AMATEUR RADIO DEFENSE

PUBLICATION OFFICES:
Monadnock Building
San Francisco - California

JANUARY
1941

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VOL. 1 ● No. 3
JANUARY, 1941

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BUSINESS OFFICES

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AMATEUR RADIO DEFENSE

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In the Interests of
Amateur Radio Defense Association

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CONTENTS FOR JANUARY

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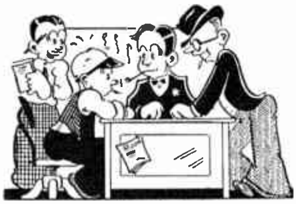


Chats with the Editors

The American Way in Radio

DURING the Spanish-American war a top-sergeant lined up his men and barked: "If any of you guys can repair a typewriter, step forward — the Captain wants to see you!"

In that particular company there was one typewriter and, as the top-sergeant discovered, just one man who could repair it and operate it effectively. For in those days, if you can imagine, typewriters were pretty much of a novelty. The one man who saved the day had a reputation in his home town for being a sort of Thomas A. Edison. He was the town tinkerer, the boy wonder who put things together and made them work. It just hapened that among the articles he had tinkered was a busted typewriter. It had given him an opportunity to learn the ins and outs of the machine, and he had developed considerable skill in using it.

Naturally, he was invaluable to the American forces in Cuba.

This incident might be called an example of "the American way." It illustrates why American soliders and sailors and marines shoot straighter than any other fighters. It explains why American flyers are better than anybody else's best. And it tells why American radio operators are the fastest, most accurate operators on the air.

Americans are the "I'll-do-it-myself" people in this world. They don't "let George do it" because they can do it better themselves. They do lots of things — play golf, swim, build miniature airplanes, ride horseback, grow flowers, snap pictures, and so on—all in their spare time, as hobbies. Among many such activities, amateur radio ranks highest as a national asset—militarily and economically.

Amateur Radio Defense is published for the purpose of reminding America of this amateur radio heritage. Somebody needs to tell the cockeyed world, now and all the time, that amateur radio has always been, is now, and always will be doing its full part in perpetuating "the American way." Someone needs to do this because there are, unfortunately, individuals and interests who will sell the American way down the river if they can make a dollar at it. Amateur radio has already suffered much from these people. Roll your dial across the amateur frequencies and you will find the answer. There isn't room for a decent static burst any more, let alone a well-regulated amateur signal! Amateurs are suffocating for lack of air.

And now is our chance to make the most of it.

Today amateurs can say to the powers-that-be: "Yes, we have thousands of potential military operators, thousands of splendid technical men who can tear down the manufacturer's product and rebuild it *better* than the manufacturer built it. But we *could have more*, and they *could be better*—if we had had the room in which to train them.

"Our best traffic men have had to fight unconscionable interference to the detriment of their speed and skill. Our best technical men have been hampered in the same way, and by the lack of frequencies in which to experiment."

A nation which hears this in the face of great national emergency is going to demand: "This neglect shall not go on!"

That is just where *Amateur Radio Defense* steps in. To the powers-that-be, *Amateur Radio Defense* is going to be the voice that says: "Amateur radio must continue if America is to surpass the rest of the world in communication tomorrow as she does today. This means there shall be more amateur frequencies, more privileges for the radio amateur. The man who pounds a key, the man who speaks into a microphone, and the man who develops a better circuit—they must be encouraged as America wants them encouraged!"

That, indeed, is the American way—and *Amateur Radio Defense* is going to fight for it!

—*L. R. Huber, Assoc. Editor*

QSL Cards From W.A.R.

. . . Recently the Navy's station *N.A.A.* announced a schedule with amateurs in the 3.5 and 7 Mc. bands, and those contacted will receive a QSL card. Now comes an announcement that the War Department's station *W.A.R.* will listen for amateurs on Tuesday, Wednesday, Thursday and Friday nights, between 7 and 2 o'clock, Eastern Standard Time. The station will operate on 4,025 Kc. and contacts with amateurs in the 3,500-4,000 Kc. band are desired. Likewise, the same station will operate on 13,320 Kc. between 10 and 11 o'clock in order to listen for calls from amateurs in the 14,000-14,400 Kc. band. It is stated that the Signal Corps desires to foster closer relations between amateurs and the Army Amateur Radio System. Special QSL cards acknowledging contact will be sent to those who work *W.A.R.*

Speculation is rife in amateur circles as to the intent of these contacts. Entirely aside the privilege of displaying a QSL card from an army or naval radio station, it seems evident that Uncle Sam is on the look-out for telegraphers with good, clean "fists." Contacts with thousands of amateurs will eventually give the government operators an accurate analysis of the average amateur's operating ability, and sooner or later a valuable list of "first choice" amateur telegraphers will be in possession of Uncle Sam.

Those regularly engaged in amateur radio reserve activities, either in the Army or Navy net, are of known ability—and this ability was proved before the amateurs were accepted for membership. Looking into the future, the Government is faced with a dangerous shortage of experienced radio manpower. Yet it is known that there is a great reserve in the amateur ranks which participates in neither the Army, Navy, or other net of *any kind!*

A recent discussion of this problem among a group of fifty licensed radio amateurs brought to light some rather unusual facts. Only *one* member of the group had associated himself with a military reserve radio net. Of the fifty present, eleven were gainfully employed by commercial radio communication services, yet all were active on the air in the amateur bands. The commercial radio men, looking back to the days of the first World War, know that the facilities of the corporations by whom they are employed will be taken over by the Government in time of national emergency. So they don't particularly care whether or not they work *N.A.A. or W.A.R.* . . . because they know they'll work for Uncle Sam if the time comes when they are needed again. Then, in the same assemblage, was another group. Approximately a dozen, all told. All businessmen. All with very fine amateur stations on the air. Men too old to be drafted. Asked how many would volunteer to enter the radio services of the Government in the event of an emergency, every man raised his hand. This is related only to prove the extent of cooperation which Uncle Sam can expect from the ranks of the amateurs. And so we come to the point—Amateur Radio Defense Association is aggressively going about the task of enrolling thousands of skilled amateur radio telegraphers not subject to the provisions of the draft. Isn't it plain to see that in A.R.D. we have an organization which will *stay put*—whose membership will not be broken up by shifting its manpower from place to place—an organization composed of older, tried-and-proven operators with some of the finest amateur stations in America at their disposal. Indeed, these men can—and will—perform a service!

So, then, as we ponder the headlines in a newspaper: "Radio 'Hams' *Get* War Aid," we wonder if it wouldn't have been better to have written it like this: "Radio 'Hams' *Give* War Aid."

* * *

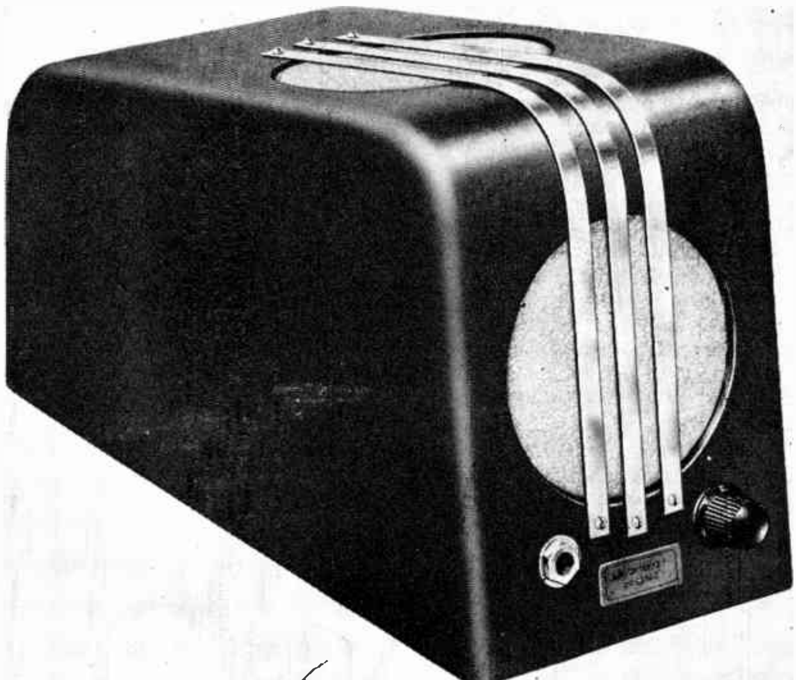
Good Grief!!!

. . . Just as we go to press, word comes from the Federal Communications Commission of a very serious infraction of the laws. Read the report, and groan: "A fake "SOS" marine distress call has been traced by the Federal Communications Commission field inspectors to a New England amateur radio operator. Investigation developed that the signal which caused useless concern and wasted valuable time was part of a dramatic program reproduced by the amateur in question to give his fellow hams "code practice." The Commission warns the amateur that transmission of this danger signal is inappropriate for code practice, or in any other situation when an actual emergency does not exist. On the other hand, the Commission has taken cognizance of the valuable contribution by amateurs in providing emergency communication during the recent Texas flood, when regular wire facilities were temporarily disrupted."

* * *

. . . Turn to page 73—an application for enrollment in Amateur Radio Defense Association awaits your signature. Help strengthen radio defense—mail the application *now!*

Attention C-W Men!
SHIP OPERATORS — AMATEURS



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Provides 100% readability—a combination electrical, mechanical and acoustical filter—this amazing device takes up where crystal selectivity leaves off—25-cycle band-width gives super selectivity to any receiver.

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Get yours now and begin at once to enjoy REAL C-W Reception! Only $13.75 net—once this good news gets around, every C-W Ham will have one. See your Meissner Parts Jobber TODAY!!

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"A FAMOUS NAME FOR TWO DECADES"

QRA's Of Staff And Contributors

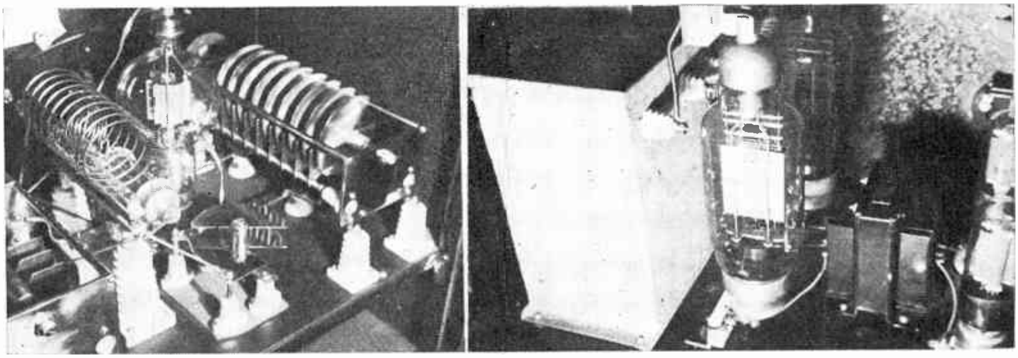
Stanley W. Johnson -- W6SZ -- Joins A.R.D. Staff

★

ANOTHER fortunate addition to the staff of A.R.D. is one of amateur radio's oldest and most renowned DX champions, Stanley W. Johnson, W6SZ, of San Francisco. We asked him to join A.R.D. because his equipment is rated super-tops in amateur circles, capable of blasting a hole into the air when conditions are good or bad, precisely what will be needed in the event this nation requires the services and the equipment of the better amateurs when an emergency arises. "Stan" has worked about everything worth working in every part of the world. Cards from amateurs everywhere attest to his R9 plus signals. What better choice could we make than to appoint this champion our DX Column Editor? So we introduce him to you, with a photograph of his likeness, and a few shots of his super station. These photographs have never before been shown, and A.R.D. is the only organization Stan has ever joined. It is a pleasure and a privilege to have him with us.

Stan believes wholeheartedly in Amateur Radio Defense Association. He is ready and willing to perform any duties which will help strengthen our national radio defense. He is a competent radio engineer, has taken life easy of late, can pound brass as good as he talks into the mike, and—until DX again becomes a world-wide possibility he will talk to you through a monthly column in these pages. He has a wide clientele of DX friends in almost every part of the world, and with these he has maintained a steady correspondence. You'll be thrilled to learn what some of the x-DXers are doing now and what they hope to do in the future. It will be almost like talking to your old buddies when you read about them in these pages. Stan promises to make his Column lively, because he knows what you want.

HIS super station is almost entirely home-built. The tuning condensers in the transmitter were made by hand. Each plate was carefully cut, the corners rounded, and the parts plated in chrome. All of the meter holes on the front panels were cut by hand. This laborious task consumed more than one year of Stan's uninterrupted time. Many of the big power units were likewise built in his own workshop, and the completed transmitter is a joy to behold. In this fascinating work he was assisted by his buddy, Max Fisher, who in the business world is Assistant Cashier for the American Can Co. Together, these two men succeeded in building one of the most efficient and beautiful amateur



Here is the Kalifornia Kilowatt at W6SZ in all its grandeur. It's an Eimac 450TL. operating as cold as a cucumber with 999.99 watts input. The modulator (right-hand illustration) likewise employs large tubes. but with conservative output, which is one of the reasons why W6SZ's speech quality is tops.

radio stations in America. The radio room is streamlined, with chrome fittings. The entire lower portion of Stan's home is his radio department. Then, too, there is a rumpus room, and a bar, where light lunch and heavy refreshments are served.

The antenna at W6SZ, and many a reader will emit a groan now that the details are disclosed, is a single-wire vertical operating on 20 meters. A stick in the back yard, a length of wire—and there you have the answer to world-wide DX, R9 plus! Instead of spending his money and his time on costly beam arrays, Stan preferred high power and a simple antenna. Being located smack-up against one of San Francisco's legendary "mountainettes," it would have been impractical to get the proper results from a beam array, which is another reason why the vertical antenna was chosen.

The receiver is a superhet with crystal filter, almost entirely built by hand. Like the transmitter components, some of the receiver parts and shield cans are chrome plated. The shield cans are lined with felt in order to reduce vibration. All wiring is under the radio room floor, in conduit. A single receptacle takes care of all the connections. You don't see a wire in the station—so here you find "wireless" communication which does not belie its name.

Until DX returns again, Stan will occupy himself with his monthly column in this magazine, keep the chrome plating bright in the radio room, stand-by to help Uncle Sam if the membership of Amateur Radio Defense Association is called upon to do its important part, and continue his work on the 20-meter band.

If, by chance, you are in communication by mail with x-DXers in the far parts of the world, Stan will appreciate hearing from you, because it is entirely possible that other readers of A.R.D. can contribute information of interest to Stan's new column. Maybe some old-time ham pal has been decorated for bravery, maybe he signed "30" in a bomb raid or military engagement, or maybe he wants to correspond with some of us who "knew him when."

Let's keep the DX fires burning, for as surely as there is a difference between plus and minus we will again work those famed DX men when hostilities cease.

★

Max Fisher is Stan Johnson's buddy. The illustration shows him at the tuning dial of W6SZ's superhet, wondering what has happened to all the DX that once roamed over the dial. Max will soon be on the air with a station of his own . . . a kilowatt, or nothing, he says.

Association News

AMATEUR Radio Defense Association is in receipt of a splendid tribute from Chairman James Lawrence Fly of the Federal Communications Commission. You will find it in another part of this magazine. To know that our efforts have received recognition in Washington is most encouraging. Chairman Fly is unquestionably the most outstanding and the most competent leader the F.C.C. has had in its entire history. There is no fear of radio stampede with a captain of such ability at the helm of communications. The big corporations don't frighten him, and he has never been known to pull his punches. He is a champion of the cause of the every radio man, and the little ham as well. As long as he remains in control of the F.C.C. you can rest assured that the amateur's privileges and frequencies will not be jeopardized. He extends sincere Holiday Greetings to the membership of A.R.D.A., and we in return answer his CQ with a resounding MX, HNY, and 73 to you, too, OM!

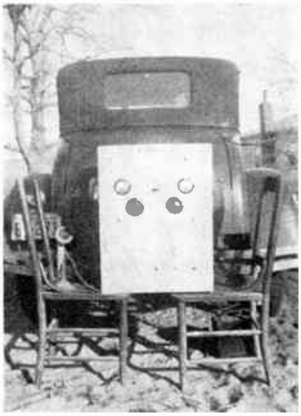
* * *

BY THIS time, thousands of amateurs will have wondered why their hoped-for certificates of membership in A.R.D. have not been received. The certificates were ordered ninety days ago, but we still await an official OKay to reproduce the signature of the **one** leader whose name is so intensely important on the face of these parchments. Because the certificates will be awarded to worthy amateurs only, and because they are not offered as magazine subscription "bait," you are asked to stand-by for the good news which will eventually come. Once your application for enrollment in A.R.D.A. has been accepted, and once you are in possession of the prized membership certificate you will be numbered among those in whom this Nation can rely for assistance when the hour of need shall strike. Ours is a radio preparedness measure of the first order. It is not a racket!

* * *

THE editor's mail reveals that the owners of many of the Nation's most elaborate amateur stations are seeking enrollment in A.R.D.A. Of far greater significance is the fact that none of these top-notchers have chosen to affiliate themselves with **any other** amateur organization, **not even a local network!** Thus we are enrolling into the Association the facilities which approach or even exceed those of many 1-Kw commercial stations. Stranger still is the fact that 99 per cent of these men are ex-commercials. They have joined A.R.D.A. because, as some so aptly put it, "We are sold on the idea; it's not just another scheme to provide swivel chair positions for high-salaried job holders." As the file of photographs of our most elaborate amateur stations is loaded to the hilt, we hope to publish a pictorial section in a later issue of **A.R.D.**—showing a large group of pictures which are "a treat for sore eyes"—pictures of stations so good that Uncle Sam wouldn't want to close them down in the event of an emergency, because they can perform a service as valuable as that of any commercial or military station. We didn't have these super amateur stations in the last war. Ever look at it from that angle?

BUD CRAWFORD, W9BDO, of Seneca, Nebraska, whose chirps and quirps of radio amateur activities have been published in various publications, will hereafter supply **A.R.D.** with similar information. Many members of the A.R.R.S. have read Bud's writings in the network's Nebraska bulletin, and we are fortunate in being able to add him to our rapidly growing staff of contributors. Bud sends us a picture of W9WRY's emergency portable equipment, supported on the rear of a truck, to prove that amateurs in his district are already defense-minded. W9WRY's transmitter consists of a 6V6G Jones Harmonic Oscillator working into a medium power final amplifier. Two Vibrapacks are used because they give better voltage regulation, and apparently with lower current drain, than a single, heavily-loaded Vibrapack. The transmitter operates on 160 'phone, also on 80 and 40 c.w.



W9WRY's Portable

Bud Crawford tells us that his number wasn't drawn in the draft. "I'm too grey-headed", he says, "so I'll try a few bottles of Kolor-Bak, and see if I can get my youth back at the same time." Here are a few notes penned by Bud:—

. . . W9TKK discarded his blonde-brunette and joined the radio division of the air corps; he is now in training at Chantue Field.

. . . W9IDO is another who did not wait to be "grafted"—he volunteered for service, just like W9TKK. Got his feet wet while on guard duty—slipped—fell into a hole, and broke one of his slats.

. . . W9YUM (Young Unmarried Man), famous for his 90-foot mast and inverted "V", enlisted a year ago. He is now at March Field, doing some glorified hamming for the air corps. States that he certainly has gained a lot of knowledge from the army instructors, and that ham radio has been a wonderful help to him in absorbing the stuff.

. . . I'll have more items for you next month. MX, HNY and 73 from ol' Dubblya Nine Bit Dawg Once.

W9OMD

● Disputing the belief that the sun rises in New York and sets in Hoboken, we find a de-luxe amateur station as far west as Muncie, Indiana. Its owner is Wm. J. Quick, M.D., shown here at his home station, and again with his elaborate emergency-powered field equipment. The Doctor was one of Indiana's first to enroll for membership in Amateur Radio Defense Association. It is needless to elaborate upon the service which his equipment can perform, at a time when it will be most useful. Fortunate is A.R.D. for his membership. ●

The photographs show the business-like station of W9OMD. In the larger illustration, reading from left to right, are the following: Collins 30FXC with Jones r-f section, consisting of de-luxe signal shifter, 6L6GX, RK20 and an Eimac 152TL. The antenna is a General three-element close-spaced rotary 10-meter beam. The beam is mounted on a 14-foot tower directly over the shack on a flat portion of the roof. The class-B modulator has a pair of 830B's and the crystal microphone is a Shure 70SW. The direction indicator and world time clock (of very little use now, the Doctor states), are on top of the signal shifter. A smaller transmitter is housed in the cabinet above the loudspeaker; this transmitter has a pair of 47 pentodes in push-pull, and is used on rare occasions on the 160, 80 and 40 c.w. bands. Its output is about 20 watts. The receiver is a National 101-XA. Under the receiver are a pair of telephone switches to control the large transmitter. Frank Jones built the transmitter seen at the right. It has a pair of Eimac 100TH's, modulated by a pair of 203Z's with 800 watts to the final. This big transmitter lays a powerful signal into the dx regions, as well as into the BC sets of neighbors!! One feature of this transmitter which has proved highly satisfactory is the automatic modulation control, which uses an 866A. In the smaller photo the "engineer" hovering over the exhaust pipe of the 550-watt, 110-volt a.c. Kato generator is Ewing Chancellor, W9HJJ, while the official keeper of the log is W9DOK, Vard Skinner, both of Muncie, Indiana. W9OMD is holding the carbon mike which kicks a 6SJ7 into a 6L6 and 812.

Radio Progress In 1940

A Complete Summary by the I.R.E.

THE year 1940 in radio is marked by unusual commercial activity and increased production, as well as by several engineering advances and the advent of new services for public use.

Record Production of Radio Receivers and Tubes

YEAR-END statistics compiled by the Institute of Radio Engineers show that 11,000,000 radio receivers were produced during 1940, a record-breaking figure. In 1939 9,000,000 sets were produced. In 1940, table model receivers continued to be the most popular, accounting for 41 per cent of the total and selling at an average list price of about $32.00. An important new trend was the increased popularity of radio-phonograph console combinations which comprised 25 per cent of the total at an average list price of $133.00. Seven per cent of the output was made up of radio-phonograph models with home recording attachments, selling at an average price of $141.00. Automobile sets kept pace with a total production of 2,300,000 sets. In all there were approximately 1000 different models of radio receivers available.

The number of radio tubes produced was 110,000,000, another figure never before equalled, amounting to four tubes for every family in the United States. Somewhat more than half these tubes were supplied to manufacturers of receivers, the remainder to the public for replacement purposes.

In addition to this record-breaking production for public consumption, the industry prepared to produce vast quantities of radio apparatus and parts for the U. S. Army and Navy defense program. By the end of the year, contracts totaling nearly $50,000,000 had been awarded to radio manufacturers by the U. S. Army Signal Corps and the Defense Commission.

Trends in Radio Receivers

ONE of the outstanding developments was the miniature receiver, weighing less than five pounds and powered by small readily renewed batteries. These "personal" or "camera-type" radios took the public fancy to such an extent that some 200,000 of them were sold in the latter half of the year. In the larger receivers, the general adoption of loop aerials, contained within the cabinet, made unnecessary the erection of aerials for local reception.

A great increase in the sale of phonograph records occurred, brought about in part by the wide distribution of radio-phonograph combinations and in part by the reduction of list prices of classical as well as popular records. The home recorder, offered several years ago only in the most expensive models, reappeared this year as an inexpensive and practical adjunct to the phonograph combination.

For the first time automobile radio sets were produced with short-wave tuning bands, making it possible to keep in direct touch with Europe while traveling. Push-button tuning of automobile sets became widely used to reduce the amount of attention required in tuning from station to station.

International Broadcasting Goes Commercial

THE Federal Communications Commission, acting in response to the increased importance of international broadcasting brought about by the European War, took two steps to increase the effectiveness of American short-wave stations, particularly those serving South America. Effective July 1, 1940, all short-wave broadcast stations in the United States were required to maintain a minimum power of 50 kilowatts (equal in power to the largest of the standard broadcast stations in this country), and to employ directive aerials which would further increase the power of the station, in the direction of the intended audience, by a factor of ten. The Commission also authorized commercial sponsorship of programs carried by these short-wave stations, thus permitting the broadcaster to regain at least a part of the expense of operating the station. Programs particularly designed for overseas listeners were developed.

Broadcast Stations to Shift Positions

IN 1940, the North American Regional Broadcast Agreement, concerning the wavelengths of broadcast stations in Canada, the

(Continued on page 14)

VOLTAGE REGULATION
DRIFT CORRECTION . . .

STABILITY in the "HQ-120-X" was obtained, first, by a voltage regulator for the high frequency oscillator so that even considerable changes in line voltage have no appreciable effect on the oscillator frequency—the oscillator doesn't see-saw back and forth during unsteady line conditions. Second, the "HQ-120-X" has drift correction which takes care of oscillator changes due to temperature rise. The usual warm-up period has been reduced to a matter of minutes. Mechanical construction probably has the greatest bearing on stability. In the "HQ-120-X", special attention was paid to design of the tuning condenser and coil rack so as to practically eliminate the possibility of twist during temperature changes. If you are looking for high-class performance at a moderate price—try the "HQ".

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PRECISION PRODUCTS FOR BETTER RADIO

HAMMARLUND

Radio Progress In 1940 - *Cont'd.*

United States, Mexico and other neighboring countries, was ratified by all the governments concerned. Following the provisions of this agreement, the Federal Communications Commission established March 1, 1941 as the date on which the majority of the United States broadcast stations will shift their dial positions, in order to permit a more equitable distribution of radio space among the various countries and to reduce interference. Over 90 per cent of the more than 800 standard broadcast stations will be affected. Radio servicemen were looking forward to a considerable business resetting the mechanism of push-button-tuned receivers, but no great inconvenience is expected from the shift and the gain in improved reception, both locally and over long distances, is expected to be very great.

The year was marked by a large number of applications for increased power by standard broadcast stations, many of which were granted by the government on the condition that interference would be prevented by the use of directive aerials, which would concentrate the increased energy in the direction of the intended audience and away from other stations sharing the same channel. Many additional broadcast stations, mostly of low power, were authorized.

Frequency-Modulation Broadcasting Established as Public Service

SO FAR as new services for the public are concerned, an outstanding announcement was made by the Federal Communications Commission in May, 1940, setting aside 40 channels for frequency-modulated ("staticless") high-frequency broadcast stations, five for educational purposes and 35 for broadcasting to the public. Approximately 50 applications for permission to erect FM broadcast stations were presented to the Commission during the year, and the majority of these had been granted by the end of the year. Beginning January 1, 1941, FM broadcast stations are authorized to operate commercially, that is to charge sponsors for time on the air, on the same basis as standard broadcast stations. On and after that date, FM stations are required to supply at least two hours per day of programs especially designed for the FM audience.

Increased activity in the manufacture of FM receivers, including several additions to the models previously offered, was in evidence particularly at the end of the year. Prices range from about $50 for a unit intended to convert a standard receiver to permit FM reception, to several hundred dollars for elaborate combination models fitted with FM, standard broadcast, short-wave and phonograph facilities.

Frequency modulation was adopted as the medium for two-way police communication in several new installations, including the State Police systems of Connecticut and the City of Chicago. The use of FM for aircraft communication was also under investigation.

Commercial Television Held Up Pending Study of Standards; Expected to Resume Activity Early in 1941

PLANS for early commercialization of television broadcasting, which had been scheduled for the end of 1940, were interrupted by the decision of the Federal Communications Commission to re-examine the transmission standards. To carry out this program a large committee of experts, the National Television Systems Committee, comprising 168 members and including nine subcommittees charged with investigating special aspects of the standardization problem, was organized in August and was ready to render its report to the Commission at the end of the year. The Committee was sponsored by the Radio Manufacturers Association, with the advice and consent of the Federal Communications Commission, but acted as an independent body.

Meanwhile television broadcast stations continued to operate on an experimental basis, although the sale of television receivers was curtailed by the uncertainty concerning standards. Experimental broadcasting continued in New York, Philadelphia, Schenectady, Chicago, and Los Angeles. In August, 1940, the National Broadcasting Company's New York television transmitter concluded 15 months of regularly scheduled programs which covered practically every field of entertainment and instruction. The station then went off the air to shift wavelength, in accordance with a reallocation ordered by the Federal Communications Commission, resuming service in October.

Among the programs telecast were notable political events, including the Republican Convention in Philadelphia, covered by cameras which relayed the program to New York over coaxial cable circuits, and the Democratic Convention at Chicago, covered by mo-

(Continued on page 72)

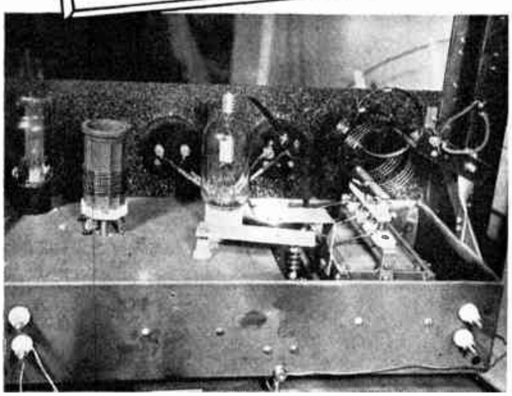
150 WATTS OUTPUT WITH A SINGLE 35T

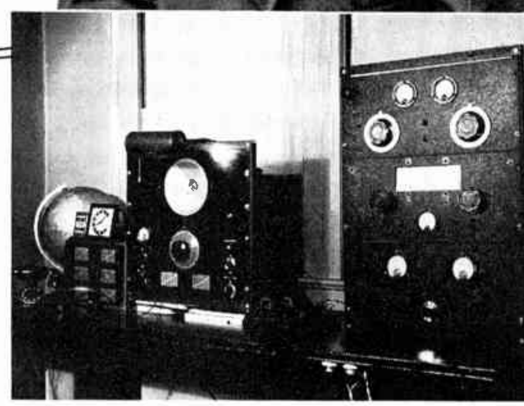
WINS DX CENTURY CLUB MEMBERSHIP FOR

ED HOPPER

AMATEUR STATION

W2GT





Above is shown the complete station W2GT. At left is a close up of the lone Eimac 35T that was responsible for 150 Countries contacted and confirmed.

Ed's success should be an inspiration to the amateur who operates a low power station—certainly it's a definite indication of what you can expect with an Eimac tube in your "rig." Ed says: "Choosing Eimac tubes was not accidental but, based upon the experiences of many friends who found, as I have found, that Eimac tubes give long life, dependability, stability, are easy to neutralize and easy to drive."

