R-10A rcvr, 520-1500 KC . . 19.95
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Sierra 137A Dir. Coup. 39.95
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G.R. 1482B Std. Inductor 100 UH 25.00
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X885A Phase Shifter 225.00
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H.P. 400HR AC V.T.V.M. 195.00
Rutherford B7 Pulse Generator 200.00
Measurements Corp. 82 Sig. Gen. 20 cycles to 50 MC 250.00

Just arrived H.P. 130C Scope DC to 500KC $450.00

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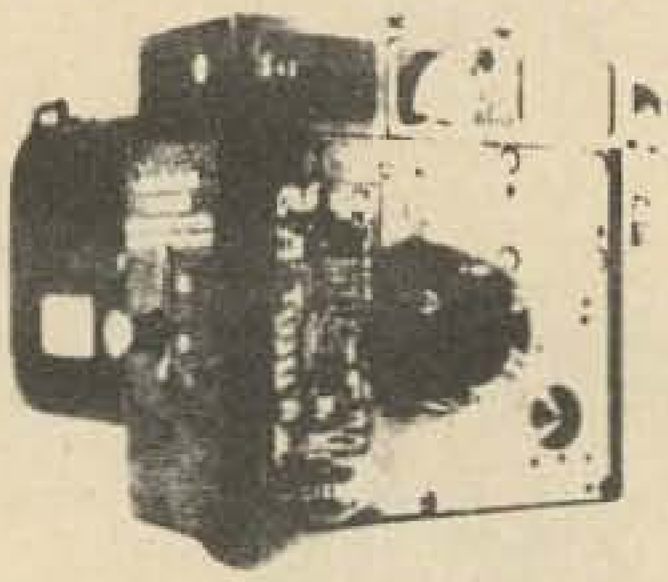
GOV'T-INDUSTRIAL

SEQUENCE CAMERA



This electrically sequenced camera takes 1600 pictures on a roll of standard 35 millimeter film. The camera is offered complete with a 35 MM focal length F 2.3 Bausch & Lomb Baltar lens with stops to F16. 24 volt operation. Identification of each frame is possible by means of a data recording chamber which permits data card information to record in the corner of each frame. Watches are available which fit in the recording chamber so that the time each shot was taken will also be recorded. Camera may be used for time lapse photography, oscilloscope recording and data panel recording. Complete camera with lens and one magazine $75.00 ppd. Spare 100 foot magazine $25.00 ppd. 24 hour recording watch for data chamber $25.00 ppd.

EXPOSURE METER CONTROL

This little unit lights up a lamp when illumination is below predetermined threshold. Contains high sensitivity cds photodetector, transistor, potentiometer, lamp & relay. About the size of a quarter. May require relay adjustment to work properly. Complete with circuit applications & design data information . . . . EMC 2/$2.00 ppd

RECORDING HEADS READ-WRITE

These heads are removed from the magnetic Memory Drum made by Hughes Aircraft at a cost of $6400.00. D.C. resistance 30 ohms. Frequency response 20 Hz to 12 KHz. A.C. impedance 4K Ohms.

HRH $1.00 pp . . . . or 12 for $10.00 pp.

5.5 RPM PERMANENT MAGNET MOTOR

5.5. R.P.M. Permanent Magnet Motor - Reversible, continuous duty, Ball Bearing various mfg. - globe, etc. A planetary gear reduction motor with a 10 oz. in. torque. Motor will efficiently operate with input varying between 3 VDC & 35 VDC producing an output speed between .3 & 5.5 RPM. Motor will serve many useful functions as telescope drives, turntables, and other slow speed drives. Dim: 1-3/8 dia. x 3-5/16 LG, Shaft Dim: 5/16 dia. [lg. G.M.D.C.

Available in two speeds: 10 RPM & 5.5 RPM.
.Order No.10 GPMM and 5.5 GPMM $7.50 pp

TACHOMETER KITS

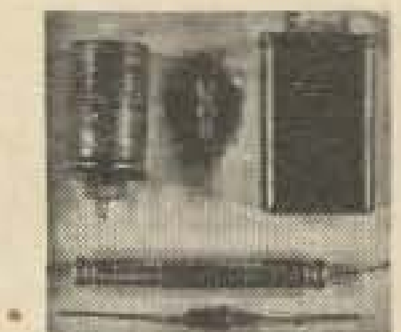
We bought a large quantity of tachometer meter movement and dials as shown, and while we were wondering how to sell them, one of our customers showed us some ingenious tachometers he developed, using this meter movement. We bought the designs and are offering them to you as kits of electrical parts only, which we are selling at far below the price of the meter alone.

Kit 1. Tachometer & dwell meter, operates from distributor of 4, 6 & 8 cylinder engines.
Transistorized . . . . TK1 $5.00 ppd.

Kit 2. Out board motor, engine tachometer. Simply hold wire lead near spark plug wire & pulses are picked up and registered. Works on 2 or 4 cycle 1, 2, 4, 6 or 8 cylinder engines.
Transistorized . . . . TK2 $12.50 ppd.

Kit 3. Photo electric tachometer. This is very ingenious. Point the pickup head at propeller of model airplane, or other rotating parts & meter registers rpm by measuring frequencies of interrupted light . . . . TK3 $12.50 ppd.

TANTALUM CAPACITORS



Buy these brand new tantalum capacitors for less than the price of equivalent aluminum foil units, & get high reliability, infinite life, small size, & high temperature performance in the bargain. The regular price of these units is from 10 to 20 times our low price.

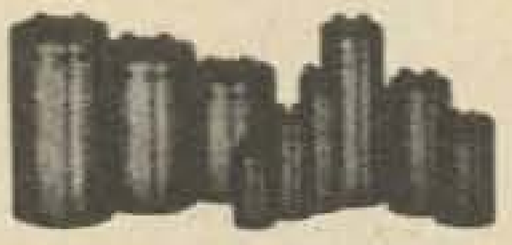
Left . . . . 25 mfd @ 180 volts . . . .$1.75 ppd
Left . . . . 8 mfd @ 270 volts . . . .$1.75 ppd
Center . . . 3.9 mfd @ 75 volts feed thru . . . . . . 3/$1.00 ppd
Right . . . . 400 mfd @ 75 volts . . . .$2.00 ppd
Right . . . . 1000 mfd @ 50 volts . . . .$3.00 ppd
Middle . 26.5 mfd @ 30 volts, non polar . . . .$1.00 ppd
Middle . . . . 2 mfd @ 100 volts . . . . . 3/$1.00 ppd
Bottom . . . . 1 mfd @ 75 volts . . . . . 4/$1.00 ppd

POCKET TRANSIT

The army used this transit for roughing in gun emplacements. But any one who needs quick and accurate surveying information will appreciate the precision and convenience of this instrument. These transists are selling at least 50% below current retail prices. We do not expect the supply to last long. For quick, accurate surveying, this transit functions as a sighting compass, prismatic compass, hand level and clinometer. Convenient for topographic and preliminary surveys of all kinds. With case and operating instructions.

BPT $30.00

Computer Grade Giant Capacitors



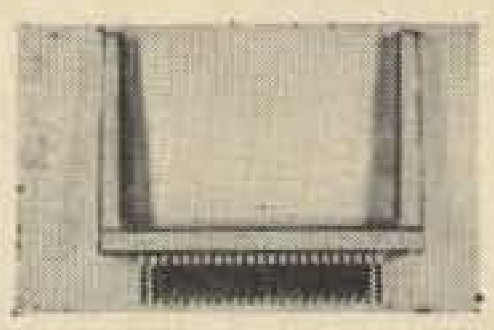
These brand new capacitors are in great demand as filter capacitors for I.C. logic circuits, power supplies, etc. These will take the noise out of the most stubborn circuits, where all else fails. Net price is from $4.00 to $18.00 each.

wt.	Size	Price ea.	12 for:
2#	110,000 µf 15v	$2.00	$20.00
2#	6,000 µf 75v	1.50	15.00
1#	4,000 µf 50v	1.00	10.00
2#	25,000 µf 25v	1.50	15.00
1#	9,300 µf 15v	1.00	10.00

BF ***Enterprises***
P.O. Box 44
Hathorne, Mass 01937
617-532-2323

SURPLUS BARGAINS

PRINTED CIRCUIT EDGE CONNECTOR



We have been lucky enough to obtain a large quantity of these connectors which take a 4" x 5½" x 1/16" thick printed circuit board (or two 4" x 2½" boards side by side using a ½" center partition). The connector has 48 gold plated contacts, spaced on 0.200 inch centers,suitable for solder or wire wrap connections. Manufacturers OEM Price for this connector is $7.60 each. We have suitable unetched copper clad board approximately 4" x 5½" available to fit this connector as well as pre-etched Universal Logic cards described elsewhere in this ad. Take advantage of this special while they last. From what we have heard the gold alone is worth over 50 cents. **PCEC $1.50 each, 10 for $12.00, 100 for $100.00. PCEC-BOARD Matching, approx. 1/16" x 4" x 5½". Double clad board unetched 25 cents each, and quantity but only available with purchase of connectors.**

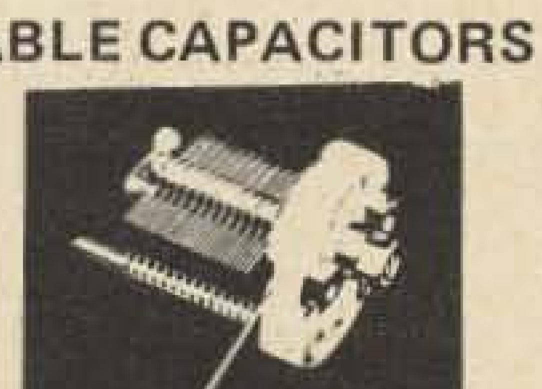
SYLVANIA TYPE 5ECIC INDICATOR LAMPS

These hard to get lamps are made to operate directly from the output of DTL or TTL Integrated Circuits. Draws only 40 milliamps at 5 volts. Eliminate the complexity of using driver transistors and separate supplies and conserve power. Solder directly to PC Board. Brand new, factory fresh, packaged with full 7/8" leads S5ESIL 10 for $4.00 ppd

USAF NAVIGATOR WRIST WATCH

These world renown 17 jeweled movements were made with exacting craftsmanship & mil-spec requirements. The watches were made by Bulova, Elgin & Waltham with a hack mechanism by pulling the crown to stop the second hand; so the time may be set to the exact second. All are in good used condition with 24 hour luminous dial, St. St. case & expansion band.
USAF WW . . . . $20.00 ppd.

