AMATEUR RADIO DEFENSE

PUBLICATION OFFICES:
Monadnock Building
San Francisco - California

FEBRUARY
1941

25 CENTS
Yearly Subscription $2.50

How COMMUNICATIONS EQUIPMENT *is Made*

How would you like to go behind the scenes on a personally escorted Motion Picture Tour to see how amateur communications equipment is made?

Here is your opportunity to see each step in precision production, from the raw material to the finished receiver with each step photographed from actual work in the factory of the "World's Largest Builders of Amateur Communications Equipment."

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the hallicrafters inc.

CHICAGO, U. S. A.

USED BY 33 GOVERNMENTS

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SOLD IN 89 COUNTRIES

New High Fidelity FM-AM TUNER

MODEL S-31
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NOW you can have FM-AM reception by a turn of the bandswitch with the Model S-31 Hallicrafters commercial FM-AM Tuner. Covering the broadcast (AM) band and the 40-51 mc. high frequency (FM) band. The Tuner combines the FM and AM circuits in one chassis with either instantly available at the turn of the bandswitch.

SPECIFICATIONS—9 tubes—Frequency range, band one; 550 to 1600 kc., band two; 40 to 51 mc.—Power output 130 milliwatts undistorted—Output impedances 500 and 5000 ohms—Power consumption 120 watts—Controls: bandswitch, radiophone switch, main tuning, audio gain, tone control, "S" meter adjustment, phone jack. Operating from 115-125 volts, 60 cycles AC. Panel dimensions 19"x8¾". Dust cover dimensions 17"x8¾"x11⅛". Write for prices.

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The Model S-31, a Hallicrafters amplifier, delivers 25 watts of high fidelity audio power to either speaker or 500 ohm load. Designed for rack mounting and for use as a companion unit to the FM-AM Model S-31 Tuner it will provide reproduction of sparkling depth and brilliance.

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the hallicrafters inc.
CHICAGO, U. S. A.

USED BY 33 GOVERNMENTS . . . SOLD IN 89 COUNTRIES

VOL. 1 ● No. 4

FEBRUARY, 1941

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In the Interests of

Amateur Radio Defense Association

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CONTENTS FOR FEBRUARY

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Chats with the Editors

Our front-cover illustration

. . . When it comes to preparedness activities, Howard W. Johnson of Seattle, W7NU, is right in the thick of things. As president of the Amateur Radio Club of Seattle, it keeps him going to stay ahead of the other live wires up in the Pacific Northwest, and here we see him on Boeing Field with his 2½-meter rig, helping the Army check on flights of the new Boeing flying fortresses. The four-engined flying fortress in the background is just about to take off, while Howard keeps his eye and his ears on one in the air, about to land.

As for the portable equipment—it's a parallel-rod 2½-meter oscillator utilizing an HY-615 tube modulated by a '41, powered by a motor-generator developing 225 volts from a six-volt storage battery. The receiver is a super-regenerative HY-615.

Johnson is an old timer, having started his radio career in 1923 with the call letters 7JJ. Most of his activities these days are on 20-meter fone, using a rotary beam and 350 watts power. He has worked KC4USA at the South Pole consistently with this rig. Johnson is an ex-fleet reserve man, having served as a signal quartermaster during his reserve activities.

* * *

. . . The third commerical station to request permission to broadcast editorial material from the pages of this magazine is KMYC of Marysville, California. Previously, two Eastern stations requested similar permission. The right to reprint or broadcast material other than technical is granted freely to each and all, without reservation. On the Contents page is a notice which reads: "*Technical matter must not be reprinted without permission.*" This statement was not intended to include general editorial material of a non-technical nature, such as the activities of Amateur Radio Defense Association, *The Editor's CQ*, and information released to us by the Federal Communications Commission in Washington. It is gratifying to know that our efforts have already received wide recognition. And, by the way, we have just learned that an Amateur Radio Defense Association is being organized in South Africa!