35T

EIMAC REPRESENTATIVES

California, Nevada
HERB BECKER, 1530 W. 104th St., Los Angeles, Cal.

Wash., Ore., Idaho, Mont.
GENERAL SALES CO., Verner O. Jensen, 2605-07 Second Ave., Seattle, Wash.

Colo., Wyo., New Mexico, Arizona, Utah
RICHARD A. HYDE, 4253 Quitman St., Denver, Colo.

N. Caro., S. Caro., Georgia, Tenn., Flor., Ala., Miss.
JAMES MILLAR, 316 Ninth St. N. E., Atlanta, Georgia

N. Y., N. J., Penn., Md., Del., Dist. of Col., Maine, N. H., R. I., Conn., Mass.
ADOLPH SCHWARTZ, 14726 Elm Ave., Flushing, New York

Texas, La., Okla., Ark.
J. EARL SMITH, 2821 Live Oak St., Dallas, Texas

Chicago, Illinois, Wisconsin
G. G. RYAN, 549 W. Washington Blvd., Chicago, Ill.

Ohio, Mich., Ky., Ind., Minn. Mo., Kan., Neb., Iowa
PEEL SALES ENGINEERING CO., E. R. Peel 154 E. Erie St., Chicago, Ill.

Eimac TUBES

Eitel-McCullough, Inc.
San Bruno, California

The Editor's CQ

PROGRESS REPORT

AMATEUR Radio Defense Association has been successfully launched and is now being manned with volunteer workers. Patriotic amateurs in many states have already organized local defense units and sent lists of members to Headquarters, with requests that they be advised as to the names and addresses of Area Communication Officers so that regular drills may be started. There are now only two areas without a temporary ACO and as soon as these vacancies are filled the complete list will be published in these pages. The available information, together with confidential instructions, is meanwhile being mailed in the form of Official Bulletins which will not be published.

A.R.D.A. plan of organization is quite similar to that of the A.A.R.S., long a successful and highly efficient body of skilled telegraphers and traffic handlers who have written a new chapter in the history of amateur radio. Because A.R.D.A. functions cooperatively with the military services as a civilian adjunct, it is most reasonable that its administration be patterned closely upon that of the military chain. Its organizational diagram, as printed herewith, should either be filed for future reference or displayed on station walls.

The present Area Communication Officers were among the first of the most capable men to volunteer. Upon them falls the responsibility of appointing and directing the activities of the several State Communication Officers in their respective areas. Their work is proceeding as rapidly as is consistent with wise selection of those most likely to be approved for permanent duties by the rank-and-file of the membership in their states.

Meanwhile, every enrollee should acquaint other amateurs with the purposes and advantages of membership, should help organize local units, and should submit new names for enrollment. Besides what has previously been published in these columns, it may be added that this new Association is being accorded wide recognition and praise.

WHY JOIN NOW?

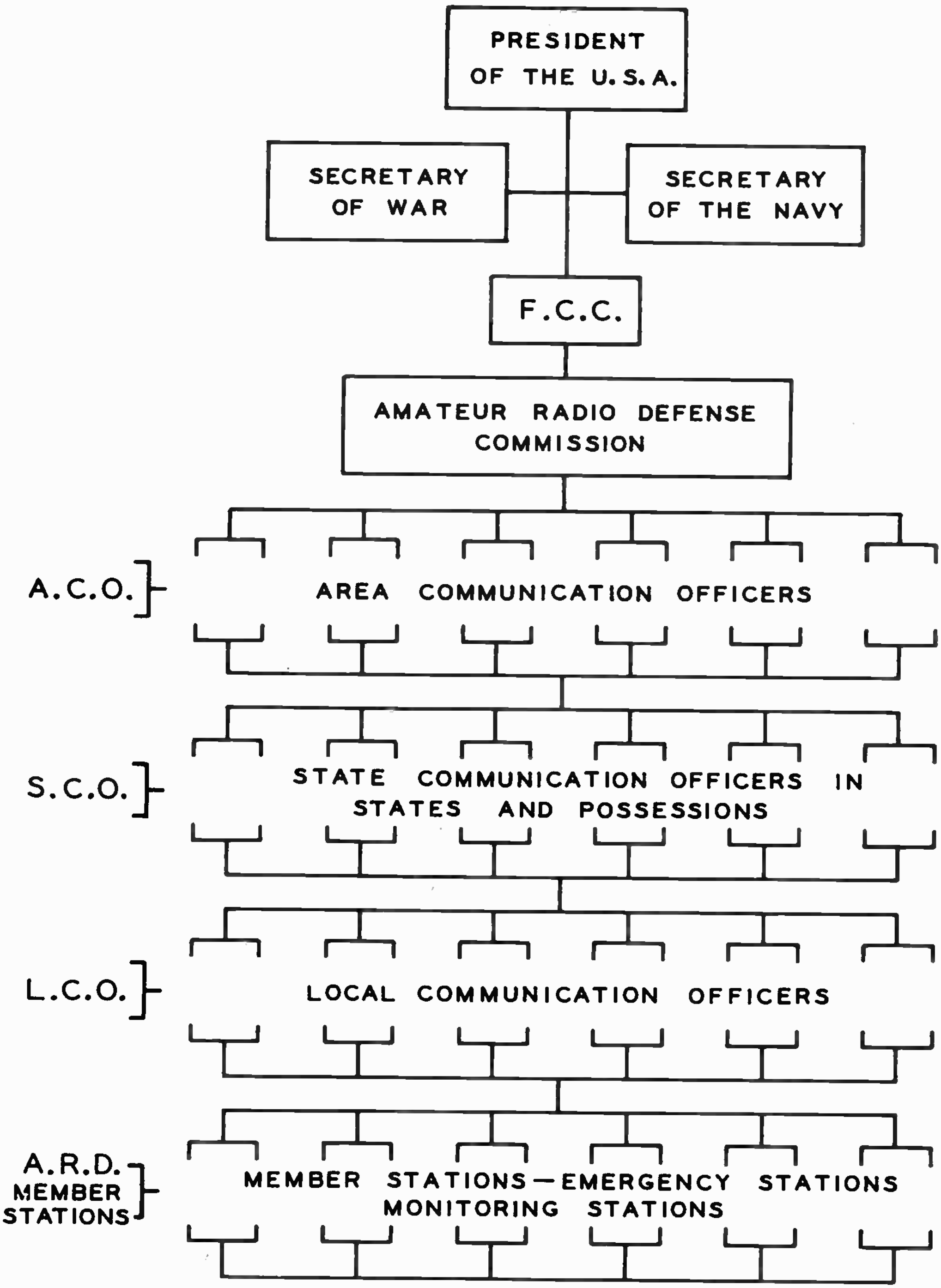
THE A.R.D.A. movement is lauded as being the most sensible and meritorious of any yet attempted in amateur ranks. It competes with none, has no ax to grind, and is non-political. It is accomplishing a noble purpose. Its membership already includes many top-notchers in the amateur fraternity—crack telegraphers, old-timers, men with military training in radio and traffic handling.

Bear in mind, however, that it is not a direct arm of the military service. It is entirely distinct and separate from the Army and Navy Radio Amateur Services, which it supplements but does not supplant. The accomplishments of these worthy organizations are ample for peace-time requirements, but must be amplified greatly to meet any wartime emergency, when all defense facilities must be rapidly expanded.

The A.R.D. undertaking will be of great value to the Government, because in time of peace we are collecting data about amateur stations throughout the nation. By doing this preparatory work now, no time need be lost if or when it becomes essential to the national defense. The answers to the questions in the enrollment blank anticipate what the Government will want to know.

Whilst A.R.D.A.'s primary purpose is founded on the unselfish ideal of enthusiastic voluntary service to the Nation in its hour of need, the Association subsumes a sufficient element of self-interest to justify the eager support of every amateur who wants insurance that his station will not be shut down in case of war. Once that Washington understands the essentiality of this reserve army of radio experts, there need be no fear of further restrictions on amateur radio. Consequently, if you are not subject to the provisions of the Selective Service Act, enroll at once under the A.R.D.A. banner, thus helping yourself by being ready to help others.

Plan of Organization -- Amateur Radio Defense Association



Holiday Greetings to Amateurs

THROUGH the medium of AMATEUR RADIO DEFENSE, I extend fraternal holiday greetings to all amateurs, and at the same time convey to them my personal appreciation of their patriotic cooperation in meeting present problems in this important field of communication.

RESPONSES received by the Federal Communications Commission from individual and organized amateurs throughout the country indicate that they are fully cognizant of the reasons necessitating the adoption of various temporary restrictions to cope with the international situation, and that there is mutual desire for enforcement.

THIS helpful spirit of the amateur is in keeping with his valuable service in the past. The Commission is well aware of the amateur's contribution to the art of radio and it has often praised the amateur for his aid in time of local emergency. Today it recognizes the new role of the amateur in helping to safeguard the national security.

THE amateur can rest confident that this Commission will not curtail his normal activities any more than the national security may justify.

JAMES LAWRENCE FLY,
Chairman, Federal Communications Commission.

NEWS from WASHINGTON

Rules Waived for Radio Operators

As a particular convenience to licensees drafted or otherwise called into military service, the Federal Communications Commission suspended until January 1, 1942, that part of its rules and regulations requiring proof of satisfactory service in connection with renewal of commercial and amateur radio operators (Section 13.28 governing commercial operators, and Sections 12.26 and 12.66 affecting amateurs). This blanket exemption pertains to nearly 100,000 operators of both classes.

General waiver of these provisions was considered at a conference of Commission officials with representatives of interested labor organizations, including the International Brotherhood of Electrical Workers, Commercial Telegraphers Union of North America, American Communications Association, Maritime Committee of the C.I.O., National Federation of Telephone Workers, Federation of Long Lines Telephone Workers, and the Association of Technical Employees of N.B.C.

The controlling factor in the formulation of this broad and simple procedure was the mutual desire to relieve those called into service of routine details. The Commission is aware of the importance of maintaining the present high standards of proficiency of licensed operators, and also of guarding against a shortage of such skilled workers. It will, accordingly, continue to give these problems careful attention, and should experience indicate the need for change the Commission will act accordingly.

★

Connecticut's State Police Radio System, First to Make Use of FM System, Described to Radio Engineers

Frequency-modulation, the new system of interference-free high-fidelity broadcasting scheduled for regular commercial operation next year, has been applied with success to another field, two-way communication for police, according to Daniel E. Noble, former professor at the University of Connecticut, who presented a paper to members of the Institute of Radio Engineers in New York. Dr. Noble described the equipment recently installed by the State Police of Connecticut which uses frequency-modulation transmitters located in ten "troop areas" throughout the state, as well as in the cruising cars which patrol the highways of the state.

Reliable two-way communication has been proved possible between any car and the nearest headquarters station with a generous factor of safety using the FM equipment, despite the hilly nature of the state and the interferences caused by heavy traffic in the city areas. The cars are fitted with 25-watt transmitters which consume only about two-thirds the current required by a conventional police-car transmitter of the same power. The FM car transmitters have roughly 50 per cent greater transmission range.

An important aspect of the new system is the fact that it can be adapted to the radio channels now assigned to police service. FM stations for broadcast service require more space than conventional broadcast stations. In police work, however, high fidelity of reproduction is not required. Intelligible speech may be transmitted on the FM police equipment without additional channel space, a fact which may make possible a wide adoption of FM.

★

Distinctive Calls for FM

To provide distinctive calls for FM (frequency modulation) broadcast stations, the Federal Communications Commission has adopted a new system of call letters with interposed numbers for this now commercially recognized broadcast service.

Under international agreement, to which the United States is a party, the first letter (in some cases the first two letters) of a call signal indicates the nationality of a station. The United States is assigned the use of three letters—N, K, and W. Hence the present domestic assignment of combinations beginning with these letters. Call letters beginning with N are reserved for the exclusive use of the Navy and Coast Guard. Call letters beginning with K are assigned to broadcast stations located west of the Mississippi River and in the territories. Call letters beginning with W are assigned to stations east of the Mississippi River. Any existing call letters not in accordance with this procedure is due to the fact that the station was licensed before the allocation plan was adopted.

Consequently, the first call letter of an FM station must be K or W, depending on its geographical location.

A second letter for an FM station will be assigned in alphabetical order (with exception of E, which will be reserved for non-commercial educational stations using frequency modulation) to each station on a given frequency as licensed, thus providing 25 stations in each area for a given frequency. If more than 25 stations are assigned on a given frequency, an additional letter will be necessary.

However, between the initial letter and supplemental letter (or letters) two numbers will be utilized. These numbers will indicate the frequency assignment. This is possible because all FM stations are in the 42,000-50,000 kilocycle band, and because all FM frequencies are assigned on the odd hundreds in kilocycles. Thus, the first figure and the last two figures of the frequency assignment can be dropped.

In addition, and where possible, the city or area will be indicated by the second letter or a combination of second and third letters. Letter combinations of this character have been assigned to each of the metropolitan trading centers. Thus, stations in Boston will terminate with the letter B, while stations in New York City will terminate with NY. Similarly, stations in the District of Columbia will be identified with the suffix DC.

In brief, here is how the system works: W41B would indicate an FM station in the eastern section of the country (Boston) operating on the frequency of 44,100 kilocycles. By the same token, K43SF would apply to an FM station in the western part of the United States (San Francisco) on the 44,300 kilocycle frequency.

The letter E in the alphabetical arrangement will identify non-commercial educational broadcast stations employing FM on the new high frequency broadcast band. Five channels (42,000 to 43,000 kilocycles) are available to these educational stations.

There is no international regulation to bar the use of this FM identifying system. In fact, a like principle is followed by Chile in assigning calls to standard broadcast stations in that country. The arrangement provides ample source of calls for future FM stations. It is about the only source of new call combinations which can be adapted, inasmuch as other types of calls are assigned by treaty to stations and services other than broadcast. It has the additional advantage of permitting identification of the frequency actually used, and for that reason should be popular with listeners as well as broadcasters.

Further, it will not disturb the approximately 15,000 remaining four-letter call combinations which are being assigned to the older services at the rate of between 40 and 50 a week. Even if this average does not increase such a reservoir will not last more than six years. It should also be noted that under international treaty, ship stations have priority in the assignments of radio call letters from the four-letter group.

★

$8,000,000 to Speed Television Development

DEVELOPMENT of television to a workable unified system is being speeded by an aggregate of $8,000,000 which has been budgeted for that purpose by some two score individuals and firms which, to date, have been authorized by the Federal Communications Commission to engage in such practical research and experimentation on a nation-wide basis.

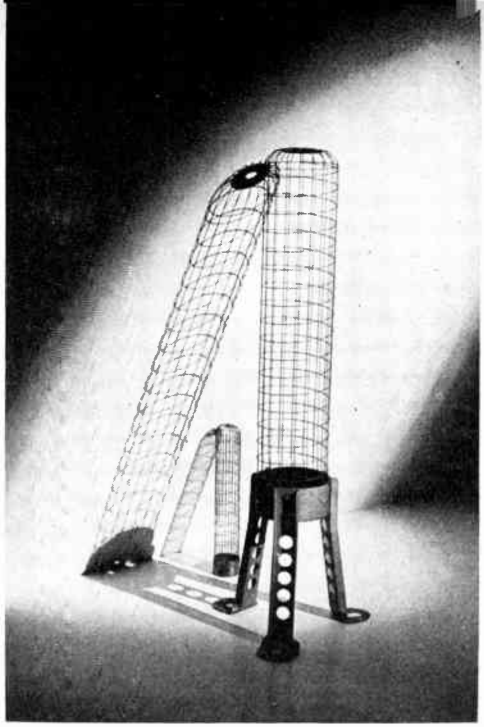
Expenditure of more than $3,000,000 is proposed by 10 television projects which received Commission approval on November 15th. Two of these grants are to the Hughes Productions Division of the Hughes Tool Co., which has $2,000,000 available for stations in Los Angeles and San Francisco. The establishment of Howard R. Hughes proposes to experiment in program production development in cooperation with Hughes Productions of Hollywood; study studio lighting effects; seek improvement of television transmitters, cameras, and synchronizing generators; test transmission of various numbers of lines between 421 and 525; compare different types of synchronizing signals, and try FM (frequency modulation) for the sound accompanying the pictures. In both cities the Hughes concern will operate on Television Channel No. 2 (60,000-66,000 kilocycles) with 10 kilowatts aural and visual power.

At the same time the Commission authorized like experimental operation for five other Los Angeles applicants:

Columbia Broadcasting System, Inc., to operate on Channel No. 8 (162,000-168,000 kilocycles), 1000 watts aural and visual power; for the purpose of transmitting to ascertain public reaction and otherwise conducting a program of research in Los An-

(Continued on page 60)

Grid Circuit Considerations For R-F Amplifiers



Non-technical, easy-to-understand information on how to determine the correct driving power for the grid circuit of an r-f amplifier. Explanation of losses, and their cure. Here is a manuscript every amateur should read, and remember.

By Frank C. Jones, Technical Editor

EVERY designer and builder of radio transmitters is confronted with a number of technical problems, each of which will be treated in a series of technical articles beginning with this discussion of the grid circuit. The information is taken from laboratory notes compiled over a period of several months while the writer was checking many types of transmitter tubes for operation in class-C amplifier circuits.

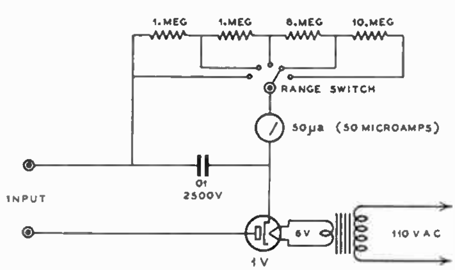
THE grid driving power lost in the grid-bias supply and used in the grid structure is the product of the d.c. grid current and the peak r-f grid voltage. This is practically equivalent to the actual power as expressed by the product of peak values of r-f voltage and current divided by two, since the peak grid current is approximately twice as great as the d.c. grid current in a class-C amplifier.

A peak vacuum-tube voltmeter connected across the grid coil will serve as a means to measure the peak r-f grid voltage, and a d-c milliammeter in series with the grid-leak, or C-bias supply, will read the d-c. grid current. A simple diode-type vacuum-tube voltmeter, made with a type-IV rectifier tube, bypass condensers, low-loss socket and power connector cable, and a 0-50 microampere meter with rotary switch and resistor multiplier is suitable for measuring voltage of from slightly less than 50 up to 1,000 volts. The unit in service in the writer's laboratory wastes only a small fraction of a watt of grid power. The type-IV tube base is slotted with a hacksaw blade in order to reduce r-f losses, and the tube is connected directly across the grid tuning condenser with short wiring leads.

The grid-bias power loss is the same for grid-leak bias, cathode bias, or fixed bias voltage supply, or for any combination of these. Tube tables always include this loss and the power used by the grid (which

Peak vacuum-tube voltmeter used by the author for making the tests from which the information in this manuscript was compiled.

causes heating of the grid) as one item. For example, a measurement on a 35T grid circuit indicated that 8 watts of grid driving power was required under certain conditions in a class-C r-f amplifier. This value remains constant at any frequency of operation, and the reason for difficulties in grid circuit drive, or excitation, at high radio frequencies is due to external losses. These consist of tuned circuit losses, impedance mismatch, and radiation and dielectric losses which may be a great deal larger than the actual power used in the grid circuit.



Circuit diagram of the peak vacuum-tube voltmeter illustrated above.

Each tuned circuit wastes from 5 to 15 per cent of the r-f power delivered to it by the plate circuit of the preceding tube. This holds true for the driver plate circuit, likewise for another tuned grid circuit if link coupling is employed, where there is an additional r-f power loss. With capacitive coupling the mismatch may result in an even greater grid driving power loss. The radiation and dielectric losses increase rapidly, especially at very high radio frequencies. Many amateurs have had the experience of communicating over distances of several miles without antenna connection of any kind; the radiation is from the coils which act as small loop aerials. Radiation can also emanate from wires, condenser frames, etc. All these represent a power loss, since the ultimate objective is to let the antenna perform the function of a radiator of r-f power. The same radiation losses occur in driver and grid circuits, but to a lesser degree.

Another impedance mismatch can easily occur in either capacitively- or link-coupled grid circuits, due to a change of grid impedance under load conditions in a class-C amplifier. An example is a 35T, or its equivalent, which had a measured grid imepdance of 3,000 ohms when driven by an exciter, but without applied plate voltage to the r-f amplifier. This grid impedance showed an increase to approximately 5,500 ohms when plate voltage was applied, and the plate circuit loaded by an antenna so that the d.c. plate current was of the normal value. If there is no regeneration in the neutralized r-f amplifier, and if the regulation of the r-f driver is reasonably good, there will be a reduction of d.c. grid current of from 20 to 50 per cent in the driver stage when it is properly loaded. The change of grid impedance may cause an impedance mismatch sufficient to cause considerable decrease of available grid driving power.

(*Continued on next page*)

All of these grid circuit losses usually cause the apparent efficiency of the buffer plate circuit to be from 25 to 35 per cent, instead of from 60 to 75 per cent, which might otherwise be expected from noting the actual plate dissipation in the buffer tube. In the specific example, this means that the buffer stage should have from 25 to 35 watts input in order to furnish 8 watts of grid driving power, even at fairly low radio frequencies.

A tentative suggestion for buffer stage design, for operation over a wide band of frequencies, would be the use of different multiplying factors which can be applied to the tube tables listing the actual grid driving power. These tables do not allow for the additional power losses, some of which are several times as great at 30-mc. as at 2-mc. The buffer plate power input may be approximately 3 times the tube table values of grid driving power for frequencies below 4-mc., 4 times for frequencies between 4- and 9-mc., 5 times between 9- and 20-mc., 6 times for 30-mc., and perhaps 10 or 12 times for 60-mc. If the driver stage is to be operated as a frequency multiplier, these factors should be increased by approximately 50 per cent.

Some of the aforementioned losses have given headaches to many engineers and amateurs. A classical example is the case of an exciter with a 6L6G tube, a unit which will deliver as much as 20 watts into a dummy antenna load. This exciter will drive a tube such as a 35T with ease at low radio frequencies, but it will fail miserably in the higher frequency bands, such as 30-mc. The "apparent grid driving power" at 30-mc. is so much greater than the actual driving power that even a type-807 doubler or buffer stage may not fully drive the 35T, or an equivalent tube.

A properly neutralized r-f amplifier, such as a balanced push-pull circuit, often gives the amateur a lot of worry because of the drop in grid current when the plate voltage and antenna load are applied. Degeneration is sometimes mentioned vaguely as a cause for this effect. However, this effect is the result of a change of grid circuit impedance, and not degeneration, and if there is no reduction in grid current the operator can be fairly certain that the r-f amplifier is regenerative. Regeneration may, and usually does, make an amplifier unsuitable for modulation of any type, except c.w.

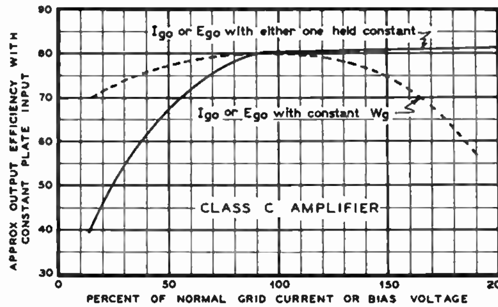


Fig. 1

This same Curve is shown in the Engineering Applications section of this issue, where the Eimac 304TL tube is treated extensively. The Curve was supplied by the Eitel-Mc-Cullough organization, to whom we are indebted for this cooperation.

THE relation between power output and d.c. grid current or bias voltage for a typical class-C amplifier is shown by the curves of Fig. 1.

The solid-line curve is for the case when the grid-bias voltage is held constant at a little more than twice cut-off value, and the grid current is varied by changing the link coupling to the grid circuit. This same curve holds approximately true for constant grid current, and for an increase or decrease of bias voltage from the normal value, or 100 per cent. These curves can be applied to almost any tube by using the 100 per cent values of grid current listed for typical operating conditions of a c.w. or plate-modulated r-f amplifier in the tube table data.

The solid-line curve indicates that the power output and efficiency drops rapidly for values of grid current below normal, but that very little increase is obtained at above-normal values of bias voltage or grid current. The slight increase of efficiency actually permits some increase of power output, particularly if the plate dissipation is held at a constant value, rather than maintaining a constant plate input. The grid driving power rises very rapidly as compared to the increase of power output. This means that the final amplifier may only have a power gain of from 5 to 10 when operating at very high plate efficiency and lower plate dissipation, as compared to the normal case of a power gain of some value between 12 and 20.

The broken-line curve of Fig. 1 applies to the general case of an amplifier driven by a small exciter or buffer which has limited power output. If the bias voltage is increased by an increase of bias resistance or voltage supply, a decrease of grid current will result,

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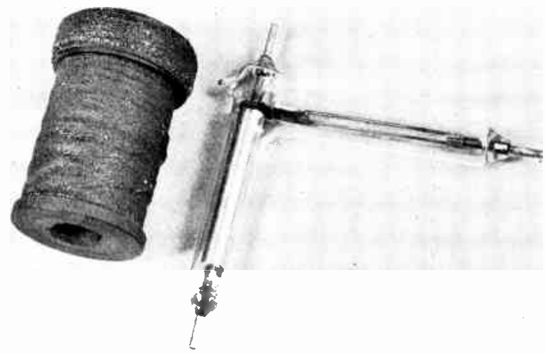
Vacuum-Type Antenna Relay



A NEW development in antenna changeover relays is the high-vacuum type, illustrated in the photograph. This device will also find numerous other switching applications, because of the high values of voltage which can be broken without danger of external sparking.

One use for this new *Eimac* Vacuum Relay is in the aircraft field, where the device has proven highly satisfactory for switching the plane's antenna from send to receive. The absence of an exterior spark makes for complete safety, for there is no danger that gases or fumes will be ignited from a sparking contact. Commercial and military planes are already using this relay extensively.

The relay is of the single-pole-double-throw type. It will carry several amperes of current. The solenoid and relay contacts are in a highly-evacuated glass chamber. The external magnet coil which actuates the internal solenoid is energized by batteries, and the coil is placed over one of the arms of the relay. This energizing element enables the movement of the solenoid in a manner identical to that of a conventional relay. By placing the relay contacts in a vacuum, the physical size of the device can be made very small for the high amounts of power handled.

This relay, furthermore, is ideal for moderate speeds of c. w. keying in high voltage circuits, although it was designed primarily for antenna change-over service. Numerous industrial applications also suggest themselves, and amateurs will welcome it for keying the primary of large transmitters.

Grid Circuit Considerations

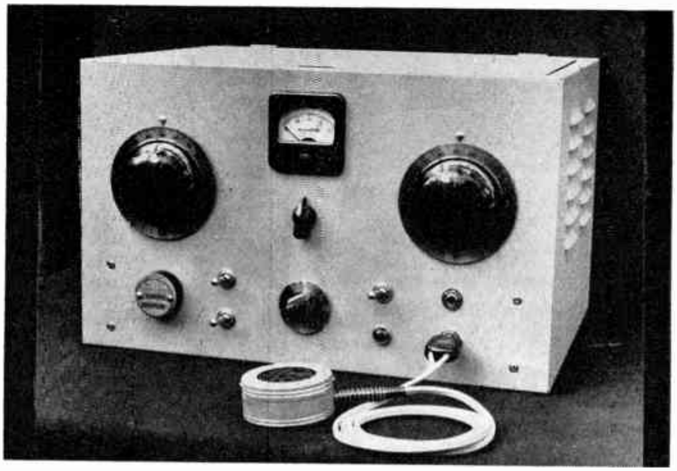
(Continued from preceding page)

and the efficiency of the amplifier output will be reduced. This results in higher plate loss and less power into the antenna. From this same curve it can be seen that a decrease of grid current, or bias voltage less than normal, will result in a gradual decrease of amplifier efficiency not as great as in the case where one factor was held constant (solid-line curve example).

The actual slopes of these curves may vary with different tubes, load conditions, and driver stage regulation, yet the variation is not very great since these curves are the composite values of a large number of different types and sizes of transmitter tubes.

There are several other important factors in connection with grid circuits of transmitter tubes, applying particularly to plate-modulated r-f amplifiers; they will be covered in a succeeding issue of this magazine. Among the items are curves showing how to operate high and low mu tubes in plate-modulated r-f amplifiers with much less than normal grid current, but with excellent linearity of modulation. Another item is the improvement in linearity with some types of high mu tubes which never seem to show a perfect oscilloscopic pattern of modulation and usually kick downward in plate current during modulation peaks.

Note: Frank C. Jones will continue this series for many months, telling you in A-B-C expressions the things you have long wanted to know about the function and operation of each and every circuit and component in a transmitter for c.w. or voice communication. You will acquire a new slant on your knowledge of circuit design, and you will want to file this data for constant reference because it will be wholly unlike that of any other treatment of the subjects.



3-Tube-All-Band-'Phone-C.W. Transmitter With New RCA-815s

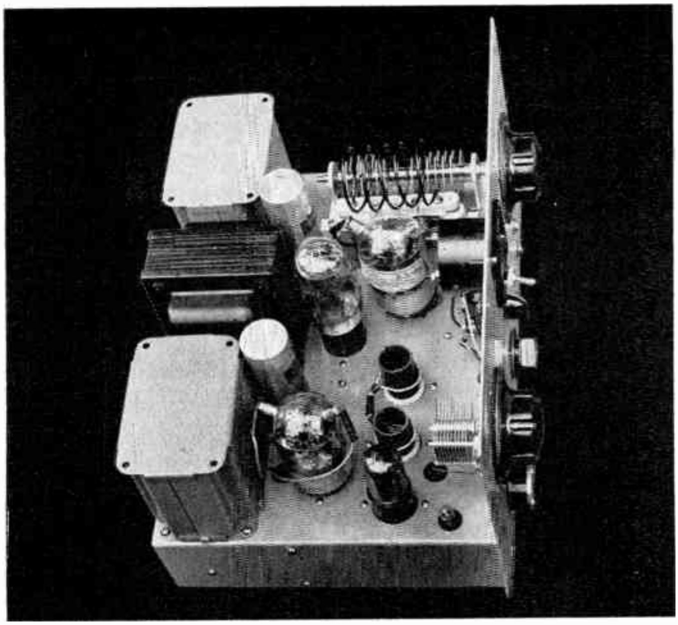
The new RCA-815 Dual Beam Pentode is here incorporated into a low-cost, versatile transmitter which should appeal to amateurs who want to build an inexpensive set for all-band, phone-c.w. operation. The cost of the transmitter is less than $50.00, including tubes. Numerous writings have shown how to incorporate the new tube in conventional UHF circuits, but here is a manuscript that tells how to use it all the way from 160 meters to 10.