ULTRA MINIATURE VARIABLE CAPACITORS



Use this high quality type MAPC - Hammarlund Steatite - insulated variable capacitor for miniature receivers and transmitters. Also makes a good stable trimmer for X-tal oscillators, etc. Ultra compact, bright plated finish, screw driver adjust. Capacitance 4.5 — 100 mmf. These unused packaged capacitors are a great bargain for the builder.
UCVC 3 for $1.00 ppd. 12 for $3.50 ppd

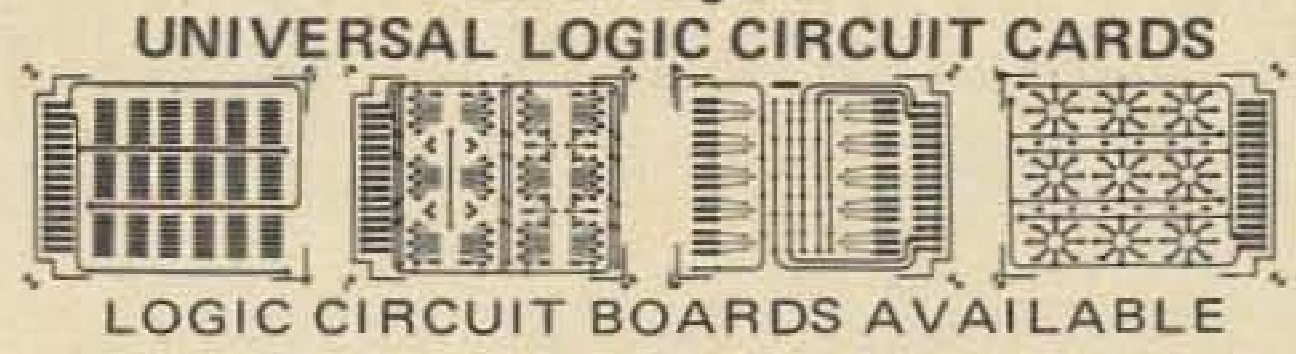
SPEED CONTROL APPLIANCE SWITCH

This switch has three positions OFF—½ON—ON. The ½ON control is obtained by a 3 amp 400 PIV diode wired across the switch. In the half speed position the diode is placed in series with the load. Priced at less than the value of the diode alone . . . . **TSSS 2 for $1.25 ppd**

Send 25¢ for catalog 703. Jam packed with surplus bargains . . . Best yet . . . Just fantastic . . . Free with an order.

Instant Logic!

UNIVERSAL LOGIC CIRCUIT CARDS



LOGIC CIRCUIT BOARDS AVAILABLE

CB 8 TO 5 — for 9 — 8 pin 5 can I.C.
TO CB DIP — for 9 — Dual-in-line I.C. TO
FP — for 9 — Flat Pack I.C.
CB FDC — for transistors & components.
CB 10 TO 5 — for 9 — 10 pin TO 5 can I.C.

TO NEW LARGER BOARDS TO

Our previous Universal Logic Cards are still available as advertised, but for those of you who like to put more circuitry on a single board, new varities are available.
These boards are the most useful items we have ever offered, and one of the best sellers. We offer them at 1/5 the price of others. How? By using surplus connectors and copper clad board, and etching them in huge quantities. We have sold 10,000 of these boards in the past few months, and orders keep climbing as customers find out how useful they are. The use of the boards is simple. The board has a pattern etched on it for mounting integrated circuits. You drill out the desired hole pattern. The power leads are already routed around the boards. Discrete components and transistors can be mounted in the locations between the I.C.'s. Then you route the wires between the I.C.'s and to the connector, and you are ready to count, compute, or whatever. Here are the cards available: ILCC — original — pads for 14 pin dual-in-line on one side, 10 pin to 5 on the other, transistor pads on both sides as previously advertised, complete with a surplus PC card with edge connector, and mating connector. You take the connector off the surplus card, and throw it away (or salvage lots of useful components from it). Will mount four integrated circuits, and two transistors. Size 2½" x 2½". See previous ad for illustrations.

2 Cards & mating conn.	2ILCC	$ 2.50pp
10 Cards & mating conn.	10ILCC	10.00
100 Cards & mating conn.	210ILCC	88.00

LILCC - New larger size cards 3" x 4" mounts 9 integrated circuits in pattern as illustrated above. Specify which type pattern you want. Pattern on one side only. Same connections and salvage board as ILCC provided.

2 Cards & mating conn.	2 LILCC	$ 3.50pp
10 Cards & mating conn.	10LILCC	15.00

SPECIFY PATTERN DESIRED

ULILCC - Still larger 4" x 5½" size, mounts 16 integrated circuits into edge connector PCEC shown on left of page.

2 Cards & mating conn.	2ULILCC	$ 5.00pp
10 Cards & mating conn.	10ULILCC	22.00

SPECIFY PATTERN DESIRED

FREE TOOLS. If you place your order for $10.00 or more worth of merchandise before April 1st we will give you a free surplus used high quality American made Kreuter or Utica long nose plier or small diagonal (no choice).

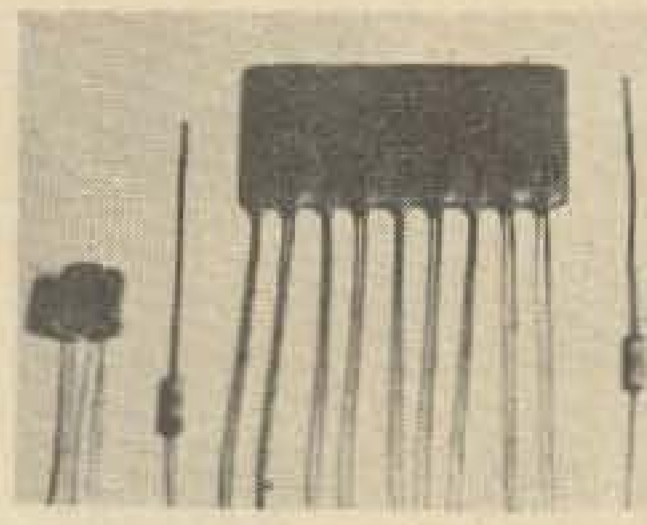
BF ***Enterprises***
P.O. Box 44
Hathorne, Mass 01937
617-532-2323

SPECIAL!

COMPLETE BISTABLE FLIP-FLOP KIT

Includes Sprague printed Circuit, 2 transistors, 2 diodes and circuit diagram.

Stock No.
A1100 .50 each, 5 for 2.00, 12 for 4.00



SPECIAL!

COMPLETE MONOSTABLE FLIP-FLOP KIT

Includes Sprague Printed Circuit, 2 Transistors, 1 diode, and Circuit diagram.

Stock No.
.40 each, 6 for 2.00, 12 for 3.50 A1101

SPECIAL With every order of $10.00 or more, select $2.00 worth of items FREE

INTEGRATED CIRCUITS

Stk. No.	Type	Case	Function	
A3000	907	TO-5	Four input gate	.75
A3001	914	TO-5	Dual 2 input gate	1.00
A3008	914	FP	Dual 2 input gate	1.00
A3002	915	TO-5	Dual 3 input gate	1.00
A3003	923	TO-5	JK Flip Flop	1.00
A3007	3M4-923	FP	JK Flip Flop	1.00
A3005	1M4-925	FP	Dual 2 input gate	1.00
A3004	926	TO-5	Buffered JK Flip Flop	1.00
A3006	926	FP	Buffered JK Flip Flop	1.00

(FP-Flat Pack)

SILICON CONTROLLED RECTIFIERS (SCR'S)

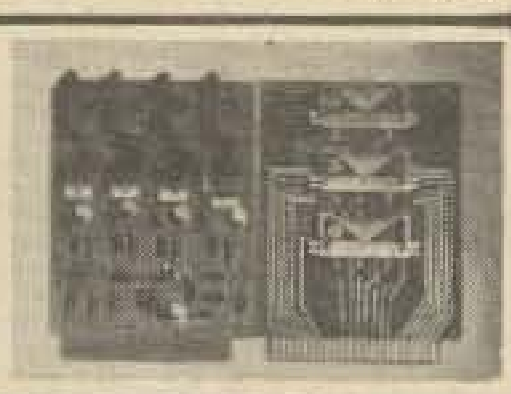
A4200	50 Volts	1 Amp	TO-5	4/1.00
A4201	100 Volts	1 Amp	TO-5	2/1.00
A4202	200 Volts	1 Amp	TO-5	3/2.00
A4203	300 Volts	1 Amp	TO-5	4/3.00

