amateur 73 radio

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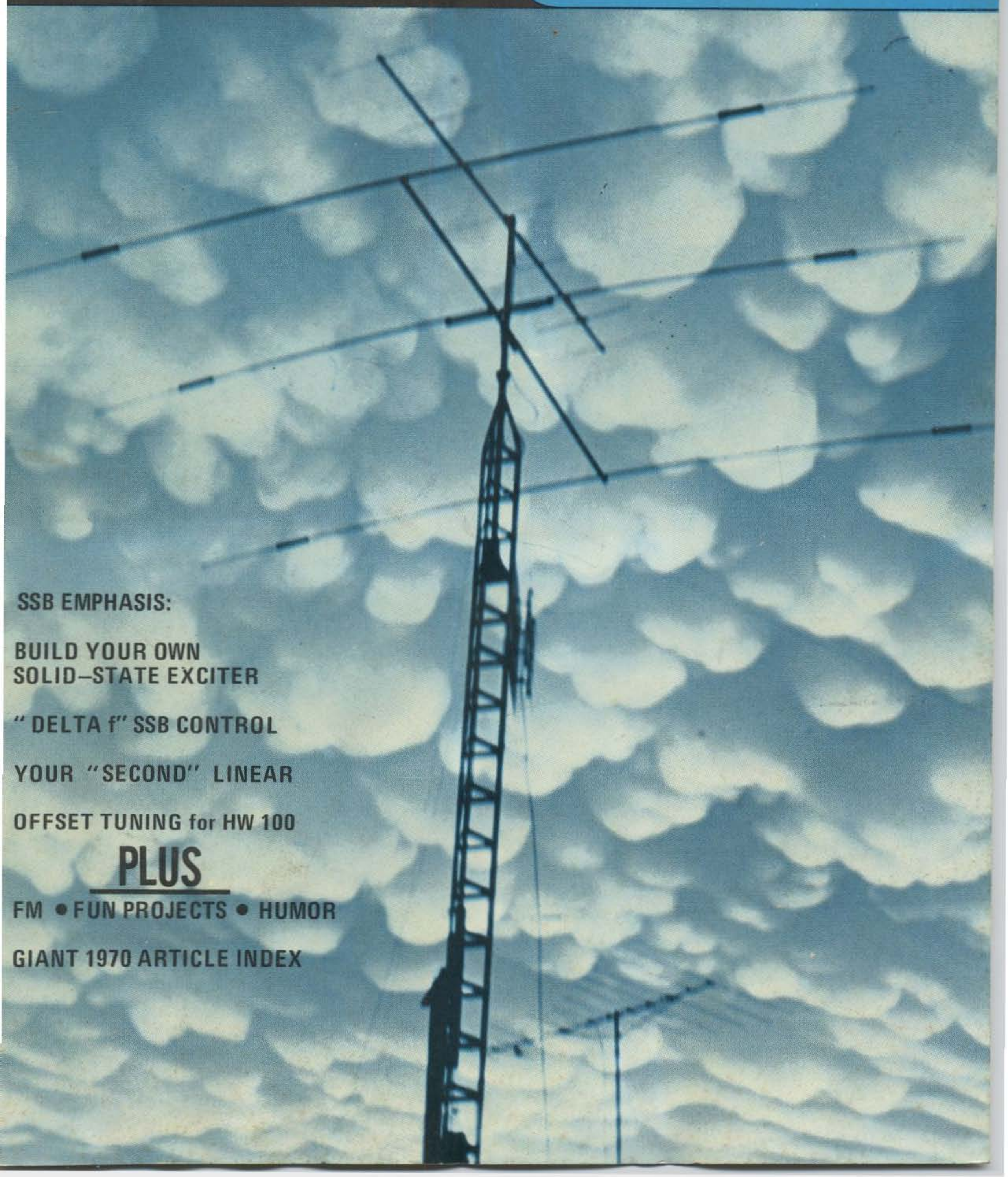

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GIANT 1970 ARTICLE INDEX

#123 December, 1970

amateur 73 radio

Features

Contents

73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per one year elsewhere. Two years $10 in U.S. and $12 overseas. Three years $14, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. *Phone: 603-924-3873.* *We could hassle you about subscribing, giving gift subscriptions, bugging possible advertisers and all that, but we won't. If you want to go through the next month with one of the blackest curses known to man on your head then all you have to do is ignore 73. . .do not subscribe. . .do not send in ten gift subscriptions for friends (or enemies, depending upon how you think of 73). . .do not let Collins know that you thought they were out of the ham business because they have not advertised in 73 in over ten years. Go ahead and risk a curse so powerful that it could well have a serious effect even upon your family two generations later.*

The Cover

An impressive shot of the sky through K9JFD's beam. The photo was submitted by Mrs. Gene Markos as a birthday surprise for hubby.

Amateur Radio News Page

December MCMLXX | Monthly Ham News of the World | 73 Magazine

CHICAGO OUTLAWS HAM RADIO!!

CHICAGO AMATEUR CLUB BRINGS SUIT

Chicago. Under city zoning ordinances, Chicago has forbidden amateur radio stations to be set up in residential areas. According to information published in the Chicago Daily News, the ban can only be waivered on payment of a special $100 fee.

Proceeding on the grounds that such anti-ham legislation is unconstitutional, a group of Chicago amateurs (the Chicago Area Radio Club) filed suit in district court, charging the city with attempting to regulate a service that is already being regulated by the federal government. The suit seeks to have the U.S. district court enjoin the city of Chicago from enforcing its ordinance and from collecting fees for waiving such ordinances.

In supplying this information to 73 News, Art Housholder (K9TRG), manager of Spectronics, Inc., a Chicago area ham radio firm, said the action of the city and the counteraction on the part of the CARC were topics of

U.S. Navy Radioman First Class Larry Hollingsworth sets up personal phone patches for crew members aboard the frigate Yarnell, reducing the impact of transglobal separation between family members.

discussion at club meetings around Chicago and on ham radio nets. Most of the comments, he indicated, were directed against the inequitable city ruling. He also expressed concern that should the court favor the city rather than the amateur operators, other metropolitan areas might follow suit, dealing a crushing blow to amateur radio.

NO-MONITOR REPEATER OPERATION PROPOSED

The editor of 73, Ken Sessions (K6MVH), has submitted a proposal to the FCC that calls for toned repeaters to be allowed to operate without the requirement for UHF monitoring. Under present rules, no remotely operated repeater may be used unless the specified repeater licensee is monitoring from the UHF control point stipulated on his license. The rules make it impossible for the sole owner of a repeater to operate his repeater from a mobile or from any site away from his control point.

Sessions' proposal would make it legal for continuous monitoring to be abandoned when certain fail-safe measures and tone control have been incorporated into a repeater system. Tone-burst and whistle-on repeaters, under the proposed ruling, would require no fixed-control-point monitor as long as effective automatic measures have been incorporated into the repeater design to suspend operation of the repeater when its emissions deviate from the rules of the Commission. Untoned repeaters would continue to fall under existing rules.

MODERN NAVY USES HAM RADIO AS MORALE BOOSTER

Lucius Seneca, an ancient philosopher, once said, "It is through the essence of letters that friends are, in a manner, brought together."

Although Seneca was talking about letters one writes, his thoughts can also be applied to the call letters of ham radio station WBØBDH. aboard the guided missile frigate USS Harry E. Yarnell, presently circling South America on Unitas XI operations.

Bringing people together via ham radio and telephone patches is the off-duty "pleasure" of radioman Larry Hollingsworth. "It is a pleasure to be able to set it up so one of the men on the Yarnell can talk to his wife or girlfriend back in the States," emphasizes Hollingsworth.

Running WBØBDH is Hollingsworth's hobby. His main job is radio watch supervisor and controller at Yarnell's communications division.

Instrumental in establishing WBØBDH before Yarnell departed her home port at Newport, Rhode Island, Hollingsworth obtained an FCC license and was designated supervisor of the amateur radio activity.

"It has really been fantastic," Larry says. "We have been gone two months and I have completed almost 400 calls. It is a real morale booster when we are 8000 miles from home."

Unitas is an annual training exercise involving the United States and the major maritime nations of South America. Larry and the Yarnell will circle South America and return to the United States in mid-December.

A real asset of the service has been demonstrated in situations where an emergency is involved. One chief petty officer on Yarnell received a letter from his wife saying they had suffered a very serious fire in their home. "The letter lacked many details which were important to the chief so we placed a call home via the ham setup," Hollingsworth stated.

A Navy wife, who is presently living in Norfolk, Virginia, and whose husband is on the Yarnell, in a letter to the Yarnell's commanding officer, wrote: "Larry's efforts have certainly helped bridge the miles between my husband and myself, and those four wonder words, 'I love you – over,' have kept us close in spite of the miles that separate us. It is warming to know there are those who understand the voice of a loved one can make a long separation at least bearable."

"We really have received outstanding cooperation from ham operators throughout the United States," the radioman said. "Almost all phone patch stations we contact seem more than willing to help us place our calls."

He does encounter the humorous aspect also. He was talking to an operator in the midwest one evening and the man agreed to make phone patches for Yarnell men. However, the operator's wife was using the phone and after ten minutes of idle chatter over the airwaves, Hollingsworth finally had to thank the man and sign off.

Originally from Albia, Iowa, Hollingsworth presently makes his home in Middletown, Rhode Island, with his wife Lynda and two children, Lee and Lynette.

Larry is anxious to talk to any operators in the world who would like to contact him on the air or by writing to him in care of the USS Harry E. Yarnell (DLG-17), Fleet Post Office, New York. Phone patches to the States are actively sought and QSL cards are available.

GALAXY MOVES TO LINCOLN: Something Big in the Offing?

Lincoln NB. The acquisition of Galaxy by Hy-Gain is now complete, according to R. A. Kobold, spokesman for Hy-Gain Electronics. The company has brought all Galaxy's operations from Council Bluffs, Iowa to Lincoln, Nebraska. Kobold hinted of some sparkling new products to be evolving from the merger, but would not be specific as to detail.

Galaxy watchers seem to think an unveiling of something new could take place at the big SAROC convention in Las Vegas this coming January. According to reports from within Hy-Gain's executive offices, the company has reserved six booths for the occasion. This "extravaganza" attitude could point to an announcement of something the company feels spectacular.

AMATEURS IN ACTION

Coast Guard Commends Ham For Meritorious Service

Washington, D.C. Admiral P. G. Prins has personally expressed thanks on behalf of the U. S. Coast Guard to J. P. Corrigan, a radio amateur who provided communications with a ship at sea during a personal shipboard emergency.

In a letter to Corrigan, the admiral reported: "On the afternoon of August 26, it was reported that the radio operator on (the ship) Stella Lykes had apparently suffered a heart attack. This denied normal communications with the ship and required that all information be passed through the ship's amateur radio. From that time through the evening of August 29, when the ship arrived in Honolulu and transferred the patient ashore, you maintained highly effective communications, passing medical advice for the U. S. Public Health Service, rescue operations information for the Coast Guard, and port arrangements for the ship's agent, Oahu Railway and Terminal Warehousing Company."

By way of expressing the appreciation of the Coast Guard, Admiral Prins said, "Your diligence and constant willingness to help are noted with pleasure. I feel that this has been an outstanding display of the humanitarian spirit of amateur radio operators everywhere."

Copies of the admiral's letter were sent to the Lykes Brothers Steamship Company, employer of the cited amateur, to Oahu Railway and Terminal Warehousing Company, and to the U. S. Public Health Service in Honolulu.

EARLY 73 BRINGS $25!

The January 1961 issue of 73, good copies of which sold just three years ago for as little as $10, now is bringing $25. This issue, one of the rarest of the early 73 issues, was bid to the $25 price at the ham auction at the ARRL National Convention. This issue featured the first published circuit for the RCA Nuvistor and was in wide demand during the early 60s. Now, with JFETs and things, the issue is more of value as a collector's item. The article on using the Eico modulator with the Johnson 6N2 also helped make that particular issue rare.

HAM OPERATOR HELPS BOY GET CRITICAL OPERATION

(Reprinted from Florida Skip)

by WA4ABY

Josef Darmento (W4SXX) has won the recognition of his community and the plaudits of the ham radio fraternity for his assistance in helping a small Italian child receive a crucial heart operation. His able use of ham radio paved the way for 4-year-old Fabio Piampiani to undergo a heart operation last month by Houston's famed Dr. Michael DeBakey.

On June 9 Joe intercepted an urgent plea on 20 meters from I1BAX, Roger, a doctor in the Adriatic Sea fishing village of Civitanove. Roger outlined to Joe that the child had an atrophied right ventricle and would die if he didn't get an operation within three months. Responding, W4SXX then contacted his wife visiting in Austin, Tex., who in turn talked with Dr. DeBakey in Houston. The famous pioneer of heart transplant surgery gave his tentative approval for an operation at no charge, if the child could be brought to Houston.

Darmento, a Merritt Island resident and a physicist with the Air Force Eastern Test Range, relayed this information back to Italy and arrangements were made for the boy's trip to the United States. Concerned Italians donated nearly $6,000 so the boy could receive another chance at life. Finally, during early July little Fabio Piampiani made the trip from Rome to New York and on to Houston. W4SXX enlisted the aid of three New York hams

HAMS CITE

IN CONGRESSIONAL RECORD

*Washington, D'C'*The Honorable Emilio Daddario, Connecticut appointee to the house of representatives, pointed to the service of U.S. radio amateurs during a meeting of the house in September. From the Congressional Record comes the account of Daddario's speech, which said in part: . . .*I rise today to call attention of the House to the valuable services performed by amateur radio operators — "hams" as they are frequently called. Operating their own private radio stations, hams render emergency assistance in providing communications during disasters such as Hurricane Celia. We have all read accounts of such activities and are well aware of the invaluable help these volunteers provide. What is not so well known is the continuing assistance hams provide in alleviating a most human problem — the loneliness and suffering that comes from the separation and lack of communications between our servicemen and their families. Those of us who daily see our wives, children, and close friends forget that there are hundreds of thousands of young people whose contact with their families is limited to letters and occasional photographs. Like the concerned public servants they are, hams have stepped forward to lend their aid and provide radio communications facilities so that servicemen abroad can talk to their loved ones at home. Using "phone patch"*

OVER 2000 ATTEND ARRL NATIONAL IN BOSTON

by W2NSD

The Boston ARRL National Convention was an unqualified success this year with well over 2000 amateurs and their families in attendance, setting a record for ARRL National Conventions in recent years.

The sad part was the tiny display area, a far cry from a few years back when most of the manufacturers in our hobby supported these National Conventions. Outside of a few distributors, the main displays were by Drake, Mosley (Carl himself was there, by gosh!), Cushcraft (Les Cushman was there!), National, Swan, Signal One, etc., plus a few newcomers such as Ten-Tec, Ehrhorn, Lee, etc. Even the most avid scrounger of data was hard put to spend more than a few minutes in the exhibit area.

As outlined last month, pressure from HQ prevented the convention committee from permitting any 73 personnel from participating in any way in the programs. Fortunately 73 was able to get a small auditorium room for one of the convention days and hold several FM forums, meetings and discussion groups, show slides of Jordan, discuss incentive licensing, and keep conventioneers from starving to death with good New Hampshire freshly squeezed cider and homemade donuts. Many thanks were received for the feed from convention goers with either stunned pocketbooks or stunned taste buds from eating at the local restaurants.

The proliferation of local hamfests and conventions has put a strain on the larger manufacturers, but perhaps they should make every effort to save enough time and money to support a national convention, for without their support a convention looks more like a small-town picnic and is disappointing to amateurs who have come from afar for the expected gala affair.

Lele Defilippis (HB9AMY), at right, poses with two others of his recent all-band DXpedition to Liechtenstein. QSLs are to be mailed to HB9AMY. Box 768, Lugano 1, Switzerland.

(K2JSO, W2IOM, and WB2CBP) to assist the boy's mother in finding the right plance from JFK airport to Houston.

Sorrowfully the child died on the operating table July 12. But at least the boy had a chance at life he wouldn't have had if it weren't for ham radio.

In an editorial entitled Humanitarian Ham, the newspaper Cocoa Today said, "We think this is a fine example of man's humanity to man."

For his pivotal role in this outstanding example of the good in our hobby, Florida Skip last month saluted Josef Darmento as "Ham of the Month."

equipment coupled directly to their own radio receivers and transmitters, hams call friends and parents of servicemen on the telephones and let them talk to their absent soldier in Vietnam who use military radio facilities over there. Acting as the vital link, the ham provides a much needed human contact between individuals separated by the war.

RADIO AMATEURS "FILL IN" FOR LOST LANDLINES

*Cuba, NY.*When a work crew accidentally cut through an underground telephone cable recently, the local civil defense group was alerted immediately, bringing to life an organized communications network revolving around a 2 meter FM repeater.

According to Gailerd Perkins (WB2IDQ), eleven stations, working through the Mt. Chaos repeater (WA2UWT). were deployed at key positions to plug what the Ocean Times Herald referred to as the "telephone gap."

Volunteers manning mobile radios supplied through the CD office's RACES network – and some CB'ers – patched together an emergency network by which the Cuba Memorial Hospital and the fire, police, and ambulance services of the community could maintain instant contact.

A local CD official said that no real emergency arose during the phone outage, but the network was ready and operative "jus[illegible]e."

INTERNATIONAL NEWS

Swiss Government Okays FM Repeaters

Switzerland. The Swiss Government has given the go-ahead to amateurs who want to put up repeaters on the 2 meter and 450 MHz amateur bands. Due to the narrow operating spectrum in the 2 meter band only the input or output of a repeater can be placed in that band: the other end of the repeater system must be placed in the 450 MHz region.

Swiss amateurs are expected to set up their repeaters with inputs on the 2 meter band where they can make most effective use of mobile range.

MARS Ops Break UHF DX Record

U. S. Hq., Ft. McPherson, Ga.– Bill Byrd (WA4HGN) of Muscle Shoals, Ala., and Paul Wilson (W4HHK), of Collierville, Tenn., set out to break the UHF DX record, and break the world record they did!

Bill and Paul are both amateur radio operators, and members of the Third U. S. Army Military Affiliate Radio System (MARS), as AD4HGN and A4HHK, respectively. Both are inveterate experimenters, anxious to advance the "state of the art" in their avocation

From IARU Region 1 News: "AROUND THE REGIONS"

AUSTRALIA:

The Wireless Institute of Australia has secured permission for the use of slow-scan television on all amateur bands as authorized in Australia. The bandwidth of emissions shall not exceed that of an A3 signal. Identification is to be by call sign in visual form on the televised picture and by telegraphy on the telephony sound channel.

BULGARIA:

The 7th National Convention of the Central Radio Club of Bulgaria was held on 26 April 1970 in Sofia. Delegates from amateur clubs approved the methods of development of amateur radio in Bulgaria. The convention called for further development of SSB telephony and VHF/UHF amateur communications in this country.

DENMARK:

The following information concerning reciprocal licensing has been submitted by the Danish Posts and Telegraphs.

The Danish General Directorate of Posts and Telegraphs is prepared to consider applications from aliens provided that they will stay in Denmark for a reasonable period of time and provided that they have a certain firm connection with Denmark. case whether a license will be granted or not. If a license for operation in Denmark is granted, this will be done without a renewed technical examination and code test.

GERMANY:

The Distrikt Niedersachsen has plans to establish another training course in Wolfsburg which is supposed to take place during the Easter holidays of 1971. Talks with the management of the Wolfsburg Youth Hostel have already been opened and it is most likely that the course will materialize.

The training will include lectures on techniques, laws, and regulations for amateur radio, and training in Morse code.

GHANA:

The latest edition of "9GI News" reports the tenth anniversary of the inauguration of the Ghana Amateur Radio Society. The number of licensed amateurs in Ghana is now shown as 40.

MALTA:

The Malta Amateur Radio Society has obtained the use of a historic building, known as the Zabbar Gate, for use as its headquarters. The building originally formed part of the fortifications erected by the Crusaders. The

NIGERIA:

NARS reports considerable interest in amateur radio at the Kaduna Polytechnic from where a station is active under the call 5N2KPT. The licensee of 5N2KPT is David Wilcox, G2FKS. It is hoped that arrangements can be made to acquire, without payment of customs dues, equipment suitable to start a club station. Certainly it seems right that an educational institution should be able to obtain a concession from the authorities.

SWITZERLAND:

In Switzerland there were 917 amateur licenses in force at the end of 1969. Membership of USKA at the same date totaled 790 full members and 655 associates.

The regulations governing amateur radio have undergone some slight modifications in 1969. The minimum age for obtaining a license was lowered from 17 to 15 years. Operation of repeater stations is allowed on 450MHz and 2m.

USA:

The Foundation for Amateur Radio Inc., a nonprofit institution devoted to advancing the interests of amateur radio with its headquarters in Washington, D. C., announces the esta-

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Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business venture. No display ads or agency discount. Include your check with order. Deadline for ads is the 1st of the month two months prior to publication. For exmaple: January 1st is the deadline for the March issue which will be mailed on the 10th of February. Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue. For $1 extra we can maintain a reply box for you. We cannot check into each advertiser, so Caveat Emptor. . .

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ROCHESTER, N. Y. will again be headquarters for the huge W. N. Y. Hamfest, V. H. F. Conference and Flea Market, May 15, 1971.

CLEGG VENUS 6M SSB TRANSCEIVER, matching AC 416 supply, speaker; excellent, $250. Also NC-98, matching speaker; good, $55. K1EOP, 1234 Ridgebrook Ct. S. E., Grand Rapids MI 49508. Tel. (616) 455-1594.

FOR SALE OR TRADE: Frequencie Meters BC221; TS174; TS323. All with Powersupply and Modulation. Lampkin 205A Deviation Meter. Make offer for cash or trade for Griddiposcillator; Distortion Analyzer, RF Volt meter or what have you. K5IDD Walter Tilleman, 351 Furr Drive, San Antonio TX 78201.

RED HOT! 5RK Delta Tri-bander — Sensational breakthrough in Delta Loop design. Proven outstanding DX ant. Highest quality; also heavy duty high performance quads. Check our low prices. Island Electronics 4102 Ave. S., Galveston, Texas 77550.

NOVICE CRYSTALS: 40-15M — $1.38; 80M — $1.83. Free flyer. Nat Stinnette Electronics, Umatilla FL 32784.

FABULOUS OLD TIME RADIO SHOWS on tape. Drama, comedy, mystery. Catalog $1.00 (refundable with order). RADIO RERUNS, P.O.Box 724, Dept. 73, Redmond, Wash. 98052.

2M FM - GALAXY FM-210. Complete with power booster for mobile or 115V operation. Used for 73 tests only. $200. less crystals. Wayne Green, 73 Magazine.

FABULOUS CONDITION! SB301 Receiver with 400 Cycle CW Filter, $265; DX60A Transmitter and HG10B VFO, $70. Jan WB6VRN, 1201 Grand Vista, Monterey Park CA 91754.

SALE: Super Pro 600 for Rack Mount. J. Modeste WA2LGJ, 615 Casanova St. Apt. 1, Bronx NY 10459. Tel: (212) 329-0147.

SR-2000 AND AC SUPPLY, realigned by 1st, will ship purchaser's expense, best reasonable offer. J. Richeson, Yolo High School, Rt. 1 Box 1900, West Sacramento CA 95691.

I5 JOHN F. RIDER PERPETUAL TROUBLE SHOOTER MANUAL for sale — $350 — or would trade for Swan-270-OR-Heath-101 — OR sim. Trnscvr. I. S. Olson (Wn6agb) Box 337, Mendocini CA 95460.

THE 20th ANNIVERSARY DAYTON HAMVENTION will be held on April 24, 1971 at Wampler's Dayton Harra Arena. Technical sessions, exhibits, hidden transmitter hunt and an interesting program for the XYL. For information write Dayton Hamvention, Dept. 7, Box 44, Dayton OH 45401.

SELL APACHE XMTR with SB-10 Adaptor, $100. Also Drake 2B w/Xtal calibrator & spkr, $180. Paul Reuter, W-9-Rov, Robinson IL 62454. Tel. (618) 544-2234.

EDITORIAL

THE NAURU CURSE

by Dan Whitsett W4BRE

Of the 300 or so countries I have worked the past four years, two or three stand out as being unusually exciting contacts. These stand out not necessarily because they were the most rare, but because of the effort I had to put out to get them – or maybe the unusual manner in which they were worked. Just recently I made what has to be one of my two most exciting DX contacts. Nauru is certainly not the rarest catch on the band, but for some reason it had eluded me throughout my DX chasing. I had seen in the various DX columns and magazines where the fellers were occasionally working Nauru, but never once did I hear him. The main reason was perhaps that his operating hours would have meant for me to be on between 1–4 a.m., and I felt confident that someday I would find him on during my regular hours. The months went by and still no Nauru. The call changed from VK9 to C21, and I continued to look for him. Then my confidence began to fade, as I began to read that the only operator there, C21JW, would be closing down for good very soon.

Then I saw in Gus' "DX'er" that the middle of June was the deadline. I had one week to find and work C21JW – a station that I had not been able to find for 27 months.

So, with seven days in which to get the job done, I set my alarm clock the first night for 1 a.m. Listening until 4 a.m., I didn't hear anything of C21JW, WA6FYC, one of the guys I had asked for assistance on the first night of this "mission impossible." He told me that C21JW was on 14.128, and that he would try to break them, and hold him for me. I leaped out of the bed, and like Jim Ryan setting the world's record four-miler, I dashed into the ham room, turning on every switch I could find.

Just knowing that he was on the air, and that I knew what frequency was more than I could handle and still keep cool.

Just as the receiver warmed up, I heard WA6FYC on CW on 14.128. Then some Australian came back to him and said, "Sorry OM, but C21JW just QRT'd, and QRT'd for good, since he's packing up to leave Nauru."

There is no way in the world I can explain my feelings upon hearing those words . . .but I believe every true DXer will know the emotions I felt.

But then, I heard a "break," and a voice said, "This is C21JW, I'm still listening." Oh Happy Day! My heart almost leaped out of my chest. Even though he stood by for WA6FYC I started pounding the keyer, "C21JW DE W4BRE PSE PSE PSE K."

He came back, he came back . . .I've got him! Oh hang on . . .don't have a heart attack yet . . .please hang on until we exchange reports.

He turned it to me, I gave him a report and I was in the process of asking him to listen for me in the

of radio communications. They have conducted endless experiments; designed, built, and modified equipment, much of it furnished by MARS; and tried new techniques in preparation for their record-breaking communications feat on 2300 MHz this summer. Bill, father of three, works for the Tennessee Valley Authority as an instructor of student generator plant operators. Paul, also married and the father of two, is a television broadcast engineer for a station in Memphis, Tenn.

On July 9, Bill drove a panel truck to a place called Sunset Rock near Bon Air, Tenn. Inside the truck was seemingly enough exotic radio equipment to monitor a space flight, and on a trailer behind, looking not unlike a large mechanical turtle, was a specially tuned and rigged 10-ft. dish antenna.

Working from an elevation of nearly 2000 ft. above sea-level, and using an astrocompass to point his dish antenna in precisely the right direction, Bill first attempted to contact Paul on the morning of July 10. Repeated attempts that first day were unsuccessful, but early on July 11 another call brought the looked-for response: "This is *W4HHK reading you loud and clear!*"

The record thus established was for 249 statute miles, as established by aeronautical charts. And the record is now official, having been recognized early in September this year by the American Radio Relay League.

To the uninitiated, the distance may not seem very astounding in this age of moon voyages and globe-girdling communications. But the record set by Byrd and Wilson was at a frequency of 2.3 GHz – approximately four times as high as that of the highest-frequency UHF TV stations on the air in most parts of the United States.

At that frequency, and even at those as much as 75 times lower, communication is normally limited to line-of-sight, or the horizon. And 249 miles is more than 160 miles beyond the horizon in the location used by Bill and Paul.

Also, there's the matter of power. Commercial UHF TV stations routinely use more than a million watts of power to send an acceptable signal 50 miles or less. Bill and Paul communicated over their record-breaking distance using less than 1 kW, the legal limit.

It all adds up to a most impressive achievement, especially when one remembers that it was accomplished by two amateurs using mostly home-built or modified surplus equipment. If the two southern gentlemen who accomplished it will excuse the expression, their feat stands as a notable example of modern yankee ingenuity.

(L-R) A4HHK and AD4HGN. Operating as W4HHK and WA4HGN on the amateur 2300 MHz Band, set a new tropo-scatter distance record on 11 July 1970, when a two-way contact was made between Bon Air, Tenn. and Collierville, Tenn., a distance of 249 statute miles.

Aliens have to adopt the usual procedure when applying for an amateur license (submit an application to the general directorate). It will always depend on a decision in each individual

members of MARS plan to restore the building and undertake conversion work. A picture of the Zabbar Gate with members of MARS appeared recently in the "Malta Times."

Paul M. Wilson of Collierville, Tenn. stands beside the antenna used in his radio moon bounce experiment. Wilson is a member of the Third US Army Military Affiliate Radio System which provided most of the parts he modified in order to build his imposing radio station.

blishment by it of a Hospitality Committee with the objective of providing visiting foreign licensed radio amateurs with an opportunity to meet some of our local active hams and if desired visit a local amateur station.

CROSSBAND RESULTS

WAR, NSS, NPG,and AIR had a combined total of 8,208 QSOs during the twelve hours and forty-five minutes devoted to the military-to-amateur crossband portion of the communication tests. Included in this total were 197 air/ground QSOs made by Navy aircraft on the east and west coast. Commemorative QSL cards have been mailed to all contacts that could be identified. Any amateur who has not received a QSL card confirming his contact should address a request for confirmation to the appropriate station, or Armed Forces Day Contest, Attention: Headquarters, U.S.Air Force, PRCOM, Room 5B531, The Pentagon, Washington, D. C. 20310. This request must include the amateur's call sign, the station worked, time of contact, and the frequency utilized by the military station.

73 GOES TO VIETNAM

The 43 MARS stations in Vietnam and Thailand are all getting copies of 73 now on a gratis basis through the efforts of Alex Scherer A9EU of Ottawa, Illinois. It is hoped that this amateur radio magazine will interest the many operators at these remote stations in getting on the ham bands and in pursuing amateur radio when they return to the U.S.

MERRY XMAS AND HAPPY NEW YEAR from WQCVU, Iowa's most truthful station. Generally on 20 meter SSB. Collins KWS-1 and 75A-4. Telrex Optimum spaced beams. WØCVU, Chas. W. Boegel, Jr., 1500 Center Point Road N. E., Cedar Rapids IA.

TR4 & AC3 just factory checked and alined. First Certified check for $450 winner. David Beckwith, W2Qm,M, Box 226, Pompton Lakes NJ 07442.

TECH MANUALS — R-390/URR, R-390A/URR, TS-186D/UP, BC-639A. R-274/FRR, OS-8C/U, $6.50 each; R-274/FRR, OS-8C/U, $6.50 each; TS-174/u, TS-175/U, TS-323/UR. $5.50 each. Hundreds more. S. Consalvo, 4905 Roanne Drive, Washington DC 20021.

HA-460 AND TR-108, both lightly used, $75 each, ppd. David Welty, 320 N. Blackstone, Tulare CA.

HAM-M ROTOR AND CONTROL, $94.95. Ideal Christmas gift for Dad. RG8U foam coax $.10 a foot FOB. Monte Southward, WB8GZQ, R1, Upper Sandusky OH 43351.

BUY, TRADE, SELL USED RECEIVERS, or trade for new general merchandise. Available HQ-200, 51S-1 SX-122 and BC-799B. 10-day money-back guarantee. 30-day warranty on parts and labor. Steven Kullmer, Evergreen Hatchery, Dysart, Iowa 51114.

FOR SALE EICO 720 xmtr — $45.00; Johnson 6N2 xmtr — $45.00; HA-1 Keyer w/VIBRO Keyer — $65.00;ARC-5 rcvr w/115 VAC p. s. — $20.00; Novice Xtals - $.75; Regency GT-523 mobile C' B' xcvrs — $35.00 each; EICO 221 VTVM — $20.00; AC-1 QRP xmtr — $20.00; P-2 SWR meter — $15.00. Need cash for graduate school. Will ship collect. R. O. Lust, WB9DWG, 320-4 North Tratt St., Whitewater, WI 53190.

TOLEDO MOBILE RADIO ASSOCIATION'S 16th ANNUAL HAMFEST AND AUCTION will be held February 21, 1971, Lucas County Recreation Center, Maumee, Ohio. $1.00 registration. Open table sales. Map and info write: TMRA W8HHF, Box 273, Toledo, Ohio 43601.

GREENE Center dipole insulator, with ... or ... without balun. See November issue 73, page 107.

SAROC, January 7-10, 1971, Flamingo Hotel Convention Center, Las Vegas, Nevada. Sponsored by Southern Nevada ARC, Inc., Box 73, Boulder City, Nevada. Advance registration +14.50 per person accepted until January 4, regular registration at door, includes Flamingo Hotel Late Show and drinks, Sunday breakfast, Cocktail parties, technical seminars and meetings, ARRL, DX, FM, MARS, QCWA, WCARS-7255, WPSS-3952 and WSSBA. Ladies program. Flamingo Hotel SAROC room rate $12.00 plus room tax, per night, single or double occupancy January 3 through 12, 1971. Mail accomodations request to Flamingo Hotel. Mail advance registration to SAROC, W7PRM, Club president. W7PBV, SAROC Convention chairman.

DRAGON FLY ... antenna, for 20-40-75 meters ... no traps ... no compromise ... eight months in development ... one feed line ... SWR one to one guaranteed. Construction drawings $5.00. Box 423, Wakefield RI 02880.

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MSI-DTL INTEGRATED CIRCUITS: Guaranteed new — gates $.56, F/F $.72, dual F/F $.92, MSI $2.00, dual Lamp drivers $1.60. Other inexpensive parts. Mitch-Lan Electronics Co., Dept. 7370, P. O. Box 4822, Panorama City CA 91412.

CAPACITORS. 100 MFD at 3 kv. Aerovox or Sprague, 6" x 8" x 14". Single terminal welded steel cans. 2 for $35.00, FOB. W5DAU. Box 1443, Hobbs NM 88240.

FOR SALE — MAKE OFFER: Gonset GSB-100, SSB XMTR; Hammarlund HQ-110C; Homebrew 800 watt linear. John McLean, 5603 N. 12th Ave. Phoenix, AZ 85013

FM CRYSTALS FM-210. They're accurate, by International. Transmit: 146 22, 146.25, 146.28, 146.31, 146.34, 146.46, 146.76, 146.94. Receive: 146.76, 146.88, 146.94. $5 each, singly or in lots. Wayne Green, 73 Magazine.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA

but I did talk with several Californians who had worked him. I told them of my plight, and asked them to call me if they should hear him.

The next night when I heard someone mention his call, my hopes got up and I called in . . .but he had just left a few minutes before. Knowing he was around somewhere, I frantically searched the band that night, but absolutely nothing.

The fourth night my clock again went off at 1 a.m. Bear in mind that I would only have been asleep for an hour or so, and when the clock would go off, it would scare me half to death. Again I found a QSO where C21JW had just signed out to go look for a friend. I searched the band and found his friend, but no Nauru.

Again the fifth night . . .nothing. The sixth night, same story – and I was beginning to believe I had the Nauru curse.

On the seventh night, which was going to be my last try since he was due to leave in a day or so, and since there was no way in the world I could survive this ordeal any longer, I tuned the band for two hours . . .all in vain. Finally giving up, admitting that the Great White Father didn't have in his plan for W4BRE to work C21JW, I staggered off to bed.

I must have only been in bed for 10 minutes or so when the phone rang, scaring me out of my wits; it was phone band, when, forgetting that my amplifier was tuned up around 14.275, Blam! FUSES BLEW! OH NO! I've lost him. I've LOST NAURU. WE HAVEN'T YET EXCHANGED REPORTS.

If I thought I was panicked when 6FYC first phoned me, that was nothing compared with now. I WAS OUT OF MY MIND. Well, I must have set a world's speed record because when I got back on the air C21JW was telling me that he couldn't go to the phone band because he had to leave. Good enough, I was plenty happy just to get the contact.

WA6FYC and I moved up to the phone band, and I was thanking him . . .offering to send him money, my car, my house, anything in appreciation, and mopping the sweat off my brow, trying to regain a little composure, when "Break, Break, this is C21JW."

He had a change in plans, didn't have to leave just that minute, and came up and ragchewed with 6FYC and me for 30 minutes!

What an experience . . .I was dying to tell the people at the office and my other friends about it . . .but no one . . .absolutely no one but an honest-to-goodness true DXer could understand and appreciate this absolutely absurd, insane, and ridiculous undertaking, and why, after it was all over, I would say to myself . . .it was well worth it.

SELL HEATH DX-60A, 5 crystals. Used very little Guaranteed to be in good working condition. Make offer. Arris Sigle, 543 N. 2nd, Osborne, Kansas 67473.

VARIAC, 120 volt, 20 amp., uncased, new $25.00 each plus shipping (25 lbs. each). Brian Sherrett, TUSLOG, Dept. 6 Box 557, APO New York 09254.

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WANTED: Heathkit HA14 Linear Amplifier with or without tubes, HL9KQ American Embassy, APO San Francisco CA 96301.

Merry Christmas

Peace *Peace*

Sage, who is celebrating her first birthday on December 31, my wife Lin, and I all wish every one of you a very merry Christmas. We're sitting on one of those Heath Boonie Bikes, by the way, and we have lots of fun bouncing around the New Hampshire hills and forest trails on them.

Director Green?

Many readers ask why I don't run for ARRL director since I know the organization so well and have proposed so many ways of improving it. Frankly, I somehow doubt that the executive committee would waive the bylaw prohibiting ham publishers from running for director, even though they have in the case of ARRL stalwart KØNL.

It would be nice to be able to run for the job and I think I could be a considerable help in bringing the League into the 1970s if I were elected. What, you ask, would I do as a director of the ARRL to improve that conservative old institution?

Better Directors

Probably the first thing I would do would be to try to encourage amateurs to run for director in other divisions of the ARRL who are interested in improving amateur radio to replace those directors who are there for the prestige of the office rather than as true representatives of their constituents. Little can be done to improve the League until at least nine of the 16 directors want to improve it. Right now it seems hopeless.

Sound Financial Basis

There is no excuse for the League losing money every year! There are many ways to increase income and to cut expenses. By reducing the size of QST by a fraction of an inch so it would fit on modern web offset presses and by using more modern paper a saving of thousands of dollars a month can be achieved. There are many other areas where substantial savings can be made without losing any valuable services. We can see that the League investments are bringing in a maximum return. We can plan ahead for continued nonprofit operation, but an eventual end to the tax-free status.

Washington Lobby

Only when the ARRL has a registered lobby in Washington can it truthfully say that it represents amateur radio. Such a lobby would put an end to the doubletalk excuses from HQ and would give amateur radio the first real opportunity to protect itself in Washington. A monthly newsletter to congress would be invaluable in laying the groundwork for a lobby. Amateurs are making news all over the world, but few outside of our hobby hear about it. We need to beat our drum. It is entirely possible that much or all of the cost of a lobby in Washington could be financed entirely separate from the ARRL, thus keeping League expenses down.

Emerging Nations

The key to the future of amateur radio lies entirely with the votes of member nations of the International Telecommunications Union at Geneva. It would behoove us to keep this in mind and devote some time and energy towards protecting our frequencies internationally. The ITU is presently controlled by the emerging nations of Africa and Asia and the League could be of great help to many of these countries at little cost. It could offer custom-made amateur radio regulations for individual countries, complete with amateur license exams. It could organize expeditions to these countries to explain the value of amateur radio to the heads of the countries and their top officials. Club stations could be organized in the countries, probably in high schools. If equipment is not available it could be arranged to be donated by interested amateurs and manufacturers. Every effort should be made to assure amateur radio votes at the ITU.

A Modern QST

The club magazine would interest many more amateurs if it were written in a warmer and more friendly tone. It would look more like 1970 with modern type and better layout design. Readers might have more confidence in the League if both sides of controversial problems were openly discussed in QST. Some of the departments which fill up so much of the space in QST could be shortened or eliminated in the interests of bringing information of interest to the most readers.

Directors Meetings

The inability of management to get decisions from the directors more than once a year has

(cont. on p. 102)

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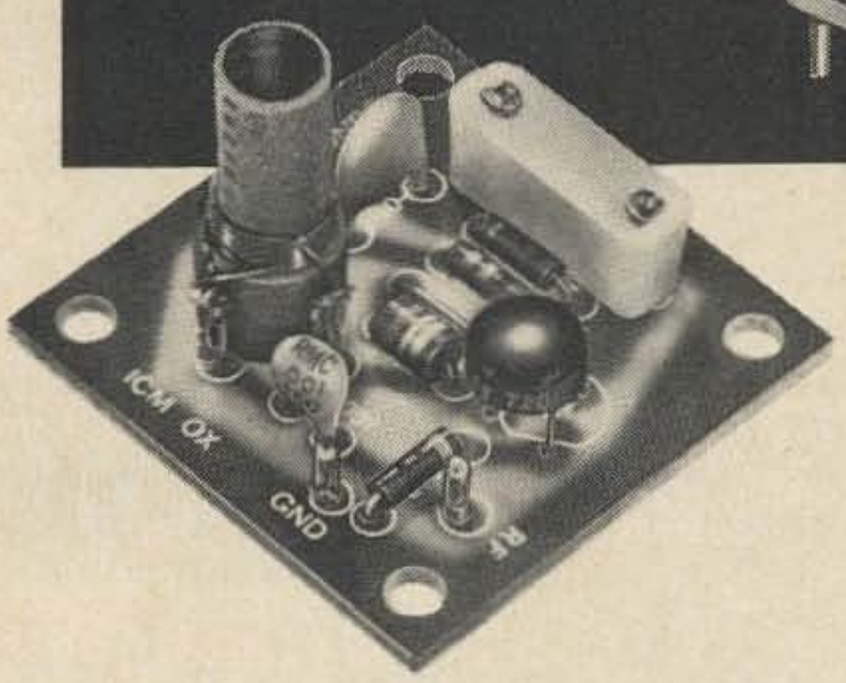

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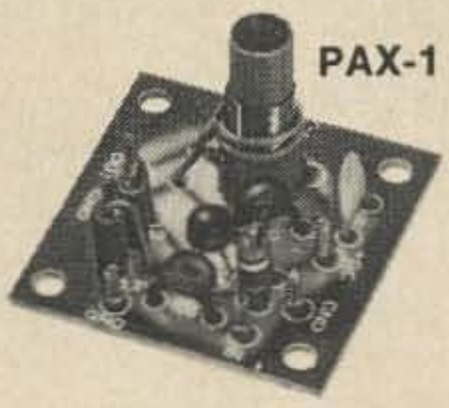
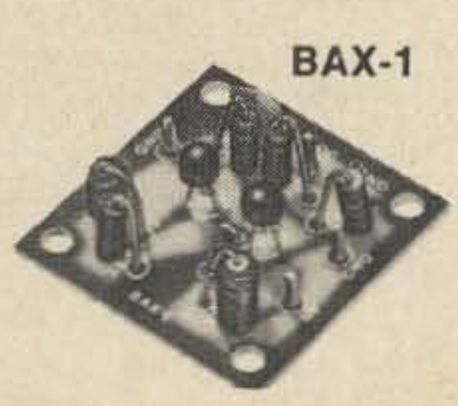

PAX-1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Mr Virgo Himself

Editorial by Ken Sessions

Last Chance for SAROC Flight!

From early indications, the upcoming "fun" convention in Las Vegas (January 1971) will be the biggest success of any ham convention ever held anywhere – bar none. If you've got a vacation coming, or if you would just like to take the wife and get away for a weekend, by all means attend! Even if your wife doesn't like conventions, she'll want to go to this one – because Las Vegas is a magicland – probably the only place in the world where you routinely bump into TV personalities, movie stars, and other famous personages. (Last year I poked Don Rickles with a Motorola telescoping antenna.)

If you're planning a West Coast vacation anyway, here's your chance to be really sneaky. You can fly on one of SAROC's two chartered "champagne" planes (from New York or Chicago), stay a full 3-night weekend at the Flamingo, enjoy a couple of stage shows, and buddy it up with hams from everywhere – all for less than conventional airline rates.

As if that weren't enough, additional free "flings" are being sponsored by public-spirited groups and organizations. For example, Ham Radio magazine is footing the bill for an all-you-can-drink cocktail party on Thursday night; the next evening, Swan Electronics is picking up the tab for the same kind of arrangement. And the FM boys in Las Vegas are planning a head-busting three-night open house, with free hard, soft, and hot stuff to drink.

The round-trip "everything included" plane fare from New York is $229 (from Chicago, it's $199), and there's a full-page ad in this issue that tells exactly all that the price includes. But the ad doesn't tell you that SAROC is *the* Western convention, where the accent is on fun and the emphasis is on ham radio. This January will mark the Sixth Annual Radio Operators Convention and the fourth (and by far the biggest and best) national FM convention.

With the August FM lineup (practically all the big names in repeaters) and the unprecedented current popularity of VHF FM, a turnout of more than a thousand FM'ers is expected. This, coupled with the already well established popularity of the other aspects of SAROC, should make it a convention to top all others in ham history.

If you're going, better make plans now. If you don't reserve a seat on one of the charter flights before November 25, you'll have to get there under your own steam – and that could get expensive.

Discrimination. . .

Wayne Green used to mention occasionally that the League wouldn't let him speak at this convention or that – that the League wouldn't let him set up a booth for 73 at various League-sponsored affairs, and other seemingly unfriendly or discriminatory actions on the part of the ARRL. To be quite blunt, I only half-believed him because his charges all seemed to be so fantastic.

But at the recent Boston convention, I found out for myself. I was invited to speak on repeaters, and accepted. But the League said no. I saw a letter Huntoon had written saying that I wasn't fit to speak at any League convention.

A few of the fellows protested to the League, even to the extent of offering mild threats of "breaking off" with ARRL affiliation. But Robert York Chapman, New England Division's director, answered one of the protestors with a counterthreat. It is never too late, he said, for the League to back out of backing the convention. Clearly, the convention planners had to make a choice between the League and the staff of 73.

Working almost surreptitiously, but closely with the convention planners, 73 rented an auditorium in the hotel where the convention was being staged, then held its own programs with its own speakers. And the whole thing went off extremely well.

The next convention was Tarrytown, another League-sponsored affair taking place within the Hudson division. I suggested to Wayne that we set up a booth there.

"Go ahead and try," Wayne told me. "But I can tell you now that they'll tell you their booth space has already been sold out."

Well, I tried anyway. I contacted Harry Dannals, who told me in a very friendly and congenial manner that there would never be any space for 73 in any convention that he is involved with.

Now, fellow readers, I have just told you the truth. There is not one ounce of exaggeration in the foregoing. And if Harry Dannals is an honest man, he will certainly admit that what transpired between us was exactly as I have related.

I charge Harry Dannals with discriminatory practices, and I charge the ARRL with sanctioning such practices. I don't want to make an enemy of Dannals, because, quite frankly, he is a personable and congenial fellow. But he must learn that his acts are not those of a responsible director.

Those of you in the Hudson division who agree with me could probably carry a great deal of weight if you'd drop Harry a line letting him know how you feel.

. . .K6MVH/1■

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The TEMPO "ONE" SSB transceiver represents the culminating achievement of many years of experience in the amateur radio field. Modern design, superb performance, high styling, sturdy construction, outstanding reliability, exceptional value . . . all these factors combined for the first time in an amateur SSB transceiver make the TEMPO "ONE" the obvious choice in today's amateur market. Power input: 300 watts PEP SSB, 240 watts CW. Five band coverage: 80 through 10 meters. VFO range: 500 khz. Complete with: Selectable Sideband, Crystal Calibrator, VOX, Receiver Off-set Tuning. Price: $298.00. AC/ONE power supply 117/230 volt 50/60 cycle . . . $99.00 DC/ONE power supply 12 volts DC . . . $107.00

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Ed. Note:
Last month (or the month before), Raving Dave took on the Technicians in the country, and after three rounds went down for the count. This month, as "Dave the Brave," it's Conditionals. Watch for his subsequent attacks on Novices, premarital sex, Mexican food, the electoral college, and motherhood.

Leaky Lines

AN EDITORIAL by DAVE MANN K2AGZ

1 DANIEL LANE, KINNELON NJ 07405

In previous issues I have mentioned phone patches, usually Latin-American in origin, which have been QRM'ing the DX frequencies, especially the low end of the 20 meter phone band, in ever growing numbers. The response of the readership has not been particularly encouraging; there seems to be a feeling that nothing can be done about the situation because, in the words of one of my correspondents, ". . .foreign operations cannot be regulated or controlled." While this is partially true, let me assure you that it is not completely impossible to effect changes. There is no basis for the total frustration which has been expressed.

There are certain actions which can be taken that may prove to be effective; for example, a large percentage of these patches are being run by stations in Florida and Puerto Rico, both of which are indeed subject to the regulations of our own licensing authority. The FCC – while many U.S. hams may consider it unsympathetic to the needs and desires of the amateur fraternity – is quite responsive and sensitive to reasonable requests, *when they are made in a responsible and constructive manner*. It is far from an impossibility to envision the establishment of an officially designated frequency allocation which would limit the patches to sequestered portions, as is presently done with RTTY, thus going a long way toward eliminating the annoyance.

But there is another side to this coin. The phone patch stations are also entitled to a fair measure of consideration. There is no foundation, either in the regulations or by operating precedent, for DX'ers to feel that they are entitled to a preemptive "lock" on those portions of the bands which they regard as desirable, and that they are perforce within their rights in bludgeoning the opposition into submission by their sheer weight of numbers, by using power amplifiers, extravagant antenna systems, or by any other means. There is still a right and wrong, after all.

The problem is a knotty one. Both groups have raised legitimate complaints. Both have valid grievances. And somewhere along the line, accommodations must be found so as to create order out of chaos.

A tangential point is being raised by the General class operators. Many DX stations seem to restrict their listening frequencies solely to our U.S. Advanced and Extra class subbands, making it virtually impossible for the Generals to compete for DX on an equitable basis. Of course, it must be acknowledged that it is awfully simple for anyone to master the relatively elementary material covered in the single examination element which upgrades them to the Advanced class. Anyone who is at all serious about working DX would be more than willing to devote a small portion of his time toward accomplishing this simple task.

The Conditional class ham, however, is faced with a genuine crisis. He must qualify in all elements, both CW and theory . . .is given absolutely no credit for any elements in any of the exams . . .hence must pass the 13 wpm code test plus the General and Advanced theory elements. Many of us are prone to forget that there are vast numbers of people who hold this grade. If you will examine the figures (they may be found in recent issues of the callbook), you will learn that of the total ham population, more than 10% fall into this category. There are 10 states in which Conditionals outnumber Generals! In a few of these states the examination points are truly beyond a reasonably convenient traveling radius. But in several of the states referred to, this is not the case, and I fear that the Conditional ticket has been acquired under terms which could not be regarded as completely justified by the circumstances. The regulations have been applied, in all too many instances, to circumvent the qualifying requirements, and some persons who could easily be expected to get to the examination points have simply exaggerated the hardship angle of the physical infirmity excuse. I am personally acquainted with several self-styled "invalids" who eat like horses, work like mules, and climb up and over ridges like mountain goats during the deer

(cont. on p. 104)

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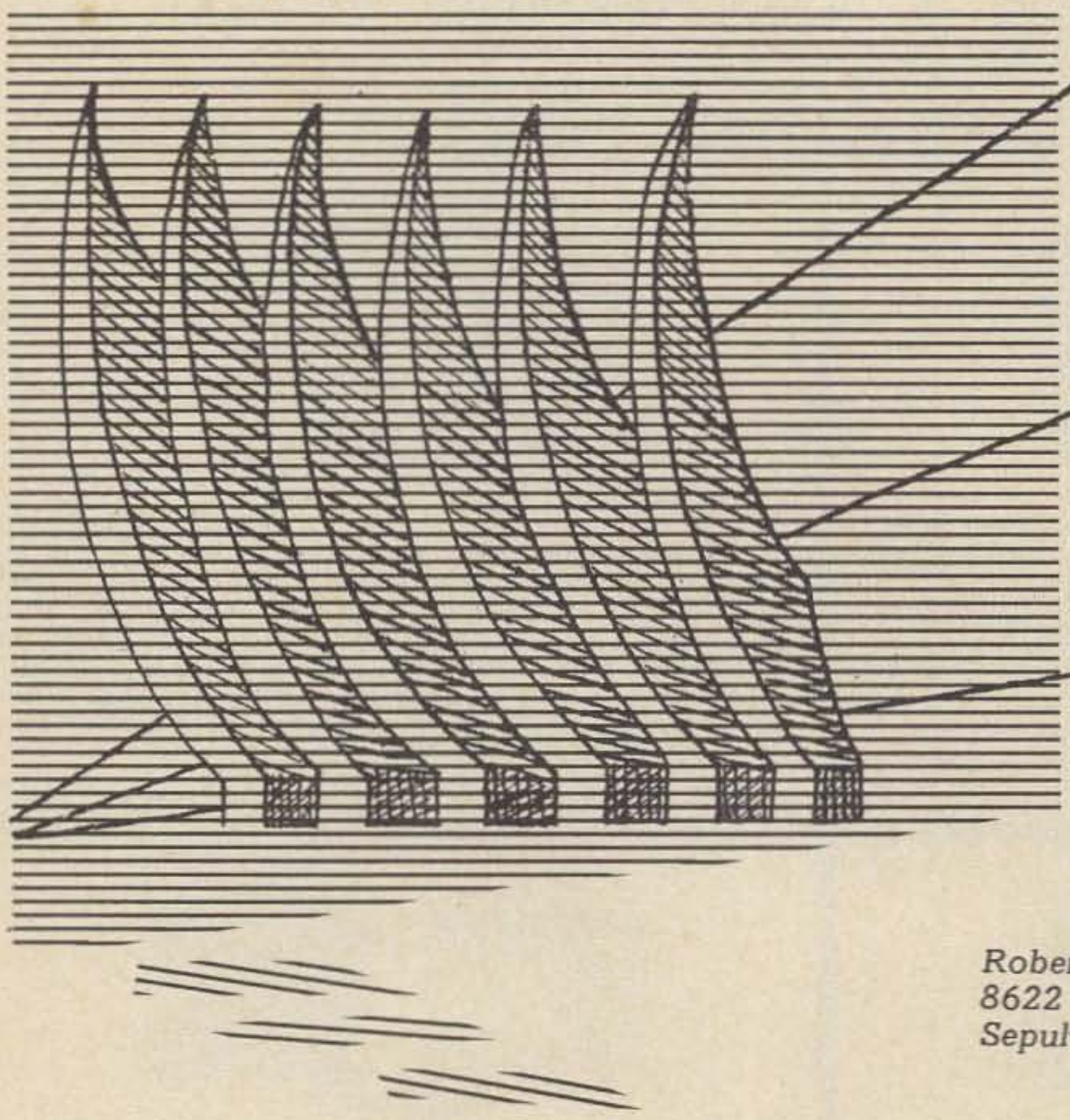


Robert E. Bloom W6YUY
8622 Rubio Avenue
Sepulveda CA 91343

My original thoughts about undertaking a design project of this magnitude were brought about through a challenge by W6EGZ, after having just completed a three-year design of a solid-state receiver. This was early in 1966. Based upon the complexity of the receiver it was anticipated that about one year would be required to complete the transmitter. This would mean using all available evenings and weekends, abandoning all on-the-air operation and all other aspects of ham radio. As with the receiver, it took a similar three-year period.

The big hangup in progress was encountered in designing a satisfactory third-mixer stage, free of parasitics. I tried many mixer configurations initially without success.

It wasn't until the advent of a magical "black box" concept that appeared on the industrial electronic market, cloaked in secrecy and at a price of just under $200 that progress once again was under way. This started a frantic search for literature and information as to how this thing called a "double-balanced mixer" was operated. I say "magical" as this circuitry is so versatile that it can be used as a phase detector, frequency doubler, current-controlled attenuator, balanced modulator, pulse modulator, phase detector, etc. But let's start at the beginning.

Were it not for the availability of all commercial test equipment this project would not have been attempted. Such items as a Hewlett-Packard counter, generators, and meters; Tektronix oscilloscopes; Measurement Q meter and grid dip oscillators; temperature-controlled oven; sheet-metal cutting and bending equipment; and a Heliarc welder were some of the items used. For those who wish to duplicate all or part of this system, all pertinent dc and signal voltages are called out and all pertinent coil data can be found listed in Table I. All circuits other than the bulk elements of the power supply and the final are of modular construction; in today's technology of miniature construction this is the easiest and neatest, and lends itself readily to circuit change.

The individual circuits were first breadboarded, checked out, and then made into modules using single-sided 5/16 in. copper-

Table I. Coil and Transformer Data.