* * *

THE announcement of a new tube usualy prompts a desire to hurry for the workbench in order to determine just what can be expected of the bottle under actual circuit tests. This is particularly true if the tube looks like it possesses some new and interesting features. The new RCA-815, with double-beam elements supported in a squatty, sturdy envelope, is such a tube. We saw it advertised recently, and the price was given as $4.75. It looked like a lot of tube for the money, so we wrote the corporation tycoons and asked if this price was correct — it seemed like a lot of tube for less than five dollars. Back came the answer: "We hope so!"

The general design of the tube is such that it lends itself readily to compact construction and short connections. Its general features are not unlike that of a conventional beam tube, such as the 807, yet it possesses an added advantage of low grid drive for quite healthy outputs of r-f. Aside from its ability to perform excellently in r-f service, this tube — with its push-pull application abilities—is well suited for modulator service. For this reason, the little transmitter described in this text was conceived and built. A new tube—a new idea—a transmitter for all-band operation with power inputs ranging from 40 to 60 watts—yes, the bottle had possibilities!

THE design of a transmitter for all-band operation is not the easiest problem for the constructor to solve; a number of multiplier stages enter into the considerations. We were on the look-out for extreme compactness, and confronted with the necessary evil of housing the power supply, r-f stages and modulator in a compact case; everything had to be built upon a single, small chassis. Extreme flexibility was desired, with the added ability to shift from band to band with a minimum of tuning controls. The



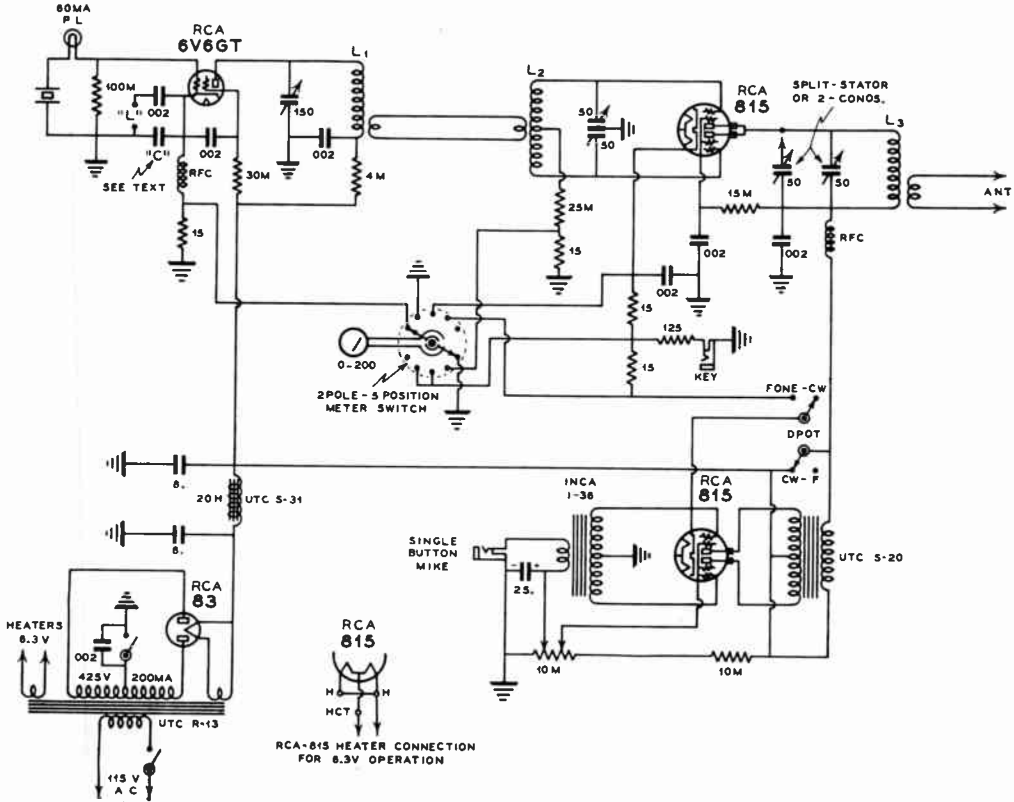
● *Looking into the complete transmitter, the Millen tuning condensers are plainly shown. The power supply components are UTC, with specifications given in the schematic. The final amplifier shows a 10-meter coil in place.*

lower frequency bands, 160- and 80-meters, present no unusual design problems, requiring only the proper crystals, and working the 815 as a straight-through amplifier. The screening of the tube is such that, with ordinary care and layout- it is entirely possible to do away with neutralization.

It should be mentioned here that a general purpose transmitter of this type calls for a very definite compromise. In the interest of using as few tubes as possible, the normal driver stage was omitted from the modulator, the latter being driven directly from a high step-up ratio microphone transformer. These special units are made by *Inca*, *Kenyon* and *Thordarson*. No grid current is possible in this case, and hence the audio power output of the modulator is itself limited to about 20 watts. Both the audio and r-f power outputs are limited by the size of the power supply, which must of necessity be compact if the transmitter is to live up to its original promise. One thing leads to another, and the builder must realize that a 1-kw transmitter can not be built into a match box. But if you are satisfied with a modest amount of power, all-band operation, extreme simplicity of control, and low cost—here is the transmitter that will fill the bill.

In a transmitter of this design it is always desirable to use as few tubes as possible. Each time a tube is eliminated from the circuit, a tube socket and all its associate equipment is likewise obviated. By process of elimination the final version of the transmitter consisted of three tubes—a crystal oscillator capable of doubling, an 815 in the final amplifier, and another 815 as a modulator.

It is advisable to first give consideration to the highest frequency of operation, and use this frequency to dictate the eventual design. In normal amateur practice, the 10-meter band is the highest to be included in an all-band transmitter. Consideration must then be given to a suitable fundamental frequency for the crystal oscillator. To avoid cranky and erratic operation of the oscillator, it was definitely decided that conventional 40-meter crystals would be chosen. For 10-meter operation the crystal oscillator doubles to 20, and drives the 815 as a push-push doubler, whose output circuit is tuned to 10 meters. The particular harmonic crystal oscillator circuit adopted makes it possible to mount the plate tuning condenser directly on the front panel. In one form of *Jones* oscillator, where the tuning condenser is not by-passed directly to ground, this mechanical feature would have been impossible.



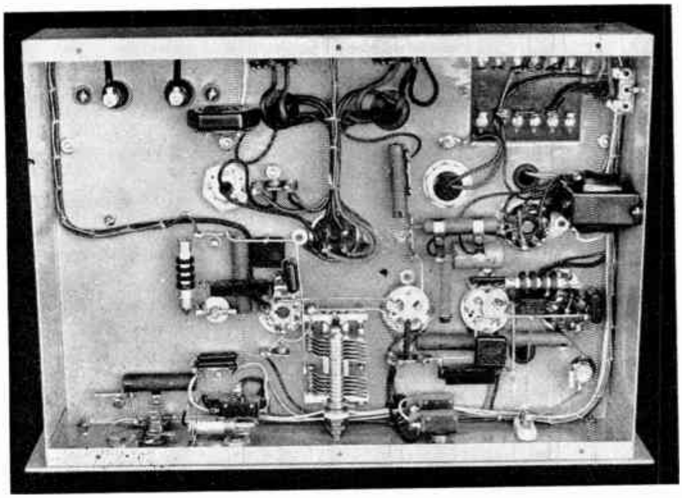
Complete Schematic Wiring Diagram of All-Band, 'Phone-C.W. Transmitter

The newer *Jones* oscillator, in which a cathode choke is included, presents no such difficulty. Note that the tank tuning condenser is connected directly from plate to ground. This method of connection was chosen intentionally, since the circuit across the tank inductance is completed by the mica by-pass condenser. It is a point worthy of note to relate that a fixed mica by-pass condenser of 150$\mu\mu$f. (.00015) is used in place of the more conventional and adjustable padder or trimmer condenser from oscillator to ground. Although the crystal was mounted on the front panel for convenience when changing crystals, there is actually a very decided electrical advantage, in that the crystal is completely shielded from the remainder of the circuit. This results in lower crystal r-f current. In this transmitter the crystal current is extremely low for all cases of harmonic operation.

The crystal stage has a plug-in coil for each band of operation. When it is desired to work straight-through in the oscillator circuit, a link is soldered across the two small pins of the coil form, within the coil. This link closes circuit "*L*," shown on the schematic diagram. This connection automatically places a .002 mica condenser from cathode to ground, thus effectively short-circuiting the cathode choke and eliminating the possibility of regeneration.

In a push-push doubler circuit the two grids of a tube are obviously in push-pull, and the two plates in parallel. The effect of this connection is to produce twice the number of "kicks" in the plate circuit, thus greatly improving the doubling action. It is essential that exactly the same amount of drive be delivered to both grids, and hence the use of a balanced grid circuit with a split-stator tuning condenser. Any tendency for an unbalanced condition in this circuit, and particularly the use of a single-section standard tuning condenser across the grids, will inevitably result in spurious oscillation, or the unbalance will be so great that only one tube will function.

For straight-through operation, the parallel connection was chosen in preference to push-pull. On the 160-meter band, the physical size of a tuning condenser would be out of the question for a compact transmitter. And even if such a condenser were feasible, its minimum capacity would be so high that no inductance would remain in the circuit for resonance on 10 meters. As designed, the tube plate-to-ground capacities are rather



• *There is no hay-wire under the chassis, and the workmanship is not of the rat's-nest variety. Small components are secured to tie-strips and much of the wiring is cabled and laced.*

high in this transmitter, and the coil for 10-meter operation has but five turns. Yet in spite of this small inductance, the plate current dips to approximately 30-ma. Considering that this stage is then acting as a doubler, such a minimum value is excellent, and indicates good efficiency as well. The actual meter reading is approximately 45-ma., since both plate and screen currents are metered simultaneously.

For operation in the low-frequency bands, the two sections of the split-stator tuning condenser are in parallel. This is accomplished simply within, or on, the plug-in connection of the coil itself. For straight-through operation the grid circuit is likewise parallel-connected. Here again, both sections of the split-stator grid tuning condenser are tied together, and to one end of the coil. To complete the circuit, the other end of the coil must be by-passed to ground. This is accomplished with a small mica condenser mounted inside the coil form.

Although this transmitter will be used primarily for 'phone, a c.w. keying jack has been included, connected between the cathode resistor and ground. A d.p.d.t. switch for changing from c.w. to phone is also provided; this switch breaks the cathode circuit of the modulator and short-circuits the modulation transformer. The cathode resistor is common to both the final amplifier and modulator, in order to stabilize the grid (cathode) bias on the modulator. Such stabilization is required because of the large plate current excursions in the 815 modulator with speech input.

The speech driver tube was eliminated for purposes of simplicity. A high step-up ratio transformer (100-to-1 turns ratio) makes it possible to develop enough audio grid swing to secure reasonable power output. As previously stated, a driver stage could be used advantageously, in that it would allow small amounts of grid current, with consequent increase in audio output from the modulator. A *Western Electric* F-1 single-button carbon microphone was chosen in the interests of simplicity and economy. This unit has excellent fidelity within the voice range, and is readily obtainable from any supply house which carries *W.E.* parts. No microphone batteries are needed; the microphone voltage is secured from two resistors which comprise the bleeder system. The modulator screen voltage is also supplied from this same divider. A heavy by-pass condenser must be connected across the point where the microphone transformer is tapped across the divider.

The power supply has condenser input in order to obtain higher plate voltage from a readily available small transformer, such as the *UTC* unit chosen for this design. Electrolytic condensers are not satisfactory for the input circuit, although they can be—and are—used in the output section. The supply potential under load is approximately 400 volts. Two switches are included in the power circuit. One switch closes the primary, in order to light the filaments. To prevent simultaneous application of power, a second switch is included in the center-tap of the secondary winding.

Rationalizing
The Harmonic Oscillator

Have you a cracked crystal in your morgue? And have you wondered why your harmonic oscillator wouldn't work as a high-power transmitter? The author tells you some of the do's and don'ts of crystal oscillator operation — a technical treatise that deals with a timely problem — and with utter frankness.

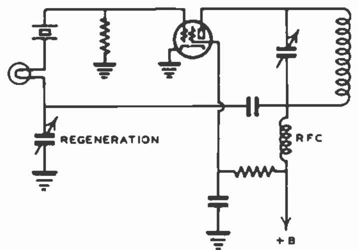
*By Clayton F. Bane**

DOUBTLESS you, too, have been victimized by a harmonic oscillator. Honestly, when you removed the crystal from the holder and found that it had either a nice crack or an outright hole in it, upon whom did you place the blame—yourself, and the fact that there might possibly have been something wrong with the manner in which you set the circuit up, or upon the man who proposed the oscillator circuit? Frankly, both of you could have been at fault. The inventor, because he failed to tell you that his circuit might exhibit entirely different characteristics when built into different mechanical versions, or perhaps yourself—for failure to realize exactly what you were trying to do. A somewhat different approach to the basic analysis of harmonic oscillators may help to produce sure-fire results, and at the same time remove the burden of blame from the shoulders of the inventors of really worthwhile circuits.

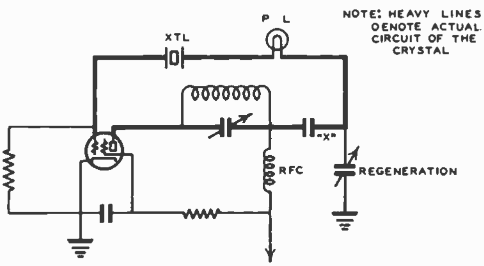
Regardless of the trick names applied, harmonic oscillators basically fall into only a few classes. Almost without exception, all are capable of creditable performance in the hands of men who know how the circuits work and what they are trying to accomplish. Among these is the *Tri-Tet* oscillator, one of the first to be introduced to the amateur. Well can I remember the trail of broken crystals and the complaints against it, shortly after its introduction, although virtually all of the trouble came about by inability to understand the underlying principles involved. This circuit worked—it still works, the objection to it now is the fact that it is relatively obsolete and has largely been supplanted by more simple circuits. From personal choice, backed by extensive commercial use, I prefer either of the two *Jones* circuits. I know these circuits work—I've built dozens of transmitters using them. Still, many amateurs have expressed the belief that there was something basically wrong with the *Jones* oscillators, and that it was impossible to get them to work. Not so, gentlemen!

Consider one version of the *Jones* oscillator as shown in Fig. 1. Failure to realize just what type of bull one has by the tail can be sometimes traced to the fact that in the interests of standardization, circuit draftsmen follow a certain pattern in their layouts. This Fig. 1 circuit is a good illustration. If one disregards the theory involved, this drawing would off-hand appear to be the conventional tuned-plate, fundamental crystal oscillator. Of course, even when it is known that the L/C circuit is tuned to some harmonic of the crystal, the original impression still persists. In normal cases such an impression will invariably mean that the circuit will be treated as a straight-through oscillator. Reasoning may be that if 400 volts works on the latter it will also work when the oscillator is, for example, doubling. This reasoning can be entirely fallacious, for certain sets of conditions.

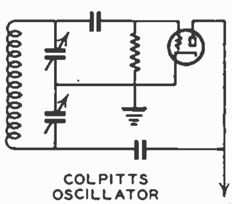
*Chief Engineer. Technical Radio, Inc.



JONES OSCILLATOR
FIG. 1



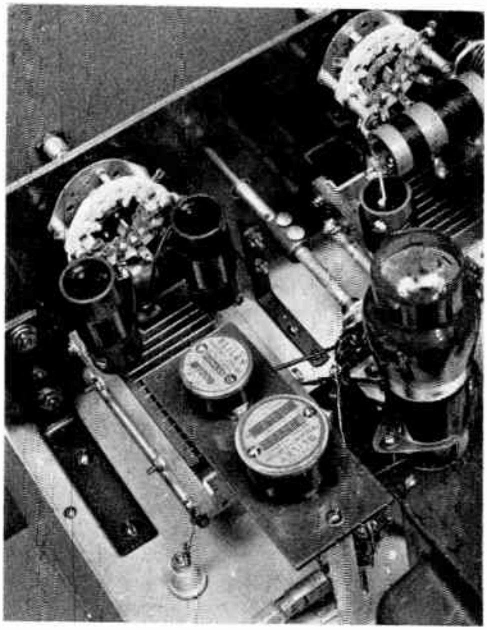
JONES OSCILLATOR IDENTICAL TO FIG. 1
FIG. 2



COLPITTS OSCILLATOR
FIG. 3

Should the same circuit be redrawn so as to appear as in Fig. 2, it suddenly loses its familiar identity, even though Fig. 1 and Fig. 2 are exactly the same. It doesn't take much imagination to see that the crystal is connected across the tube, from grid to plate. The fact that the L/C circuit is in series with the plate doesn't alter the fact that this is the clue to why the crystal oscillates. The crystal is independent of the L/C harmonic-tuned circuit, and actually works as a *Pierce Oscillator*. Why the crystal can oscillate without seeming to have a tuned circuit can be understood if it can be shown that the *Pierce* is actually the familiar *Colpitts* oscillator, with the crystal itself replacing the inductance. Electrically, a quartz crystal may be considered as an extremely high inductance in series with a small capacity. A conventional *Colpitts* circuit is shown in Fig. 3. In the *Pierce* circuit, the crystal replaces the inductance and the grid-to-ground and plate-to-ground capacities of the tube replace the two variable condensers. If the ratio of these two capacities is correct the circuit will oscillate at the fundamental frequency of the crystal. This briefly explains why the circuit can oscillate at the crystal fundamental frequency. It does not explain why the radio-frequency voltage across the crystal can be at such wide variance in different circuit arrangements and layouts.

In order to improve the efficiency of the circuit for harmonic operation it becomes necessary to make it regenerative, and here is where the principal difficulties arise. To keep the radio-frequency voltage which appears across the crystal to a safe value, it is definitely necessary to make this regeneration *controllable*. *Jones* provided a condenser for this purpose, which is highly effective—if the parts and wiring layout are such that the regeneration is confined to the circuits of which the condenser is a part. It is easily possible to come to grief in the *Pierce* oscillator portion of the circuit, since different capacities from grid-to-ground and from plate-to-ground will cause different feedback ratios and greater or less initial crystal current. Such variation in capacitance might be introduced by long leads from the crystal—long and indirect ground path between grid and plate circuits—capacity of crystal holder to chassis—capacity of L/C circuit to chassis. These are some of the reasons why there is such a wide variation in the performance between oscillators which would initially appear to be a wire-for-wire copy of each other. *Jones* knew from the start, and he did one of the only things possible—he introduced a flashlight bulb in series with the crystal to act as a danger signal. When these lamps start going out, one after the other, don't condemn the circuit. Rather, look for the *cause*. Don't think that the 60-milliampere bulb specified was a misprint, and replace it with a 150-mill bulb. This procedure inevitably leads to a cracked crystal. Thus far, the discussion has been largely on the theoretical side, and entirely negative as far as suggesting possible cures. In many cases, a full realization of the problems involved will suggest the proper course of action, since



Jones harmonic oscillator with tapped coils and rotary switch for multi-band operation. Two crystals enable the oscillator to deliver output from 160 to 20 meters. A small rotary switch selects either the 160- or 40-meter crystal. Both sides of the crystal are either in or out of service—rather than cutting-in or out the grid connection only.

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the possible offending elements will then be known. As a suggestion for an initial set-up on a new circuit about to be tried for the first time, the following may have some merit.

(1) *Never* start out with high voltage on the oscillator until you are definitely certain that the regeneration is controllable. Put a series resistor in the plate and screen circuits of the oscillator, so that the voltages are reduced to approximately half their normal value. This assumes that the crystal current will probably be too high and that some work will have to be done in order to reduce it to a reasonable value.

(2) *Always* use a 60-milliampere flashlight bulb in series with the crystal. When you buy the bulb, ask to see the box, so you can be certain that it is 60-mill and not something else. Don't trust your judgment on how bright a 150-mill bulb will be at 60-milliamperes. You will always be wrong if you guess. Note that a 150-ma. bulb will just barely show a dull red at 60-ma. The bulb is your tell-tale and also a fuse—never leave it out of the circuit. Make certain that it is in series with the side of the crystal opposite to that which goes to the grid of the tube. Be careful about getting it in "*X*" in Fig. 2.

(3) Always start out (in the circuit shown in Fig. 2) with the regeneration condenser at full or *maximum* capacity. Decrease the capacity in slow steps, meanwhile tuning the L/C tank carefully through its range, watching for the slightest indication of a dip in the plate current.

(4) Under no circumstances attempt to adjust the oscillator for plate current dip or for crystal current, unless the grid circuit of the following tube is connected. If capacity coupling is used, be certain that the tap is on the crystal plate tank and that the following tube has its filament lighted, but do not apply its plate or screen voltage. This latter tube then will act as a diode vacuum-tube voltmeter (oscillator output being indicated by the grid meter on this tube), as well as a load for the oscillator. The oscillator should not be adjusted without load since, as has been stated, the circuit is regenerative and the proper amount of regeneration for no-load and load will be entirely different. While it is true that the load presented to the oscillator will be different when the plate voltage is applied to the following tube, the grid circuit alone will be sufficiently close for preliminary set-up.

(5) It is not necessarily true that the plate current of the oscillator must take a very sharp and definite dip in order for it to be working properly. The regeneration condenser must be *decreased* in capacity until some indication of plate current dip is achieved as the L/C circuit is tuned through resonance. When this indication is found, adjust for the lowest plate current value on the particular dip (even though it be but 10-ma.) and observe the lamp in series with the crystal. If this is not showing any, or a very low amount of brilliance (remember we are working at half voltage), decrease the regeneration condenser still more. This should permit greater plate current dip.

(6) In the above procedure, it will be well to stop after the first reasonable dip is located (reasonable in this case being anything up to 15-milliamperes), and apply the normal plate voltage momentarily to observe the comparative brilliance of the lamp at high and low plate voltage. If the lamp gets very bright at high voltage, you may

rest assured that the oscillator is not controlling properly, and one or more of the dodges for reducing crystal current should be tried.

(7) Do not use any more regeneration than is absolutely necessary. That is to say, if the oscillator plate current dips to 10- or 15-milliamperes only, and still the grid meter on the following stage shows adequate grid current for proper excitation, don't carry the plate current dip too far. More regeneration invariably means more crystal current. Even though the particular crystal can stand the increased radio-frequency current, the heavier current will heat the crystal and increase its frequency drift. Take a harmonic oscillator at its true value, namely a device in which the function of two tubes is combined in one. A highly regenerative harmonic oscillator is a "trigger" device, and very hard to handle. When simply doubling in the oscillator there is no need for such border-line adjustment.

(8) If the r-f crystal current persits in running high even with low plate and screen voltages, the following may be applied, in total or in part:

(a) A small 25-micro-microfarad mica condenser should be tried from oscillator grid to ground.

(b) A similiar condenser should be tried from the opposite side of the crystal itself to ground. Either or both condensers may be used if they are effective in reducing crystal r-f current.

(c) If the grid leak, cathode, and regeneration condenser all return to separate points on the chassis (also screen by-pass), try bonding them together with a piece of bus bar. If this is ineffectual, try returning each in succession to another point on the chassis. In about nine cases out of ten an erratic oscillator can be tamed by simply breaking up the ground-loop circuits. It is astonishing the amount of current that can be measured across a three-inch section of chassis under certain circumstances. It is further surprising how far removed from actual ground certain excellent-appearing grounds can be.

(d) Don't overlook coupling between the crystal holder and the crystal plate tank. Also coupling from the plate of the tube (when glass), to the crystal holder.

(9) Bear in mind that the regeneration setting for an individual harmonic oscillator is unalterably tied-up with the activity of the particular crystal used. That is to say, an inactive crystal may require considerable regeneration to give results. When an active crystal is plugged into the same circuit, the regeneration may be so great that the crystal r-f current will rise tremendously. In setting-up, be certain that your oscillator is either set-up for a compromise adjustment for either type of crystal, or else that all your crystals are uniformly active.

(10) Always check your oscillator to be absolutely certain that the *crystal* is doing the oscillating. A cranky crystal that requires a large amount of regeneration may actually be working only on a "trigger" basis. The check for self-oscillation is extremely simple. Tune your receiver to the output frequency of the oscillator and turn on the beat oscillator so that a steady beat note may be obtained. Now bring your hand close to the oscillator plate coil. If your circuit is crystal, the pitch of the beat note will *not* change. If it is self-excited the pitch will change, due to the capacity of your body tuning the circuit to a new frequency. Be suspicious of very large and abrupt dips in oscillator plate current, since in many cases these indicate self-oscillation. The real criterion of dip is the grid meter of the next stage. Basically, all that is wanted is a reasonable value of plate current in the oscillator, low crystal r-f current, and the requisite amount of drive for the next stage. Since it is impossible to set-up the oscillator without a load, the no-load plate current is meaningless. Remember that the grid circut of the following stage constitutes a definite load, and the oscillator plate current minimum will thus be higher than if it were working unloaded.

The remarks and suggestions made herein are the direct result of a number of years of work with all types of harmonic oscillators. both in amateur and commercial equipment. While specifically applied to one type of *Jones* oscillator, for the most part they should apply equally well to any other type wherein the crystal itself is basically operating in a *Pierce*-type circuit, and where regeneration is deliberately introduced in controlled amounts. The writer wishes to again point out that the effect of circuit capacity (which will be different in any two individually designed units) is one of the indeterminate factors in the performance of a harmonic oscillator. Other things being equal, any oscillator can be made to work, but in many cases only after application of the proper corrective measures as indicated by the particular problem involved.

Battling Shunt Capacity in Tank Circuits

Practical Information on What to Do When the Condenser and Coil Will Not Tune to Resonance

*By F. D. Wells, W6QUC**

SHUNT capacity has played more havoc and cost more hours of wasted effort than any other obstruction in the amateur's path to the eventual kilowatt. There are few who do not sooner or later remove their hay-wire tank coils in order to replace them with the new manufactured varieties which add glamour to the rig. The coil is purchased and the socket for it installed; the switch is thrown, and the tank condenser is tuned for resonance, but the expected dip in plate current fails to materialize.

A quick glance at the catalog shows that the coils should tune to 10 meters with a capacity of 28$\mu\mu$f. The 150$\mu\mu$f tuning condenser has a minimum of capacity of 7$\mu\mu$f., so the tank current should dip with the condenser about one-fifth of the way toward maximum capacity. The condenser is set at minimum, the switch is again thrown, and the condenser hopefully tuned toward maximum capacity. Still no dip.

One of three courses is now open: First is to remove the modern improvement, replace the old hay-wire tank coil, light up the pipe and spend an evening operating. Second is to wait until morning, take the coil back to the store, give vent to all accumulated rage and demand the return of the purchase price. Third is to get out the pliers and start to work on the new coil. The third, of course, defeats the purpose of the original project, as there is no instrument superior to a pair of pliers for destroying the appearance of a coil.

Assume the tank is in the plate circuit of a 6L6G buffer doubler driving the grid of an 811. If a metal chassis is used and the coil socket is mounted directly on it, and if in addition the tank condenser is mounted fairly close to the chassis, the stray capacity to ground of the entire circuit from the plate of the 6L6G to the grid of the 811 would probably be 25 to 30$\mu\mu$f. and would rarely be under 15$\mu\mu$f. The coil, then, has across it a minimum of 36.5$\mu\mu$f.: 15 $\mu\mu$f. strays, 5.5$\mu\mu$f. input capacitance of the 811, about 9$\mu\mu$f. output capacitance of the 6L6G and 7$\mu\mu$f. minimum capacity of the tank condenser. The manufacturer said the coil would tune to 10 meters with a capacity of 28$\mu\mu$f!

A smaller tank condenser, say 35$\mu\mu$f, would help slightly since it has a minimum capacity of 4$\mu\mu$f. However, the plate capacity of the 6L6G and the grid capacity of the 811 cannot be changed. Consequently, with this arrangement the stray capacity must be limited to 9.5$\mu\mu$f so that the total capacity across the coil will not exceed 28 $\mu\mu$f. A difficult thing to achieve with metal chassis construction!

When link coupling is used, the problem is not so severe, since the grid capacity of the 811 is no longer across the tank coil.

ANOTHER common problem is to determine the size of the condenser needed to cover a given frequency range. It can be simplified by considering the frequency ratio instead of frequency range, and the capacity ratio instead of the capacity range. The frequency ratio is obtained by dividing the highest frequency to be covered by the lowest frequency to be covered. The capacity ratio is the ratio of the maximum capacity to the minimum capacity, *not of the condenser*, but of the complete circuit, since there are ordinarily shunt capacities in the circuit.

These shunt capacities upset calculations when a two-to-one frequency range in the tank circuit is contemplated. If it is desired to have a single tank which will tune both 80 and 40 meters, a 100$\mu\mu$f condenser might be selected for this purpose. Since a two-to-one frequency range requires a four-to-one capacity range, the 100$\mu\mu$f condenser with a 6$\mu\mu$f minimum looks quite promising. Assuming that the tube capacities and the stray capacities amount to 35$\mu\mu$f, maximum capacity across the circuit is 100 plus 35, or 135$\mu\mu$f and minimum capacity across the circuit 35 plus 6, or 41$\mu\mu$f. The ratio of maximum to minimum is 135/41, or 3.3 instead of 4. A larger condenser is needed.

If a 150$\mu\mu$f condenser with a minimum of 7$\mu\mu$f be chosen, the maximum circuit capacity would be 150 plus 35, or 185$\mu\mu$f, the mini-

(Continued on page 51)

*Engineer, Technical Radio, Inc.

Emergency 'Phone For Defense Service

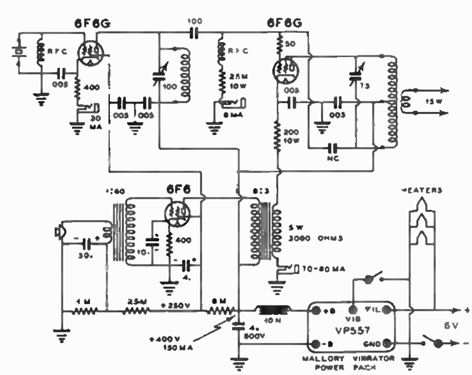
RADIO defense groups, and individual amateurs as well, have requested technical information on the design and construction of a low-power unit which can be operated from a source other than the 110-volt a.c. mains. Here is such a transmitter.

Technical Considerations

THE small radiotelephone transmitter units shown in the photograph can be mounted in a standard carrying case for portable or emergency operation from a storage battery. The transmitter is capable of delivering approximately 15 watts of carrier when used with a heavy-duty 400-volt *Mallory Vibrapack*.