ZENER DIODES

A4010	1N751A	5.1 Volts, 400mw	5/1.00
A4011	1N3039A	62 Volts, 1 Watt	3/1.00
A4012	1N3822	3.6 Volts, 1Watt	5/1.00
A4013	1N3000B	62 Volts, 10Watts	2/1.00
A4014	1N3048B	150 Volts, 1Watt	3/1.00
A4015	¼M3.0	3 Volts, ½Watt	4/1.00
A4029	1N429	5.6 Volts, 1Watt	4/1.00
A4038	1N961B		
A4040	1N3048	150 Volts, 1.7ma (Matched pair)	.75

DIODES

A4005	1N629	Hughes PIV 175, 30ma	8/1.00
A4006	1N1200	Sylvania PIV 100, 70ma	8/1.00
A4007	1N2326	RCA Rectifier PIV 200, 100ma	5/1.00
A4008	1N3195	RCA Rectifier PIV 600, 500ma	10/1.00
A4009	1N3255	RCA Rectifier PIV 600, 500ma	10/1.00
A4030	1N541		
A4032	1N3208	Motorola Silicon Rectifier 50 Volts, 15 Amps	3/1.00
A4034	1N4785	RCA	
A4050	1N2071	Sylvania Bullet Diode PIV 600, 750ma	8/1.00



TRANSISTORS

A4019	2N3904	Motorola	5/1.00
A4022	MP1546	PNP Germanium Power transistor 100W .75	3/2.00
A4000	2N277	Motorola Power Transistor PNP Germanium 55 Watts .75	3/2.00
A4001	2N1183B	RCA Power Transistor PNP Germanium 7.5 Watts .75	3/2.00
A4002	2N1204	Motorola	5/1.00
A4003	2N231	PNP Germanium (RF)	5/1.00
A4004	2N2925	NPN Silicon Gen Purpose	5/1.00

A4016	FET Field Effect Transistor To-18 25 Volt Source to Gate N Channel	.50 5/2.00
A4017	Tunnel Diode Similar to 1N3717	.50 5/2.00

MISCELLANEOUS ITEMS

A8010	2000 Ohm Multi turn trimmer	.75
A9004	To-3 Power Transistor Sockets	8/1.00
A9040	Fan Motor 110 AC	1.00
A9001	Sun Sub-miniature slide switches	3/1.00
A9003	Fuse Holders (Panel type)	6/1.00
A9032	Dialco 28 Volt pilot light bulb and assembly	3/1.00
A9065	Mercury Wetted Relay Clare HG-1002	1.00
A9066	Powerstat Type 10B 1.75 Amps (Removed from equipment)	2.50
A9067	Isolation Transformer Triad N-51X	2.00
A9062	D.C. Servo Motor, 24 Volts, 4.2 Amps	9.95
A9063	Nickel-Cadmium Batteries 1.25 Volts, 4AH	1.25
A8012	Precision Resistor 1.0 Meg. 0.1%	3/1.00
A8013	Precision Resistor 500 Ohm 0.1%	3/1.00
A9054	Delay Line 10-40 usec Imp. 2000 Ohms	2.00
A2031	Miniature variable Capacitor 3-75 uufd	3/1.00
A9068	Printed circuit boards (no components	8/1.00
A9069	Printed circuit boards with components	5/1.00
A9000	Slide Switches SPDT	5/1.00
A9005	Earphone elements (used in pillow speakers)	4/1.00
A9018	Neon Pilot light & bulb TEC	4/1.00
A9022	Neon Pilot light & bulb Drake	4/1.00
A9046	Ni-Cad Battery 4AH	1.25
A9050	Motorola MOA 930 A1 single phase .5 Amp voltage doubler 25 volts	4/1.00
A9070	Heinemann Circuit Breaker 0.5 Amps 250 vac	1.00
A9071	Heinemann Circuit Breaker 7.0 Amps 250 vac	1.00
A9072	Heinemann Circuit Breaker 6.0 Amps 250 vac	1.00
A9073	Heinemann Circuit Breaker 10.0 Amps 250 vac	1.00
A9074	Aligator Clips H.H. Smith Insulated red	10/1.00

VARIABLE RESISTORS

Your Choice 5 for 1.00, can be mixed

A8001	100K Screw Driver Adjust
A8002	Dual 1000 Ohm P.C. Mount
A8003	50 Ohm
A8004	1000 Ohm Miniature P.C. Mount
A8005	100 Ohm P.C. Mount
A8006	2000 Ohm P.C. Mount
A8007	5 Ohm
A8008	500 Ohm
A8009	5000 Ohm Miniature

Lots of other items — send for free flier; All merchandise fully guaranteed. Please include postage; excess will be refunded.

DELTA ELECTRONICS CO.

BOX 1, LYNN, MASSACHUSETTS 01903

WILL BUY FOR "CASH" ALL TYPES
MILITARY ELECTRONIC PARTS EQUIPMENT-TEST EQUIPMENT

ITEMS BELOW FOR SALE

RECEIVERS

R122A/ARN12 Receivers 75 MC Signal AM	4.95
BC603 20-27 MC 12V Input	40.00
R447/ARN5D 332.6-333.8 MC 24VDC	5.00
R89/ARN 5A as above	5.00
R268/ARN5A as above	5.00
RS38 Mikes	4.50
R48/TRC8 FM Receiver 230-250 MC 115V 60Cy	28.00
FM Transceiver 30-50 MC as is	ea. 12.50
CV217/ARN30 B10 Convert.	ea. 6.00
Gear Head Motor 1/6HP 110VAC Reversing 345 RPM output	12.95
Meters 0-1 MA (scale in RPM's) for cars; uncased	1.95
Variacs 20AMP 115V IN 0-130V OUT	ea. 20.00
Meter 0-50 Microamp	ea. 4.00
XFR 115V IN 6.3V 2A OUT	.99
URC4-URC11 Emergency xmtrs. not checked out	ea. 15.00
PL359–.25	PL259–.25
CB Walkie-Talkie damaged 100 MW w/xtals; Need repair	ea. 7.50

GENERATORS

2500 watt Portable, gasoline driven engine generator 120V 60 Cy. 1 cyl. 6.5 HP, 2800 RPM, 250 lbs., used good with oil inhibitor, each	$225.00
Hand Generators for Ringing Telephones or light small bulbs G25/Pt.	1.95
Mast Base (for antenna) Flexible w/Feed thru insulator for MS Sections	3.75
Mast Sections for above, each	1.25
EE8 Field Telephone Portable Hand Ringing uses 2 flashlite batteries up to 17 miles used working, each	15.00
1/4 Mile Reel of wire on DR8 Reel	7.00
Sound Power Handset works without Batteries. Set of 2 Pcs, set	15.00
Sound Power Head and Chest Set works without Batteries, each	12.50

HEADSETS–MIKE'S–USED–GOOD

HS33 600 ohm imped. w/cushions	$ 6.75
HS30 250 ohm imped. w/604 xfr.	1.25
H63/U w/Boom Mike 600 ohms	3.95
H113/U 600 ohms	3.00
M29/U Hand Lip Mike Press to Talk	3.00
M2/UR Announcers Tiq Mike	3.75
T17 Hand Push Button Mike	6.00
Dial Telephone Desk Style	4.00
Desk Telephone Less Dial	2.95
H33/PT Press to talk Handset w/matching Male & Female audio plugs	4.00

TELETYPE EQUIPMENT

Polar Relays D163119A (255A)	2.00
TT52 Transmitter Dist.	20.00
TT16FG Reperf.	35.00
T372/FCC3 XMTR	25.00
T379/FCC3 XMTR	25.00
R525/FCC3 Rec.	30.00
R533/FCC3 Rec.	30.00

COMMAND TRANSMITTERS

5.3-7MC Less tubes used as is	2.50
4-5.3MC Less tubes used as is	2.50

KEYERS

TG34 Keyer Code Practice Set to reproduce signal from inked paper, variable speed, oscillator w/speaker and phone jack 115 & 230V in small trunk (no tape) used good, each	12.00
AN/GSCTI Code Practice Set	12.00
Code Key J37, each	3.00
Thigh Code Key J45, each	4.50
Heavy Duty Code Key, each	2.50

UPM4A Test Set Complete	$200.00
CV94/FGC5 Tel. Code Converter Rec.	15.00
0-100/FGC5 Sig. Dist-Driv Rec.	12.50
CV81/FGC5 Tel. Code Conv. Trans	15.00
TT64/FGC5 Sig. Dist. Trans	15.00

WE HAVE PARTS & COMPONENTS FOR THE FOLLOWING SETS: BC–SCR–GRC GRR–PRC–SB–TRC–VIA–ARN 21–ARC 33–ARC 34–ARC 21–ARC-65–FRC–PE TRANSISTOR POWER SUPPLIES–DYNAMOTORS–ARC 44–GRC 27–GRT 3–URC GMD1–TA–TCC–BC–VRC–GN–SRC–CD–Hand Sets–Head Sets–Telephone–Cables