Coil or Trans. Identif.	Core Material	Primary Turns	Secondary Turns	Tap from bottom	Wire type	Notes	Transmitter Stage
T	Ferrox-Cube cup core 1811P A100–3D3	80 (700 μH)	16		Pri. 7/41 Sec. 15/41	Unloaded "Q" 280 Resonant at 453 kHz with 170 pF	Balanced modulator
T1	Ferrox-Cube cup core 1408P A100–3D3	70 (500 μH)		7	7/41 Litz.	"Q" Unl. 230	453 kHz LF ampl.
T2	Ferrox-Cube cup core 1408P A-40-4C4	30 (40 μH)	2	4	30/44 Litz.	"Q" Unl. 170	1st mixer 2045 kHz
T3	Powdered-iron slug-tuned ceramic form ¼" dia both coils	40		5¾	7/44 Litz.	"Q" Unl. 55 "Q" Loaded 5	Broad-band, 2nd mixer
T4	Ferrox-Cube toroid 266T-125-4C4	13 Trifilar	13 26 total wound		26 solid Teflon cov.	Sec tap is the end of one winding & start of another.	Double-balanced mixer
T5	Ferrox-Cube toroid 266T-125-4C4	9 Trifilar	8 wound		26 solid Teflon cov.	Pri tap is the end of one 9-turn winding & start of other 9-turn winding.	Double-balanced mixer
L6	Powdered-iron slug-tuned ceramic ¼" dia	25			28 solid enameled	Trim with 8–35 pF miniature trimmer & fixed 75 pF silv mica capacitors	7.0 MHz transistor rf ampl
	3/8" ceramic, brass, slug-tuned	10½			24 solid enameled	No trimmer	14.0 MHz
	Powdered-iron slug-tuned ¼" ceramic form	11¼			26 solid enameled	Trim with 8–35 pF miniature trimmer	21 MHz
	Powdered-iron slug-tuned ¼" ceramic form	10			20 solid enameled	No trimmer	28.0 MHz
L7	Powdered-iron slug-tuned ¼" ceramic form	15		2¾ & 9 turns	26 solid enameled		Band selection osc 3rd mixer
T8	Ferrox-Cube cup core 1408P A-40-4C4	50	2		Pri 32 Sec 28	Resonant with 22 pF silver mica at 24.5 MHz	1st mixer, oscillator
T9	Powdered-iron slug-tuned 3/8" ceramic	80	20	Pri 24 Sec 9 & 15	32 solid enameled	See text	Vfo output transformer
L10	Powdered-iron slug-tuned ¼" ceramic form	25			28 solid enameled	Trim with 8–35 pF miniature trimmer & 75 pF fix. silv mica	12BY7 driver plate, 7 MHz
	Brass, slug-tuned 3/8" ceramic form	15			24 solid enameled	Trim with 7–25 pF miniature trimmer	12BY7 driver plate, 14 MHz
	Brass, slug-tuned 3/8" ceramic form	10			26 solid enameled	Trim with 8–35 pF miniature trimmer	12BY7 driver plate, 21 MHz
	Powdered-iron slug-tuned ¼" ceramic form	9			20 solid enameled	Resonate with 10 pF fixed silver mica	12BY7 driver plate, 28 MHz
L11	2" dia AirDux 1606T coil stock	15		3&8	14 plated	Tune with 200 pF 2 kV split-stator, Johnson 200F D20/ 155-505 C-11 midget air-tuned 300 pF (Hammarlund MC-325-M)	Multiband coupler, final

clad board. (Printed circuits could have been used; however, the construction about to be described was preferred as it lends itself to change where printed circuitry does not.)

It was first necessary to redraw the schematics, keeping all symbols to actual size and positioned exactly as they would appear on the finished board (according to the overall block diagram, Fig. 1). A dot

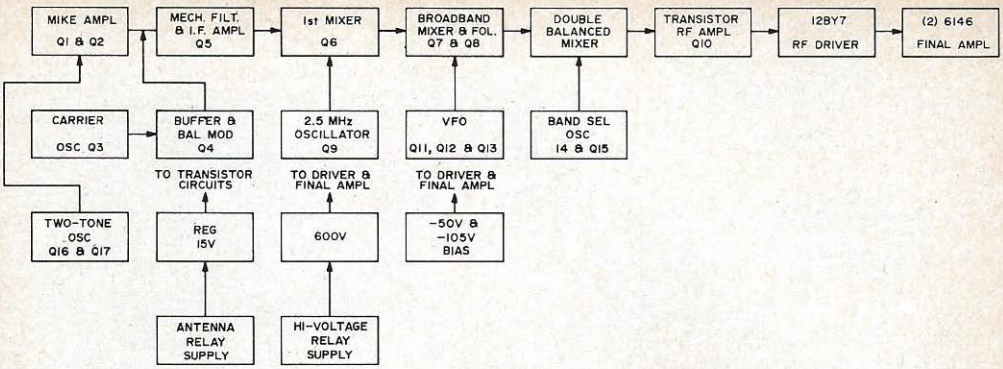


Fig. 1. Block diagram of sideband transmitter.

was placed at each junction on the schematic, each dot representing the placement of a small silver-plated terminal. The schematic was then cut to the desired size and taped to the copper-clad side of a board. An automatic centerpunch was used to mark each dot on the drawing. The schematic was then removed and the board was drilled using drill sizes compatible with the terminal diameters.

Three sizes of plated terminals were procured: feedthrough types where connections are necessary on both sides of the board, long types for ground terminals which would protrude at the copper-clad side and soldered to the copper for good grounding, and a short type that would not reach through to the copper. These terminals were used as tie points for components and wiring.

A special tool which could be inserted into the chunk of a drill press was made up. This tool was used to press the terminals into the undersized holes in the board. The transistor sockets were glued into holes from the copper side using Eastman 910 adhesive. All module boards were fitted with ¼ in. diameter aluminum standoff mounting spacers at each corner; these were tapped out to accommodate 6–32 machine screws. Only transformers, transistors, and test points were mounted at the top (copper-clad side of the board). Occasionally it was necessary to mount a resistor on the top side – which made it convenient for substituting resistance values when making final (optimum) gain settings. (The transistors, incidentally, are itemized in Table II.)

All capacitors other than negative-coefficient types of values to 1000 pF are silver mica dipped (dogbone); almost all resistors are of quarter-watt capacity. The chassis, shield partitions, and some of the metal boxes were fabricated from scratch. This was especially necessary for the vfo compartment because of the size and structural stability desired. The chassis, 20 x 10 x 2¾ in., was constructed, Heliarc-welded, and subdivided into three main sections. The left third is the transistorized exciter, the middle is the vacuum-tube driver and final and the right side contains the power supplies.

Table II. Transistor Lineup.

Position	Function	Type	Configuration
Q1	Audio	2N3860	NPN
Q2	Audio	2N3860	NPN
Q3	Carrier Osc	2N3702	PNP
Q4	Buffer	RCA 40235	NPN
Q5	I-f ampl	2N3707	NPN
Q6	Mixer 1	2N3250	PNP
Q7	Mixer 2	2N3250	PNP
Q8	Mixer buffer	2N3250	PNP
Q9	2.5 MHz osc	2N3250	PNP
Q10	R-f amplifier	2N3250	PNP
Q11	Vfo osc	RCA 40235	NPN
Q12	Vfo driver	RCA 40235	NPN
Q13	Vfo emitter fol	2N5183	NPN
Q14	Band select. osc	2N708	NPN
Q15	Osc emitter fol	2N5183	NPN
Q16	Two-tone osc stage	2N929	NPN
Q17	Two-tone osc stage	2N929	NPN

Schottky hot carrier diodes in double-balanced mixer are Hewlett-Packard type 2800 or 2900.

No credit is taken for the circuitry of the 12BY7 rf driver or parallel 6146 multiband-coupler final amplifier (Fig. 2), as this was lifted out of the 1965 ARRL

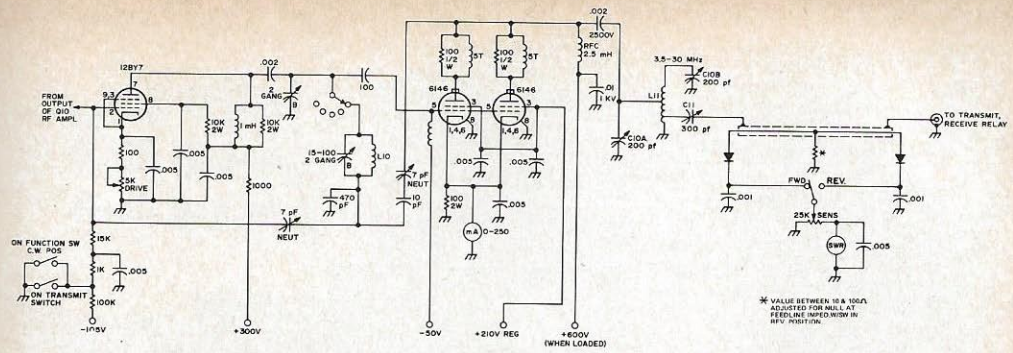
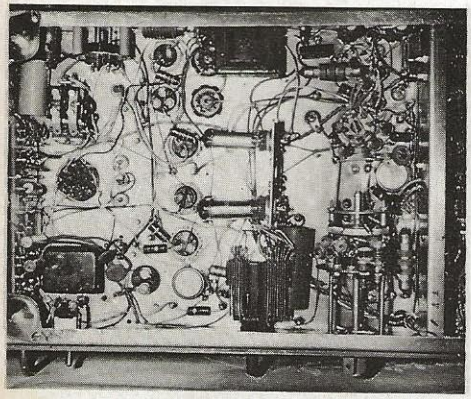


Fig. 2. Driver and final rf amplifier.

Single Sideband Manual, pages 74–76. Looking at the bottom view of the chassis with the front panel away from you, at the upper left side is the module containing the two-stage audio amplifier, Collins mechanical filter, and i-f amplifier stages. The amplifier was designed to roll off by 12 dB per octave at each end of its 300–3000 Hz range. The transformer inside the dynamic microphone was rewound to match the 5 kΩ amplifier input impedance. There are two gain controls on the amplifier input circuit. The main gain control is set to operate full-on and could have been replaced with fixed resistor values and a switch. However, the versatility is desirable.

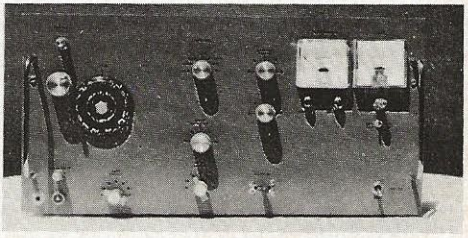


Bottom view of sideband exciter.

Following the main gain control is a 2.2 kΩ resistor and 500Ω pot which together form a fixed attenuator used to set the optimum input gain. The arm of the 500Ω pot is used to set the input level of the two-tone oscillator. Once set, the screwdriver adjustment is locked in place.

Carrier oscillator, buffer amplifier, and balanced modulator (Fig. 3) are in a minibox located on the top rear of the chassis behind the vfo. The crystal frequencies for the carrier oscillator were selected at points 25 dB down the sides of the mechanical filter response curve. Although only one crystal was necessary to place the exciter in the proper sideband mode for all bands, having the other sideband available provides more flexibility of operation should one want to use it.

Buffer amplifier transistor Q4 has an unbypassed 2.5 kΩ pot in its emitter. This allows carrier output to appear at both the collector and emitter and the degeneration thus provided makes the stage highly stable. The potentiometer and its associated switch allow controlled carrier to be injected into the divider network of the i-f amplifier. The carrier control knob is located at the upper left hand corner of the front panel. Carrier injection among other things is used for tuning up the transmitter on AM and CW. When the function switch is in the single tone mode, a two tone pattern can be viewed on an oscilloscope



Front panel.

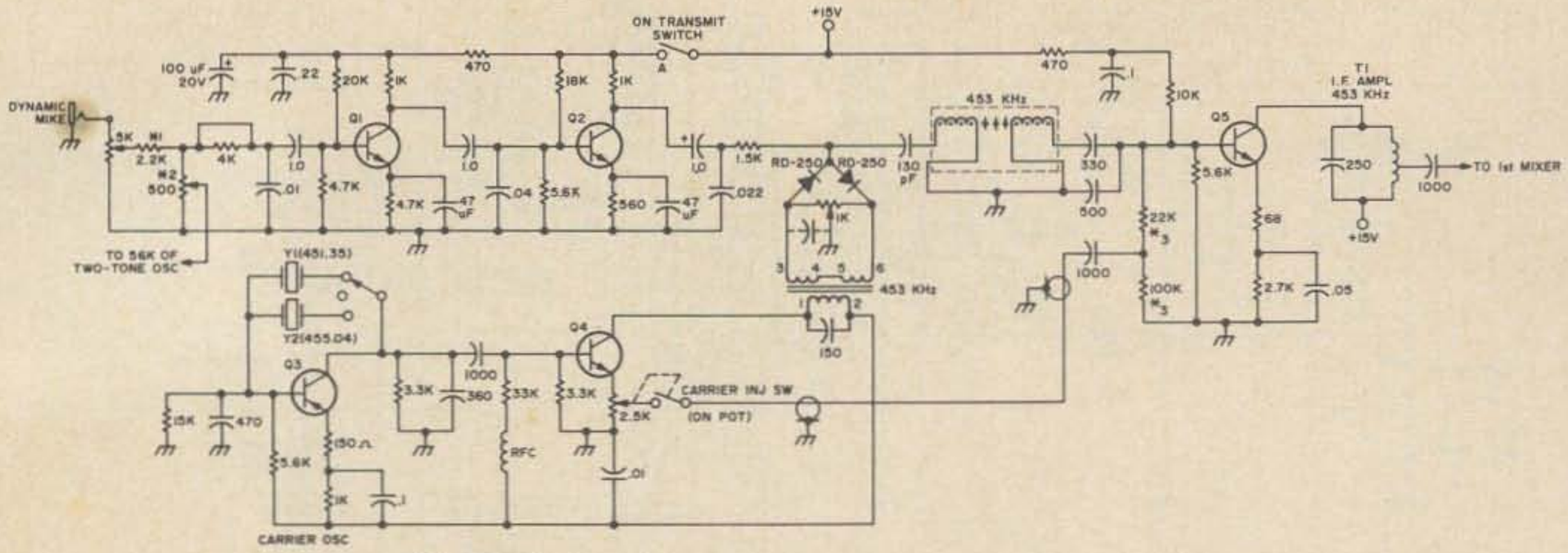


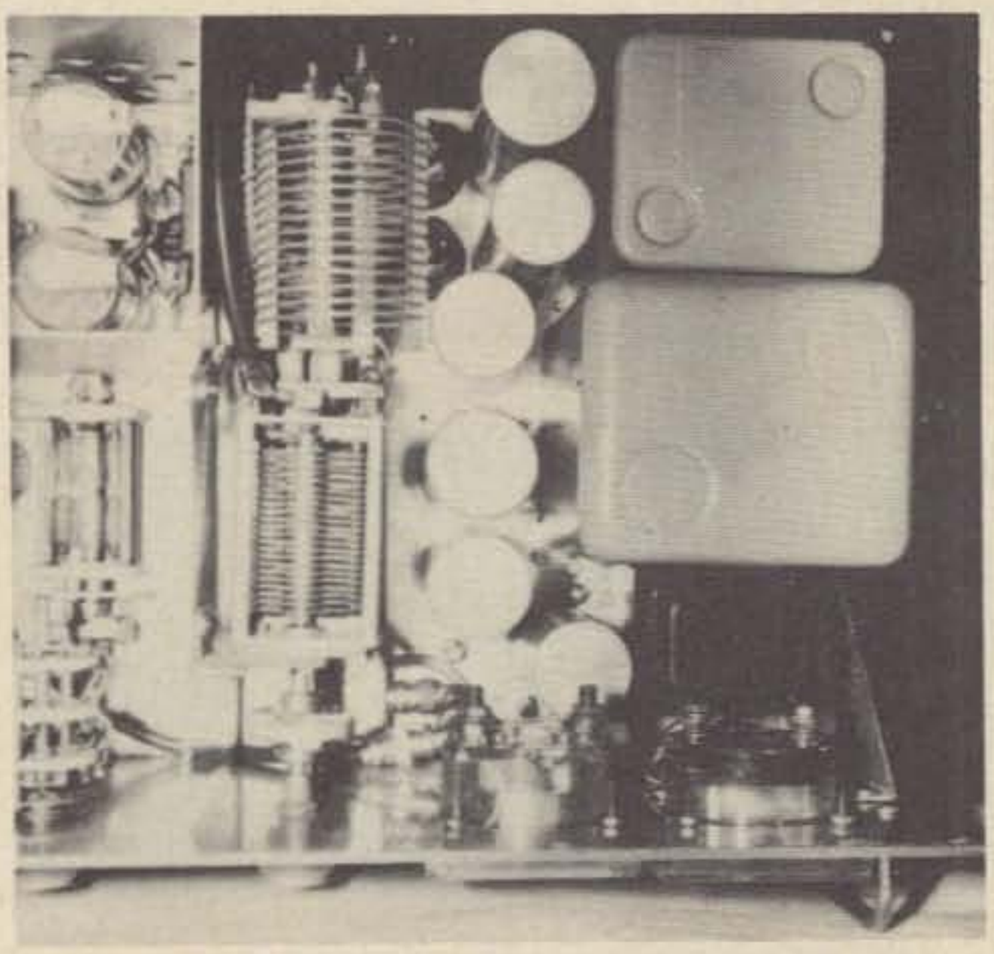
Fig. 3. Audio, balanced modulator, mechanical filter, i-f amplifier, carrier oscillator, and carrier buffer amplifier.

for linearity monitoring and testing. The mechanical filter is one of the higher quality Collins multi-element 3.1 kHz variety with steep skirts down to 90 dB. The input is series tuned while the output is series-parallel tuned using capacitors in a divider configuration. The loss introduced by the filter is only 9 dB and the gain of the following i-f amplifier had to be severely limited by tapping the coil of T1 near the bottom end and inserting degeneration in the emitter of Q5.

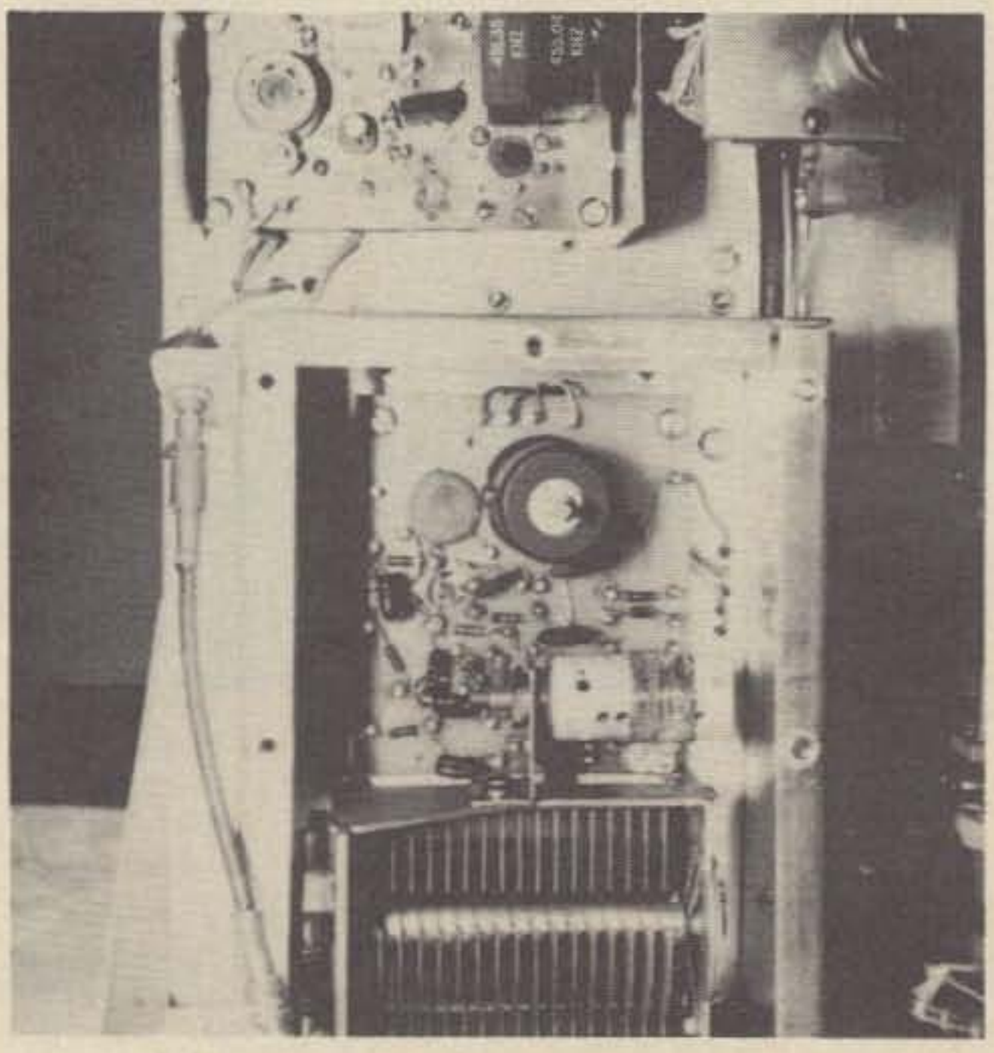
Overall gain measurements for this board were made using a 10/1 divider scope probe connected at the collector Q4 of the i-f amplifier. Using a single tone signal and no carrier, the 500Ω pot in the audio amplifier input circuit is set for a 2.5V p-p indication measured at the base of Q1. Inserting carrier to produce a 100% modulated sideband signal, the amplitude will increase to 4.8V p-p. Turning off the carrier and switching to a two-tone audio signal the indication will be 3.8V p-p.

The next board, which is located in the lower left-hand corner on the bottom of the chassis, contains the 2045 kHz first mixer and 2.5 kHz crystal oscillator. The major problem encountered with this stage was in designing a mixer transformer, T2, with a Q high enough to reject the 2.5 kHz oscillator signal from its output. This was finally accomplished using the core material and data as furnished in Table I.

The 1.8 kΩ series resistor from the 453 kHz i-f to the base of the second mixer was selected to limit the signal to the mixer. With a two-tone signal, the mixer output amplitude at the collector of Q6 is 1.9V p-p. A voltage divider network consisting



Power supplies and complete final amplifier.



Vfo with lid removed; also shows selectable sideband crystals and balanced modulator.

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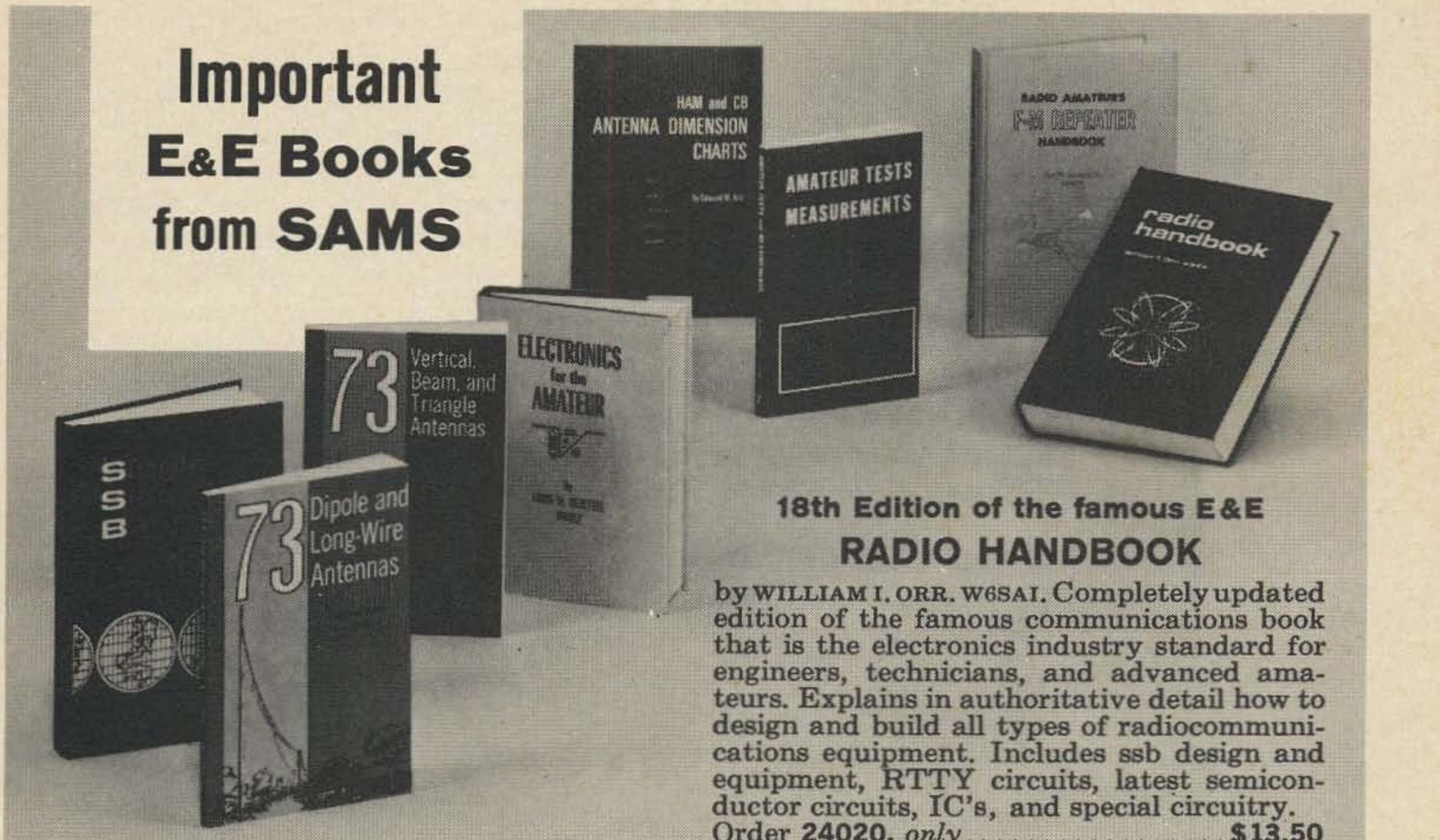

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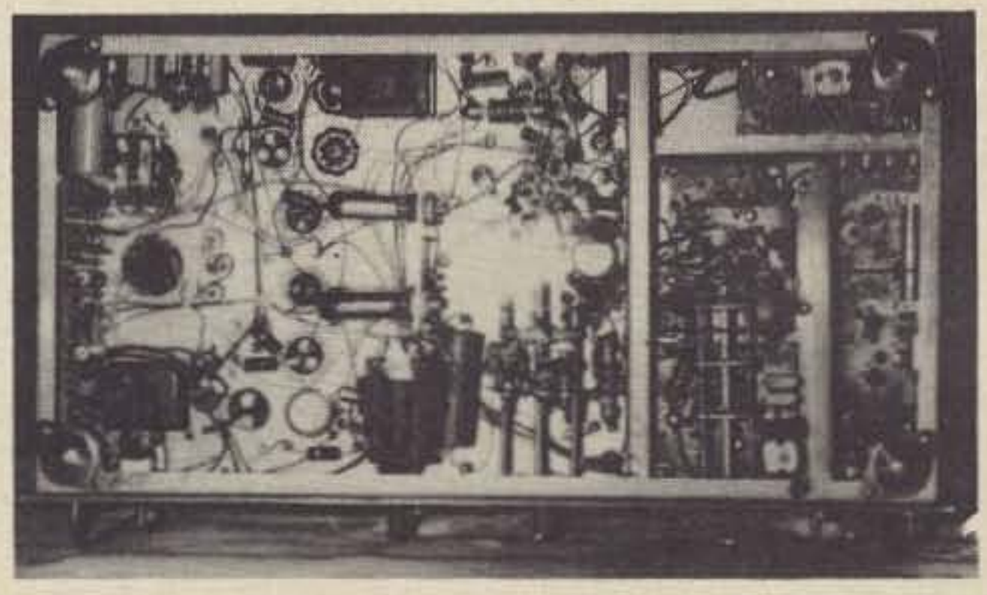
Left – band select switch and 6146 sockets. Middle – band select crystal oscillators, 2nd and 3rd mixers, and rf amplifier. Right – Mike amplifier, mechanical filter, and i-f amplifier. Back – 2.5 MHz crystal oscillator and 1st mixer; two-tone oscillator.

of a 220 and a 150Ω resistor shunts the secondary of T2, setting the first mixer output signal level at 300 mV p-p. This measurement is made with transistor Q7 removed from its socket. A voltage dividing network optimizes the 2.5 kHz oscillator signal to the mixer T8, limiting the drive to 550 mV p-p. Both T2 and T8 coil data is critical and is listed in the coil data chart, Table I.

In the chassis compartment just to the right of the audio and 453 kHz board are a total of 3 modules. Toward the panel is the band selector crystal oscillator stages, Q14 and Q15. To the rear of the band selector is the broad band second mixer Q7 and emitter follower Q8. Mounted on top of this board is the third mixer, the double balanced mixer using the latest techniques, and the rf amplifier Q10.

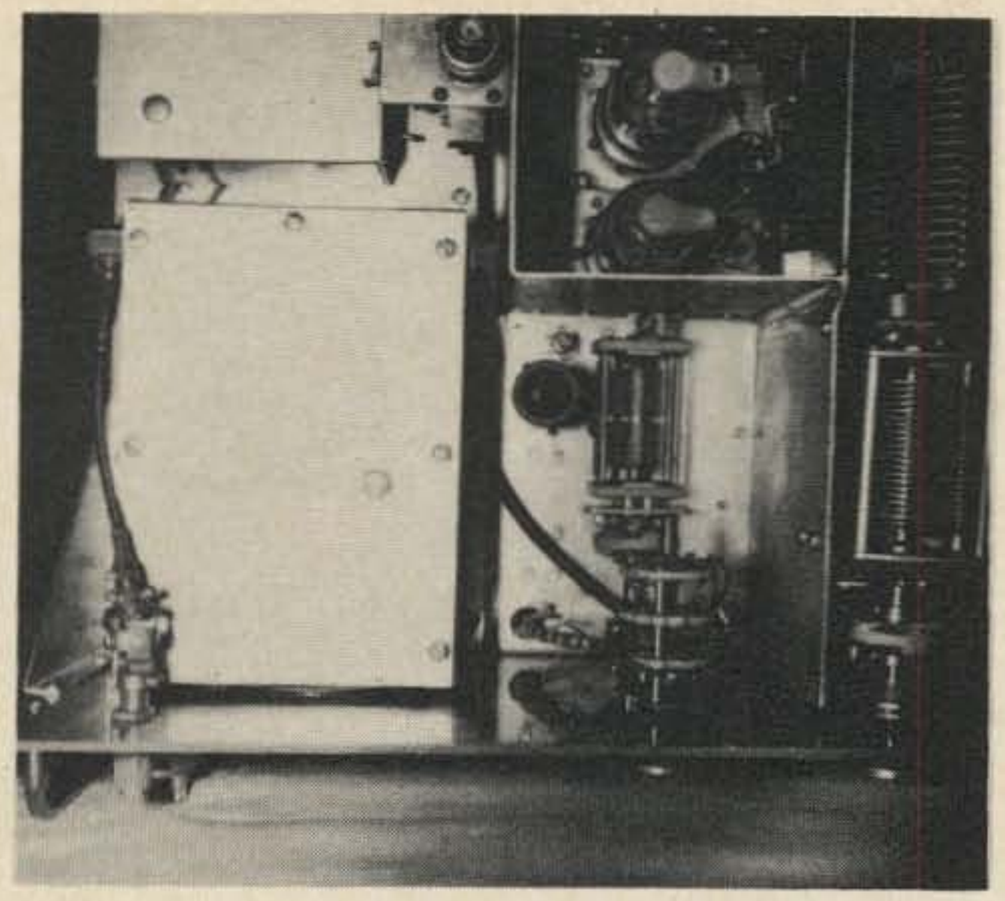
The second mixer has a fixed frequency input of 2045 kHz and a vfo input of 2900–3550 kHz, making the usable output frequencies 4945–5595 kHz. The problem encountered here was to develop a coupling circuit with a flat response over 650 kHz. The coils were wound on ¼ in. ceramic slug tuned forms, resistive loaded to a Q of about 5. The coils are spaced ¾ in. on centers. The coupling capacitor value is very critical; the calculated value is 10 pF but in practice optimized out at 8pF. The circuit has a frequency response flat to better than 2 dB. Coil data can be found in Table I. Unloaded Q of each coil is about 55. The collector Q7 is tuned for the low frequency end of the bandpass while the emitter of Q8 is tuned for the high end.

T4 and T5 are wound on 4C4 ferrite toroids, 3/8 in. diameter. Ferrox cube 266T125 or equivalent may be used. I must have wound 40 coils of four different diameters and ½ doz. materials before coming up with a final design. Most of the materials tried seemed satisfactory except for the problem of driving their low input impedance. The key was to select a material with high enough permeability to obtain an input of something over 50Ω using a small number of turns and setting the emitter follower current to 10 or 15 mA. All of the information I received from engineering contacts advised designing both input and output coils with identical number of turns but I found this only to be true if a very wide frequency range was desired.



Bottom view of power supply and final amplifier.

My final design emerged with coils T4 and T5 with 13 and 9 turns respectively. These coils must be trifilar wound. It is recommended that the three lengths of 26-gage wire be of different color so that they may be easily identified. This is not an absolute necessity as identification can be made using a continuity meter. Twist the three lengths of wire around each other and then wind onto the toroid cores, spacing the turns evenly over the entire circumference and then tacking into place



Vfo, 12BY7 driver, 6146s, tuning capacitor for 3rd mixer and driver, and function switch.

using a small quantity of Polystyrene cement. Use the cement sparingly as the capacity effect is critical.

Actually, the mixer has a bandpass much wider than needed – possibly as great as 200 MHz – and should the cement spoil the higher frequency end, you will never know it as frequency interest ceases beyond 30 MHz.

The diodes used in the balanced mixer are Hewlett-Packard Schottky hot carrier type 2900. The type 2800 was found equally good. Experiments with 1N269, 1N270, and 1N277 types were found to operate satisfactorily in this frequency range also. The driving signal level into transformer T4 is 700 mV (p-p) and is measured using a two-tone audio signal source with no carrier inserted. Examination of the schematic for the balanced mixer and rf amplifier (Fig. 4) reveals many components, yet all are contained on a board 1¾ x 1½ in.

The only other circuits in this compartment are the band selector oscillator module and coil switch assembly. The rf coils are mounted on a metal disk-shape shield which is assembled as part of the bandswitch. (See ARRL sideband manual, page 66 for ideas on this subject.) Both the rf amplifier and the 12BY7 driver stages are panel-tuned by a miniature 8–108 pF two-gang capacitor. The tuning knob for this is located just to the left of center on the panel.

The function selector switch (Fig. 5) is also panel mounted. This allows selection of operate, zero-beat, CW, single-tone test, and two-tone test. The problem posed by the band selector stage (Fig. 6) was in obtaining an equal output amplitude from each crystal. This section had over three designs before the final one. This may not have been a problem at all if similar type crystals had been used but it turned out for the best since the selection of crystal types ceases to be critical. It is to be noted that for 80 and 20 meter operation the same 9 MHz crystal would be used. Although the final will tune from 80 through 10 meters, no coils were made for the rf amplifier and driver stages for the 80 meter band. Switch

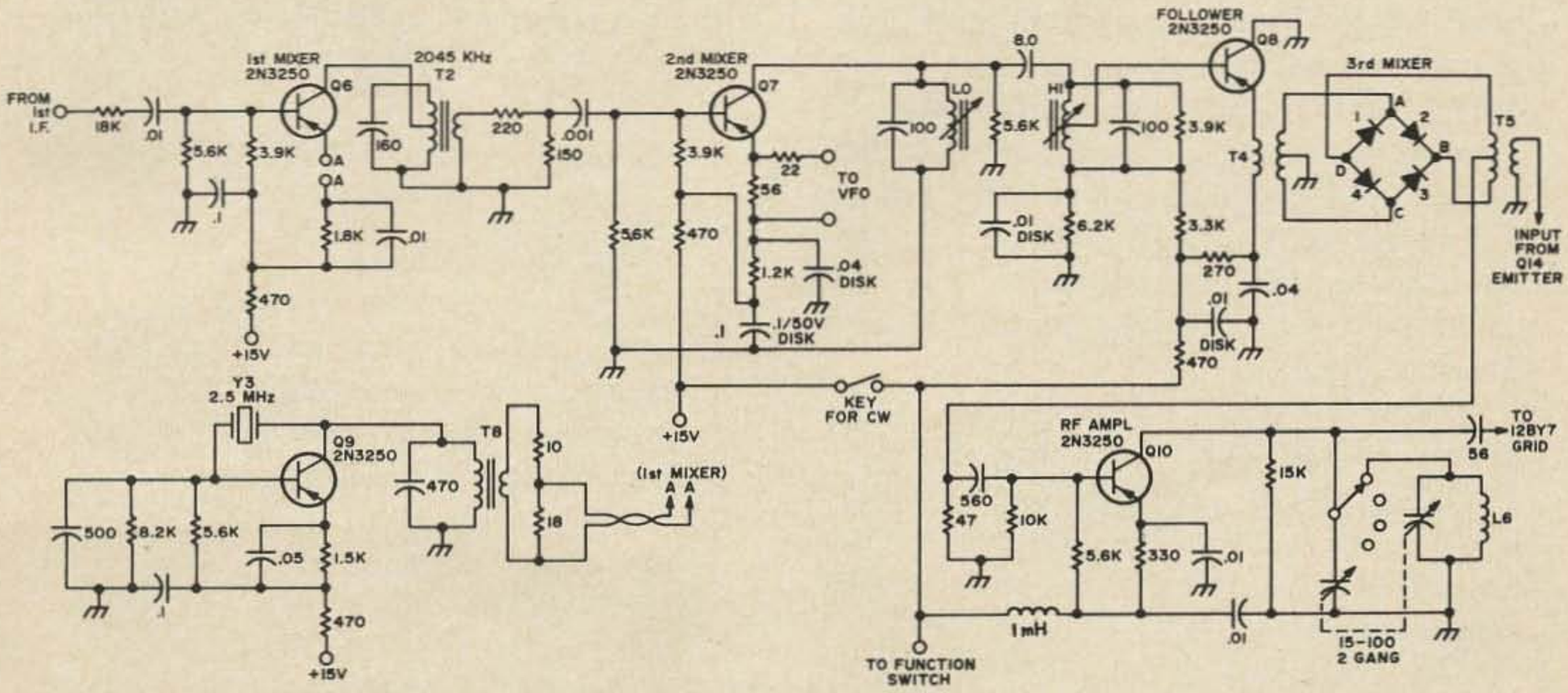


Fig. 4. Balanced mixer and rf amplifier.

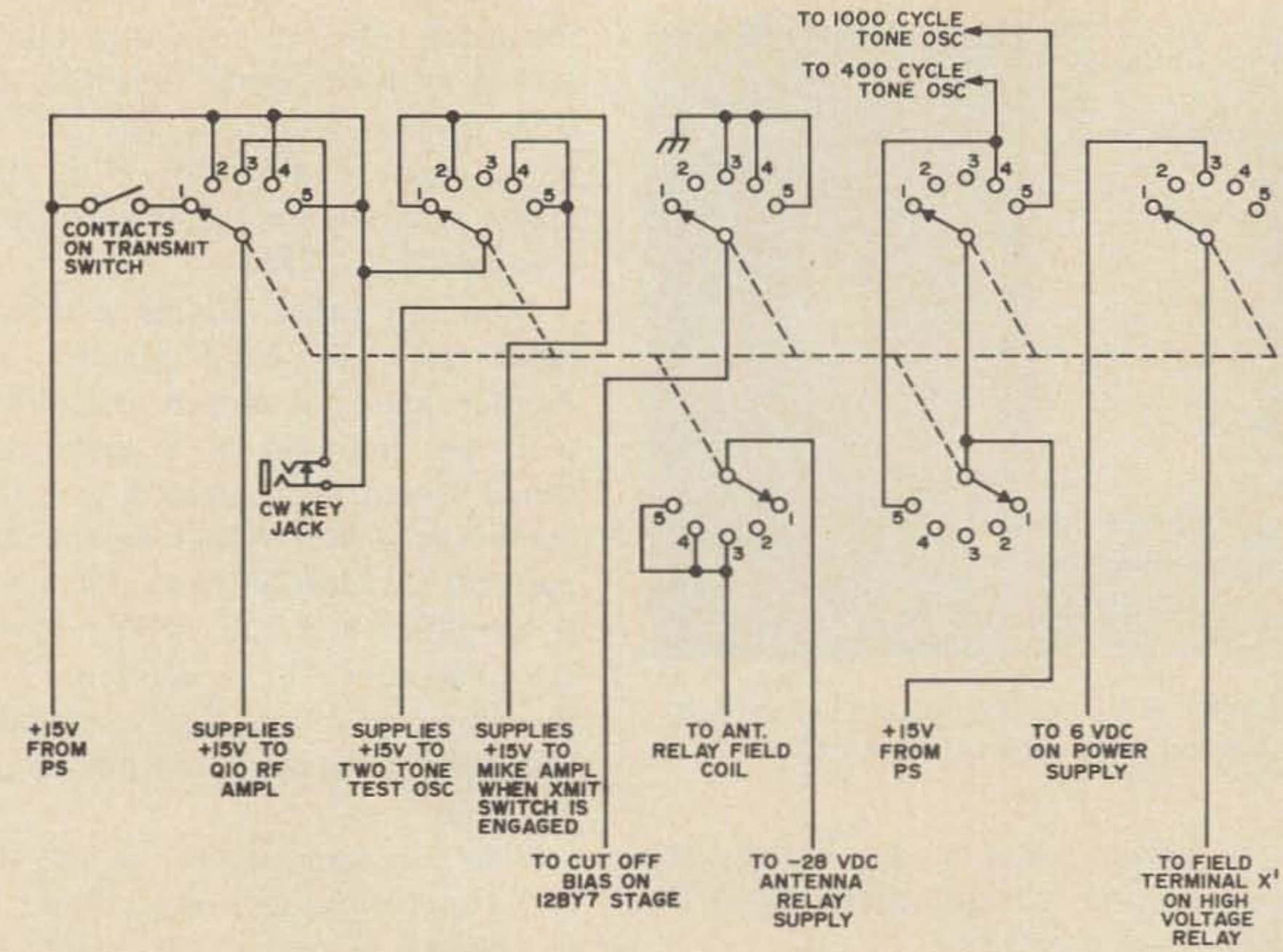


Fig. 5. Function switch.

positions are provided and 80 meter coils can be incorporated at a later date if desired.

Because of the 650 MHz maximum frequency coverage of the vfo it will require three crystals to completely cover the 10 meter band. A 23 MHz crystal covering 27.945–28.595, a 23.6 MHz crystal covering 28.545–29.195 and 24.2 MHz for 29.145–29.795. Other combinations can be used of course. In that these cannot be switched, one must decide what third of the band is desired at a time, changing crystals in order to move to any other third of the band. It would be possible to design a board and switching arrangement containing all crystals, making it possible to switch to any portion. My interests in this band do not go to this extent and I am satisfied to pick mine a third at a time.

The largest board on the bottom of the chassis is the one containing the mike amplifier, mechanical filter and i-f amplifier 6 x 1¾ in. Actually the entire exciter portion takes up only one third of the chassis space.

The vfo module is contained in its own shielded box and is located on top of the chassis and in front of the box containing the crystal carrier oscillator, buffer, and balanced modulator. Incidentally, these two modules were completed about a year before other modules of the transmitter, including construction of the basic chassis.

The vfo (Fig. 7) was designed using a tuning capacitor out of an ARC-5. As you know, this capacitor is considered as fine in quality and stability as any obtainable. The oscillator coil is wound on a ribbed ceramic form ¾ in. in diameter. The big problem with this stage was developing a pure sine

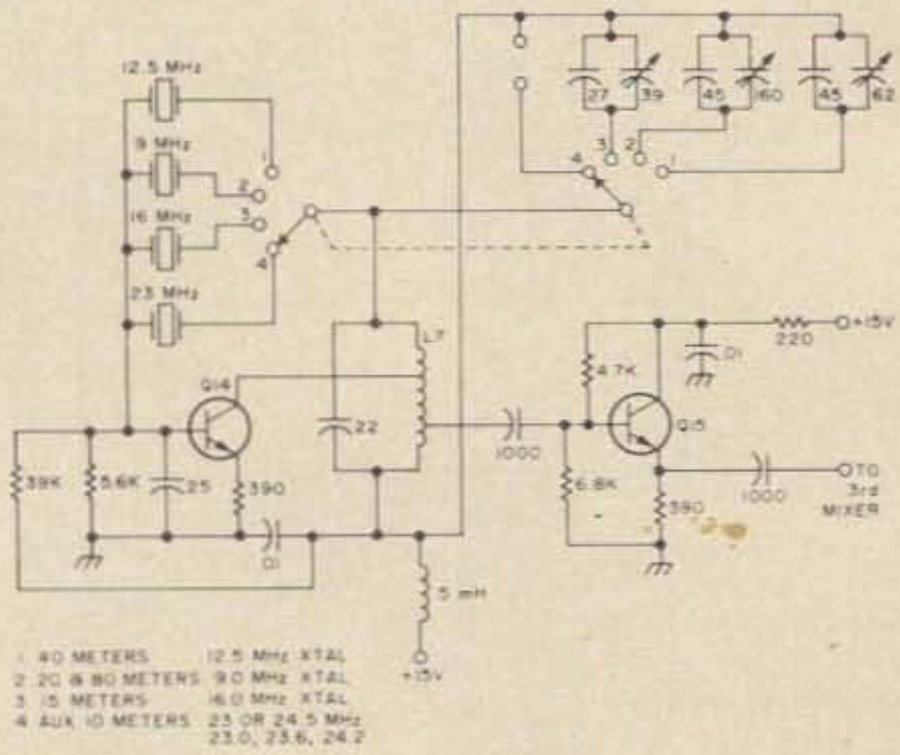


Fig. 6. Fixed crystal oscillator to third mixer (double-balanced mixer).

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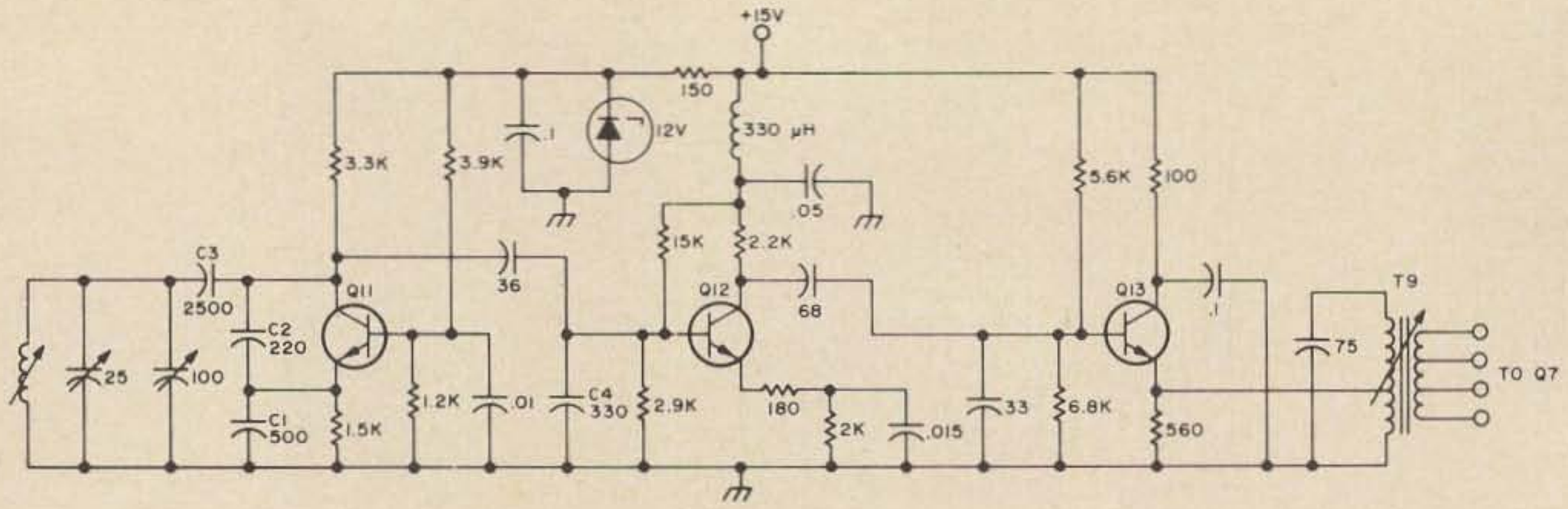


Fig. 7. Variable frequency oscillator (2.9–3.55 kHz).

wave (undistorted) rf output signal across the band. This was finally obtained after designing an amplifier (Q12) and emitter follower (Q13) that reduced the loading on the tunable oscillator.

An HP counter and temperature-controlled oven were used for the process of stabilizing the oscillator. Critical components are C1, C2, and C3. C1 and C3 are silver mica dogbones while C2 comprises four separate capacitors (2 ea. 68 pF N-750s, a 21 pF N-330, and a 63 pF NPO all in parallel). Looking back over my data, the temperature tests were run for over two weeks. Frequency drift is 11 Hz for a change of 25°F over the vfo frequency range of 2.9–3.5 kHz. Once this module was completed, the unit was closed completely and not opened again until pictures were recently taken of the entire transmitter. At that time, only the top cover was removed.

At the time this unit was designed I did not know what output voltage would be required to drive the second mixer as plans for this stage were still quite a way down the road. Hence, a multitapped coil with output from 1.0 to 2.5V p-p was made. This turned out to be a bad guess as the output from the lowest tap was more than optimum. Rather than go back and redesign the coil (T9), a 22Ω series resistor to the emitter of Q7 was incorporated, thus optimizing the second mixer for the best output waveshape. It is suggested that anyone duplicating this design use a secondary winding on the 3/8 in. diameter ceramic slug-tuned T9 form of 12 turns tapped at 4 and 8 turns, rather than the information as given in the coil table. No series resistor is needed if this winding data is used.

The two-tone oscillator (Fig. 8) is located in the same compartment with the 2.5 MHz oscillator and buffer module and is mounted to the back side of the chassis in a vertical position.

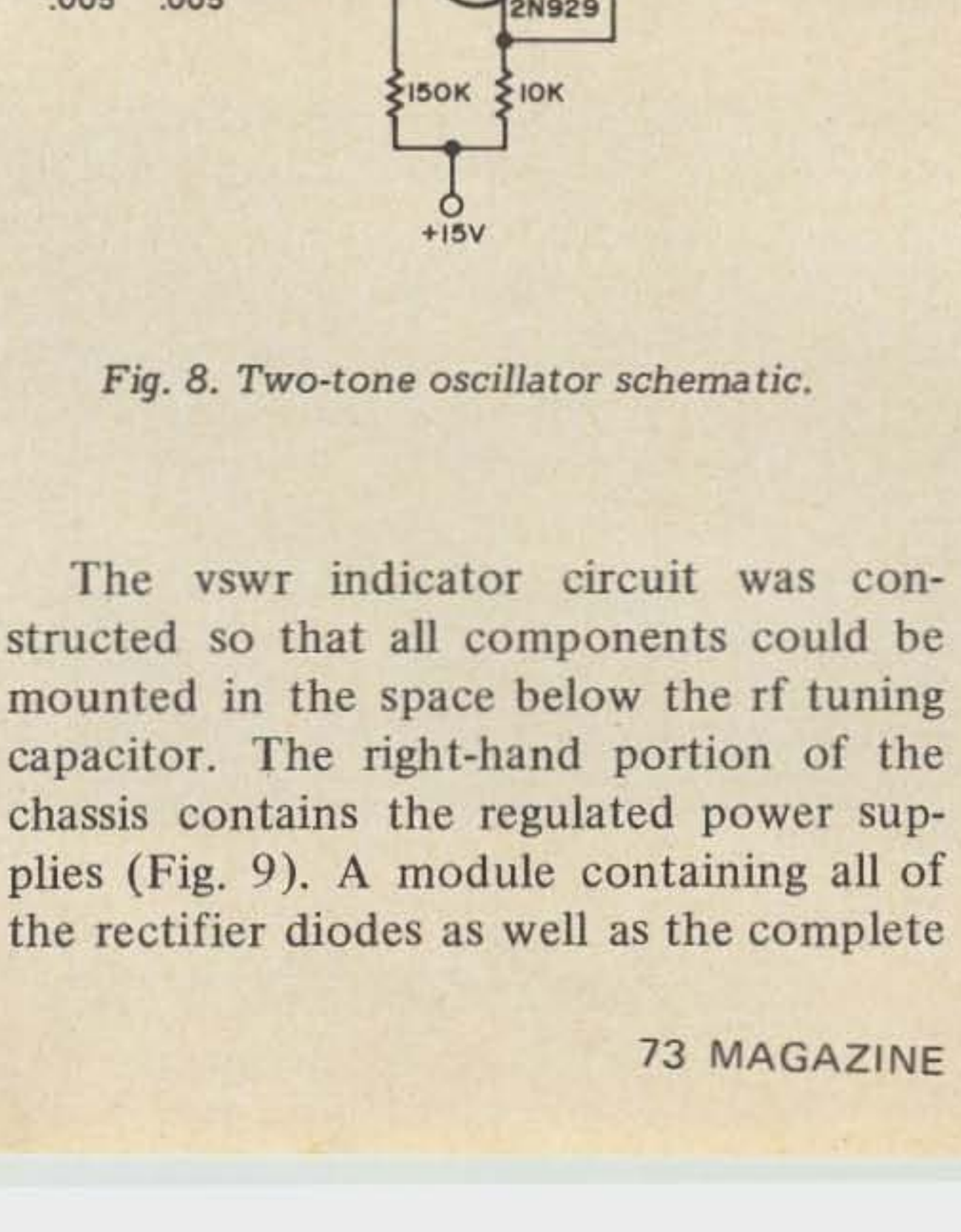


Fig. 8. Two-tone oscillator schematic.

The vswr indicator circuit was constructed so that all components could be mounted in the space below the rf tuning capacitor. The right-hand portion of the chassis contains the regulated power supplies (Fig. 9). A module containing all of the rectifier diodes as well as the complete

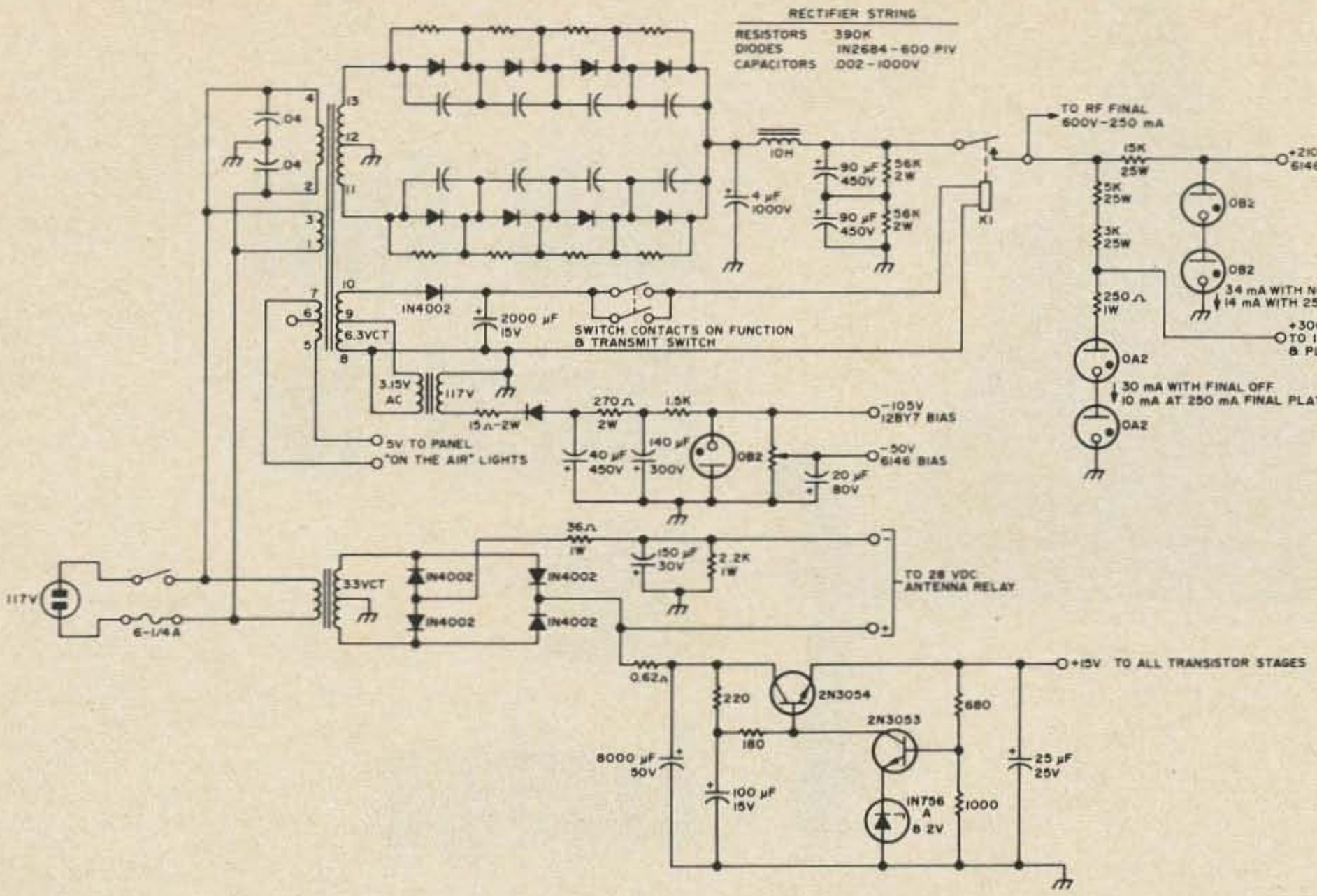


Fig. 9. Power supplies for SSB transmitter.

component circuitry for the low-voltage and antenna relay supply mounts on the side of the chassis.