* * *

. . . We have been asked how a magazine as large as A.R.D. can be published successfully with so few advertisements. The answer is simple—we have received as many as 30 paid subscriptions in a single mail. When additional advertising support is received, more pages will be added.

* * *

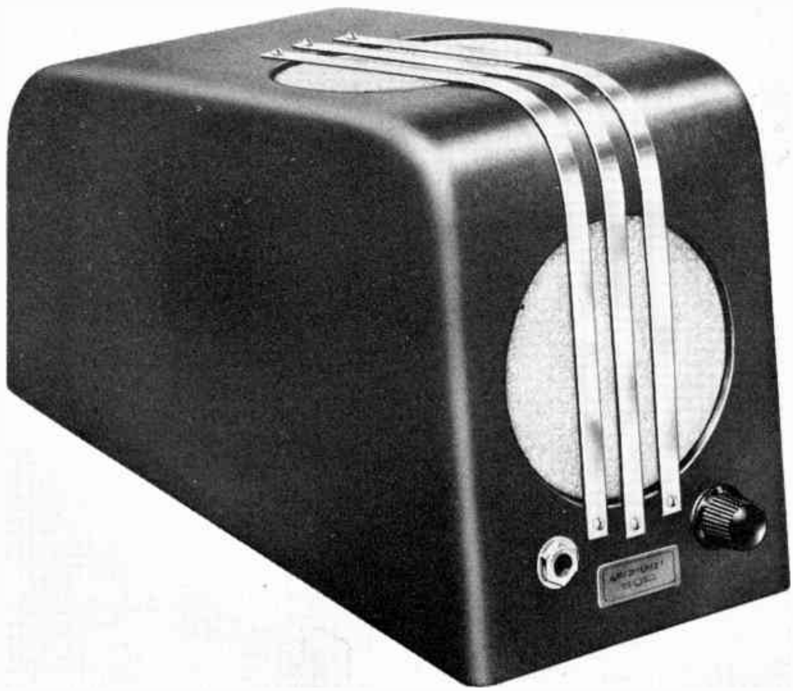
. . . It seems that A.R.D. has two classes of readers—the "haves," and the "have nots." The "haves" have the resources to build a big transmitter, the "have nots" have the shorts. The "haves" want more information on bigger and better transmitters, the "have nots" want more information on how to save every penny possible on good, small transmitters. We will attempt to satisfy both groups, with high power data for the men who cash dividend checks, and medium power data for those who pay for their own juice.

* * *

. . . Something new is being attempted editorially in this issue. It concerns the amateur's antenna. Over and over we are asked: "*What will such-and-such an antenna do on its fundamental frequency, on its harmonics—what happens when it is operated at a frequency lower than its fundamental—what do the radiation patterns look like—can it be top-loaded—will it work as a vertical—what happens when I am forced to cut six feet off the far end because of lack of space—how do I couple the transmitter to the feeders for multi-band operation?*" And still the questions come. We thought these questions are answered in the many good books now on the market. Some are—some are not. If the idea clicks, we will continue each month with a similar discussion of another antenna type—until we have run through the lot. Do you like the idea? If so, drop us a card; if not, we'll drop it like a hot resistor.

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.

Connected in place of a regular speaker, it eliminates the interference without reducing the signal! Tube Hiss is completely gone—QRN, no longer troublesome! QRM is practically obsolete—cuts right through those South American phones!

Can not be used on phone reception—cut over switch on Selector connects standard speaker for phone reproduction. With Selector "ON," you never know the phones are on the air! Peaked at 1000 cycles, all signals come in with the same clear, ringing tone. Absence of back-ground noises makes the weakest signal quite readable.