The circuit consists of a straightforward 6F6G pentode crystal oscillator for either 160- or 75-meter operation, by merely changing the plug-in coils and crystals. Another 6F6G serves as a neutralized r-f amplifier, driven by the crystal oscillator. This amplifier tube is cathode-modulated with a 6F6 pentode, connected to a single-button carbon microphone. The microphone current is obtained from the high-voltage supply through an R/C filter, since this connection permits the transmittr to be operated from an a.c. power supply for home station service. The R/C filter eliminates all trace of vibrator or power supply hash in the audio system.

The filaments of the 6F6G tubes can be operated either from a 6-volt storage battery



or from a 6.3 volt a.c. power transformer. Standard plug-in coils of the *B & W* type are suitable for the band of operation desired.

The particular electrical design of the transmitter permits relatively high r-f output with cathode modulation, which is comparable to plate modulation as used in the average small transmitter. The r-f amplifier tube is connected as a triode. The 50-ohm, 1-watt resistor in the input grid lead acts as a parasitic suppressor.

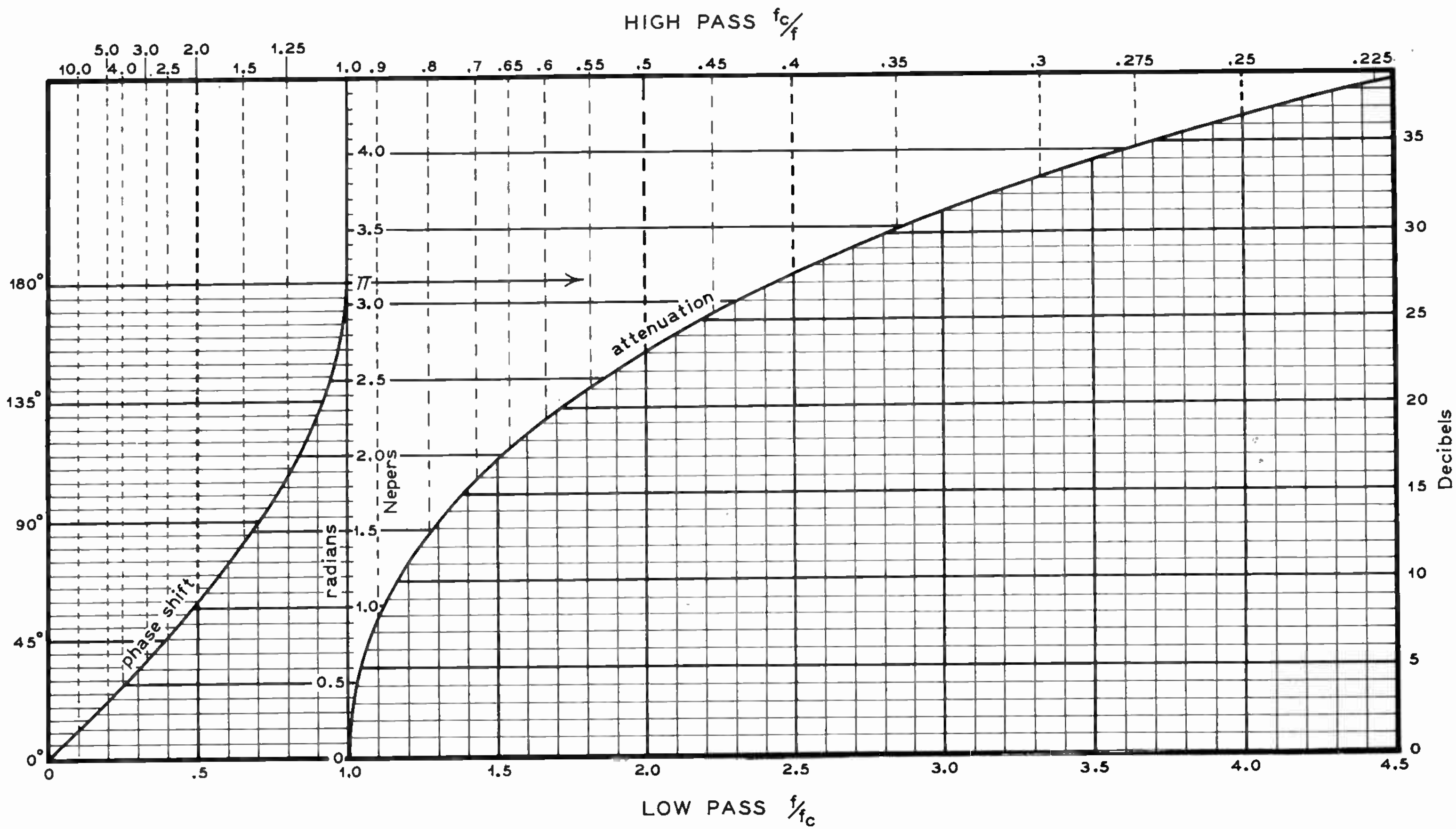


Fig. 1—Chart for Estimating Attenuation and Phase of Frequency Ratios. Also Shows Characteristic Curves for Low-Pass Section.

Filter Performance Estimator

A remarkable, new means for finding the loss and phase at a given frequency, or vice versa, in either a low-pass or a high-pass section.

By Arthur H. Halloran

THE performance of a filter, i.e. its effect on the magnitude and the phase of the frequencies in the current which it passes to the load and which it by-passes from the load, is readily determined when the impedance of the filter is matched to that of the load so as to suppress any reflected wave. The two curves in Fig. 1 give approximate values of phase shift and attenuation for low-pass and high-pass filters of either the π- or the T-type. Whilst it is drawn to illustrate the characteristics of a low-pass section referred to the bottom scale, the numerical values also apply to a high-pass section when the top scale is employed. Before applying the chart to its primary purpose, that of determining the cut-off frequency which will minimize the ripple or hum due to an objectionable frequency in a rectified a-c power supply, let us study its general construction and meaning.

The curve at the left indicates the amount of phase shift for frequencies whose ratio to the cut-off frequency are from 0 to 1 along the bottom scale and from 10 to 1 along the top scale, the former corresponding to the frequencies which are passed by a low-pass filter, and the latter to those which are passed by a high-pass filter. The vertical scale at the left gives the phase angle in degrees and that to the immediate right gives it in radians. It may be seen that the cut-off frequency is 180 degrees out of phase in both cases. For the low-pass filter, the phase angle decreases as the frequency ratio becomes less, being zero for zero ratio (direct current). For a high-pass filter, the phase angle decreases as the frequency ratio increases and is negative in sign, whereas for a low-pass filter it is positive. It will be noted that all by-passed frequencies are 180 degrees out of phase. The phase angle is of minor importance in the design of power packs, but is of major interest in some other applications of filters.

The curve at the right indicates the attenuation or decrease in magnitude of frequencies as they depart from cut-off. For the low-pass filter, this means the higher frequencies corresponding to the ratio scale along the bottom of the chart. For a high-pass filter it means the frequencies lower than cut-off as shown by the scale along the top of the chart. The attenuation is zero for all frequencies which are passed to the load. The scale at the right indicates the amount of attenuation in decibels, whilst that to the immediate left is in nepers, where 1 neper = 8.686 db. A scale of per cent of ripple might also be added at the right in accordance with the values given in a later table.

Application to Power Supply Filter

WHEN the output current is 30 db less than the input at a specified frequency that frequency is assumed to be inaudible. The chart shows that 30 db corresponds to $f/f_c = 2.82$. This means that the objectionable 120-cycle hum from a full-wave rectifier can be minimized when

$$f/f_c = 120/f_c = 2.82, \text{ whence } f_c = 42.5 \text{ cycles.}$$

The selection of 42 cycles as the cut-off frequency for the example given in the first instalment (A.R.D., Dec., 1940) on "A Filter Design Calculator" is thus seen to be justified. That article contained an obvious error which should be corrected, namely substitute henries for farads as the last word in the second paragraph of p. 38.

If the same filter were used with a half-wave instead of a full-wave rectifier, thus producing an objectionable 60-cycle hum from a 60-cycle a-c source, the frequency ratio would be

$$f/f_c = 60/42.5 = 1.41,$$

for which the corresponding drop is seen to 15 db, which is not sufficient to make the hum inaudible. However, by using two sections the drop would be $2 \times 15 = 30$ db, which is ample for the job. This is in accord with a general rule that n identical sections in series multiply by n the db drop due to one section.

Furthermore, if two sections were used to minimize the 120-cycle component, the size of the individual coils and condensers could be reduced—at the cost of using more of them. Each section should be designed for 15 db drop. The chart shows that this is given by a frequency ratio of 1.4, whence

$$f/f_c = 120/f_c = 1.4, \text{ or } f_c = 85 \text{ cycles.}$$

The design chart in the previous instalment shows that for an 85-cycle cutoff and a 3000-ohm load, L = 13 henries and C = 1.3 μf. From Fig. 2 of that instalment it is seen that a 2-section T-type filter requires two 6.5 henry coils, one 13-henry coil, and two 1.3 μf condensers, whereas two π-type sections require two 13-henry chokes, one 1.3 μf and two 0.65 μf condensers.

The bandwidth control filter cited in a previous example was designed for a cutoff at 3100 cycles. For 5000 cycles the frequency ratio is thus

$$f/f_c = 5000/3000 = 1.66,$$

which the chart shows corresponds to a drop of only 19 db. This might open an argument as to whether more satisfactory results might be obtained by selecting a cutoff at 2500 cycles, when the drop for 3000 cycles would be only 11 db and for 5000 cycles would be 23 db, as can readily be verified by the chart.

Performance Formulas

THOSE who prefer getting exact results by means of formulas, instead of the approximate results given by the curves in the chart, which are plotted from the values given by the formulas, will need two sets of tables to be found in engineering and mathematical handbooks. These are a table of circular sines and angles in radians for finding the phase angle, and a table of hyperbolic cosines for finding the attenuation constant.

For a low-pass filter the phase angle b is equal to twice the angle whose sine is f/f_c when f is less than f_c, corresponding to the frequencies which are passed to the load without being attenuated. This is expressed by the formula

$$b = 2 \sin^{-1} f/f_c$$

The procedure is merely to double the angle whose sine is f/f_c, as found in the table. The attenuation a in nepers is equal to twice the angle whose hyperbolic cosine is f/f_c when f is greater than f_c, corresponding to the frequencies which are by-passed from the load 180 degrees out of phase. This is expressed by the formula

$$a = 2 \cosh^{-1} f/f_c$$

The procedure is merely to double the angle whose hyperbolic cosine is f/f_c, as found in the table. Multiplication of nepers by 8.686 converts them to decibels.

The inverse operation of determining the frequency ratio which will provide a specified db drop, is accomplished by first converting db to nepers by multiplying by 0.1151, then dividing by 2 to get the value of the angle, (the two operations can be combined by multiplying by 0.0575) and finally consulting a table of hyperbolic cosines to find the frequency ratio corresponding to this angle.

For a high-pass filter the same formulas apply when f_c/f is substituted for f/f_c. The passed frequencies are those for which f is greater than f_c, and the by-passed frequencies are those for which f is less than f_c.

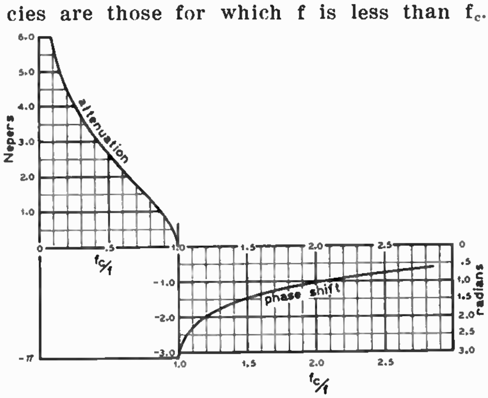


FIG. 2

Fig. 2—Characteristic Curves for High-Pass Section.

Fig. 2 shows the characteristic curves for a high-pass section when the curves are plotted with reference to an increasing, instead of a decreasing, frequency ratio. It is thus plotted with reference to f_c/f along the bottom scale.

a is the angle for which $f/f_c = \cosh a/2$ along the left-hand scale, and b is the angle for which $f/f_c = \sin b/2$ along the right-hand scale.

Proof of Formulas

FOR the closed circuit consisting of y,Z,x/2, in Fig. 3, a T-section, the input current I flows through y to develop a voltage $E_1 = Iy$, and the output current i flows through $(y + Z + x/2)$ to develop a voltage

$$E_2 = -i(y + Z + x/2).$$

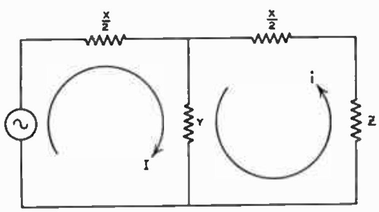


FIG. 3

Fig. 3—Currents in T-Section.

Knowing from Kirchhoff's Laws that the algebraic sum of all the voltages around a closed circuit is zero, we thus have

$$Iy - i(y + Z + x/2) = 0$$

$$\text{whence } \frac{I}{i} = \frac{y + Z + x/2}{y} = 1 + Z/y + x/2y$$

For a T-Section we have previously found

$$Z = \sqrt{xy}\ \sqrt{1 + x/4y}$$

$$\text{whence } Z/y = \sqrt{x/y}\ \sqrt{1 + x/4y}$$

$$\text{and } I/i = 1 + x/2y + \sqrt{x/y}\ \sqrt{1 + x/4y}$$

$$= 1 + x/2y + \sqrt{(1 + x/2y)^2 - 1} \quad \text{......(1)}$$

A similar analysis of a π-type section, where

$$Z = \frac{\sqrt{xy}}{\sqrt{1 + x/4y}}$$

would show that eq(1) likewise expresses its current ratio. Consequently, the remaining problem is to interpret eq(1) when the values of the corresponding frequency ratios are substituted for x and y.

For a low-pass section we have previously found

$$x = \omega L,\ y = -1/\omega C, \text{ and } f_c = 2f_o$$

$$\text{whence } x/2y = -\omega^2 LC/2 = -f^2/2f_o^2 = -2f^2/f_c^2$$

Substitution of this value in eq(1) then yields

$$I/i = 1 - 2f^2/f_c^2 + \sqrt{(1 - 2f^2/f_c^2)^2 - 1} \quad \text{......(2)}$$

Interpretation of eq(2) depends upon whether f is less than or greater than f_c. Tedious calculations of its values corresponding to various values of f can be neatly side-stepped by letting $f/f_c = \sin b/2$, when f is less than f_c. This is illustrated in Fig. 4 where the angle $b/2$, defined by BOA in the large circle, is half the size of the angle b, defined by BCA in the small circle, whose diameter is half that of the large circle. Upon representing f_c by OB, the hypotenuse of triangle OAB, and representing f by AB, we have

$$f/f_c = AB/OB = \sin b/2$$

Then

$$1 - 2\,f^2/f_c^2 = 1 - 2\sin^2 b/2 = \cos b$$

and

$$\sqrt{(1 - 2f^2/f_c^2)^2 - 1} = \sqrt{\cos^2 b - 1} = j \sin b.$$

Substitution of these values in eq(2) yields

$$I/i = \cos b + j\sin b = e^{jb}$$

$$\text{whence } i/I = \cos b - j\sin b = e^{-jb} \quad \text{..............(3)}$$

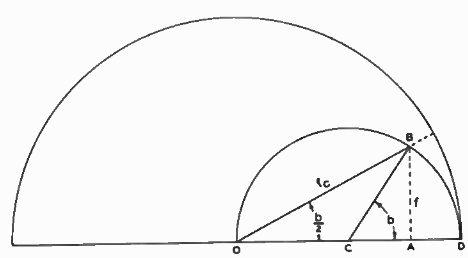


FIG. 4

Fig. 4—Relationship of Circular Functions.

Eq(3), which gives the ratio of the output to the input current, defines the position of a unit radius in terms of an angle b, which is the phase angle. The negative sign means that the angle decreases from a maximum of π radians when $f/f_c = 1$ to a minimum of zero radians when $f/f_c = 0$, as previously explained in connection with Fig. 1.

When f is greater than f_c, the ratio f/f_c cannot be the sine of an angle formed by the arc of a circle, inasmuch as neither a circular sine or cosine can be greater than unity. This difficulty is easily overcome by employing the hyperbolic sine (abbreviated sinh) or hyperbolic cosine (abbreviated cosh) of an angle as illustrated in Fig. 5.

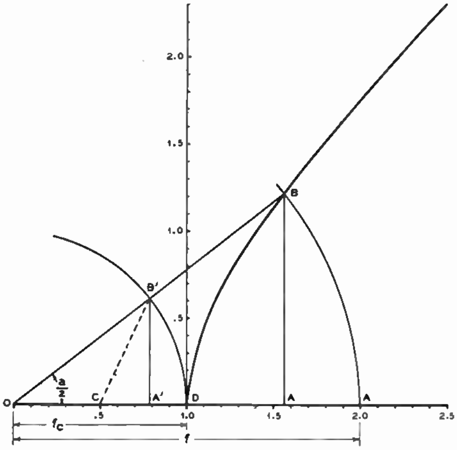


FIG. 5

Fig. 5—Relationship of Hyperbolic Functions.

Here the curve DB′ is the arc of a circle whose radius is defined by

$$r^2 = (OB')^2 = (OA')^2 + (A'B')^2$$

and whose circular functions are

$A'B'/OB' = A'B'/OD = \sin a/2$

$OA'/OB' = OA'/OD = \cos a/2$

from which is derived $\cos^2 a/2 + \sin^2 a/2 = 1$.

Furthermore, the curve DB is the arc of a hyperbola whose "radius" is defined by

$$r^2 = (OA)^2 - (AB)^2 = (OD)^2$$

and whose analogus "hyperbolic functions" are

$AB/OD = \sinh a/2$ and $OA/OD = \cosh a/2$

from which is derived

$\cosh^2 a/2 - \sinh^2 a/2 = 1$,

whence $\cosh a/2 = \sqrt{1 + \sinh^2 a/2}$

$$\sinh a/2 = \sqrt{\cosh^2 a/2 - 1}$$

Consequently when $f/f_c = \cosh a/2$, we have

$1 - 2f^2/f^2_c = 1 - 2\cosh^2 a/2 = -\cosh a$,

$\sqrt{(1 - 2f^2/f^2_c)^2 - 1} = \sqrt{\cosh^2 a - 1} = \sinh a$.

Substitution of these values in eq(2) then gives

$$I/i = -\cosh a + \sinh a.$$

From mathematical texts we learn that

$$\cosh a = \frac{e^a + e^{-a}}{2} \text{ and } \sinh a = \frac{e^a - e^{-a}}{2}$$

whence we have $I/i = -e^{-a}$ and $i/I = -e^a$

where $e = 2.718$ is the base of the natural system of logarithms, and a is found from a table of hyperbolic cosines by doubling the angle defined by $f/f_c = \cosh a/2$.

The coefficient a gives the attenuation in nepers, corresponding to any frequency f greater than f_c. Thus since

$$i/I = -e^a, \text{ we have } a = -\log_e i/I.$$

As the number of decibels is given by

$$db = 20 \log_{10} i/I$$

and as natural logarithms are converted into common logarithms through multiplication by 0.4343, we have

$$a = -8.686 \log_{10} i/I \text{ db.}$$

The previously mentioned general rule that n identical sections in series multiply by n the db drop due to one section is deduced from the fact that if I be the input to the first section and i_1 be the output, then

$$i_1/I = -e^a \text{ or } i_1 = -Ie^a.$$

For the second section i_1 is the input and i_2 is the output, whence

$$i_2/i_1 = -e^a \text{ or } i_2 = -i_1e^a = -Ie^{2a}.$$

Continuing in the same manner for n sections we can readily find that

$$i_n/I = e^{-na}$$

whence na becomes the attenuation factor for n sections.

The percentage of output to input current is given (approximately) by the following table:

%	db	%	db	%	db
2	34	10	20	50	6
3	31	15	16	60	4.4
4	28	20	14	70	3.1
5	26	25	12	80	1.9
6	24	30	10	90	0.9
7	23	35	9	100	0.0
8	22	40	8		
9	21	45	7		

Orders Are Like Eggs

Ignoring the Small Radio Manufacturer Is Only an Invitation To the Age-Old One-Basket Tragedy

*By Louis R. Huber**

EVERYONE knows the old adage about Mrs. Grundy, who carried all her eggs in one basket. When something hit her from behind, she didn't have even an omelet left. The lesson has become a classic and, today, national defense orders are just like eggs. If you put them all in one basket and something happens—blooie! You're stuck. Bottleneck trouble. Remember what happened at the Gilfillan Brothers plant in Los Angeles a few weeks ago? That's what we mean.

Gilfillan had contracted to build thousands of sets for use in military aircraft. When their plant burned, they went out of the picture. Delay results. The sets must now be built elsewhere. National defense takes it on the chin. Whether the fire was caused by sabotage or not is beside the point. What counts is the fact that there are hundreds of smaller radio manufacturers whose combined facilities can handle that order and much more. Yet most of them have not been able to get even a coil to wind for national defense!

You can say what you want about Gilfillan. Maybe the loss *was* covered by insurance. Maybe Gilfillan did have a big plant, filled with production experts and geared for mass output. And Gilfillan was right across the alley from the aviation centers of the west. That's the easy way of explaining why such a big order was dumped in Gilfillan's lap. But *Amateur Radio Defense* isn't impressed by easy answers. We are interested in the fact that this big order must now be reallocated. Valuable time is lost—forever.

Would it not have been far wiser in the first place to have broken this huge order up into several smaller orders? In San Francisco there are two large manufacturers who could have produced the goods, yet their factories are now almost idle. In all west coast cities there are smaller concerns who could have handled parts of this same order. Their regular crews have dispersed to the shipyards and the aircraft plants. They are perhaps lost to the radio industry and they are vital workmen whose skills are difficult to find. All because it seemed better to give this one large order to just one manufacturer.

So much for the problem of idle factories. Let us turn, now, to a factory which *has* obtained a national defense order. This should make everybody happy, but it doesn't. Under the prevalent bidding system, this manufacturer has been forced to cut to the bone. He has had to shave labor costs. He has been given every reason for cutting his workmen's throats and thus violating the National Labor Relations Act, or even the Wage-Hour law. He would rather not have such an incentive. But let us suppose he *has* got the contract; he is ready to go ahead. But he finds that, to meet specifications, he must have certain parts—and those parts can not be obtained. Bottleneck trouble. After much delay, however, he gets the parts; but before he can deliver the finished product, he has slipped past the delivery date. He must accept a penalty. His profits vanish. He has been a patriotic American, but it has ruined him. Don't laugh—for this already has actually happened.

Amateur Radio Defense maintains that such things should not occur in our national defense program. They need not, if common sense is used. One radio manufacturer suggested a common-sense solution the other day: "Let the government send a representative with each substantial order," he said, "and give that representative full power to authorize changes in specifications which will speed up production without injuring quality."

Sensible? We'll say so! Instead of stalling production on a minor technicality—such as if two threads instead of three aren't visible above a nut — such a representative would say: "Go ahead, Mr. Manufacturer: if you can't lick your production problems according to the details in the specifications, lick them another way. As long as the ultimate results are what Uncle Sam wants, God bless you and go to it!"

The competitive bidding system, in fact, proves faultier the more you examine it. Of

(Continued on page 70)

*Associate Editor

Success Secrets of a Radio Club

Some pertinent suggestions for founding and successfully conducting the kind of a radio organization which will be lasting. Taken from the model San Francisco Radio Club, Inc., which has weathered every storm over a long period of years and is today more strongly united than at any time since its inception.

ORGANIZATION is all-important for the success of any cooperative effort, voluntary or compulsory. The former is the more difficult of achievement because a voluntary effort is often subject to the whims of the individual, his personal likes and dislikes, and his willingness or ability to perform certain of the duties assigned him. A compulsory effort, on the other hand, usually lacks the spirit and enthusiasm of those who are "regimented" or forced to perform a service. It is for this reason that a voluntary effort, properly handled, can be made to function as successfully and efficiently as a compulsory effort, once the "secret" of holding the constituents together has been found.

An effort is now being made to organize a great number of small and large volunteer groups into local Amateur Radio Defense units. And it is the purpose of this article to help the individuals interested in defense activities, so that the effort can be made as simple as it will be successful. There is perhaps no better example of organization than that adopted some years ago by the San Francisco Radio Club, Inc., and the reader who is anxious to get an A.R.D. unit under way in his vicinity without further loss of time can profit immeasurably from the few words of advice which follow.

Ten years before the first World War, several amateurs gathered at the home of a fellow amateur to discuss organizing a local radio club. The movement was undertaken long before wireless became known as radio, and when only a scant dozen amateurs were available for club membership in a rather wide area. The first problem confronting the founders of the club was one of fraternalism, in order to help keep the air free from malicious interference, because in the early days of radio it was common practice for the amateur to tell the commercial stations to get off the air. Life was made rather uncomfortable for those engaged professionally by the "trusts," as the amateurs dubbed them. And it was common practice for a good amateur to handle traffic for some of the commercial stations, because many an old-time amateur

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The San Francisco Radio Club, Inc., in session. A portion of the membership is gathered around Arthur H. Halloran, editor of Amateur Radio Defense, *who is explaining the A-B-C's of filter design X-Y-Z. How many of your friends on the air can you identify from this picture? You'll see Frank Jones, F. D. Wells, C. F. Bane, Wes Little, Paul Bickel, Fred Cookson, Herb. Pherson, R. J. Higby, Harry Elliott, Harold Emmal and a few dozen others. The photograph is by N. R. Farbman, W6SEM, staff photographer.*

found himself with better equipment than was in use by some of the commercials. Those were the days when spark signals were heard and sent clear across the Pacific Ocean to the Orient, and on the low frequencies, at that. Wavelengths were a matter of choice or opinion, as were call letters and power input. The sky was the limit.

The amateurs of San Francisco realized that some plan of cooperation with their commercial brothers was in order, otherwise neither "ham" nor "commercial" would be able to enjoy his "wireless" for long. Some of the commercial operators were friendly to the amateur, others openly hostile. Some of the older men of amateur radio still recall the invitations sent to amateurs by commercial operators to visit the big stations atop the hills, and no sooner would the amateur start climbing the hill than a deluge of rocks, bricks, boulders, etc. would come rolling down the hill—and the poor, young hams would run for shelter. But there were others of a more friendly nature, and it was these men who played an important part in getting all wireless factions to work together harmoniously.

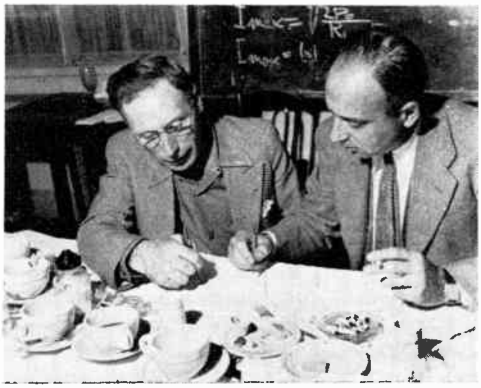
The San Francisco Radio Club began with a very few members, the ultimate total was set at 26, for this is the run of the alphabet from A to Z, and each member was assigned an "RS" call—*R* for radio, *S* for San Francisco. The first member would be assigned RSA, the last RSZ, and once the quota of 26 had been filled there would be no opportunity for others to enter the sacred portals of the organization. This was done partly because there were fewer than 26 amateurs in the city and it did not seem possible that a heavy influx of new amateurs would be in evidence for many years to come.

The club's first problem was the age-old matter of meeting quarters, and then the customary unpleasantness of finance. Meetings were held at the homes of various members, but soon came the urge to locate in a permanent place, and with it the undisputed fact that rental must be paid. For many years the situation was discussed pro and con, and always the matter of finances reappeared.

Thousands of amateurs know, and other thousands will learn sooner or later, that these two problems—housing and rental—are the bugaboo of every organized amateur group. They are responsible for most of the failures of amateur club affairs, for the discontent among the membership, for the lack of interest in the club's future. It required many years for the San Francisco Radio

Left: Sam C. Van Liew, W6CVP, is the President of San Francisco Radio Club, Inc. He is an old-timer, very active on 10-meter 'phone and 40 c.w. A machinist by trade. He conducts the meetings in a business-like, stern but friendly manner. But when the meetings are adjourned he is just another ham, even as you or I. Every member of the club is his friend, and of all in the organization none is more beloved than W6CVP.

Right: Determined to lick a problem before the speaker is given a chance to leave for home, two club members are seen in deep thought in the illustration to the right. With hand to his forehead is Chas. E. Thompson, W6UQ, one of the club's charter members, and pondering with him is Thail L. Haire, W6AEB of Mackay Radio. These two old-salts rarely miss a meeting, and both are actively on the air. Thompson is in business for himself—refrigeration—a cold subject, so he comes to the club to warm up on radio.



A. W. Fonseca, W6NYQ (right) and Harry Elliott, W6PHX. Both are 10-meter 'phone enthusiasts, known to almost every amateur on the band. W6NYQ is an executive with the Pacific Tel. and Tel. Co., and a former president of the club. He is the arranger of the club's technical programs. In the photograph you see him at work on a problem solved on the table cloth, for the benefit of W6PHX. It has often been said that waiters and waitresses could become rich if only they could analyze or decipher the myriad of "intelligence" written on table cloths.

After-meeting pow-wows last far into the night, sometimes until the wee-small hours of the morning. Members hate to go home. They gather in small groups, cuss and discuss their problems. Here you see Hal. Ayers W6NGV, making the issues plain to W6NCB, W. D. Hewartson. The bottles in the foreground once contained milk, beer, ale, lemonade. The amateur's taste is as varied as his bands of operation. Hal Ayers is another ex-president of the club, and for years he set the type for "Radio" magazine in the plant where the magazine was then produced. W. D. Hewartson was on the air before World War I, and is another of the Charter Members of the club.

Club to find the solution, but once found it was without question the one and only redeeming factor which served to make the club the powerful organization it is today. This club is one of the world's oldest, its present membership still includes a number of the "two-letter call" amateurs who were its charter members, and it has continued to function and to grow through the years, while hundreds of other clubs have failed.

What the club has done to enable it to progress in times both good and bad is as simple as A-B-C. In the first place, a careful analysis was made of the whims of the membership: it was realized that (1) a permanent address must be found, (2) matters of finance must form no part of meeting discussions, (3) there must be no initiation fee and no dues, (4) there must be no wide divergence in the age of the membership, (5) each meeting must be publicized among members and prospective members, (6) a speaker must be provided for each meeting.