The high-voltage transformer is hermetically sealed, containing three centertapped secondary windings. The 6.3V winding serves three functions: furnishes the 6.3V needed for tube heaters, it operates the high-voltage relay, and it furnishes 3.15V primary power to operate a separate transformer for the bias supply. The high-voltage rectifier string is made up of 8 1N2684, 600 PIV · diodes, each shunted with 390 kΩ resistors and 0.002 mF (1 kV) capacitors for transient suppression.

The ac. line switch has a configuration that turns on the low voltage dc supply in its center position and adds line power to the high-voltage supply in its up position. The function switch is a three-deck, five-position, seven-circuit affair made up from an Oak switch kit.

Function Selector

Function positions are as follows; Sideband, tune, CW, single-tone, and two-tone. Positions 1 and 2 are similar except that in position 1 there is no supply voltage on the third mixer until the transmit switch is activated. In position 2, voltage is supplied to the mixer and by inserting carrier; the vfo can be set to zero beat in the receiver at the desired frequency. This condition is not desired on position 1 as it may interfere with the reception of the station being worked.

In the CW position, voltage is removed from the audio stages, and B+ is supplied to the driver and final. The telegraph key interrupts B+ to both the second and third mixers as well as the transistor rf amplifier stages. Positions 4 and 5 provide voltage to one or both of the tone generators, respectively.

The transmit switch is the multileaved telephone switchboard type, and in the transmit mode controls the following: cuts the bias voltage to the 12BY7 driver, energizes the high-voltage and antenna relays, supplies voltage to the audio amplifier and third mixer, and switches the *standby* and *on the air* panel lights.

. . . W6YUY ■

Solid-State Control for SSB Exciters

E. Dusina W4NVK
571 Orange Ave W
Melbourne FL 32901

The conventional approach to solving the critical problem of tuning a sideband receiver is to use lots of bandspread and a very good mechanical knob linkage to give very fine tuning adjustment capability with little backlash. Sometimes, though, even the best knobs get jerky and develop some backlash after a hundred hours use or so. The only difference between very good knobs and not-so-good knobs is the amount of this jerkiness.

To forever remove this backlash problem and give you a degree of tuning fineness such as no mechanical dial can approach, you need only add a simple diode variable capacitor for precision frequency shifting, or "delta frequency" control.

The best amount of delta frequency ($\triangle_f$) for amateur use appears to lie between 200 and 400 Hz. The fellows with separate transmit and receive controls have an awful time staying on frequency in a roundtable, and I frequently have to shift the full 400 Hz from the operating frequency to reach the worst of them. This control is especially necessary to tune in a feminine voice, since the exactness of tuning SSB gets very critical as the voice pitch gets higher. I have never been able to get clear reception on female ops with my mechanical dial, but with the vernier $\triangle_f$ there is one critical frequency where their voices clear up noticeably.

This control is a must for the serious phone-patch operator, too, since hams who develop a facility for understanding a highly garbled SSB voice forget that the layman does not have this tolerance, and can't understand even a slightly garbled voice. In receiving an off-tune patch, they will be polite, but they may be, in reality, missing much of it.

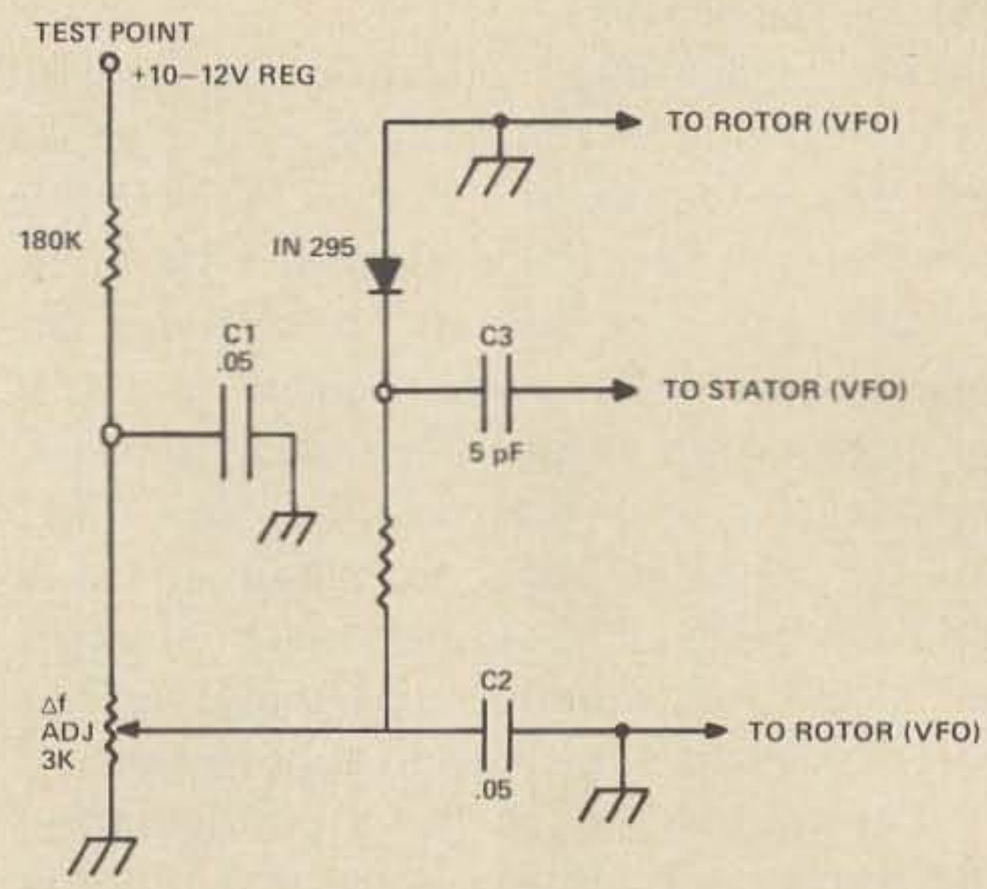
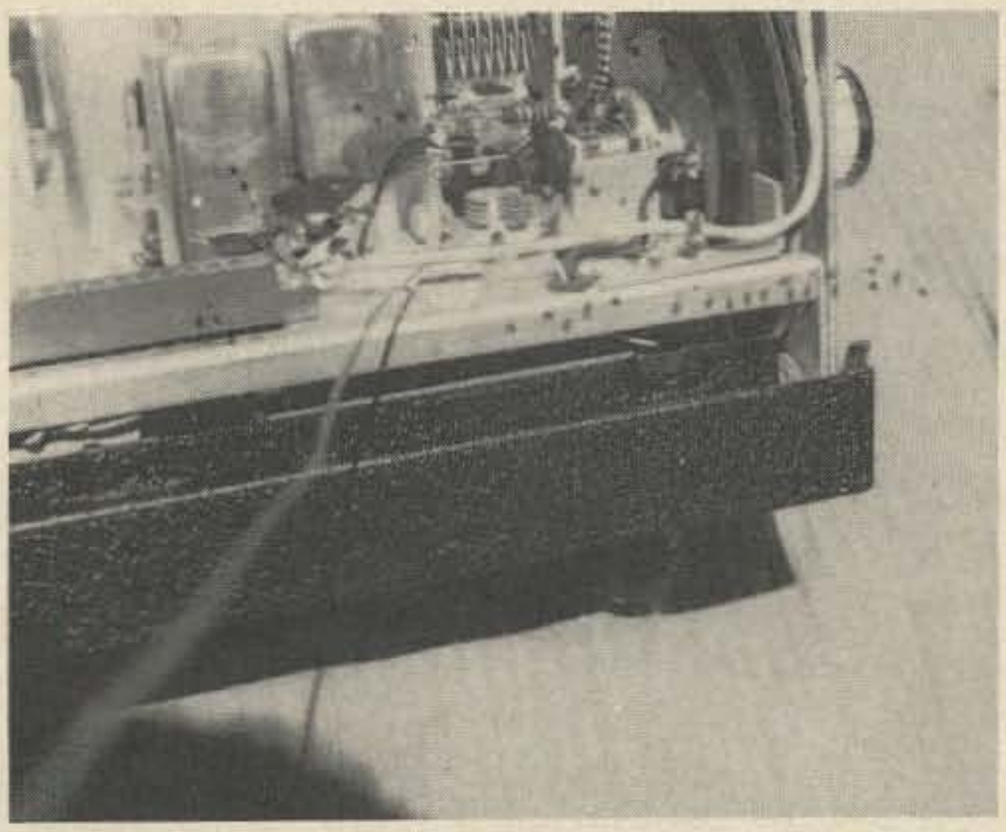


Fig. 1. Schematic diagram of "delta frequency" vernier control for SSB receivers.

This critical nature of SSB has to do with the harmonics and overtones of the voice, all being shifted the same number of hertz instead of being shifted the same percentage of frequency. You who have tape recorders are probably aware of the fact that the voice doesn't appear to suffer much if the tape speed is slightly wrong, although music does protest some. With the same degree of error in frequencies, applied as a frequency offset (which is the same number of hertz regardless of frequency), even voices become seriously garbled, and music comes out as total nonsense. If you doubt how critical this is, try to tune in music on one of the foreign BC stations with your sound just right until you get zero frequency error and the proper phase, within about 90 degrees of the station carrier. Even with this vernier control, you won't find it easy to tune to music, since a phase-lock receiver and residual carrier must be used to get phone company quality out of SSB.

The circuit for the $\triangle_f$ control is shown in Fig. 1. As indicated, the only adjustment device added to the existing receiver is the tuning pot, which can be mounted anywhere you please. A shielded line of a three-wire twisted line can feed it. Since only dc is present on these lines, their length is of no consequence. However, this is a moderately high impedance circuit of up to about 3 kΩ, so keep the pot leads



The entire circuit can be placed neatly within the existing space of most transceivers. This photo shows the components mounted near the vfo capacitor in a Galaxy.

away from ac lines or you might induce enough ac to FM your vfo a small amount.

Placement of parts is not critical, but keep the components attached to the vfo tuning capacitor rigid, or the whole thing will be microphonic. Keeping reasonably short leads on the components will accomplish this objective just fine.

The pot I used was a used 3 kΩ TV pot. I drilled a 3/8 in. hole in the front panel, and mounted it as shown in the photo. Whatever pot you decide to use, make the hole in the panel far enough away from the calibrated dial to keep the pot from rubbing the dial after it's installed. A small diameter pot makes things a lot easier.

Tuneup Procedure

Before connecting capacitor C3 to the vfo stator, tune in a carrier and zero-beat the signal on your SSB receiver. Use your crystal calibrator if it is of the 100 kHz marker type, or use a commercial BC station that is easily *identifiable*. Pick a low vfo frequency so that your vfo tuning capacitor is almost completely meshed. This minimizes the frequency shift when you connect C3. Set the 3 kΩ pot to its center of range and connect the free end of capacitor C3 to the stator of the vfo tuning capacitor. The carrier that was zero-beat will shift frequency as you do this because you just *added* a couple pF capacitance in parallel with the vfo tuning capacitor. You will have to *remove* an equal amount from the trimmer on the vfo to bring back the zero-beat on the same carrier you had before. (Be careful not to zero-beat another carrier!)

To remove the capacitance, unmesh the vfo trimmer just enough to zero-beat the carrier like it was before you attached C3. That's all there is to it; your vfo is now back in perfect alignment, and you will be able to shift the frequency up and down about 300 Hz with the pot.

Diodes to Use

I used a 1N925 TV video detector diode, but just about any type will work. Since we are only using a couple of picofarads of the diode in parallel with 30 pF or more of vfo tuning capacitance, it matters little whether the diode is a low-Q computer diode, a detector diode, or a high-Q varicap. If the diode you use doesn't give you enough shift, just reduce the value of R2 some (not below 10 kΩ, though) or increase the value of C3 (not above about 10 pF).

This $\triangle_f$ control shifts both transmitter and receiver frequencies; therefore, in a roundtable discussion, if you tune off to hear a station, go back to the original pot setting before transmitting. If the other fellow has a transceiver, leave the pot where you hear him best, since this automatically makes him hear you best also.

More elaborate circuits can be designed which automatically return your vfo to the center range of the pot when you transmit, by using a contact on your transmit relay and putting a fixed bias on the diode when you transmit. The desirability of this is questionable, however. With this circuit, simplicity is foremost, and in a regular QSO, you just adjust the pot to hear the other party and leave it.

If you don't mind boring a small hole in the face of your transceiver you are sure to find a handy spot for the adjustment shaft. This one was placed in the upper left corner, right above the vfo dial.

Should you tremble at the thought of poking a hole in your "store-bought" rig, bring the pot wires out to a little handy box, so you can remove every trace of your modification later if you desire. I personally would pay more for a used rig with this control, but to each his own. You can also calibrate the pot in hertz if you have a calibrated af generator to compare its shift with.

. . . W4NVK ■

HAMS are a FuNnY BuNcH of PEoPle!

Al Brogdon, K3KMO
RFD 1 Box 390A
State College PA 16801

Hams are a funny bunch of people. They will work for days with their beam antenna orientation to make sure it is pointed to within one-half degree of the indicated direction – never considering the fact that the beamwidth of the antenna is 40 degrees.

They will overload their transmitters by factors of 50% or more, and milk that last watt out of it – when it takes a power increase of four times to make one S-unit difference.

They will stay out of a ham club and complain until the cows come home about how poorly it is run. But they never want to join and work to straighten out the club's problems.

They will spend five hours and more a day building and installing ham equipment, telling the wife all the while that they just don't have time to put a new line cord on her iron.

Some of them will crank their final amplifiers up a little and run 3 kW PEP, never thinking about the fact that they would have to run more than 5 kW to make a significant difference in signal strength above 2 kW PEP. A few of these hams have time to think this over during their license suspension period.

They will spend hours every day talking with people all over the world, but never say hello to their next door neighbor.

They will tell their wives they can't afford a new chair for the living room while they are writing out the order for a new $700 mobile installation.

They will buy surplus equipment to save money, and then spend an amount of money on it's conversion that would have bought good commercial gear that would have done the same job better.

They will set up stations with which they could communicate their ideas, but they they will give a signal report, a brief weather report, a description of their station, and run out of things to talk about.

They will spend an entire 48-hour contest period at the rig, leaving it only to catch short naps and take care of necessary bodily functions, but during the week they can't spare 10 minutes of their time to play with their kids.

They will buy complex and expensive electronic keyers so the extra dots and dashes their sloppy keying causes will be well-formed and correctly spaced.

They use Q signals on voice, and then have to use phonetics to get the letters across, since voice is better suited for communicating words than for transmitting individual letters.

They will apply for every ham award they can qualify for to document their accomplishments, when many of the certificates are for a level of accomplishment roughly equivalent to being able to cross the street without getting run over.

They will load half a ton of amateur gear and antennas into the car and take off for Field Day, but then have to suspend operation halfway through the contest because the didn't bring a spare fuse.

They will take great pride in being a ham radio operator, and tell all their nonham friends of the many accomplishments of ham operators, and of the advances in the state of the art brought about by hams, when they themselves haven't been on the air in three years.

But one of the funniest things of all about hams is the typically human shortsightedness of most hams. They see all the faults of their fellow hams, and they are quick to criticize, but they are not aware of their own shortcomings. Aren't you glad that you and I aren't that way?

. . . K3KMO ■

Clifford Klinert WB6BIH
520 Division St
National City CA

A 2M MINITRANSMITTER For Repeater Use

When an FM repeater finally came to San Diego last summer it was soon obvious that new possibilities and requirements were placed on 2 meter FM equipment. First of all, high transmitter power was no longer required nor desirable. In many cases output power in the milliwatt level was adequate to activate the repeater since it is virtually line-of-sight to most parts of the county. Also, high power on 146.34 MHz would cause interference with Los Angeles area remote stations that are similarly located on high mountaintops. This would add further strain to already delicate relations with the Los Angeles groups who can (and do) jam San Diego just as easily.*

Secondly, a large number of RCA CPCR2D pocket receivers had become available for portable use, but the transmitters available with them were not transistorized and the batteries were heavy and expensive. With this arrangement, and with the repeater, it became possible to have full use of the repeater while walking around on the ground in most parts of the area. This is probably the most fascinating part of repeater operation, approaching the science-fiction TV shows by being able to talk to someone a hundred miles or more away while walking around on the streets of a city with a hand-held transceiver. However, the idea of having to carry tubes and batteries while doing this was still quite revolting. Solid-state transceivers are becoming available, but are still in the $250 to $350 price range. In view of this, it was finally decided to continue work on a solid-state transmitter. This article describes the first successful results of that project.

Design

Figure 1 shows the schematic of the transmitter as it is now. The most significant part is the oscillator, which offers maximum simplicity and reliability. The crystal frequency is 18.29250 MHz, and is multiplied eight times to get the 146.34 output frequency. Amateur designs of about a year ago used oscillator frequencies in the 8 MHz or lower range. With the sloppy interstage selectivity as used in this transmitter, lower frequency crystals cause more spurious multiples because they are closer together in frequency. With a crystal frequency of 18.0 MHz, the multiples will be at least 18 MHz apart, and it is easier for the tuned circuits to select the proper multiple and reject others. A Motorola varicap is used to modulate the oscillator. With an audio input of about 22.5V

* Ed. Note: Author is making reference to L.A.'s R.O.B.I.N. (Remotes Operated By Insociable Nets) problem.

peak-to-peak (maximum bias on the diode from the power supply), the deviation is a little more than the 5 kHz at the output frequency. Two varicaps might be used in parallel if more deviation is desired – if it doesn't lower the frequency too much to compensate by lowering other capacitances.

A few notes about the crystal should be made: The crystal must be a "fundamental" cut to work in this circuit. An overtone crystal will oscillate on its fundamental frequency, and will be different from its marked frequency. The crystal load capacitance in this circuit is about 20 pF and this should be noted in the crystal order. A general-purpose type crystal (0.01% error) might be satisfactory, but a commercial-standard 0.001% crystal was ordered by mail, and quickly tweaked down on frequency with the 15 pF trimmer.

The three stages following the oscillator are all conventional common-emitter, LC-coupled doublers. While operating, they are driven into class C. Interstage matching is accomplished by trial-and-error tapping of the coils.

The use of ordinary resistors in the base bias circuit was found to be most successful. This avoids the resonance problems when chokes are used, and probably helps stability by lowering circuit Q. Large capacitance (0.01 μF) bypass capacitors were used to minimize the chances of low-frequency oscillation. Since the gain of the transistors increases at lower frequencies, it is possible to have low-frequency feedback paths that have been overlooked while concentrating on the VHF circuitry.

Using the coil in each stage for the dc return to the collector not only simplifies design, but provides a low-impedance collector return for lower frequencies that would not be possible if choke-and-capacitor coupling were used.

The final transistor can be driven to as much as 2W dc input in this circuit, but was held to one watt to reduce heat dissipation problems and battery requirements. Power can be adjusted by changing the value of the emitter resistors in the multiplier stages, and changing interstage coupling. (Ed. Note: This unit can be used to drive the DyComm 15W FM power amplifier described in 73 review, September 1970.)

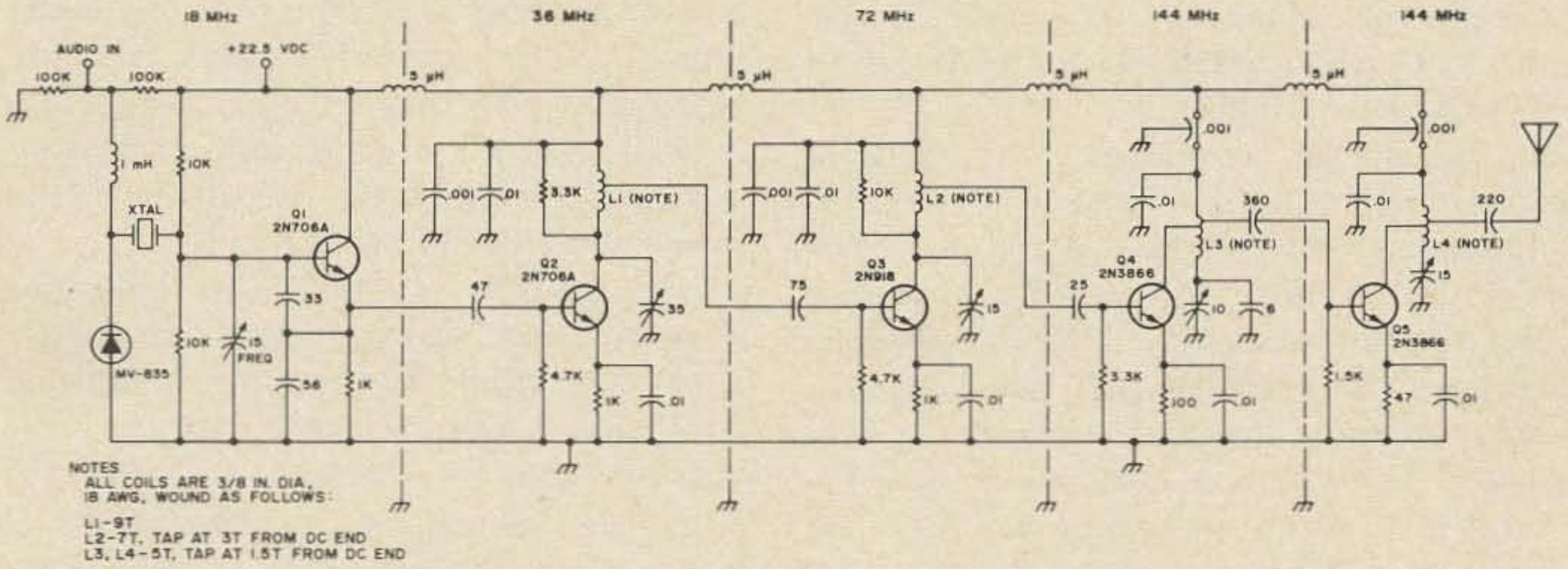


Fig. 1. Schematic.

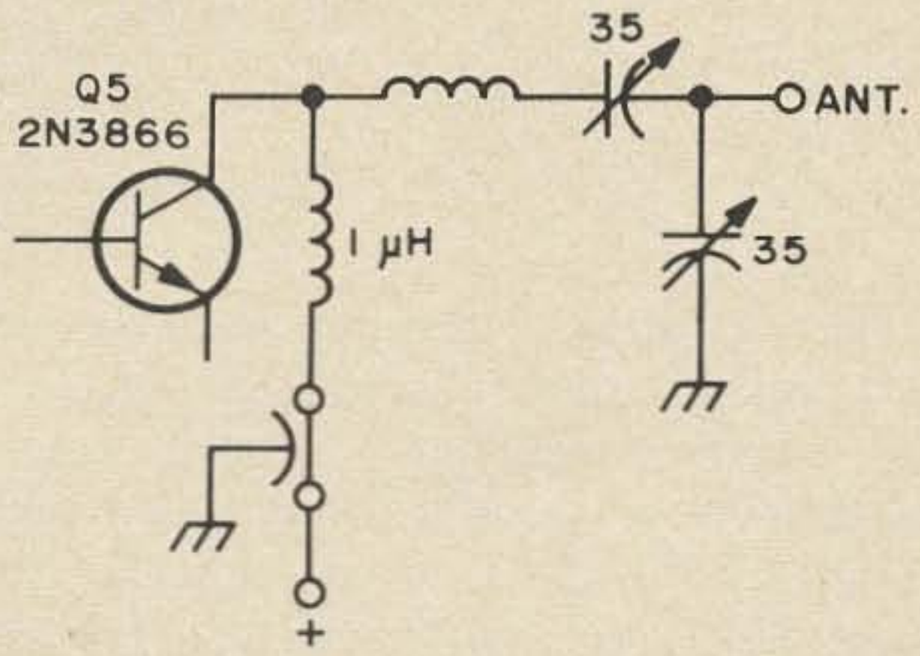


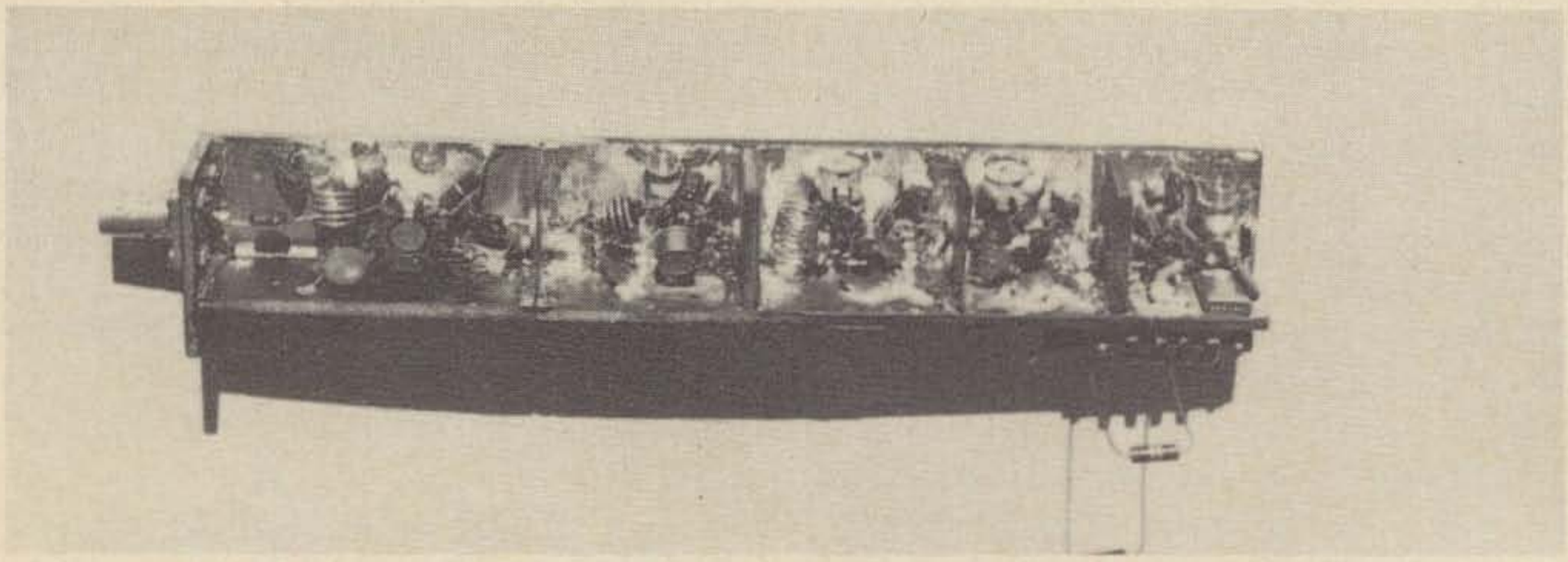
Fig. 2. Alternate Output Circuit. L can be five or six turns 3/8 inch diameter, #18 wire. Try to make it work.

A more popular output tuned circuit is included in Fig. 2, but it was not tried in the transmitter because the circuit used in Fig. 1 was considered satisfactory.

Construction and Tuning

Simply having a schematic available does not mean that it will be easy to build a transmitter. Construction is very simple, but making it work will occupy the majority of the time. Since all transistors are different and any two transistors with the same number can have widely different impedance and gain parameters, the tuned and coupling circuits will require extensive adjustment. Many of the values in the schematic will probably be a little different in different transmitters.

Considerable experience as well as appropriate test equipment is required for the tuning and tweaking. A grid dip oscillator is a must, and a general-coverage receiver that can cover all the frequencies between the oscillator and final output is always handy. An swr bridge or power meter that works at VHF is necessary for tuning for output power, as well as all the other tools and test equipment that are usually available in the average shack.



Photograph of the complete minitransmitter strip. Note how stages are shielded into "compartments."

The circuit was laid out on a double clad printed circuit board that makes a very simple arrangement. Small Teflon standoffs were glued to the board with epoxy to provide a place to solder the transistors. Details of the construction and parts to be used will mostly be left to the individual builder. Anyone who would build this transmitter probably would have his own pet methods and parts available to work with. As a final resort, industrial parts catalogs will list all the components necessary.

Speaking of parts, half-watt resistors can be used, but quarter-watt resistors will be easier to work with because of size. In the case of the driver and final emitter resistors, power considerations will necessitate the use of half-watt resistors. Small dipped mica capacitors are used for interstage coupling. Other than the feedthrough bypasses, disc ceramic capacitors were used for bypassing. Indeed they are not the best, but seemed to work in this case. Just make sure that all parts are as small as possible. JFD makes good ceramic bypass capacitors as well as small disk variable capacitors. The crystal holder is the HC-18/U type and is soldered into the circuit.

The transmitter should be built one stage at a time, starting with the oscillator. Each stage should be checked and tuned as it is built. The oscillator will be easy because there is nothing to tune but frequency adjustments and the circuit is very easy to get working. Check for output while listening to a receiver tuned to the crystal frequency. Adjust the two resistors that provide the bias to the varicap to put the diode voltage at about 10V measured at the diode–crystal connection with a VTVM or oscilloscope.

An audio signal voltage can be applied at the "audio in" point in the schematic. Make sure that the audio source is isolated with a series capacitor to prevent affecting

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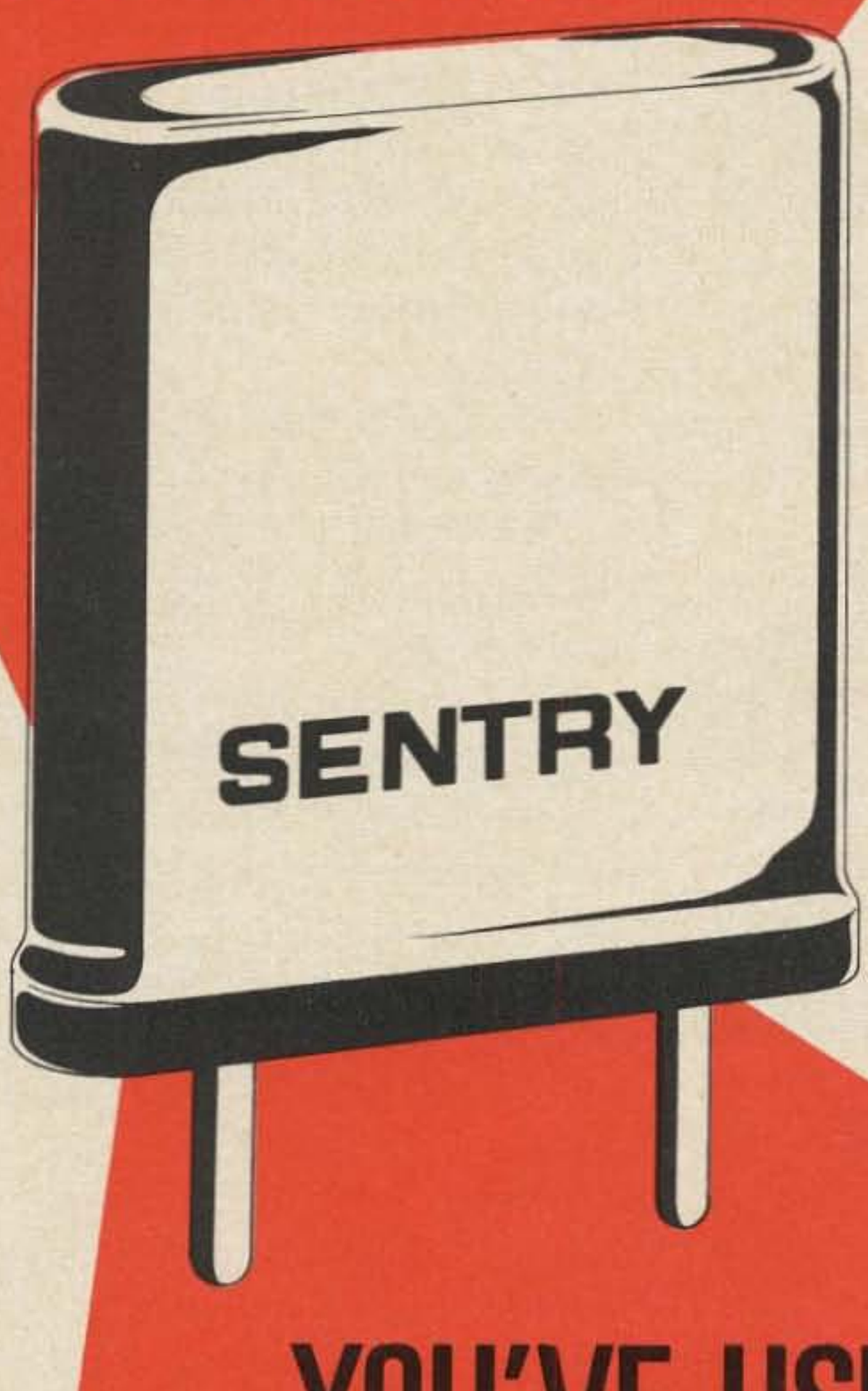

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the diode bias. A maximum of about 20V peak-to-peak can be applied here. A preassembled imported audio amplifier can be used for modulation, or an amplifier can be built to fit individual requirements. If the amplifier is designed for driving a speaker, a transformer may be necessary to step up the output voltage. It should be possible to detect FM from the oscillator by listening to a general-coverage AM receiver and slope-detecting the signal.

Tuning the multiplier stages can be accomplished by measuring the emitter voltage of the following stage while tuning the preceding one. Voltage across the emitter resistor measures emitter current, which is a measure of rf drive. To determine that the stage is operating class C, compare the emitter and base voltage, as measured with a VOM. The emitter should show more voltage than the base. The base never really has more bias voltage than the emitter, but when the VOM probe touches the base, it partially shorts out the rf there and reduces or eliminates drive. Since the emitter is bypassed, measuring emitter voltage has no effect on the rf drive. A grid dip meter must be used for the final tuning to be sure that the state is operating on the right frequency, and to check for parasitics.

The resistors across the coils in the schematic were used as a cure for parasitic oscillations. The stage should be built without the resistor first, and then resistors can be added when instability occurs. A grid dip meter can be used to detect parasitics and oscillation, but an AM general-coverage receiver is much more sensitive.

Adjusting the output stages is just a matter of changing taps on the coils while watching for transistor overheating, checking for parasitics and oscillation, and retuning each time for resonance. Also be sure to check that the right harmonic is being tuned for on the grid dip meter used as a wavemeter.

Leave a TV set turned on; it will let you know when oscillation breaks out and give a little entertainment while you're working. Watch channel eight; the 36 MHz signal tends to come through the 72 MHz doubler, and multiply five times in the 144 MHz doubler to cause TVI on channel eight. This has been the major source of TVI after the transmitter was operating properly. A 36 MHz series-tuned trap might be used at the collector of Q3 as a last resort, but with proper tuning this should not be necessary.

The final results will take a considerable amount of time depending on the intuition or "feel" that the builder has for what is happening in the circuit.

Conclusions

This transmitter has provided good results in the final analysis, but there are problems and changes that could be worked out. The thing is quite difficult to tune and clean up, and some kind of standard chassis, housing, shield, board, or whatever should be designed to provide ease of mechanical construction and duplication, rf shielding, and mechanical strength. Double-tuned, inductively coupled interstage circuits might be used to provide better selectivity. Tapped iron slugs are available, but I haven't located a source. Supposedly, this would be much less expensive than using the ceramic variable capacitors, and much smaller.

Other variations of this same theme might include a low-power 100 mW version for short range use with an absolute minimum of size and power consumption. Be creative.

. . . WB6BIH ■

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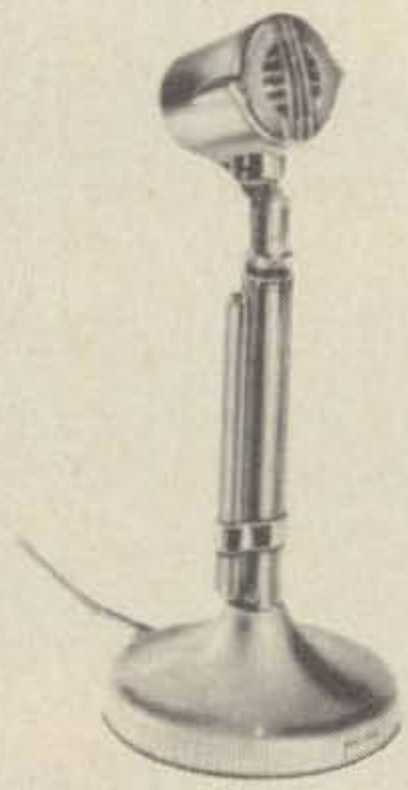

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Theory

The theory behind this method of offset tuning is simple when you recall some of the laws we all knew to get our ticket (and then promptly forgot as they were of no *practical* value). Inductive coupling is the first order. This is the method by which we will get the change into the rig without altering or soldering. This method will allow you to introduce a change in the frequency of the main vfo. You'll also want to be able to remove the change at will, as on transmit. Figure 1 shows that the inductive coupling links the main vfo with the added tuned circuit. It is with this outboard tuned circuit that we can change the received frequency. The capacitance of the variable capacitor should be *low*. Try and keep it in the area of the tuning capacitor of the vfo. In my rig, the HW-100, this is 63 pF, so anything near that will do. The vfo coil in my rig is 5 μH so I kept the inductor of the remote circuit as near to this as possible. None of the values are too critical as to demand adherence to strict values. By keeping close to the values of your rig you will have better tracking and zero beating of the received CW signal. And you'll know that when the remote tuner is switched out of the circuit you are still near enough to be hearing the same signal you were listening to on the offset tuning. The greater the change in the offset tuning circuit values, then the greater the coverage up and down frequency from the zero beat. I felt that in CW a great range of offset tuning was not of any use and it also would make tuning more difficult. I just about use the full rotation of my capacitor and keep within the passband of my rig, the tuning rate is slow enough that I can move it around in the 400 Hz CW filter I have added to my HW-100. It is this simple remote tunable circuit that allows the offset tuning.

Construction and Circuit

The variable capacitor I used is a BC tuning variable with only the rear section in use. If you have any old variable in the

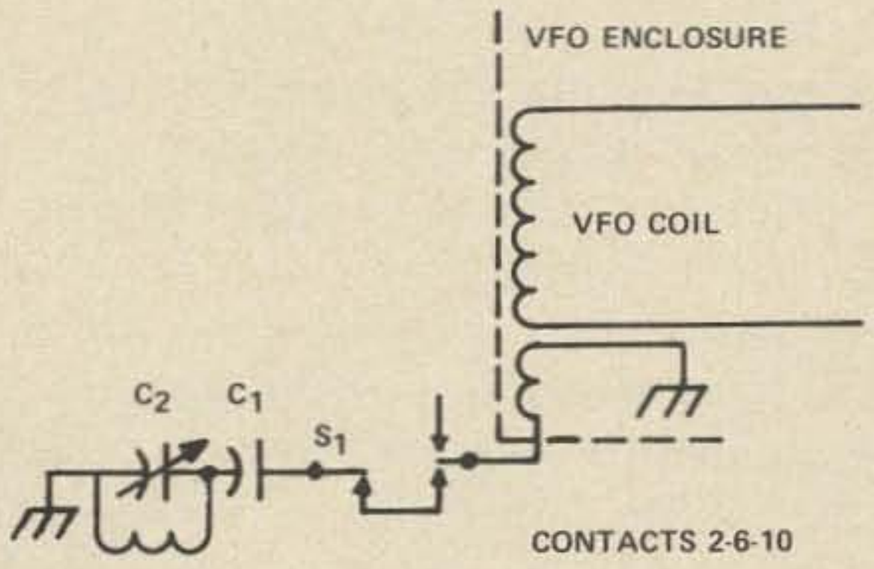

Fig. 1

junkbox, then that's the one you use. I reduced the high capacitance of this section by putting a 100 pF Mylar capacitor in series with it. (You can fool around with values until you get what goes best with your rig.)

The coil for the remote tuner was made after looking in the ARRL handbook; I found that a 1½ in. long coil by ½ in. wide (36 turns per inch) would give me close to 5 μH, which is good enough. The coil was made by winding 24-gage magnet wire, enameled, around one of those fat pencils used for advertising gags. The size of the wire is not important just so you can get about 36 turns to the inch on a half-inch diameter.

If you have spent any money up to this point you need a new junkbox. Now for the hookup.

The vfo of the HW-100 is removed according to the Heath manual instructions. Reference will be made to my HW-100, but any transceiver that allows you to get at the vfo and its coil can be used with this offset tuner. The vfo is turned bottom-side-up so the inside of the enclosure is accessible. Be careful not to damage the screened dial. One end of the pickup wire has its insulation scraped away and it is soldered to ground on the inside of the vfo, as close to the coil as you can manage. This is the only soldering and modification to the rig. In my rig, the ground for the coax feedthrough into the vfo was used as ground. With tension on the ground connection, make one full turn around the vfo coil and while still keeping tension bring the wire to the nearest spade bolt. Wrap the hookup wire around the bolt 2 or 3 times, just for anchorage. Make these turns just at the base of the spade bolt where it meets the edge of the vfo enclosure and tuck the turns down into the little space between the shaft portion of the spade bolt and the edge of the enclosure.

By tucking the turns of wire into these spaces you will keep them from being cut or grounded by compression from the edge of the vfo enclosure when it is remounted and the nuts tightened. It is most important that the turn of wire around the vfo coil stay in place without the least movement. Movement of any kind no matter how slight, even from vibration, can alter your received signal a few hertz up or down the band. A drop of some kind of glue will do the job of keeping the wire turn in place.

Remount the vfo as directed in the Heath manual. Make sure the remaining free end of wire is not caught under the edge of the vfo and is outside the vfo enclosure. The wire is now fed to S1, from S1 to C1, to rotor of C2, then to ground from C2.

If automatic switching is desired, place RL1 contacts 2-6-10 before S1. The homebrew coil is placed across the variable capacitor to ground, placing it in parallel with C2. Keep all leads as short as possible. This completes the wiring of the remote offset tuner.

Alignment

The transceiver must now be adjusted only because the loop of wire around the vfo coil has moved the vfo frequency and it will not be the same as the readout frequency of the dial. This alignment is simple because the *vfo is not adjusted*. This is the part that can be frustrating at first because you do not know where the frequency has shifted to. I found the turn of wire dropped my vfo down 30 kHz. This meant nothing had changed as far as function of my vfo except that there now was a 30 kHz shift down the band. This was corrected by "slipping" the dial on the rig until the frequency coming from my vfo and the readout frequency on my dial were the same. I used CHU, 7335 kHz, as my locating frequency. I used this instead of my signal generator only because my transceiver receives CHU (and besides, I was too lazy to set up my signal generator). Any method of obtaining a locating frequency is fine.

For alignment with the offset tuner in the circuit, tune in a CW signal on any band with the offset tuner out of the circuit. I found RTTY signals to be of longer duration and more dependable. Adjust the vfo for the highest meter reading of the locator signal. Place the

variable capacitor of the offset tuner in the fully unmeshed position. Put the offset tuner into operation by closing S1. When S1 is closed you should still receive the same locator signal if your capacitor and coil values are close to the values in your rig. One thing you may notice is a change in pitch of the locator signal due to a slight frequency shift (but don't worry about it). I am only interested in following the drift of a CW signal – not in how much frequency spectrum my offset tuner ranges over or in how many hertz the CW signal drifts. (Though this can be done if you care to take the time to calibrate for it.)

Adjust the variable capacitor so that when the remote tuner is removed from the circuit by S1, the pitch (frequency) will be close to the pitch of the signal from the rig alone. What you will be doing here is getting a zero beat for the offset tuner against the rig. Try to get this position of the offset tuner as close as you can to the rig's signal. Mark this zero beat position on the variable so you can return to it at any time. Now when you're receiving and the offset is placed at zero beat you can tune up or down frequency as a CW signal drifts. I found that my zero beat on the offset did not change from band to band. It would appear that alignment for one band takes care of all the bands. This completes the adjustment and alignment of offset tuner and the transceiver.

Placement

My offset tuner at present is outboard. It can be mounted in the HW-100 without making holes in the front panel. The screws in the upper right and left corners of the front panel are replaced by the variable capacitor and the on–off switch (S1). The components in this case will have to be of the miniature type to use the holes as they are now. To use what comes out of the junkbox, in my case, meant enlarging the holes. But I think this is one case where modification will add to the worth of a rig and should not be a deterring factor. The shame of it all would be spending money for miniature parts after having come this far for free.

. . . WA2EAW ■

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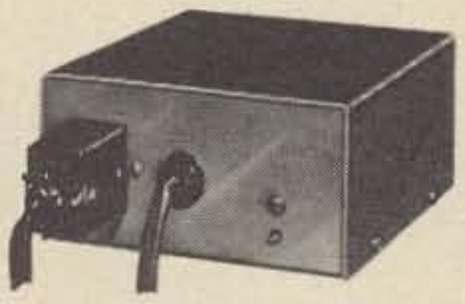

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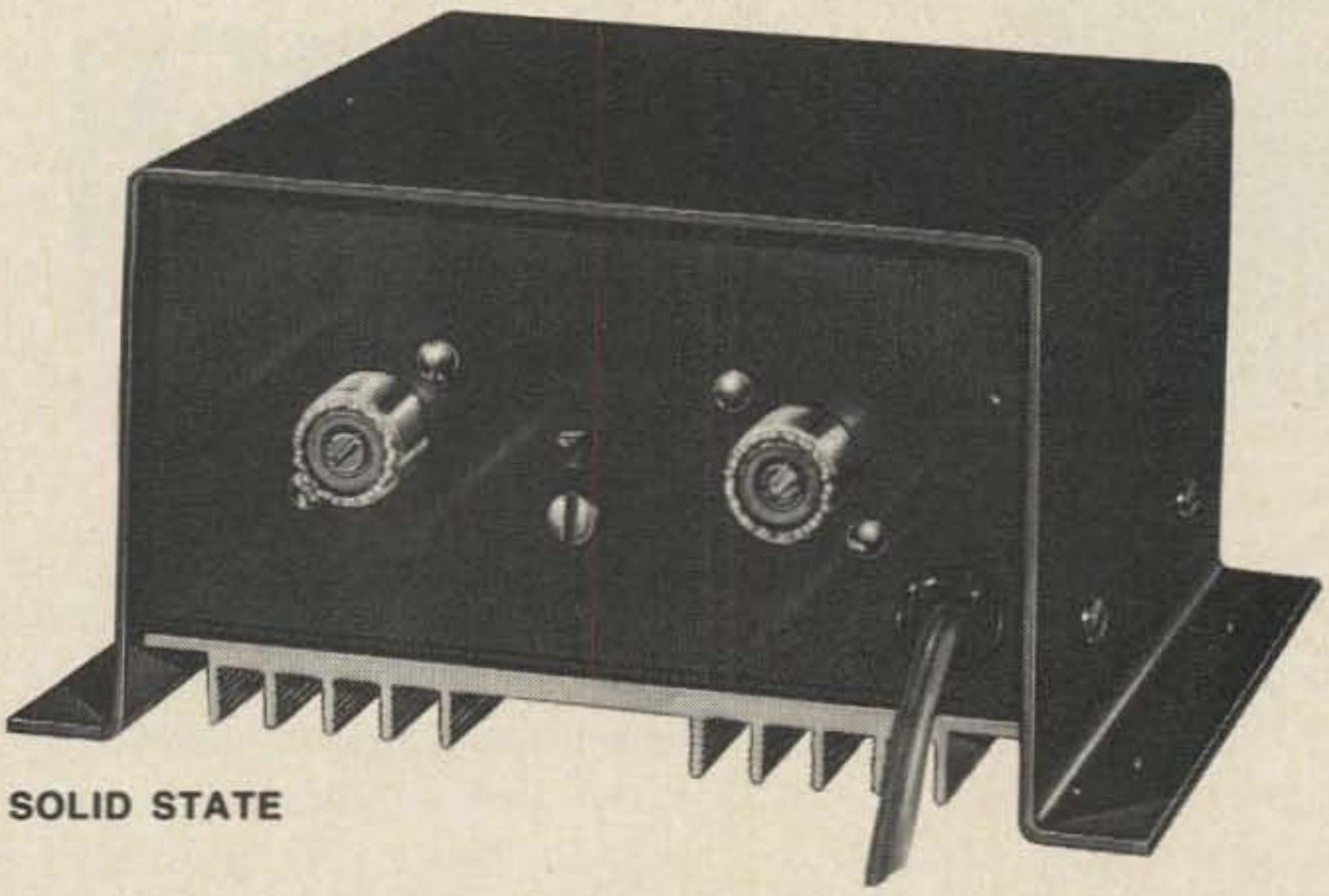

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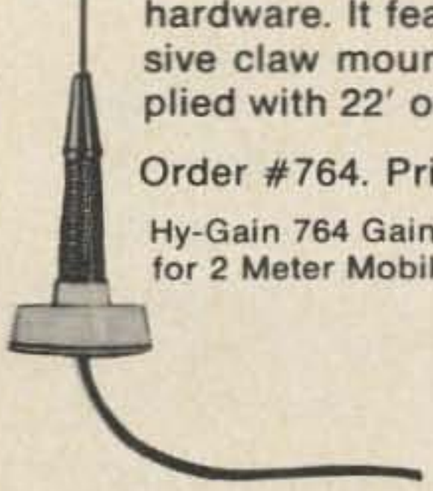

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The Little GATE DIPPER

John Aggers W5ETT
1509 Desoto
Ponco City OK 74601

Covering 1.7–225 MHz, it is simple, inexpensive, and easy to build.

Possibly you now own a grid dipper, but is it small, easy to handle, and cordless, making it completely portable? If not, you will want to build this gate dip meter. The cost is extremely low – only about $7. All parts are readily obtainable and construction is simple. The plug-in coil forms, using battery plugs and polystyrene tubing, are easy to make.

The Circuit

An MPF 102 FET is used in a modified Colpitts circuit. Except for the #1 coil, where a choke is used, the B+ is fed to the centertap of the coil. This is necessary to obtain a fairly constant gate current as the oscillator is tuned to its end frequencies. Drain current varies from 4 to 1 mA proceeding from 225 to 1.7 MHz. At the same time the gate current varies from 20 to well over 50 μA.

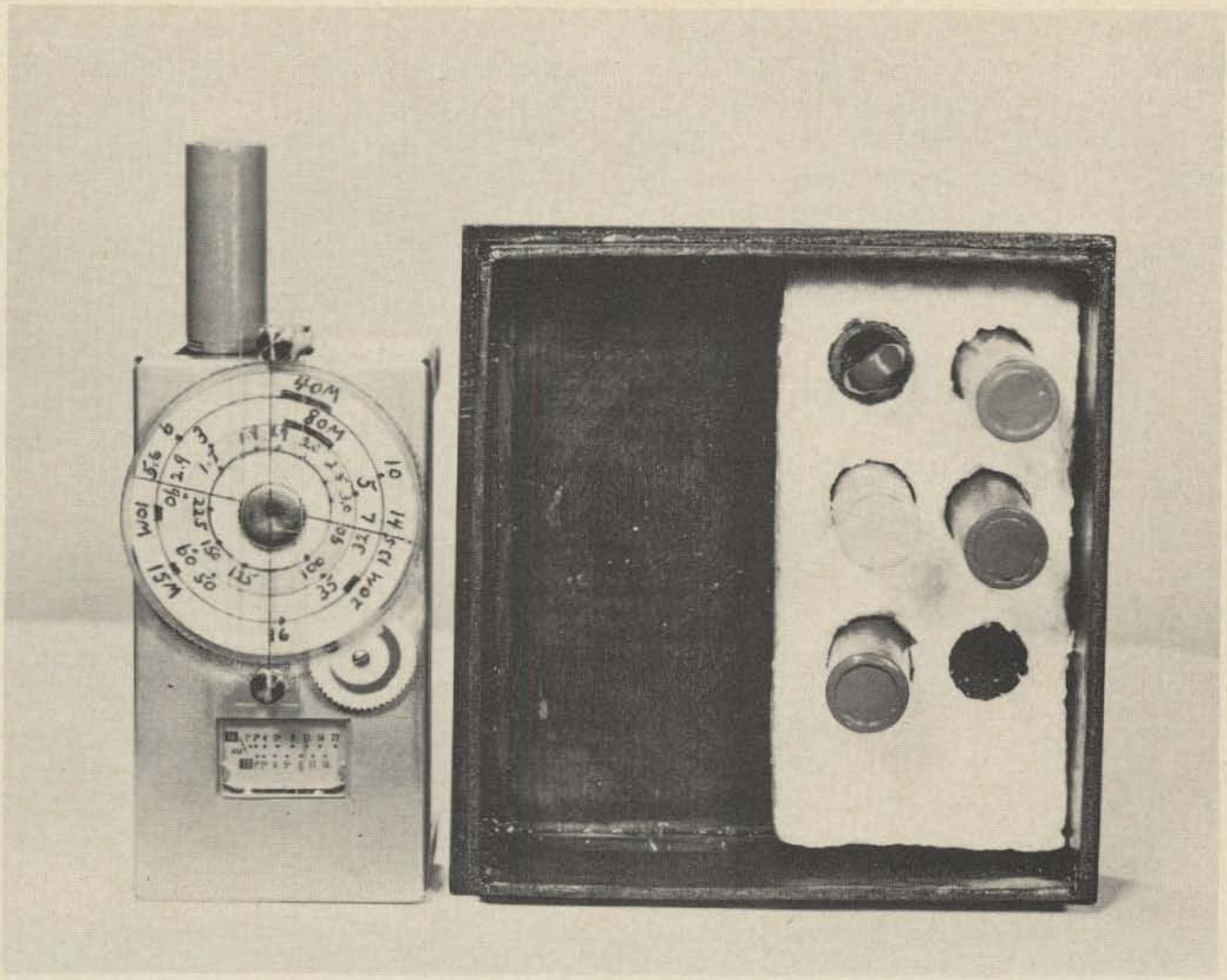
From this, it is apparent that the stronger the oscillations the smaller the drain current and the larger the gate current. In gate dip operation, as power is drawn from the oscillator the drain current will increase and the gate current will decrease or dip.

Limited wavemeter operation, obtained by switching off the B+, is accompanied by a slight shift in calibration. When the circuit picks up rf, the FET suddenly goes into oscillation using the rf as its battery. Thus, the amount of rf picked up must be large enough or there will be no oscillation and no meter indication. However, despite these deficiencies, it is still considered a useful mode of operation and for that reason has been included. It is only necessary to wire the sensitivity control so that the resistance is maximum when the switch is in the off position.

Construction

A natural finish aluminum minibox (4 x 2-1/8 x 1-5/8 in.) is used for the meter case. The variable capacitor came from an old transistor radio and measured 1 3/8 x 1/2 x 1 in. The shaft was already squared and tapped for a small screw. Since those listed in the catalogs have a plain or flat shaft, you will have to use a collar with setscrew, or drill and tap the shaft. The trimmer capacitors are not used and should be removed.

To make the coil socket you will need three pin receptacles from an octal socket, two pieces of 1/8 in. Plexiglas approximately 7/8 x 3/4 in., and one battery plug for a pattern. The pins of the battery plug form a triangle. I shall refer to the holes at the base as the outside holes. Drill holes in one piece of plastic to match the pins of the battery plug. Match the two pieces of



The little gate dipper with spare coils.