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 Editorial Contributors

W6QBU Endorses A.R.D.A. With His Membership

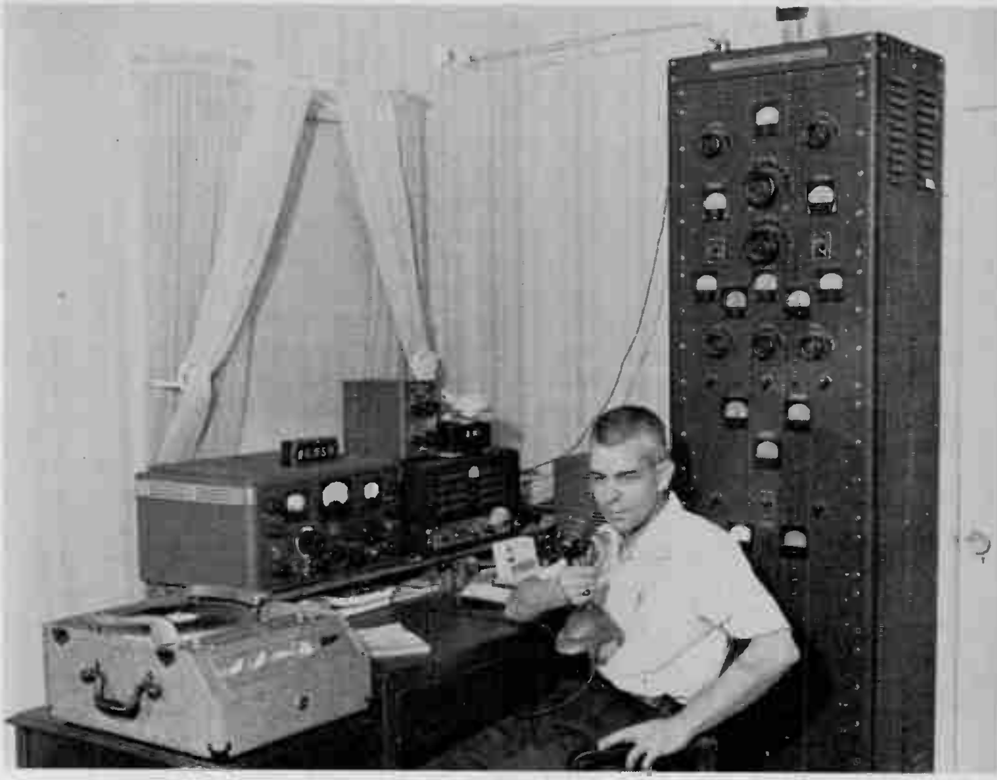
★

NOT many amateurs in the United States have been longer on the air than B. J. Osborne, W6QBU, of Oakland, California. His activities began in 1905, and for 36 years he has been at the key—or at the mike—except for an interval just long enough to penalize him with the loss of his earlier call letters. His handle is "Barney," a familiar one on any of the 'phone or c.w. bands. By profession he is a structural steel engineer, one of the shining lights at the Moore Shipbuilding and Drydock Co., where he is in charge of a major defense undertaking with almost 1,000 men under his supervision. He has a great dislike for haywire, and the neatness of his station arrangement reflects his beliefs. He did not overlook the antenna, nor the tower—and because of this we managed to get an excellent constructional article for the pages of this issue. Barney's tower is one the neighbors discuss—rather than cuss—for it is a commercial-appearing structure, the kind any amateur would be proud to own.

The station at W6QBU is the acme of mechanical skill, and it is regretted that our staff photographer, W6SEM—who is responsible for all of the photographs of Barney and the "QBU" tower—could not find space behind the transmitter rack to shoot a few pictures of one of the best-looking exciters and r-f amplifiers we have yet had the pleasure to see.

The receiver is a National HRO, to the right of which is the indicator for the rotary beam array. Behind this indicator is a loudspeaker, built into the indicator box to conserve table space. To the left of the HRO is the transmitter control box with switches and controls for c.w. and 'phone, etc. The speech amplifier is at the extreme left of the operating desk. The final r-f amplifier has a pair of Eimac 100THs in push-pull. The crystal oscillator is of the Jones harmonic type, with pre-tuned tank units for rapid change of bands. Six Bliley variable-frequency crystals are available for any band of operation.