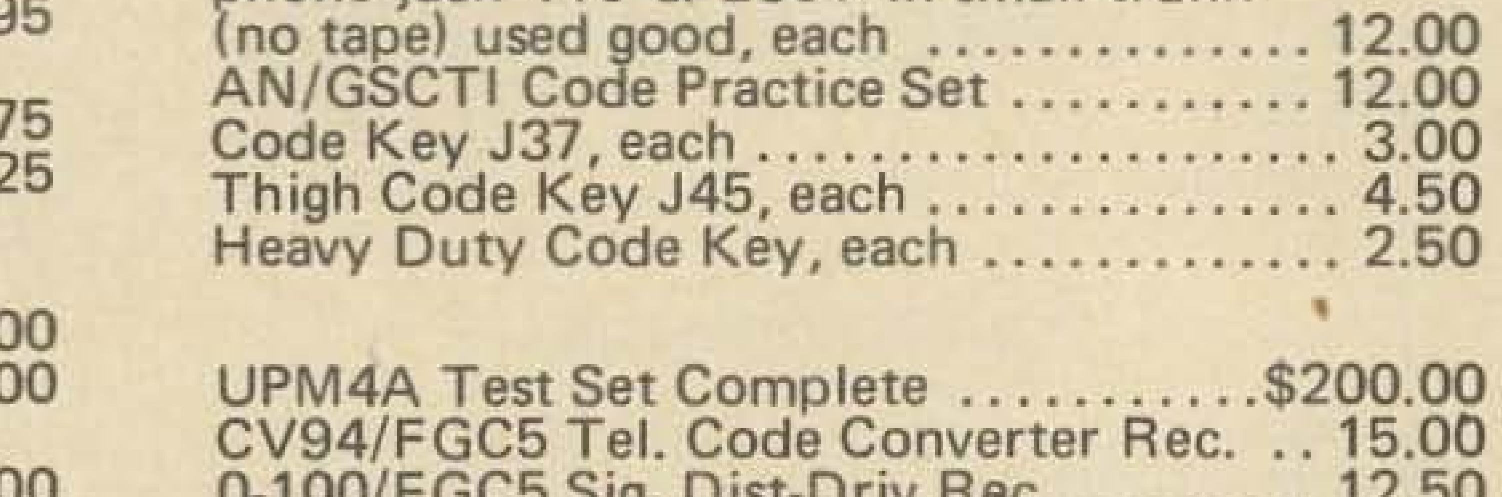
We have millions of items that we do not catalog. We invite you to visit our retail outlet which is open on FRIDAY NITE 5 to 8 PM and SATURDAY 9 AM to 5 PM.

We buy all types of parts and Modules for Army and Airforce Communications. Send sample picture, Fed. Number or Sig. Number. We are buyers not askers.

Send your inquiries by Sig-Fed-Mfr-Mil Dwg Numbers. Manufacturers Prototypes Avail. It it's Electronics we have it or may get it. The largest inventory available.

ELECTRONICTOWN

"THE EYES AND EARS OF THE INDUSTRY"



1617 South Main Street and Anker Road — Wilkes Barre, Pa. 18702 — Area Code 717 824–7859

JENNINGS VACUUM VARIABLE – NEW

UCSH-50 15 to 50 MMF
10,000V $19.95
UHC-75 10 to 75 UUF
45,000V 24.95

COOLING FAN

blower, 4 pole 110v 60 cyc motor with 4 bladed nylon fan. Very quiet, about 50 CFM 2¼"W x 3"H x 2¼"D. Sh. wt. 3#. $2.25 ea.

HEAVY CHROME CABINETS
Front rolled to hold panel in place. No rear panel 5-1/8"W x 2-5/8"D x 3-1/8"H. NEW
95¢ ea . . . . 10/$8.95

METER 0-60 AMP 2½"
Round aircraft type with shunt
NEW $2.25

TELETYPE PAPER 8½" wide
rolls sh. wt. 40 pounds. 12/$4.95

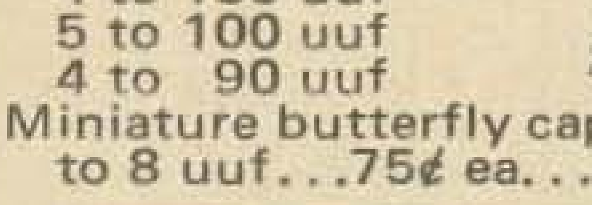
CATHODE MAGNETIC TUBE SHIELDS
3".....$1.49   5".....$2 49
500 mmf at 500V Feedthrus 20/$1.00
.001 uf at 600V By-pass cap . . . . 12/$1.00
100 BUD 100 UUF¼" shaft$1.50
20 to 120 mmf per section
Butterfly 8¾" x 6¾" x5"D ¼" shaft 7500 VAC
NEW $7.50

MICA TRIMMER CAPACITORS

4 to 50 uuf	CHOICE
4 to 130 uuf	15¢ ea.
5 to 100 uuf	8/$1.00
4 to 90 uuf	

Miniature butterfly cap. 2.3 to 8 uuf. . .75¢ ea. . . . . .10/$5.95

DUMMY LOAD
50 Ohm 150 Watt Noninductive metalic film.
$1.50ea. . . . . 4/$5.00



PISTON TRIMMERS
glass JFD-VC11G panel mount .6 to 14 uuf. . 50¢ ea. . 10/$4.49

VARIACS GENERAL RADIO & OHMITE 60 cyc. Input 120v, output 0-280v 1 amp or input 240v, output 0-280v 2 amp. Pullouts in excel. cond.
(10 lbs.). . $6.95

PC BOARDS
2 x 2. . . . . .15¢
3 x 6. . . . . .35¢
4 x 6. . . . . .45¢
Etching solution . . . . 99¢ pt.
Resist paint . . . . .79¢ bt.

R & R DOZEN (13) for price of twelve

100 KC CRYSTAL CALIBRATOR

KIT NO. 1
K100c-2 100 KC CRYSTAL CALIBRATOR. First PC board kit contains components for 100 KC output. The output of this little unit is really very stable, ±.005% or better at 100 KC. Voltage requirement is 4.5VDC (3-1½V flashlight batt.). Complete with crystal, integrated circuits and all components.
ONLY $4.95

KIT NO. 2
K100C-2A Contains two PC boards with components of Kit No. 1 and has additional components to deliver outputs of 50 KC & 25 KC band edge markers. Complete Kit K100C-2A (shown in photo) will deliver stable harmonic-rich outputs of 100 KC, 50 KC and 25 KC band edge markers. Units deliver a square wave which gives useful harmonics up to 50 MC.
ONLY $7.95

TRANSFORMERS NEW
All Primaries 110V 60 Cyc.

Jefferson Electric 10,000V
23 Ma. . . . . ea. $4.95
UTC-CG-33 6.3V 4 Amp. . . . 1.95
12 Volt 5 amp w/circuit breaker 3.00
CG-131 UTC Plate to Grid Pri. 15K ohm Sec. 135K ohms +28 DBM. Commercial Grade . . . . ea. 1.25

AMPHENOL CONNECTOR SALE
PL259. . . . . ea. $ .45
10/$4.00. . . . . .100/$37.50

CRYSTAL OSCILLATOR KITS

Using IC UL 914 Stable, harmonic-rich output osc. range 100 KC to 10 MC – Kit includes Fairchild IC UL 914, crystal sockets, resistors, capacitor, & PRINTED CIRCUIT BOARD, with instructions for assembly. . . . . . .$2.00 per Kit.

$10.00 FOR $1.99

Over-stocked on CAPACITORS. $10.00 worth for only $1.99. Less than 25¢ per lb; 8 lbs.

ALL NEW NO PULLOUTS

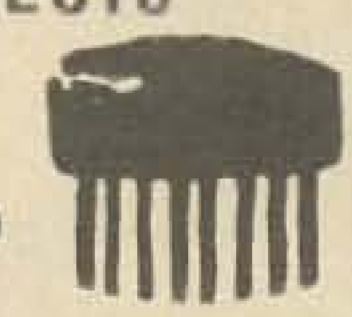
Guaranteed to your satisfaction or your money back. Don't miss out on this **SALE.**

ELECTROLYTIC CAPACITORS
Power Supply Type
1000 mfd @ 260V
$1.75 ea 4/6.25
500 mfd @ 200V
1.50 ea 4/4.95
15,000 mfd @ 35V
1.75 ea 4/6.26

ALL CAPACITORS NEW NO PULLOUTS

1000 PIV 1½ Amps
epoxy diodes. . . . . 10/$3.75

INTEGRATED CIRCUITS FACTORY FRESH NO REJECTS

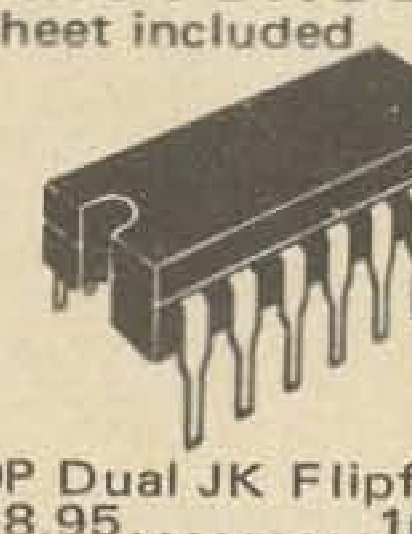


FAIRCHILD

UL 914 w/30 projects dia. . .80¢ ea
10/$7.50. . . . . .100/$65.00
UL 923 J.K. Flipflop with spec. sheet. . . . .$1.50 ea
10/$13.50. . . . . 100/$110.00

MOTOROLA

Spec sheet included



MC790P Dual JK Flipflop. . .$2.00
10/$18.95. . . . . .100/$179.50
MC789 Hex Inverter
MC724 Quad 2 Input Gate
MC799 Dual Buffer
ABOVE 3 IC's Choice. . . $1.10 ea
10/$9.95

TWO LOCATIONS

R & R ELECTRONICS
311 E. South
Indianapolis, Indiana
46225

R & R ELECTRONICS
1953 S. Yellowsprings
Springfield, Ohio
45506   Dept. C69

PLEASE refer all mail order to Ohio store

$2.00 minimum order FOB Springfield, Ohio. COD order 25% deposit. Please add sufficient postage, we refund unused amount. Ohio customers add 4% sales tax. PLEASE refer all mail order to Ohio store. Watch for our booth at this summer's "Hamfests."