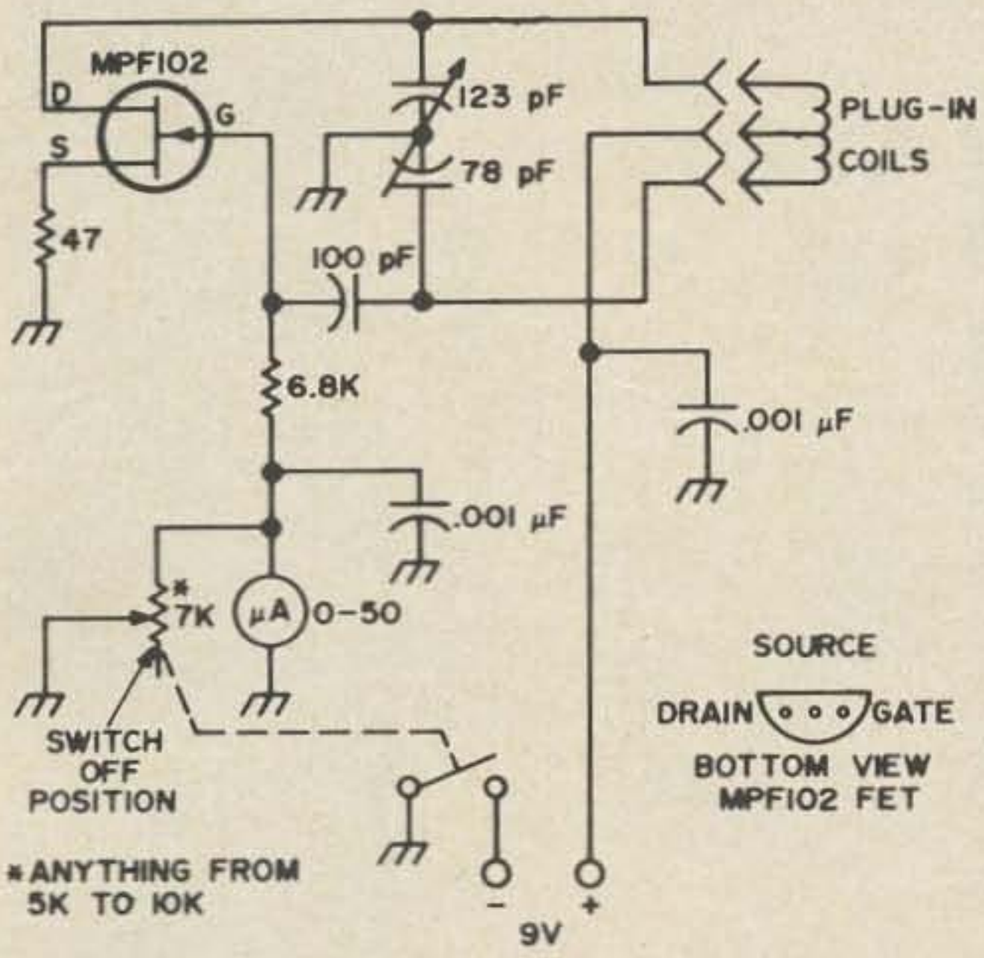


Fig. 1. Schematic diagram of the little gate dipper.

plastic, clamp in a vise, and drill the two outside holes in the second piece. Bend the lug part of each socket pin to a right angle. Slip one over each outside pin of the battery plug. Using this as a jig, solder the lug portions to the stators of the variable capacitor. Remove the plug, and the pieces of plastic should fit down over the variable capacitor. The lug part of the center socket pin is brought out between the two layers of plastic.

File a small notch in the bottom piece to accommodate the lug. Before cementing the two pieces together and to the frame, make each hole slightly larger than the diameter of the socket pins. This will allow for expansion when the plug is inserted.

The dial is made of 2-1/4 in. diameter 1/8 in. Plexiglas. To give the dial a rough edge, for good thumb traction, I heated an old gear wheel and rigged up an arrangement to rotate the dial against it. The gear should have rather coarse teeth and rotate with the dial, or you will create flat spots.

The variable capacitor can now be mounted in the case. Position it so that the top and sides of the dial will be just about even with the edges of the case.

The dial marker is mounted on square aluminum posts. The top post (2 in. long) has 1½ in. of its length filed down to a 1/8 in. thickness to reduce its bulky appearance. To make the hairline, scribe a line in a ½ in. wide piece of plastic and fill in with a ballpoint pen.

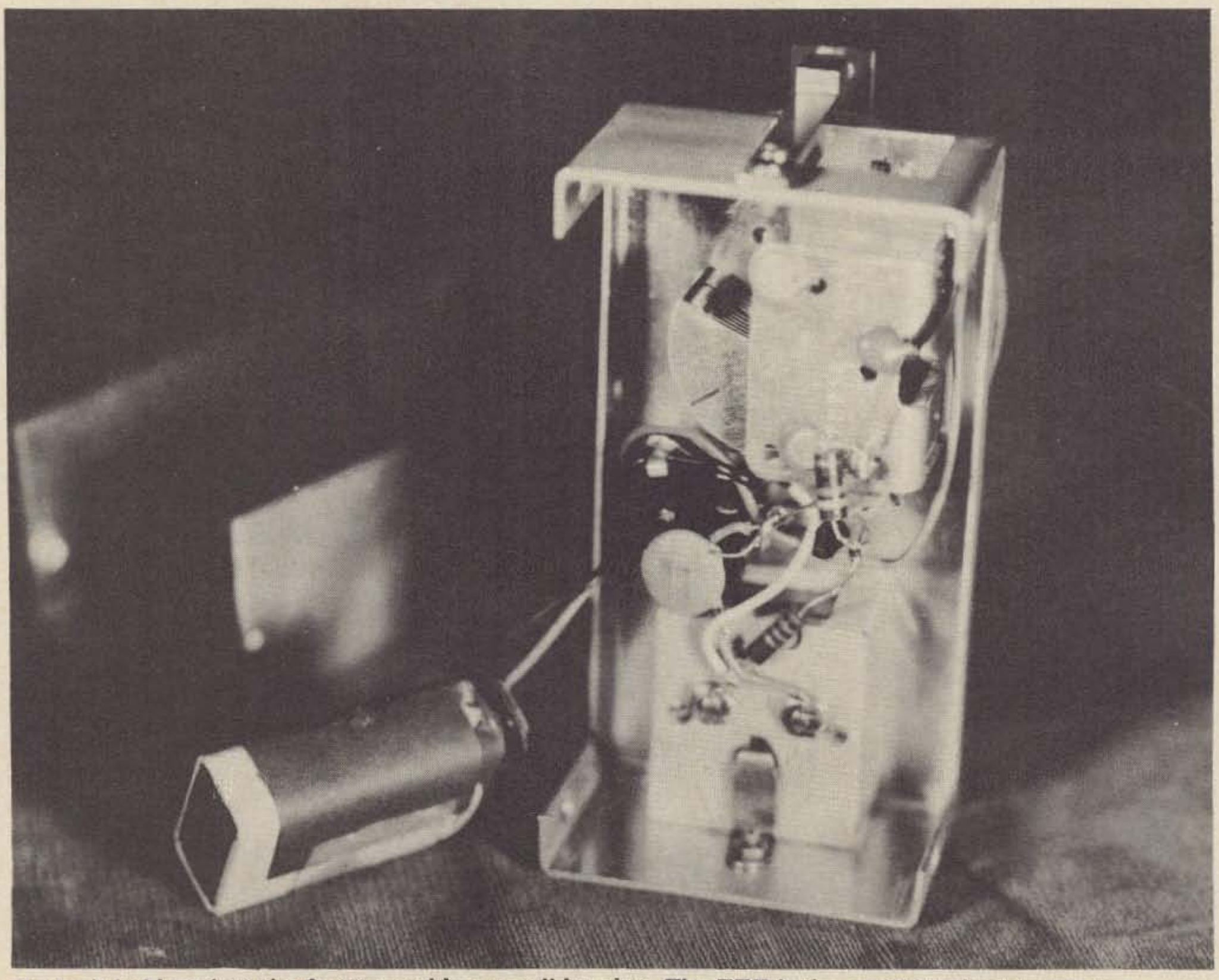
The sensitivity control I used was already prepared for the knob shown. If you don't have one like it, use a dime-size pot and a setscrew knob. Any resistance from 5 to 10 kΩ will be fine.

Keystone light meters are available from Olson Electronics in a package of five ($3.99) or Transistors Unlimited Co. (75¢ each). Some modification of the meter is necessary. Remove the light cell and series resistor. Drill two holes, spaced ½ in. apart in the back of the case to pass 4–40 machine screws for easy soldering, make sure the heads and nuts are clean and free of any nickel plating. The screws should be filed even with nuts in order to make room for the battery. Solder the leads from the meter movement to the terminals, but be quick because the plastic case tends to melt in a hurry.

Wiring is just a here-to-there proposition, requiring no terminal boards or terminal lugs. The FET is soldered in place supported by its own leads. With reasonable care you should not damage it. A battery holder was found unnecessary; however, it is a good idea to wrap a layer of tape or stiff fiber paper around the battery to prevent the metal case from shorting out the meter terminals.

Coil Construction

Figure 2 and the photo give the necessary dimensions and show the parts needed to make the coil forms. The battery plugs are listed in the catalogs to fit #482 and M3 batteries. The center pin should be filed slightly shorter to make the plug seat evenly in the socket. While you are at it, file the nickel plating from the ends of all plug prongs. This will make for easier soldering.



Meter is held against the front panel by a small bracket. The FET is the small black object in the center.

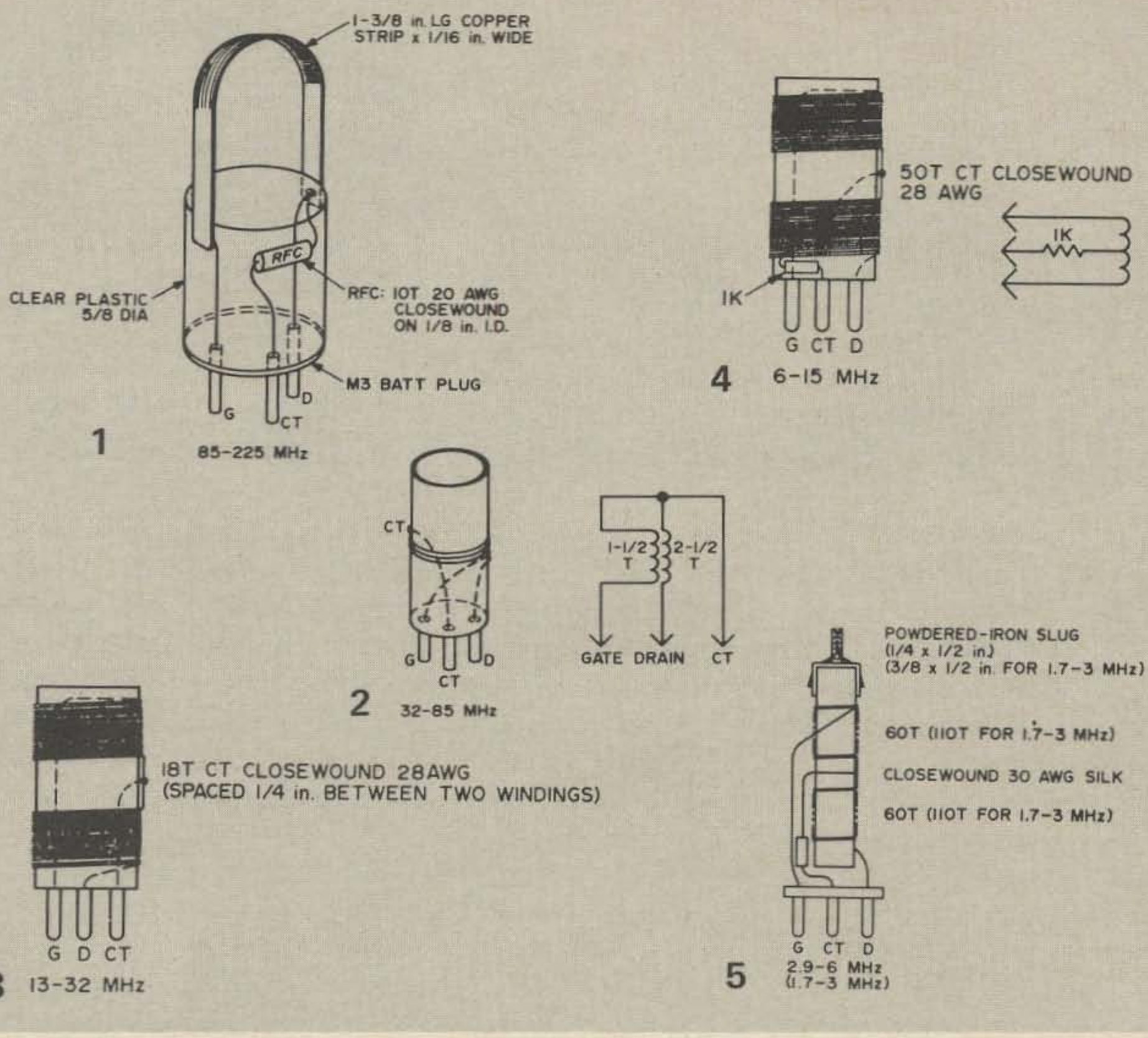


Fig. 2. Coil configurations for various frequencies of resonance.

Complete coil information is given in Fig. 2. However a little explanation may be in order. The irregular method of winding the #2 coil is necessary to reach 85 MHz and still maintain oscillation. With 4 turns close-wound the highest was too low. With the 4 turns spaced, oscillation ceased at the highest frequency. The 30 AWG silk wire was taken from a TV flyback transformer. The resistors in the centertap of the last three coils improve the meter's sensitivity slightly. They are mounted right next to the coil winding. With a slight groove filed inside the insulating sleeve, it should slip over the resistor.

The #6 coil is layer-wound as space permits and scrambled wound the rest of the necessary turns. The top winding of all coils should end near the very edge of the coil form. This will make for easier coupling to a tuned circuit. After the coils are checked out the insulating sleeves may be glued to the plug base.

Allow the glue to dry for several days before plugging the open ends of each coil with a small cardboard disk. The coils are painted with colored lacquers. Colored paper between the coil and the insulating sleeve will probably work just as well.

Calibration

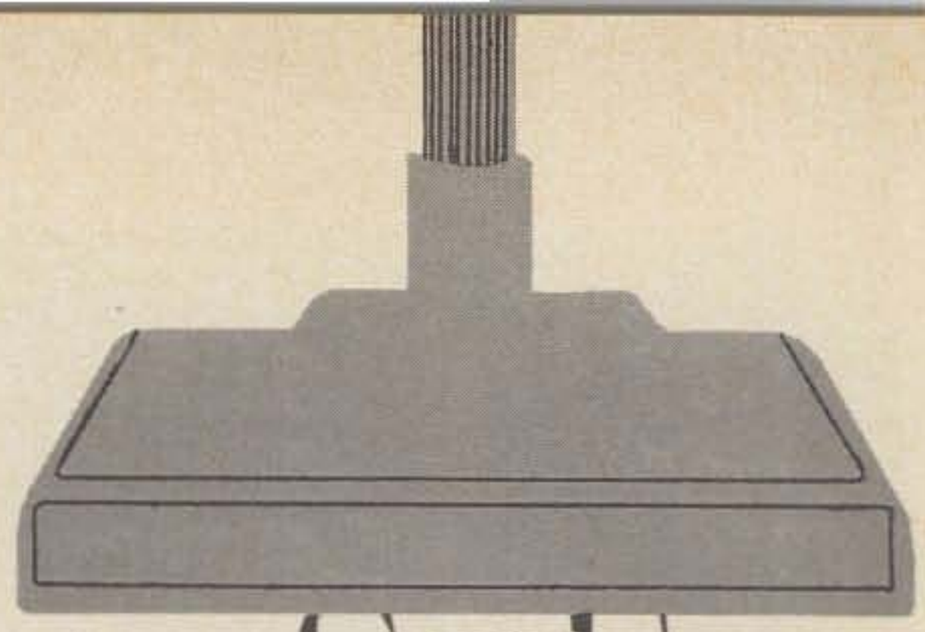
For calibration purposes, you will need another indicating oscillator or dip meter. Operate it in the diode or wavemeter mode and loosely coupled to the gate dipper. I calibrated only 5 points on each scale plus any ham bands which appeared. Remember the dipper is not a frequency meter but something to get you in the ballpark.

Conclusion

The little gate dipper was checked against a well known commercial tube equivalent and, as near as I could tell, they were just about even. The battery should last for a long time because the current drain is extremely low.

. . . W5ETT ■

Marlene F. Derfler
804 48th St. S.
Great Falls MT 59401



CLINKS IN A VACUUM

(A LOW PRESSURE ARTICLE FOR WIVES)

My husband is a builder. No, he doesn't build coffee tables or bookshelves or breakfast nooks. Instead he builds important things like linear amplifiers, grid dippers, calibrators, and all those other things you need around the average American home.

They say that Nature abhors a vacuum. Well, my husband does too. Most of the time I understand his drilling and pounding, his screams when he grabs the wrong end of a hot soldering iron, and the horrible whistle that wakes up the baby and indicates he is getting "zero beat." Our day of trial comes, however, when all too frequently it becomes necessary to vacuum the house.

We have a shaggy dog that sheds and you have to really keep after the clumps that surround him whenever he stops to scratch. This means toting out the vacuum nearly every day.

My part of the great vacuum debate comes when I start hearing the pings, clanks, and pows of "things" being sucked into my little vacuum's innards. It sounds disturbingly like bullets ricocheting among the rocks in a "B" western movie and it certainly can't be doing my vacuum any good. Investigation long ago showed these "things" to be various little pieces of plastic stripped off the ends of wires, bits of wire, melted glops of solder, small nuts and bolts, and other little indescribable things of Ham Husband origin. We have agreed that he should keep his activities confined to the spare room that is his "shack," but these things come out on his shoes, follow like a dust storm in his wake, and I think roll out by themselves in the night. Once, when I shoved a handful of "clinks" that I had gathered out of the vacuum bag under his nose, he peered at it, carefully picked out the little nuts and screws, and ran back to his shack mumbling something about precious hardware.

There is another side to the story to be sure. I usually just get the vacuum started and have suffered through the initial ten or twenty internal ricochets when he comes tearing out of that dark hole, often with headphones strung around his neck, striving to be heard over the combined noise of the vacuum motor and a sound like ball-bearing Ping Pong. After pulling the plug out of the wall (a move which someday may be fatal because he wired it himself), he finally gets across the point that my vacuum is making a horrible noise in his radio. I suppress the urge to ask him why he doesn't talk to this horrible noise just like he does to all the others and instead I ask the same question that I always ask him.

"Is there any way to cure our mutual noises without my giving up vacuuming and you giving up ham radio?" At the mention of the latter sacrilege he usually turns paler and retreats a few feet toward the comforting smell of burning solder. It is hard for him to turn any paler because the only sun he ever gets is when he works on antennas during the winter and at an occasional hamfest in the summer, but the burning solder smell is always around.

Normally then, we just stare at each other, both of us silently remembering the time he did try to do something about *his* noise. On that occasion he had grabbed up my vacuum and carried it off to his lair where he gutted it and added little round things to its insides with his ever-ready soldering iron. In a way he did temporarily solve both of our problems because when he plugged it in he blew the last fuse we had in the house. I wouldn't let him replace the fuse with a piece of solder, so he tramped out to the store muttering something about "ac working voltages."

I haven't let him touch my vacuum since, of course, but I ask him the same question each time just to bring him back to his senses. He usually is torn for a moment or two, contemplating an ocean of dog hair on the one hand and a normal life on the other. Remembering that dog hair gets into the fan on his linear amplifier, he usually compromises at this point and says, "QRX one . . ." I take the minute to pick up whatever bits and pieces and "things" I can see that he carried out with him on his last excursion. When I start vacuuming again after this mysterious ritual of "QRX" I know I'll be greeted by a sound worse than a trio of two-year-olds let loose to play with all the kitchen pots and pans.

All this that I have been telling you was true until just the other day. On that particular fateful day we had gone through our usual routine and I had asked him the usual question. This time to my amazement he said, "You know, sweetie, maybe you're right. I should spend more time with you instead of with my projects and radio. I could help you around the house. We could go out more, meet new people. I couldn't get much money for all that homebrew gear, but I could give it to somebody who could use it and then you wouldn't have any more clinks in your vacuum cleaner."

That day I was so happy! We closed the hamshack door and right then he started to help me around the house. The first thing he did to help was to shake out the rugs. The same eyes that can spot the latest transistor in a radio store window from a moving car at six hundred feet didn't see

my hand washables hanging on the line upwind, but he was helping! The second thing he did to help was to put the dark things in the washer for me. He even included the skirt to my dark wool suit which was in the pile going to the cleaners. He said he wanted to make a full load.

That night we got a babysitter and went out to dinner. He paid ten dollars for our steak dinner, and then my reformed husband suggested that we go somewhere else for an after-dinner drink. Dazzled by all the attention, I happily agreed. We had just gotten settled with our dollar-fifty after-dinner drinks when who should pass by but his old high school girlfriend and her heavy-handed, shifty-eyed husband.

After we had paid the babysitter her ransom and my husband was taking her home, I began to think. "It would be nice to have help with the housework, but the experience might take years off my life. What would he do when he found that doing chores together really isn't much fun? Would he go to the bar with the boys and maybe run into that floozie without her heavy-handed husband? The ham friends that come over now are really quite polite, even when they are loaded down with all that stuff they carry in and out. At least now he's around if I need him. That smile on his face when he shows me his latest contraption does bring a lot of joy into the house . . ."

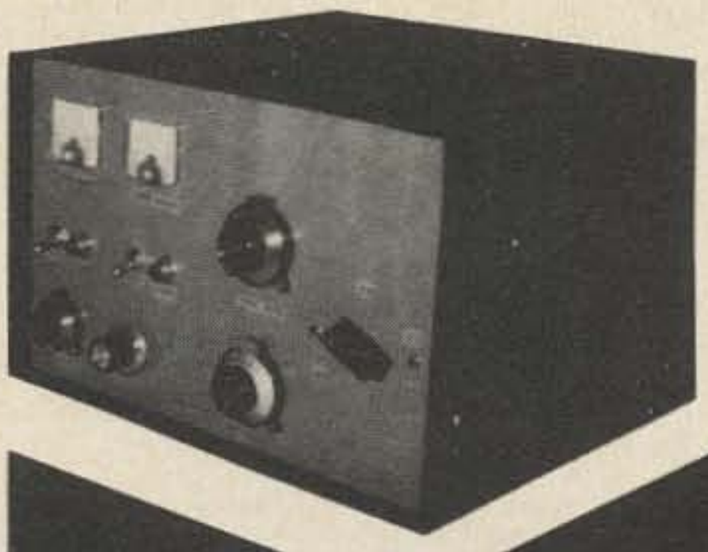
The next day we agreed that we should go into the hamshack together and start to clean it out. It was just by chance, of course, that I bumped against the receiver and turned it on. When that station came on calling CQ I was only curious when I asked, "Can he hear you as well as you hear him?" It was with a great deal of pleasure that I saw his eyes flash with an inner determination not to weaken, which died when flooded out by the desire to get just one more signal report.

The smell of burning solder fills the air around our house. The clinks in the vacuum cleaner are still there, but somehow they mean something different to me now than before. They mean I have a ham at home that loves me.

. . . Derfler ■

Norman Ralph W4AYI/5
124 Teresa Drive
Greenville MS 38701

YOUR SECOND LINEAR

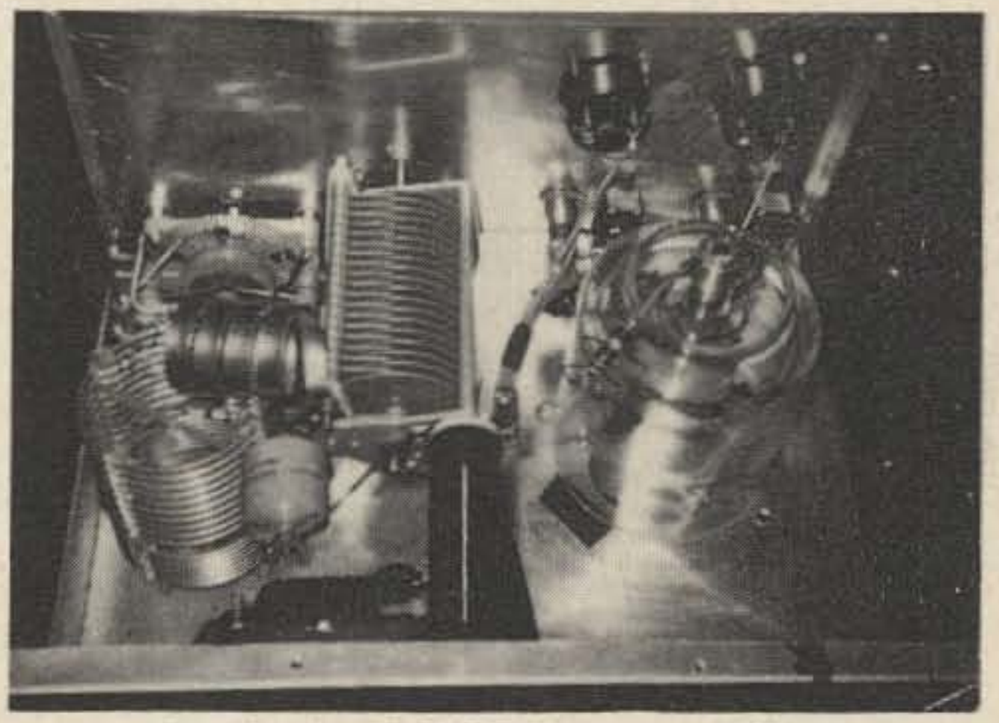


After building a grounded-grid linear using four 811As and modifying it, improving it, etc., I decided to build a linear that would perhaps reflect some of the knowledge and experience I had learned.

Much thought was given to what type of tube or tubes would be used. The new 3-500Z was chosen for several reasons. First, a tube requiring plate voltages in the 2–3 kV range was to be desired to keep the plate tuning capacitor to a reasonable size (250 pF). Secondly, a tube with a large plate dissipation was wanted to give a much larger margin of safety than was available with the 811As. The 3-500Z has a plate dissipation of almost twice that of four 811As. Third, the low output capacitance of the 3-500Z enables it to be used at higher frequencies much easier. Fourth, the 3-500Z efficiency range makes it very versatile. Output ranges from 750W out with 1.1 kW input at 3 kV to 500W out with 800W input at 2 kV. And finally, the intermodulation products are very low with the 3-500Z as with other zero-bias triodes designed for grounded-grid class B service. Here is a table showing typical operation of the 3-500Z.

Dc plate voltage	3.0	2.5	2.0	kV
Zero sig. pl. current	160	130	95	mA
single tone pl. current	370	400	400	mA
single tone grid cur.	115	120	130	mA
PEP input power	1110	1000	800	W
PEP useful output pwr	750	600	500	W
Resonant load imped	5000	3450	2750	Ω
Cathode input imped	115	100	100	Ω
Intermodulation prod.	−30	−33	−38 (3rd order)	dB

The schematic diagram of the amplifier (Fig. 1) is pretty much self-explanatory and there is not very much new about the design. It follows what is in the handbook and other publications. A high-capacitance tuned input circuit was used to obtain greatest linearity. Without the tuned input circuit the exciter sees a low load impedance over part of the rf cycle and a very high impedance over the remainder of the cycle. Consequently, the waveform suffers. Also with an untuned input the rf plate current return path to the cathode must travel the outside shield of the coax to the exciter plate circuit and then back the center conductor to the cathode. This can result in high intermodulation distortion. With the tuned input circuit these problems are solved as the tank circuit provides



Inside the 3-500Z linear amplifier.

a "flywheel effect" for good waveform and a short rf return to the cathode.

Many of the components used were obtained from suppliers advertising in 73. Relay K1 in the rf section is included to enable the linear to be switched in and out of the circuit with the plate voltage switch S2.

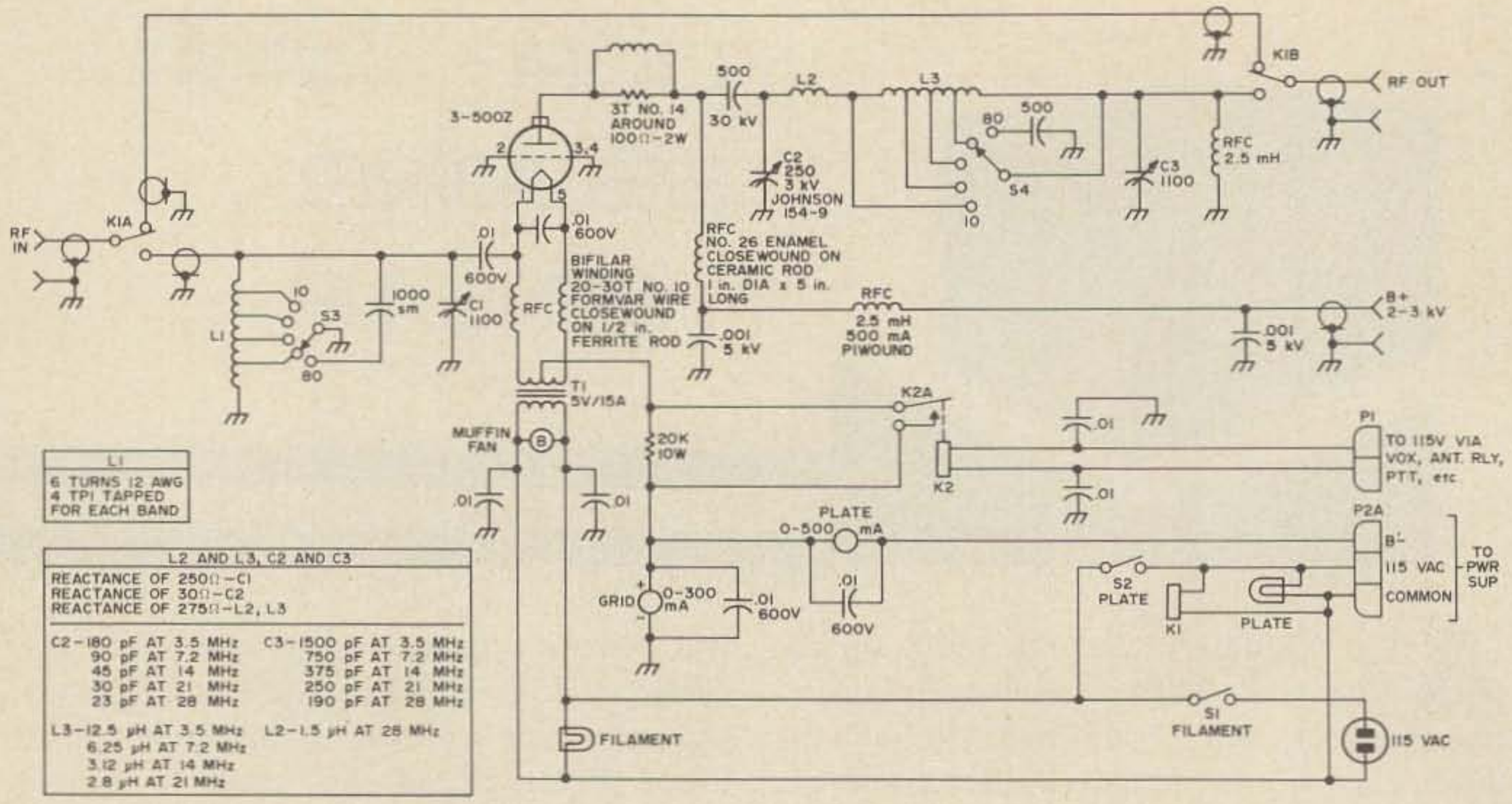


Fig. 1. Schematic of the 3-500Z linear amplifier. Coil data is shown on the table insert.

Tube Socket

The tube socket is home-made. I cut a 3 in. round hole in the chassis for the tube socket. The socket consists of a 4 in. piece of Plexiglas with a 2 in. hole cut in it (Fig. 2). Five large tinned forked terminal lugs were purchased from a local automotive store. These could be made to fit the pins of the 3-500Z by springing the part of the lug where the wire normally would be inserted. I bent the forked part at a right angle and bolted to the Plexiglas in position to take the pins of the tube.

The part of the terminal lug taking the tube pins protrudes out and down into the 2 in. hole and air can flow freely around all the pins. Short wide copper straps were run from the forked part of the terminal lugs to the chassis on the three grid pins of the tube when the Plexiglas is mounted under the 3 in. hole in the chassis. This not only effectively grounds the grid pins, but also provides a heatsink for them.

I used an SK-406 chimney, but you could use a chimney from a Coleman double mantle lantern. The lantern chimney sells for under $2, which is quite a savings over the SK-406. However, as the sides of the lantern chimney are straight, they do not deflect the air flow past the plate heat dissipating connector, so the tube should be observed closely that it doesn't overheat. A suggested remedy for this disadvantage of the lantern chimney would be to cement a ring-shaped piece of Plexiglas to one end of the chimney. The diameter would be slightly larger than the diameter of the chimney and the center hole would be 2.5 in.

The HR-6 plate heat dissipating connector must be purchased separately and lists for $2.20, but a supplier that advertises in 73 has them listed in his current catalog for less than a dollar.

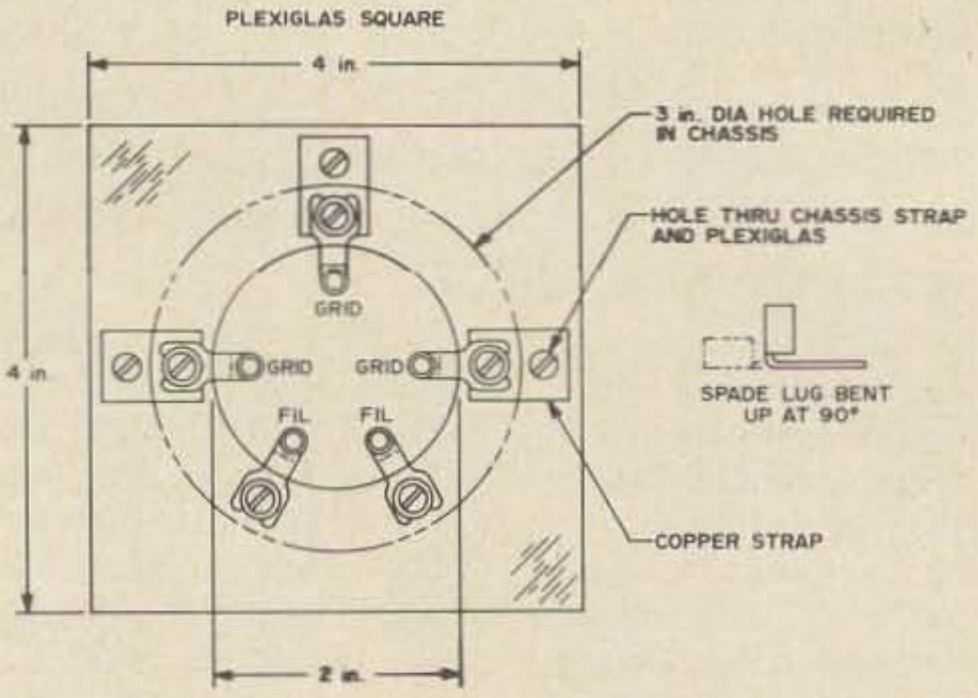
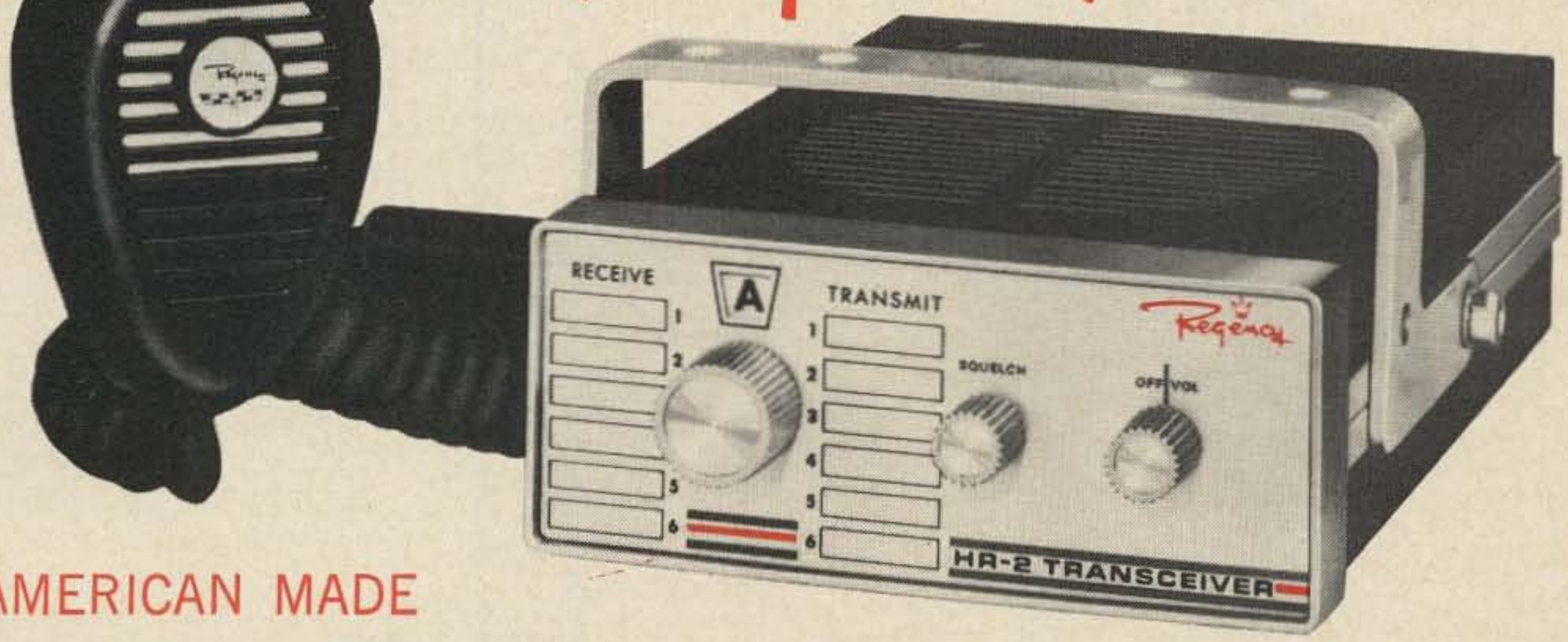


Fig. 2. Layout and plans for the do-it-yourself tube socket.

Regency HR-2



AMERICAN MADE

Mobile 2 Meter FM Transceiver

Here is what the 2 meter, FM Ham World has been asking for.

Specifications: 90 day warranty

RECEIVER

The HR-2 receiver is a double conversion, superhetrodyne with highly selective ceramic filter.

Frequency Range	144-148 MHz
Sensitivity	0.35 μv (nom.) 20DB Quieting
Selectivity	6DB Down ± 16KC 50DB Down ± 32KC
Audio Output (3-4 Ω Speaker)	3 Watts 10% Distortion 5 Watts Maximum
Channels	6 Crystal controlled with provision for adding an additional 6 channels
I.F. Frequencies	10.7 MHz & 455KHz

TRANSMITTER

The HR-2 transmitter uses phase modulation for the ultimate in carrier stability. Built in SWR load mismatch circuitry provides protection against open and shorted antenna conditions.

Frequency Range	144-148 MHz
Power Output	10 Watts (min.) @ 13.6 VDC
Modulation	Phase Modulation with automatic deviation limiting
Deviation	Automatic Limiting with internal adjustments from 0-15KC deviation
Microphone	Plug-in, hand held, high Z Ceramic supplied
Channels	6 Crystal controlled with individual trimmer capacitors for Frequency netting

GENERAL

Power Requirements	13.6 Volts (nominal)
Receive (Squelched)	180 MA.
Receive (Max. audio output)	800 MA.
Transmit	2.5 Amps (max.)

STANDARD EQUIPMENT

Built-in 4″ Speaker
Mobile Mounting Bracket
SO-239 Antenna Connector Socket
T & R Crystals for 146.94 MHz
PTT Ceramic Mike

only $229.00 Amateur Net

Regency **ELECTRONICS, INC.**

7900 Pendleton Pike, Indianapolis, Indiana 46226

This is actual size and shape of our radio. Cut it out and place it under your dash to see how compactly it fits.

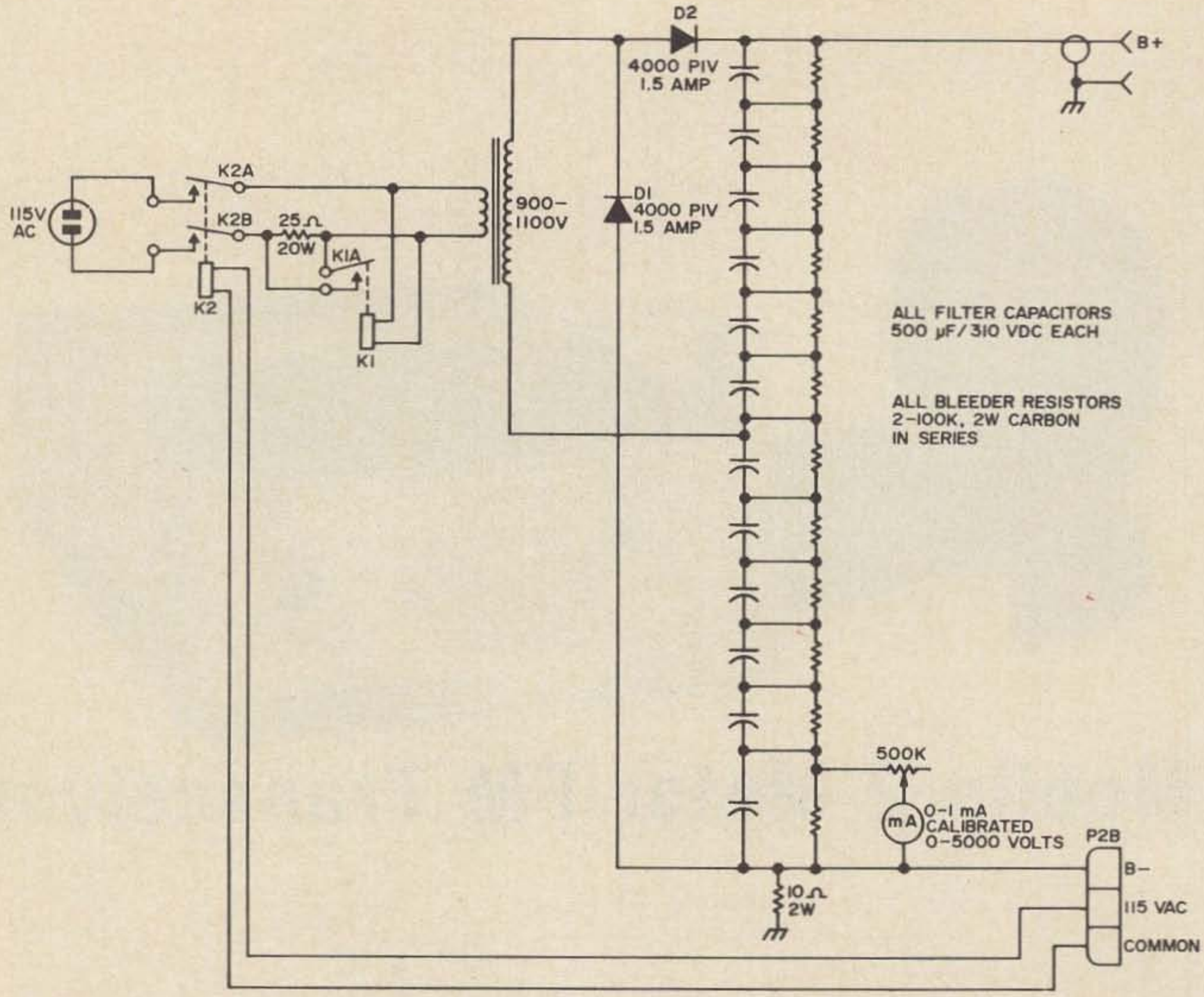


Fig. 3. High voltage power supply.

Power Supply

For the power supply (Fig. 3) I used the filament transformer from an old TV. I removed the shell from the transformer and discovered the filament windings wound on top of the primary with the secondary HV wound on the bottom next to the core. I removed the filament windings, counting the 5V windings, and then wound a new filament winding using the 10-gage wire I used on the filament choke. I taped up the HV secondary leads and they are not being used. The voltage checked out at 5.25V without the tube in the socket and 5V with the tube in the socket and lit. The shell was replaced on the transformer for maximum shielding. In use, the transformer stays cool at all times.

The pi-network is designed around a reactance of 275Ω in the coil, 250Ω in the tuning capacitor, and 30Ω in the loading capacitor. This will give you a Q of 20 if you use a plate voltage of 3 kV. If your plate voltage should only be 2 kV or you should later add a second tube your Q would still be a respectable 10. At 2.5 kV the Q is almost 14. Actual values of L and C are given in the chart on the schematic.

All the metering is done in the negative lead of the cathode circuit. This keeps high voltage off them and allows the grids to be grounded direct. The panel meters are small imported ones that sell for less than $5 each. The voltmeter in the power supply could be mounted in the rf section if desired.

The power supply is of standard design with a full-wave voltage doubler system that gives an approximate no load voltage of 2.8 times the secondary. Voltage regulation will depend on transformer capabilities and house line voltage regulation as well as the output capacitance of the filter. The filter capacitors used here were pur-

chased from an ad in 73 for $1 each and provide over 40 μF of filtering.

A relay and 25Ω 20W resistor was put in the primary circuit of the transformer as shown in the schematic to protect the rectifiers from the high surge of current that occurs when the large filter capacitors are charging. The other relay was installed in the power supply to keep the control wiring to the rf section in a small cable of 20-gage wire.

The power supply is a separate unit. It is in a well ventilated, completely enclosed box that is kept under the operating bench.

Finishing Touches

The rf section is enclosed in a home-made cabinet. I had a local sheet-metal shop cut and bend the aluminum to my specifications. I painted the panel a light gray and the bottom and top cover are painted black. The tube and input circuit are mounted on one side of the cabinet, and the pi-network and filament transformer are in the other half of the cabinet. An access panel was cut in the bottom plate under the chassis and a Roton muffin fan mounted on the cover plate. Rubber feet were mounted on the bottom to let air under the cabinet.

There you have it – a linear that no longer looks like a "Rube Goldberg" special and is pleasing enough to the eye to be placed alongside your exciter. There is, by the way, enough room in the rf section for a second 3-500Z if you have power supply enough to handle it.

. . . W4AYI/5 ■

. . . IF HE ALREADY OWNS GET HIM

The HT-2 Mark II, now with a new and improved transmitter, is the only 2 meter FM walkie-talkie built for the amateur. It features an extra-sensitive receiver with crystal and mechanical filters for excellent selectivity, and 1.6-2 watts out with very good audio quality. The ideal rig for repeater operation — in town or hilltopping! Comes with many extras.

Amateur Net $269.95

One year warranty — all products.

The IC-2F Deluxe 2 meter FM transceiver, shown here with the matching IC-3P AC power supply with built-in discriminator meter.

It's undoubtedly the finest amateur 2 meter FM transceiver on the market. This unit has better than 0.4 μv sensitivity, uses FETs, ICs, and ceramic filters and, as a result, the receiver audio is superb. Rated at 10+ watts out (often delivers 12-15). Has 6 channels, transmit and receive.* The APC (automatic protection circuit) prevents PA failure due to open, shorted or mismatched antenna. Great for mobile applications — it's so small and compact. The IC-2F is a beauty!

Amateur Net $349.95
IC-3P 49.95

*Available soon — concentric 6 position switch allowing 36 channel combinations!

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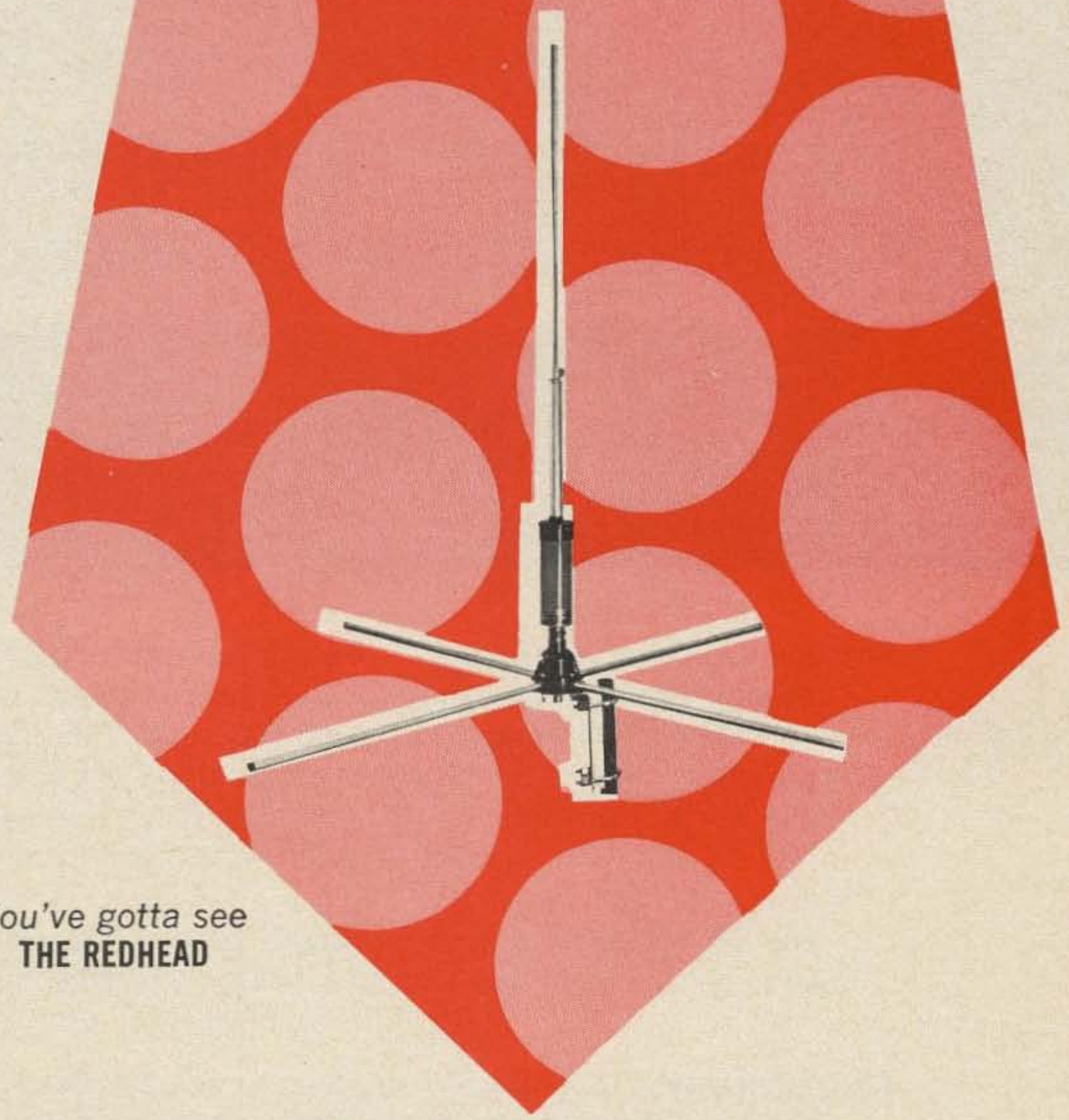
But if he doesn't, surprise him with one of our fine 2 meter all solid-state FM transceivers or that exciting new "REDHEAD," the AS-2HG 2 meter gain antenna.



You've gotta see
THE REDHEAD

The AS-2HG two meter FM 3.4 db gain groundplane antenna is the newest addition to the Varitronics quality line. This commercial quality antenna is built of heavy gauge aluminum tubing and is adjustable for minimum VSWR over the entire 2 meter band. Rated at 500 watts, it's easy to assemble and all mounting hardware is included.

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A very happy holiday season to all of you from all of us.

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Standard Communications SR-C806MA

professional quality, solid state, 2-way radio, designed especially for amateur use

Amateur radio enthusiasts have been using surplus V.H.F. - FM equipment for years, but until recently most of this equipment was not specifically designed for amateur use, and was very expensive. Standard Radio Corporation,* one of the largest manufacturers of electronic equipment in the world, has applied solid state technology to develop a professional quality 2-meter system specifically for amateur use.

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GENERAL

Freq. Range — 143 to 149 MHz
12 channels in 2 MHz spread

Supply voltage — 11 to 16 VDC.
13.8VDC nominal

Current Consumption — .15 amp receive standby. 2.4 amp transmit

Polarity of supply voltage — Negative ground

Number of channels — 12-Supplied with 4 channels

1) 146.94 MHz Tx and Rx (national calling channel)
2) 146.34 Tx — 146.76 Rx (repeater channel)
3) 146.20 Tx — 146.80 (repeater channel)
4) 146.34 Tx — 146.94 Rx (repeater channel)

Microphone — Dynamic type with retractable neoprene cord

Dimensions — 6⅞"w x 2½"h x 9⅞"d

Weight — 4½ lbs. max.