The facilities of W6QBU, and the many years of commercial and amateur radio experience enjoyed by Barney, have been placed at the disposal of Amateur Radio Defense Association, of which he is one of the charter members. In his long years of amateur activity he has not been a member of any other national organization. He volunteered his equipment and his services to A.R.D.A. because he is a two-fisted American, quick to realize the merit of a defense project so vital as that of our Association.



W6SSN Pledges His Services and Equipment for Defense

★

THE editor's **Forecast of Future Events** in January A.R.D. predicted a technical manuscript on W6SSN's version of an adjustable rotary array in the pages of the issue you now hold in hand. This prediction was made in good faith, but it was not possible for the engineering draftsman to complete the many intricate sketches of the mechanical innovations in time to catch this issue. Instead, we will talk about W6SSN himself—meanwhile asking you to QRX for the next issue, in which his rotary beam will be discussed.

Amateur Radio Defense Association was honored with a membership from W6SSN as quickly as the first announcement of the defense plan was made known to him. The photograph above (another of W6SEM's crack shots) shows the kilowatt transmitter and latest model Hallicrafters receiver, also a recording outfit, control box, pre-amplifier, and frequency meter.

W6SSN's handle is "Milt"—his name Milt Wimsby. He holds a responsible appointment with the municipal authority of Alameda, California—being in charge of electrical facilities for the Board of Education. He is typical of the men who have chosen to affiliate themselves with Amateur Radio Defense Association—better men, better equipment, better defense! It is obvious that a station the likes of his can be tremendously useful to our Government in an emergency. For this reason W6SSN has not permitted his interest in amateur radio to wane. He is a clear-thinking, conscientious engineer, and instead of curtailing his activities he has gone so far as to instruct his wife in amateur radio—to the extent that she is now putting the finishing touches to a 500-watt 'phone-c.w. transmitter of her own.

W6SSN, and W6QEU (facing page) are but two of the great host of highly skilled amateurs who have seen fit to join A.R.D.A. Each month a number of photographs of other member stations will be shown, particularly those in the eastern states. We will prove to our Government, with the aid of these pictures and descriptive comment, that we—as members of Amateur Radio Defense Association—have already been "through the ropes". Our stations are constantly in operating order, ready to take over if and when other communications services fail. There is no substitute for experience, and by this token we can assure those in command of our military forces that we can "sit in" with the best of them when it comes to dots and dashes, or conveying information by 'phone.

Like 95 per cent of our membership, W6SSN has chosen to cast his lot with A.R.D.A. exclusively; he belongs to nothing else in amateur radio. He is not interested in handling traffic, except in the line of national defense—because, like most A.R.D.A. members—traffic is something they were once paid to handle in commercial radio. These men are not interested in titles, traffic totals or tomfoolery. The mere fact that thousands of them had no previous affiliation with any amateur organization, and —above all—the impressive fact that they own some of the best amteur stations in America, is the principal reason why something had to be done to acquaint Uncle Sam with these unknown patriots of amateur radio. Total radio defense will be achieved only after every available facility is brought into the limelight.

Association News

John P. Gruble, W7RT, Appointed A.C.O.

Seventh Area Defense Preparations in Capable Hands

IF THERE'S one thing characteristic of John Gruble, W7RT, it's his enthusiasm for ham radio, which has occupied his almost-undivided attention for eleven solid years. But that isn't all. John was a healthy runner-up in the Seattle councilmanic campaign last year, the youngest candidate on the ticket. He is radio supervisor for the National Youth Administration in the state of Washington, has had two years of pre-law university training at the University of Washington, and in season is a wholesale vegetable dealer. If that doesn't prove he knows his onions in more ways than one, what can?