◆ JEFF-TRONICS ◆

TEST EQUIPMENT

Kartron 101-DR Electronic shorted-turn indicator .... $ 25.00
Federal 804-CS1 Microvolt Generator. 8-330 MC .... $ 95.00
Hickok 610 TV Sweep Generator, less case & dial bezel .... $ 25.00
Fluke 101 VAW Meter with 3 shunts .. $150.00
G-R 874-LBA Slotted Line. Like New .$140.00
G-4 874-VI Voltmeter indicator ...... $ 20.00
G-R 1213-C Unit time/freq. Calibrator. Less pwr. supp. .... $ 85.00
Dumont 294-A Oscilloscope, with power supply. 160 lbs. $125.00
G.E. ST-4A TV Sweep Generator ..... $ 75.00
Kay Model RF-P "Marka-Sweep" Sweep and Marker Generator .... $ 35.00
Kay "Mega-Marker Sr." Tv Marker Generator .... $ 20.00
Simpson 604 "Multicorder" recording Multimeter .... $ 70.00
Keithley instruments 515 megohm bridge $100.00
Sola 23-90-150 Constant voltage trans. output variable 0-130V @ 7½ amps. max. V & A meters on panel. Like New $100.00
Sorensen "Nobatron" 150-5. 0-150 VDC @ 5 amps. max. adjustable current limiting $150.00
Philbrick R-100B Dual power supply, +300, -300V at 100 MA .... $ 22.50
Lambda Model 28 pwr. supply, 200-324V DC @ 100 MA .... $ 25.00
TG-34A Code Practice machines. Unused .... $ 20.00
Gear-Head Motors, GE, 50 oz.—In. Torque, 56 rpm. 115V 60 cy., capacitor motor, with capacitor .... $ 6.00
Selsyn Assembly, contains 2 GE 2JIGI Selsyns, plus gears, etc. Used, good, only .... ea $ 2.00

SG 87/AQM 2 Sonar Test Set. Low Freq. Signal Gen. w/dB meter, ultrasonic transducer, 3 12AU7 tubes, nice alum. case. New .... $ 15.00

Power Transformer, 275V No Ct., 125 MA, 12V @ 2 amps. Upright mount. 8 lbs. .... $2.00 .... 4 for .. $ 7.50
Power Transformer, 490-0-490V @ 75 MA, 5V @ 2 amp, 6.3V @ 5.5 amp. Open frame. 8 lbs. .... $ 2.00
16 Volt Transformer @ 15 amps. Open frame. 8 lbs. .... $ 4.00

Adjustable Choke, 1-20 Hy. 900 ohms. Fully cased. 2" x 1.3" x 1.3" .... $ 1.50
Oil-filled Capacitor, 1 mf 3000V DC GE Pyranol, ... $1.50 ea. .... 10/ $ 12.00
5 mf 440V AC Capacitor, Sangamo, Rect. can .... $ 1.00

Mica Trimmer Capacitors, 3-30 pf. ea. . $ .10
Variable Capacitor, 170 pf max. 1000V Screw driver adj. .... 60¢ .... 2/$ 1.00
Variable Capacitor, Johnson 110R25, 110 pf max. 1250V ... $1.50 ea. .. 4/$ 5.00
Capacitor Assembly, 4 Johnson 160-127, miniature, 17 pf max. on Phenolic strip. ONLY .... $ 2.00

Micrometer Spindle, LS Starrett #263-M, 0-25 millimeters In .01 mm graduations. ONLY .... $ 5.00

AC Vacuum-Tube Voltmeter, made by Trio Labs. 3" panel meter w/built-in amplifier. Range 0-42V, but w/input divider removed, it is about 10 mv. Requires 100 vdc & 6.3V to operate. w/schematic. Used, good .... $ 4.50

MOTORS

12 vdc Auto Heater Fan Motors, shunt wound. 5/16" diam. shaft both ends.$ 1.00
6 vdc Auto Heater Fan Motor. 5/16" diam. shaft, one end .... $ .50
Induction Motor, 2-pole, 115V 60 Cy. 3/16" diam. shaft. Good for fans, etc. .... 85¢ ea. .... 6/$ 4.50
4-pole Induction Motor, 3/16" diam. shaft, made for tape recorder..... ea. $ 1.25
Power Cord, 3-wire #16, 9 ft. long, green plastic w/grounding plug ...... $ .75

RELAYS

DPDT, Ceramic insulation, 28 vdc coil, We've sold hundreds of these in the past, just found some more. Good for antenna relay, etc. 10 amp contacts. .... $ .75
DPDT, 220V 60 Cy coil. "Wheelock" made by Signal Engineering. Very high grade. 10 amp contacts. $1.50 each .... 4/$ 5.00

METERS

Weston 0-500 AC milliameter. #1524. 2" round .... $ 2.95
Treplett 0-25 MA DC Model 221-T. 2" round. No calibration, just 2 marks. "F" & "R", can be erased. $1.75 ea 4/$ 6.00

ELECTROLYTIC CAPACITORS TWIST-PRONG CAN

80 mf. 450 vdc & 2 mf. 350 vdc .... $ .75
30 x 75 mf. 150 vdc .... $ .40
40 x 90 mf. 150 vdc .... $ .40
100 mf. 150 vdc .... $ .40
160 mf. 250 vdc & 20 mf. 450 vdc & 40 mf. 150 vdc .... $ .50

ROTARY SWITCHES

4-poles, 5-positions, 2 decks, Phenolic. $ .35
2-poles, 4-positions, small audio type. . $ .25
Single-pole, 11-positions, plus 2 special decks. Phenolic... 30¢ ea. . . 4/$ 1.00

On mail orders; please add sufficient money for postage. Any excess is immediately refunded. Minimum order $2.00

For our Canadian customers, the Parcel Post rate is $1.00 for the first 2 pounds, and 30¢ for each additional pound or fraction. U.S. funds.

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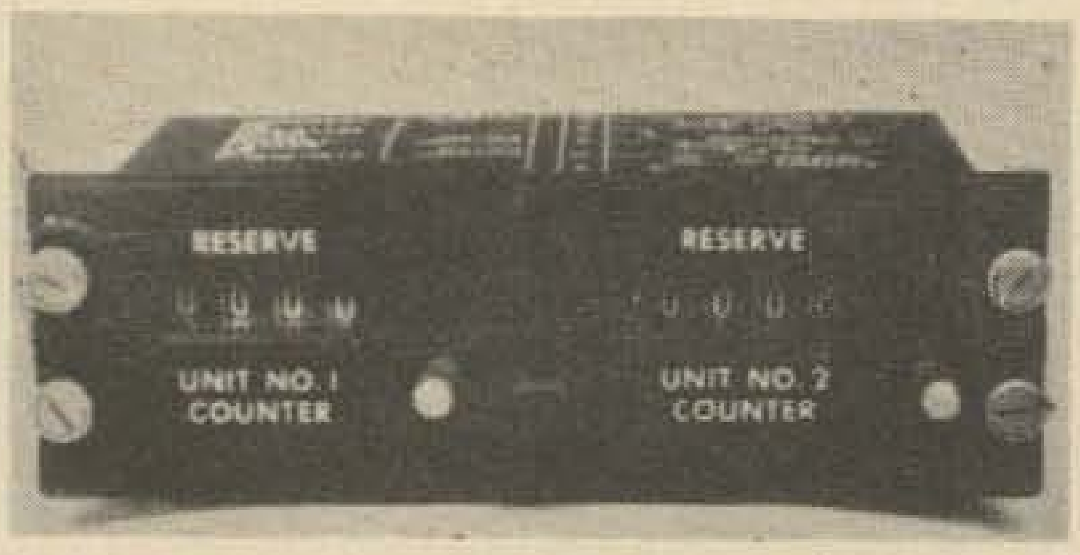
IMPULSE COUNTERS

#1. VEEDER ROOT—4 Digit, 0000-9999 115 VAC 6W. Pushbutton reset to zero. Dim.—1¼"H x 2"W x 3"D. Used—Guaranteed Excel. . $4.50 ppd.