Frequency stability — .001% (—10 to +60°C)

TRANSMITTER

RF power output — .8 or 10 watts

Audio response — +1 —3 dB of 6 dB/octave pre-emphasis

Output impedance — 50 ohms nominal

Deviation — Internally adjustable to ±10 kHz min. factory set to ±7 kHz

Spurious and harmonic attenuation — 50dB below the carrier power level

Audio roll off above 3 kHz — 12 dB/octave

Type of modulator — Phase

RECEIVER

Sensitivity — .35 or less microvolts for 20 dB quieting

Squelch sensitivity — Threshold — .2 microvolts or less

Maximum (tight) — Between 20 dB quieting sensitivity and 20 dB quieting plus 10 dB

Deviation acceptance — Up to ±15 kHz deviation

Spurious and image attenuation — 50 dB below the desired signal threshold sensitivity

Adjacent channel selectivity (30 kHz channels) — 60 dB attenuation of adjacent channel

Type of receiver — Dual conversion superhetrodyne

Audio output — 2 watts minimum

Audio distortion — 10% maximum at 1 watt output

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(complete as shown with microphone and built-in speaker)

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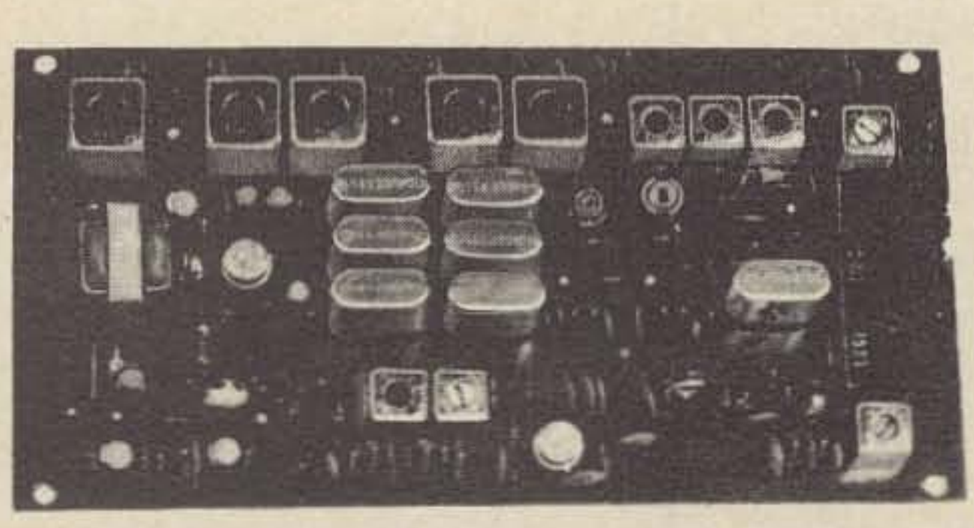

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94 installed
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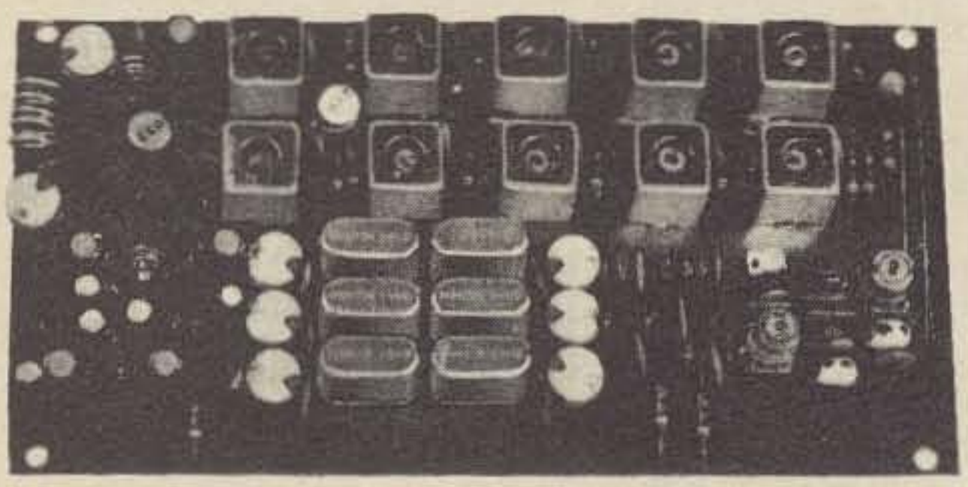
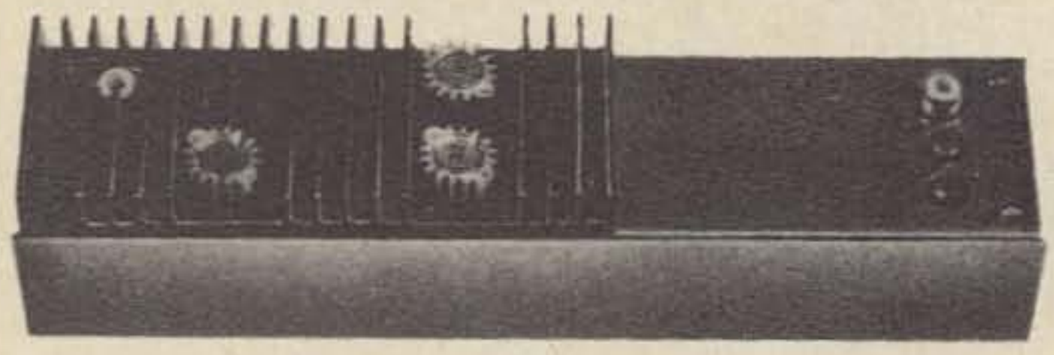


TRANSMITTER PC BD.
0,5W min.
34, 94 installed
3.5"x7"x1"
$79.10



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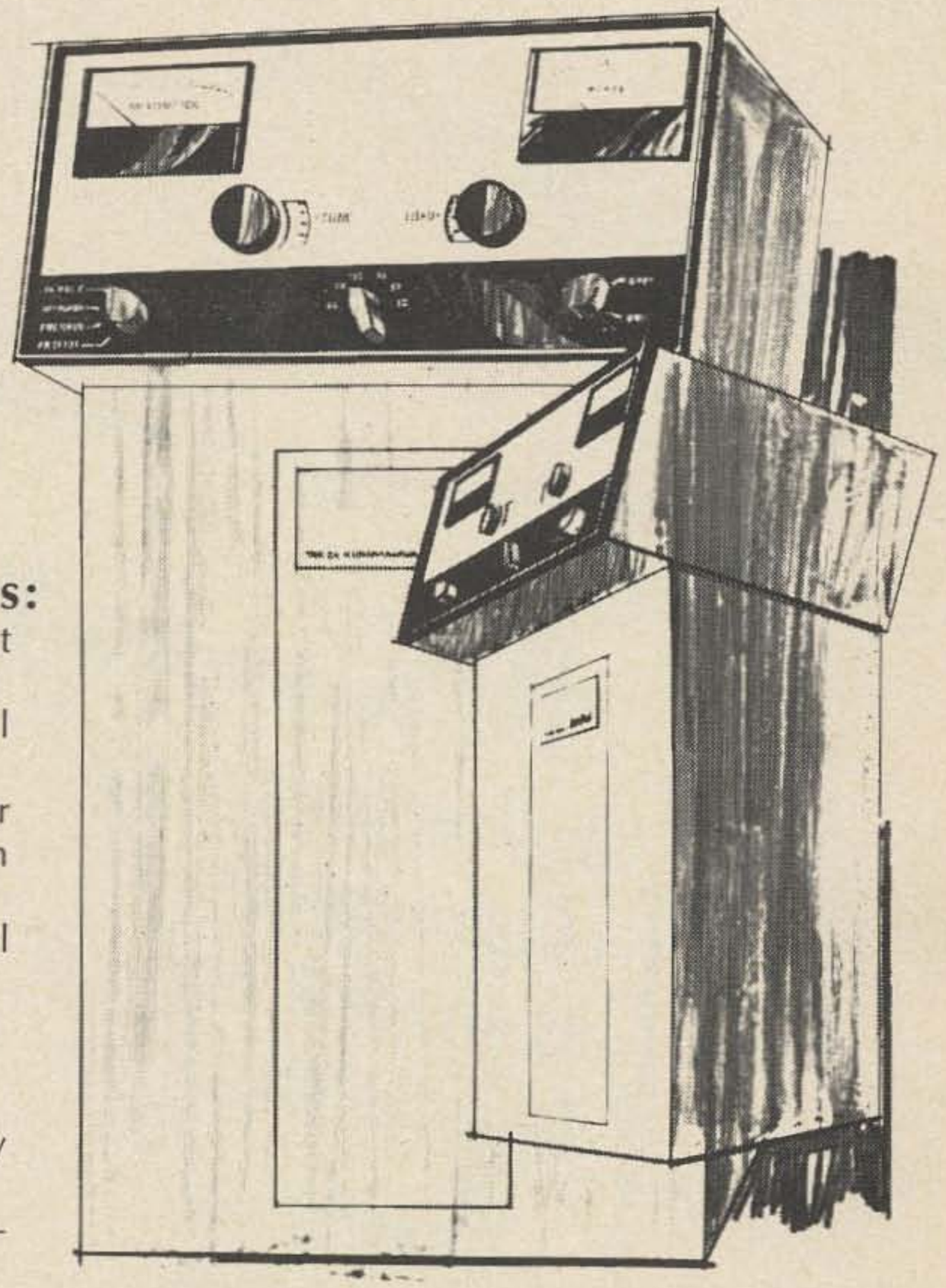

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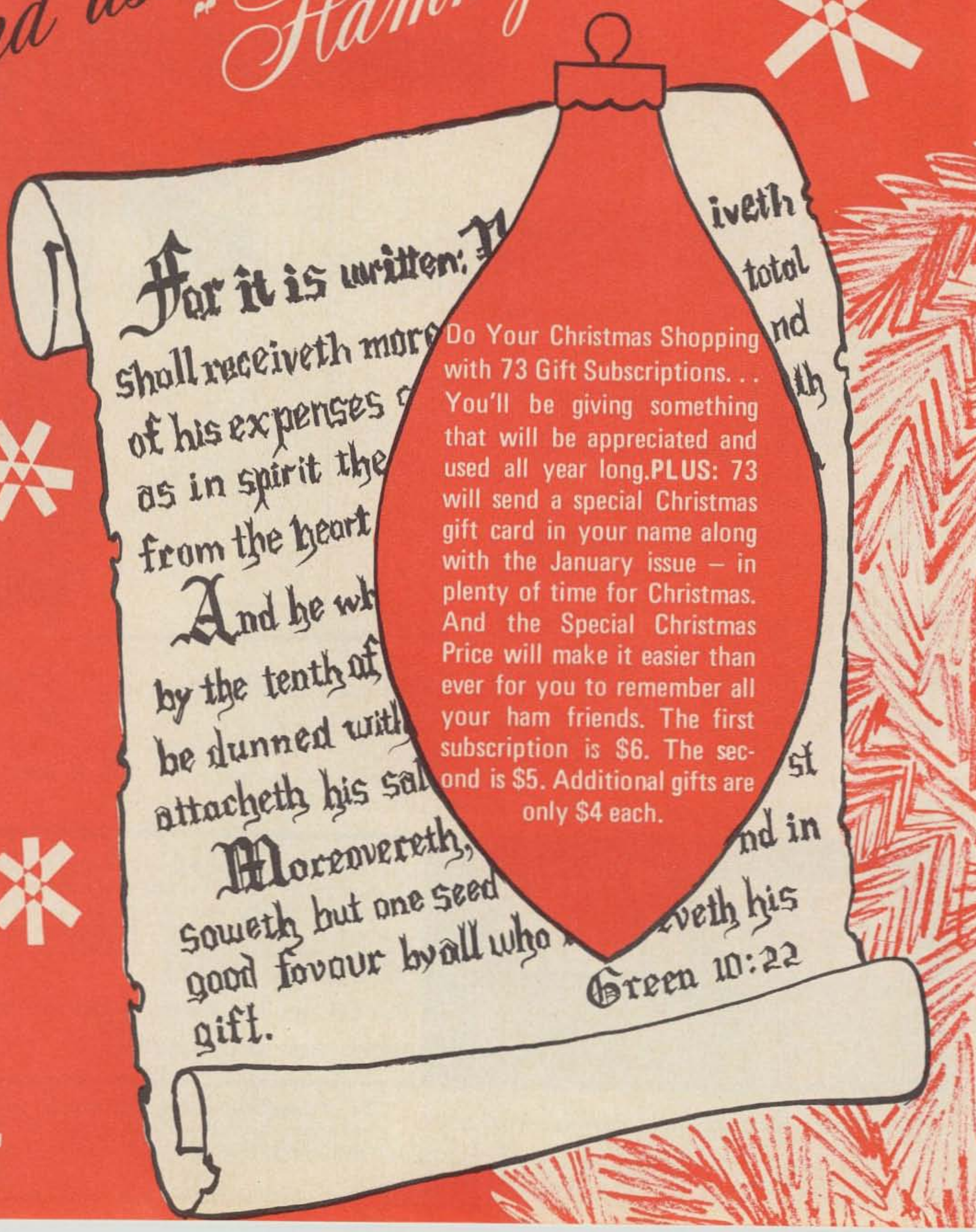

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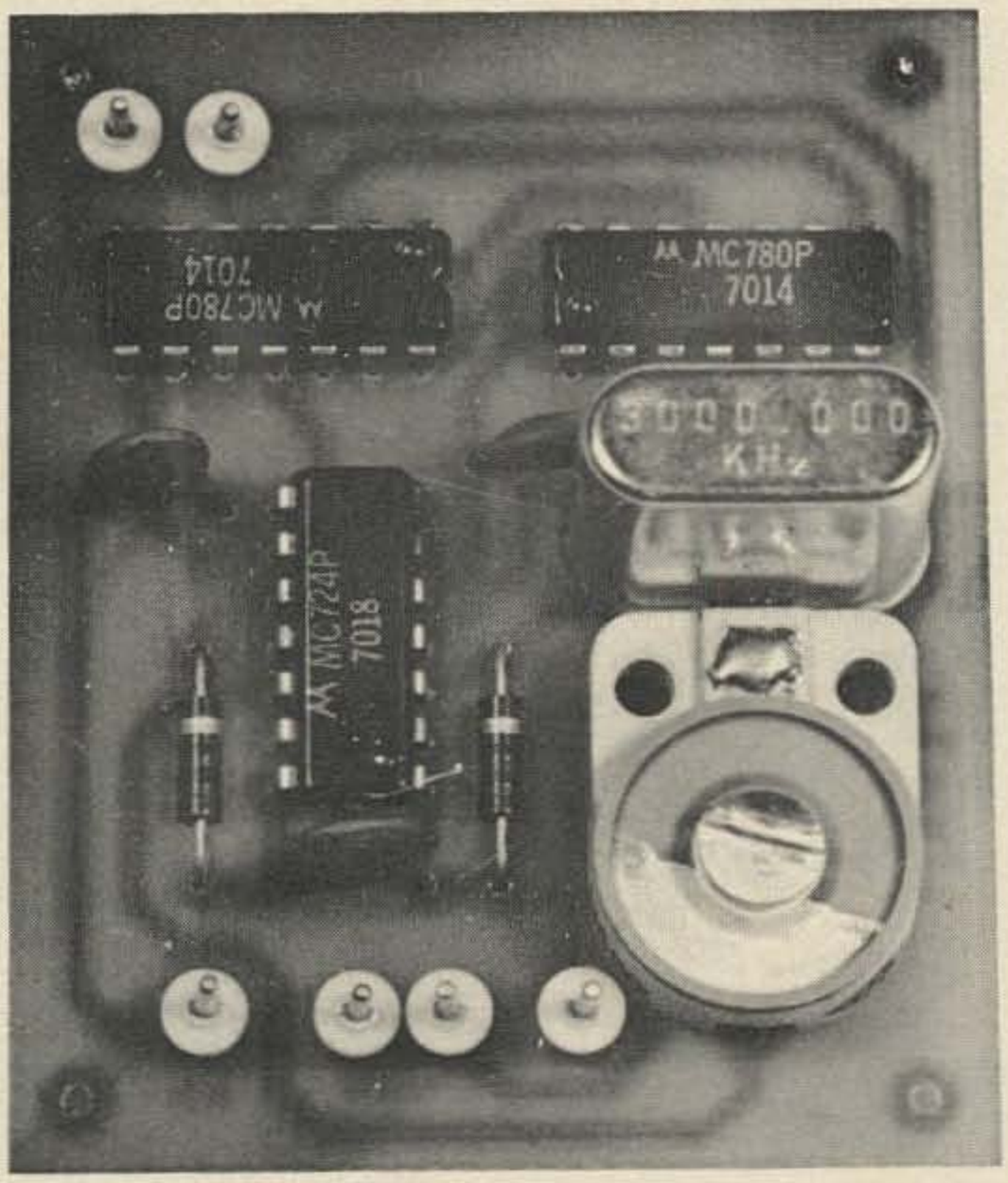

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URM-26 Signal Generator, 3—405mhz, portable type in case, replaced Model 80 with military. . $225.00
IE-19 Test Set for SCR-522, has signal generator, field strength meter, VHF 100—156mhz, complete in case . . . . . $ 18.50
Motorola F4MV-24B(B)1C, 152—174mhz, FM modulation and carrier station monitor, used for FM alignment $125.00
UPM-6B Transponder Test Set, used to check aircraft transponders. A popular set $175.00
H.P. 460B Wide Band Amplifier, 19" rackmount . . . . . $ 35.00
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Tektronix RM-181 Time Mark Generator . . . . . $ 27.50
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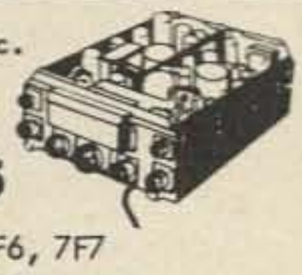

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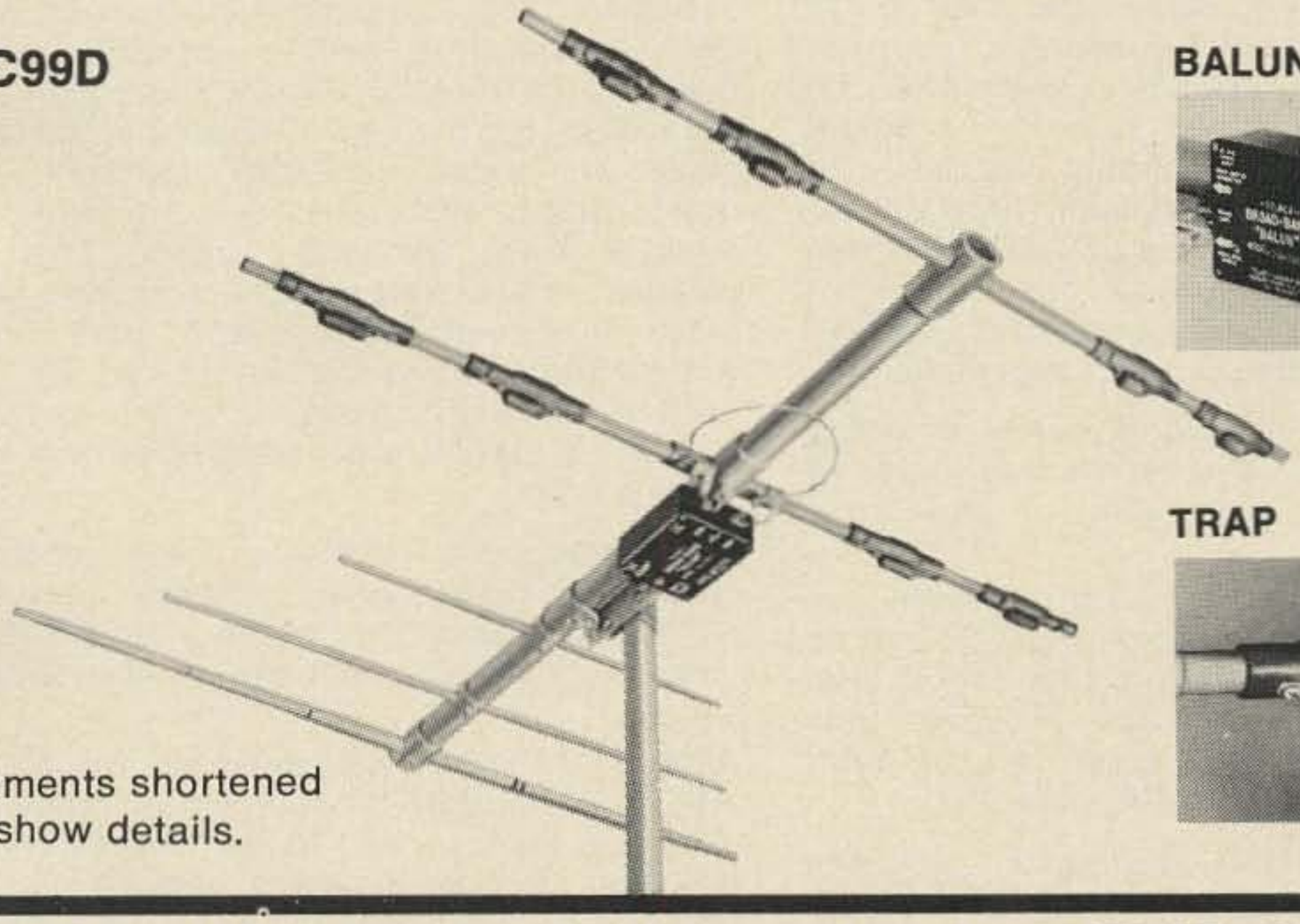

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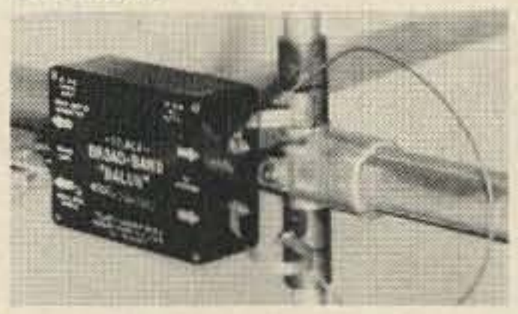

TRAP

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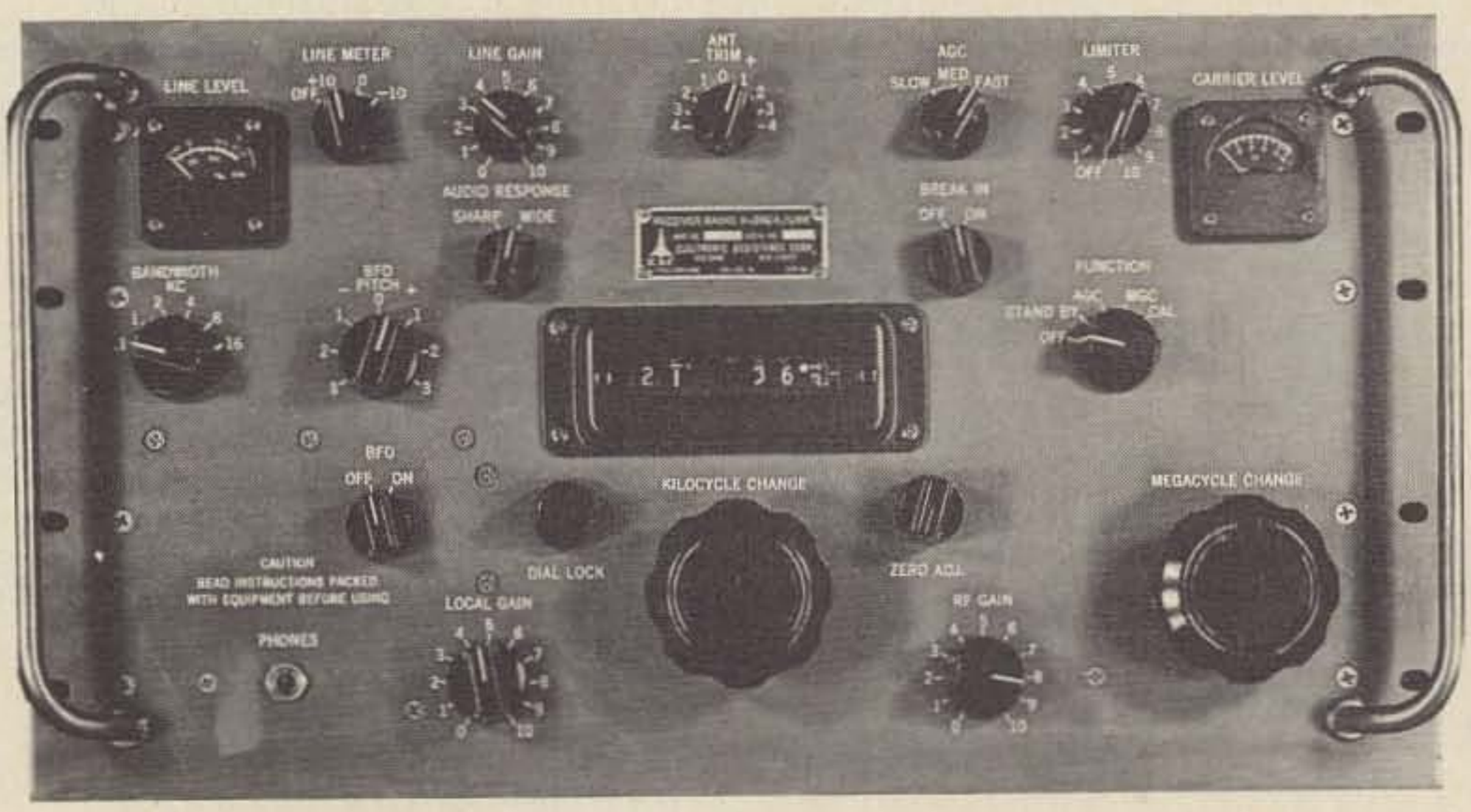

The R390A communications receiver, long used for military surveillance of discrete frequencies between 500 kHz and 32 mHz, is available now at but a fraction of its worth. Both new and remanufactured sets are in stock each furnished with appropriate Instruction Manuals and necessary ancillary parts.

Providing digital readout with an accuracy to 300 Hz, the R390A is the latest and best made general coverage communications receiver that *you can buy*. Robustly constructed on sub-assembled units this receiver provides unequaled stability and maximum flexibility of controls. Six degrees of band pass from 100 Hz to 16 kHz and two positions of audio filtering enable this set to be used for the most sophisticated moon bounce conversion purposes all the way down to deluxe short wave listening.

Mechanically this receiver is a marvel of gears, ratchets, and cams providing ferrite slug tuning of both the front end and one of the triple conversion IF stages.

There are two audio systems within the set, one intended for feeding a monitored 600 ohm telephone line and the other used for a local loud speaker loop. Two meters are provided, one measuring the incoming RF signal and the other the level of audio set to fit a 600 ohm line.

The balance of this set is impressive, the knobs for example having been designed for maximum comfort. The controls are not so closely set that any of them are awkwardly adjusted. There is, of course, a dial lock and a means of zero adjusting to the extremely high quality calibrator circuit provided internally. There is, of course, the antenna trim control and the AGC slow, fast, and medium control. The very effective noise limiter is built in and of course the receiver is designed to be used with associated transmitters and is therefore provided with a muting cirucit.

Both balanced and unbalanced antenna inputs are available, and there is an IF output at 50 ohms to enable the receiver to function with a spectrum analyzer or a panoramic adaptor.

Perhaps one of the most unusual advantages of the receiver is its extreme stability. It is so good, for example, that you can pretune the receiver to any choice frequency such as the Canadian Time Standard CHU in Ottawa or to our American WWV even while the set is cold and in off position. Turning on the set and then turning up the audio control will reveal the desired signal perfectly tuned in. So accurate is this presentation that you can literally use the receiver as a frequency meter. This unusual stability is achieved by a combination of superb mechanical engineering and very expensive permeability tuned oscillators one of which is used as a VFO control while the main one, of course, is ganged mechanically with a kilocycle change knob.

Thermostatically controlled ovens enclose both PTO's and the crystal oscillator circuitry. The R390A can be used remotely with suitable signal circuit control connections to the terminals of the set.

Although the set was designed for CW, MCW, AM, FSK and SSB, it does not contain a product detector. We can add in our shop a compatibly designed product detector assembly at a small additional cost which will facilitate tuning sideband signals.

This is the ultimate communications receiver priced at a figure that serious-minded individuals can afford. Many professional men or those who have recently retired have purchased these receivers from us to their entire satisfaction. It is the kind of set which will last years and years and years. Indeed there would be no normal reason for ever wanting to replace such a set for the

generally available merchandise made these days does not begin to approach in quality or performance what you can expect from the R390A. Foreign customers should understand that the set will also function on 230 volts 50-60 cycles. Although when packed in its special container the shipping weight is 100 lbs, the net weight of the set itself is but 75 lbs. The shipping cube is 3.9 cubic feet.

If sufficient numbers are interested, we will prepare an illustrated brochure about this receiver and make it available without charge. In the meantime, study the specifications and if you are in the vicinity of Harvard, Mass, do stop in for a demonstration of this superb communications receiver.

PRICE LIST

R390A new	$1495
R390A new fitted with product detector	1565
R390A remanufactured	1195
R390A remanufactured fitted with product detector	1265
R390 remanufactured	995
R390 remanufactured fitted with product detector	1065
R391 new	1995
R391 new fitted with product detector	2065
R391 used	1795
R391 used fitted with product detector	1865

The R390 is the original series set. Essentially the same is the R390A with a more complex mechanical tuning system and a voltage regulated power supply. The 391 is a special series similar to the 390 but intended for servo-controlled remote operation of up to seven pre-determined frequencies. Above prices are FOB Harvard, Mass. Shipments are effected in approximately two weeks after receipt of order and remittance.

TECHNICAL CHARACTERISTCS OF R390A RECEIVER

Type of circuit: Triple-conversion superheterodyne on eight lowest frequency bands; double-conversion superheterodyne on all other bands.
Frequency range: 0.5 to 32 mc.
Types of signals received: A1,cw; A2, mcw; A3, voice; A9, single side-band, F1, frequency-shift keying.
Type of tuning: Continuous; frequency read directly on counter-type indicator.
Method of calibration: Built-in crystal-controlled.
Calibration points: Every 100 kc.
Audio power output:
- 600-ohm unbalanced line ..... 500 mw, minimum.
- 600-ohm balanced line ..... 10 mw, minimum.
- Headphones ..... 1mw, minimum.

IF selectivity: 100 cps to 16 kc bandwidth in six steps.
Intermediate frequencies:
- First variable IF (used on eight lowest frequency bands) 17.5 to 25 mc.
- Second variable IF (used on all bands) 2.5 to 2 mc on lowest band: 3 to 2 mc on all other bands.
- Third (fixed IF) 455 kc.

Power source: 115/230 volts ac ±10%, 48 to 62 cps.
Power input:
- 115/230 volts ac: 225 watts total; 140 watts with OVENS switch turned OFF.

Number of tubes: 26 (including current-regulator tube RT510).
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- Unbalanced: Straight-wire of random length or vehicular-mounted whip.
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STUDY GUIDE GENERAL CLASS LICENSE

Part V Something for Nothing

For nearly 50 years, the vacuum tube reigned supreme and virtually unchallenged as *the* amplifier for electronics. From the passing of the spark gap and decoherer in the years following the first world war until the advent of the transistor in 1948, the vacuum tube had no serious competition.

The period of the vacuum tube, not entirely by coincidence, was also the time during which electronic engineering as it now exists made the major part of its growth, and the characteristics of the vacuum tube left their indelible imprint upon the entire field.

And despite the phenomenal growth of semiconductor electronics, some areas yet remain the province of the vacuum tube. UHF amplifiers, cathode-ray tubes such as TV picture tubes, and high-voltage devices are three major regions in which the vacuum tube remains the least expensive device to do the job.

Both because the vacuum tube is still in wide use, and because many other areas of electronics and radio in particular are built upon a foundation derived from vacuum-tube experience, the General class amateur examination contains a number of questions dedicated to determining the applicant's knowledge of vacuum tubes and their operation.

The specific questions in the FCC study list are:

5. Describe the operation and usage of a cathode follower.

8. How is the plate circuit efficiency of a vacuum tube determined?

14. What is meant by the maximum plate dissipation of a vacuum tube?

51. Compare the operating features of the grounded-grid and grounded-cathode amplifiers.

Not one of these four questions makes any sense at all, unless you are already familiar with the principles upon which a vacuum tube operates. Before we can get into the details required for the FCC questions, therefore, we must delve into just how tubes do their job. Then we can examine the various ways they are used and the factors which limit their use, to determine answers to the exam questions.

Our first question, then, will be "How does a vacuum tube work?" When that is out of the way, we can move on to learn "What factors limit a vacuum tube's usefulness?", and finally find out "How are vacuum tubes used?" By the time we get even a brief view of the realms opened up by our final question, we should have adequate knowledge of tubes and their operation to handle any questions such as those on the study list.

With such a broad set of questions, and limited space in which to explore them, we cannot go into excessive detail about any part of vacuum-tube operation. Here, we're only providing enough to satisfy the General class exam questions.

How Does a Vacuum Tube Work?

Before we can determine how a vacuum tube works, we must first determine just what a vacuum tube amounts to. Even though we know that by "vacuum tube" we mean only those gadgets used in radio transmitters and receivers, that still leaves an almost unbelievable amount of territory – diodes, triodes, tetrodes, pentodes,

hexodes, heptodes, multifunction tubes, klystrons, magnetrons. . .The list doesn't go on forever, but it might as well.

All of those special types of tubes share the fact that they consist of electrodes sealed into a tube full of vacuum. Since "vacuum" is defined as the absence of anything else, that's where our phrase about "something from nothing" derives. Unfortunately as we have just illustrated, that's not precise enough to sort out the kind of "vacuum tubes" the exam is concerned with.

Rather than try to define all the differences, let's start with the one common element and see what develops.

We already know that an electrical circuit, to be a circuit, must be complete. That is, it must have both an input and an output. Even the simplest vacuum tube, then, must have at least two different electrodes sealed into its vacuum, one for input and one for output.

The first recorded vacuum tube was just about that simple. It was built by Thomas A. Edison in 1883, and its operation as a vacuum tube was purely accidental. Edison was trying to improve his newly invented incandescent lamp, and one of his experiments was to put a metal plate into the bulb near the filament (Fig. 1). He discovered that when the filament lit, a small electric current flowed between plate and filament. The discovery was duly noted, published, and became known to the world as "the Edison effect." Since it did nothing either way for the operation of the light bulb, Edison apparently ignored it and went on to other inventions – thereby missing the chance to become known as the inventor of electronics atop all his other laurels!

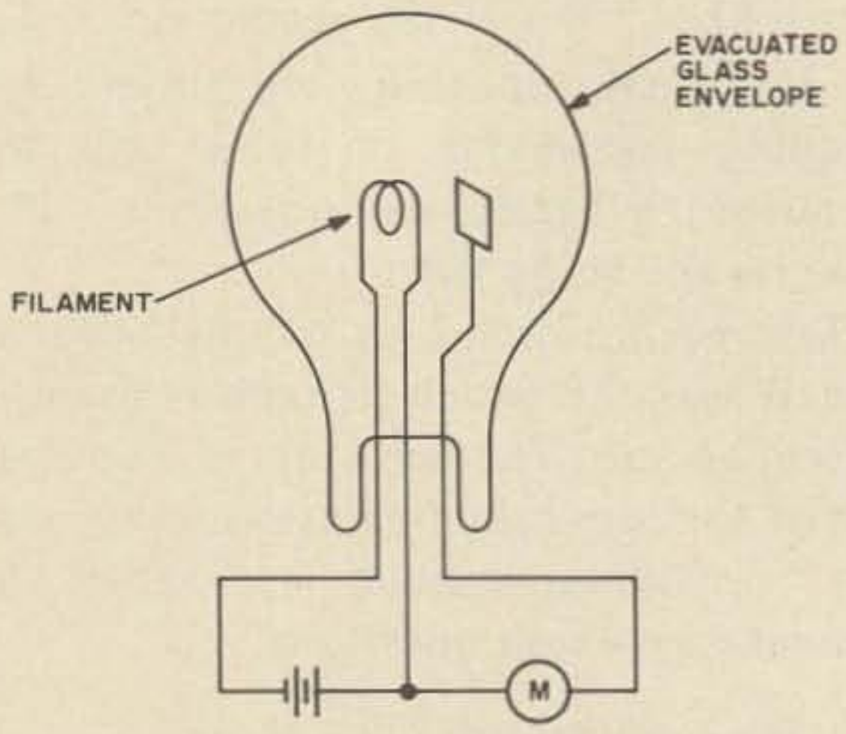


Fig. 1. Vacuum tube owes its existence to Edison effect, discovered by light bulb's inventor. Circuit which revealed Edison effect is shown here. Metal plate was sealed into bulb, near filament but electrically insulated from it. When filament lit, current flowed between plate and filament. More current flowed when plate was connected to positive pole of filament battery, than when connected to negative. Edison didn't know why this happened; others followed it up.

Serious scientists did, however, sit up and take notice of the Edison effect. As a direct result of it, Sir. J. J. Thomson spent several years in study and experiments, and in 1900 or so announced to the world his "electron theory." That's the familiar structure of electrons, protons, and neutrons which we accept now as the "true" picture of the way things are made, and the reasons for electric current.

The electron theory explained the current of the Edison effect as an "evaporation" of electrons from the surface of the filament, caused by the heat energy present in the filament. As these electrons boiled off, some struck the metal plate – and any time we have electrons in motion, we have to have a current. That's the current Edison observed.

Edison also noticed that when he connected the metal plate to the positive side of a battery, the current flow went up, and if the connection was to the negative side, the current went down. This showed that the moving particles had to be negative in polarity, since they were attracted to a positive pole and repelled by a negative one.

A few years later, in 1905, an Englishman named Fleming obtained a patent on a device making use of the Edison effect, which he called a "valve." It was intended to detect radio signals by making use of the one-way property inherent in the current flow from a hot filament to a metal plate (anode). It worked in just the same way as today's diode detector circuits, and it established the vacuum tube as a part of the growing art of radio communications.

Let's look a little more closely at just what goes on in the simple diode, since it was the first vacuum tube to be discovered,

the first to be used, and is still the basis of all conventional vacuum-tube action.

We have, as we have mentioned, two elements inside the vacuum for a diode. One is known as the cathode, and the other is called the anode, or plate.

The cathode is normally heated to a rather warm temperature (between 1000 and 3000°F.) The heating may be done by a separate "heater" which is electrically insulated from the cathode itself, or it may be done by forcing a current through a high-resistance cathode material. Normally, an indirectly heated cathode makes use of a "heater," and the word "filament" is reserved to mean a combination heater and cathode. So far as the basic principle of operation is concerned it doesn't make much difference where the heat comes from so long as it's present, but in practice if ac is used to provide heating power it's better to keep the ac out of the signal circuits, and so the heater–cathode combination is most frequently encountered in ordinary tubes.

At the cathode temperature, some of the electrons of the cathode material literally boil off into the empty space surrounding the cathode. This forms a cloud of electrons known as the "space charge" around the cathode itself.

The plate or anode is separated from the cathode by distance, and it's far enough away that the space charge never quite reaches it.

Under these conditions, with no voltage applied between plate and cathode, the space charge is self-limiting. It always contains all the electrons emitted (boiled off) from the cathode, and so always has a negative charge which just balances the positive charge produced on the cathode by loss of the electrons.

If the temperature of the cathode is raised so that more electrons are emitted, the space charge will increase, but the current flow to the plate will remain essentially zero. Similarly, if the cathode temperature is lowered, the plate current will remain unchanged at zero.

If we return the cathode to "normal" temperature and put a small positive voltage on the plate, the picture changes. The positive voltage on the plate attracts some of the electrons from the space charge, and a current flows between plate and cathode.

Not all the emitted electrons reach the plate, though. When we put voltage on the plate, this created a "voltage gradient" from cathode to plate something like a hill in the path of the emitted electrons (Fig. 2), and only those electrons which left the

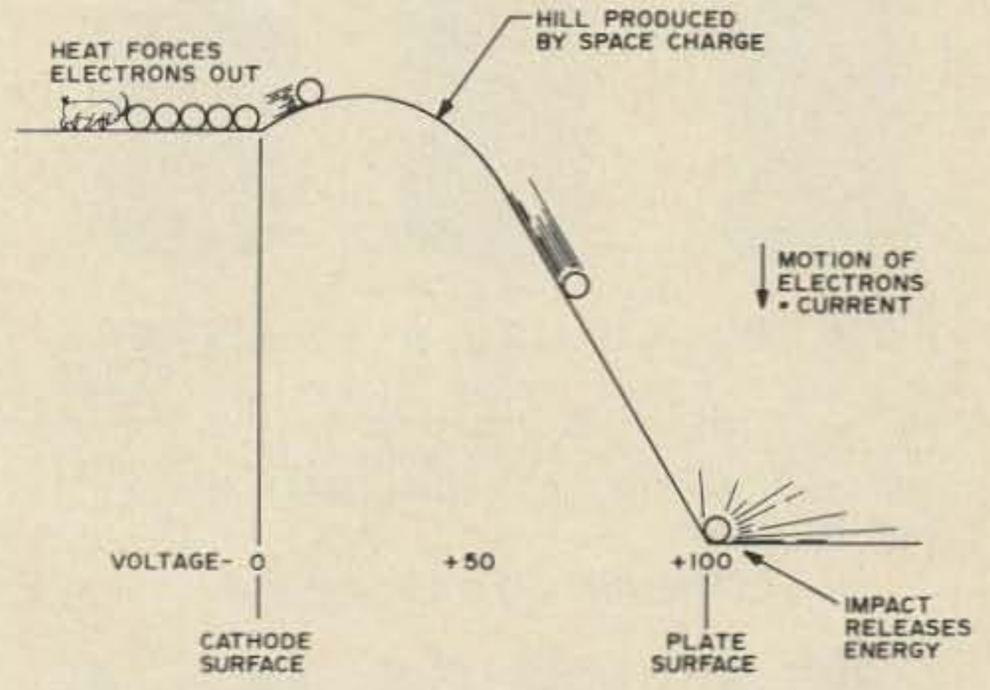


Fig. 2. Action of electrons inside simple diode tube is shown here. Difference in voltage between cathode and plate surfaces forms a "voltage gradient" shown here as a downhill slope. Space charge puts a hump in this hill, near the cathode. Angry ram represents action of heat, boiling electrons off the cathode surface. Those electrons with enough energy to make it over the hump fall down the hill, and hit the plate with a crash, releasing more heat.

cathode with enough energy to "make it up the hill" go to the plate. Some are repelled by others in the space charge, and a few even return to the cathode as a result.

Making the cathode hotter doesn't change things much – but if we cool it down somewhat, the number of electrons in the space charge is reduced and we find that the "hill" is not so steep. As the temperature cools, we find one point at which all the emitted electrons go over to the plate.

We can achieve the same effect without changing cathode temperature if we simply increase plate voltage. When plate voltage is high enough, it will pull all the electrons over the hill.

In a diode, we have only these two factors available with which to vary the

plate current. If either stays constant, the other exercises control (so far as it is able). With constant plate voltage, cathode temperature will determine the current up until the increased space charge with increased temperature makes the hill "too high" for the plate voltage to pull electrons over. With constant cathode temperature, plate voltage will be the ruling factor until it is great enough to pull all the electrons over the hill, at which time temperature again takes over.

This "hill" effect determines the maximum power dissipation rating for the tube, in a slightly indirect manner. The "hill" is *between* cathode and plate, so that electrons leaving the cathode must "climb up" the hill to get past it, and those which reach the plate are "falling down" the other side. (The analogy to a hill is not quite real, but if the voltages are plotted on a graph as in Fig. 2 it's close enough for all practical purposes.)

The more electrons that hit the plate, or the harder they fall, the more shaken will be the molecules of the plate material. This shaking up of molecules is what we generally call heat, and a large amount of it goes on in a typical vacuum tube. Plates often run at a dull red glow, and some tubes are designed to operate with their plates white hot – with the heat *all* coming from the impact of the electrons falling down the "voltage hill" between cathode and plate.

Any material eventually gets hot enough to melt, and the plates of vacuum tubes are no exceptions to this rule. For this reason, any tube is rated for a "maximum plate dissipation" which is the power in watts the plate can safely convert into heat. Power is the rating factor because it includes current (the number of electrons hitting the plate) – and voltage (the hardness with which they fall). It's also easy to calculate and to measure, in operation.

While we've explained "power dissipation" ratings in terms of the simple diode, it's the same situation for any kind of tube. Not only the plate is involved, either. Any electrode which is more positive than the cathode (on the "downhill" side of the voltage hump) must dissipate the impact energy of the electrons that get to it, and

such electrodes are individually rated for maximum power dissipation.

The diode's main usefulness in radio today is as a polarity-sensitive switch (Fig. 3). If the plate is positive to the cathode, it conducts a current, while if the plate is negative, the electrons are repelled and

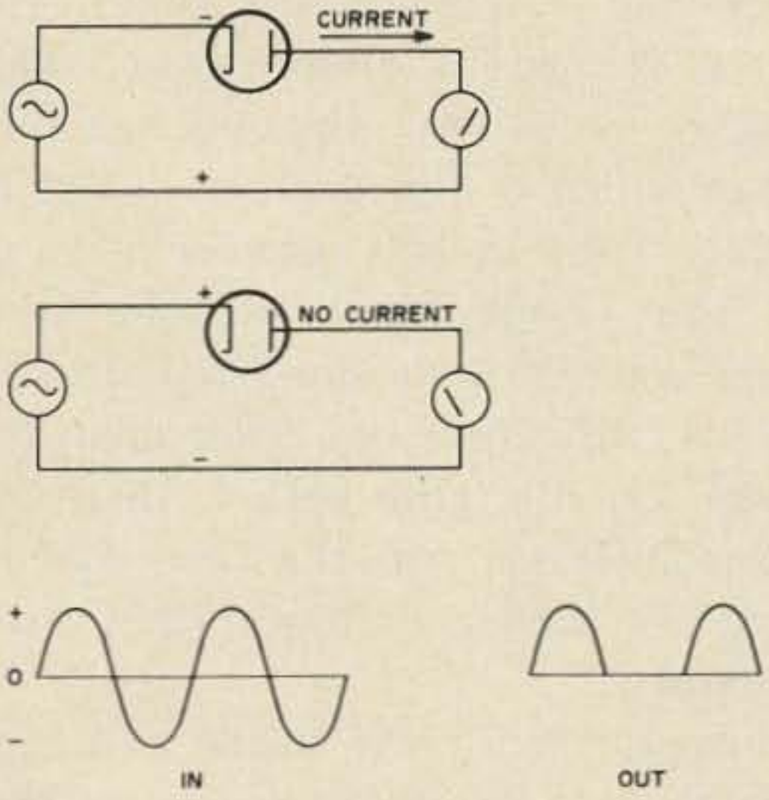


Fig. 3. Primary use of diode in electronics today is as a switch. When plate is positive (top) current can flow. When plate is negative (center) no current flows. This action can be used to change ac input into pulsating dc output (bottom), or to detect the envelope of an amplitude-modulated radio signal, as well as for many more exotic uses not strictly a part of radio.

current flow stops. This makes it useful as a power rectifier to change ac to pulsating dc, and also as a nonlinear device for modulation, mixing, and detection of signals (which we'll explore later).

The first great advance over the diode came about when Lee DeForest surrounded the cathode with a coil of wire which he called the "grid" (Fig. 4). By applying a negative voltage between the grid and the cathode, it became possible to add a new dimension of control.

For proper operation of a triode, as the three-element tube is known, cathode temperature and plate voltage are kept in the range where plate voltage controls cathode current. The plate is kept positive to permit large currents, but the grid is kept negative so that it repels electrons from its neighborhood and so holds down the plate current.

The effective "size" of the grid, as it shows up in its interference with plate

current, depends upon the voltage applied to it. The more negative the voltage, the more effectively the grid blocks current flow. It's possible with most tubes to bring plate current down to zero by putting an extremely negative voltage (known as "cut-off voltage") on the grid. If, on the other hand, the grid is allowed to reach a positive voltage, it acts just like another plate, and loses its control of current flow.

For normal amplifier operation, the "bias" voltage applied to the grid is somewhere between the limits of cutoff and positive voltage, and is chosen so that the variation in plate current which results when small changes occur in the grid voltage is a reasonably true replica of the variations in the grid voltage. Picking the right combination of plate voltage, plate current, and grid bias to achieve this happy effect is one of the fine points of engineering design work which we won't go into deeply right here.

For our purposes, we can think of the tube as something a little different. As we mentioned in our previous installment, either a tube or a transistor can be considered to be just a resistor in the circuit from cathode to plate, with the value of the resistor being controlled by the grid voltage.

This is a somewhat unconventional approach to the matter – and one you won't find in any engineering testbooks – but it works. Keep in mind that the more negative the grid-to-cathode voltage, the more ohms in the "resistor" presented between plate and cathode connections, and the less negative the grid, the fewer ohms in the "resistor." As grid voltage goes positive, then, the resistance value goes down and more current flows. If the tube is in series with a fixed resistor, this will reduce the voltage at the plate, and we have a change in plate voltage which is brought about by the change in grid voltage which is 180 degrees out of phase.

When used in this manner as an amplifier, the triode vacuum tube operates almost exactly like the transistor except that its resistance is controlled by the *voltage* on its grid rather than by the *current* injected into the base, and it uses somewhat higher voltages than do most transistors.

However, both the triode and the transistor share a common problem. The grid and the plate are both conductors, and they are separated by an insulating medium. This makes them form a capacitor – which permits some of the plate voltage to feed back to the grid. This plate-to-grid capacitance makes the triode tricky to handle as a radio-frequency amplifier (and the transistor too, for that matter, but we're talking about tubes at the moment).

To solve the problem, another grid structure was introduced between the original grid (now called the "control" grid) and the plate. The new grid, being added to screen the control grid from the plate, was called the "screen" grid. It was, like the plate, connected to a positive voltage so that it had little or no effect upon the electron stream passing through, but was bypassed through a capacitor to ground to prevent any signal from coupling back through grid–plate capacitance.

The screen grid worked nicely, and the resulting structure is known as a "tetrode" because it has four elements. However, it introduced a new problem. Sometimes the plate voltage is driven to a value *lower* than the screen voltage. Electrons still hit the plate hard – hard enough to knock a few "secondary" electrons free. These secondary electrons then went to the screen

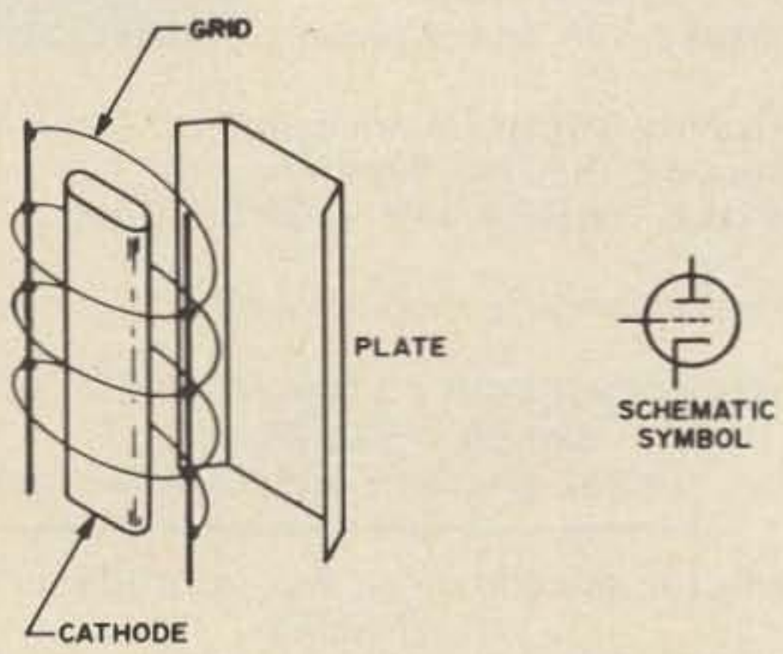


Fig. 4. Introduction of grid between cathode and plate made it possible to control cathode current by means of a separate isolated electrode, and gave birth to electronic amplification as we know it today. Appearance of simple triode is shown at left; schematic symbol is at right.

rather than returning to the plate. The result was an effective "negative resistance" between plate and screen under certain conditions, which could cause oscillation.

The direct cause of this effect was the fact that the screen was the most positive thing around when secondary electrons were released. A direct cure was installation of still another grid, the third, between screen and plate. This "suppressor" grid is connected to the cathode, so that it will be more negative than either screen or plate. When secondary electrons leave the plate now, the negative charge on the suppressor grid drives them right back where they came from.

With five elements – a cathode, three grids, and a plate – the resulting tube is known as a pentode. Most present-day rf amplifier tubes are pentodes. Some power tubes are "beam power" tubes; they make use of special beam-forming plates attached to the cathode, which focus the electron beam in such a way as to create a "virtual suppressor" by space-charge effect between screen and plate.

Each of the additional electrodes introduces a small amount of noise into the signal. Normally this is of no consequence, but in critical applications such as the first stage of a VHF receiver, triodes are still preferred despite their problems simply because of their low noise.

The many other kinds of tubes you may meet are, for the most part, combinations of the kinds we've examined here. They all start out with the elements of a diode, and all conventional tubes then add grids as necessary to do their job. Often two or more separate tubes are combined in the same envelope for convenience (the 6U8A (Fig. 5) is an example of a triode and a pentode sharing the same chunk of glass), but the essential structure remains unchanged.

What Factors Limit a Vacuum Tube's Usefulness?

The vacuum tube is a most useful gadget, but each individual one is limited in its use by a number of factors. One of these, power dissipation, we've already met. Some of the others include such things as the circuit efficiency, operating frequency limits, and power requirements.

The major limits on any specific tube are those set by its power requirements, power dissipation, and operating frequency limits. The power requirements include both the power necessary to heat the cathode and that required to operate the tube's plate circuit (and screen, if any). Power dissipation involves not only the ratings, but the method by which the tube is cooled. Frequency limits are usually one-sided. Almost all tubes will operate at frequencies down to and including zero (or dc), but every tube has an upper frequency limit beyond which it will no longer act as a tube should. Let's examine these in reverse order, looking at the frequency limits first.

The absolute frequency limit in any tube is set by the physical distance between its electrodes. The electrons in the tube do *not* travel at the speed of light; they take a definite amount of time to make the trip from cathode to plate. If the signal frequency is so high that the distance from cathode to plate is an appreciable part of a wavelength, then everything goes sour. For instance, a positive-going signal at the grid should increase plate current – but if it's a half-wave from grid to plate, the plate current will be decreasing at that instant rather than increasing, and cannot increase until a half-cycle later when the grid signal is going negative.

Almost no tubes actually make it up to this limit, though. Other factors impose even lower frequency limits on them. One is the combined effect of the cathode

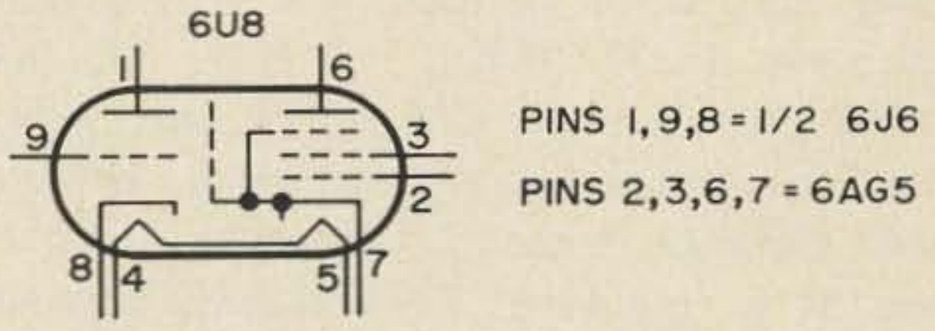


Fig. 5. Combination tube such as type 6U8 is actually two different tubes enclosed in same glass envelope and sharing same heater for convenience. Triode half of 6U8 is same as half a 6J6, while pentode portion is same as a 6AG5. Portions can be used independently.

structure's own inductance and the capacitance from cathode to each other element in the tube. Taken all together, these effects add up to a low-pass filter circuit which prevents any signals above the filter's cutoff frequency from flowing through the cathode – and so makes the tube unusable at these higher frequencies.

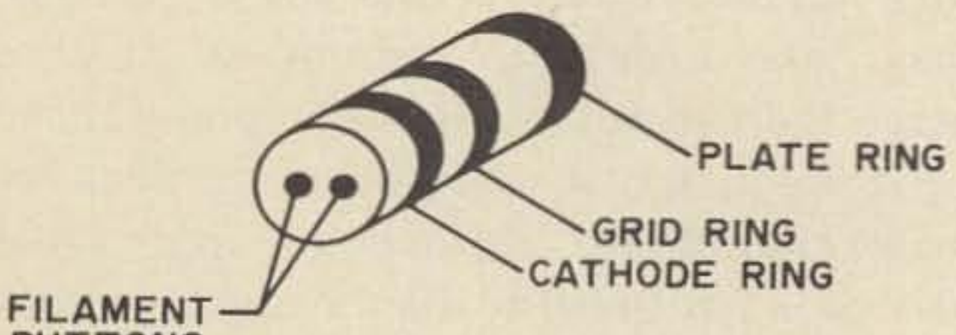


Fig. 6. In quest for UHF operation, tube designers have come up with strange designs. One is this "planar" triode which is made of ceramic, with electrode connections coming out as rings around tube body to eliminate lead inductance as much as possible. Tube operates well into UHF region, but still has an upper frequency limit.

Tube designers combat these limits by making tubes intended for VHF operation physically small, and providing multiple connections for all elements. An extreme example is the family of tiny "planar" triode tubes made for space use, which have no connector pins as such. Instead, each element is brought through the envelope as a ring (Fig. 6). Distance between elements is reduced to thousandths of an inch. The tubes operate far into the UHF region – but they still do have frequency limitations.

Power dissipation comes about because the electrons which compose the cathode current have energy, and release it in the form of heat when they get where they're going, as we already saw. The limiting factor here is almost always purely physical; when things get just so hot, they melt. It's not uncommon to see overloaded power tubes with large dents in their glass envelopes, where heat has softened the glass to such an extent that anything can change its shape!

The type of cooling provided has a lot to do with the limiting effects of power dissipation. If a stream of cool air blows past a tube, it can handle much more heat than if it is sealed into an airtight box of polished aluminum. Very-high-power tubes are often liquid cooled, with water actually flowing through the interior of the plate structure just like an automobile engine's cooling jacket. Published ratings usually assume good ventilation is provided.

Power requirements limit the usefulness of tubes in a number of ways, most of them indirect. In comparison with a transistor, for instance, a tube requires much more power – so much so that the vacuum-tube portable radio is almost extinct now. More power is necessary for heating the filament of just one radio tube than is used by all the transistors of an average pocket receiver.

Similarly, in the case of mobile radio equipment, those tubes which require extremely high plate voltage supplies, or high current, are usually ruled out because operating power is limited.

In some instances, even when high voltage and high current are available, the comparative danger of high-voltage oper-

ation as compared with low-voltage circuits (transistors, etc.) tends to swing the choice away from the tube.

Circuit efficiency also limits the usefulness of any circuit, not just those using tubes. In general, the efficiency of any circuit is the ratio between power put *into* the circuit and power taken *out*. For vacuum-tube amplifiers, it's sliced a little thinner in the standard definition of plate circuit efficiency.

Plate circuit efficiency, according to this definition, is the ratio of *signal* power output to *supply* power input (Fig. 7). It

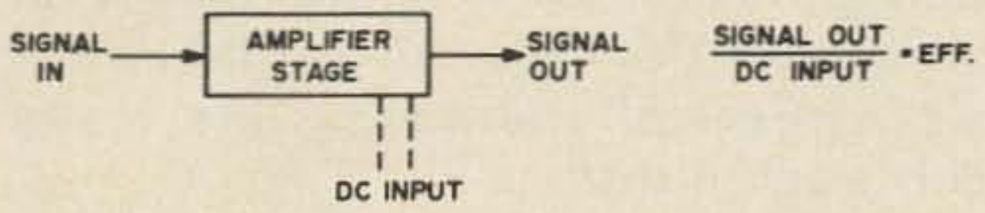


Fig. 7. Efficiency of an amplifier or a circuit is figured as shown here, by dividing signal output power by dc power put into the stage. Input signal power is ignored in the calculation.

has nothing to do with signal power input. Thus, an rf amplifier which operated on 1 kV plate supply and drew 500 mA current would take 500W from the supply. If it delivers 300W of rf output, its plate circuit efficiency is 60%.

While circuit efficiency up to 95% or better is possible on paper, almost no working circuit has ever been built which gets better than 75 to 80% efficiency. The trouble with the higher efficiencies is that they measure all rf power output, not just that at the signal frequency. In order to get figures above 75%, it's necessary to choose operating conditions which greatly increase the percentage of harmonics in the output – and all the "extra" output power consists of just those harmonics!

Most audio power amplifiers are far less efficient than this. Typical figures are around 20 to 25% for "moderate" distortion. We'll get into this a bit more a little later when we look at some of the ways in which tubes are used.

The definition of plate circuit efficiency contains a built-in loophole, and in the early days of SSB operation many operators took advantage of the same loophole (which was also in the FCC rules at that time). The loophole is this: signal power input is not taken into account.

Some types of amplifier circuits use only a small fraction of the input signal as input, and feed the rest right on through into the output circuit. Such an amplifier can, for instance, accept 100W of signal input power, amplify 10W of it by a factor of 30 to get 300W, and feed through the remaining 90W of input to the output. The output power will be 390W, yet the amplifier produced only 300 of them. If input power were to be reduced to 10W, output would drop only to 300. And in either case the dc supply power taken by the circuit would be the same. This means that the same circuit might produce 300W at an efficiency of 60%, or 390W at an efficiency of 78%, with no change in the circuit or its adjustments!