Sounds foolish? Not at all. The matter of finding a permanent address was quite simple, but it was solved only after years of unsuccessful attempt to hold meetings in public buildings, lodge halls, civic structures, school auditorium.s shacks in the hilly part of the city where a ham station could operate with success, and in almost every other place the amateur could suggest.

Three photographs of club membership activities. Left: Robert (Bob) Hutchinson, W6BGW, tells W6ROO what it's like to work Admiral Byrd for a period of 4 hours solid on the 20-meter band. Bob is pointing to the south pole, and W6ROO stares in amazement.

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Center: L. G. (Pat) McGorray, W6JDP (Jack Dempsey's Punch) is at the left, checking the treasurer's report with Gibson M. Gray, W6PUX. Pat introduces the visitors and new members, and his introductions have long been the cause of many a hearty chuckle on the part of the membership. His humor is spontaneous, original. When photographed for the picture shown here, he professed his desire to have his picture taken with his arms around a "big shot," so that "people will think I know something about radio." Gib. Gray, who handles the club's finances, is a San Francisco businessman and a full-fledged, clean-cut ham.

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Right: F. D. Wells, one of the club's technical advisers, is playing the game of square-root and round figures with Arthur H. Halloran (face to blackboard), after the technical discussion is completed. For hours many members will corner the speaker-of-the-evening, bombarding him with questions, even to the sidewalk, or into his automobile, where some "meetings" have continued until almost daylight.

To hold a group together, year in and year out, and in order to make stronger the ties of goodfellowship, it was at last realized that some of the members should be present for dinner on club nights. So a banquet room in a neighborhood restaurant was found, where no rent is paid. On alternate Fridays the club meets in this room, perhaps two dozen members present for an a-la-carte dinner. yet enough to make it worthwhile for the restaurant proprietor to reserve the hall on alternate Fridays for the sole use of the radio club. And this plan, in great measure, is responsible for the club's success. Because no rental for quarters is paid, the bugaboo of finances is unknown to the members of the San Francisco Radio Club.

It was found that the membership could be broken into three groups, (1) those who are present for dinner at the club, (2) those who have dinner at home, change clothes and appear on the scene somewhat later in the evening, (3) those who attend night school and who do not appear at the club until after 9:00 p.m., at which time the technical talk gets under way.

Only those who have seen their favorite radio club come and go will understand the wisdom of the advice to locate in a rent-free place. Nothing is more disturbing to the membership than the consistent squabble over finances—to pay rent, etc. Eliminate the financial worry and your club can be made a success literally before it opens its doors.

The dinner hour at the club is a pleasant one. Personal problems are discussed, and the members engage in a general round-table chat. Any restaurant proprietor will gladly give quarters to a radio group if a reasonable number of members will be present for dinner on club nights.

It was found that a radio club can be conducted without benefit of initiation fee, because money is unnecessary for any particular purpose. Why, then, impose financial restrictions upon the membership when these finances are not required? A club can function successfully from the collections taken among those present, so long as this fund is adequate to cover the cost of mailing the twice-monthly meeting notices. And this is the only expense the San Francisco Radio Club incurs. Nothing else is needed, nothing else would further help to strengthen the club in membership numbers or in morale. At the close of each meeting the Treasurer "passes the hat," in the case of the San Francisco club it is a water glass, into which those present deposit what they can afford to contribute. There is no set amount for the contribution; the individual has his choice. If he is without funds, he deposits nothing; if he is "flush" he often deposits from 10c to 25c per meeting, yet it is a rule rather than an exception to find a few greenbacks in the "hat" at almost every meeting. And, strange as it seems, these larger contributions are usually made by visitors who feel that they have spent an enjoyable evening at a low cost.

The two ex-W6USA operators are members of San Francisco Radio Club, Inc. The portion to the left shows Bob Hansen, W6MPC, and Johnny Werner, W6ONQ, hard at work on a tube characteristics chart which was part of a technical talk on tube curves. Both men are now with the Eimac Company, making vacuum tubes for commercials and hams. Almost every local radio plant is represented by members in the club. The small photograph to the right again shows W6-ONQ, also Clayton F. Bane (seated) who ponders a deep technical problem. Bane is another of the club's technical advisers.

The club now has 224 members, each of whom is sent a penny post-card twice a month, announcing the forthcoming meeting. It costs approximately $4.50 to address and print these cards—and this is the *only* expense with which the club is faced. It collects from $6.00 to $14.00 per meeting "in the hat," and there has been a cash surplus in the treasury for almost ten years. As soon as this surplus reaches the dangerously high figure bordering $100.00, something is done to reduce the cash balance. Usually an amateur in need is provided with some part or gadget for his transmitter or receiver, or an amateur in a hospital is supplied with something he could ill-afford to buy himself. Or a social affair is held, and some of the treasury surplus consumed in liquid form.

The reading of the financial report consumes approximately 15 seconds of each meeting—that's all! The minutes of the previous meeting consume another 15 seconds. All matters of regulating the club's affairs are in the hands of a Board of Governors; this Board meets for a few minutes once each month. The Board reports to the membership only when there is something of an important nature to report, otherwise the membership hardly knows that it has a governing board.

Politics is entirely taboo, and the club has no affiliation with any association, organization, or other group. It takes orders from none. It gives orders to none. Its ranks are not divided. Those who profess a desire to argue or squabble at meetings are quietly asked to resign. Applications for membership are first passed upon by a membership committee. Undesirables are not given an opportunity to join.

The San Francisco Radio Club has often been erroneously referred to as a "snooty" organization. Nothing is farther from the truth. After almost 30 years of experience in conducting radio clubs, the founders of the organization, and the newscomers as well, have learned to profit from past experience. Only those who are more than 21 years of age are eligible for membership. The younger amateurs engage in activities of their own, in small groups, but they do not have a club of their own. They are invited to attend special lectures on certain stipulated occasions, when word is broadcast and publicized in radio stores that an "open meeting" is to be held.

Some of the best-known local radio engineers are members of the club, and they direct its technical affairs. The membership has been addressed by numerous men of note and it has always been possible to secure good speakers because of the accepted fact that a large turn-out is the rule, and the members, as a whole, are thoroughly able to understand and digest the subject matter of a technical talk. Then, too, the banquet room is a most inviting place, fitted with the club's public address system, equipped with a large blackboard, and a good lighting system to enable all to see what is being written on the board.

The meetings begin with the dinner, as aforementioned, then a general discussion, announcements from the individual members, introduction of new members and visitors, each of whom is required to tell about himself, his activities, etc., and the final portion of the evening is devoted to technical talks, followed by questions and answers. Almost any amateur's problem can be solved by someone in attendance, and the club has proved itself a storehouse of technical ideas.

Average attendance is approximately 25 to 30 per cent of the membership total, which is considered a satisfactory average in a large metropolitan area.

Because the San Francisco Radio Club, Inc., has survived through all the years of amateur radio, almost from the days when the first spark was heard in a 75-ohm headphone, those interested in getting an Amateur Radio Defense unit under way can well copy the plan outlined. Eliminate the problem of a meeting place, eliminate the distasteful discussion regarding finances, let the members contribute what they will towards the mailing of meeting notice cards, and you can be sure that you will hold your membership almost wholly intact through the years.

Appoint as few officers as possible; only a few men in any club will prove their worth when work is assigned. The San Francisco club elects its officers once each year. No president has served more than two terms. The secretary telephones the meeting notice information to a local mailing bureau, where address stencils are on file for the membership. These stencils cost but 5 cents each. Everything possible is done to reduce work and to save time in the conduct of the club's affairs. Members and visitors appear in clean clothing, the meetings are conducted with informality, yet in a dignified manner. The membership respects its officers, and the officers respect the membership. This is another reason why the much talked about San Francisco Radio Club, Inc., continues to grow in membership, prestige and popularity. It meets but twice each month. Weekly meetings were the rule, years ago, but a change was made which proved for the better; twice a month is often enough to hold any good organization together.

★

How Old Is an "OM"?

THE young amateur who gets a thrill when someone calls him an "old man" had better wait until he reaches the "after 40" stage in life, to awaken to the stark realization of how funny it isn't to be a "really old man." It is amusing to see two young amateurs chin-wigging in a radio store, or at a convention, calling each other "OM," yet the combined ages of the two wouldn't stack up to more than half of that of one half of one old man. Why try to make an old man out of yourself before nature does the job, and in a more thorough fashion? When I was a "young OM," I used to work hams all night long—now it takes me all night to work one of them. Listen to that shrill, squeaky voice of some youngster in his 'teens calling a still younger ham an OM, and you'll get what I mean.

Let's change this thing to YM (young man), and give the youngster the same break the wimmin folks get. You never hear 'em call the wife an OW (old woman) on the air, because they know better'n that! They may try it once—just once—that's all. No matter how old the old-woman gets, they still call her the xYL. Come on, boys, let's make a clean breast of this business — call the youngsters YM, the really young wives YL, and those with one foot in the grave YF (wife—just like the telegraphers say). And, by this means, some enterprising YM won't try to run away with the first YL he hears on the air, because she may be old enough to be his grandma. And they'd look funyasell walking down the street together, wouldn't they—calling one another OM and YL. Grrrrrr!

—An Old Fossil.

Technical Questions *and* Answers

Question: What causes my plate r-f chokes to collapse?

Answer: Flash-over of the tuning condenser may cause a very high flow of plate current, resulting in a tendency for the pies of an r-f choke to pull towards one another, due to the high magnetic field set up by the increased current flow. If the frame of a split-stator tuning condenser is not insulated from direct ground by means of a high-voltage mica condenser, the flash-over of the condenser will permit d.c. current to flow to ground across the r-f arc. This amount of current is usualy ample to collapse an r-f choke. Installation of an isolating mica condenser will prevent the formation of a d.c. arc, and will, in most cases, protect the r-f choke and rectifier tubes in the event of condenser flash-over.

* * *

Question: Why is the fundamental frequency called the "first harmonic"?

Answer: The harmonics are multiples of the fundamental frequency, and since the first multiple is 1, the first harmonic is the same as the fundamental frequency.

* * *

Question: Why does the gain of a three-element beam seem to drop off over a portion of the band?

Answer: The radiation resistance of a three-element beam is only a fraction of that of a single dipole antenna, with the result that the selectivity and resonance impedance curve of the three-element beam is much greater than that of a simple antenna. If the electrical lengths of a beam are not altered when changing the frequency of operation, the gain will be reduced—just as in any parallel-tuned circuit in a transmitter or receiver.

* * *

Question: Why is it always necessary to tune an r-f amplifier to a dip in plate current?

Answer: If the circuit Q is sufficiently high, i.e. if the L/C circuit is correct for normal operation, a class-C r-f amplifier should be tuned to the point which results in minimum d.c. plate current for a given loading effect. This adjusts the circuit to unity power factor, so that the minimum r-f plate voltage coincides with the maximum plate current, under which conditions the tube operates with minimum plate dissipation. Departure from this tuning point lowers the plate efficiency and results in less output, higher d.c. plate current, and greater plate dissipation.

* * *

Question: Is a doublet the same as a dipole antenna?

Answer: A doublet antenna is short enough to be considered as having uniform current throughout its length, and is therefore shorter than a dipole. The dipole antenna is one with a full half-wave of "in phase" currents distributed along its length. Many technical writers have interchanged these two terms while referring to a resonant half-wave or dipole antenna.

* * *

Question: What is meant by "in phase" and "180 degrees out of phase"?

Answer: Electrical or radio waves are said to be "in phase" when coming together so that like effects are additive. 180 degrees out of phase refers to two waves in which the like effects tend to cancel each other.

* * *

Question: Why is a meter often connected into the cathode rather than into the plate circuit?

Answer: This method of connection is often used in order to place the meter at a point as near zero d.c. potential to ground as possible. When the meter is connected into the high voltage plate lead, the case should be well insulated from the chassis or common ground and protected from contact by the operator by means of a glass panel. This is not necessary if the meter is placed in the cathode circuit.

Poor Man's Beam Antenna

Again our Frank C. Jones announces something with widespread appeal. This time it is a mighty simple beam—hardly more complicated than a single-wire antenna. Particularly those who build F. D. Wells' 10-Meter 'Phone, described in this issue, will welcome this beam to complete an ultra-modern, low-cost amateur installation.

By Frank C. Jones

THERE is hardly an amateur who, at one time or another, has not felt the urge to build a beam antenna. Obstacles of many kinds usually lie in his path. A rotary array is a rather complicated mechanism, and many amateurs are without the means to erect such a device. Then, too, the multi-element array, unless properly built and adjusted, often proves no better than an ordinary single-wire sky-hook. And, furthermore, in these times of uncertainty — and with little in the form of DX to conquer— there is a growing demand for a simple, effective, inexpensive beam. Described here is such an antenna, which costs about three dollars to build.

The entire antenna unit and its feeder system can be cut to size, erected and coupled to a transmitter without need of feeder-stub tuning adjustments, and with no adjustments to the tuned circuits in the two-wire feeder.

This simple beam antenna consists of two close-spaced half-wave antennas out of phase, of the form described by *G. H. Brown* and *J. D. Kraus* in the *Proceedings* of the I.R.E. The method of feed is unlike that developed by *Kraus* for his flat-top, or *W8JK*, beam. His method utilized a resonant quarter- or three-quarter-wave stub with a 600-ohm line tapped part way up the tuned stub. The simplified beam under discussion in this text has its 600-ohm feeders connected directly to the antenna elements through a Y-matching system, similar to that of matched-impedance-fed dipole antennas. The general details are shown in Fig. 1, which gives dimensions for an antenna suitable for operation in the amateur 10-meter band.

The two radiators are an electrical half-wave in length at the desired frequency of operation, and the radiators are spaced in a horizontal plane as high above earth as practical. The spacing of the antenna elements

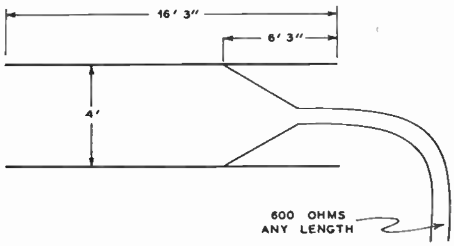


Fig. 1

should be approximately one-eighth wavelength, since the radiation resistance drops to very low values when this spacing is reduced. The radiation resistance at fairly high elevation above earth is approximately 10 ohms (see Fig. 2) with one-eighth wavelength spacing between the two driven antenna elements. This radiation resistance drops to approximately 5 ohms at one-half wavelength spacing, which means that the loss resistance will be a greater proportion of the total antenna resistance, and the gain and efficiency of the antenna will consequently be reduced. The loss resistance is usually at least one ohm, and it may be even greater with insufficient or poor insulation at the ends of the antenna wires. It is desirable to connect two or three 5- or 6-inch insulators in series at each end of the antenna wires.

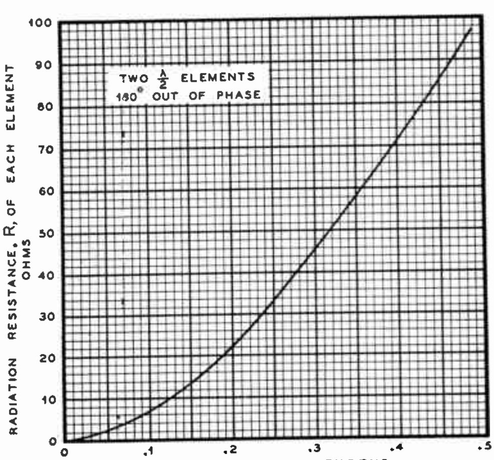
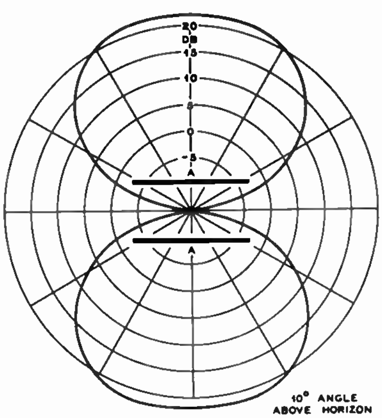


Fig. 2

Bamboo rod spreaders are satisfactory for end supports, and a similar spreader can be used at the point of feeder connection to the antenna wires, if a very long antenna, such as one for 75-meter operation, is to be constructed.

The antenna structure can be swung between two masts, or other supports, preferably with light rope or cords tied to the bamboo spreaders at the ends, and brought down to a tie point below. This will enable the antenna to remain in a horizontal plane, and also prevent it from swaying in the wind.

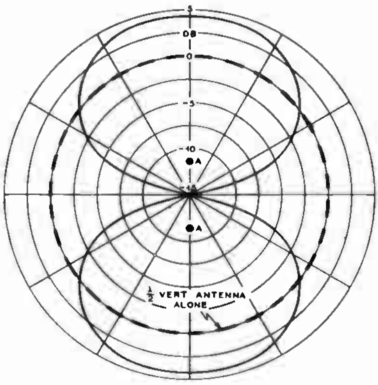
THIS antenna has a radiation pattern similar to that of a half-wave antenna, but with a more pronounced null point off each end. Maximum radiation occurs at right-angles to the plane of the wires, as shown in Fig. 3. This is for the horizontal pattern at a vertical angle of 10° above the horizon, a good angle for DX transmission and reception. The gain of this antenna over that of a simple half-wave antenna ranges from 3 to 4 db. Test measurements on a small-scale model operating at 4 meters gave the same measured gain as that obtained from the *W8JK* antenna.



2 DRIVEN HORIZONTAL λ/2 ANTENNAS 180° OUT OF PHASE 1λ IN HEIGHT ABOVE GND

Fig. 3

The radiation pattern for one of these beam antennas with vertical polarization is shown in Fig. 4. The antenna wires are in a vertical plane, and the feeders run out at right-angles to the antenna wires. In either the horizontal or vertical construction of this beam antenna, the Y portion of the feeders should drop away at right-angles to the antenna, if possible. The fanned-out portion should usually be about 50 per cent greater than the antenna spacing; for ex-



2 DRIVEN VERTICAL $\frac{\lambda}{2}$ ANTENNAS 180° OUT OF PHASE — $\frac{\lambda}{8}$ SPACING.

Fig. 4

ample: about six feet down to the first feeder spreader for the system shown in Fig. 1, with an antenna spacing of four feet.

The 600-ohm line is practically non-resonant and can be of any length. It can be inductively coupled to the transmitter tank circuit—or, if preferred, to a separate parallel-tuned antenna circuit which in turn is link-coupled to the transmitter tank circuit.

The radiation pattern of either the horizontal or vertical type is broad enough so that one antenna will completely cover two of the most desired directions of transmission. If transmission in all directions is desired, two antennas can be erected, one at right-angles to the other, and separate feeders brought into the operating room to a d.p.d.t. switch for selecting the antenna desired. The antennas are bi-directional since both elements are driven with 180° phase difference by the two-wire feeder system. If there were no radiation from the fanned-out portion of the feeders, it would be possible to insert a small inductance or stub in one feeder in the radio room in order to make the antenna uni-directional. This would change the feeder voltage phase from 180°, but with a serious unbalance in the feeder system. Experiments in the 10-meter band proved that is was possible to affect a difference of two *R* points or more in reception or transmission by inserting a 6-foot stub into one feeder wire, then into the other, by means of a pair of d.p.d.t. knife switches. The feeder radiation prevented as much discrimination as should have been obtained theoretically, and on some signals from other directions no appreciable difference could be noticed. The most practical system is one with a balanced feeder, each feeder wire having the same length, in a bi-directional setup. The principal consideration was to develop a small beam antenna which would more than double the power or signal strength in certain directions, as compared to a simple matched impedance dipole or half-wave antenna. The additional cost of the extra antenna element, insulators and bamboo rods is usually less than one dollar more than the cost of a single antenna with two-wire matched impedance feeders.

The beam shown in Fig. 1 is fed in a manner somewhat similar to a single-wire fed antenna, with the exception that another element is substituted for earth. Less loss results in the feeder system, and its efficiency approaches that of a matched-impedance-fed dipole feeder.

It is possible to add half-wave sections in a cross-over connection to the ends of the simple beam, just as described by *Kraus* for his flat-top beam. Each additional two-wire half-wave section raises the antenna gain approximately 1.5 db. and makes the beam more directive.

Suggested dimensions for the simple beam antenna are listed in the *Table*:

Frequency in Megacycles	Antenna Length in Feet	Feeder Connection Point from end of Antenna, in Feet	Antenna Spacing
29	16¼	6¼	4
14.2	33	12¾	8
7.15	65½	25	12 to 16
4.0	117	45	20

As with any beam antenna having very low radiation resistance characteristics, the selectivity is fairly great and less gain will be obtained at off-frequency resonance, and the standing wave effect along the feeders will be increased. For those desiring full band coverage this loss in gain can be minimized by utilizing a parallel-tuned antenna tank circuit which can be made to maintain resonance in the entire system at frequencies either side of the natural period of the antenna elements. In most cases, an untuned coupling coil can be coupled to the tank coil in the final amplifier. One turn, more or less, in the coupling coil—or a variable link arrangement — can be used to insure proper amplifier load at any desired frequency in one band of operation.

Battling Shunt Capacity

(Continued from page 34)

mum capacity would be 7 plus 35, or 42 $\mu\mu$f. The capacity ratio 185/42 is 4.4 and the tuning ratio is $\sqrt{4.4}$, or 2.1. This tuning ratio is not too great because a slightly greater than two-to-one tuning ratio is necessary if it is desired to cover the low edge of 80 meters to the high edge of 40 meters. It is excellent practice to add about 35$\mu\mu$f to both the maximum and minimum capacities of condensers, as cataloged, in order to get a rough idea of the range they will cover when actually wired into a circuit. Even this addition is not too liberal.

These basic principles apply to frequency meters, electron-coupled oscillators and receivers, as well as to transmitters. An electron-coupled oscillator offers an excellent example of the effect of shunt capacities, inasmuch as high shunt capacities are used to give a high C-to-L ratio in the interest of stability.

Take the case of an e.c.o., whose fundamental frequency falls in the broadcast band and for which the shunt capacity, *including tube capacities and strays,* is to be 400 $\mu\mu$f. What tuning capacity shall be chosen in parallel with the 400$\mu\mu$f fixed capacity to tune from 870 to 100 kc., the second harmonic, of course, covering the 160-meter band? The tuning ratio is 1000/870 or 1.15. This must be squared to find the necessary capacity ratio—slightly over 1.32. Offhand a 100$\mu\mu$f condenser with a 7$\mu\mu$f minimum might be thought of as a possibility. With the 400$\mu\mu$f condenser across it, a 1000 $\mu\mu$f condenser would tune from 500 to 407 $\mu\mu$f, a range of 1.23 to 1. Obviously not enough. The second choice would be a 150 $\mu\mu$f with 7$\mu\mu$f minimum. The range of this condenser with the 400$\mu\mu$f across it would be 500$\mu\mu$f to 407, a ratio of 1.35-to-1. This just fits the need and would be the size selected.

* * *

After bragging to your friends how easy you contact the "folks back home"—has it ever happened to YOU?


QRM QRN
by Les. Funston W0QQU
HELLO JOE? ARE YOU SURE THAT CHOKE COIL GOES IN THE PLATE CIRCUIT?
YES LADY - YOUR GROUND CONNECTIONS ARE PERFECT!
DID YOU BRING THE BATTERY?
NO - DIDNT YOU?
I WANT A BANDAGE FOR MY BLEEDER!
WHAT!
25¢
CHEEP
CRYSTALS
RADIO ... 300
WATCH 100
WIRE STRETCHERS
BIG SAIL
BEE BATTS
RADIO PARTS
BEER BOTTLE INSULATOR

---More QRM and QRN

By Phillip Space

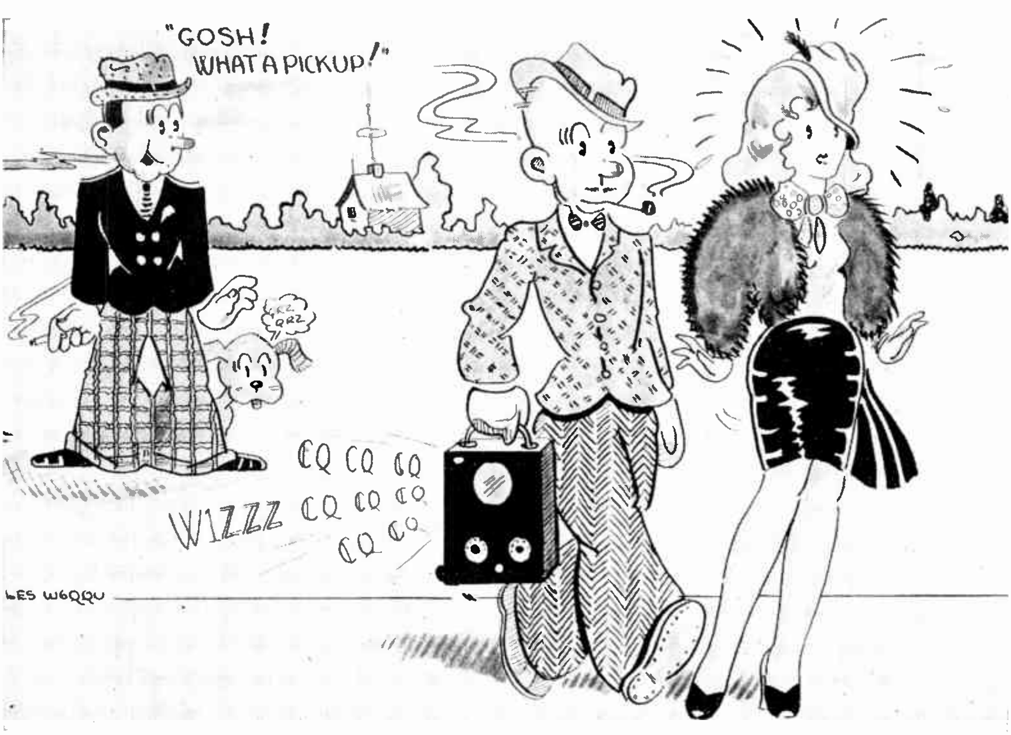
. . . "Radio hams have lots of humor—all of it bad." writes a reader of *A.R.D.* He threatens to remove this page from this magazine, if we continue our quirps. Then comes another who demands more *QRM* and *QRN*, with a threat of cancelling his subscription if we don't make good. So we compromise by running two pages of HI HI this month.

* * *

. . . Turn back the pages of history to Volume 1, Number 1, of *A.R.D.* and you will find a squib about the placard above the engineer's desk, reading: "Quiet, Please—Genius at Work!" In the Heintz and Kaufman plant, one of the engineers has a somewhat similar sign which reads: "Quiet, Please—Genius Concentrating!" Into the office walked a radio inspector for one of the Government services. Who's this *Genius* around here?" queried Uncle Sam's profit-buster, as he read the sign. "It's me," said the factory engineer. Some hours later a difficult engineering problem presented itself to the slip-stick magicians. It was solved by one man only. "Who did it?" queried the Government man. "I did," said the factory engineer, "didn't you read the sign?"

* * *

. . . This doesn't belong in a humorous column, then again it does. It actually happened to W6BIP. "Bip" is known to every contest score-juggler in the ham bands. He asks for (and receives) a furlough from his post behind the alleged 40 per cent discount department of a radio parts store, in order to participate in any kind of a competition known to man or ham. But some evil-minded person made hamburger steak out of the sweepstakes for Bip, by throwing a Ford spark coil and battery into a neighboring yard. The racket created by the device produced an R-7 background in Bip's receiver. It put him out of the contest. The spark coil and dry cell were placed into a paper bag, with the on-off toggle switch protruding. Bip's next-door neighbor spotted the device and telephoned the police. Amid the wail of sirens not only the cops but also the F.B.I. agents arrived at the scene, for the good neighbor reported an "electric bomb" in her back yard. Aroused by the confusion, Bip ventured forth to find the cause of his QRM. The reason why you won't find W6BIP—even among the trailers — in the recent sweepstakes is now disclosed in truth. "And I always believed what I read about my brother hams," said Bip, as he tore *"The Amateur's Code of Honor"* from his handbook.



Delouse Your Transmitter!

--Clean-Up those unwanted parasites

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This series of information tells how

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By The Technical Staff

PART I

PARASITIC oscillations are present in a majority of amateur radio transmitters. There has been a woeful lack of information on this important subject, and no major attempt has been made in the amateur radio press to thoroughly analyze the cause of the various forms of parastics, or to suggest a cure. Nearly all newly-designed transmitters, either for amateur or commercial service, are literally infected with the parasite

Parasitic oscillations can cause side-band splatter, additional carriers can be radiated in the side-bands, and other objectionable features such as instability, voltage flashover, poor circuit efficiency, and breakdown of transmitter tubes and other components is entirely possible. Some types of parasitic oscillations affect the purity of a c.w. carrier, or the quality of a modulated carrier in a radiotelephone transmitter may be of a poor order if parasitics are in evidence.

A parasitic is a spurious oscillation in a tube circuit of a radio transmitter. Its oscillating frequency, or frequencies, will not be the same as that for which the transmitter is designed. The elimination of parasitic oscillations is accomplished most successfully by the cut-and-try process, for there are numerous types of parasitics, and this calls for a careful study of the circuit layout.

The two general forms of parasitic oscillations are: (1) *"trigger," or highly-damped, oscillations, and* (2) *undamped oscillations.* The trigger-type of oscillation is often the result of a keying shock, or a transient during peaks of modulation. These oscillations are started more easily with high plate voltage and low grid bias, due to the increased value of mutual conductance. The parasitics may occur only during a portion of the modulation cycle, and consequently they are sometimes difficult to locate.

The general cure for nearly any type of parasitic oscillation consists of detuning and damping the circuit in which the oscillation takes place. Sometimes the elimination of one form of parasitic will cause still another form to appear. Some commercial transmitters have had as many as a dozen different types of parasitic oscillations, all of which had to be removed before the transmitter could be placed into service.

The peculiar operation of an r-f amplifier, or the poor voice quality of a plate- or cathode-modulated radiotelephone transmitter, can often be traced to some form of parasitic.

Parasitic oscillations can be still further classified, as follows:

(1) Those which occur at low frequencies,

(2) Those which occur in the vicinity of the carrier frequency,

(3) Those which occur in the ultra-high frequency region of from 1½- to 10-meters in wavelength.

Low-Frequency Parasitics

LOW-FREQUENCY parasitic oscillations usually result from the use of high-inductance r-f chokes in the grid and plate circuits of an r-f amplifier, as illustrated in Figs. 1 and 2. The actual circuits are neutralized at the carrier frequency, but not at the lower frequencies in the range of resonance of the plate and grid r-f chokes.