#2. Dual Four-Digit DOWN COUNTERS. Front panel adjusts to any number up to 9998. Counts down to zero. 28 volts DC coils. 2 - 28 volts DC or AC Panel Lamps. Like New. . . . . $6.50 PPD.

CIRCUIT BOARD ASSEMBLY

Unusual Find!!! Digital Assembly. 3 Boards mounted on a frame with panel. Fixed center board. Outside boards are hinged and swing out. Use frame for breadboard assemblies. Panel 2 3/8 x 8 5/8. Depth 15". All parts easy to remove. 300 1N658, 77-114 Sw. Xsistors, IN754 Zeners, Unijunctions, Tantalums, & much more.

Board #1 - As above $4.00
Board #2 - As above + 1 Clare Mercury wetted relay module, #HGSM1001 . . . . $5.50
Board #3 - As above + 3 Clare Mercury wetted relay modules, #HGSM1001 . . . . $6.50

SHIPPING WEIGHT 5 LBS.

TRANSFORMER SPECIALS

1. Pri. 115VAC — **$6.50**
   Sec. 1) 20-0-20VAC @ 10 A.
   Sec. 2) 14-0-14VAC @ 5 A.

2. Pri. 115VAC — **$3.50**
   Sec. 1) 17-0-17VAC @ 2A.
   Sec. 2) 70-0-70VAC @ 50 ma.
   Sec. 3) 30-0-30VAC @ 25 ma.

4. Pri. 115VAC — **$4.50**
   Sec. 1) 6.3VAC @ 6A.
   Sec. 2) 18VAC @ ½A.
   Sec. 3) 450VAC @ 55ma.

5. Pri. 115-230VAC — **$8.00**
   Sec. 1) 1500VAC @ 250 ma.
   Sec. 2) 115VAC @ 1.5A.
   Sec. 3) 33VAC @ 0.7A.

ALLOW 20 LBS. SHIPPING ON ALL TRANSFORMERS AND WE WILL REFUND ANY DIFFERENCE. WE SHIP UPS.

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G10 EPOXY GLASS
1 oz. Copper 1 Side

Pkg. Quant.	3/64"	1/16"	3/32"	1/8"
1 9x12"	$1.50	$2.50	$3.50	$5.00
2 6x9"	"	"	"	"
4 4½x6"	"	"	"	"
6 3x4½"	"	"	"	"

This item postage prepaid.

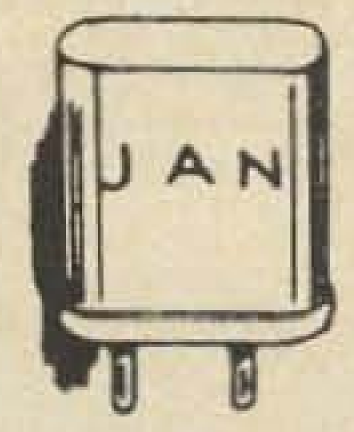
Every order unconditionally guaranteed.

TRI RIO Electronics

2614 Lake Shore Dr. LaCrosse, 2, Wis. 54601

THIRD OVERTONE CRYSTALS HC6/U HOLDER

The crystal frequencies listed are third and fifth overtone types and should be used in an overtone circuit. Order by frequency and holder type HC6/U. Listing is in megacycles. We will make to order any non-oven type HC6/U crystal from 15 MC to 55 MC .005% tol. at $3.00 each. Be sure to specify exact frequency and whether you want it made at series resonance or parallel. If parallel what capacitance. If possible send a crystal known to be on frequency so that we can correlate and return crystal with order. For overtone receive crystals we must know the exact crystal frequency, the operating frequency, the IF frequency and the number of times the crystal frequency is multiplied. Stock crystals below are listed in megacycles.



$1.75 EA

3 for $5.00

11.311	21.003	26.610	30.155	33.525	37.074	39.680	41.125	43.185	45.083	50.700	64.600
11.381	21.053	26.620	30.200	33.625	37.111	39.703	41.166	43.208	45.100	50.960	65.083
11.406	21.103	26.670	30.266	33.649	37.148	39.740	41.250	43.250	45.125	51.100	65.600
11.431	21.153	26.680	30.375	33.657	37.200	39.777	41.325	43.259	45.208	51.275	66.600
11.450	21.203	26.700	30.575	33.700	37.222	39.800	41.333	43.416	45.275	51.376	66.750
11.456	21.253	26.710	30.700	33.750	37.259	39.814	41.375	43.444	45.300	51.416	67.116
11.481	21.303	26.720	30.711	33.800	37.266	39.851	41.416	43.449	45.700	51.469	67.167
11.500	21.353	26.730	30.822	33.850w	37.300	39.888	41.500	43.458	45.895	51.576	67.600
11.506	21.403	26.750	31.111	33.955	37.333	39.925w	41.583	43.481	45.900	51.750	67.611
11.556	21.435	26.760	31.280	33.975	37.370	39.962	41.658	43.500	46.208	52.275	67.750
11.581	21.437	26.770	31.388	34.400	37.388	40.000	41.666	43.518	46.275	53.275	67.944
11.600	21.453	26.888	31.700	34.444	37.400	40.037	41.687	43.625	46.300	53.416	68.250
11.606	21.503	27.120	31.825	34.488	37.407	40.041	41.833	43.640	46.375	53.458	68.333
11.631	21.553	27.125	31.850w	34.511	37.444	40.074	41.875	43.700	46.395	53.625	68.416
11.681	21.577	27.158	31.888	34.688	37.471	40.083	41.916	43.703	46.750	53.708	68.500
12.056	21.600	27.194	32.000	34.700	37.518	40.111	41.923	43.740	46.885	53.750	68.600
12.477	21.603	27.220	32.222	34.720	37.555	40.148	41.958	43.777	46.900	53.791	68.611
14.935	21.977	27.233	32.250	34.866	37.592	40.185	42.000	43.814	46.916	54.125	68.783
15.006	22.155	27.455	32.282	35.055	37.600	40.208	42.055	43.851	46.979	54.275	69.240
15.325	22.200	27.612	32.287	35.185	37.629	40.222	42.166	43.888	47.100	54.541	69.250
15.360	22.825	27.629	32.302	35.422	37.666	40.250	42.250	43.895	47.110	54.625	69.279
15.435	23.006	27.640	32.307	35.688	37.700	40.259	42.279	43.900	47.275	54.708	69.333
15.506	23.577	27.700	32.350w	35.703	37.703	40.296	42.333	43.925	47.300	54.791	69.750
15.935	23.833	27.705	32.357	35.740	37.711	40.333	42.388	43.958	47.406	54.875	70.000
16.435	24.006	27.994	32.606	35.777	37.740	40.370	42.416	43.962	47.562	55.000	70.083
16.506	24.033	28.022	32.667	35.814	37.777	40.407	42.437	44.000	47.645	55.083	70.450
16.730	24.123	28.050	32.700	35.851	37.800	40.444	42.500	44.041	47.700	55.125	70.500
16.935	24.190	28.054	32.800	35.888	37.814	40.458	42.541	44.080	47.785	55.250	70.600
17.000	24.260	28.150	32.850w	35.925	37.851	40.474	42.592	44.083	47.850	55.275	70.667
17.435	24.400	28.198	32.857	35.933	38.000	40.481	42.625	44.100	47.900	55.625	71.333
17.935	24.444	28.227	32.875	35.962	38.110	40.500	42.658	44.111	48.275	56.275	71.722
18.435	24.455	28.338	32.965	36.148	38.140	40.518	42.703	44.148	48.583	56.500	71.750
18.935	24.588	28.405	32.975	36.200	38.148	40.541	42.722	44.166	48.750	56.750	72.000
19.006	24.615	28.627	32.985	36.222	38.160	40.555	42.740	44.185	48.791	56.918	72.600
19.200	24.668	28.640w	33.015	36.259	38.200	40.583	42.750	44.259	48.979	56.993	72.660
19.916	24.700	28.688	33.025	36.266	38.244	40.592	42.791	44.275	49.000	57.116	72.833
19.935	25.110	28.700	33.035	36.296	38.300	40.629	42.833	44.296	49.125	57.275	73.416
20.000	25.250	28.715	33.055	36.311	38.333	40.666	42.850	44.300	49.177	58.416	73.600
20.006	25.400	28.722	33.065	36.333	38.350	40.703	42.851	44.370	49.208	58.600	73.667
20.435	25.555	28.735	33.075	36.400	38.600	40.708	42.875	44.465	49.275	58.783	73.783
20.500	25.700	28.752	33.085	36.592	38.800	40.740	42.888	44.481	49.290	59.000	74.500
20.506	25.711	28.830	33.105	36.600	38.900	40.750	42.900	44.497	49.312	60.083	75.083
20.533	25.861	28.878	33.115	36.666	38.906	40.777	42.916	44.500	49.666	60.450	75.333
20.700	25.945	28.888	33.125	36.700	38.952	40.791	42.925	44.518	49.730	60.700	75.450
20.703	25.977	28.938	33.135	36.711	39.200	40.814	42.944	44.562	49.850	60.750	80.000
20.733	26.120	29.000	33.155	36.777	39.243	40.833	42.958	44.583	49.875	61.750	81.000
20.753	26.220	29.406	33.165	36.800	39.400	40.851	42.962	44.592	49.895	62.187	83.500
20.777	26.229	29.426	33.175	36.814	39.500	40.888	42.988	44.666	49.906	62.600	83.542
20.803	26.241	29.640	33.185	36.851	39.518	40.925	43.074	44.703	50.121	62.944	83.542
20.853	26.510	29.688	33.195	36.888	39.555	40.962	43.083	44.729	50.122	62.984	85.000
20.903	26.550	29.700	33.225	36.925	39.592	40.963	43.111	44.740	50.250	63.187	86.355
20.935	26.560	29.800	33.255	36.962	39.600	41.000	43.125	44.777	50.275	63.416	90.000
20.953	26.570	30.000	33.333	37.000	39.629	41.037	43.148	44.814	50.427	63.600	94.000
20.977	26.580	30.066	33.350w	37.037	39.666	41.041	43.166	45.000	50.500	63.783	100.000