For the definition of efficiency, this loophole is closed by requiring that only the power output *produced by that circuit* be used in calculating efficiency.

The loophole in the rules had to do with the maximum power limit. It was originally stated as "1 kW to the transmitter stage which delivers power to the antenna," and the fellows who found the loophole went through it by using a 1 kW final of a type which could feed through almost unlimited power, and driving it with a 10 kW "driver." Most of the 10 kW, of course, would go right on up to the antenna, with apparent efficiency in the final of several *hundreds* of percent.

The loophole no longer exists. Part 97.67 of the current edition of the Rules and Regulations states that power input shall now be measured to "the tube or tubes" delivering power to the antenna, and the Commission has served notice that in the case of feedthrough amplifiers, this is interpreted to include all driver stages as well.

How Are Vacuum Tubes Used?

While at first glance it would appear that vacuum tubes are used for many purposes, we can compress all the uses for the ordinary garden variety of tube (that is,

all except such special-purpose items as TV picture tubes, oscilloscope CRTs, tuning indicators, and the like) into one, with our "voltage-variable resistance" concept introduced in the previous section.

The diode, for instance, when it is being used as a rectifier, changes from being a very high resistance (when cut off) to a relatively low resistance (when turned on). The amplifier simply controls the flow of current between two terminals in response to the voltage between one of the two and a third. The oscillator is simply an amplifier connected in a special circuit. Even the digital logic circuits used in early electronic computers for timing and storage can be viewed as resistances controlled by voltages.

The exact characteristics of any individual type of tube such as, for instance, the 6C4 triode, depend upon the materials from which it is made, and primarily upon the shape and spacing of its electrodes.

These shape and space factors are generally called the "internal geometry" of the tube type, and they fix the amount of effect the grid voltage will have upon plate current, the maximum plate dissipation, the maximum cathode current, etc.

If you know the geometry of the tube – or what amounts to the same thing, know what its effects are – you can apply the tube in almost any way you like. To make life easier for equipment designers, the people who design and build tubes run measurements upon their products and publish "characteristic curves" which describe the key factors.

A typical characteristic curve for a triode (Fig. 8) graphs plate current against plate voltage for various values of grid voltage. A not-so-typical curve might graph plate current against grid voltage, for various plate-voltage values. For most designers' purposes, though, the plate-current/plate-voltage curve is best, so it's the one most often supplied.

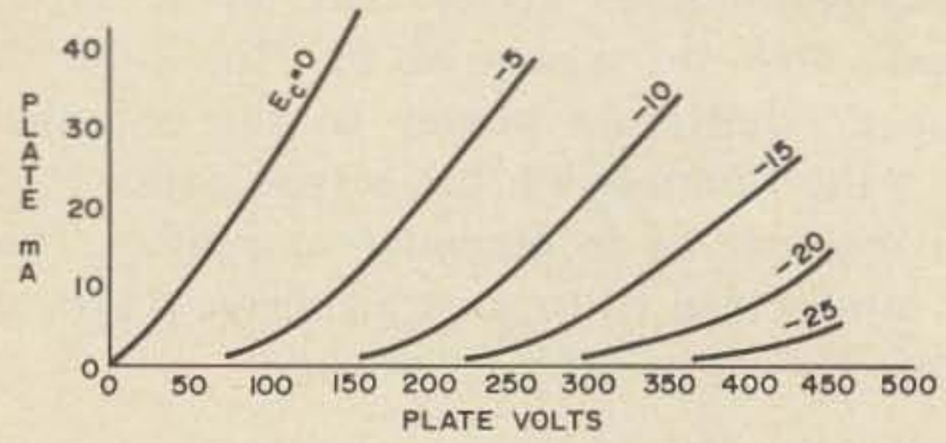


Fig. 8. Typical set of plate-voltage/plate-current curves for a triode tube shows relation of plate milliamperes to plate volts for six selected values of grid voltage. Relationships for other grid voltages must be interpolated between these, if they are needed.

However, if we know plate current and plate voltage at any instant, then by Ohm's Law we can determine the effective plate-to-cathode resistance represented by the tube.

If the tube's plate is working into a reactance rather than a resistance, as for instance the primary of a transformer, or a choke-coupled output circuit, the plate voltage averages out to be constant and the manufacturer's curves can be used as they are. Changes of grid voltage then change only plate current.

If the plate works into a resistor, as in a resistance-coupled amplifier, it's a bit different and the picture gets messier. A "load line" must be drawn on the curve to determine the dc plate voltage present at any instant.

By using the curves, together with his accumulated training and experience, the equipment designer picks an "operating point" for the tube by proper choice of the plate and grid voltages, so that the change in grid voltage will cause a corresponding change in resistance between plate and cathode. That is, if a 0.5V increase in grid voltage causes a 10% drop in resistance, a 1V increase of grid voltage should cause a 20% resistance drop and a 1V decrease at the grid should result in a 20% increase of resistance. These figures are, of course, merely examples and do not correspond to any actual circuit.

When this had been done, the result is a circuit which produces for its output an "amplified" or stronger version of the input signal. The "linearity" of amplification is a measure of how accurately the output follows the input; another phrase used for the same effect is "distortion."

Notice particularly that this same process occurs in any kind of amplifier based on tubes or transistors, no matter what the circuit's name may be. Class A, B, or C amplifiers, as well as grounded-grid,

grounded-cathode, and cathode-follower circuits, all act on this same basic process.

The terms "class A," "class B," and "class C" describe the operating point of the circuit. A "class A" circuit is intended to produce low distortion, and to give an output which is a faithful replica of the input. A class B circuit's operating point is much closer to the cutoff point (a true class B circuit operates exactly *at* cutoff); output is distorted but efficiency is higher. A class C circuit remains cut off most of the time and passes current only during the peaks of the input signal. Output is distorted beyond recognition but efficiency is highest under these conditions. Since the distortion can be removed from a continuous (unmodulated) rf signal by a resonant circuit, class C amplifiers are used for rf.

As we have already learned, any circuit requires two conductors to complete it; we can think of one as the "hot" lead and the other as a "return" path for the current. The usual "return" past in most radio equipment is the chassis, which we refer to as "ground" or "common" since it is often connected to ground, and provides a common return for all signal paths.

Our vacuum tubes, with their associated components, convert an input signal into an output signal. This means that four conductors are involved, two for each signal. The return for each signal, however, is almost invariably grounded, which reduces the number of conductors to three – an input "hot" lead, an output "hot" lead, and ground. This is fortunate, since a triode tube has only three elements; we have exactly enough conductors to assign one conductor to each element; with neither elements nor conductors left over.

Because of the physical means by which the tube does its job, the input *signal* must be applied between grid and cathode, and the output signal must be taken from plate and cathode. However, this does not necessarily mean that the cathode must be connected to ground, input to grid, and output to plate.

While it's true that the most conventional use of tubes follows just that assignment (called grounded-cathode operation), we can connect our common ground to any one of the three elements (Fig. 9). If, for instance, we ground the grid, then we must apply the input between cathode and ground. In order to take output with only one wire at the plate, we must pass all the output current through the input circuit. That is, since the input is connected to the cathode, the output signal's path must go through the input to get to the cathode in order to reach the plate.

Similarly, we could ground the plate. The input signal is now applied between grid and plate, while the output signal is taken from cathode and plate. For the input to get to the cathode, it must travel through the output circuit.

This means that in both the grounded-grid and the grounded-plate (usually called cathode-follower) circuits, the input and output circuits are directly connected. In the grounded-grid circuit, they are in series, so that all the current of one must pass through the other, while in the cathode follower, they are in parallel, so that the voltage of one becomes the voltage of the other.

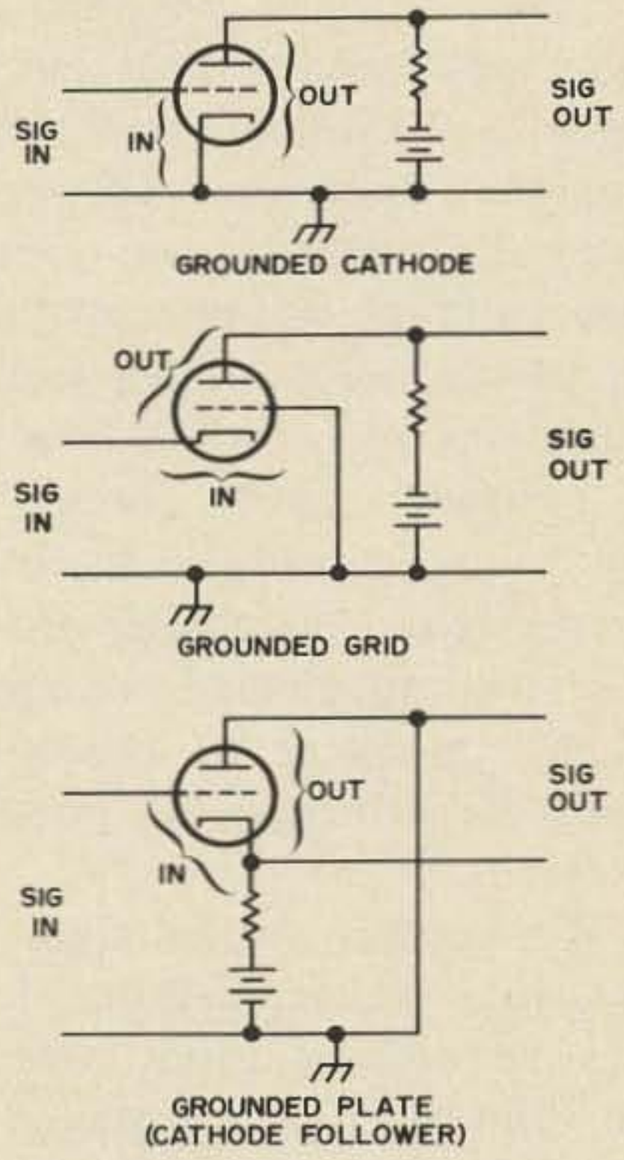


Fig. 9. Differences between the three ways of connecting tubes in amplifier circuits are shown here. These are simplified schematics and leave out all the necessities such as grid bias, coupling capacitors, etc., to emphasize the similarities and differences of the three different circuit types.

In the conventional grounded-cathode circuit, the input and output circuits are isolated and do not interact so directly.

The apparent differences between these three different circuits are due primarily to this difference in relationships of input and output signals. In the grounded-grid circuit, a small input voltage causes a large change in plate current – which forces a large change in input current because of the series connection. This makes the circuit look like a low impedance to its input, and a very high impedance to the output. It also permits feedthrough of power from input to output.

Since it's voltage rather than current which interacts in the cathode follower, the effects are reversed. Input impedance is very high, and output impedance is very low. Coupling of signal from input to output is small; voltage gain is always less than 1, which means that a cathode follower actually introduces a voltage loss.

The gain of any individual tube is determined by the internal geometry of the tube, together with the applied voltages and currents. If voltages and currents are the same, the tube must provide the same gain in any of these three circuits. The stage, however, need not deliver the same gain.

For instance, a conventional grounded-cathode amplifier has its input and output circuits separated and minimizes interaction between them. In such a circuit, the stage gain can approach the maximum of which the tube is capable. Both the current and voltage of the input signal can be made larger in the output.

A grounded-grid stage, however, has its input and output circuits in series, so that the output current and input current must always be the same. Its gain can affect only the signal voltage. Thus the current gain of the grounded-grid amplifier cannot exceed 1, but high voltage gain is possible. While the gain of the tube itself remains high, the interaction between input and output signals outside the tube reduces stage gain.

The cathode follower has its input and output circuits effectively in parallel, so that the voltage in an;out must be approximately the same. Its gain can affect only current. Voltage gain cannot be greater than 1, but high current gain is possible. Again, the tube gain is unchanged, but the input/output interaction outside the tube provides the restricting factor.

Since both the grounded-grid and the cathode-follower circuits produce less gain than does the grounded-cathode arrangement, and since amplifiers are usually intended to produce gain, this gives rise to the question "Why use these inefficient circuits?"

Each of them has its own unique properties, which provide certain advantages in special situations. When the properties are not needed, the special circuits aren't used.

The grounded-grid amplifier reduces the stray coupling between input and output circuits inside the tube, because the grid acts as a shield between cathode and plate. This makes it possible to avoid having to "neutralize" a high-frequency amplifier, and in some cases makes it possible to operate a given tube at a higher frequency than would otherwise be possible (by modifying the effect of the built-in "low-pass filter" we examined earlier).

In addition, the low input impedance of the grounded-grid circuit is often convenient for a high-power rf amplifier, and the capability of feeding through power from input to output is also nice (although no longer offering a loophole in the FCC regulations).

Contrary to popular opinion, there is no appreciable difference in amplification quality between a grounded-grid amplifier and one using the conventional grounded-cathode circuit. Quality in each case depends upon proper adjustment of operating point and input signal level, not upon the choice of the common electrode.

The cathode follower's special properties depend upon its high input impedance and low output impedance. This makes it ideal for use in transforming impedances from high to low levels. The input capacitance is reduced by the same factor that input resistance is increased, making the cathode follower an excellent device for coupling energy out of critical circuits such as rf oscillators. The low output impedance makes it capable of driving a feedline without any intervening transformer, although other factors make this idea less attractive than it may sound at first.

The cathode follower offers an ideal example of "feedback" in action; this is an important idea in all electronics, and seldom appears so clearly illustrated as in the cathode follower. Let's take a conventional grounded-cathode circuit and change it, step by step, into a cathode follower to see how feedback provides all the special characteristics of the cathode follower while the tube itself continues to operate just as it did before.

We'll start with an imaginary triode which operates normally with a plate-to-cathode potential of 100V, a cathode-to-grid potential of 5V, and a plate current of 10 mA. Under these conditions, with a 10 kΩ resistor as its load, the tube provides a voltage gain of 21 times (Fig. 10). That is, a 0.1V change in grid voltage will change the plate current by 210 μA, causing the plate voltage to change by 2.1V. A 1V change in grid voltage will change plate current by 2.1 mA, causing a plate voltage change of 21V.

Now let's move 1 kΩ of the plate load resistor around to the cathode circuit, leaving 9 kΩ in the plate lead (Fig. 11). This 1 kΩ in the cathode circuit is in both the cathode–grid circuit and in the plate–cathode circuit, so that the plate path still sees 10 kΩ.

If we change the grid voltage by 1V, the plate current will change by 2.1 mA. This will increase the cathode voltage by 2.1V (if the grid is going positive so that the current increases) and decrease the plate voltage by 18.9V. The plate–cathode voltage change is still 21V. The output voltage change would be less than that, however.

Unfortunately, the 2.1V change in cathode voltage is of such a polarity as to *reduce* the effect of the 1V input signal; were the entire 2.1V increase to occur, it would completely cancel the input signal

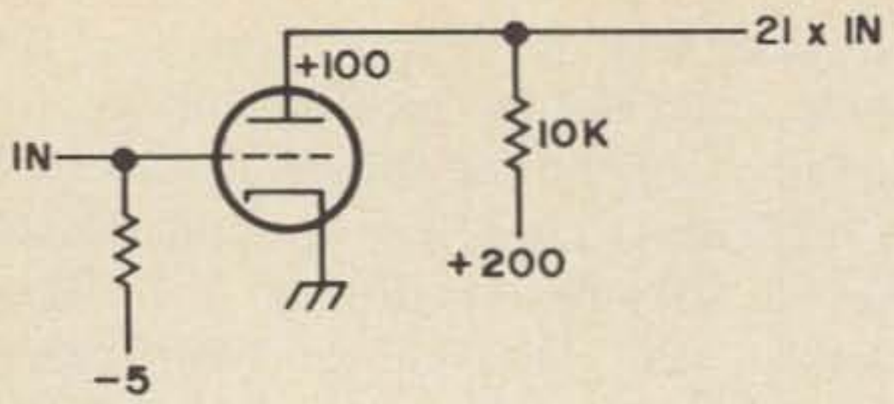


FIG. 10

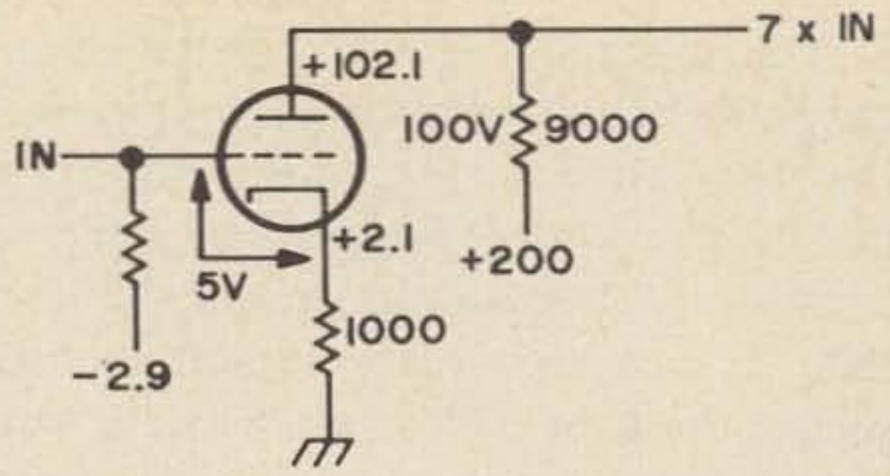


FIG. 11

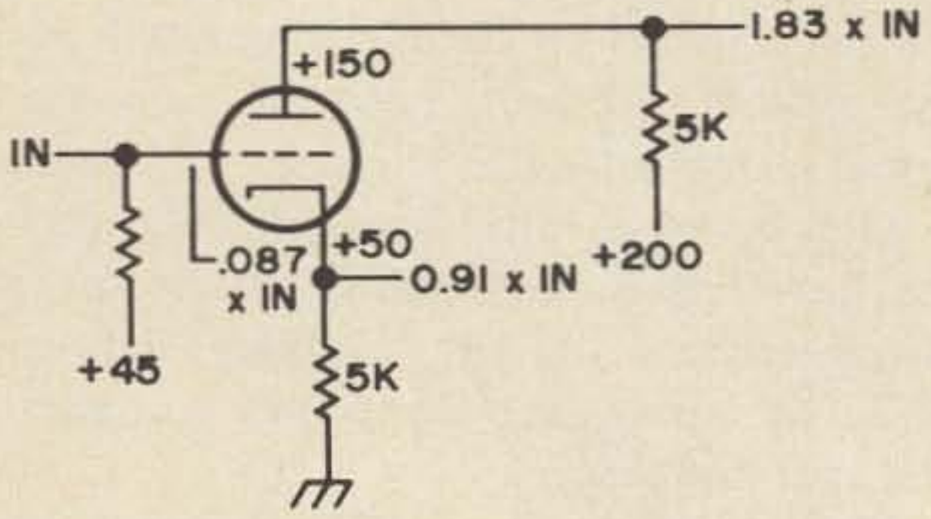


FIG. 12

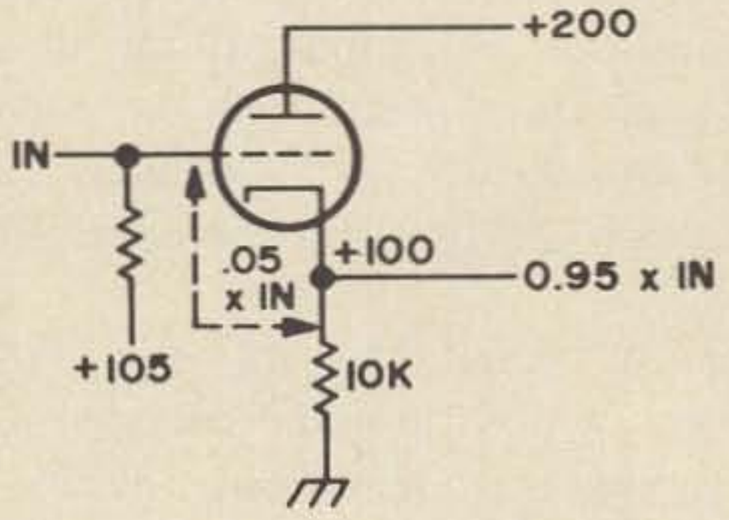


FIG. 13

Figs. 10–13. These four schematics illustrate how feedback introduced by resistance in cathode circuit reduces stage gain although tube itself continues to operate unchanged. Voltage applied to grid maintains grid-to-cathode voltage at 5; as cathode voltage changes, grid voltage is changed to always be 5V less.

which produced it. This, of course, cannot happen. What does happen is this:

The *effective* input signal is the one between grid and cathode, while the actual input signal is between grid and ground. When the grid voltage goes up 1V, it cannot do so instantly but must increase a few millivolts at a time. As it does so, the cathode voltage comes right along behind to buck it – and at some point they meet and level off so that 1V applied between grid and ground produces a grid-to-cathode voltage just right to permit the cathode-to-ground voltage at that instant.

In our example, this will happen when the grid–cathode voltage is a little higher than 0.322V. The cathode current increase caused by this voltage is a little more than 0.67 mA, and the rise in cathode voltage is about 0.676V. The two voltages add up to 0.998 – which would have been 1.0 except that we rounded off our figures.

The "feedback" voltage appearing across the cathode resistor, then, reduced the effective input voltage to a smaller value. This in turn reduces the output signal voltage, since there is less input signal available to the grid. Stage gain is reduced – but the tube itself is still providing a 21-time voltage gain.

Input resistance of the stage increases, because resistance is defined as voltage divided by current (Ohm's Law). Only the effective input voltage sees the original stage input resistance, but the entire input signal is affected. This means that the original input resistance must be multiplied by the same value that the voltage is divided by in order to keep current constant. In our example, the effective voltage is about a third of the actual voltage, so the effective input resistance is three times that of the original circuit.

Now let's move some more of the resistance from the plate circuit to the cathode (Fig. 12). This time, let's make it 50/50, with 5 kΩ in each.

The feedback causes the effective signal input voltage to be smaller than the actual input, just as before, only more so. Where in our first example the cathode voltage rose 2.1 for every volt increase in grid–

cathode voltage, it will now rise 10.5 because of the greater resistance.

Effective stage gain under these conditions is reduced from 21 times to about 1.83 times. That is, a 1V input signal from grid to ground will produce an apparent 1.83V change in plate voltage – which means a 183 μA change in plate current.

This means that the increased cathode resistance caused the leveling-off to occur with an effective input voltage of only about 0.087V. The remaining 0.913V of the input signal was bucked out by cathode voltage.

Input resistance, similarly, is much greater now.

If we move all 10 kΩ over to the cathode circuit (Fig. 13), we find that effective stage gain is down to 21/22. That is, a 1V input signal will cause a 0.954V change in cathode voltage. The effective input between grid and cathode, then, is only about 0.05V. The tube is still producing its 21-time gain, because 0.05 times 21 is 1.05 (actually the input is a little less than 0.05, providing 0.95V out). Input resistance is now 21 times larger than originally.

The cathode follower circuit we have just developed can accept much larger input signals than could the grounded-cathode circuit with which we began. For instance, we had a 5V bias on the grid at the beginning, which meant that any input signal more positive than 5V would carry the grid positive (a condition to be avoided in most cases). With the approximate 20-time division of actual input voltage produced by the cathode follower's feedback, a 5V input signal is effectively reduced to 0.25V, and even a 20V input signal is effectively cut back to 1V from grid to cathode.

Where originally we ran out of the operating range with a 5V signal, we can now go up to a 100V signal without exceeding the same operating limits.

This is not the only advantage produced by controlled feedback. The changes in input and output impedance are also due to feedback's modification of effective voltage and current levels. Not so obvious is the fact that any distortion introduced by the tube is reduced, because it is *not* a part of the original input signal.

The grounded-grid amplifier's characteristics of low input impedance and high output impedance are also the result of feedback; in the grounded-grid circuit, it is current that feeds back rather than voltage, and this reverses the effect upon impedances.

Feedback also makes oscillation possible, if the feedback voltage boosts the input signal rather than bucking it. We'll go into all this in another chapter, however, when we examine practical amplifiers and transmitter circuits.

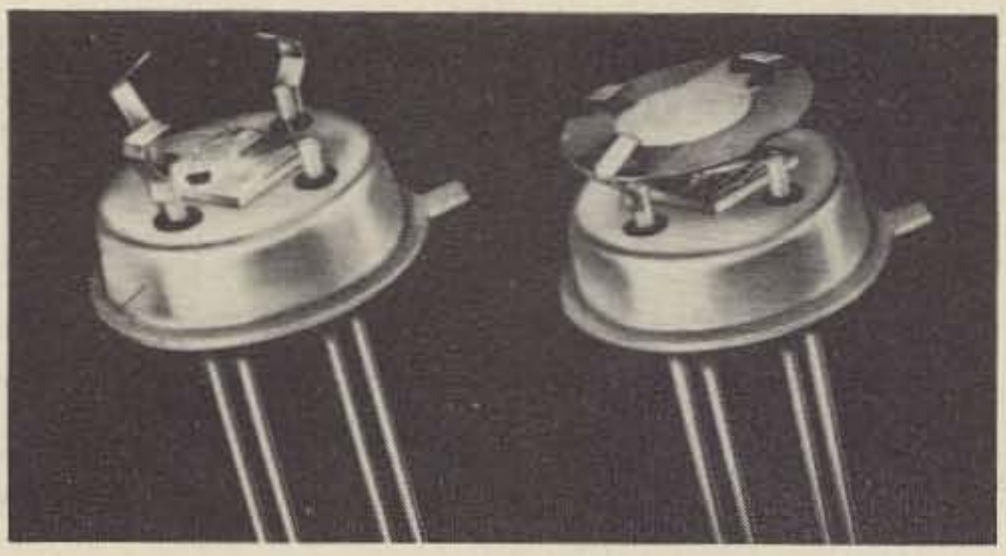
A Place to Start

By this time, we've fairly well covered the basic components and ideas upon which electronics and radio theory are built. With our foundation established, we're ready to begin putting things together into operating circuits. One thing which any circuit must have is a source of power, so the power supply is a good place to begin our study of practical circuit theory.

. . . Staff ■

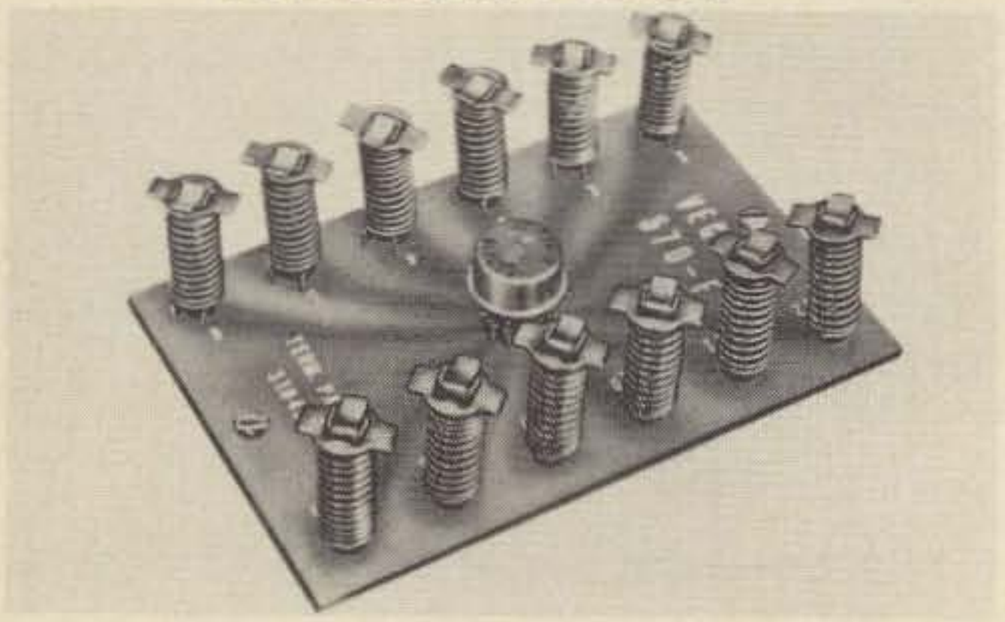
NEW PRODUCTS

Crystal-Controlled Microcircuit



A crystal-controlled microcircuit oscillator (Model MCO-F), which uses thin-film capacitors and resistors on a single substrate, is totally contained within a 4-lead TO-5 Koldweld package. The new unit is designed for application as the local oscillator or second mixer in dual-conversion receivers. It is especially suited for use in advanced paging and personal portable receivers where rugged environmental conditions may be encountered. *TRW Electronics, 1100 Glendon Ave., Los Angeles CA 90024.*

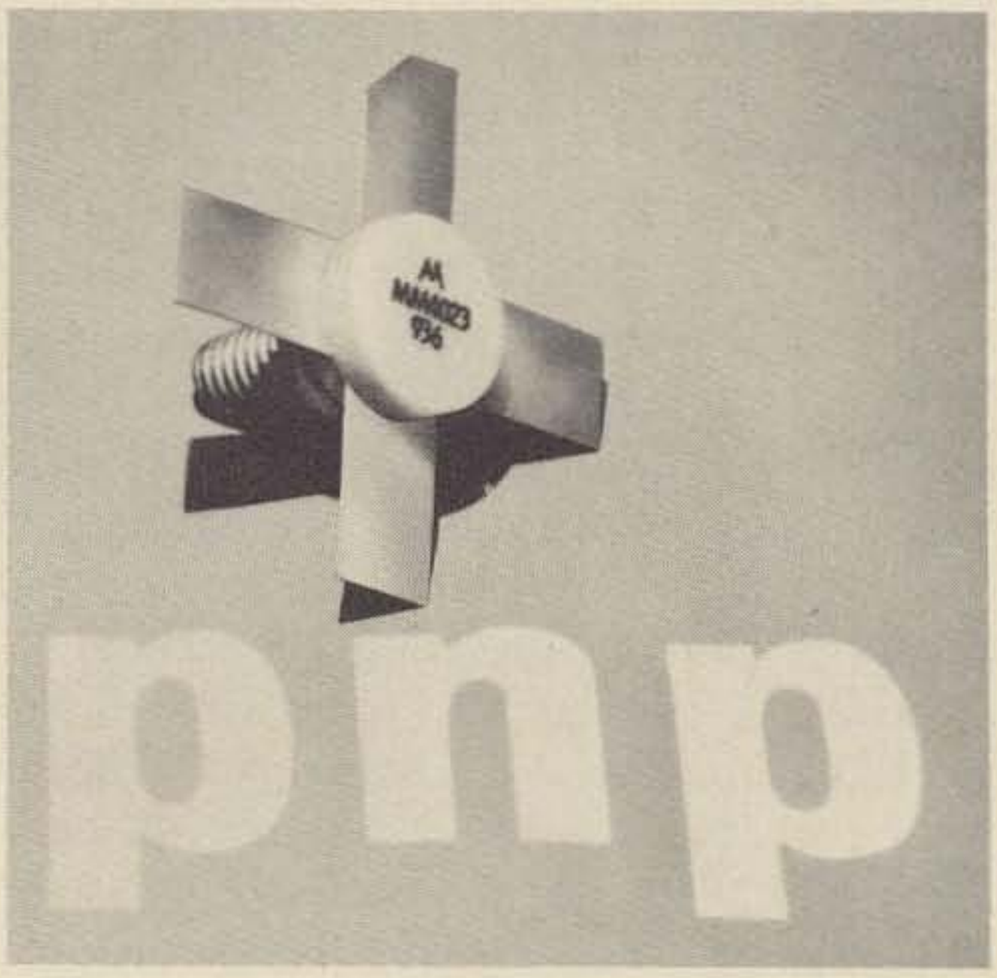
IC Breadboard Socket



A new device is now available for breadboarding with 12-lead, round TO-5 integrated circuits. The device consists of an epoxy glass wafer, 2-3/8 x 1-5/8 in., on which is mounted a 12-pin socket, the tabs of which have been soldered to two adjacent rows of reliable solderless terminals.

The device should speed IC breadboarding because as many as four solderless connections can be quickly made to any terminal pin with ordinary hook-up wire. If discrete components are required, they may also be easily connected. *Vector Electronic Co., 12460 Gladstone Ave., Sylmar CA 91342.*

Power Transistor Line Expanded



Four new transistors have been added to the industry's only line of silicon PNP rf power devices. The transistors, types MM4020 thru MM4023, bring to nine the number of devices in Motorola's PNP rf power family and increase the variety of output powers available to the designer. These now range from 0.5W to 40W @ 175 MHz.

Each of the transistors features balanced-emitter construction for maximum safe operating area, isothermal design for flat power output versus temperature performance, and low lead inductance stripline packaging.

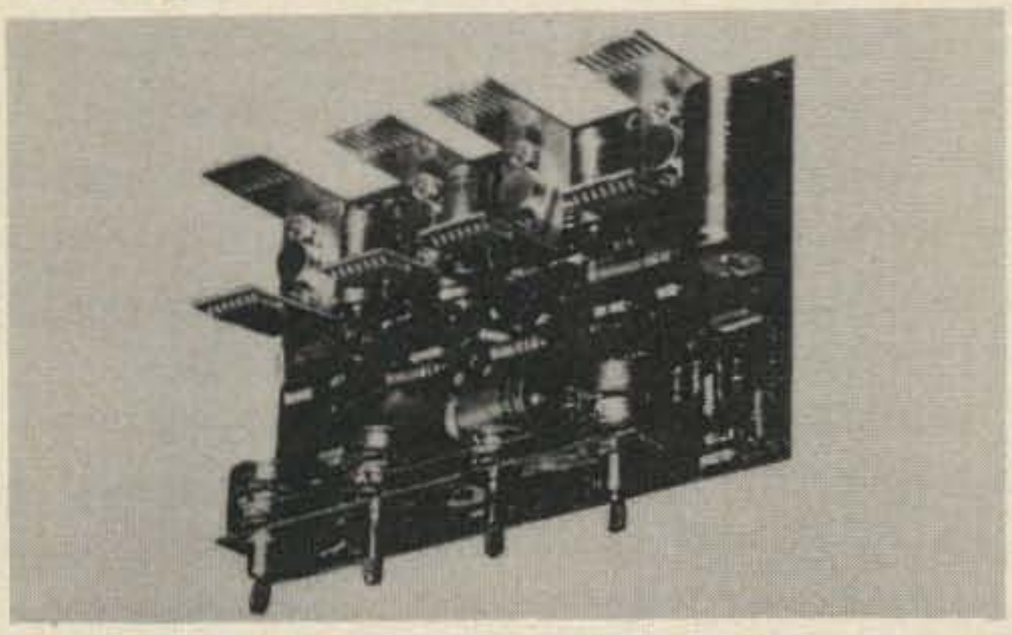
The transistors are designed for the 12.5V VHF large-signal amplifier amplifications required in military and industrial equipment operating at frequencies up to 250 MHz.

In the unusual construction used for the four new transistors, thin-film Nichrome resistors in series with each of the multiple emitters distribute power evenly throughout the chip. This technique prevents "hot emitters" and results in maximum safe operating area and a rugged device that

stands up under the high voltage standing wave ratio conditions sometimes occurring in a mistuned rf system.

The MM4020/21/22/23 transistors bring another important characteristic to the rf designer – exceptional output power stability versus temperature – through the use of isothermal design. This type of transistor design insures the even generation and flow of heat in and from the chip so that the "power slump" usually encountered in an rf power device operating near its maximum frequency is nearly absent. *Motorola Semiconductor Products Inc., Box 20924, Phoenix AZ 85036.*

Amplifier Modules in Semi-Kit Line



Eight different special and general-purpose audio amplifier modules are being offered by GC Electronics Division of Hydrometals, Inc., as part of its new Calectro-Amperex line. Basic module shown here is a 20-watt stereo amplifier, which is blister-packed and displayed on a pegboard rack. The line also includes lower-power hobbyists' amplifiers and guitar amplifiers, along with a professionally finished universal chassis/cabinet kit. *Ivens Stanton Assoc., 122 East 42nd St., New York NY 10017.*

Miniature FM Mobile Unit

The Regency solid state Model HR-2 features a 10W of rf power output with operation on any of 12 transmit and receive channels. The receiver section of the new radio is double conversion, superheterodyne with a highly selective ceramic filter for operation on both wide and narrow band signals. Sensitivity is rated at 0.35 μV, 20 dB quieting. The transmitter features phase modulation for exacting

carrier stability. Individual trimmer capacitors enable frequency netting for optimum performance in point-to-point or repeater applications. Built-in swr load mismatch circuitry protects against open or shorted antenna conditions.

The 2¼ x 5½ x 7½ in. package comes complete with plug-in ceramic microphone, built-in speaker, and mobile mounting bracket. One pair of factory installed transmit and receive crystals on 146.94 MHz are included in the $229 amateur net price. *Regency Electronics, 7900 Pendleton Pike, Indianapolis IN 46226.*

High Power on 450 MHz!

Requiring only 8–10W of rf input power, the Alpha PA-100 UHF amplifier will achieve a power output of 100W. Designed for fixed base station or repeater use in the 450 MHz band, this compact unit has a self-contained solid-state power supply, no electromechanical moving parts, and requires only 5¼ in. of rack space. The true integrated coaxial plate cavity construction assures high plate efficiency and low plate operating temperature, making possible continuous-duty use while assuring long component life. The grid input circuit works to suppress harmonics generated by the input transmitter, thus reducing the problem of intermod. The PA-100 is said to be easy to install and is ideal to upgrade existing low-power repeaters or base transmitters. *Alpha Electronic Services, 8431 Monroe Ave., Stanton CA 90680.*

High Power on 2 FM

The new "22'er FM" by Clegg features 60W of rf input power plus a highly sensitive TUNABLE receiver. Ten crystal-controlled channels are available for transmit. Made in the United States. *Clegg Associates, Inc., Littell Road, East Hanover NJ 07936.*

Solid State Transmitter-Receiver

Another 2 meter FM transceiver has just been introduced to the amateur scene. The unit sells for $250, has a 5W transmitter, 6-channel receive-transmit, FET front end. The i-f's and af circuits are IC, and the unit comes with two installed channels (.94 direct and .34–.94). A front panel meter indicates signal strength and rf output relative power. Price includes mike, bracket, and dc power cable. *Telecomm, Box 461, Cupertino CA 95014.*

Phase-Locked-Loop Linear IC

Two new "phase-locked loop" linear integrated circuits are ideally suited for such applications as accurate multiplication and division of frequencies virtually in any ratio, according to *Arthur E. Fury, Manager of Linear Product Marketing.* Range of operation extends from subaudio frequencies to VHF.

"These units are unique in the industry," Fury said, "because they are designed to perform mathematical functions that are quite impractical with digital circuits. Our devices can multiply, divide, and even fractionalize frequencies virtually in any ratio. For example, they can divide a fundamental frequency by 10/3, if desired, a process which is virtually impossible with digital devices."

Operating range of the 562, a model of the device fabricated with a dielectric isolation process, is 0.1 Hz to more than 50 MHz. The 562 chip is 67 by 75 mils in size. Signetics engineers designed the two new phase-locked loop circuits in direct response to comments received on the first PLL linear circuits which were introduced by the company several months ago. "We have added a number of features," Fury said, "which makes the phase-locked loop more useful for specific applications. Most important among the features is that we have opened the loop and provided connections that permit the insertion of external devices into the loop circuit."

Four separate sections comprise each device: a phase comparator that also operates as a multiplier and mixer, a low-pass filter, an error-signal amplifier, and a voltage-controlled oscillator. The loop circuit has been opened between the VCO and the phase comparator.

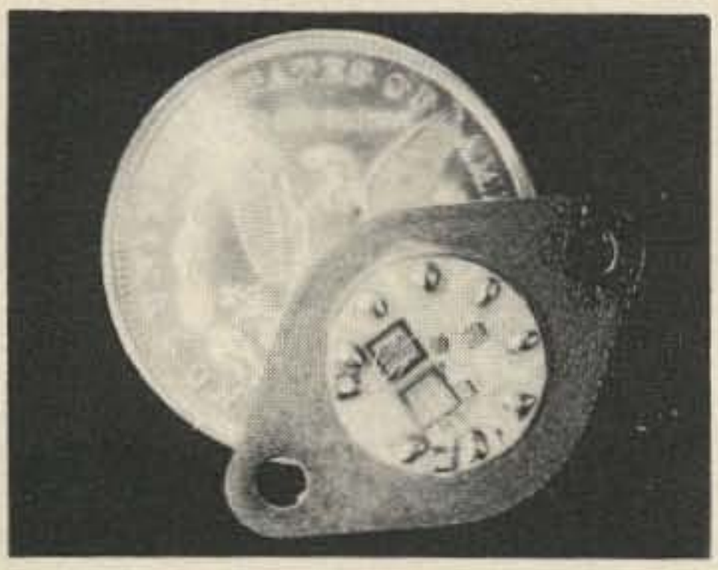
Additional information is available from *Signetics Corp., 811 East Arques Ave., Sunnyvale CA 94086.*

Low-Harmonic High-Power Linear

Raytrack Company of Columbus, Ohio is introducing its new lowband linear amplifier, the DX2000L. This amplifier has an input capability of 2 kW PEP SSB, and 1 kW AM, CW, and RTTY, and is for operation on the 80–10 meter bands. The DX 2000L is the first high-power linear amplifier to use a hybrid tank circuit (Raytrack's unique toroid and air inductor combination). This system gives the DX2000L extraordinarily high efficiency on all of the 80–10 meter bands, and, in combination with the pretuned toroid input makes this amplifier far less prone to radiate TVI, according to the manufacturer.

Two zero-bias triodes (EIMAC 3–500Z) are operated in class B and are preneutralized for maximum stability. Other features include: an adjustable alc output (negative feedback) that is compatible with all standard equipment; an exciter feedthrough that eliminates the need for additional relays to operate the exciter only; *precision* taut-band meters; and a very handsome case. The DX2000L has a separate power supply that is included in the price. *Raytrack Co., Columbus OH.*

Hybrid Power Amplifier



TRW Semiconductors announces the addition of the HMD 2000 hybrid power amplifier to their microelectronic product line. This amplifier can be operated in either a linear or switching mode with capabilities of delivering 3A peak current for power supplies to ±25V. Mounted in a TO-3 package, it is ideal for a broad range of applications including switching; class B servo; hi-fi audio amplifiers, and motor drivers. Power amplifier is priced at $10.50. *TRW Semiconductor Div., 14520 Aviation Blvd., Lawndale CA 90260.*

Yipes, It Talks!

W. Edmond Hood W2FEZ
116 W. Park Street
Albion NY 11411

I shall never forget one Hallowe'en, long ago when I was a neophyte in electronics. My dear old grandmother, God rest her, came into the parlor ready to settle down with a good bloody murder mystery. It was quite late and the whole family, she thought, was sound asleep. She switched on the light.

"Good evening."

Grandma jumped back. Then, getting a grip on her nerves, she quickly checked the closet, looked under the couch and behind the curtains. She was quite alone in the room.

"What 'cha looking for?" It seemed to be coming from the coffee table. An old newspaper lay innocently on the table. Grandma adjusted her glasses, bent over the table and scrutinized the paper. She was breathing rather hard.

"Lady, you really ought to do something about those adenoids."

Grandma jumped back as if she had seen a rattlesnake. "It talked," she gasped, "The d——thing talked!"

"So, what's wrong with that? Do I get all shook up when you talk?"

Grandma was completely befuddled by now. The last remaining black hairs on her head had just turned snow white. Then a strange thing happened. She shrugged her shoulders, set her mystery aside, and began to talk. Of course she never told anybody about the conversation, but she confided with the newspaper that she hadn't had such an enjoyable conversation in ages. The two of them chatted together until the wee small hours.

I never had the courage to confess to Grandma that I had been the culprit. A few times after that, when she thought she was alone, she tried to strike up a conversation with other newspapers, but none of them were anywhere near as sociable as that Hallowe'en issue.

Since I've already mentioned that I had been the culprit, you've probably guessed that there was a loudspeaker concealed in the room. Not exactly. The secret really lay in the newspaper. If grandma had picked it up, she'd have caught on right away. Fortunately for me, she was far too polite to lay hands on her guest.

It's really a pretty simple thing to rig. All you need is a copy of the Daily Dirt and a package of aluminum foil. Open up a full sheet and spread a strip of the foil inside it. Fold the sheet over and lay another strip of foil on top. When you fold the sheet again, if you've done it right, the foil should be completely concealed and the paper should look the same as it did when it was on the news stand. The two pieces of foil should be insulated from one another by the paper. In other words, the whole business should look like a big capacitor. The next step is to wire it up, but before we do, let's take a look at how and why it works.

I said before that it is a big capacitor. I can qualify that slightly and say that actually it is an electrostatic loudspeaker. The

audio signal is impressed between the two foils. Since two oppositely charged objects attract each other, and since the audio signal consists of a varying voltage, there is a

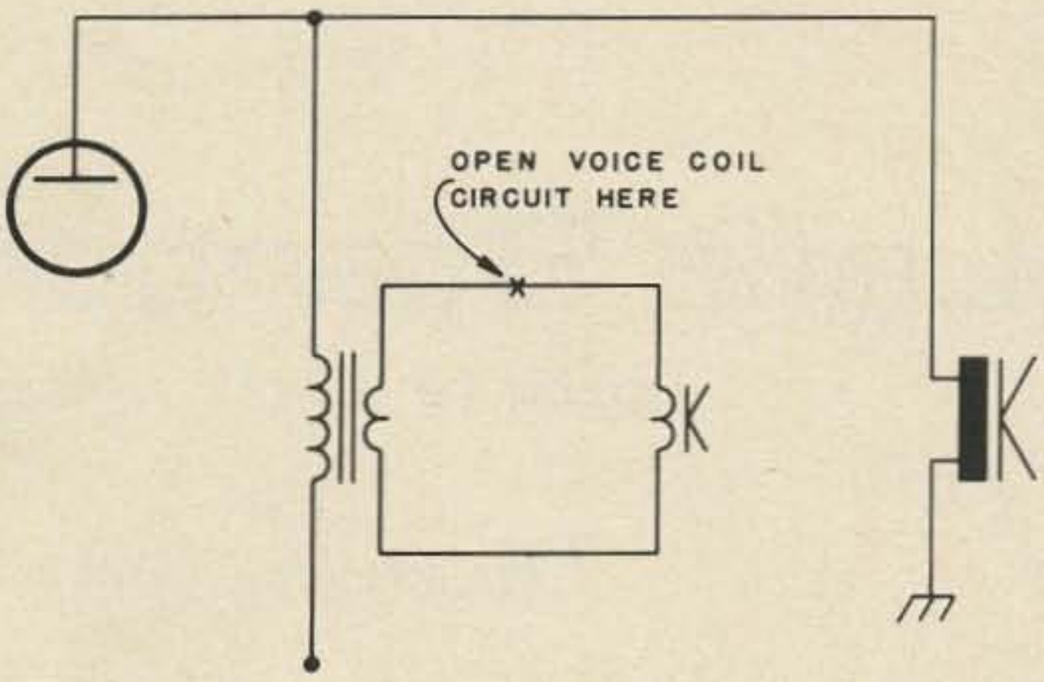


Fig. 1. Method of connecting electrostatic speaker to vacuum tube output.

varying attraction between the plates. The plates, in this case the foils, will therefore vibrate and reproduce the sound.

When I first rigged up this demonic device, solid state equipment was virtually unheard of, so I simply connected one foil to the plate of my final amplifier tube, and the other to the chassis. Electrostatic speakers work best when the audio is riding on top of a high dc voltage. This polarizing voltage, as it's called, was neatly provided by the plate supply voltage which was there anyway.

Nowadays most audio equipment is solid-state. Since solid-state operates under very different conditions, you will now have to artificially duplicate vacuum tube conditions. An electrostatic speaker, you see, is a very high impedance device, and so it must be fed with a high voltage signal from a high impedance source. You can meet this requirement by connecting a small output transformer in reverse. That is, the voice coil winding connects to the output terminals of your amplifier. The plate winding connects to the foils. A polarizing voltage of a hundred volts or so can be supplied either from a rectifier or from a battery, the capacitor, C, providing a path for the audio voltage.

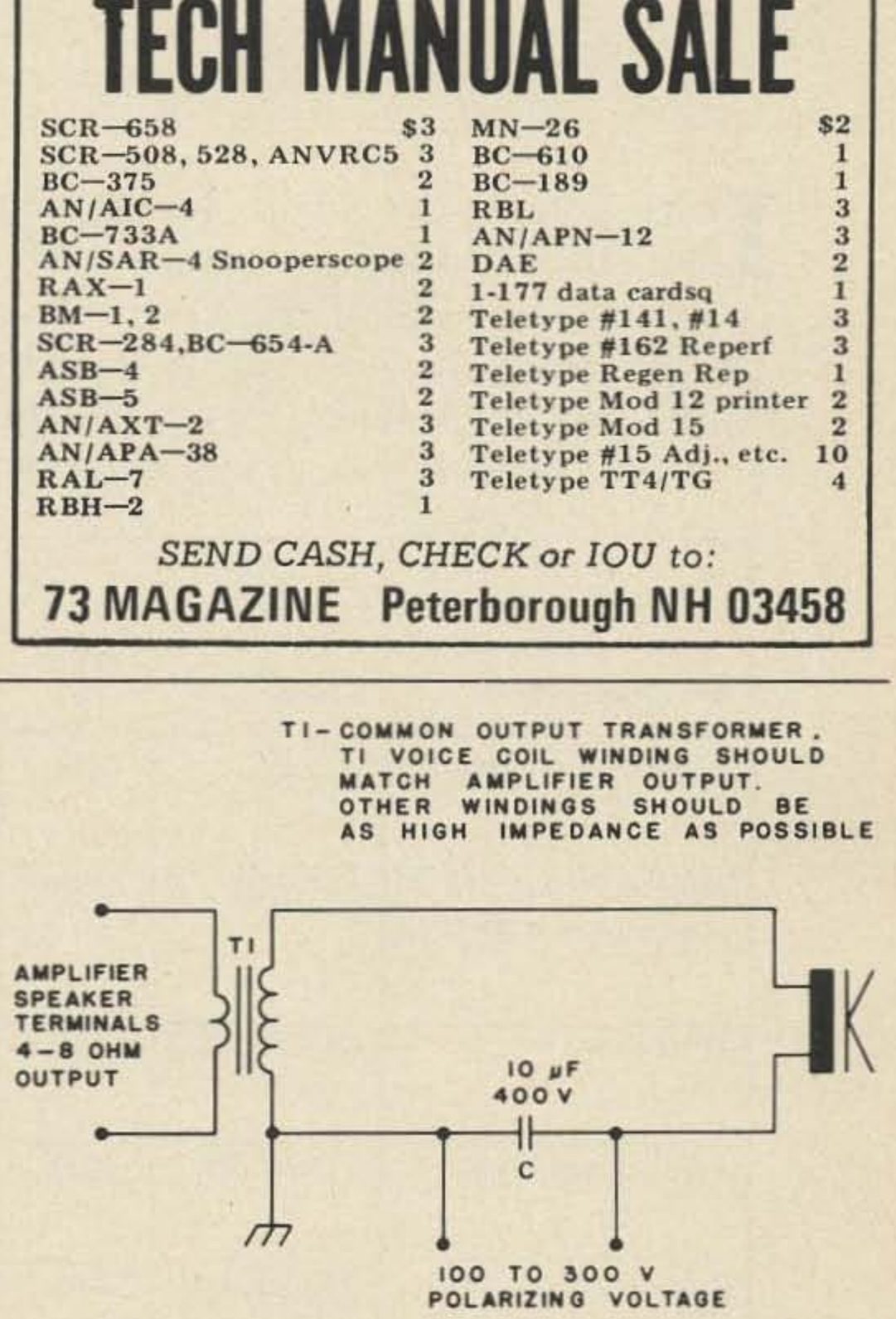


Fig. 2. Method of connecting electrostatic speaker to output of solid state amplifier.

Even if you do not have a sweet old grandmother to bug with this tomfoolery, it can still be an excellent party gag, and I know of no better way to have your best friends tag you as an absolute unmitigated nut.

. . . W2FEZ

REGENCY

an FM Late Starter

. . . could be a front runner!

Ken Sessions K6MVH

I have nothing but praise for Regency's new HR-2 miniature multichannel all-transistor 2 meter FM transceiver. This is far and away the best buy in American-made amateur FM units. It's priced right, it performs right, it has a very respectable output power, and it is one of the smallest units obtainable. And it has some very desirable features that none of the other manufacturers have thought of yet.

Of all the good points, the price itself is the most impressive. At $229 there should

Manufacturer	Model	Price ($)	Channel Combinations Available	Total Xtals T	R	Mfr Loc	Xmtr Pwr Out (W)	Rcvr Sens (μV - 20 dB)
Regency Electronics	HR-2	229	12	6	6	U.S.	10–12	0.5
Galaxy (Hy-Gain) (w/power booster)	FM-210	230	9	3	3	U.S.	2.5	1.0
Telecomm	FM144-10F	250	6	6	6	U.S.	10	0.5
Varitronics (Inoue)	FDFM-2S	270	6	6	6	Jap.	10	0.8
Standard	SR-C806M	349	12	12	12	Jap.	10	0.5
Varitronics (Inoue)	IC-2F	349	36	6	6	Jap.	12–15	0.4
Clegg Associates	22'er	400+	Tunable	10	0	U.S.	30	0.4
R.L. Drake Co.		329	12	12	12	Jap.	10	0.5

be no reason at all for any VHF enthusiast to put off going to FM any longer. You're just not going to get on 2 meters FM in style for anything less.

Now let's take a look at what you get for that $229:

How about power? The Regency HR-2 runs between 10 and 12 watts *output*. The Motorola transistor that the Regency unit uses in the final rf amplifier is guaranteed to crank out at least 10 watts, and the people at Regency are making sure that each unit produced meets or exceeds that specification.

Deviation level. When the Regency leaves the factory, the deviation is set at 10 kHz. Since this is a little much for the New England repeaters, I had to crank our test model down to about 7 kHz. The deviation can be adjusted anywhere from less than 5 to slightly more than 15 kHz with an easily accessible pot inside the rig. The unit comes with microphone, too, by the way – and from reports of the local repeater groups, the audio is exceptionally clean.

What about the receiver? The receiver is a dual-conversion superheterodyne type with six-channel capability. It is relatively broad-banded, requiring no peaking on individual channels in the 2 meter range. A ceramic filter in the second i-f stage gives adequate selectivity for most metropolitan areas, even where adjacent channels are active.

If you buy this rig and later decide to add crystals, you've got to be a bit choosy as to where you buy your rocks. The HR-2 has no means of rubbering "receive" crystals onto frequency; if the crystals are off, your receiver will be off. The people at Regency say nobody will ever have trouble if they order from Sentry Manufacturing Company (Oklahoma), International Crystals (Oklahoma), or Shepherd Industries (Kansas). To my mind, the lack of

Accessories Included in Purchase Price	Extras You Must Buy	Comments, Special Features	Problems, disadvantages
Microphone, power cord, mobile mounting bracket, crystals for 146.94.	None	See text	No meter; no receiver rubbering capacitors.
Power plug.	ALL	Power booster supplies 24V dc to final transistor to bring the rf output up to 5W. (costs $50 extra).	No accessories, no meter, unstable rubbering capacitors.
Mike, mobile mounting bracket, power cord, crystals for 146.34 and 146.94.	None	Panel meter for rf out & signal strength.	Test unit did not meet specs.
Mike, mobile mounting bracket, power cord, crystals for 146.34 and 146.94.	None	Illuminated panel meter for rf out & signal strength in.	Antenna connector makes sloppy fit to VHF connector.
Mike, mobile mounting bracket, power cord, crystals for 146.94.	None	High/low power switch; illuminated panel meter. Add-on amplifier avail.	Squelch and volume controls too tiny for easy mobile operation.
Mike, mobile mounting bracket, power cord, crystals for 146.34 and 146.94, antenna connector, spare fuse, connector for optional external speaker. Discriminator test socket and plug.	None	Panel meter illuminated white on rcv, red during transmit. Meter indicates S-units and rf out. Freq selector switch is concentric so xmit and rcv channels are independently controlled.	
Ac/dc power supply, microphone, power cords for ac and mobile operation.	None	Built-in ac/mobile power supply.	Tunable receiver. Too large for mobile use. Tube-type transmitter final.
Mobile antenna, coax, mobile mount, mike, ac/dc pwr splys.	None	Built-in ac/mobile pwr supply. Extremely selective & stable rcvr.	Transmitter has vacuum-tube final.

Amateur Test and Measurements by W5REZ. $5.50
Using VOM, scope,VTVM, dipper, SWR bridges, etc. Covers amateur uses of test equipment in the ham station. 208 pages, softbound. Interestingly written, covers tuning receivers, all kinds of transmitters, etc. Invaluable for every hamshack.

Electronics for the Amateur by W5REZ . . $7.95
Hardbound book, 272 pages. Covers entire theory needed for passing amateur licenses. Fine book for instructors, and for amateurs wanting a refresher course before exposing themselves to the FCC examiners. Hardbound books look nice and last.

Handbook of Transistors, Semiconductors, Instruments and Microelectronics by Thomas $14.50
453 pages, hardbound. For the working engineer, circuit designer and technician. Very thorough. Limited supply. Published at $25.