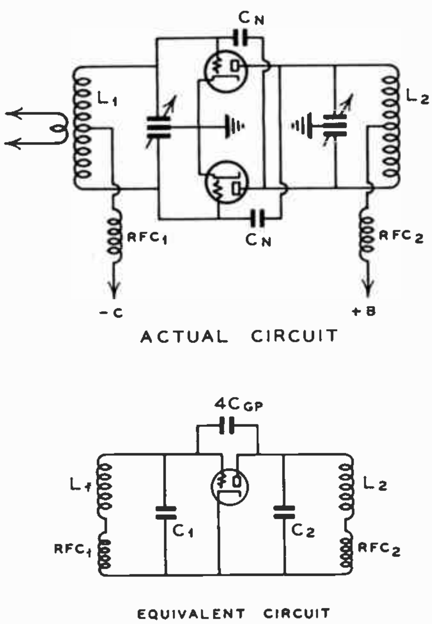

Fig. 1

In Fig. 1 the equivalent circuit for a low-frequency parasitic oscillation is a form of tuned-plate-tuned-grid oscillator, in which the tubes in push-pull connection are effectively in parallel, and the neutralizing condensers merely increase the grid-to-plate capacity of the equivalent tube. The relatively small carrier frequency inductances L_1 and L_2 are usually neglected when sketching the equivalent circuit, as illustrated in Fig. 2. The best method of eliminating this particular type of low-frequency parasitic oscillation is to eliminate the grid r-f choke, by completely removing it from the circuit. It is always good practice to use as few r-f chokes as possible, relying upon the circuit proper to have an r-f impedance low enough to by-pass all of the r-f current.

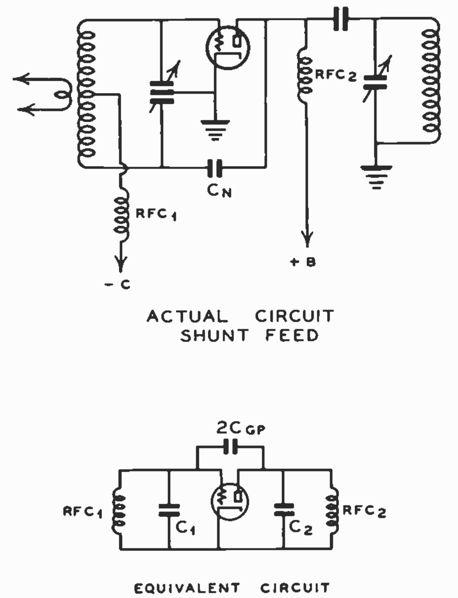

Fig. 2

The circuit illustrated in Fig. 3 is sometimes used. Here a small r-f by-pass condenser C_1 is connected from the lower end of the r-f grid choke in a shunt-fed amplifier circuit. Condenser C_1 should be eliminated, in which event the grid resistor R_1 will introduce sufficient damping in the tuned grid circuit to prevent low-frequency parasitic oscillations. If this resistor has a value of at least 2,000 ohms, enough damping will be provided to eliminate the low-frequency parasitic. In the case where the grid bias connection is made to the nodal point of a tuned circuit of the type shown in Figs. 1 and 2, the grid-leak can be connected directly to the center of the coil. If the grid bias is secured from a C-bias supply source, connection can be made to the center of the tuned grid coil without the use of an r-f choke, or to any voltage node, such as the lower end of the grid coil, as illustrated in Fig. 4. Grid and plate r-f chokes are required in the type of circuit diagrammed in Fig. 3, but in the case of a class-B linear, grid-modulated, or cathode-modulated amplifier there may be no grid-leak resistance to produce damping in the grid circuit. In this case, the grid choke RFC_1 should have either a higher or lower value of inductance than that of the plate r-f choke, RFC_2 in Fig. 3.

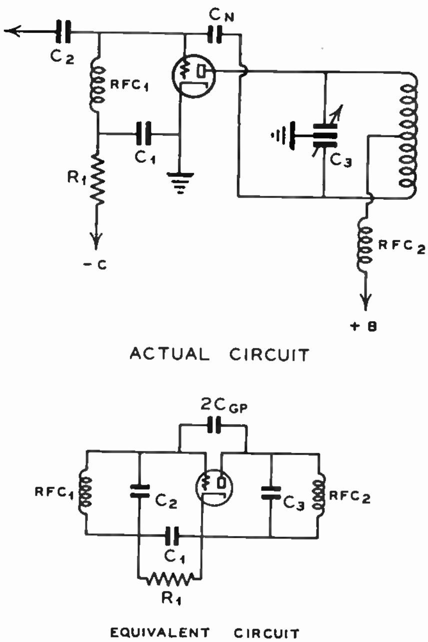

Fig. 3

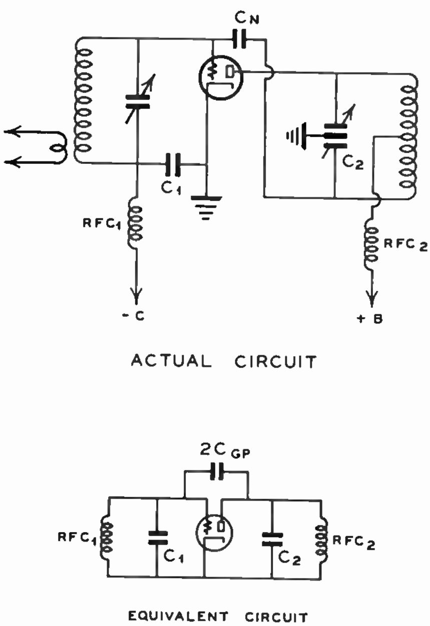

Fig. 4

Since the d.c. grid current is always less than the d.c. plate current, it is generally more practical to use a grid choke with very high inductance, ranging in values from 8- to 30-mh., and a 2- or 2.5-mh. r-f choke in the plate circuit of short-wave transmitters. Smaller wire can be used for winding the r-f choke for the grid circuit, thereby insuring a large value of inductance in a reasonably small space.

A low-frequency parasitic oscillation can occur in the circuit of Fig. 4, since the equivalent circuit is a tuned-plate-tuned-grid arrangement, yet this is an exception rather than a rule, because C_1 is usually large enough to detune the grid circuit sufficiently to prevent oscillation.

A push-pull r-f amplifier can be operated with shunt grid feed, of the form shown in Fig. 5, where the r-f chokes RFC_1 and RFC_3 have inductance values of approximately 2-mh., and RFC_2 has from 16- to 30-mh.

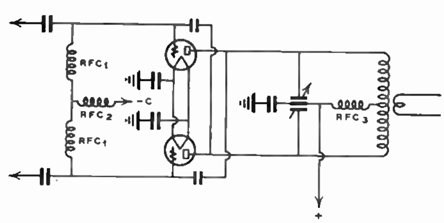

Fig. 5

The low-inductance chokes RFC_1 in the grid circuit of a push-pull amplifier are usually more effective at high frequencies, and they absorb less power from the grid circuit than the two large r-f chokes, such as RFC_2 when connected directly to each grid circuit. In Fig. 5, RFC_2 effectively prevents low-frequency parasitic oscillations, without introducing grid circuit loss of any kind.

Medium-Frequency Parasitics

SOME circuits, particularly the one shown in Fig. 6, will often oscillate at radio frequencies in the general region of the carrier frequency. The actual circuit has the appearance of a neutralized amplifier, yet the equivalent circuit is seen to be a tuned-grid-tuned-plate oscillator. The grid circuit is tapped across a portion of the driver tuned circuit, and the inductance between this tap and the r-f ground point may resonate with the series-tuned plate circuit to C_1 and one-half of L_2.

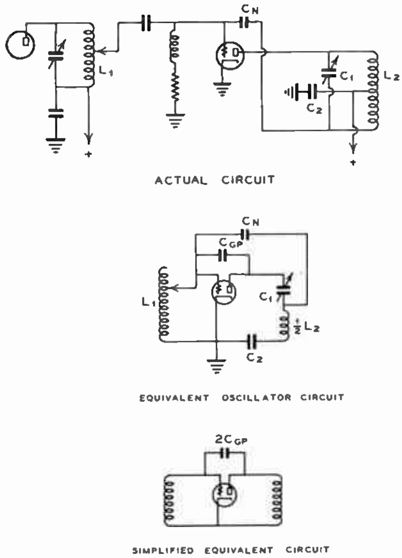

Fig. 6

The cure for this form of parasitic circuit is the substitution of a split-stator plate tuning condenser, with its rotor connected to ground. The tendency for a parasitic oscillation is lowered when the grid circuit is tapped across the entire winding of the driver plate coil L_1.

Another form of medium-frequency parasitic oscillation may occur in any r-f amplifier whose link-coupled grid circuit is tapped directly on the grid coil, and the r-f output link of r-f transmission line tapped directly across a portion of the plate coil, as shown in Fig. 7.

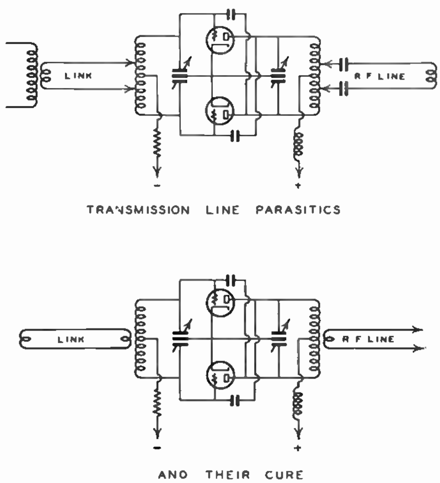

Fig. 7

The inductances and capacities of the r-f links or lines will result in a complex type of parasitic oscillation circuit in the grids and plates of the r-f amplifier. The amplifier is not neutralized for the multi-resonant condition of this amplifier. Inductive coupling between the tuned circuits and the r-f links or lines will usually stop this form of parasitic oscillation; if not, the grid circuit line should be detuned. In some transmitters, and likewise in some receivers, the grid and plate circuits are tuned by means of low-capacity condensers connected across only a few turns of the coil. This type of circuit will often generate a parasitic oscillation at a frequency where neutralization is wholly ineffective. Vernier tuning control is highly undesirable, yet it is sometimes used where a fixed tank condenser, such as the vacuum type, is connected across the entire coil, and with an additional condenser of low capacity shunted across only a few turns of the coil. It would be far better practice to use a variable inductance, rather than a variable condenser, to tune the tank circuit to resonance.

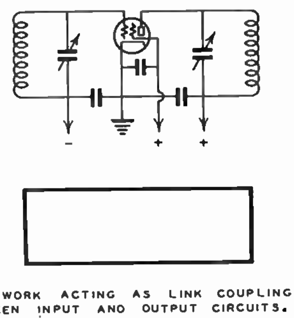

Fig. 8

The mechanical layout of a transmitter will sometimes be such that its framework will act as a link-coupled circuit between the input and output circuits of an r-f amplifier, as illustrated in Fig. 8. This link-coupling may produce either regeneration or degeneration, depending upon the phase of the feed-back voltage. If there is sufficient regenerative feed-back, a parasitic oscillation may take place in the vicinity of the carrier frequency. This form of framework coupling can occur in either a neutralized triode or screen-grid amplifier circuit, and produce oscillations in spite of careful shielding between grid and plate circuits. In the case of a neutralized triode amplifier this form of coupling between the two tuned circuits will give rise to either a very low or very high value of capacity in the neutralizing condenser in order to properly neutralize the circuit at the carrier frequency. This circuit will probably be unneutralized at nearby frequencies, and it may function as a *Meissner Oscillator*. The cure for this type of parasitic oscillation is to rearrange the grid or plate coils, or to open-up the transmitter's framework with an insulator, in order to prevent a closed-coupling link between the grid and plate coils.

The inductive resistance of the neutralizing leads in an r-f amplifier will usually cause the amplifier to become unneutralized at a frequency near the normal operating value. This effect is often encountered in multi-band transmitters. A typical example would be either a single-ended or push-pull amplifier in which the capacity of the neutralizing condenser is not the same in the 10-meter band as in the lower-frequency bands, such as 80 and 40 meters. An attempt has been made to illustrate a cure for this effect in the push-pull circuit of Fig. 9. If the neutralizing condenser is mounted closely adjacent to the plate circuit, the relatively long cross-over leads to the grids of the tube have an appreciable reactance which will interfere with the neutralization at certain frequencies. If the grid leads to the driver stage, or tuned grid circuit, are tapped part way along these neutralizing condenser leads, the amplifier can be neutralized over a very wide band of frequencies.

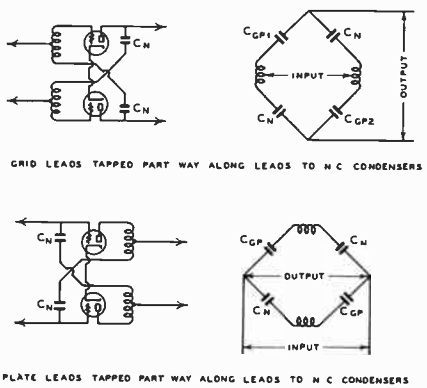

Fig. 9

The neutralizing circuit becomes a perfect Wheatstone Bridge. Likewise, if the neutralizing condensers are mounted close to the grids of the tubes, and the leads crossed-over to opposite plate terminals, the output leads to the tuned plate circuit can be connected to some points along these leads, thereby permitting neutralization over a wide range of bands. In the circuits of Fig. 9 the long neutralizing leads are represented as inductances, since a straight wire has appreciable inductive reactance at very high frequencies.

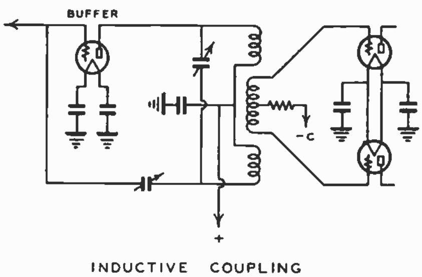

Fig. 10

A very satisfactory method of eliminating medium-frequency parasitics caused by interstage common ground coupling leads, in the case of capacity-coupled circuits, is shown in Fig. 10. Inductive coupling eliminates the possibility of this type of parasitic oscillation. The grid coupling coil can be interwound, or wound in the center of the buffer tuned plate coil, and can be made to provide the same degree of coupling as a capacitive arrangement. The grid coil, in practice, usually has from 50 to 125 per cent of the number of turns as used in the plate coil for the buffer stage. In some cases the C-bias can not be connected to the center-tap of the grid coil, because a 5-prong coil may be in service. In this event, the C-bias can be shunt-fed to the grids, through a pair of high-inductance r-f chokes, ranging in value from 10- to 20-mh.

* * *

Note: Part II will appear in the next issue. It will deal with Ultra-High Frequency Parasitics and their cure. Then follows a comprehensive treatise on step-by-step circuit checking, so that you can locate all forms of parasitics, quickly and easily, and eliminate them from your transmitter.

It Once Was DX

By Stanley W. Johnson, W6SZ

. . . DX may come, and DX may go, but the DX men go on forever. This new column in **Amateur Radio Defense** is published for the purpose of keeping alive the DX spirit, because we are confident that yesterday's thrills and today's chills will be tomorrow's revitalization of the amateur's foremost ambition—a contact with a new country or zone. Like the British, we raise both thumbs (and all our fingers, too) when they ask: "Is the DX man downhearted?" I was requested to write this column for **A.R.D.** because of my wide acquaintance among DX men the world over, and because I have maintained an uninterrupted flow of correspondence with the shut-downs in foreign lands. Your help is solicited to enable me to keep these pages filled with news of interest. So here we go with the first attempt to tell you what a few of the DX men are doing—

* * *

. . . **G6BW** informs me that a lot of old timers have decided to keep their Anderson Air Raid Shelters after the war, using them for ham shacks—inasmuch as they are both YF and BCL proof.

GM2UU is an Air-Raid Precautions Warden

. . . Amateurs in the service are frequently shuttled from pillar to post, and thus they become the walking-talking news organs of ham activities from one end of the British Empire to the other. Those not in the service are found at various home-defense posts, or in part-time training. The xDX maestro, **GM2UU**, is an Air Raid Warden in charge of his District in Scotland. "Doug" stands watch as many as 14 hours a day, operates his business between bombing raids, and fills-in the remainder of a 24-hour day by conducting a canteen for service men at a (- - - - - 5 words censored) Coast port. He arises at 2 o'clock in the morning, and sleep is a big problem, he says. But Doug is an optimist; he tells us that this training will prepare him for long hours of operation when DX returns, and he'll be able to work the rig 24 hours a day without thinking of sleep. He further states that a bumper crop of boys is coming off the Sound Detector Squads, and that these fellows ought to be able to distinguish between DX, QRM, or just plain QRN after they complete their training!

* * *

. . . **FA3CH** is a French army officer with the Algerian forces. He states that the R.I. used the ax on all of his radio equipment, and what couldn't be chopped to pieces was burned . . . alive!

. . . **F8NT** saw some real action at the front and has returned home in one piece. He says the grub they were fed in the army was far better than they now receive at home.

* * *

. . . **ZE1JH** relates a mighty sad incident. Together with his buddy, who had a 10-year old son, the trio decided on a pleasure trip to Chingola, in Northern Rhodesia. The party went swimming in the river. A large crocodile seized the youngster, dragged him under the surface, and the boy was never seen again.

* * *

. . . **I1FM** is reported back from Africa on sick leave from the army.

* * *

. . . **SM7UC** saw plenty of aerial and naval action from his home in Akarp, Sweden. The cannonading was so bad at times that he was forced to plug both his ears. His entire equipment was carted away by the R.I., and all that the OM has to show for it is a certificate and a receipt for the return of the apparatus—if and when. He says the job was so thoroughly executed that he doubts if Sweden will be bothered with Amateur Quislings for a long time to come.

* * *

. . . **VS1AE** didn't get much of his information past the censor. He tells us that he is as busy as a short-circuit to ground, doing a lot of marine installation work for the Government. Also tinkering with UHF gear. He started to say something, which reads like this: "Keeping - - - - - (5 words censored) equipment. You guess the rest!

* * *

. . . **PA0MZ**, our old friend Felix in Apeldoorn, had just completed a dandy 3-element rotary beam when the bottom of the world fell out from under him. Not only was his entire station confiscated and carted off in a Govt. truck, but his loss is the greater because the metal parts of the beam were confiscated, and may soon be flying at somebody in the form of shells, or airplane wings. He relates that is was a pathetic sight to see his beam carted away, with the long metal elements wiggling in the wind—as much as to say "Good-bye, OM, won't be seein' you again"!

* * *

. . . **G6GO** relates that many hams are enrolling in correspondence schools in order to enhance their knowledge while they wait for the comeback of DX. A lot of military preparatory material is also sent free, whether you ask for it or not. An interesting sidelight on the matter, as told by **G6GO**, who wants to read ham literature only, goes like this: "Once a 'am, always a 'am, and if a bloak can't fiddle or twiddle with 'am civilian gear, 'e'll jine the forces and while 'e fiddles 'e may get himself a Jerry to boot."

* * *

. . . That's all I have for this month, folks. I'll be back in the next issue of **A.R.D.** with the latest from the war zone. HNY and 73.—W6SZ.

NEWS FROM WASHINGTON

(Continued from page 21)

geles in conjunction with that of its New York television station.

Earle C. Anthony, Inc., to operate on Channel No. 6 (96,000-102,000 kilocycles), 1000 watts aural and visual power; to study the relative merits of horizontal and vertical polarization in the Los Angeles area, with particular study of the effect of ignition and diathermy interference, and transmission over salt water, to Catalina Island.

Leroy's Jewelers, to operate on Channel No. 10 (186,000-192,000), 1000 watts aural and visual power; "to further improve the quality of pictures transmitted by television from the standpoint of reception quality and to determine the system of television transmission which will produce the best results for widespread use from a visual and optical standpoint."

May Department Stores Co., to operate on Channel No. 12 (210,000-216,000 kilocycles), with 1 kilowatt aural and visual power, for general research and experimentation in the Los Angeles area.

Television Productions, Inc., a subsidiary of Paramount Pictures, to operate a television relay station on Channels Nos. 13 and 14 (234,000-240,000; 240,000-246,000 kilocycles, 250 watts visual power, to supplement television broadcast station W6XYZ, also in Los Angeles, for which the applicant has a construction permit. The latter, using Channel No. 4 (78,000-84,000 kilocycles), proposes experimentation with the "DuMont standards."

In addition, the Commission granted stations to New York, Chicago, and Manhattan, Kans., as follows:

Metropolitan Television, Inc., New York, to operate on Channel No. 8 (162,000-168,000 kilocycles), I kilowatt aural and visual power; to develop program techniques for determining public tastes, including the use of two television theaters where daily programs will be projected for free public viewing. This applicant is associated with two department stores, Bloomingdale Bros. and Abraham & Straus.

Columbia Broadcasting System, Inc., Chicago, to operate on Channel No. 4 (78,000-84,000 kilocycles), 1 kilowatt aural and visual power; to participate in CBS television research by developing data on Chicago conditions that may assist in the ultimate determination of polarization and synchronization for a national television service.

Kansas State College of Agriculture and Applied Science, Manhattan, Kans., to use Channel No. 1 (50,000-56,000 kilocycles), 100 watts aural and visual power; to determine propagation characteristics, study horizontal and vertical polarization, and experiment with various synchronizing systems using various numbers of lines and frames.

These contemplated programs of research and experimentation are pursuant to Commission requirements looking to development of television to a point that will enable the industry to agree on a uniform transmission system of acceptable technical quality.

Cooperation of the industry is further reflected in the comprehensive survey of the television situation now being conducted by the National Television Systems Committee. Organized last July through the joint efforts of the Radio Manufacturers Association and the Commission, this committee represents the pooled engineering experience of the industry. Its various panels have been making a detailed study of many phases of television.

The Commission designated Monday, January 27, as the time to receive a formal overall progress report from the full committee. Members of the Commission plan to visit the New York area on January 24 to see late television developments first-hand prior to this conference with the National Television Systems Committee.

An investment of $5,000,000 is represented in previous television authorizations by the Commission. This list, which shows wide distribution of facilities, includes Balaban & Katz Corp., Chicago; Bamberger Broadcasting Service, Inc., New York; Columbia Broadcasting System, New York; Crosley Corporation, Cincinnati; Allen B. DuMont Laboratories, New York, Washington and Passaic, N. J.; Don Lee Broadcasting System, Los Angeles, Hollywood and San Francisco; First National Television, Inc., Kansas City, Mo.; General Electric Co., Schenectady; General Television Corporation, Boston; National Broadcasting Co., New York, Philadelphia and Washington; RCA Manufacturing Co., Camden, N. J.; Philco Radio & Television Corporation, Philadelphia; Purdue University, West Lafayette, Ind.; Radio Pictures, Long Island City, N. Y.; State University of Iowa, Iowa City; WCAU Broadcasting Co., Philadelphia; Zenith Radio Corporation, Chicago, and The Journal Co., Milwaukee, Wis.

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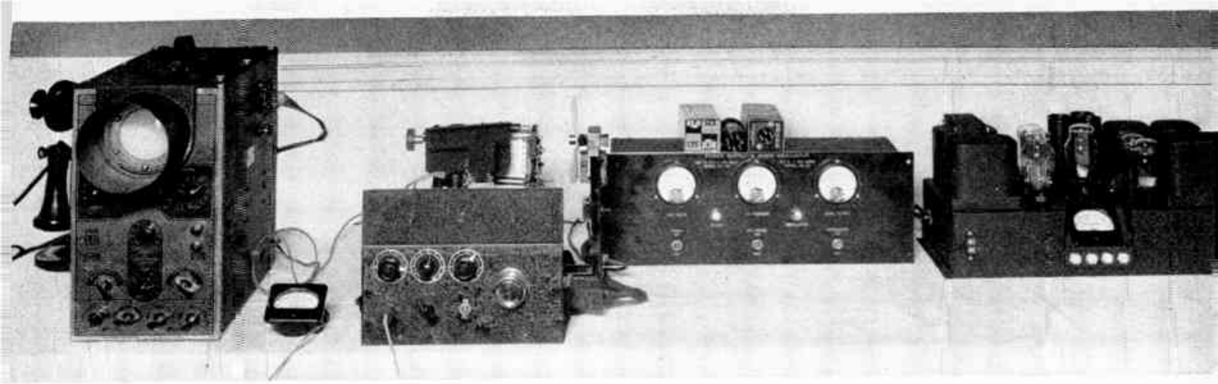


The Engineering Forum

F. D. Wells

• *The Forum Editor presents his own version of a highly-effective noise silencer. He will appreciate your comment, after you have had an opportunity to put the circuit "through the ropes." Please refer to Item No. 9 when corresponding with the Editor of this Department.*

No. 9—Noise Silencer

THE problem of noise silencing has been somewhat neglected in recent publications. Several years ago many articles were published, and many circuits produced, which were so satisfactory that little has been added since. However, a new silencer circuit has been tried recently which shows such unusual merit that it bears investigation by everyone plagued with automobile ignition on the high frequency bands.

If the circuit is broken-down into its two component elements, it will be seen that the elements proper are not new. One is a series-type noise silencer, the other a shunt-type. However, both functions are accomplished by a single 6H6 tube. The device is entirely automatic and seems to be as effective as silencers with two tubes.

When the circuit was originally tried, it was hoped to realize the effect of a double-acting silencer, in order to catch the noise coming and going, so to speak. To describe what takes place, let us assume that on a given carrier a potential of 10 volts negative is produced at the point *A*. Since the diode load consists of two equal resistors, a potential of 5 volts negative will occur at the point *B*. Under 100 per cent modulation, the point *B* will vary from 0 to 10 volts negative. If *B* goes beyond 10 volts negative, due to some sudden extraneous noise peak, such as produced by an automobile ignition system, one diode short-circuits *B* to ground, and the other diode becomes an open circuit and refuses to pass audio voltage to the volume control. It might be thought that if one element operated satisfactorily, nothing could be gained by adding a second element. To check this, the shunt silencer was left in the circuit and the series silencer snapped on and off to see if it contributed anything. There was a marked improvement with the addition of the second element.

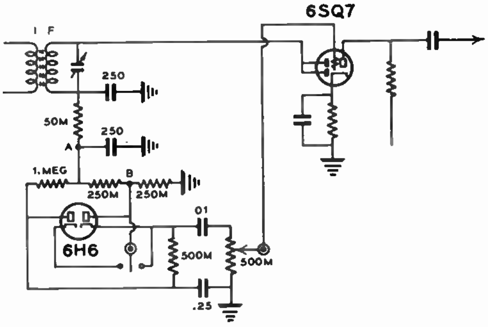


Fig. 1—New Series-Shunt Type Silencer

The silencer can be made more effective if the resistor between *A* and *B* is made smaller than the one from *B* to ground. The result is to start the silencing effect before 100 per cent modulation is reached. This can not be carried to extremes, else the distortion becomes too severe.

This combination silencer has been used under varying conditions for a period of two months and has proved to be particularly effective on weak signals.

ENGINEERING APPLICATIONS

EIMAC 304TL MULTI-UNIT TRIODE

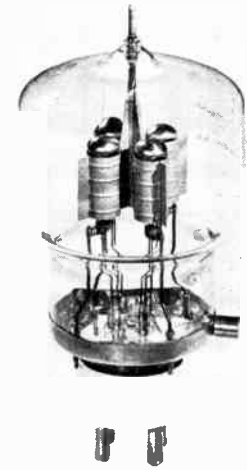
THE Eimac 304TL is a multi-unit tube in which four complete triodes are assembled in a common envelope. The transconductance of this tube is four times as high as that of a single 75T with its single tantalum plate and grid. The mechanical construction of the 304TL is such that the elements are connected in parallel; the plates are mechanically and electrically tied together, thereby obviating the possibility of parallel-type parasitic oscillation, a condition which might occur when several 75T tubes are operated in parallel. The low interelectrode capacitances of the 304TL permit operation at frequencies ah high as 200-Mc., approx. The tube will deliver high output in radio or audio circuits from heavy-duty low-voltage power supplies.

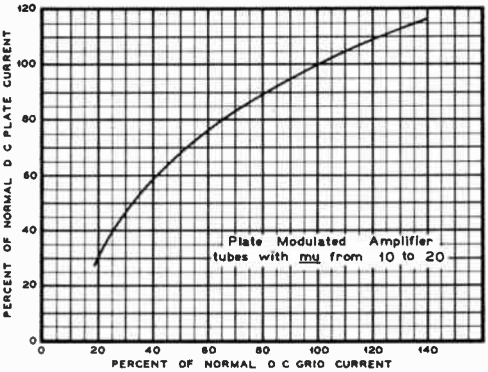
The plate elements are designed to operate at a light cherry red color at a normal dissipation rating of 300 watts. The color of the anode can be used as a tuning indicator for determining resonance and output loading.

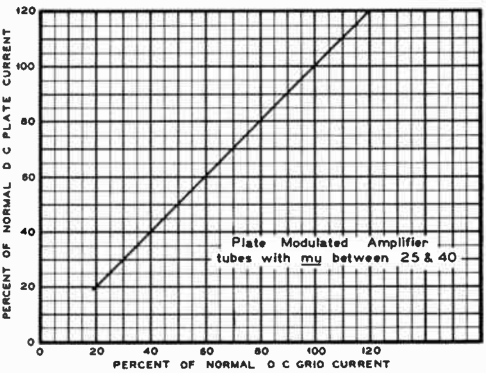
The values of grid driving power listed under Typical Operating Conditions are for the actual grid driving power used by the grid, as well as the power loss in the grid-bias supply. This combination of losses is nearly constant at different radio frequencies; however, other losses in the grid circuit may vary greatly with a change in frequency. The dielectric and radiation losses increase greatly at high radio frequencies, becoming of major importance in the UHF region. Each tuned circuit has a loss of from 5% to 15% of the power delivered to it. Due to circuit losses, impedance mismatching, radiation, etc., in the grid and driver circuits, the apparent power required may be several times that listed in the Tables. A typical circuit may have a grid impedance of 1,500 ohms without applied plate voltage to the 304TL tube. This impedance may increase to approximately 3,000 ohms when plate voltage and antenna loading are applied to the amplifier. If the driver stage has reasonable good regulation, the change of grid loading impedance will cause a drop of d.c. grid current and grid driving power.