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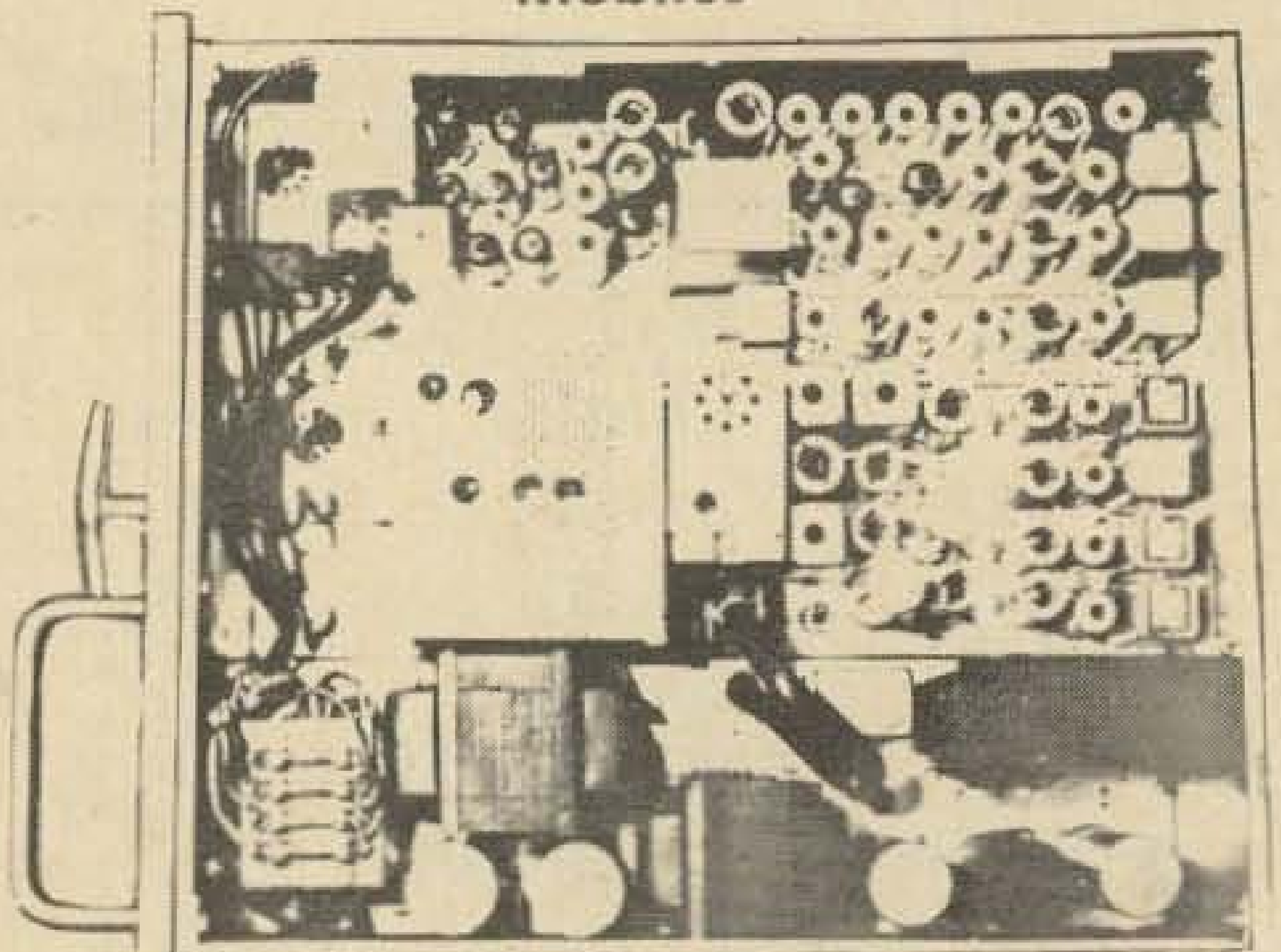
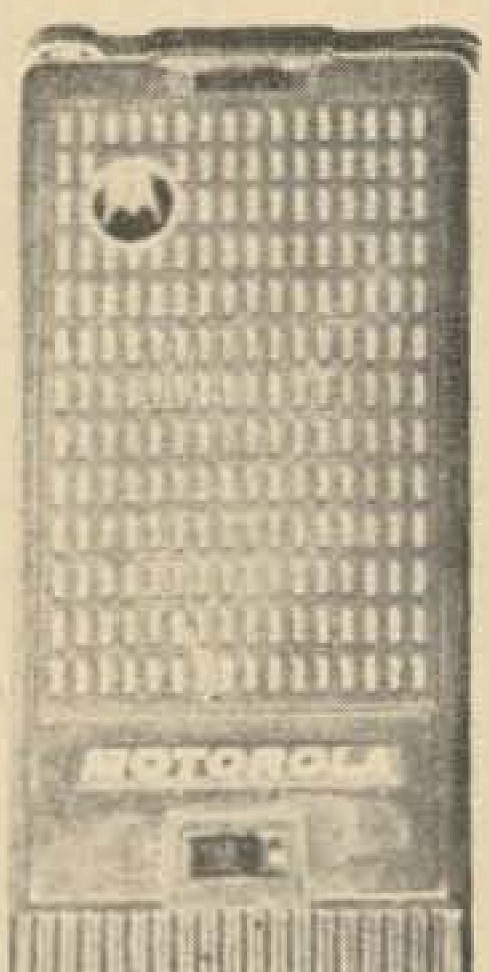


MODEL T53-GJV 6/12 volt. These units are exceptionally clean and in mint condition. They are complete with 4 freq. control head, cables, mike, speaker. Xmtr-narrow band, rcvr is wide band. Less crystal ovens & ant. Only $175.00 ea.

G.E. PROGRESS LINE–150mc; 60 watt; four frequency-MA/E-36. These are also very clean and in mint condition. Complete with all access., less crystals & ant. $225.00 ea.



MOTOROLA 150mc transistorized pocket pager receiver. HO3ANC-1102AQ. Excellent cond., less battery $34.95 ea.

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MOTOROLA "HT" series Handi-Talkies. 150mc. Prices vary according to model: standard, universal, 1 freq., 2 freq., P.L., etc.

G.E. PROG LINE, 30–54mc, 6/12 volt, 60 watt. Complete with all accessories. (less ant). Single freq. $100.00 ea., Dual freq. $110.00 ea., Four freq. $130.00 ea.

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DIGITAL decoder, Secode RPD 634 $19.95 ea.

MOTOROLA 150mc Handi-Talkies guaranteed operating, less mike and battery FPTRU1 . . . . $19.95 ea.

MOTOROLA power supply NPN 6023A for P31, P33BAC.I/batteries . . . . 4.95 ea.

MOTOROLA charger for H11, H13 pocket xmtrs, NLN6121A $9.95 ea.

MOTOROLA 150mc receiver strips; very clean 6V . . . . .25.00 ea.
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MOTOROLA transistorized "Big Voice" power speakers . . . . 19.95 ea.

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ELECTRONIC ORGAN Transistorized, known brand, electronic assemblies, two manual spinet. $60.00 f.o.b., send SASE for particulars. W9YCB, Rural Route 2, Box 52A, Angola IN 46903.

TWIN CITY ARC AUCTION 1:30 p.m., March 22, 1970, Lambs Auction House, 1600 N. Oak, Champaign IL. Details contact K9QZI, 807 W. Charles, Champaign IL 61820.

COLLINS 75A4 Excellent shape $390.00; Collins 32S1 with power supply, used very little $425.00. Walt Williams, 1706 Parkridge, Arlington TX (817-261-9653).

RAGS hamfest Syracuse, New York, April 11, 1970 at Song Mountain. Box 88, Liverpool NY 13088.

AUCTION, NORTH JERSEY really different; new equipment booths, prizes; food and drink and bargains galore. Sunday afternoon (April 19) from 1 p.m. til dark, at the Arbor Inn, Rock Ave. and 7th, Piscataway NJ. Easy to reach from Rt. 22 turn south on Rock Ave. 1½ miles; sponsored by Tri-Country Radio Club.

QSL's??? Samples 25¢ (refunded) Sakkers, W8DED, Holland MI 49423 (mention 73 Magazine).

SELL HEATH H.W. 12 W/extra finals $90.00; with H.P. 23 power supply $135.00; S.B. 200 amplifier $200.00. All gear is clean and in excellent condition. Write Robert Shaw W9EII, Box 154, Rankin IL (217-397-6211).