When *Amateur Radio Defense* looked for an Area Communications Officer for the W7 call area, Gruble ranked highest on the list of available radio amateurs. It happens that the W7 area is by far the largest, and probably the most strategic. Embracing the K7 area—the Territory of Alaska—which is by itself one-fifth the size of the United States, the Number Seven ACO is going to have a big job on his hands. Alaska ham traffic has always been of the *bona fide* variety—

• Here's the operating spot at W7RT. Equipment includes HQ120-X receiver with home-made preselector, and an auxiliary receiver in the SW3 atop the HQ120-X. Transmitter is an 811 final with 150 watts on 40 and 20 c.w. Note two WAC certifs—from two locations, first in Seattle, and next in Goodnews Bay, Alaska, as K7RT.

• From A to Z, John Gruble knows his traffic work, and he has the cards to prove it. Tossed on the floor for photo purposes (Gruble is an expert photographer), this is only the sixth district segment in W7RT's QSL list. Every visible card is a W6 actually contacted—and it seems as if they're all there, from W6AA to W6ZZZ. Gruble holds a 35-w.p.m. code certificate, copies by stick or mill. It was Gruble's idea to hold international field day — in the days before the war—and the idea was copped off by the officials of an amateur "relay" association.

• *Deep in thought, Gruble contemplates his job as ACO in the seventh call area, which is largest of them all (includes Alaska, one-fifth as large as the U. S. proper).*

fewer rubber-stamp messages (almost none, as a matter of fact), and plenty of honest-to-gosh emergency traffic. Gruble will make it his job to swing this kind of thing into a national-defense stance.

Himself an A-1 op, Gruble will insist on quality for his area in the ARD defense set-up. Tentative plans call for a nucleus of good operators and stations to act as (1) state communications officers in each state and Alaska in the W7 and K7 area, (2) local communications officers in any spot where local units will function as small clubs. This personnel will make it its job (3) to secure more capable operators to form more local units and will establish (4) state networks which will dovetail into the national set-up of ARD.

At present Gruble has the state of Washington rolling already, on a weekly network meeting at one p. m. Sundays, on 7156 kc. W7RT uses 150 watts to an 811 final on 40 and 20 c.w., with seven crystal frequencies available on 40 meters. He copies 35 w.p.m. upward, on the stick or the mill. Alaska hams especially are urged to hit this Sunday schedule. It will be familiar work for them, because Gruble spent a nine-month hitch with the Goodnews Bay Mining Co. at Goodnews Bay, Alaska, and was on the air as K7RT during that period. It is not established that Gruble dug any gold nuggets during his Alaska sojourn; but that isn't astonishing, considering it was a platinum mine. Perhaps he has better contacts as a result, however.

Results so far in Gruble's ACO activity: W7EK, Everett Kick in Everett, Washington, is taking a keen interest—another of the old timers who see in ARD something ham radio has needed for a long time. Kick has lined up W7GYO and W7EGE of Everett, and is lining up a nearby ham with a sound truck which delivers plenty of a.c. power for emergency ARD work. W7EOR of Everett is on the ARD list, as are W7HZG of Pomeroy and W7HJZ of Ferndale, Washington. Many others are being contacted weekly.

Gruble has hardly opened his organizing campaign, what with the Christmas season coming on at the time of his appointment. A past president of the Amateur Radio Club of Seattle, Gruble will speak before its meetings each month—first Friday—at the Gowman Hotel. Opening gun was fired at the first 1941 meeting—January 3. Any and all radio amateurs in the seventh call area are urged to get in touch with Gruble at once, as much organizational work must be done, state and local communications officers to be appointed, etc.

The W7 and the K7 area is out to show the rest of the country what preparedness means!