These various loss factors may cause the driver to have an apparent efficiency of between 25% and 35%, even at relatively low radio frequencies. The plate dissipation in the buffer tube may indicate some value of plate efficiency between 60% and 75%, resulting in a loss of at least 50% in power output of the buffer, and this loss is of no use in driving the amplifier grid circuit. These conditions are typical of any properly balanced and neutralized r-f amplifier in which no regeneration or parasitic oscillation are present. A suggested rule for determining the buffer tube power input is to multiply the values of grid driving power, as shown in the Tables, by 3 for frequencies below 4-Mc., by 4 for frequencies between 10- and 4-Mc., by 6 for 30-Mc., and by 9 for 45- to 50-Mc. If the driver is operated as a frequency doubler, these multiplying factors may be subject to an increase of 50%.

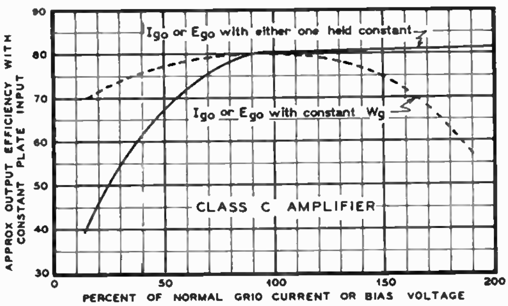
The values of power output, as shown in the Tables, are for watts delivered by the tube to a tuned plate circuit. The conventional tuned circuit may have approximately 10% loss of the power delivered to it, and there is always a possibility of a greater power loss in transforming the plate circuit impedance down to a few

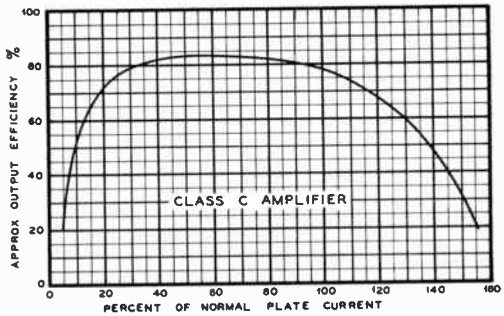






EIMAC 304TL MULTI-UNIT TRIODE—Continued





ohms when operating into a low-resistance antenna.

The high current. low plate voltage characteristic may be used to operate into very low antenna load resistances much more effectively than with other types of tubes.

Cathode Modulation

DC plate voltage	1000	1000	1500	1500	2000
DC plate current	400	480	360	440	350
DC grid voltage	–220	–220	–300	–300	–450
DC grid current	20	40	10	30	10
Grid Driving Power	7	18	4	12	6
Peak AF grid voltage	120	170	135	155	210
Peak AF cathode voltage	400	580	600	900	820
Avg. AF power (sine wave)	80	140	110	200	140
DC power input	400	480	540	660	700
Plate dissipation	180	300	240	232	300
Pct. plate efficiency	55	62.5	56	65	58.5
Approx. carrier output	220	180	300	428	400
Cathode Impedance	1000	1200	1670	2050	2350

The larger ratios of AF-to-DC power input will result in better linearity of modulation, greater efficiencies and power outputs. The grid-bias return lead should tap into the cathode modulation transformer winding. The values of current and power are doubled, and the cathode impedance is halved, for push-pull operation.

Class-B Audio Amplifier (2 Tubes)

DC plate voltage	1000	1250	1500	2000	3000
Zero Sig. DC plate current	400	300	200	200	200
Max. Sig. DC plate current	1400	1280	1200	1000	750
DC grid-bias voltage	–67.5	–100	–135	–180	–280
Plate-to-plate load impedance	1500	2200	3000	5000	9500
Power output	800	1000	1200	1400	1500

A suitable driver transformer would have a ratio of

$$\frac{\text{pri.}}{\frac{1}{2}\text{ sec}} = 1 : 2.$$

The approximate peak driving power is 50 watts (25 watts avg.), which can be obtained from push-pull-parallel 2A3 tubes (or 6L6 tubes with inverse feedback) for voice communication service. A single pair of driver tubes in push-pull connection may be used when only 75 per cent as much a.f. power is required from the Class-B stage; the value of maximum signal d.c. plate current and plate efficiency, however, will be somewhat lower. One-fourth as much driving power will permit attainment of approximately one-half as much output as the Table shows.

Class-AB$_1$ (2 tubes, no grid current)

DC plate voltage	1250	1500	2000
Zero signal DC plate current	150	150	150
Max. signal DC plate current	400	383	300
DC grid bias voltage	–120	–150	–200
Peak grid-to-grid AF voltage	235	295	390
Plate-to-plate load impedance	4500	6250	10500
Power output	250	275	300

● The output efficiency varies approximately as shown in the Curve for different values of d.c. plate current corresponding to various degrees of antenna load. The plate circuit efficiency is usually lower at normal load than at 70% or 80% load. however the r-f output is higher in proportion. The values of 100%. or normal load, were chosen so as to obtain high r-f output with a plate dissipation not exceeding the normal ratings at the higher values of d.c. plate supply. Normal values of d.c. plate current at low plate voltages may be relatively low, in order to obtain good linearity in modulated r-f amplifiers. The values shown in the Tables are for typical normal currents which correspond to 100% in the Curves.

● It is possible to obtain good linearity in a plate-modulated r-f amplifier when the grid driving current is less than normal, provided the antenna loading is reduced in order to lower the d.c. plate current. The Curve indicates the reduction in plate current necessary for good linearity at any value of d.c. grid current where 100% values are those corresponding to the normal values listed in the Table. The d.c. grid bias should be at least twice cut-off for the particular value of d.c. plate voltage. The power output will be reduced, due to less antenna coupling and lower d.c. power input to the plate circuit.

● The solid curve indicates the relative output circuit efficiency which may be expected for different values of d.c. grid current or d.c. grid-bias voltage. This curve applies in general to

(Continued on next page)

EIMAC 304TL MULTI-UNIT TRIODE—Continued

(Continued from preceding page)

the case of holding the d.c. grid-bias constant and varying the d.c. grid current, or vice-versa. If the grid circuit driver has a limited amount of power available, the dotted curve may be used to determine the effect of varying the bias voltage or grid current from the normal 100% values listed in the Plate-Modulated or C.W. Tables which show typical operating conditions. The total d.c. grid-bias must be at least twice cut-off for any plate-modulated amplifier, which means that it can not be reduced much below 100% on the curves without loss of linearity. The d.c. grid current can be reduced, provided the antenna loading and plate current are reduced also.

With limited grid driving power, an increase of either the grid current or bias voltage above normal will cause a reduction in output efficiency. The 100%, or normal, values given in the Tables for C.W. or Plate Modulation operation are usually the most economical for proper design of the driver stage. Too much grid current may cause overheating of the grid element, as well as secondary emission. A large increase of bias voltage will permit attainment of slightly greater output efficiency and lower plate dissipation. These Curves apply for normal load conditions and may be modified slightly for greater or lower values of antenna loading.

* * *

UHF and FM Service

THE figures for c.w. operation apply to frequency-modulated amplifiers after due consideration to the higher circuit and dielectric losses which occur in the UHF region. The plate dissipation of 300 watts per tube is the factor which may limit the values of power supply voltage and plate current at very high radio frequencies. The circulating r-f current in the grid and plate leads of the tube is much greater in UHF service, since the interelectrode capacities of the tube become a large portion of the tank circuit capacities. Thus the seals of the tube may become excessively heated, with a consequent limitation of the input and output power which the tube can handle in the UHF region, either as an oscillator or amplifier.

Parallel-rod or concentric line resonant circuits of correct electrical and mechanical construction are desirable at the very high frequencies. The relatively low interelectrode capacities of these tubes, and their small physical size and short r-f leads, combine to make these tubes effective for operation at frequencies as high as 200-Mc., approx.

Radiation-type connectors should be fitted to the grid and plate leads, particularly to the latter.

Characteristics

Filament voltage	5 or 10 volts
Filament current	26 or 13 amperes
Amplification constant	10
Grid-plate capacity	10uuf.
Grid-filament capacity	10uuf.
Plate-filament capacity	1.5uuf.
Bulb	G28
Overall height	7½-in.
Maximum diameter	3¼-in.
Base	Johnson No. 213 Special

Tube should be operated in a vertical position with ample ventilation.

Maximum Ratings

Plate dissipation	300 watts
DC plate voltage	3,000 volts
DC plate current	1,000 ma.
DC grid current	150 ma.

* * *

Plate-Modulated or C.W. Amplifier

DC plate voltage	1000	1250	1500	2000
DC plate current	800	800	800	750
DC grid voltage	–250	–300	–400	–500
DC grid current	135	135	135	130
Grid Driving Power	75	80	90	100
DC power input	800	1000	1200	1500
Plate dissipation	240	300	300	300
Pct. plate efficiency	70	70	75	80
Approx. carrier output	560	700	900	1200

If the tube is operated at lower values of plate current, the grid current should be proportionately reduced.

* * *

C.W. Amplifier

DC plate voltage	750	1000	1500	2000
DC plate current	700	800	800	700
DC plate current	700	800	800	700
DC grid voltage	–100	–160	–225	–300
DC grid current	150	135	125	130
Grid driving power	45	50	50	75
DC power input	525	800	1200	1400
Plate dissipation	210	300	300	300
Pct. plate efficiency	60	62.5	75	78.5
Approx. power output	315	500	900	1100

* * *

Frequency Doubler

DC plate voltage	1000	1250	1500
DC plate current	500	440	400
DC grid voltage	–450	–600	–750
DC grid current	80	80	80
Grid driving power	52	60	72
DC power input	500	550	600
Plate dissipation	300	300	300
Pct. plate efficiency	40	45	50
Approx. power output	200	250	300

* * *

Voice Communication Grid Modulation

DC plate voltage	1000	1250	1500
DC plate current	300	320	267
DC grid voltage	–175	–220	–250
DC grid current	9	6	2
Grid drving power	2	2	1
Peak AF grid voltage	112	120	140
DC power input	300	400	400
Plate dissipation	200	280	280
Pct. plate efficiency	33	30	30
Approx. carrier output	100	120	120

Better modulation linearity is secured with low values of d.c. grid current and heavy antenna loading. The grid circuit should be stabilized with a swamping or r-f loading resistor. A wide range of adjustments may be used, and more power can be obtained if the degree of modulation capability is reduced and the amount of carrier shift increased.

OHMITE DUMMY ANTENNA RESISTOR

• From the Ohmite laboratories comes an innovation in resistor design which makes possible a combination of constant r-f resistance, low inductance, high wattage dissipation and compactness. The D-100 Dummy Antenna resistor represents an outstanding achievement in resistor design making available for the first time a small, high wattage resistor suitable for high (15 megacycle) radio frequency power measurements. A simple, accurate and direct means of measuring r-f power is thus made available to the amateur, experimenter and manufacturer, and to the operators of aviation, police and broadcast stations.

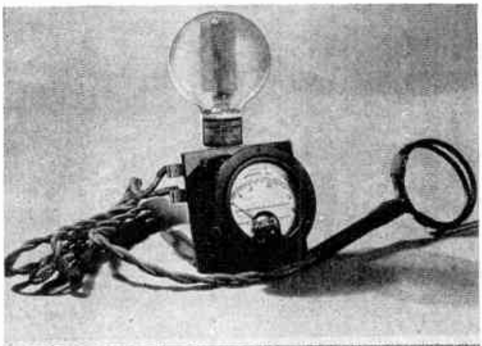
Among the outstanding applications of the Ohmite D-100 Dummy Antenna are: its use in tuning up a radio transmitter for maximum efficiency by making possible the accurate measurement of the r-f power output (and consequently the efficiency) of the final amplifier as well as of preceding stages; and also its use while tuning up to keep the signal off the air and eliminate unnecessary interference. In short, the Ohmite Dummy Antenna resistor provides a new and useful test instrument for radio-frequency use.

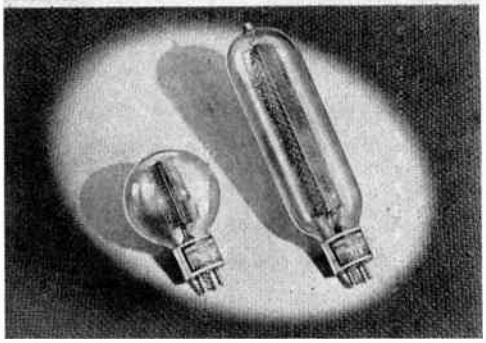
This new Dummy Antenna Resistor has a non-inductive, space-wound resistance element of unique design which is mounted in a glass bulb, evacuated and gas filled. A four prong steatite tube base provides convenient mounting in a standard tube socket. A variety of resistance values are available to match concentric, twisted pair and open wire transmission lines.

The curves in Figures 1 and 2 show the frequency and load characteristics of the Model D-100 and serve to indicate the marked superiority of the Ohmite Model D-100 to other forms of resistors heretofore used for high frequency work. The radio frequency resistance of a Model D-100, it can be noted, is practically constant at all frequencies up to and even beyond 15 megacycles. The impedance also rises only very slightly with increase in frequency, changing less than 10% at 15 megacycles. The curves in Figure 2 illustrate the slight change in resistance with load of the Model D-100. Contrast this with the lamp bulbs, which have been heretofore used as the best loads available for high radio frequency use, where the change in resistance from no load to full load amounts to approximately 12 times for a tungsten lamp and 2 times for a carbon lamp. The constant impedance and resistance of the Ohmite Model D-100 insures that the impedance match is maintained at all loads and that the r-f power can be simply calculated using Ohm's Law, knowing the current and the Dummy resistance.

Outstanding Uses of the Ohmite Dummy Antenna

1. To measure accurately radio transmitter final amplifier output.
2. To determine transmitter efficiency.
3. To measure accurately exciter output.
4. To serve as a radio frequency wattage indicator when used in conjunction with an r-f ammeter and a coupling link to tune individual stages, etc.
5. To determine transmission line losses.
6. To check the impedance match between transmission line and antenna.
7. To provide a non-radiating load to reduce interference and prevent off-frequency operation during periods of test and adjustment.
8. To reduce band congestion during neighborhood transmission.
9. To enable transmitter adjustment during Quiet Hours.





The upper illustration shows an Ohmite Dummy Antenna Resistor, Ammeter and Link Assembly for measuring transmission line losses. The lower illustration shows two Ohmite Dummy Resistors, one for low power measurements, the other for high power (upper illustration referred to as Fig. 9 in text).

10. To serve as a non-inductive, non-capacitive resistor of 100 watt rating in other r-f circuits. (See Figures 1 and 2 for characteristics.)

Measuring the Output of a Transmitter Having an Untuned Line

Transmitters having untuned transmission lines are particularly well suited to power output measurement by means of a Dummy Antenna. These transmitters have a pick-up coil or an antenna network to match the output circuit to the surge impedance of the transmission line. Since properly terminated untuned lines present a constant resistance load of value equal to the surge impedance of the line, a non-inductive resistor may be substituted for the feeders if the resistor matches the line surge impedance. A D-100 of the proper resistance may, therefore, be interchanged with the feeders to measure transmitter output. The illustration in Figure 3 shows the method of connecting the D-100 to the transmitter antenna terminals. A 73 ohm Dummy Antenna should, of course, be used to replace a concentric or twisted pair line (approximate value 73 ohms) and a 600 ohm Dummy to replace an open line (600 ohm approximate resistance).

With the D-100 connected as shown, the transmitter should be retuned and the excitation

OHMITE DUMMY ANTENNA RESISTOR—Continued

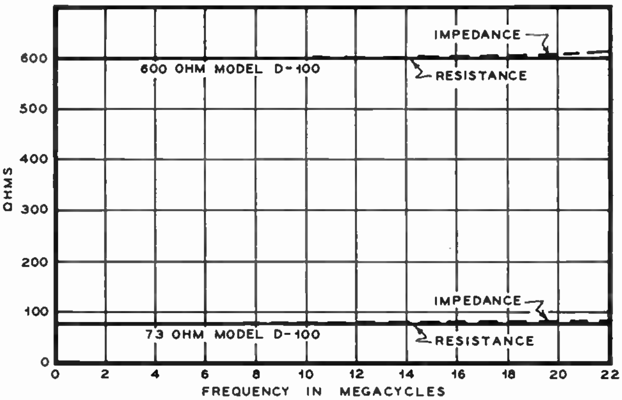


Fig. 1—R and Z Versus Frequency

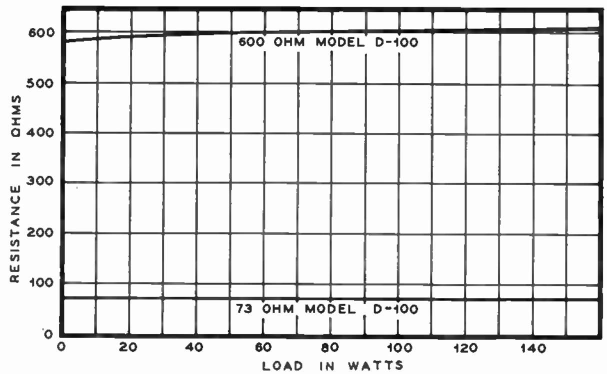


Fig. 2—R Versus Watts Load

and antenna coupling carefully adjusted for maximum output as indicated by the radio frequency ammeter. The D-100 does not become incandescent within its rating and **any color brighter than a dull red glow indicates serious overload.** Ohm's Law for power may be used to determine the output. As an example, let us assume that a transmitter normally operates into a 600 ohm line. When a 600 ohm Dummy is connected, as shown in Figure 3, assume the r-f ammeter reads 0.38 amperes. Substitute 0.38 for I and 600 ohms for R into the equation, I^2R = Watts.

$$I^2R = 0.38^2 \times 600 = 0.38 \times 0.38 \times 600 = 86.6 \text{ watts}$$

Figure 10 provides a curve for quickly, conveniently and accurately determining output from ammeter readings. Since slight variations in resistance with changes in load (due to the temperature coefficient of the wire) are taken into consideration and the chance of mathematical errors is eliminated, we recommend the use of this curve.

Meters

For maximum ease and accuracy in reading, a 0.5 or a 1.0 ampere r-f ammeter is recommend when a single 600 ohm D-100 is used, and a 1.5 ampere meter should be used for a single 73 ohm Dummy for full power readings. The 0.5 ampere meter is also handy for very low wattage readings when the 73 ohm Dummy is used to check exciter stages.

Higher Power or Special Resistance

The D-100 is rated to carry 100 watts of unmodulated r-f but will safely carry the intermittent increase in average power caused by modulation. For loads over 100 watts (or when special resistances are desired) several units may be connected in parallel, in series, or in series-parallel. Circuits of Figures 4 and 5 can be used as required. Nine units in series-parallel can be used for 900 watts maximum. Ammeters of range suitable to the maximum power will be required for these circuits.

Measuring the Output of a Transmitter Having Tuned Feeders

For transmitters using the Hertz type antenna with tuned feeders, a short twisted-pair line and pick-up coil should be substituted for the feeders and regular coupling coil. Figures 6, 7 and 8 illustrate a 73 ohm D-100 Dummy coupled to the three general types of amplifier circuits. Note that in all cases the coupling coil is placed at a point of low radio frequency potential (at the point where the plate supply is connected). The regular antenna feeders are disconnected when the dummy is connected to the transmitter. When parallel tuning is used in the feeder coupling system, the tuning condenser must be removed from the circuit.

Figures 6 and 7 show the method of coupling to either push-pull or plate neutralized amplifiers with the coupling coil placed around the center of the tank coil. Correct placement of the coupling coil is shown in Figure 8 for either screen grid, pentode or grid neutralized circuits. Transmitter type 73 ohm twisted pair or concentric cable is recommended for the link to insure correct impedance match. The line may be any short convenient length. With the Dummy Antenna connected, the transmitter should be retuned and the coupling coil and excitation **carefully** adjusted for maximum output as indicated by the ammeter. The output in watts is obtained from Figure 10 or from Ohm's Law. The D-100 should **not** show any appreciable color **(beyond a dull red at 100 watts)** as it is not intended to become incandescent. **Any appreciable color indicates serious overload.**

Measuring Exciter Output

Fig. 9 (page 65) illustrates a convenient type

OHMITE DUMMY ANTENNA RESISTOR—Continued

mounting for a 73 ohm Dummy Antenna and a 1.5 ampere r-f ammeter which provides short leads between the Dummy and meter and a twisted pair coupling link for proper impedance match. This assembly is in effect a convenient and accurate radio frequency wattage indicator which can be used to tune individual stages to peak efficiency. The twisted pair link should be some convenient length (3 to 6 ft.) and the pick-up coil on a short wand is particularly well adapted for tank coils wound on receiving type plug-in forms. The coupling to the succeeding stage must be removed and the special coupling loop (of size and turns suited to the coil) placed around the coil at the point where the plate supply is connected. As before, the stage should be carefully adjusted for maximum output. The output in watts is determined from Figure 10, or from Ohm's Law. Stages not operating properly and exciters not delivering enough power to drive succeeding stages can be quickly located.

Determining Transmitter Efficiency

Every amateur wants to know the plate circuit efficiency of all stages of his transmitter in order to secure the maximum transmission miles per input dollar. This is only possible with the transmitter operating at peak plate efficiency, as readily determined with the Ohmite Dummy Antenna. Plate circuit efficiency equals watts output divided by watts input, the input being the plate voltage multiplied by the current in amperes (1000 milliamperes equal 1 ampere).

Example: Suppose an amplifier is operating so that the radio frequency output, as obtained by one of the methods previously described using a D-100 resistor, is 90 watts. The plate voltage is assumed to be 1000 volts and the plate current 150 milliamperes (0.15 amperes).

$$\text{INPUT} = E \times I = 1000 \times 0.15 = 150 \text{ watts.}$$

$$\text{EFFICIENCY} = \frac{\text{Output watts}}{\text{Input watts}} \times 100 = \frac{90}{150} \times 100 = 60\%$$

(*Continued on next page*)

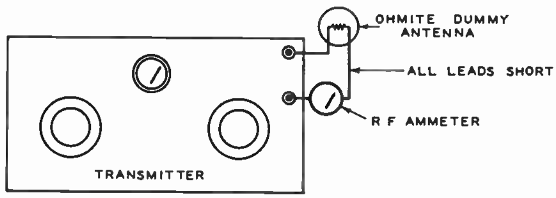
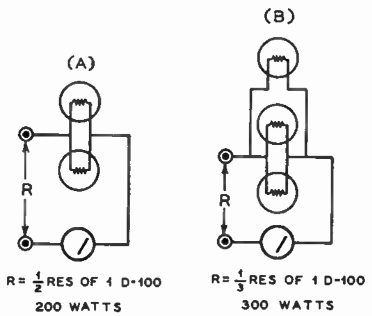


Fig. 3—Dummy Antenna Replacing Untuned Line



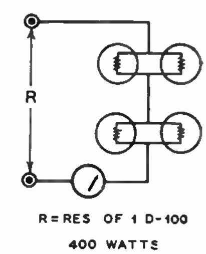


Fig. 4—(A) For 200 Watts. (B)—300 Watts

Fig. 5—Connection for 400 Watts (Max.)

Units illustrated in Fig. 4 should be individually fused.

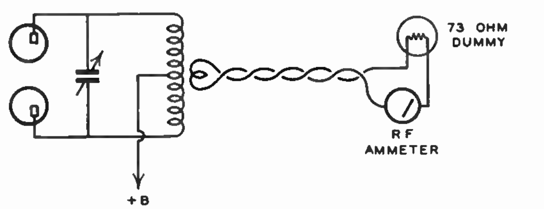


Fig. 6—Push-Pull Stage

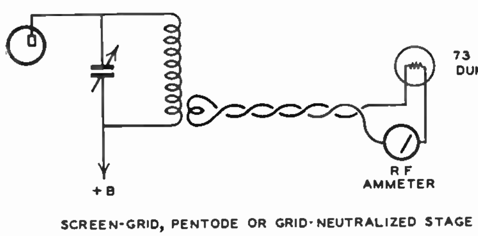


Fig. 8—Screen-Grid, Pentode or Grid Neutralized Stage

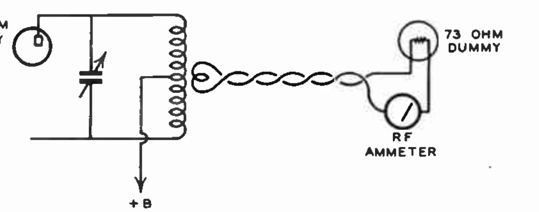


Fig. 7—Plate Neutralized Stage

OHMITE DUMMY ANTENNA RESISTOR—Continued

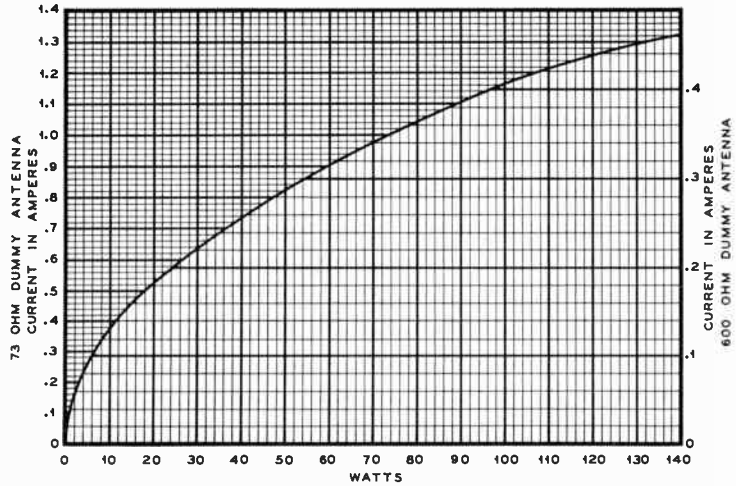


Fig. 10—Watts Versus Current for 73 Ohm and 600 Ohm Dummy Antennas

Untuned Transmission Line Losses—Line to Antenna Impedance Match

To measure transmission line loss, the antenna is disconnected and a D-100 is connected in series with a radio frequency ammeter across the end of the line. Short connecting leads between line, D-100 Dummy Antenna and ammeter should be used. A 73 ohm Dummy should be used for concentric and twisted pair lines and a 600 ohm unit for open wire 600 ohm lines. The transmitter should be carefully tuned for maximum output using the loosest coupling which will still give an accurate indication on the meter. The power in watts can be obtained from Figure 10. A second reading of power is then made with the line disconnected and the dummy at the transmitter—with excitation, input and coupling maintained the same as in the first reading. The difference between the output measured at the transmitter and that measured at the end of the line will then equal the line loss. A serious mismatch between line and antenna will be indicated by an increased line current when the dummy is substituted for the antenna.

Eliminating Interference

It is impossible to calculate how much interference is created by amateurs while tuning up and testing or during neighborhood transmissions. By substituting the Ohmite Dummy Antenna it is possible to tune up or test parts of the transmitter at full power without radiating interference to great distances. Because there is a weak field radiated directly from the transmitter itself, it is also possible to communicate within the immediate neighborhood. This also aids considerably in local duplex transmission as it permits working closer to the transmitter frequency without blocking the receiver. This method is even more successful than reducing power as even a few watts in a good antenna will cover great distances. Many amateurs also find the Dummy Antenna permits tune-up during Quiet Hours.

Operating Instructions: Important

The D-100 Dummy Antenna is a resistor, and, therefore, dissipates heat while in use. Provision for free and adequate natural ventilation should be allowed for in mounting. The D-100 is **not** intended to be operated incandescent. Under full load the resistance element should glow **only a dull red, visible only in semi-darkness.**

Description	Model D-100	Model D-250
Bulb diameter	3⅛"	2½"
Height from bottom of base	4¾"	9 1/16"
Overall height	4 15/16"	9⅝"
Base diameter	1 11/32"	1 11/32"
Resistance tolerance	±5%	±5%
Distributed Capacity, mmf. (Approx.)	5	13

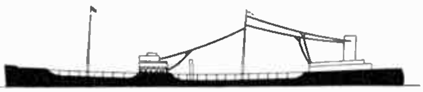
Connections are made to the two large prongs except for the D-250-600 which has one connection at the top.

Catalog No.	Watts	Ohms	Inductance mh. ±10%
D-100-13	100	13	0.19
D-100-18	100	18	0.19
D-100-34	100	34	0.19
D-100-64	100	64	0.33
D-100-73	100	‡ 73	0.33
D-100-100	100	100	0.33
D-100-146	100	†146	0.33
D-100-219	100	†219	1.0
D-100-300	100	300	1.0
D-100-400	100	400	1.0
D-100-500	100	500	1.0
D-100-600	100	‡600	1.0
D-250-73	250	‡ 73	0.33
D-250-600	250	‡600	1.1

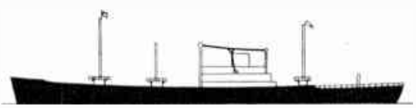
†For parallel operation to obtain 73 ohms at increased watts.
‡Most popularly used resistances.
List prices: D-100, $5.50. D-250, $11.00.

The Multicoupler-Antenna System for Marine Service

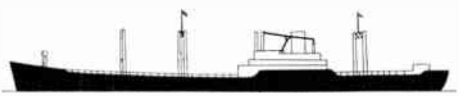
To PROVIDE officers and sailors with ideal broadcast and short-wave reception from their own sets, merely by plugging into convenient antenna-ground outlets, over seventy tankers and cargo ships are equipped or being equipped with the marine multicoupler-antenna system, manufactured by Amy, Aceves & King, Inc., of New York City, antenna engineers and licensors of the system. Radio wiring has become a standard feature for Maritime Commission cargo ships of the C-1, C-2 and C-3 classes, as well as on most oil tankers.



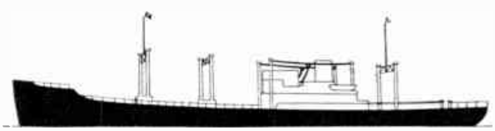
OIL TANKER
MULTICOUPLER ANTENNA RIGGING



C1-B - CARGO SHIP
MULTICOUPLER ANTENNA RIGGING
(TWO AERIALS REQ'D. ONE SHOWN)



C2 - CARGO SHIP
MULTICOUPLER ANTENNA RIGGING
(TWO AERIALS REQ'D. ONE SHOWN)



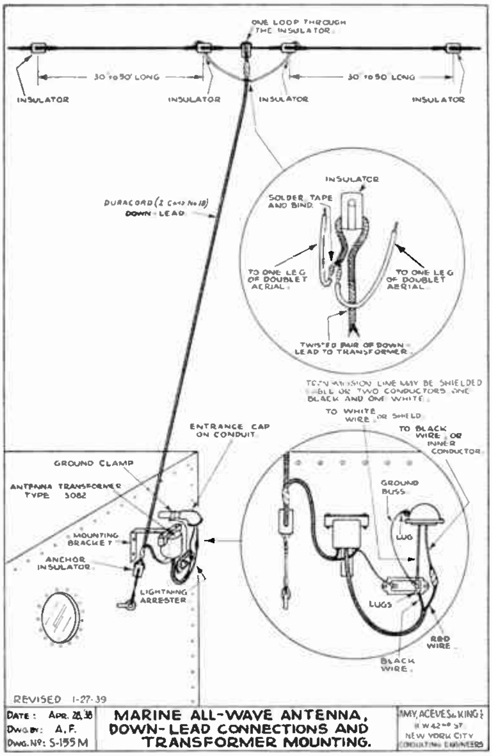
C3 - CARGO SHIP
MULTICOUPLER ANTENNA RIGGING

A single aerial is made to serve up to 21 individual sets through as many convenient radio outlets. Additional aerials are installed if more sets are to be accommodated. One tanker, the Esso "Nashville" for example, has three aerials serving 34 outlets.