SALE: Clegg Zeus $300 and interceptor $325; Drake TR4 with power supply $500 and R4B $325; Olson "6" with Lafayette 6 & 2 VFO $100. All mint condition, factory manuals and cartons. Any reasonable offer considered. Barney Scholl, 1655 Kimberly Road, Sharon PA (412-342-4462).

GREENE. . .center dipole insulator with. . .or without balun. . .see 73, November '69, page 107.

BC-221-M calibration book and xtal. CW only. Excellent condition. Pick up only. Best offer over $40. WA2SJW, Ron, 11 Crescent Dr., Old Bethpage NY (516-293-8588).

TMC GPR-90 RECEIVER $250. TMC MSR-4 Receiving mode adaptor, $100. HR-10 Receiver, $50. HX-11 Transmitter, $25. Robert Clauser, 114 Sandhill Rd., Lebanon PA 17042.

NOVICES! Interested in traffic? ENTN meets daily on 3726, 7:30 est. All amateurs in Eastern U.S. invited. For information: WA3JSU/1, 200 Washington Street, Middletown, Conn.

WORLD RADIO has used gear with trial-terms guarantee! SR34AC $129.95; HW32 $89.95; Swan 250 $199.95; 500C $379.95; DuoBander 84 $99.95; 753 $119.95; SB33 $189.95; Galaxy 5mk2 $279.95; 75A $209.95; 75A3 $209.95; 75S3B $499.95; SX101mk3 $159.95; Drake 2A $159.95; 2B $179.95; NC300 $149.95. Free "blue-book" list for more. Write: 3415 West Broadway, Council Bluffs IA 51501.

GPR92 $250 Used 3 years, stored last 3 years. Excellent buy. Ship prepaid. K6ZAM, 6908 Sierra Bonita, Sacramento CA 95831 (916-428-5934).

MUST SELL Heathkit HX-20, HR-20, HP-20, $175., Apache SB-10, $125., VF-1, $10., 14AVQ, Radials, $25. Bob Miller WA6MTY, 1377 Newport Long Beach CA 90804.

SPECIAL OF THE MONTH RG11A6U Coaxial Cable, 1st quality, brand new—12¢ a foot or any length to 2500 feet. Antennas, Inc., Dept. B, 512 McDonald Road, Leavenworth KS 66048.

CHICAGO SUBURBAN RADIO ASSOCIATION Annual Hamboree on March 22nd at East Avenue and 55th Street, Countryside (La Grange), Illinois. Flea market and prizes. For further information contact Wilson Thomas, W9KWA, 4017 Vernon Ave., Brookfield IL 60513 (312-485-0451).

SX-130 with speaker — $110.00; HQ-170AC — $200; both like new, may make offer. Bob Ensminger, 11388 Campus, Loma Linda CA 92354.

TECH MANUALS — TS-173/UR, BC-638A, $5.50 each; R-390/URR, R-390A/URR, OS-8C/U, URT-7, TED, $6.50 each. Many others. List 20¢. S. Consalvo, 4905 Roanne Drive, Washington, DC 20021.

LEARN CODE with your tape-recorder. Beginners course, up to 9 wpm on 7 inch reel. Price $5.95. Harold Whaley, Box 2011, Waianae HI 96792.

COLLINS 310B—1/3 EXCITER with coils; General Electric 30—50 MHz 250 watt transmitter and modulator $500. or best offer. SASE. Millen 3 in. CRT magnetic shields $5. ppd. K8ONM, 37610 Lakeshore, Mt. Clemens MI 48043.

LOOP new communications system; details available for $1.00; write George WA4NQR, 102 Willow Road, Savannah GA 31404.

WANTED Turret tuner with coils or old chassis with tuner for Hammarlund SP400X receiver; later model with 13 plate stator and 14 plate rotor; will pay good price. Ralph Williams, Dixfield ME 04224. Box 372.

SELL: ICO 723 60 watt xmtr—$30; matching Eico vfo—$30. R. Christie Franklin, 89-29 163rd Street, Jamaica NY.

NOVICE CRYSTALS: 40-15M $1.33, 80M $1.83. Free flyer. Nat Stinnette Electronics, Umatilla FL 32784.

INDIANA'S MOST PROGRESSIVE HAMFEST Sunday, May 24, rain or shine. Sponsored by Wabash Co. Amateur Radio Club. Write Bob Mitting, 700 Centennial, Wabash IN 46992.

COSMIC BLUE National NC-270 receiver, 80—6 meters, SSB, AM, CW (.6 hz filter), Notch Calibrator, excellent condition. Best offer. Gary Prant, 320 White Birch Drive, Cinnaminson NJ 08077.

SUPER GAIN (R) ANTENNA much gain, makes exciter sound like linear. See pgs 8 & 144, Oct. 73. GUERILLA (R) high efficiency ant. See pgs 57 & 113, June 73.

5 x 8" PC BOARD, 1542 labeled solder points, Twin-tracks, 39 rows, 3 power loops, YOURS, postpaid. $2.95 with order No. 1-2-1000. Bert Adams Enterprises, PO Box 101, Miami FL 33152.

WANTED: COLLINS 310B Does someone, anyone, have a 310B that I can borrow or buy? Jock White ZL2GX, 152 Lytton Road, Gisborne, New Zealand.

ROCHESTER, N. Y. is again Hamfest, VHF meet and flea market headquarters for largest event in northeast, May 16, 1970. Write WNY Hamfest, Box 1388, Rochester, NY 14603.

GET YOUR "FIRST!" Memorize, study—"1970 Tests-Answers" for FCC First Class License. plus- "Self-Study Ability Test." Proven. $5.00. Command, Box 26348-S, San Francisco CA 94126.

73 IS AVAILABLE to the blind and physically handicapped on magnetic tape from: SCIENCE FOR THE BLIND, 221 Rock Hill Road, Bala Cynwyd, PA 19004.

RTTY GEAR FOR SALE. List issued monthly, 88 or 44 MHy torroids 5 for $2.50 postpaid. Elliott Buchanan & Associates, Inc., 1067 Mandana Blvd., Oakland, California 94610.

"TOWER HEADQUARTERS!" 11 brands! Heights aluminum 35% off! Strato crank-ups, low cost! Rotors, antennas and gear discounts. Phone patch $11.95. Catalog—$.20 postage. Brownville Sales Co., Stanley, WI 54768.

RG8U FOAM COAX—fresh. 10¢ per foot—any length. PL259-S)239 40¢ each, 15/$5.00. UG175 9/$1.00. FOB. Monte Southward, Rt. 1 A, Upper Sandusky OH 43351.

MORE LETTERS . . .

DX

I am planning to make several trips between now and 1972 to rare DX locations in Europe and Mediterranean areas. I would like to receive a few QSL cards from U.S. DXers stating the five rarest prefixes in decending order of importance. Underline the particular prefix(es) *you* need. When trips are planned, an itinerary will be sent to each respondee. Do not list any "U.s." Vandegrift, MATCOM, LSMO, APO, NY 09052.

Hugh Vandegrift DL4VA/WA4WME

Christian Ham Fellowship

The Christian Ham Fellowship is one of the newest of the many ham organizations among licensed hams in the country today. This new organization now has over 300 members and an explanation of the organization for those hams who might be interested is therefore given in this letter.

The purpose of the organization is to promote Christian fellowship among those hams who are Christians. To a born again Christian this is a vital need and privilege. A Christian Ham Callbook has been published and is available for a mere dollar donation to cover mailing and printing.

The organization also is active in gospel tract mailings, and many of the members have a gospel verse or two on their QSL card as their testimony. Anyone wishing to join the organization and simply believes that Jesus Christ is Lord and Savior is welcome to write in for a free data card on the organization. This data card is then filled out and their name is listed in the new issue of the Christian Ham Callbook. The main reasons for the organization's existence is to offer Christian fellowship among Christian hams and to learn how a Christian ham can be a witness for Christ to other hams.

Rus Sakkers W8DED
Box 218
Holland MI

QRP

With great pleasure, we wish to report the results to date of a number of QRP experiments, conducted by W7BVV, Bill Gibson, Salem, Oregon, and myself. Path length was computed to be 1650 miles, and frequency of operation is 28.760 MHz.

Date	Power	Mode	Station wrkd/hrd
12/29/69	2.5 μW	CW	W7BVV
01/04/70	2.5 μW	CW	W7BVV
01/04/70	25.0 μW	AM	W7BVV
01/05/70	2.5 μW	CW	W7BVV
01/05/70	25.0 μW	CW	W7BVV

Our computations and measurements imply that the minimum power required to maintain a CW circuit over the path between W7BVV and this station is on the order of 1μW. We continue to work towards this goal. We have worked many other stations throughout the US and Canada with power outputs down to 100μW AM phone. In addition, we wish to report that we worked CE7DW, Puerto Mont, Chile, 600 miles south of Santiago, with 250 mW AM phone, and received a report of 5 x 7.

Dick Shoup KL7YU
Box 5-828
College AK

73 Readers' DOUBLE BONUS

Want info quick? Just check the box next to the name of the advertiser of your choice in the index below. We'll rush your name to the firm so you can get all the dope direct from the source. (Don't forget to include your name and address at the bottom.)

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- ☐ Oscillators (code)
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- ☐ PC negatives
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- ☐ Receivers
- ☐ Receivers (FM)
- ☐ Surplus Elec.
- ☐ Towers
- ☐ Transceivers (FM)
- ☐ Transceivers (VHF)
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- ☐ TV/Fax

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