IBM Electronic Circuit Analysis Program By Jensen. Hardbound, 400 pages, published at $25, limited supply at $9.00.

Radar Detection by DiFranco. Hardbound, 654 pages, published at $20, limited supply $8.00.

Audio Systems by Crowhurst . . . . . $7.95.
Audio for the engineer, the hi-fi addict, and the broadcast engineer. Every radio station should have this handbook handy.

Electronics Reference Handbook Hardbound. $7.95
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This is a book on isolating the circuit containing the TV defect, not a theory manual. It should help you get those sets moving.

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Electromechanical Devices for Energy Conversion and Control Systems, by Del Toro
Published at $25. Limited supply at $10. Hardbound, 617 pages.

tweaking ability on the receiver is a distinct disadvantage – but it is overshadowed by a considerable margin when I consider the unit's sales price.

Special features? The most useful single feature of the HR-2 is its multiplicity of transmit–receive combinations. There are six crystal positions each for the transmitter and the receiver, but a twelve position switch is used for selection. The first six positions on the switch (numbered 1 through 6 on the faceplate) select the six crystal positions, and the next six positions on the switch (labeled A through F) can be used to select specific combinations of the various crystal sets. Positions A through F are chosen by jumpering on the switch itself, so that there are a total of 12 available channel sets from only six sets of crystals.

How does the Regency HR-2 stack up? Probably the best way to determine the relative merits of the HR-2 is to compare the unit with other 2 meter FM transceivers. The chart on the preceding pages will give you an opportunity to make your own comparison and evaluate the features you consider to be the most important.

...K6MVH ■

73 BOOKS FOR HAMS

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Does math scare you? — It shouldn't. This easy-to-understand book explains the simplified exponential system of arithmetic, simple formulas, logarithms, and their application to the ham shack. 50¢

FM ANTHOLOGY

Vol. I. This book is largely a collection from FM Bulletin, edited by K6MVH and WA8UTB. The material is taken from the editions of February 1967 through February 1968.

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73 Magazine

Peterborough, N. H. 03458

Lew Christy WB6QQP
342 E. Second Street
Rialto CA 92376

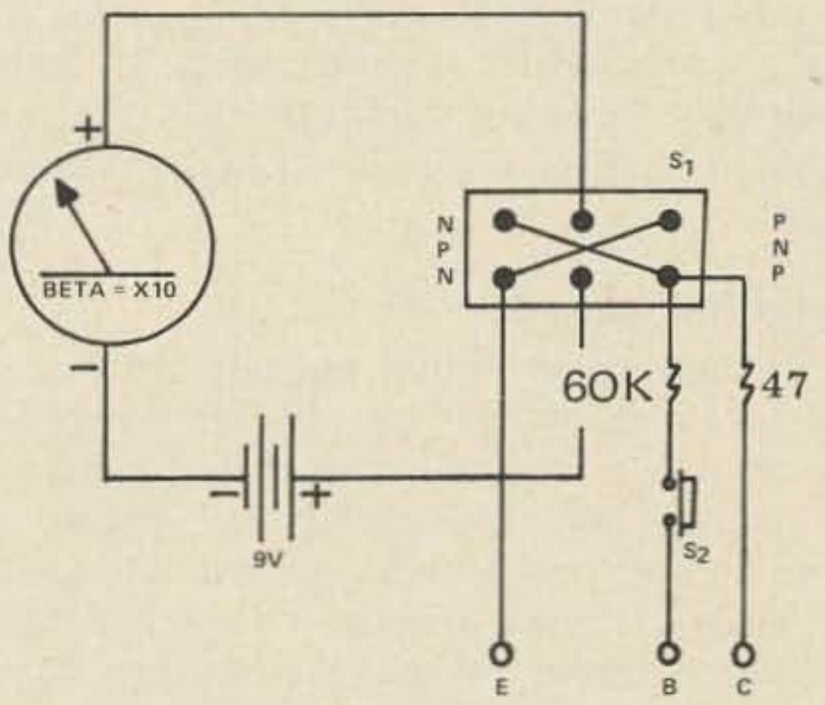
Transi-Test

Of all the various transistor tester projects that have appeared in numerous amateur radio and electronic magazines this past decade, I believe I have come up with a circuit that will outdate previous articles. Many of these projects have been designed so you may utilize a tester with your scope, VTVM, or some other gear.

This particular circuit, which I named the "Transi-Test," is designed with simplicity and is very accurate in measuring beta, leakage, and shorts. It will test any NPN or PNP transistor (signal or power). I also find it great in checking silicon or germanium diodes by using the emitter and collector leads to test for shorts and leakage. The Transi-Test is 100% portable, using a 9V battery for its power supply.

Most transistor testers employ a 4pdt switch for polarity, but this one is designed around a dpdt switch, which is easy to find at any parts store. To say the least, all the parts can probably be found in your own junkbox! I used a Premier #SPC-23 meter case to give the Transi-Test a professional appearance. The three test leads should extend 6 to 8 in. from the front of the case. For easy connection to small transistors, a micro alligator clip should be used such as the Mueller #34-C. Be sure to use an alligator insulator on the collector lead to prevent the emitter and collector leads from shorting together due to stiff test leads. This will save unnecessary battery failure.

If you do transistor servicing quite frequently, it is advisable to use a toggle switch (S1) which will last indefinitely. The only holes that have to be drilled in the case are for the three test leads, using rubber grommets. The SPC-23 meter case is already prepunched for the meter and two switches, which is why I happened to choose this particular one. Bud Radio also manufactures a case identical to this one.



After completion of this small project, you can rummage through your junkbox and start identifying those "lost cause" transistors that have been lying dormant all this time. I'm sure you will find the Transi-Test to be a very valuable test instrument on your workbench.

Lew Christy WB6QQP ■

been a strong factor in freezing the League into immobility. We cannot afford this paralysis in the 1970s. If directors were to attend four regional ARRL conventions each year (east, midwest, southwest, west) and consult the membership at open forums at these conventions, they could act immediately upon the wishes of the members. Their way would be paid to the four conventions by HQ.

Public Relations

A competent public relations firm (preferably run by an amateur) should be engaged to promote amateur radio with articles in national magazines such as Life, Look, Newsweek, Playboy, etc. They could coordinate amateur radio talent such as writers, cartoonists, and performers for maximum effect. They could help to organize ham films for television, for schools, and even shorts for movies. They could prepare strip slide shows for schools and libraries. They could prepare news releases for the papers and news services, thus making sure that amateur accomplishments reached the television, papers, and radio.

Club Material

In order to increase interest in radio clubs throughout the country the ARRL should have a wide variety of films available, covering all aspects of amateur radio operation...contests, DXpeditions, moonbounce, television, RTTY, traffic nets, mobile operation, repeater operation, etc. There are many amateurs that would be happy to work to produce films and slide shows on amateur radio subjects if only there were a central organizing effort. ARRL could provide this coordination. Films and slides can do a lot toward building club membership as any member of sports car clubs and skin diving clubs, will tell you. Amateur radio is almost alone in its lack of interesting program material for clubs. This should be a function of the League. Who else *is* there?

Outgoing QSL Service

Virtually every other national amateur radio society in the world provides an outgoing QSL service for its members sending cards to other countries. There are, as far as I know, no insurmountable problems stopping the League from providing a similar service. This should be carefully investigated from the viewpoint of finding out how to do it rather than trying to find out why it can't be done.

Legal Fund

The legal problems involved in setting up an emergency fund for helping amateurs fight lawsuits which, if lost, could seriously affect the whole amateur radio hobby should be investigated and overcome. Is there any real reason why the League should not help beleaguered amateurs in such legal fights?

Amateur Radio's Future

Satellite repeaters for FM and ATV are within the realm of technical feasibility today. The League should take the lead in planning for the future of our hobby. Even the cost of a set of satellite repeaters covering the whole world could be organized by the ARRL. Perhaps the techniques of multiplexing can be developed and applied to solve QRM problems on 20m and other crowded bands. Dialog in QST on new ideas should be encouraged.

Radio Clubs

It is possible that the role of amateur radio clubs could be expanded in the administering of exams for the FCC.Certainly the clubs could be a powerful factor toward developing new amateurs with guidance and encouragement from HQ. A monthly newsletter to provide dialog between radio club presidents and the directors might help encourage amateurs to take more interest in their future.

IARU Development

The International Amateur Radio Union, made up of the national amateur radio societies of the world and organized by ARRL could function better and provide better leadership if ARRL were to publish a monthly newsletter for all member societies. At present all that is provided, I understand, is a yearly calendar. Region 1 (Europe and Africa) periodically publishes newsletter. The amateur radio societies in the rest of the world might have more confidence in IARU if it provided some leadership and communications.

The IARU could spearhead a drive to collect older amateur radio equipment and ship it to underdeveloped nations. The shortage of equipment is one of the most important deterrents to new amateurs in these countries. India could have thousands of amateurs instead of a few hundred if only gear were available.

Unity of the IARU societies would provide unity toward the problems of the ITU and frequency allocations. Communications is the first step towards unity.

New Books

The ARRL book department should be turned upside down and cleaned out. One look at the Editors and Engineers handbook is enough to prove that a major change is needed in the production of books at HQ. The yearly ARRL Handbook changes like a glacier. Not only that, but one of life's more frustrating experiences is to try and learn radio theory from that book. This is not necessary as we showed with our license study courses.

Spend 25¢ and buy a copy of the ARRL book on "Operating an Amateur Radio Station." This publication is all too typical of League literature and is beyond description. As a director I would make every effort I could to see that those re-

sponsible for this type of claptrap were transferred to some other job.

The League has a responsibility to produce interesting and up-to-date books on every aspect of amateur radio. They should have thorough study books on each amateur exam, not memorization manuals as they do right now. They should have a definitive and continually updated book on RTTY, DX, ATV, FM, moonbounce, traffic, VHF, learning the code, high-speed code, frequency measuring, 160m, antennas, microwaves, etc.

QST can carry information on building gear, on new developments, and such, but books are needed to provide detailed information on specific interests. Obviously these would all pay for themselves.

New General Manager

Few amateurs with whom I have talked have had anything encouraging to say about their visits with the present ARRL manager. Though I don't talk with him often, I must admit that on each occasion I have found him to be as close-minded as the visitors have reported. If he were capable of doing his job we would not have the growing problems here and all over the world which he has brought upon us.

Were I to be elected a director I would try to get the other directors to start looking for a suitable manager for ARRL.

It would not be simple to find the right man for this difficult job. There are many qualifications that he should have to be worthy of consideration. But you may be sure that such a man exists and that it is important that he be found before it is too late.

What sort of man do we need for this post? As I see him, he should be a man who has devoted a good deal of his life to amateur radio. He certainly should have a record of being interested and active in several branches of the hobby...DX, TV, RTTY, VHF, FM, traffic, etc. I would expect that he has done a good deal of building and designing. I would think it strange if he had not had several articles published.

The ARRL is a $1,500,000 business, so we should expect our man to have experience in running a medium-sized business. One of the problems at HQ is mismanagement of finance. There is no shortcut to business knowhow.

Our manager is also the editor of QST, so some background in publications would be valuable. He will need this to help cut the present runaway costs of publication of the magazine. Of course he could learn about all this after being hired if you like the idea of on-the-job training at your expense.

Our man should be able to speak well in front of large groups. The general manager is also a front man for ARRL and must attend most ARRL functions as host. He would also be expected to speak for the United States at international gatherings and at the ITU.

One would hope that the manager of the ARRL was highly intelligent. Can we afford to have a mediocre brain at the head of 265,000 U.S. amateurs? And remember that he is the titular head of amateur radio worldwide. This spot calls for all the brains we can muster.

I suspect that we should also be sure that the man we choose is one with a long history of getting things done. A man's history speaks for him. If he is too wealthy he has devoted himself to wealth alone and not to other interests. Has he a wide number of accomplishments? Is he well read? Will he be interested in working for a modest salary with his major payment in achievement? The answer is simple, of course. If you ask any director of any large corporation how he goes about finding a new general manager, he will tell you that there are a number of organizations that specialize in just that. You consult one and let them find your man.

Most of the directors that I have talked with recognize that it is important for them to locate a new general manager, but they are afraid to take the bull by the horns.

Other Ideas

This is by no means the end of my ideas for improving the ARRL, but I have probably lost 90% of my readers already and should shut up. Now that I've told you some of the things I would try to do if I were elected director of the ARRL, perhaps you can encourage your own director to go ahead with some of them. Or you can work to get a director elected that will do what you want.

73 at Boston

The ARRL National Convention hit Boston in the fall this year, providing a splendid display of New Hampshire foliage for those interested in beauty.

When I got word from the convention committee that no one from 73 would be permitted to speak at any convention function, I made arrangements to hire an auditorium room in the hotel to provide forum space for those interested in FM, repeaters, ham politics and my slides of Jordan taken just before the civil war there.

In 1969 we took along an international Crystal microwave oven and cooked some New Hampshire hotdogs as a feature of our exhibit. This was popular, but I didn't want to repeat so we decided to have some freshly squeezed New Hampshire apple cider along with fresh home-made New Hampshire donuts this time.

On the Friday afternoon before the convention we went up to Hancock (N.H.) and helped Joe Quinn run off almost 30 gallons of the best apple cider you ever tasted. Early Saturday morning we stopped by Crane's Bakery in Jaffrey (N.H.) and picked up 73 dozen old-time New England donuts. None of those machine-made crullers for us! There wasn't a really round one in the bunch.

We served the cider and donuts all day Saturday in between slide shows, forums, and talks in our auditorium room. By the way, one really outstanding show was put on by George Pataki YO2BO, showing slides of visiting DX hams and his recent visit to DX'ers in Europe.

To those who have written to thank us for the feed and the programs, we hereby acknowledge your notes and want you to know we appreciate your thoughtfulness.

A Look Around 73

In looking at last year's staff picture we see several absentees, alas. Two of our gals left to get married, and a third left to work with her husband who started his own business.

We've had some interesting replacements for the dear departed, starting with Nancy, who was with us back in early 1970, but had gone off to seek her fortune in Colorado, and returned, she's not sure why. Nancy puts together most of the ads in each issue as well as laying out many of the articles. Jan, the other gal in the art department, does most of the rest of the articles. In her spare time Jan is an outstanding artist, joining Lin out in the 73 art studio afternoons and weekends.

Ken Sessions (K6MVH) has added a new dimension to the editing of 73, as well as an almost undetectable tendency to favor FM articles. Ken is responsible for the new arty look of the articles in 73.

Taylor Sage joined us recently and does just about everything that we can't get anyone else to do, from supervising the maintenance of the HQ building to keeping our recalcitrant machinery running. His wife Gigi handles the bookkeeping.

In our print shop we have Jeff Parsons and Biff Mahoney, who run our three offset presses, turning out local job work as well as office forms, advertising letters, and stuff like that. 73 is printed in Wisconsin, not here, but we do have complete facilities for smaller printing jobs and turn out our books right here.

Nixon Letter Reprints

Several clubs have called and written asking for bulk copies of the October 73 Action Coupon addressed to President Nixon. This coupon requests an investigation of the recent increase in license fees for radio amateurs. If you would like reprints of this page just send a self-addressed stamped envelope to 73, Peterborough, N.H.03458 and indicate how many reprints are desired.

Ham Bumper Stickers?

Several readers have suggested that bumper stickers be made available for amateurs. Since we have dandy facilities for printing up bumper stickers here at 73 we are all for the idea. But what do you want on the stickers? We are open for any clever suggestions. The only sticker we have seen so far is BAN THE HAM, and that doesn't seem appropriate.

73. . .Wayne■

Leaky Lines *(cont. from p. 14)*

season, but who lapse into a state of sudden paraplegia when any mention of the FCC examination is made. They remind me of some unnamed soldiers of my acquaintance, who, never having served overseas in World War II, wore some unauthorized ETO, Asiatic Theatre, Persian Gulf Command or Purple Heart ribbons on their tunics when they went out on dates with young and impressionable (or old and impressionable) females.

I know that I am running the risk of falling into disfavor with the 35,000 odd Conditionals when I say this, but I feel strongly that some changes in this situation are long overdue. Perhaps I am being unduly harsh toward the Conditionals, but ever since the implementation of Incentive Licensing, I think most of us tend toward a less permissive and less tolerant attitude concerning all "something-for-nothing" advocates.

I am already considered *persona non grata* among large numbers of Techs who objected to my published views with respect to the granting of a portion of ten meters on an exam-free basis. They labeled me with every pejorative in the book, and with a few even I had never heard before. And I suspect that this new call to sanity will place me squarely in the path of the "slings and arrows of outraged Conditionals." So be it. Might just as well be hanged for a sheep instead of a goat.

I truly believe, and I am confident that many share my view, that all classes must somehow be drawn into the vortex, the mainstream if you will, of the present context of licensing. Operating a ham station is a privilege, not to be taken lightly. Any preferential exceptions to the standards which are now being demanded (intermediate in difficulty though they may be) constitutes a very real disservice to all those who have been compelled to upgrade in order to maintain their allocations. Unless all amateurs are governed by identical rules and regulations, subject only to *legitimate* exceptions for *valid* reasons, the entire Incentive Licensing structure becomes an empty mockery.

Simply stated, I am calling for the abolishment of the Conditional class license. Now, hold on a minute . . .I didn't say I was calling for the delicensing of Conditionals, but merely for the retirement of the category. I have thought for a long time that the designation "Conditional" implies by its very name a type of second class status, carrying a certain stigma with it. Since the privileges of the class are identical with the General ticket, the only reasons why it is maintained are: (1) the holder is physically handicapped, or (2) he lives in an area so far removed from an exam point that a journey thereto would consittute an unreasonable hardship, hence has not taken the customary FCC administered exam. He has, however, attested to his proficiency in the required tech-

nical elements, by taking an exam by mail, supervised by a volunteer examiner. In all other respects the grade of license is not distinguishable from the General license. Why then must he be given this appellation "Conditional"?

An apt analogy is that of native born citizens and naturalized citizens. Both are entitled to exactly the same rights and privileges. Both are expected to shoulder the same obligations and responsibilities. No one asks a citizen whether he is native born or naturalized. He's an American citizen, and that's that! Another case which comes to mind, unfortunately still not expunged from American life completely, is the regrettable holdover from the unspeakably horrid days of Puritanism, when the innocent and blameless offspring of unmarried parents were stigmatized with the label of illegitimacy. Though they were not different in any way from others, they were regarded as inferiors, and because of this barbaric practice, were denied status in society in an unbelievably broad spectrum of areas . . .jobs, education, social acceptance, marriage, civil service, freedom from the mischievous, wagging tongues of the vicious hypocrites who enjoy making others miserable at every opportunity.

Let us grant that the mail exams have been on the up and up . . .that not a single Conditional was party to any hanky-panky. Despite this concession, there will always be those who will wink, place their fingers alongside of their noses and nod knowingly. So long as someone wears that designation on his sleeve he is fated to be suspected of having cheated. Since we have just finished granting that such is not the case, and since all the Conditionals have applauded my eminent fairness with enthusiasm, the next logical step would be to require some of them (just a few . . .75%, for example) to prove that our utter confidence in their integrity was well merited. Boy, I can hear the gnashing of teeth and the blue vitriol ascending into the air right now, really I can.

Why in the name of Tophet cannot some machinery be devised for the purpose of *taking the exam to the applicant* who cannot come in under his own steam. If a single volunteer examiner is regarded as untrustworthy, why not employ the services of (if you will forgive a Russian term) a 'troika' . . .three people are hardly likely to risk any joint dishonesty for fear of subsequent disclosure. They could undertake to administer the test to the truly handicapped person who cannot possibly get to the examining point. And the exam should be given the same weight as the regular FCC exam, with all credits applicable for higher grades. This should be limited to absolute establishment of the candidates' inability to get to the FCC office. All others should be required to meet the standards that have been established for the upper three license grades. If necessary, as seems likely, some of the additional revenues now being reaped from the increases in renewal fees (up 125%) could be applied to the establishment of additional exam centers, and could be used to help defray the salaries of additional personnel. Then, when the test is taken, either by the troika method or the FCC method, let the applicant be issued a General class license, completely indistinguishable from others, destigmatized and totally immune to the jibes and insults of any "first-class" amateurs who might feel an inclination to accuse them of skullduggery.

The fact is that we cannot, in good conscience, permit a large number of operators, comprising literally thousands of individuals, to continue to enjoy a privilege which is *earned* by the vast majority, simply by feigning physical disabilities which, in far too many instances, exist only in their wishful imaginations. We cannot continue to tolerate equality of participation by those who waltz blithely through the mile-wide loopholes of the law, which conveniently allow them to take the ticket while ignoring the basic technical requirements. No matter how sorely handicapped an individual might be, he should at least be required to conform to a standard within the limits of his own ability and competence. To offer him a completely free pass, an Annie Oakley, is not only derogatory to the rest of us . . .it is an insult to the integrity of every single Conditional with a legitimate reason for holding that grade . . .and there are many, many of them.

I am sure that we all know sightless hams, amputees, victims of dread disease, shut-ins . . .who have spurned the Conditional license, and who have insisted upon being examined in the standard fashion, just like everyone else, in order to avoid being deemed cripples or invalids. We are all mighty proud of them, for they are a source of inspiration, and their achievements set an example of courage for all of us. Within the framework of that type of pluck and determination, how can we possibly dare to countenance the flimsy alibis and "plea-copping" of the indolent, unindustrious, shallow cheats who masquerade behind the technicalities of legalistic gobbledegook, even though it may be within the definable semantic terms of the FCC regulations?

Isn't it time some changes were made?

* * *

I never saw the beat of it; when you write comment, many people take it as a personal point of privilege to challenge you on everything . . .opinion as well as fact. It is as though an editorialist had no right to express his own ideas . . .that somehow when he allows his name to appear on the printed page, he must express only that which coincides with what *they* think . . .all other ideas become invalid!

Really, you have no idea of the tone of reproof, sometimes downright abusive, which

even one's best friends are likely to use in disagreeing with this or that editorial point of view on any given subject. Take the recent growth of lists on the DX bands, for example. This has now become the chief target for the rugged individualist types who keep insisting that they prefer pileups.

I have no axe to grind either way. I have such a minuscule number of DX credits, that I'm happy to take 'em any way I can get 'em. So my views are not subjective . . .not based upon my own needs . . .therefore unprejudiced.

While it is perfectly true that a well operated station using standard power, a medium height tower and an ordinary tri-band antenna, is adequate in the average hurly-burly of a minor or medium-size pileup, it is decidedly at a disadvantage in the prodigious traffic jam which inevitably occurs whenever a rare one turns up. The recent operations at ZA, AC3, KP6, ZK1, and Gus Browning's Indian Ocean activities all demonstrated the folly of attempting to compete on an equal basis with the super-kilowatt boys with the sophisticated antenna systems. Those boys stick out like a sore thumb . . .many "dB" stronger than the other hundreds of poor shnooks calling in the pileup.

In such cases, the list method tends to favor the less powerful stations, enabling them to make QSOs which they would have very little hope of getting under normal circumstances. Of course, this displeases some of the big noises, who evidently feel that they do not wish to lower themselves by soliciting anyone's aid for the demeaning purpose of standing in line to make a contact . . .any contact. They seem to think that they should not be required to wait in line, but should be accorded instantaneous and undivided attention by whomever they call. They are perfectly willing to have everyone else stand in a long queue, twiddling the thumbs, just so long as it is not they who are made to wait. And whenever these certain parties hear a list operation in progress, a couple of them invariably try to break right in and call right on top of everybody, simply because they are just not about to get used to waiting their turn. When they are asked to move off because the DX is working to a list, they commence lecturing all and sundry on the evils of lists, and how this is likely to destroy amatuer radio. Or, they move off about two kilohertz and QRM the frequency with all of their side hash.

If ever there was a sterling reason for me to feel kindly disposed toward the lists, this would be it. I think that it is high time that some of these super-mouths on the bands were made to feel a little less secure about their positions on invincibility. It's time somebody gave them a comeuppance.

Well, anyway, to get back to the lists . . .I decided that maybe I would support a couple of them, not just to get in on the DX, but because I happen to be a strong advocate of their sponsorship of DX stations by distributing gear to them. So, I sent in a few bucks . . .not a large amount at all, and I had the unmitigated temerity to announce the fact on the air to a few fellows I know. Boy! That's when the eggs hit the fan! They wouldn't even control themselves to the extent of waiting their turn to tell me off. They said I was stupid, shortsighted, foolish, naive, ignorant, radical, vicious, treasonable, and that I was losing my marbles. They doubled, tripled, and quadrupled, drowning each other out in a cacaphony of indignant outrage.

Well, if there's one thing I've learned since beginning this column, it is this: Whenever you get an angry reaction as a result of something you've written, you can be pretty sure you're on the right track! Nothing gets people who have enjoyed an advantage (particularly an unfair advantage) more upset and riled than a movement toward equalizing the situation.

Of course, even if the edge could be taken away, they would somehow find a way to regain it. I know a couple of guys who would do it legally, by developing more efficiency in the antenna system, and that's fine with me. But the answer for many of them . . .far too many . . .would be an illegal increase in power. Don't ever get the idea that the so-called California kilowatt is confined to the Golden State. The overpowered stations are all over the map, and what's more, everyone knows it. And as long as there are people who are willing to sidestep the regulations by running illegal power, then I am solidly in favor of list-taking, because it is just about the best way yet devised for overcoming the overwhelming odds which have been unfairly lengthened by these cheats and chiselers.

TWO-TERMINAL CURRENT LIMITER

Gerald Beene
Greenville TX 75401

Many power supplies will not survive a short circuit. The reason for this is that in the low voltage supplies used for transistor circuit work, a series transistor is used to regulate the output voltage. If an unusually large current is demanded from the supply, and there is no current limiting, the peak current rating of the regulating transistor may be exceeded.

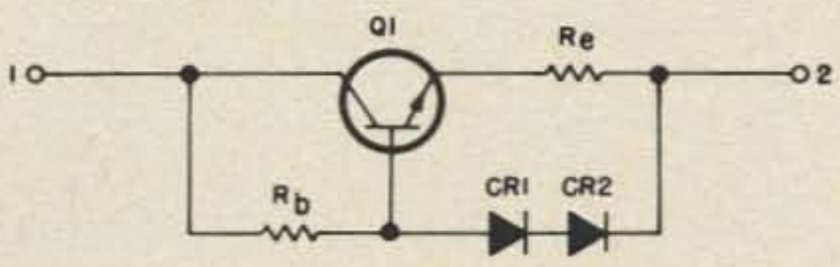


Fig. 1. Series current limiter circuit.

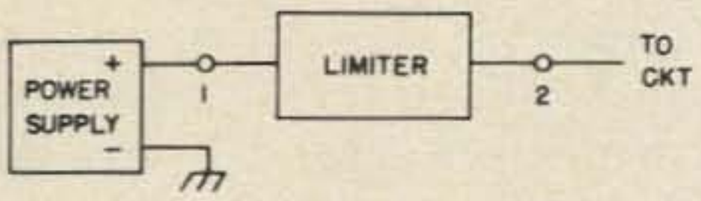


Fig. 2. Block diagram of limiter in typical application.

Other than the sensitivity of some power supplies to overload, experimental circuits are also subject to damage if for some reason excess current is allowed to flow.

A fuse alone will not necessarily provide the needed protection for current sensitive semiconductors.

The simple two-terminal current limiter shown in Fig. 1 will give instantaneous limiting for those slips of the probe, sudden shorts, etc. The use of a fuse in series with the limiter will reduce the need for a heat-sink on the transistor Q1.

The limiter is placed in series with the line so the current is from collector to emitter. Though shown polarized in Fig. 2, the limiter may be used with either polarity supply.

In order to design for a particular maximum current, select R_e such that

$$R_e = \frac{.6V}{I(amps)}$$

and make R_b about ten times as large as R_e. CR1 and CR2 are silicon diodes such as 1N4002, 1N645, 1N2070, or just about any diode capable of at least 100 mA. Q1 is a silicon transistor capable of the current to which the limiter is designed.

It works like this. R_b is small enough to keep Q1 saturated as long as CR1 and CR2 are not conducting. As soon as the voltages drop on R_e reaches 0.6V, CR1 and CR2 conduct and regulate the output current by regulating the base voltage on Q1.

Gerald Beene ■

Direct from 73

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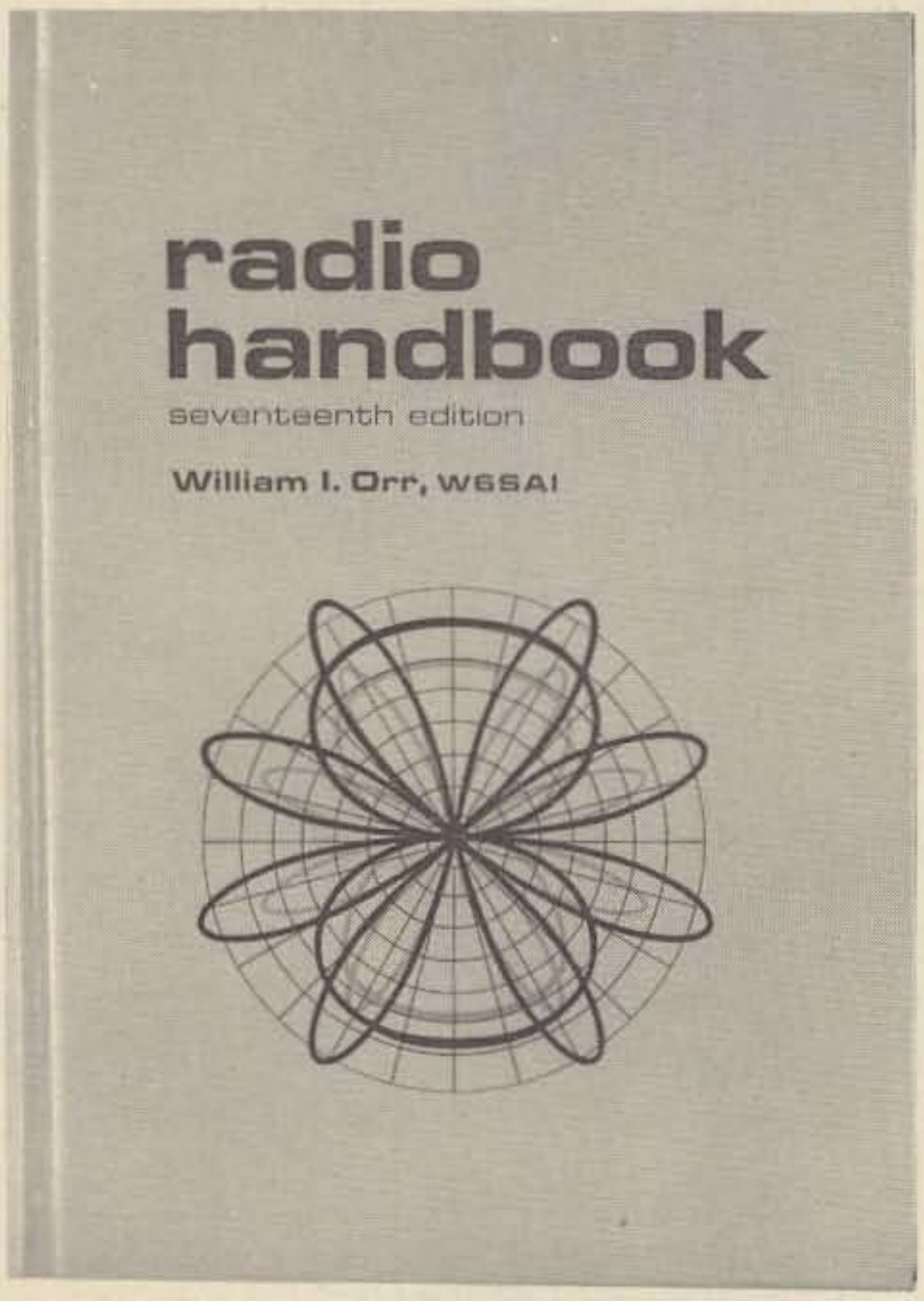

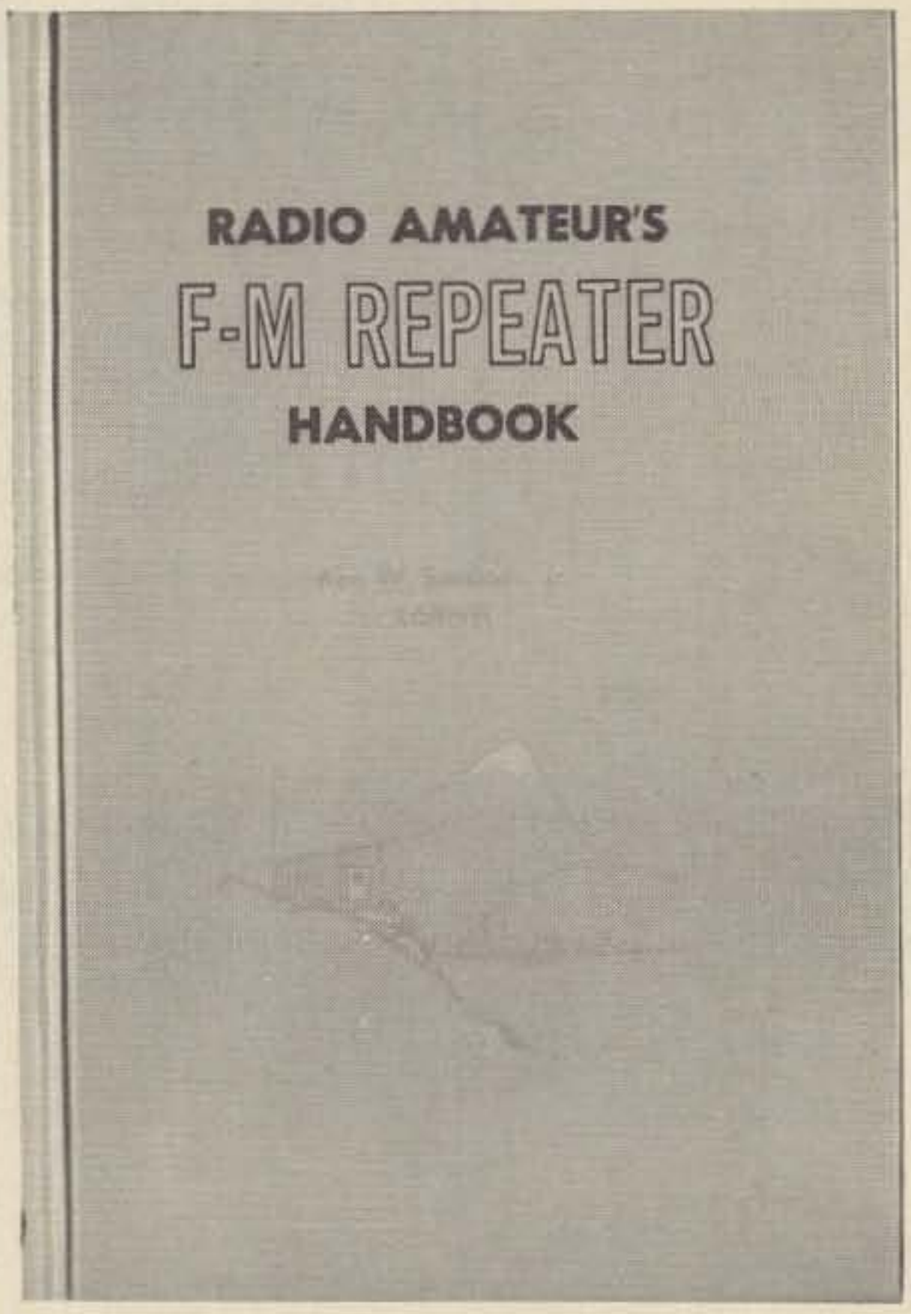

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73 ARTICLE DIRECTORY 1970

This master article directory lists, by subject, all the major articles featured in 73 Magazine during 1970. Entries are first by subject (alphabetically), then by article title (chronologically). A brief abstract of each article appears once, though the article itself might be listed under more than one category. When no abstract appears and a subject heading is shown in parentheses between the author's call and the date of publication, refer to the parenthesized subject heading to read the abstract.

Antennas

AAB—AM—FM Modulation System
W2BSP Jan
Tongue-in-cheek technical article about a system the author actually uses. He calls it "frequency aperture" modulation. The most interesting part of the article is the author's clever adaptation of a 55 gallon drum for use as a 10 meter cavity.

Base-Tuned Center-Loaded Antenna
W2EEY Jan
An antenna *can* be center-loaded without having the reactive element physically present at the center of the antenna. Transmission line transfer of the reactive element is the key.

Variable-Impedance Mobile Mount
W1EMV Feb
A rotary switch with a few capacitors can effectively change the matching impedance of a mobile antenna.

Quick-Stop and Reverse Antenna Rotator Circuit
PY2AUC Feb
A simple rotor modification to make the antenna stop when you want it to. Also lets you suddenly reverse the antenna's travel without fearing damage to anything too high to reach comfortably.

The Glop Will Get You if You Don't Watch Out!
W2OLU Feb
The effects of glop (dirt and crud) on antenna connections. Contains suggestions for minimizing the likelihood of Glop build-up.

18-in. Dipole for 15 Meters
K9LGH Feb
Supersmall antenna for cliffdwellers; incorporates two printed-circuit radiating elements.

Lossy Transmission Lines
KH6IJ Feb
A description of the effects of an antenna transmission line's losses, and a discussion as to the insignificance of swr measurements under conditions of a lossy line.

How to Megger Your Antenna
W2EEY Apr
A simple, proved method for periodically checking performance of a transmission line and antenna system. Can uncover faults not indicated by swr measurements.

7/8-Wave Mobile Antenna for 2 meter FM
W2EUP Apr
An expert describes an antenna of original design, and compares it objectively with other antennas of commercial manufacture. In the Buffalo area, this 7/8-wave antenna has held the FM mobile gain record since 1967.

5/8 Wavelength Verticals
WAØNGV May
Theory and information on 5/8-wave verticals of various descriptions. Includes radiation-angle data, construction information, and necessary equations for original design.

The Little Wonder: Mark II
W5ZBC — Jun
Another cliffdweller antenna. This one can be fashioned from an old pole lamp.

The 663 Beam
ZL2ASJ — Jun
Six elements on 10 and 15, and 3 elements on 20m. Construction plans were left out, but were printed in the Aug issue (p. 83).

Quarter-Wave Top-Loaded Mobile Antenna
W5AZE — Jun
An efficient, short quarter-wavelength dipole antenna for 20 meters.

Eleven-Element 2 meter Circular Quad
W4KAE — Jun
A new type of antenna that seems to have a lot to offer.

The Sly Beam
ZL4TAH — Jun
21 dB gain on 2 meters with a new approach to the construction of yagis.

Measuring the Difference Between Incident And Reflected Power
VE7BS — Jun
The difference is the difference. Includes circuit for measuring reflected and forward rf.

The Effects of Temperature and Frequency On Coaxial Cable Loss
W9KXJ — Jun
As transmission line temperature increases, so does loss — and vice versa. Complicating matters, the losses get worse as the operating frequency is raised. Includes charts.

Improving the Performance of Trap-Type Vertical Antennas
W2EEY — Jun
The addition of another element can considerably improve the performance of multiband verticals. The added element can be automatically bandswitched and a transmission line system used which allows simple changeover from an omnidirectional to a directive radiation pattern.

A Practical DDRR Antenna
W6WYQ — Jun
Ring-type low-profile radiator that is hard to build. Good for mobile rooftops.

Two Receivers from One Antenna
WA6UFW — Jun
An easy-to-make signal splitter that allows maximum utilization and minimum loss.

Remote SWR Indicator
W2EEY — Jun
Concentionally placed swr meters often do not indicate the true swr at the junction of the transmission line and antenna. Remote location of the reflected-power sensing portion of an swr unit is the key to true swr value indication.

The Low-Noise Antenna
WB6JNI — Jun
Blasting the theory that an antenna always works as well receiving as it does transmitting.

Measuring RF Output
WA6CPP — Jun
Using a cheapie meter to measure wattage.

Raising a Rhombic
W8DYF — Aug
All you really need is space.

Log Periodic Antenna Designs for VHF/UHF
W3DUQ — Aug
Three arrays are featured: 21—55 MHz, 50—150 MHz, and 150—450 MHz.

ATV: Getting a Better Picture
WA6BJV — Aug
Plans for a good antenna and suggestions for other station improvements.

Brew 1 on 2 — a 2 Meter Coaxial Antenna
WA0RWQ — Sep
The title is alluding to California's "Brew 102" beer. The article describes a beer-can coaxial antenna that can be fun to make if you obtain the cans as the author suggests.

Four-Wire Inverted Vee
WA6COB — Oct
Simple but effective antenna for 40 and 80 meters.

Remote Quad Tuning
W6AJZ — Nov
How to tune a quad stub from a control box situated at the operating console.

CW

The Combo
K4FQU — Jan
A CW monitor that is installed between the key and the transmitter. Contains but one transistor. Simple. Effective.

Mobile CW
K6RA — Jan
A fantastically great way to get yourself killed on a Los Angeles Freeway.

First Class Keyer Key
W6BLZ — Jan
Quickie article describes a cute modification to modernize an inexpensive but readily available "bug."

A CW Monitor
WB2GQY — Mar
How to get a 98¢ oscillator module to key on and off with rf. Uses a voltage doubler rf pickup.

Turning the AN/GRC-9 Into A Novice Rig
W6JTT — Mar
A simple conversion puts this surplus unit on 80 and 40 meters. Converted, the rig will run about 15W. Includes a detailed power supply circuit. Modulatorless, the transmitter is intended for CW operation.

What Will Become of CW?
W5TOM — May
A dissertation on the state of ham radio today, and suggestions for possible improvement. Makes a case — of sorts — for CW, and offers predictions for CW's role in amateur radio's future.

A Mobile CW Transmitter
W6BLZ — May
For those who don't know what to do with their free hands while driving.

CW Can Be Fun
Staff — Jun
An evaluation of Ord's DK-1 keyer.

QRP
WA3JBN — Jun
Two simple rigs for CW operation on 40 meters.

How to Build a Keyer and Retain Your Status as an Appliance Operator
W9KXJ — Jul
A couple of guitar picks and some relay contacts can turn out a pretty nice looking sending key.

Mobile CW Receiver
W6BLZ — Jul
For people who just can't seem to get enough code during the evening at home.

The ICmitter
Goldstein — Aug
Costs little and doesn't run much power, but it will put out a signal — AM or CW — on 40 through 160 meters.

Integrated Circuit CW ID Generator
W7PUG — Sep
A device for automatic identification — with CW — of FM repeaters. Author also offers to supply PC boards plus computer printout of any call letters, as optimized with the author's computer.

Low-Cost Automatic Keyer: A First Project
WB4MYL — Nov
Schematic, description, and circuit board layouts for an inexpensive keyer that can send from 10 wpm to over 30.

DX

How to Visit Foreign Countries
W2NSD/1 — Feb
A few salient hints for prospective travelers and sometimes DX'ers.

Ham Exchange
WA2ELA — Mar
First-hand report of a "ham exchange" whereby DX visitors stay with U.S. amateurs, then reciprocate later when the U.S. hams visit the DX country.

QSLing: Ham Radio's Own Con Game
VK4SS — Jul
One ham's negative opinion of the state of DXing today.

Latham Island DXpedition
5H3LV — Jul
Problems and successes in a recent DX trip to Zanzibar.

Worldwide ITU Prefix/Call Area List
W1SWX — Jul
Reprinted from DX'er Magazine.

YO — An Interesting DX
YO2BO — Oct
A look at Romania and a description of the hams and country.

FM

VHF—FM: A New Involvement
K6MVH — Jan
The story of FM Magazine's demise and the promise of 73 to give adequate attention to FM, an area all but neglected by ham journals in the past.

Low-Cost Electronics: Japan's FM Invasion
K6MVH — Jan
A brief overview of some of the 2m FM transceivers that are being inported for sale to the booming VHF ham market.

Setting Up the Tone-Burst System
W6TEE — Feb
The little details that are necessary in setting up a toned repeater, including a tone-burst timer for the user mobiles.

Tone Decoder for Remote Switching Applications
K6MVH — Feb
A simple and tested tone decoder that may be used for such repeater control applications as whistle-on and tone-burst access systems.

Encoders for Subaudible, Tone-Burst or Whistle-On Use
W6CZL — Feb
An extremely simple and stable transistor oscillator circuit, with adaptations for the various modes of repeater control. Includes PC board layout and construction plans.

Frequency Synthesis: The Modern Way to Control Frequency
W2EUP — Feb
A complete and comprehensive article covering theory and techniques of indirect frequency synthesis, plus schematics and a description of a practical 400-channel synthesizer used in a 2 meter FM transceiver, with only one frequency-determining crystal.

VHF—FM and You
K9STH — Mar
A "what's-it-all-about" type article covering everything that's happening in FM right now.

6-to-12-volt Filament Conversion for the 41V
W6YAN — Mar
Changing the cheaper 6V Motorola FM units to 12V types.

AC Power Supply Conversion for the Motorola 41V
K9PKQ — Mar
Schematic diagram and helpful hints for converting Motorola's trunk-mounting mobile unit to a base station.

Remote Multifrequency Oscillator for Surplus FM Units
W2ACM — Mar
Complete plans, PC layouts, and construction info for a four-frequency oscillator deck that can be used in the control head of such trunk-mounted units as GE, Motorola, Link.

Converting the Sonobuoy to a 2W FM Transmitter
W1BYX — Mar
Schematic diagram, photo, and instructions for converting the AN/SSQ-23A underwater transmitter to a 2W 2 meter FM rig. Also tells where to get such transmitters.

Kris Scanning Receiver
Staff — Mar
A close look at one of the newest entrants into the ham radio field.

A Look at Amateur FM Standards
WB6DJT — Mar
A general survey of the VHF revolution with respect to repeaters over the past few years and some suggestions for planning ahead.

A Poor Man's Frequency Meter
W6YAN — Mar
How to turn a cheap LM frequencu meter into an extremely accurate piece of test equipment. You'll need the front end from a Sensicon receiver, too.

The Fine Points of FM Operation
WB2AEB — Apr
Good common sense for FM beginners. Includes good hints on setting deviation level.

Examining FM Repeater Operation
WB6DJT — Apr
A state-of-the-art article telling it like it is, with suggestions as to how it ought to be.

A Repeater Controller
WA4YND — Apr
The myriads of mechanical contrivances that repeaters inevitably wind up with can be replaced with transistor equivalents. . .with a resulting increase in system reliability and decreases in headaches for the repairman. Complete circuits, with timers, COR, keyer control, etc.

Understanding the Carrier-Operated Repeater
K6MVH — Apr
The complicated repeater is not really so complex after all. . .it's only a matter of understanding the simple operations that are taking place when somebody transmits on the input frequency.

Evaluation: Standard 2m FM Transceiver
W6QGN — Apr
A close look at the SR-C-806M transistor transceiver.

Directory of American Open Repeaters
Staff — Apr
A comprehensive listing of open repeaters in the United States and Canada. Includes editorial introduction and writeup about repeaters in general.

FM Repeaters Under Fire From FCC
Staff — Apr
The first published notice of FCC's infamous Docket 18803. Sketchy but essentially accurate.

A Word About Repeaters

WB2AEB — Apr

The trend for the future seems to be to use a compatible deviation of both narrowband and wideband rigs: this is accomplished with a peak deviation of about 8 kHz at the repeater transmitter. Other trends and characteristics also noted. Included with the repeater directory.

7/8-Wave Mobile Antenna for 2 meter FM

W2EUP — Apr

(Antennas)

FM—AM Transmitter-Receiver Aligner

W3JKL — May

A signal generator that can be used in conjunction with a transmitter to give a zero beat for frequency measurements. Also useful for aligning FM receivers.

The Intelligent Use of 2 Meters FM

K1ZJH — May

A general description of the way it's done on FM (it IS different), and a few words of wisdom to people who aren't used to working through repeaters.

A Low-Band Police Monitor

W6JTT — May

How to modify Motorola's old, no longer used 30D type receivers by building up a simple supply and diddling with the receiver oscillator.

The Wichita Autopatch

W0DKU — May

Tied in with the local repeater, this phone patch received approval from Ma Bell. Includes descriptions of the patch and tells how Ma Bell was conned into going along with the idea.

An FM Best Buy

WA7EMM — May

How to convert the world's rarest FM rig (Comco) from commercial service to the ham band.

FET Preamps for VHF FM

WA4WDK — May

Two good preamps are described — one for 6 and the other for 2 meters. Complete performance curves, construction data, schematics, etc. are given. Preamps are grounded-gate, which offers high gain, ease of tuning, and simplicity of construction.

Allied Portable FM Receiver

K9STH — Jul

An evaluation of Allied's A-2587 pocket FM receiver.

A Two-Channel Search-Lock for FM Receivers

W3DTN — Jul

Simple gadget turns a 2-channel rig into an automatic scanner type, and provides the added capability of locking onto a channel where activity is sensed.

Super Autopatch

K6MVH — Jul

Why automatic phone patches are important for public service. Includes construction data for a patch that does everything.

Repeater Audio: Time Out for Quality

K6MVH — Aug

Use of a cathode follower to pick audio directly from the repeater's discriminator can do wonders for an ailing amateur relay system.

Optimizing Antenna Separation in FM Repeaters

K6MVH — Sep

If the receiving range of your repeater can't match the output capability, the problem could be desensitization. And chances are you can solve the problem by as simple a step as moving the antennas around a little at the repeater site.

DyComm's 15W 2 Meter Mini-Amplifier

Staff — Sep

An evaluation of a ready-made 15W class C amplifier that can be used for VHF CW or FM applications, requiring only 20 mW of drive.

Integrated Circuit CW ID Generator

W7PUG — Sep

(CW)

Low-Cost Oscillator & Infinite Attenuator for Tuning VHF Receivers

K1CLL — Sep

A signal generator with a very reliable and repeatable attenuation device for adjusting receiver front ends to maximize sensitivity.

Controlling Repeaters with Tones

K6MVH — Oct

Basic repeater control logic, and how to set up a tone control system for tone-burst or whistle-on use.

Semiautomatic FM Channel Scanning

WA0QPM — Nov

Using ordinary flasher module, this unit connects to a two-channel FM transceiver to allow monitoring of both channels by a scanning sequence. Does not lock onto a signal.

2-Meter Minitransmitter for Repeater Use

WB6BIH — Dec

A straightforward, simple transmitter with five stages using five transistors.

Regency — an FM Late-Starter

Staff — Dec

A comprehensive comparison of the Regency 2 meter transceiver with other units currently available.

General Info

Fascinating Fundamentals: Volta and His Pile

W2FEZ — Jan

The interesting story of Volta and his experiments in galvanic research. Describes an early (and easily duplicated) battery.

Fascinating Fundamentals: The Terrible Jar at Leyden

W2FEZ — Feb

Interesting historical facts about the Leyden Jar; how to duplicate it and make your own capacitor.

How Do Ham Radio Stores Decide Trade-In Prices?

W2CEP — Apr

The owner of Stellar Industries gave this rundown on the way prices are figured in the amateur radio game. Stellar is no longer in the ham business, but the article is nonetheless applicable.

Beryllia — The Lethal Refractory

WB2PAP — Apr

Take another look at those tube boxes on your shelf; those ceramic jobs that are made with beryllia could be dynamite!!

Inexpensive New Semiconductors for the Ham

WA7KRE — Apr

Descriptions and representative circuits for a whole flock of recently introduced semiconductors from Motorola. Includes dual-gate MOSFETs, several power amplifiers, thyristors, rectifiers, etc. Circuits included: VHF amplifier, audio amplifiers, telephone amplifier.

London's Science Museum Demonstration Station

Ellison — May

A look inside the museum and a description of the amateur radio facilities there. Includes photos.

Plus Ten dB. . . .

W2OLU — May

A quick way to relate power to decibels, and an easy method for calculating one commodity or the other when one of the commodities is known.

Selectivity Has Come a Long Way

Swan — May

The theory of bandpass fillers and a description of Swan's newest entry. Includes performance specs.

Science Fairs: Science Education?

Mocking — May

A revealing look at the schools' approach to science education these days. Good reading for those who care.

Bigger Knobs for Better Performance

WB21CV — May

An encapsulated rundown on the findings of a high-cost program to human-engineer consoles. Modern science now says tiny knobs can cramp your style!

Epoxies for Electronics

W9KXJ — May

How to steal a trick from the professionals and use modern epoxies to perform the bonding that once had to be done with a hot soldering iron.

Comments on FCC Repeater Proposal

Staff — May

A point-by-point reprint of the FCC's Docket 18803, along with suggested revisions to make the rules more realistic and easier to live with.

Ground Support for the Powder Puff Derby

W7ZC — Jun

The ins and outs of providing communications for the most famous air contest in the world.

The Low-Noise Antenna

WB6JNI — Jun

(Antennas)

The Effects of Temperature and Frequency on Coaxial Cable Loss

W9KXJ — Jun

(Antennas)

Government Surplus Straight From the Horse's Mouth

WA9ANW — Jun

How to get on the Government's surplus gravy train. How to buy; how to bid.

Improving the Performance of Trap-Type Vertical Antennas

W2EEY — Jun

The addition o (Antennas) in consider-

The Club for Blind Amateurs

Champagne — Aug

Pictorial story of K1TPX, the Perkins Radio Club for the Blind.

Ham Radio Chess

W1EMV/0BMW W — Aug

Two schemes for annotating chess games for over-the-air play.

What Really Happened to Hamdom?

W9HBF — Sep

The author asks why we are in the state we are. He advocates QRO and a good beam as opposed to brute force power, and points to some uncomfortable comparisons between ham radio and citizens band.

YO — An Interesting DX

YO2BO — Oct

(DX)

AC Switching with Self-Powered ICs

W2FBW — Nov

A new approach to power switching of ac circuits: rfi is eliminated, power supply diodes are protected, switch contact wear is reduced, and tube heater life extended. ICs switch at the zero current point.

Pioneer Radio on the Prairie

W6CXC — Nov

Sentimental remembrances of E. E. Krebsbach and the contributions he gave to the field of amateur radio.

Helpful Hints

Proper Use of Silicon Diodes

1WA3ACL — Jan

How to use the ratings of diodes in your rectifier projects. Includes suggested applications for such diodes.

Simple Compact 6m Bandpass Filter

WA5SWD — Jan

A high-performance TVI for 6 meters that costs less than $5 to build. The filter is to be installed in the transmitter's transmission line.

Using Diodes for Adapting AC Relays to DC

WA5SWD — Jan

Simple shorty article showing the right way to use diodes for low-voltage rectification where the object is to use dc relays with an ac supply.

The DX-35 Revisited

W2AOO — Feb

A trick or two for updating Heathkit's popular DX-35 Novice rig.

From Breadboard to Printed Circuits the Easy Way

K1AOB — Feb

A simple system for making PCs by using an Xacto knife to cur around original artwork.

ProfessionalP PCs From Roll-Your-Own Negatives

K6MVH — Mar

A means for creating high-quality printed circuits without the time-consuming and expensive darkroom processes.

Easy Diode Testing

K4JK — Mar

A clever means for nondestructively testing "bargain" diodes to learn their PIV.

Super Sizer

WA3AQS — Mar

Many little modifications that will cut the resale value of Heath's Sixer, but which will surely make the rig work better.

Renovating Surplus Meters

WA0ABI — Apr

A test or two, a dab of white paint. . . and presto!

Keep 'Em Cool in KPO Cans

G3KPO — May

Construction data for building simple heatsinks for vacuum tubes. The idea is to extend tube life and reduce heat dissipation within the tube envelope.

Epoxies for Electronics

W9KXJ — May

(General Information)

Bigger Knobs for Better Performance

WB21CV — May

(General Information)

Educated Idiot Lights
Holford — May
How to modify the car's "idiot light" warning system by adapting a buzzer to complement it.

Coax Adapter — VHF to BNC
W9MEV — Jun
A "quickie" article shows how to combine fittings to get a professional looking adapter.

Useful Cable Clamps
WA6CPP — Jun
A brisk shorty telling how to use hose clamps to hold cables.

De-RF Your VTVM
WA0FFJ — Jun
A quick and easy way to clean it up.

Two Receivers from One Antenna
WA6UFW — Jun
(Antennas)

Measuring RF Output
WA6CPP — Jun
(Antennas)

Installing the Swan 250C Noise Silencer
WA6CPP — Jun
Pictorial story tells how to do it neatly.

A Soldering Gun Tip
WB6PKA — Jul
Using silver-plated wire for soldering.

Mount That Mobile Right
K4IPV — Aug
The right kind of mobile installation will result in bigger signals, better operator safety, and more fun in hamming on the road.

ATV: Getting a Better Picture
WA6BJV — Aug
(Antennas)

Converting 24V DC Relays to 115V AC
Douglas — Sep
Three circuits and a brief article on how to accomplish this task.

Reed Relays for UHF/VHF Coaxial Switching
W7CRY — Sep
How to use reed relays in place of the expensive coax relays and get better overall performance. Includes frequency loss and isolation curves.

Neater Cabling With Nylon Cord
WA0ABI — Oct
Use of nylon and heat to make it neat.