A doublet aerial is used, comprising two lengths of wire, each 30 to 50 feet long, connecting at the center with special "Duracord" twisted-pair downlead cable leading to the antenna transformer. The latter mounts in a metal box along with the lightning arrester. Starting at the antenna transformer, a concentric-dual-conductor cable connects with the outlet couplers wired in parallel. Each coupler is placed in the usual 4 x 4 inch outlet box, provided with a cover that includes the antenna-ground receptacle and duplex power receptacles. A special polarized plug connected with antenna and ground terminals of the set, fits into the radio receptacle.

A special concentric cable is used for the radio transmission line or riser. Such a cable must have low dielectric loss, or not exceeding 2 decibels per 100 feet at 15 megacycles (20 meters), and a characteristic impedance between 60 and 70 ohms. The radio-frequency requirements for such function cannot be met with ordinary code insulated rubber wire. The engineers have made extensive laboratory tests of various cables, finally selecting two kinds of rubber-covered concentric dual conductor cables for conduit or concealed-wiring job, and one lead-covered cable for exposed-wiring jobs.

The marine multicoupler-antenna system is an adaptation of the well-known apartment-house version in wide use today. Special provisions had to be made to meet such shipboard conditions as constant vibration, high winds, salt air and funnel fumes, proximity of ship's



transmitter, and so on. The result is a fully perfected system which provides ideal reception in both broadcast and short-wave bands, with minimum background noise. There is no upkeep or maintenance expense.

Because of the metal hull and other shielding aboard ship, the usual portable or midget set with built-in aerial or loop cannot perform satisfactorily, particularly on short waves at real distances. An outdoor aerial is indispensable. However, the skipper usually resents the promiscuous stringing up of private aerials, especially since they can throw off his radio direction finder. The multicoupler-antenna system therefore becomes a necessity on the modern ship.

Due to the diversity of marine architecture, each ship is considered individually.

ORDERS ARE LIKE EGGS

(Continued from page 41)

course we must remember that it is used for a high and mighty purpose—to prevent a few concerns from hogging a lot of orders at high prices. But it doesn't work out that way. It makes too much of a good thing, and it loses all sight of speed, which today is essential. As far as high prices go, the radio industry today has reached a high state of stability and anyone can take a catalog, check price for price and tell at once if production costs are very far out of line. And national defense work is chiefly an assembly problem—plus some good engineering. It doesn't take square miles of floor space to supply these things.

In short, the small manufacturer, with a mile-long patriotism, is pleading for a "break." Give him a small part to do. He may be in Tuscaloosa or Santa Barbara, Haverhill or Walla Walla. Wherever he is, this radio game is his meat. He can produce. One big fire can't begin to burn him out. He can supply those much-needed ears for fifty thousand planes a year. Bottlenecks, to him, are things you pull corks out of. Give him half a chance, Uncle Sam, and he'll pull the cork out of the stopped-up national defense program!

* * *

THE F.C.C.'s MAILBAG

IRKED by delivery of a telegram by telephone, a Massachusetts man inquires as to regulations covering such practice. He is advised that the telegraph companies file schedules covering charges and regulations with the Commission. There is no departure from these unless the Commission finds them unreasonable, discriminatory, or otherwise in violation of the Communications Act. The tariff of the telegraph company concerned provides that "messages will be delivered by telephone when prompt messenger service is not available, or when the addressee is located in a distant part of the community." The company does not necessarily have to deliver a telegram marked "personal" to the individual to whom it is addressed. The tariff provides further: "If the sender desires a message delivered or not delivered by telephone, the words 'Phone' or 'Don't Phone' should be added after the addressee's name. These words will not be charged for."

* * *

TO a Detroit man who registers complaint about an express company the Commission points out that authority is confined to communication by means of electrical energy, hence it can take no action.

RADIO PROGRESS IN 1940

(Continued from page 14)

tion pictuers flown to New York and then telecast. The major rallies of both parties, held at the end of the campaign in Madison Square Garden, New York, brought both presidential candidates before the television cameras. A complete portable television transmitter was taken aloft in a transport plane and relayed the view to the television audience through the NBC transmitter.

Among the important technical developments were the use of ordinary telephone circuits for relaying television programs over short distances, the development of a radio-relay system operating on wavelengths of less than a meter and capable of passing television programs across the country in a series of relays, a forward step toward an eventual television network, and the demonstration of television reception in full color by engineers of the Columbia Broadcasting System. Larger pictures were shown both by the use of larger picture tubes (up to 20 inches in diameter) and by projection on a screen measuring 4½ by 6 feet. An inexpensive television camera tube was announced for amateur experimenters and simple circuits published which will permit the "hams" to set up their own sight-and-sound communication systems.

Facsimile picture transmission as a broadcast service to the public was not radically extended, but its use in newspaper work increased considerably, particularly in transmitting war pictures from Europe. Facsimile service on wire telegraph systems was extended to include the cities of New York, Chicago, Atlanta, and San Francisco.

★

Application for Enrollment

In

Amateur Radio Defense Association

★ ★ ★

PATRIOTICALLY pledging my service to the radio defense of the United States of America, I hereby apply for enrollment in the *AMATEUR RADIO DEFENSE ASSOCIATION*. I agree to keep my radio equipment in good working order, ready to meet emergencies which may arise as a result of foreign aggression or other catastrophies. I agree to participate in such tests and training in preparedness to meet disaster to normal communication facilities as may be asked of me, provided that I am not then engaged in other work which I deem more essential to my personal welfare.

IN RETURN for my pledge of service, I am to receive a Certificate of Enrollment in the *AMATEUR RADIO DEFENSE ASSOCIATION* and am to be advised, by radio or otherwise, of the activities of said association, all without financial obligation on my part. It is mutually understood that the costs of printing and mailing the Certificate of Enrollment will be borne by the Publishers of the magazine "*Amateur Radio Defense*," who pledge themselves to publicize the Association activities, to print technical information which will improve the practical effectiveness of my equipment, and to seek greater recognition for the amateur radio operator as a means for aiding the national defense.

Pledged at.., ..., **on this**.........................

Town State

day of..., **194**.....

Witness

....

Enrollee..

Full Name..

Complete Address..

Call Letters..When Received..................................

Age..Race or Color..

Code Copying Speed (1.. in Handwriting............................ (2) On Typewriter.........................

Present or Past Employment in Commercial Radio...

Army or Navy Service...

Present Station Equipment: Power..................................Operating Bands..........................

C. W.?......................................Phone?..ECO?.......................................

Antenna Type... Receiver Type..

Measuring or Direction-Finding Equipment..

Academic Education:...

Mobile Equipment (auto, boat, plane)..

Public Speaking or Writing Ability...

Nautical Instruments Owned ....

Membership in Other Communication Networks..

Organization Experience and Willingness to Enroll Others....................................

Other Special Qualifications..

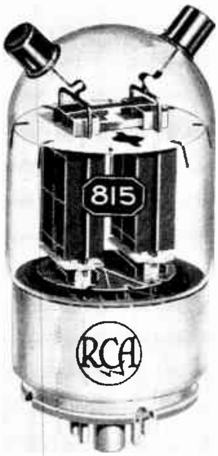
....

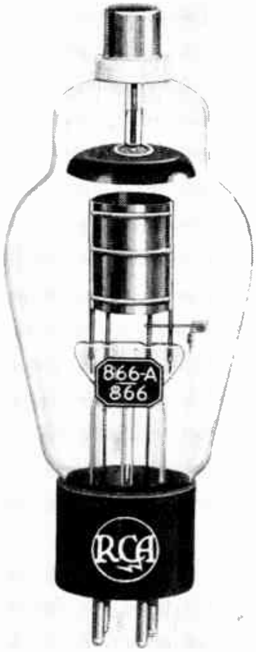
....

The above information is needed for guidance in classification for specialized services. Please write it in detail and mail it to

AMATEUR RADIO DEFENSE,
Monadnock Bldg., San Francisco.

A handsome Certificate of Enrollment will be mailed free to each licensed amateur radio operator who requests it.





New Tubes By R.C.A.

★

RADIO Corporation of America has made available the following new tubes:

RCA-3S4 POWER AMPLIFIER PENTODE (Miniature Type)

RCA-815 TRANSMITTING PUSH-PULL BEAM POWER AMPLIFIER

RCA-826 TRANSMITTING TRIODE (For Ultra-High Frequency Use)

RCA-866-A/866 HALF-WAVE MERCURY-RECTIFIER

RCA-1625 TRANSMITTING BEAM POWER AMPLIFIER (With 12.6-Volt Heater)

RCA-1626 TRANSMITTING TRIODE (With 12.6-Volt Heater)

●

THE 3S4 is intended for use in the output stage of light-weight a-c/d-c/battery-operated portable equipment. This new tube has essentially the same characteristics as the miniature type 1S4 but is designed with a filament having a center tap to permit of either a series-filament or a parallel-filament operating arrangement. The series arrangement requiring only 50 milliamperes has been provided especially for equipment utilizing a source of rectified power for the filament supply.

THE 815 is a new push-pull beam power amplifier designed for radio amateur use at ultra-high frequencies. Its exceptional efficiency and high power sensitivity permit full power input with very low driving power. A single 815 operated in push-pull class C telegraph service is capable of handling a power input of 75 watts with less than ¼ watt of driving power at frequencies as high as 150 megacycles. The total maximum plate dissipation of the 815 is 25 watts. The 815 is also useful as a modulator and as a multiplier. A single 815 can modulate another 815 as power amplifier. In multiplier service, the 815 can be used as a doubler or tripler and at the same time drive an 815 as power amplifier. Mechanical features of the 815 include its balanced and compact structure of beam units, close electrode spacing, short internal leads to minimize lead inductance and resistance, and a "MICANOL" wafer octal base. The heaters of the 815 are arranged for either 12.6- or 6.3-volt operation.

●

THE 826 transmitting triode has been designed especially for use at ultra-high frequencies. It may be used as an oscillator, r-f power amplifier, and frequency multiplier at maximum ratings at frequencies as high as

250 megacycles and at reduced ratings at frequencies as high as 300 megacycles. Maximum plate dissipation of the 826 is 60 watts in class C telegraph service. The 826 features a double-helical filament center-tapped within the tube so that effects of filament inductance can be minimized. In addition, two short, heavy leads are brought out from the grid and from the plate to individual terminals in order to reduce the inductance of these internal connections. All terminals are placed at one end of the bulb so that short leads can be used in neutralizing circuits.

●

THE 866-A/866 is a new half-wave, mercury-vapor rectifier to supersede the well-known RCA types 866-A and 866. This new tube combines the ability of the 866-A to withstand high peak inverse voltage and the ability of the 866 to conduct at relatively low applied voltage. The 866-A/866 employs a ceramic cap insulator and is constructed in a dome-top bulb. This construction minimizes danger of bulb cracks caused by corona discharge. An edgewise wound ribbon filament made of a new allow material provides a large emission reserve and improved life. Two 866-A/866's operating in a full-wave rectifier are capable of delivering to input of a choke-input filter a rectified voltage of 3180 volts at 0.5 ampere with good regulation.

●

THE 1625 transmitting beam power amplifier is similar to RCA-807 but it has a 12.6-volt heater and a 7-pin base. Because of these features, the 1625 is particularly suitable for use in aircraft radio transmitters. In these transmitters and other equipment subject to vibration and shock, the 7-pin base provides ample friction to hold the base in its socket. The high power sensitivity of the 1625 makes it especially useful in frequency-multiplier service where high harmonic output is essential. It may also be used as a crystal-oscillator and buffer amplifier in medium-power transmitters with an input up to a half kilowatt. The 1625 can be operated at maximum ratings at frequencies ah high as 60 megacycles and at reduced ratings at frequencies as high as 125 megacycles. Its maximum plate dissipation rating is 30 watts (ICAS).

●

THE 1626, a transmitting triode of the indirectly heated type with 12.6-volt heater, is designed especially for r-f oscillator service in applications requiring unusual stability of characteristics. The maximum plate dissipation is 5 watts. The 1626 may be operated at maximum ratings at frequencies as high as 30 megacycles, and at reduced ratings at frequencies as high as 90 megacycles. Because of its 12.6-volt heater rating, the 1626 is particularly suitable for use in aircraft radio transmitters.

★

Phototube Applications Explained in New Book

COMPLETE information on phototubes and their applications is being distributed to engineers servicemen, amateurs, students and experimenters throughout the country by RCA transmitting tube distributors. The material, in simplified form, is presented interestingly in a 16-page booklet prepared by the RCA Manufacturing Company.

The phototube's usefulness in light-operated relays, color discriminating devices, automatic counters, for light measuring, and for film sound reproduction, is explained in detail. The easy-to-understand discussion of phototube theory is backed up by numerous circuits and descriptive material, characteristic curves, and charted data on the complete RCA phototube line.

RCA phototubes are of two principal groups, gas types and vacuum types. Most of the gas types are designed primarily for sound reproduction, but their high sensitivity makes them suitable for many relay applications as well. Included in this group are the 868, a tube long used for sound reproduction; the 918, similar to the 868 but having the improved sensitivity; the 923, similar to the 918 in a short bulb; the 927, especially designed for 16mm equipment; and the 920, a twin tube for use in push-pull sound reproduction from a double sound track.

Other gas types more especially designed for relay applications are the 921, a compact cartridge-type tube; the 924, a small end-on type with cathode facing the end of the bulb; and the 928, with the cathode arranged to respond to light from many directions.

The vacuum-phototube group is of primary interest to the designer of light-operated relays and light-measuring equipment. The 926 has the spectral response closest to that of the eye, and is therefore of particular interest in colorimetric work. The 929 has an exceptionally high response to blue and blue-green radiation, and so is important for flame-control applications where it is desired that the tube respond to the flame and not to the heated objects in it.

The other vacuum types differ chiefly in structural details. They include the 917 and 919, two exceptionally low-leakage types which are alike except that the anode is brought out to a top cap in the 917, and the cathode to the top cap in the 919; the 922, a compact cartridge type, and the 925, a tube with short bulb.

TUBE APPLICATIONS

● One of the most talked-about features of this magazine is the "Engineering Applications" pages. Each month the editors review several new tubes and give circuit diagrams for various applications. Eventually every popular tube will be treated in like manner—giving you a file of tube inforation second to none. Turn to the Applications pages elsewhere in this issue.

NEW BOOKS and CATALOGS

"Television," by V. K. Zworykin and G. A. Morton, of Electronics Research Laboratory, R.C.A. Mfg. Co., Published by John Wiley & Sons, Inc., 1940, price $6.00.

This text consumes nearly 600 pages and is recommended to the student or engineer who desires a practical knowledge of the entire field of electronic television. The fore part of the book is devoted to fundaemntal physical phenomena with regard to electron emission, fluorescent materials and electron optics. Part II deals with the principles of picture transmission and reception. Mechanical and electronic scanning in its various forms are discussed widely, as is the subject of reproduction. Part III covers the theory of the iconoscope, kinescope, electron-gun, video amplifiers, scanning and synchronizing problems, and television transmitters and receivers. Part IV deals with present types of RCA-NBC television equipment, which may be subject to change as the state of the art progresses. This book may be somewhat advanced for the average radio amateur or serviceman, unless he is a serious student. A reading knowledge of calculus and advanced mathematics is desirable in order to fully understand the text. It is the most noteworthy text on television which this reviewer has had the pleasure of examining.

* * *

"Electron Optics In Television," by I. G. Maloff and D. W. Epstein, of the Research Division, RCA Mfg. Co. Published in 1938 by McGraw-Hill Book Co., Inc., N. Y. This 300 page book is devoted to electron optics and cathode-ray television. The text is divided first into a general introduction to television, then into two principal parts. Part I deals with the problem of focusing electron beams, mainly by means of coaxial cylindrical electrodes which form electrostatic lenses. The analogy between light and electron optics is apparent. General chapters are devoted to electron lenses and focussing in cathode-ray television tubes. Part II deals mainly with the problems encountered in the design of cathode-ray tubes for television. This section is of unusual interest to engineers confronted with cathode-ray tube problems, both for transmitting and receiving. The book is recommended as an excellent reference for students and engineers interested in current television problems.

* * *

"Engineering Electronics," by Donald G. Fink, managing editor of "Electronics." Published in 1938 by McGraw-Hill Book Co., Inc.

This textbook is recommended to students and engineers interested in the application of electronic methods to all branches of manufacturing. It is suitable as an introductory course for college students, and as an aid to the practicing engineer and specialized serviceman who is interested in enhancing his background in the field of electronics. The text is divided into three main portions: Physical Electronics, Electron Tubes, and Electron Tube Applications. All kinds of thermionic and photosensitive cells are described, both from the standpoint of operating theory and in practical circuit applications. No knowledge of advanced mathematics is required in order to understand the text nor in solving the typical problems at the end of each chapter.

From The Mail Bag of the F. C. C.

VARIOUS letters referring to discontinuance of broadcasts by the Rev. Charles E. Coughlin have been received by the Federal Communications Commission. In reply to these, the Commission reiterates that the censorship provision of the Communications Act places responsibility for the selection of program material upon the respective licensees, and the Commission cannot require a station to put any individual on the air or take him off the air.

In answering mail prompted by refusal of radio time, the Commission points out that the Act further provides that a broadcast station is not a "common carrier" such as is the telephone and telegraph. Consequently, a radio station is not required to make its facilities available to a person or group, even though offer is made to purchase time. Unlike common carrier tariffs, broadcast station rates are not required to be filed with the Commission.

* * *

UNDER its statute, the Commission explains that it likewise lacks authority to oblige such current correspondents as:

. . . The Louisville resident who complains about the commercial continuity of a certain tobacco program.

. . . The Cincinnati listener who is apprehensive that particular commercial continuities "might influence children against law and order."

. . . Residents of Lowell, Mass., and Duluth, Minn., who object to advertising liquor on the radio.

. . . Various New Yorkers who request "free speech over the airways for real Americans."

. . . A Baton Rouge, La., group which wants Sunday radio programs confined to religious features.

. . . Detroit protest that radio chains bar certain patriotic music from the air.

. . . The organization that registers indignation because it was not given opportunity to broadcast "an item of news of particular interest to local communities."

. . . And the Connecticut man who is wrathy because his receiver is not functioning properly.

* * *

BECAUSE the Commission functions largely as a licensing agency, it cannot supply—

. . . A list of stations which issue membership cards to listening clubs, as requested by a Californian.

. . . A list of "approved" radio schools, as requested by a Chicagoan.

. . . A certain radio script, as requested by a New Yorker.

. . . Program schedules, as requested by a Georgian.

* * *

BY the same token, it is unable to pass judgment upon—

. . . An original radio script written by a Philadelphian.

. . . A device invented by an Ohioan to "revolutionize" radio.

. . . A new patriotic song by an Illinois woman who wants it to open and close all radio programs daily.

* * *

INCIDENTALLY, Charles (Buddy) Rogers of Beverly Hills, Calif., is among those licensed by the Commission to operate radio aboard private aircraft. His particular call letters are KHBUD.

* * *

Ship and Coastal Service Rules Clarified

SUBSTITUTION of the term "limited (governmental)" for "private" is involved in modification and clarification of the rules governing ship and coastal services by action of the Federal Communications Commission, to become effective March 1, 1941. This was prompted by the fact that the word "private" does not adequately describe such a limited service station. A station of this class is now restricted to use for governmental purposes and is available to Federal, State, county and municipal agencies and to other persons or organizations only for the purpose of performing services for such governmental units. Part 7 (coastal) and Part 8 (ship) of the rules are affected.

Also, sections 8.51 and 8.63 of the ship rules are changed, and sections 8.72 and 8.73 are added, to permit more stringent enforcement of the requirements with respect to the licensing and operation of portable-mobile telephone and telegraph stations.

* * *

LIKEWISE, while sympathetic, the Commission can do nothing about the termination of the services of some employees of a foreign cable company by reason of the closing of a certain circuit due to the war.

Never Again

This is your last opportunity to subscribe to AMATEUR RADIO DEFENSE at the low rate of $2.00 per year. The offer has been extended for 30 days, because the volume of subscriptions received was greater than anticipated, and also because many readers expressed a desire to begin their subscriptions with the first issue of the New Year. All orders must be in our hands on or before January 30th. Thereafter the subscription price will be $2.50 per year in the U.S.A. and its possessions, and $3.00 elsewhere.

This new magazine is being so widely talked about on the air and in radio circles everywhere that our former stock of early issues is now exhausted. If you have a friend who desires to subscribe, kindly inform him that his subscription must begin with the February, 1941, number. The technical standard of editorial copy has reached a new high, and the demand for more and more magazines has risen rapidly. Protect yourself against missing a single issue by subscribing now.

* * *

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Forecast of FUTURE EVENTS

FEW amateurs have heard about the antenna tower engineered by the structural steel expert, B. J. Osborne, W6QBU. You'll hear more about it when his de-luxe beam is hoisted to the top of the tower, and he returns to the air. "Barney" Osborne is a designer of structural steel bridges, steel ships, etc. He is an executive with the Moore Shipbuilding and Drydock Co., and he went about the design of his antenna tower in the same manner as for a ship or a bridge. The tower is 70 feet high, self-supporting, built of wood, and the lumber costs exactly $17.00. The painstaking effort which went into this tower design will be related in a feature article in next month's issue. Even if you want to build a tower only 10 or 20 feet high, you will want to design it professionally, after you learn how simple and easy it is to do the job. Furthermore, the mechanical design and construction of the rotary array support is a treat to behold. The mathematical formulas for calculating the kind of a tower you want to build are original—from Barney's pen, and the sketches from his drafting board are so clear and simple that the inexperienced tower builder can duplicate the job with a minimum of effort. Our crack photographer, W6SEM, did a lot of shooting at Barney's place, and he returned with an armful of the finest pictures imaginable.

* * *

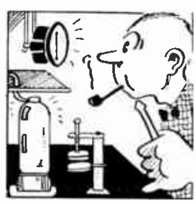
AND while we are discussing towers and antennas, we will run the gamut and give you the inside information on W6SSN's method of adjusting a rotary beam array from the bottom, rather than the top of the tower. He has devised an ingenius right-and-left-hand threaded bearing and pulley assembly, by means of which you can adjust the radiator, reflector, and director with your feet on the ground. At W6SSN's abode we found other things of interest to the amateur—little things that make big things work better. Gadgets and attachments for plate and grid tuning condensers, f'rinstance, so that you can mount the variable C in any desired place, on or under the chassis, and still rotate the things without benefit of backlash or cusswords. To cap the climax, we found W6SSN'S YF in the workshop, building a high-power ham 'phone of her own. Here is the solution to the problem: "How to stay happy, though married, to a radio amateur."

* * *

FRANK C. JONES will talk about the plate of a transmitter tube—what it does, and why—treated in the same refreshing, easy-to-understand manner as his treatise on the grid, related elsewhere in this issue. Next comes the filament of a transmitter tube, then the screen. You'll gain a mighty clear understanding of these elements and the part they play, if you follow Frank's copy with care.

* * *

THE editor-in-chief, Arthur H. Halloran, has written something of great interest for the filter-minded amateurs. Now that he has proved his theories mathematically, he will talk the amateur's language and tell you how to put his teachings into actual use in the ham shack. Then comes a treatise on Inductances, a subject which the amateur will read with absorbing interest.



* * *

ENTHUSIASM runs wild in the laboratory where F. D. Wells wields the slide-rule. "Look at that stuff," said he, as we browsed through the plant, "all of it first-class ham magazine material, and you can take your choice." So we took what appeared to be just about ham-size, physically and economically. It's for the man who wants something better for the ultra-high region. And it's ultra-high in quality, from every angle. QRX for the next issue.

From the LARGEST *To the* SMALLEST

Typical of the large broadcast equipment manufactured by UTC is the filter choke illustrated on the left, designed for a 100 KW broadcast station and weighing about 3½ tons. This unit is 100,000 times the size of the UTC OUNCER.

OUNCER HIGH FIDELITY AUDIO UNITS

The new UTC OUNCER series represents the acme in compact quality transformer practice. These units are ideal for hearing aid, aircraft, glider, portable, concealed service, and similar applications. The overall dimensions are ⅞" diameter by 1-3/16" height, including lugs. Mounting is effected by two screws, opposite the terminal board side, spaced 13/16". Weight approximately one ounce. Units not carrying D. C. have high fidelity characteristics being uniform from 40 to 15,000 cycles. Items with D.C. in pri. and O-14 and O-15 are for voice frequencies from 150 to 4,000 cycles.

(MAX. LEVEL 0 DB)
200 ohm balanced winding moy be used for 250 ohms.

Type No.	Application	Pri. Imp.	Sec. Imp.	List Price
0-1	Mike, pickup or line to 1 grid	50, 200, 500	50,000	$10.00
0-2	Mike, pickup or line to 2 grids	50, 200, 500	50,000	10.00
0-3	Dynamic mike to 1 grid	7.5/30	50,000	9.00
0-4	Single plote to 1 grid	8,000 to 15,000	60,000	8.00
0-5	Single plate to 1 grid, D.C. in Pri.	8,000 to 15,000	60,000	8.00
0-6	Single plate to 2 grids	8,000 to 15,000	95,000	9.00
0-7	Single plote to 2 grids, D.C. in Pri.	8,000 to 15,000	95,000	9.00
0-8	Single plate to line	8,000 to 15,000	50, 200, 500	10.00
0-9	Single plate to line, D.C. in Pri.	8,000 to 15,000	50, 200, 500	10.00
0-10	Push pull plates to line	8,000 to 15,000 each side	50, 200, 500	10.00
0-11	Crystal mike or pickup to line	50,000	50, 200, 500	10.00
0-12	Mixing ond motching	50,200	50, 200, 500	9.00
0-13	Reactor, 200 Hys.—no D.C.; 50 Hys.—2 MA. D.C., 6,000 ohms			7.00
0-14	50:1 mike or line to 1 grid	200	½ megohm	10.00
0-15	10:1 single plate to 1 grid	8,000 to 15,000	1 megohm	10.00

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Pep up your rig with a new Turner Mike. Enjoy true broadcast quality, professional appearance and sure-fire performance at low cost. Amateur and commercial users the world over find Turner Mikes answer their most exacting demands.

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Gain eye-appeal and performance with this new streamlined satin chrome plated mike. Smooth for voice or music. Head tilts full 90 degrees for semi- or non-directional pickup. Cable can be changed without opening mike. Built-in "wind gag"; no blast from close speaking. Diaphragm guard is built in. Large capacity crystal permits long mike lines to be run with minimum loss of level. Inertia type case absorbs mechanical shocks. Crystal impregnated against moisture and changes in barometric pressure. Exceptionally free from feed back. Range 30-7,000 cycles. High level -52DB. Rugged, dependable. Features equal to many $25 mikes. Complete with 7 foot cable set.... List **$16.50**

Model 22D Dynamic

Identical in appearance with 22X. Rugged construction; dependable performance. With 7 foot cable set List **$20.00**

Add $1.50 for 25 foot cable set.

Model 33D Dynamic

Full satin chrome finish of this dynamic mike adds class to your rig. Ninety degree tilting head gives semi- or non-directional pick-up. Twenty-five foot *Balanced Line* removable cable set permits operation under noisy circuit conditions. Output level — -54DB. Range 40-9,000 cycles. Ruggedly built for P.A. or recorder work. Built-in transformer free from hum pick-up. Can take bad climate conditions and withstands rough handling. One hundred ft. lines possible with high impedance unit, and thousands of feet with low impedance 50 ohms, complete with 25 foot cable set............List **$23.50**

200, 500 or high impedance, with 25 foot cable set.... List **$25.00**

Deduct $1.50 for 8 foot Cable Set.

Model 33X Crystal

Same in appearance as 33D, our finest crystal microphone with semi- or non-directional operation. Professional appearance, rugged, satin chrome finish, with crystal impregnated against moisture. Automatic barometric compensation. Tilting 90 degree head permits operator to speak or sing directly into mike without it being in line of vision. Removable 25 foot cable set. High output of -52 on wide range of frequencies. High capacity crystal permits long lines to be run without frequency discriminations and minimizing loss of level. Response 30-10,000 cycles. Larger, heavier unit than 22X with wider response. Complete with 25 foot removable cable set........List **$22.50**

Deduct $1.50 for 8 foot Cable Set.

Model 44X Crystal Selective Directional

Now you can *choose* the sound you want to amplify. Model 44X has 13-15DB differential between front and rear pickup, so microphone can be considered dead at the back. Eliminates audience noise and background disturbances. Reduces feedback and reflections. Allows operation in accoustically bad spots. Ninety-degree adjustable tilting head allows non-directional pickup. Unusually high level -58DB when used with standard 25 foot cable. Lines up to 50 feet may be used with no frequency discrimination and a minimum loss of level. Range, 30-10,000, cycles. Finished in satin chrome, fits any 5/8-27 stand. Moisture-proof crystal, automatic barometric compensation, blast proof, mechanical-shock proof.

Complete with 25 foot changeable cable set.....List **$27.50**

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Double your power with VT-73, built especially for voice transmission. Speech frequencies emphasized by creating a rising curvature of response between 500 and 4,000 cycles. Crisp, clear signals, even through QRM. Combination microphone, handle and stand, weighs 27 ounces. Anti-resonant cable. Climatically sealed. Fully RF shielded. Won't blast from close speaking. High output -50DB. Finished in telephone black and chrome.................List **$18.00**

Model 99 Dynamic

Was chosen as Official Mike at W6USA, California Exposition. The most rugged mike we can offer. Gun-metal finish; professional appearance. Output -54DB. Range 40-9,000 cycles.

50 ohm List.... **$27.50**

200 ohm, 500 ohm, or hi-imp. List.... **$29.50**

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