Improving Regulation in High Voltage Supplies
K6BW — Oct
Shorting out the surge resistors with a delay circuit to improve performance of a high-voltage regulated power supply.

Calibrate that Calibrator
W2KPE — Nov
Using WWV to calibrate the receiver 100 kHz calibrator more accurately than it has ever been calibrated before.

Solid-State Delta-F Control for SSB Exciters
W4NVK — Dec
Vernier tuning eliminates dial backlash and other tuning anomalies, and gives precision variable-frequency control of operating slot.

Two-Terminal Current Limiter
Beene — Dec
Simple series circuit holds current to safe level.

Humor

The Manuscript Game
Staff — Jan
Every good article gets its due reward.

How I Read the Radio Operator's Handbook and Found Happiness . . .
Johnson — Mar
The author's story of how he mastered ham radio theory overnight.

Bob-Bob-Bobbin' Along
K1YSD — Mar
Utter chaos and hilarious confusion from the pen of 73's only insane author.

That Contest Craze
VK4SS — Aug
An old tiger bares his fangs.

Code Practice a la Baby Talk
W9OXA — Sep
Sometimes there are advantages to becoming a ham that aren't even listed in the manuals.

Camouflage
K99AZG — Oct
How to buy lots of ham gear without letting the old lady know.

Clinks in a Vacuum
Derfler — Dec
A low-pressure article for wives. (Or for hubsands to show wives who don't dig radio.)

Hams are a Funny Bunch of People
K3KMO — Dec
A few of the paradoxes that make it easy for us to laugh at ourselves.

Yipes, It Talks!
W2FEZ — Dec
Fool your friends with a newspaper that talks. It's a homebrew electrostatic speaker fashioned from papers and foil.

IC Projects

Frequency Synthesis: The Modern Way to Control Frequency
W2EUP — Feb
(FM)

New Linear ICs for the Ham
WA4KRE — Feb
A down-to-earth description of Motorola's latest ICs doe amateurs, along with schematics lifted from Motorola's application notes. Includes power supply and regulator circuits, amplifiers, modulators.

A Logical Approach to Surplus Buying
K5JKX — Mar
How to identify and test ICs commonly found in the surplus market. Includes an extremely literate discussion of the principles of logic.

Low Frequency I-F Modules Using ICs
K1CLL — Mar/Apr
Description of what the author feels is the ideal i-f. This text includes a very good dissertation of the ins and outs of such popular i-fs as 455 kHz.

High-Performance Power Supply Using an IC Voltage Regulator
K0ECF — Jul
0-20V at up to 500 mA in a tiny package.

An Impedance Multiplier for the VOM
K6DQB — Jan
Using an IC to do the trick.

The ICmitter
Goldstein — Aug
(CW

Three Versatile IV Testers
WA2IKL — Sep
This article lists pin diagrams for the common ICs and describes simple testers for checking digital, linear, and counter ICs.

Understanding and Using Integrated Circuits
W6DNS — Oct
All the basics; what they are, how they're used; why they're used.

The Phase-Locked Loop Comes of Age
K5JKX — Oct
A new IC and how it can be used in some pretty sophisticated circuitry.

Low-Cost Function Generator for Experimenters
WA2IKL — Oct
Makes sine, square, and sawtooth with excellent quality.

IC Marker Generator
K4BBC — Oct
Simple IC device gives marker signal when you approach the edge of your authorized band.

Practical IC Regulator Circuits for Hams
WB2EGZ — Oct
For a 500 mA supply.

ICs for Amateur Use
K1CLL — Oct
Describes a couple of good rf amplifiers using inexpensive ICs. One for 6 meters, another for 40.

AC Switching with Self-Powered ICs
W2FBW — Nov
(Gen. Info.)

Low-Cost Automatic Keyer: A First Project
WB4MYL — Nov
(CW)

Solid-State Transceiver for 40 Meters: the SST-1
W9ZTK — Nov
A modularized QRP rig with built-in swr bridge, CW monitor. Has ICs in audio and receiver sections.

Solid-Sate Exciter
W6YUY — Dec
ICs and transistors makes this SSB exciter modern, inexpensive, and efficient.

(HR PROJ)

Yipes, It Talks!
W2FEZ — Dec
(Humor)

Keyers

Transceiver Companion
W6AJZ — Jan
This is a complete control console and accessory for the transceiver that doesn't already have everything. It includes compressor, preamp, electronic keyer, phone patch, speaker, clock, and the kitchen sink all in one neat package.

CW Can Be Fun
Staff — Jun
(CW)

Low-Cost Automatic Keyer: A First Project
WB4MYL — Nov
(CW)

Mobile

Mobile CW
K6RA — Jan
(CW)

Base-Tuned Center-Loaded Antenna
W2EEY — Jan
(Antennas)

SSB-AM-FM Modulation System
W2BSP — Jan
Tongue-in-cheek technical article about a system the author actually uses. He calls it "frequency aperture" modulation. The most interesting part of the article is the author's clever adaptation of a 55 gallon drum for use as a 10 meter cavity.

The Camper — Mobile and Portable
WA9EHE — Feb
How to get the most out of a ham station when you own a camper, plenty of radios, and like to travel a lot.

Variable-Impedance Mobile Mount
W1EMV — Feb
(Antennas)

7/8-Wave Mobile Antenna for 2 meter FM
W2EUP — Apr
(Antennas)

RF Riviera Style
K9BDJ — May
The story of a Buick-owner's problems and how he traced them down in order to eliminate mobile interference.

A Mobile CW Transmitter
W6BLZ — May
(CW)

An FM "Best Buy"
WA7EMM — May
(FM)

A Ham-Style Burglar Alarm for the Car
K2JLD — May
Description of a scheme for foiling prospective rig thieves.

Educated Idiot Lights
Holford — May
(Helpful Hints)

5/8 Wavelength Verticals
EA0NGV — May
(Antennas)

The 27-Minute Mobile Limiter
W7SOH — May
How to build an effective noise limiter. As an alternative, the author shows how to modify an existing Bishop type noise limiter. The modification takes 27 minutes.

A Practical DDRR Antenna
W6WYQ — Jun
(Antennas)

Quarter-Wave Top-Loaded Mobile Antenna
W5AZE — Jun
(Antennas)

Installing the Swan 250C Noise Silencer
WA6CPP — Jun
(Helpful Hints)

Mount That Mobile Right
K4IPV — Aug
(Helpful Hints)

6V From 12 — The Easy Way
K3GSY — Sep
High current regulator that uses two transistor and a zener. Better approach than the "dropping resistor" idea.

Semiautomatic FM Channel Scanning
WA0QPM — Nov
(FM)

Noise Clippers

A Noise Blanker That Works
W8RHR — Apr
It DOES work, but the article somehow got into print without being edited, and there are some errors. Those who want to build should drop a card to editor of 73 to get straightened out on discrepancies.

The 27-minute Mobile Limiter
W7SOH — May
(Mobile)

Installing the Swan 250C Noise Silencer
WA6CPP — Jun
(Helpful Hints)

Novel Ham Radio Projects

Converting the 4CX1000 into a Lamp
K3QKO — Jan
A clever lamp for the ham's ham. Even has a switch fashioned from a coaxial connector. Better not to use a new tube for the lamp, though; it will have somewhat of an impact on the total cost of the project.

Transceiver Companion
W6AJZ — Jan
(Keyers)

The Dip Light
VE3ECU — Mar
A grid-dipper that uses lamp intensity instead of a meter.

Add Spotting to your VFO
K8BYO — Mar
Cute and simple technique that lets you hear the vfo without transmitting.

Reverse-Current Charging
K8YUC — Mar
With an almost foolishly simple technique you can successfully recharge ordinary dry cells, and make them hold the charge again and again.

Single-Sideband on the All-Wave Radio
W7CSD — Apr
A miniature tunable oscillator provides an ideal source for a beat-frequency signal, and allows you to hear code and SSB on any selective receiver without making modifications to your store-bought gear.

A Low-Band Police Monitor
W6JTT — May
(FM)

A Ham-Style Burglar Alarm for the Car
K2JLD — May
(Mobile)

Educated Idiot Lights
Holford — May
How
(Helpful Hints)

The Consummate Console
WB2FBF — Aug
Increasing station efficiency and enjoyment with a broadcast-style console. Include's plans and construction data.

IC Marker Generator
K4BBC — Oct
(IC Projects)

Solid-State 10-Minute Timer
WB4MYL — Oct
Plans, layout, and PC pattern for a MOSFET timer for various station functions or repeater applications.

Power Supplies

Simple Bench Power Supply
ZL2AMJ — Jan
Provides four output voltages, three current-overload limits. The techniques described can be applied to other power supplies.

Proper Use of Silicon Diodes
WA3ACL — Jan
How to use the ratings of diodes in your rectifier projects. Includes suggested applications for such diodes.

A 10m/CB Preamp
WA3HMW — Jan
Using a surplus 10m preamp with a slight amount of conversion. Details include power supply instructions.

Using Diodes for Adapting AC Relays to DC
WA5SWD — Jan
Simple shorty article showing the right way to use diodes for low-voltage rectification where the object is to use dc relays with an ac supply.

New Linear ICs for the Ham
WA4KRE — Feb
(IC Projects)

Turning the AN/GRC-9 Into a Novice Rig
W6JTT — Mar
(CW)

A Simple Bias Regulator for Linear Amplifiers
ZL2ANG — Apr
Shunt regulation for bias supplies offers the advantage of low constant current drain, and it can be used with the neglected — till now — class B and AB2 linears.

Vacuum-Tube Load Box
Ashe — Apr
Schematics, photos, and construction details for a power supply test set . . .

Power Supplies From Surplus Components
WB6BIH — May
Lots of theory and a few schematics for converting old surplus junk into something useful. If you're a mathematician, this is certainly your bag.

High-Performance Power Supply Using an IC Voltage Regulator
KØECF — Jul
(IC Projects)

More Notes on Diode Stacks
W2BDG — Sep
A description of GE's high-power (5 kV at 300 mA) rectifier modules.

6V From 12 — The Easy Way
K3GSY — Sep
(Mobile)

Simple Regulated Power Source for ICs
W1RAN — Oct
Regulated power supply using series diodes (not zeners) to give precise values of required voltages.

Practical IC Regulator Circuits for Hams
WB2EGZ — Oct
(IC Projects)

Improving Regulation in High Voltage Supplies
K6BW — Oct
(Helpful Hints)

Differential J-FET Preamplifier
W4KAE — Nov
Design, construction data, and performance curves for a low-noise preamp using an RCA CA-3028 J-FET. Includes separate power supply circuit.

Your Second Linear
W4AYI — Dec
High-power linear amplifier using a 3-500Z vacuum tube for the final. Includes schematic for a kilowatt power aupply.

QRP

"Quazar" QRP 40m DSB Transmitter
WA5WWN — Jan
Good low-power rig for sideband or CW; uses 4 transistors and an audio amplifier module.

Postage Stamp Transmitter for Six
K1CLL — May
Complete plans — including part list, layout, schematic, and construction details for a transmitter that is an eighth of an inch thick and only 3/4 in. square. This one really works, too.

QRP
WA3JBN — Jun
Two sample rigs for CW operation on 40 meters.

The ICmitter
Goldstein — Aug
(CW)

VHF AM Transmitter Using Low-Cost Transistors.
Brubaker — Aug
If it'll work on AM it'll work on FM.

ICs for Amateur Use
K1CLL — Oct
(IC Projects)

2W 6 Meter Transmitter Using the Heterodyne VFO
K1CLL — Nov
Breadboard design, tuneup, and performance of an rf power stage on 6m using a $3 transistor and a stable vfo circuit.

Solid-State Transceiver for 40 Meters: the SST-1
W9ZTK — Nov
(IC Projects)

2-Meter Minitransmitter for Repeater Use
WB6BIH — Dec
(FM)

Receivers

Solid-State Double-Bandwidth Tunable I-F Converters
K1CLL — Jan
A good tunable converter can get you any frequency or band in the VHF range you want. This article tells how, and it includes schematics, parts lists, and complete instructions.

A 10m/CB Preamp
WA3HMW — Jan
Using a surplus 10m preamp with a slight amount of conversion. Details include power supply instructions.

A Simple IC Q-Multiplier
W2EEY — Feb
Using an IC opamp for a Q-multiplier. Advantages include simplicity, broad range of operation, and variable Q and peaking frequency.

High-Performance Converter for 6
WA9HES — Feb
Tube-type converter uses a Nuvistor. This article may become valuable as the last tube converter circuit ever published.

Low Frequency I-F Modules Using ICs
K1CLL — Mar/Apr
(IC Projects)

High Performance I-F Amplifier and AGC System
ZL2BDB — Apr
For CW or SSB work, you'll find this system hard to beat with its fast-attack, slow-decay characteristics. A wide latitude of stage gain is assured with both forward-and reverse-acting agc elements.

Hot Carrier Diode Mixer Converter for 2 Meters
WA6NCT — Apr
Low noise, high gain, excellent overload resistance, and a very high degree of isolation combine to make the hot carrier diode particularly attractive for applications in receivers and converters. This article has good PC layouts, photos, schematics.

FET Preamps for VHF
WA4WDK — May
(FM)

I-F Filter, Converter, AVC "Ideal" Circuits
K1CLL — May
The second half of Hoisington's two-article series on the ideal i-f. This one includes breadboarding the complete i-f system.

450 MHz Mighty Mite
K9VXL — Jul
A superregenerative receiver for 432 MHz. Includes PC layout.

Mobile CW Receiver
W6BLZ — Jul
(CW)

Deluxe Receiver Gain Control
VU2JN — Sep
Improving agc performance in tube-type receivers with the addition of a transistor control circuit. Includes chart showing tracking curve.

A Versatile and Stable MOSFET Converter for 144 MHz
WB6YVT — Sep
A low-noise, high performance converter with excellent gain.

The Phase-Locked Loop Comes of Age
K5JKZ — Oct
(IC Projects)

Differential J-FET Preamplifier
W4KAE — Nov
(Power Supplies)

RF Applications of the Dual-Gate MOSFET
Sir — Nov
Application suggestions from the engineering desk at Fairchild Semiconductors. Includes receiver circuits and amplifiers for VHF.

Repeaters

Setting Up the Tone-Burst System
W6TEE — Feb
(FM)

Tone Decoder for Remote Switching Applications
K6MVH — Feb
(FM)

Encoders for Subaudible, Tone-Burst or Whistle-On Use
W6ZCL — Feb
(FM)

A Look at Amateur FM Standards
WB6DJT — Mar
(FM)

A Work Session on the Wichita Repeater
WØDKU — Apr
Nobody knows any better than the repeater owner just how religiously Murphy's laws are followed by Nature . . .

FM Repeaters Under Fire From FCC
Staff — Apr
The first published notice of FCC's infamous Docket 18803. Sketchy but essentially accurate.

Examining FM Repeater Operation
WB6DJT — Apr
(FM)

Understanding the Carrier-Operated Repeater
K6MVH — Apr
(FM)

Directory of American Open Repeaters
Staff — Apr
(FM)

A Repeater Controller
WA4YND — Apr
(FM)

A Word About Repeaters
WB2AEB — Apr
(FM)

The Wichita Autopatch
WØDKU — May
(FM)

73 Comments on FCC Repeater Proposal
Staff — May
(General Information)

(General Information)

The Intelligent Use of 2 Meters FM
K1ZJH — May
(FM)

A Two-Channel Search-Lock for FM Receivers
W3DTN — Jul
(FM)

Super Autopatch
K6MVH — Jul
(FM)

Repeater Audio: Time Out for Quality
K6MVH — Aug
(FM)

Optimizing Antenna Separation in FM Repeaters
K6MVH — Sep
(FM)

Integrated Circuit CW ID Generator
W7PUG — Sep
(CW)

Controlling Repeaters with Tones
K6MVH — Oct
(FM)

Solid-State 10-Minute Timer
WB4MYL — Oct
(Novel HR Projects)

2-Meter Minitransmitter for Repeater Use
WB6BIH — Dec
(FM)

Reviews

Kris Scanning Receiver
Staff — Mar
(FM)

Evaluation: Standard 2m FM Transceiver
W6QGN — Apr
(FM)

The Grundig "Satellite" Receiver
Staff — Jun
An evaluation of a portable receive that has everything, including stable SSB.

CW Can Be Fun
Staff — Jun
(CW)

Allied Portable FM Receiver
K9STH — Jul
(FM)

The Knight-Kit RF Generator
W9KXJ — Aug
An evaluation of the KG-696 signal generator.

DyComm's 15W 2 Meter Mini-Amplifier
Staff — Sep
(CW)

Regency — an FM Late-Starter
Staff — Dec
(FM)

SSB

Single-Sideband on the All-Wave Radio
W7CSD — Apr
(Novel HR Projects)

A New Approach to Communications Equipment
K9ALD — Sep
The author describes a modular concept for standardizing of SSB transceiver design. The object is to improve performance of each module in an SSB system, while affording hams the opportunity of building or repairing their own.

Your Second Linear
W4AYI — Dec
(Power Supplies)

Solid-State Exciter
W6YUY — Dec
(IC Projects)

Solid-State Delta-F Control for SSB Exciters
W4NVK — Dec
(Helpful Hints)

Surplus

A 10m/CB Preamp
WA3HMW — Jan
(Power Supplies)

Using Diodes for Adapting AC Relays to DC
WA5SWD — Jan
(Power Supplies)

Facsimile and the Radio Amateur
K6GKX — Jan
More on adapting surplus equipment to ham FAX service; includes photos of equipment, block diagrams, and a chart showing transmission frequencies and times for various stations.

The Knight-Kit RF Generator
W9KXJ — Aug
(Product Reviews)

An Impedance Multiplier for the VOM
KDBQ — Jan
(IC Projects)

File Box Resistance Decade
WB4ITN — Sep
The first in a series of "file box" articles. Here the author makes a precision decade box and includes schematics for variations of his own design.

The Indicating Oscillator
KH6AF — Sep
A grid-dipper without grids. Uses FETs. Includes a circuit for amplifying microamps to milliamps, which should be handy for other projects as well. But be careful. Fig.1 is labeled 2 and vice versa.

Three Versatile IV Testers
WA2IKL — Sep
(IC Projects)

Low-Cost Oscillator & Infinite Attenuator for Tuning VHF Receivers
K1CLL — Sep
(FM)

A Low-Cost RF Wattmeter
WA3AJR — Nov
Inexpensive means of using an ordinary meter and a conversion chart to accurately gage power output from 4 to 4000 Watts.

Calibrate that Calibrator
W2KPE — Nov
(Helpful Hints)

The Transi-Test
WB6QQP — Dec
Useful but simple device can measure transistor beta, leakage, and shorts.

The Little Gate Dipper
W5ETT — Dec
Another grid-dipper with no grid; covers 1.7 to 225 MHz, yet is cheap and quick.

Turning the AN/GRC-9 Into a Novice Rig
W6JTT — Mar
(CW)

A Logical Approach to Surplus Buying
K5JKX — Mar
(IC Projects)

A Poor Man's Frequency Meter
W6YAN — Mar
(FM)

Converting the Sonobuoy to a 2W FM Transmitter
W1BYX — Mar
(FM)

An Inexpensive RF Wattmeter
WB4MYL — Mar
Simple adaptation of a piece of surplus equipment.

Power Supplies From Surplus Components
WB6BIH — May
(Power Supplies)

Government Surplus Straight from the Horse's Mouth
WA9ANW — Jun
(General Information)

Converting 24V DC Relays to 115V AC
Douglas — Sep
(Helpful Hints)

Test Equipment

Panoramic Receiver for VHF
I1SLO — Feb
A spectrum analyzer of sorts. Let's you see on a CRT the whole 2 meter band at once.

Frequency Synthesis: The Modern Way to Control Frequency
W2EUP — Feb
(FM)

Extra Services from Your Grid Dip Oscillator
WA4UZM — Mar
A plug-in adapter turns a grid-dipper into a good crystal calibrator.

An Inexpensive RF Wattmeter
WB4MYL — Mar
(Surplus)

A Poor Man's Frequency Meter
W6YAN — Mar
(FM)

Vacuum-Tube Load Box
Ashe — Apr
(Power Supplies)

How to Megger Your Antenna
W2EEY — Apr
(Antennas)

FM-AM Transmitter-Receiver Aligner
W3JKL — May
(FM)

Measuring the Difference Between Incident and Reflected Power
VE7BS — Jun
(Antennas)

Remote SWR Indicator
W2EEY — Jun
(Antennas)

Measuring RF Output
WA6CPP — Jun
(Antennas)

Amateur Wattmeter for $3.85
K1CLL — Aug
Tells you your power output from about 10 mW to 5W, over the range from 160 meters through 450 MHz. Principle is based on comparison of an rf activated lamp with another of same brilliance whose power input is known.

Transmitters

"Quazar" QRP 40m DSB Transmitter
WA5WWN — Jan
(QRP)

Postage Stamp Transmitter for Six
K1CLL — May
(QRP)

VFO Circuit
KØHVK — Jun
Tube-type for 80 and 40 meters. Easy to build.

QRP
WA3JBN — Jun
(CW)

Cheapie 6-Meter Half Gallon
K1CLL — Jul
It works out to $12.50 a quart, and features low-cost tubes, no screen voltage, no bias requirements, and no blower.

The ICmitter
Goldstein — Aug
(CW)

VHF AM Transmitter Using Low-Cost Transistors.
Brubaker — Aug.
(QRP)

ICs for Amateur Use
K1CLL — Oct
(IC Projects)

Solid-State Transceiver for 40 Meters: the SST-1
W9ZTK — Nov
(IC Projects)

Solid-State Exciter
W6YUY — Dec
(IC Projects)

Your Second Linear
W4AYI — Dec
(Power Supplies)

TV

Slow-Scan Color TV
W4UMF — Jan
The principles of color separation, as applied to slow-scan television systems. Includes spectral charts, photos of off-the-air pix.

Bibliography of SSTV
W4UMF — Jul
Complete directory of articles.

Improved Color Transmission — SlowScan TV
W4UMF — Jul
Applying the principles of color separation and synthesis.

ATV: Getting a Better Picture
WA6BJV — Aug
(Antennas)

Amateur TV is Easy
K2OJL — Dec
It actually costs no more than $100 to get started in the fun hobby of amateur TV.

(UHF)

Amateur TV is Easy
K2OJL — Dec
(TV)

UHF

450MHz Mighty Mite
K9VXL — Jul
(Receivers)

Log Periodic Antenna Designs for VHF/UHF
W3DUQ — Aug
(Antennas)

ATV: Getting a Better Picture
WA6BJV — Aug
(Antennas)

Reed Relays for UHF/VHF Coaxial Switching
W7CRY — Sep
(Helpful Hints)

VHF

Solid-State Double-Bandwidth Tunable I-F Converters
K1CLL — Jan
(Receivers)

Panoramic Receiver forVHF
I1SLO — Feb
(Test Equipment)

High-Performance Converter for 6
WA9HES — Feb
(Receivers)

Super-Sixer
WA3AQS — Mar
Many little modifications that will cut the resale value of Heath's Sixer, but which will surely make the rig work better.

Inexpensive New Semiconductors for the Ham
WA7KRE — Apr
(General Information)

7/8-Wave Mobile Antenna for 2 Meter FM
W2EUP — Apr
(Antennas)

Postage Stamp Transmitter for Six
K1CLL — May
(QRP)

The Sly Beam
ZL4TAH — Jun
(Antennas)

Eleven-Element 2 meter Circular Quad
W4KAE — Jun
(Antennas)

Cheapie 6-Meter Half Gallon
K1CLL — Jul
(Transmitters)

VHF AM Transmitter Using Low-Cost Transistors.
Brubaker — Aug
(QRP)

Log Periodic Antenna Design for VHF/UHF
W3DUQ — Aug
(Antennas)

Low-Cost Oscillator & Infinite Attenuator for Tuning VHF Receivers
K1CLL — Sep
(FM)

Brew 1 on 2 — a 2 Meter Coaxial Antenna
WAØRWQ — Sep
(Antennas)

DyComm's 15W 2 Meter Mini-Amplifier
Staff — Sep
(CW)

Differential J-FET Preamplifier
W4KAE — Nov
(Power Supplies)

2W 6 Meter Transmitter Using the Heterodyne VFO
K1CLL — Nov
(QRP)

Semiautomatic FM Channel Scanning
WAØQPM — Nov
(FM)

RF Applications of the Dual-Gate MOSFET
Sir — Nov
(Receivers)

20Meter Minitransmitter for Repeater Use
WB6BIH — Dec
(FM)

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IC Troubleshooting: A Matter of Temperature?

Many hours can be wasted troubleshooting IC equipment if you overlook one important characteristic. The popular Fairchild epoxy case ICs and the Motorola MC 700 series and HEP (dual in-line package) series are designed to operate between the temperature extremes of +59° F to +131° F (Fairchild) or +167° F (Motorola).

If your shack is in the garage like mine or at least unheated, you may very well be operating these ICs below their design temperature range during the winter months. Therefore, if your keyer, counter, or whatever seems to be operating erratically or not at all, take it into the house and give it six or more hours to attain room temperature. Then see if your trouble is still there. You may save yourself alot of time and frustration. (You may also have to buy a heater for your shack.)

Rich McMahon WA6IGU ■

LETTERS

advised by my lawyers that
ou goons don't ever proofr
l[illegible]
b[illegible]
you ignored my comments in
I insist that you print ev
should be boiled in oil ov

Bottomless

I would like to take advantage of your most gracious money saving special 3-year subscription to 73. I still have a card you gave me at a Hamfest last year so I could get 3 years for $10, but I suppose it's too late to use it now. 73 is still the best ham magazine on the market, and I am tired of having to run down to the dirty book store on Broadway in San Francisco's "Topless-Bottomless" North Beach night club strip. You would be surprised, though, how many hams from all over I have met standing in that dirty book store reading 73.

So please accept my check for a 3-year subscription to 73, and come on out to California again when you can, and maybe you can stop in and meet some hams. They're always in the dirty book store reading 73.

Larry Johnson K7VZH
2051 Fremont Street
Klamath Falls OR 97601

Jordan

After attending the ARRL convention, and sitting in on several of your meetings, I felt that I should write you. First of all, may I honestly say that I found the most interesting part of the entire convention to be located in the 73 room on the 4th floor. In particular, I was fascinated with the slides of King Hussein and Jordan, and the slides of YO2BO, whom I talked with at YO2KAC in the late 1950x. As one of those who spoke with you when you operated JY1 in Jordan, I sent my QSL card to Box 1055 in Amman and received a beautiful QSL card personally signed by the king.

I then decided to write again and request an autographed photograph of His Majesty suitable for framing. In the letter I told the king that I was a Social Studies teacher and that I would surely appreciate an autographed photograph that I could not only use for educative purposes, but also could frame for display purposes in my radio room. I really never expected an answer from such a busy and important person. About a

month later, however, the postman brought a large white envelope with ten stamps on it. On the back of the white envelope was a large gold crown.

Upon opening the letter I was amazed to find another QSL card signed by the king along with a personally autographed photograph dated July

25, 1970. Both the date and the signature were obviously in the king's own handwriting. I have framed the card, picture, and stamp section of the envelope and am enclosing a picture of it with this letter.

Vernon G. Dameron, Jr. K1DRN
265 Davis Road
Bedford MA 01730

You have no doubt kept up with the situation in Jordan in the last few weeks. According to the reports I have heard the situation is bad, especially in regards to medical help, food supplies, and so forth. Perhaps someone else has already made this suggestion but I was thinking it might be helpful if we hams banded together and all pooled our contributions for some help to the people in Jordan. I don't know who, if anyone, could organize such a program within the ham population but I would help if such a program is feasible.

The king was very friendly while you were there and it would be very generous on the part of the hams of the U. S. if we could help him in his time of need. I would appreciate your comments on this. Keep up the good work in 73. I am now a lifetime subscriber and am happy to be one.

Richard J. Malby GS9E
537-44-0619
579th Ordinance Co.
APO New York, N. Y. 09035

Camouflage

I just finished reading K9AZG's article CAMOUFLAGE, 73, October 1970, and I think I can help him out. He was in a similar position to mine, trying to get a 50 ft mast and tri-bander up without letting the XYL know. I solved the problem by covering the top section of the mast with brown paper, adding a few branches or so on it, and "planted" it. Every few months or so I added a section to the bottom to make it "grow." The tribander was painted green and covered with leaves. Next I "pruned" the lower branches off, leaving only the beam. The brown paper eventually falls of, and if the XYL is at all near-sighted, the system is almost foolproof.

Bill Ames WAØWBJ
1909 Karlin Dr.
St. Louis MO 63131

WAAS

Do you still issue the WAAS certificate? If so, will you please forward the necessary forms so that I may make application in the name of the club who sponsored and operated K6SB for the San Diego 200th bicentennial celebration. K6SD operated from October 1968 until October 1969 contacting as many hams as possible while celebrating San Diego's 200th birthday. During that year we were able to contact every state in the union, including Alaska and Hawaii, except Delaware.

So you can see K6SD does truly qualify for "Worked Almost All States."

Robert R. Smith WB6ODR
President El Cajon ARC

Yup, still available. Send 49 cards and $1.00 to cover costs of mailing, etc. . . . Wayne

FM Coverage

I am involved with two repeater groups here in the Denver area, and am in charge of a project to set up a new repeater for the Colorado Civil Air Patrol west of Denver, Colo. Thank you for the excellent coverage your magazine has given during 1970 to FM repeater activities and techniques.

Cliff Flaharty WAØ CKS
Box 1007
Littleton CO 80120

Inflation in a Nutshell

Popular opinion seems to be that the FCC fee hike is an inflationary move. Well let's get things straightened out. The fee hike happens to be a noninflationary move. By making amateurs pay more for their licenses this will take money out of circulation giving hams less to spend.

The whole thing that starts inflation rolling in the first place is the fact that people have too much money to spend. This action of spending puts more money into the hands of the business man. When he gets more money, his workers want more money. When the workers get more money this cuts down on the profit margin of the business man. Seeing that he is making less money the business man will raise prices to equal what he was making before. And the cycle goes on and on.

Joseph F. Lutz WB8EAS
2951 S. Moreland Blvd
Cleveland OH 44120

Delightful theory, but I don't believe it. I tend to agree with the economists who feel that historically inflation arrives on the heels of the night shift at the Treasury Department when they print more money than is being taken out of the economy in taxes.

. . . Wayne

CBers and Hams

What's going to happen to American Private Citizens' Radio? That's how I refer to all civilian radio communications, chiefly amateur radio and CB. Today we are in the strange and destructive position of having two separate and competing civilian radio services. Competing for members, prestige, and frequencies. How absurd! Under this set-up it's not only likely, but inevitable that conflicts will arise, and it's not too difficult to see who's been winning the last few years. I don't know how this unfortunate situation developed, completely.

I think Wayne Green came close to the solution a couple of months ago with the proposal of the Hobby Class license. This would move the CBers and their short range communications to 220 MHz, the least wanted ham band. Actually it was sort of a compromise, but the important point is: it would unite the two services into a single licensing and communication structure! I support this 100 per cent. But. There are problems. 875,000 CBers won't relish the thought of replacing their equipment, just so they can call themselves hams. Most people already think they are!!

Anyway, how about a conciliatory approach to CB? They're not dumb. Most are friendly and some are real sharp ops. If we can assimilate and unite the two radio services, not abruptly but as fast as possible, then we will be able to provide better total service, and we will have a much more powerful position in the national and international radio structure. It won't be easy, certainly; but it appears to be the only reasonable solution that would not interfere with the distinct but related services we provide.

Mark R. Hansen WA9YEC
1701 West Eighth Street
Marshfield WI 54449

Boo Boo

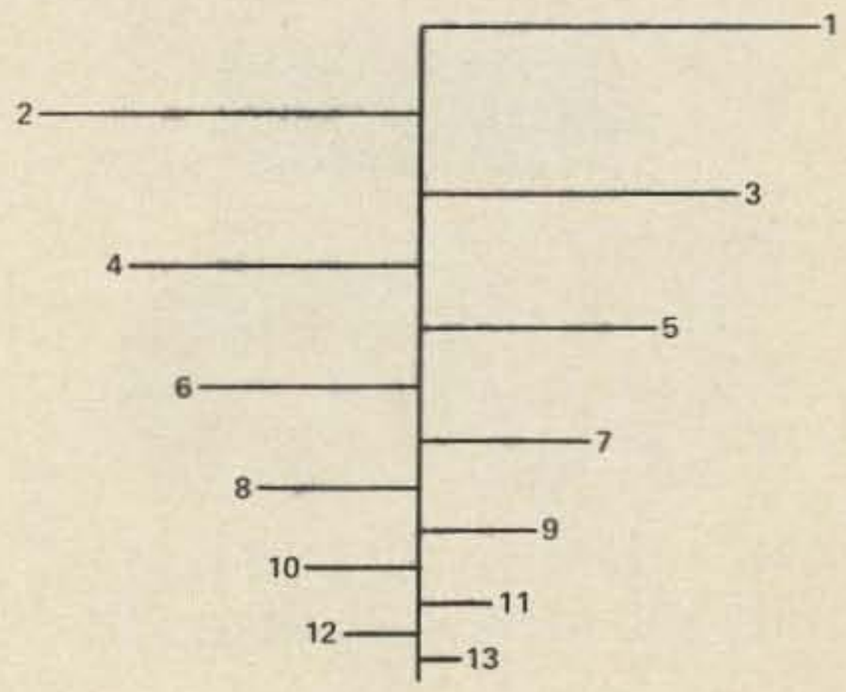
I have been receiving a tremendous amount of mail concerning two items in the August 1970 73 article on Log Periodics. Perhaps you could print a couple of items to straighten things out for your readers,

In middle columns of Table 1 (p.45), the third longest element length is 1.404 ft., not 1.304.

Also, perhaps you could redraw Fig. 1 with a top view of one boom assembly only. My questioners aren't sure of the element attachments which are not clear in the figure.

Try this idea:

TOP VIEW (one boom)



I hope you can find room to put this in 73 real soon to straighten people out.

Bill Nagle W3DUQ
RD 1 Box 188A
Honey Brook Pa 19344

Busted

My fictional story, "That Contest Craze," in August '70 issue of 73 (in which I am not too kind to a young cop who slaps on me a $5 parking fine) has prompted members of the police force here and abroad to write and say, "Why send us up...Don't we have enough trouble with the teenagers without an oldie like you getting on the wagon?"

Constable First Class Gerry Letford (VE3FTV) has added another $5 violation fine (No.110932) for illegally parking my Big Red Kangaroo car in his hometown of St. Catherine, Ontario – and if unpaid a warrant follows.

Another Constable ham mate in the north of my home State has invited me up for a few days. He guarantees to land me with something heavier than a parking fine.

In the local village here, the sergeant (who borrows my 73 mags) booked my son and said, "I'd prefer to give this ticket to your OM."

I've already paid the $5 fine that pinheaded cop put on me in the story. If much more of this keeps up, the check for it will be busted. So please, fellers, lay off. I know when I'm beat. I'll go quietly.

Alan Shawsmith VK4SS
West End
Brisbane
Queensland
AUSTRALIA

Blunders, Blunders

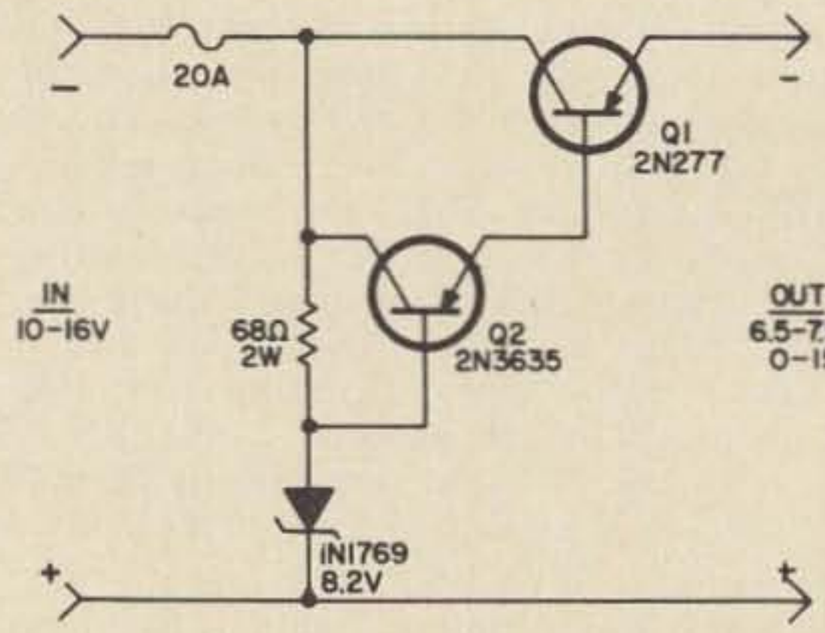
I still think your magazine is the greatest for the ham; have continued to think so ever since I subscribed very early in your magazine's career. Keep it up.

I want to be an old stinker and point out a couple of technical goofs in Sept 73. First, a little layout problem on page 30. Figures 1 and 2 are obviously interchanged. Otherwise, I have to suspect that it will work fine. I'll soon know; I am in the process of converting my old Heathkit grid dipper, since most of the key parts can be used.

Now, look at page 26 (same issue). That voltage dropper has something goofed up on it. The way it is drawn, Q1 will never conduct. Either Q1 and Q2 must be changed to corresponding NPN types or the input and output polarities must be switched (with a corresponding reversal of the zener diode). Otherwise, it seems to be a good scheme, within the limitations already mentioned by the author.

Harry K. Long, W7CQK
220 Seneca Ave NW
Renton, Washington 98055

You're right in both cases. Here's the correction for the p. 26 goof.



. . . Ken

Objectivity

This letter has a dual purpose. As long as I must write to you, I want to express my deep satisfaction with the policies of the mag. 73 mag has reached a height of editorial freedom I have not encountered even in Time or Newsweek. 73 allows each of its editorialists complete freedom while it has also opened its pages to critical comment and occasional discussion. Your heading to the "Letters" shows that you are interested in the irate and sometimes ignorant views as well as informed, intelligent ones.

Jim Altman WAØUWL/2
Box 6136, River Campus Sta.
Rochester NY

Politics, Religion and Sex

I have been an amateur for 8 years now and have become somewhat sick with the regular routine in which a QSO is supposed to be carried on. A few months ago I began to experiment on 40 meters in the way of trying to make a QSO more meaningful. I have been told by many people on the bands that politics, religion, and sex shouldn't be discussed in a QSO, but my personal feelings on this subject is different from that of the majority of hams. We are a society and almost a big fraternity of people with different interests and thoughts and if we want to get to know each other better, we should learn by our QSOs how each of us thinks. In the process of my experiment I found many amateurs that went along with my ideas. We discussed topics ranging from Vietnam to women's liberation. But it seems that whenever we would get into a sticky subject one of the members of our society would come on to the frequency and throw a carrier on, whistle Dixie, or sing the Star Spangled Banner, as the case may be. As other groups on the amateur bands have found, whenever someone disagreed with what you are doing – no matter if it is in the form of breaking the norms of the frequencies or conducting a net such as the one conducted by the students – choice stations show their intelligence by throwing all sorts of interference on the frequency. These kinds of people don't deserve the privilege of operating amateur radio.

I'd like to relate a story to the readers of 73. I have a very good friend on 40 meters (K2PJG). Bob is crippled from the waist down and is confined to a wheelchair. He is very active on ECARS and does an excellent job as monitor control. He has frequently been the recipient of all kinds of insulting remarks and has almost given up hope on the bands. I happened to be on the frequency one day when one of our fellow hams came on and started to insult Bob. When I broke in, the fellow insulted me as well. After the QSO I ran into Bob and he asked me if I knew of anyone who wanted to buy his rig. I have also thought about selling my 40 meter equipment.

Going back to my original topic of sex, religion and politics, I feel that the amateur bands might be more exciting and challenging to hams if some other hams would try my method of learning and discussing the problems of the world today. And maybe if more of us discussed problems and issues of the world and the amateur bands, there might be less conflicts and dissatisfied hams today.

If any stations wish to discuss the topics I have mentioned, just drop me a line with a sked and if possible we will have an out-of-the-ordinary QSO. Which is pretty rare to find these days.

Jim Millner
116 Cornwall Ave.
Trenton NJ

Incentive Licensing — Pro and Con

The following letters are representative samples of letters received in response to 73's incentive licensing questionnaire. Those opposed to IL far outnumbered those for; thus, we cannot reprint all of the letters against the principle, even though the "for" letters reprinted here are the sum total of all letters backing incentive licensing we received from amateurs as of 1 October.

Pro

Anything as worthwhile as amateur radio is worth the time and effort involved in learning the code (20 wpm). My gripe is that you may interpret my responses to your biased advantage, so I have only answered the questions you will have difficulty biasing.

Jerry Pope W4YRY
5112 Cedarwood Dr.
Raleigh NC 27609

I am for incentive licensing, but I think the principle should be reconsidered, perhaps favoring new bands as an incentive.

Jack Petree WB4OVX
Box 5175
Roanoke VA 24012

The only answer I can give to anyone opposing an incentive of any kind is that he must be classed as too lazy to want to better himself and (improve) his knowledge.

Bill Cooke W3GBB
427 Crain Hwy NE
Glen Burnie MD

I favor IL, but all amateurs who held the original Class A license should be issued the Extra automatically. They earned the top benefits, so why take them away?

Paul Fritich W3HHC
11 Oakleigh Rd.
Allentown PA 18104

I have Extra class...took many days of code practice but consider the time well spent. Some people will never pass the Extra, but most have the capability to do so if they really want to.

Bob WB9ABT
Rt 1 Box 269
Lake Zurich IL 60047

Twenty wpm is the speed of the expert and Extra class should be expert. Incentive licensing gives one something to strive for, keeps the mind strong. Without (such an incentive program) some people would tend to grow stale. I think incentive licensing should be as the name implies – an incentive, something extra – not something restored that was previously taken away.

John Mrozinski WB2EXI
155 Eckford Street
Brooklyn NY 11222

Con

"Indian giving" – that is, offering something in exchange for a demonstrated proficiency in certain skills then revoking that something – is a very poor way of creating goodwill.

M. W. Macy W9UM
Rt 4
Syracuse NY 46567

I want to see ham radio grow – why not give it a chance? The Generals should be given back all the bands taken from them. If incentive is necessary, let the Extra have a small part of one band for phone and code. It is not hard to see why so many people say to hell with the FCC and the ARRL and go to CB where they can have almost as much enjoyment and can work the country without all this nonsense!

Roy Gunter K9GNK
1637 Rock Spring Dr.
Alton IL 62002

In spite of the fact that I am against IL, don't get the idea that I do not study and strive to improve my knowledge of amateur radio. It's just that I would rather see us go back to the previous system.

Richard Weiner WA8WMC
Rt 2 2560 Lincoln Rd
Ludington MI 49431

Hams in Alaska are under a particular hardship with respect to upgrading because of the tremendous distances involved in getting to Anchorage (where exams are administered). But I am against IL regardless of where I am located. Thanks for standing up for the majority of amateurs, who are against incentive licensing.

Jack Bone KL7GKY
Sitka, Alaska

I'm certainly glad the FCC doesn't have anything to do with my birth certificate, marriage license, bachelor's degree, etc., where revocation of privileges could really be serious!

C. H. Smith KØERL
611 Wesley Dr.
Farmington MO 63640

Granting extra privileges to a few at the expense of the majority is hardly justifiable. The ARRL never proved it was speaking for a majority – surely the FCC must know that!

Theron Lillie WA2UIG
190 Henrietta St.
Rochester NY 14620

I don't favor IL the way the ARRL presented it and as far as I am concerned they can go to h-- with their incentive licensing.

John Perlick WBØADO
3400 Edgewood Ave North
Minneapolis MN 55427

Thanks for giving us hams the opportunity to express our feelings about IL. I do not favor the principle. I can see no useful purpose in knowing how to send and receive CW at 20 wpm unless someone simply wants to be a faster operator. The entire mess has dealt a severe blow to amateur radio; I sincerely hope the FCC will reopen the whole matter for reconsideration.

Kenneth Cregar K3KBG
3411 Stoudt's Ferry Bridge Rd
Reading PA 19605

My low opinion of IL is colored by the personal blight of downgrading after more than a half-century of good behavior on the ham bands. It all seems so unnecessary. I would think that old experienced people could be let alone and not subjected to such indignities as have been dreamed up from time to time by the ARRL. I can't be mad at the FCC, who – I am sure – simply felt that Newington could hardly be wrong. As a matter of fact I recall that the FCC turned this thing down some years earlier on the basis that it would lead to an elite establishment with a supposedly democratic government put in the anomalous position of enforcing a caste system.

R. A. Hilferty W2HEY
Box 409
Miller Place, LI, NY 11764

I hope that someday this incentive licensing thing can be rehashed...Now I have a General license which restricts me to certain portions of the amateur bands ...and the ironic thing is that Extras seem to operate in the General portion of the band.

John Stagnaro W6MAB
2305 Panorama Dr.La Crescenta CA 91214

I don't have any idea how much influence you will be able to swing in your effort to convince FCC that this whole thing was ill-advised, but if I can help by sending you my opinions, then it is the least I can do. I am against IL, and would only be for a 20 wpm requirement if use of a typewriter were optional.

Bill Gulledge W9LWG
Rt 3 Box 56
Phillips WI 54555

Finally someone uses a magazine to get opinions on the IL program on a national scale. I hope that 60% of votes is not the losing percentage (see p. 9 QST Sep 1970).

Harris WB8BTV

It's not incentive licensing when the FCC narrows and removes frequencies so as to load the remaining spectrum with nets and phone patches. And cramming ARRL activities into the highly congested remaining portions of the bands is idiotic.

R. W. Daniels KØKYH
Rt 2 Box 212
Aitken MN 56431

IL was supposed to be a step above General; instead, the space between Novice and Extra was split in three rather than two. And the present General is not up to his predecessor, who knows half the Advanced test from his old General exam. Thus, either increase the exam requirements for Advanced or throw it out! Let those who know the code at high speed get credit for it, but let the chap who doesn't know it demonstrate some alternate ability. If the FCC insists on restricted privileges, how about power? New Generals to get 150W, maybe Advanced and Extras could get the full gallon.

Joel Look W1KCR
Box 25
Claremont NH 03743

Radio Interference Reduction

Some hams try to purchase new electric razors for neighbors in an attempt to reduce existing razor QRM. However, attempts I have made to find any razor that is treated to reduce QRM, have not been successful at dealers. Finally, I received a reply from a SEARS buyer who said that their 92737 razor (Austrian) claimed to be so treated. I had read many instruction sheets with new razors without seeing any such comment on other products.

I think that the magazines should be willing to mention this, and to list products that have reduced QRM.

Note Public Law 90-379, 90th Congress, which amends the Comm. Act of 1934, permitting FCC to regulate the interference potential of devices. QST published a request for letters to FCC suggesting items heading such regulation.

I think that amateurs should encourage FCC to bring out at least a general requirement that household appliances be treated for reduction of QRM, and especially that thermostats be treated to prevent "hanging" of the contacts in a sparking condition. Also, essentially all light switches could be so treated – which I understood was required in France 35 years ago. I encourage the magazines to stir up a little thought on the use of the Public Law to reduce QRM.

E. H. Conklin K6KA
402 Oliveta Pl. Box 1
La Canada CA

Sparkling

Keep up the good work with 73 Magazine. You have a good following at KEYN. We have four active hams on the staff. Our News Director KØWTM has his two young sons licensed as Novices. I'm now working on the general manager and his oldest son and hope to get them tickets. The station supports the WØDKO repeater with tower space and power. You can imagine the response a CB organization receives when our program director (W5MGC) takes the call. Our weekend disc jockey and engineer WAØTHQ is a senior at Wichita North High School. Oh yes, we also operate a station WAØZZX on 2 meter FM from the KEYN studios.

Anyway we here at KEYN heavily support Amateur Radio and 73 Magazine. Each copy I receive from my new life subscription is well digested before I safely file it away.

Larry Waggoner WAØQPM
KEYN, 3357 W. Central
Wichita KS

Lackluster

I keep reading in the letters column the bouquets that come your way regarding the magazine. I started subscribing some time ago and thought the same way – even got the back issue Gunsmoke and enjoyed them all. However, in the last year or so, it seems to me that 73 has lost its sparkle and is becoming a lackluster publication. 'aybe it's me, maybe not. Anyway, it seems to be turning into a specialty-type magazine geared for VHF-Novice interests. Of course, maybe this is what you want.

I wonder how much the advertiser influences editorial policy? I have yet to see an article saying that a particular piece of equipment is a piece of junk. These "reviews" in all the magazines claim that anything is the biggest thing

since the ice cream cone. For instance, I had a Swan VHF antenna, made by the Stockton man, that flew apart in the wind, mainly because of insufficient hardware. I wrote something about it and sent it in – no response. Wrote another and sent it to QST – and got a nice letter from the technical consultant that they only checked the 2 meter, not the 6 meter.

I believe there is a little more than a year to go on my 73 subscription and I frankly don't intend to renew it for a lack of interest in the contents.

Paul Schuett WA6CPP

A lot can happen in a year

. . . Ken

Easter Island

On March 20, 1970, I was licensed to operate my amateur station from Easter Island with the call sign: CEØAE. I have been operating with this sign since May 20, and work all bands, CW and SSB. Only twice have I operated above 21,400 on the 15 meter band. My name is "Dave", my QSL Manager is WA3HUP, and my QSL card is red and white. I do NOT have an APO address. I have received fewer than one QSL card for every three contacts, and would appreciate more. My usual frequencies are: 28,550 – 21,360 – 14,332 – 7030 – 3530.

Fr. David L. Reddy, O. F. M.
Parroquia
Isla De Pascua, Chile

Flamboyant

In my opinion your increasingly flamboyant headlines lower the appearance and appeal of 73 to the level of cheap trash like CQ and PE, and waste space that could otherwise be devoted to several more pages of articles.

73 is not Movie Mirror or True Confessions. For examples of proper headlines for a technical magazine see July QST.

R. B. Kuehn WØHKF
St. Paul
MN

The Good . . .

A friend loaned me the June and July copies of 73 magazine. They're the greatest. I saw your notice about a bundle of back issues of 73 for $6.00. My check's enclosed. Hope I'm not too late.

I'm in a Code & Theory class. As soon as I get my Novice ticket, I'll subscribe to your fine magazine. Can't see how any amateur can be without it.

My sentiments are with your point of view on every issue in these two issues of 73. Keep up the good work.

Jim Edwards
Chillicothe OH

. . . and the Bad!

In your recent letter asking me to renew my subscription you said that you were worried that I would not renew my subscription. Well Gentlemen I would like to say that you had better start worrying for your publication has become sheer garbage in the past 9 months. If you want to sell your mag, you had better try the funny farm for they are the only people that might find your magazine of interest!

Lloyd Dolese Jr. WN5ZZF
220 E. Maple Ridge Dr.
Metaire LA

Mideast

Wayne's helping Hussein out was a true gesture of gentlemanliness in the true ham spirit. I guess you just have to remind some people that you are not a discriminating person. To me, Hussein is a person who has same common interest as myself, ham radio, and this ham fellowship (to me anyway) is not affected by either race, creed, color, religion or place of birth. As for those childish kids who say, "OK, now go to Israel or you're anti", let them go somewhere!

Wayne has befriended a great ham for all of us. May I remind some people that Hussein has understandable troubles of his own and he gets on the bands (like most of us, anyway) to relax and take it easy. You must forgive some of us, Hussein, for those pileups, but you're still a rare one for many of us. Take it easy and as long as you are a member of the fellowship of hamdom, I won't yell at you about the Mideast. My feelings remain much the same for Wayne. Keep up the good work. Times, they are a-changin'.

Chip Cohen WA1JHO

Ham Critic

It strikes me, Wayne, that the technical quality of the articles is slipping. "More Notes On Diode Stacks"" must have been written for the Novices or the XYLs. Maybe my interests just were not touched – we'll let it go at that.

Brown (W9HBF) must not have listened recently on CB; further, he should keep track of what hams do in emergency communications. I could have enjoyed the Sept. issue a lot more if this article had not been in there! QRP, yes – CB, no!

WB4ITN could have something real useful going with his file-box series if he handles it correctly, and produces some really handy gadgets for the shack.

One has to question the use of the word "waveguide" in K1CLL's attenuator article. Two coffee cans soldered together will do the same job only it's called shielding!

There are a lot of pluses in the Sept. issue: W7PUG's CW ID Generator, WA2IKL's IC Testers, K6MVH's Antenna Separation, and Douglas's Relay, etc. The study guide material is always excellent. Too, WB6YVT's 2M Converter looks good.

It is noted that the number of advertisers seems to be picking up, Wayne. Anyway, I guess you know that I read "It" from cover-to-cover. Thanks.

73's Carl K2IA
10-16 Burbank Street
Fair Lawn NJ

In regard to the letter by Ernest Robarge, who says he would make a good ham except he can't pass the code exam, it really made me laugh. Over 600 hours of code and he still can't pass it. I took 16 hours for my Novice and passed with no trouble. So as far as code goes I'm okay but I can't get enough theory to pass the General. But I'm still going to keep on and not write to 73 to tell the world what a fool I am.

Bob Mackey WN9ERZ

Somebody's sure been writing letters over your signature. . . . Ken

Atlanta Repeater Problem

K6MVH's recent editorial on the Atlanta repeater was an accurate description of the situation as it now exists in that area. I lived in Atlanta for over five years and still maintain my "4" call because of frequent trips to the Atlanta area. The group which originally began construction of the Atlanta repeater consisted of serious amateurs with a desire of promoting the growth of FM activity. This group was gradually overtaken by a group of ex-Army MARS operators who, after a change in command of the MARS group, became dissatisfied with the Army MARS FM repeater program. This group then used its political and financial contacts to establish the Stone Mountain repeater. This group has never liked to have its inner circle questioned, even while affiliated with MARS.

There still remain a few stations who will work transient mobiles. However, the control station will not work anyone with what he calls a "Yankee Brogue," which includes anyone who does not come from the 4th call area. I have been called down by that station because he cannot understand anything but deep southern drawl!! On my last visit I made the statement on the repeater that the Atlanta area was getting a bad reputation in FM circles. This stirred up some comments, both pro and con. However, it did serve to wake up some of the operators in the Atlanta area, and, for several days every transient operator was worked by several stations. Thus, I hope that Ken's editorial did some good.

Glen Zook K9STH
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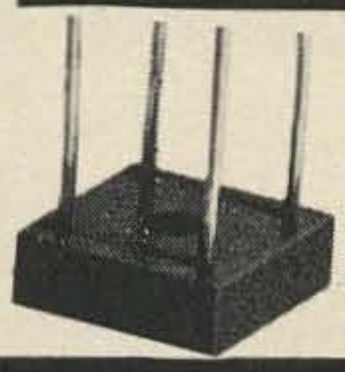

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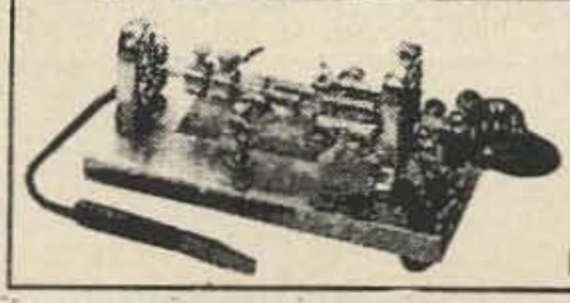

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CANAL ZONE	14	7A	7	7	7	7	14	21A	21A	21A	21	21
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CANAL ZONE	21	14	7A	7	7	7	14	21A	21A	21A	21A	21A
ENGLAND	7	7	7	3A	7	7	7B	14	21A	21	14	7B
HAWAII	21	14	14	7	7	7	7	7	14	21A	21A	21A
INDIA	7B	14B	7B	7B	7B	7B	3B	14	14	7B	7B	7B
JAPAN	21	14	7B	7B	7	7	7	7	7	7B	14B	21
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PHILIPPINES	21	14	7B	7B	7B	7B	7	7	14B	14B	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21A	21A	21	21
SOUTH AFRICA	14	7A	7	7B	7B	7B	14	21A	21A	21A	21	21
U. S. S. R.	7	7	3A	3A	7	7B	7B	14	14	7B	7B	7

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AUSTRALIA	21A	21	14	14	7	7	7	7	14A	14A	21	21A
CANAL ZONE	21	14	7A	7	7	7	7	14A	21A	21A	21A	21A
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INDIA	14	14	7B	3B	3B	7B	3B	3B	14	7B	7B	7B
JAPAN	21A	21	14	7B	7	7	7	7	7	7B	14	21
MEXICO	21	14	7	7	7	7	7	14	21A	21	21	21
PHILIPPINES	21A	21	14	7B	7B	7B	7	7	14	14	7B	14A
PUERTO RICO	21	14	7	7	7	7	7	14A	21A	21A	21A	21
SOUTH AFRICA	14	14B	7	7B	7B	7B	7B	14	21	21A	21	21
U. S. S. R.	7	7	7	3A	7	7B	7B	7B	14	7B	7B	7B
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