★

. . . **Ted Eugene Pauter, W6NYR,** is serving as temporary Local Communications Officer for A.R.D.A. in the Santa Clara Valley region. He is anxious to contact as many amateurs as possible in order to complete the chain of stations required on all the amateur bands, in accordance with the plans of our defense program. Ted is 32 years of age, not subject to the provisions of the Selective Service Act, and therefore free to devote much of his time to this all-important work. He is no stranger among amateurs in his vicinity, and therefore requires no introduction. He operates all bands, phone and c.w. Served 6 years in the U. S. Navy. Has only 20 watts on the air, but his location is so exceptionally good that he "booms in" like a higher-power station. Portable equipment for field service is now under construction and Ted will soon be ready to go "all-out" for Amateur Radio Defense Association. He has an SX-24 receiver, and he's roaming the dial now, looking for more A.R.D.A. members. His home address is 914 North 14th Street, San Jose, California. Write him—if you don't connect with him on the amateur bands.

* * *

. . . The San Francisco "Examiner" on Sunday, January 19, broke with a splendid photograph and much information on our A.R.D.A., right in the main news section on Page 3. In glowing terms, the article paid tribute to the activities of our membership. More than a half-million people in Northern California have thereby been informed of our purpose.

NEWS from WASHINGTON

New Assistant to Chairman

THE Federal Communications Commission announced the appointment of Robert G. Seaks of Harrisburg, Pa., as Assistant to the Chairman, James Lawrence Fly.

From 1934 until the present time Mr. Seaks was a member of the legal staff of the Tennessee Valley Authority, except for a period in 1931, and 1937 when he did graduate work at Yale Law School.

Mr. Seaks was graduate from Gettysburg College in 1931, after being elected to Phi Bet Kappa. Three years later he was first man in the graduating class at Duke Law School. He was admitted to the bar in Tennessee.

Mr. Seaks assumes his new duties, filling the vacancy caused by appointment of Nathan H. David to the Commission's legal staff.

* * *

Highlights in Communications Field Reviewed in Annual Report

IN AN annual report which incorporates important developments since the close of the fiscal year, the Federal Communications Commission chronicles new milestones in the advancement of broadcasting, and cites augmented duties in supervising radio, telephone, telegraph, and cable in connection with the national defense program.

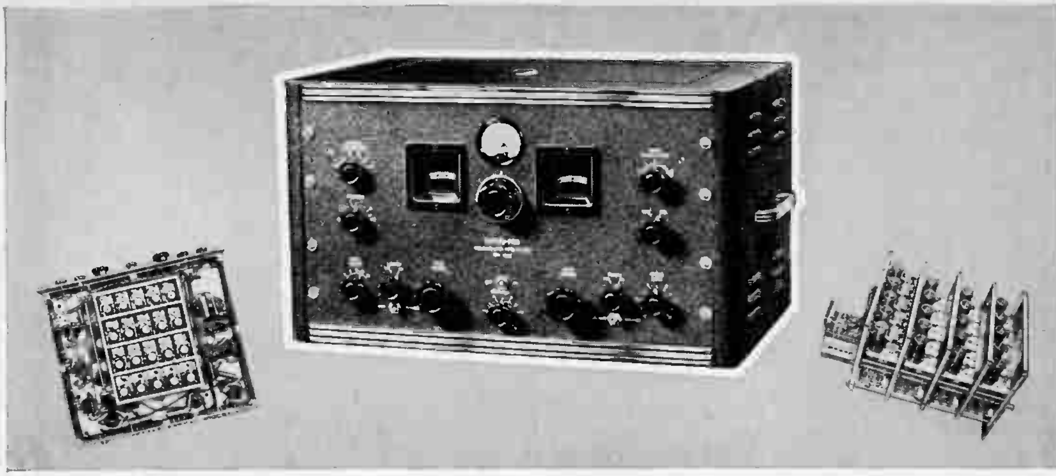
This streamlined report is almost half the size of the one last year. To summarize some of its highlights:

NATIONAL DEFENSE — The Commission's particular role in the preparedness program is to "police" radio communications. In consequence, it has added to its monitoring and other field facilities. Also, it must keep tab on on the many persons who operate electrical apparatus capable of farflung and almost instantaneous communication. So it is requiring all radio operators (about 100,000 licensees—including commercial and amateur) to prove their citizenship. Common carriers are compiling similar data with respect to employees who engage in international communication. The Commission has banned amateur communication with foreign countries, and, further, prohibits the use of portable long-distance transmitters by amateurs. Such steps are precautionary rather than disciplinary. The Commission does not want to interfere with radio and wire communications any more than is necessary for the national protection. Individuals and industries concerned are collaborating in this common contribtuion toward the national security. The relationship of radio, wire, and cable facilities to the preparedness picture is being further coordinated in planning by the Defense Communications Board, created by Executive order in September.

BROADCASTING (FM)—Last year, which marked the 20th anniversary of broadcasting, was notable because of Commission recognition of a new type of public service in frequency modulation, popularly known as "FM." The ensuing year will offer practical demonstration of FM's claimed clarity and staticless qualities. Also, by utilizing the high frequencies, FM promises to relieve the long congested standard broadcast band. Business will benefit by the new equipment, sets, and servicing which FM requires. And, by being generally limited to local coverage, this new service should have a stimulating effect on local programming. Distinctive call letters have been assigned. To date the Commission has authorized 25 FM stations to engage in full commercial operation.

BROADCASTING Standard) — This older type of broadcast (which uses amplitude modulation) should experience a marked improvement in service by reason of the North American Regional Broadcasting Agreement, effective March 29th next. Mutual interference problems are expected to be eliminated or minimized as a result of this compact between Canada, Cuba, Mexico, and the United States. To make agreement possible, the Commission is effecting an orderly shift of frequencies without disturbing the general broadcast structure. A total of 846 standard broadcast stations were operating or under construction during the fiscal year. There were 79 new authorizations and 19 re-allocations. Increased use of directional antennas is necessary in coping with the interference

(Continued on Page 67)



Equal to any EMERGENCY!

IN Alaska, Antarctic, Far East, everywhere, you will find "Super-Pro" receivers. Many provide the sole means of communication with the outside world. The sound design of the "Super-Pro" and its record of dependable performance is your guarantee of satisfaction. Engineers who choose receivers for such service just can't be wrong. Their choice of a "Super-Pro" is acknowledgment of its superiority. Take a tip from the experts and make your next receiver a "Super-Pro". It is economical too. You don't have to trade every year when you own a "Super-Pro".

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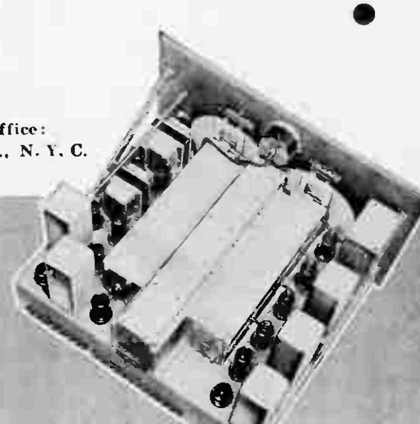


HAMMARLUND

From the Mailbag of the F. C. C.

"CAN the wavelength in a radio wave be changed after it has been broadcast?" and "Can a wave be superimposed on a long carrier wave?" are questions from a Washington State resident. The answer is of the "yes" and "no" variety depending upon the medium through which the wave or waves travel. In other words, radio waves may be modulated or imposed one upon the other within the path between transmitter and receiver, but only under abnormal conditions. The Commission explains:

"The frequency or wavelength of an electromagnetic wave does not change when the wave travels through air, through a copper wire or through any medium which has linear transmission characteristics. The amplitude of the wave and the phase are altered but the wavelength remains constant. If a square law detector or a vacuum tube is included in a wire circuit, however, the output wave becomes a function of the square of the input wave and the frequency of the wave is doubled.

"Two carrier waves of different frequency, each modulated and carrying different signals, may be transmitted on the same pair of wires and they will not interfere with each other in any way. At the output of the circuit both carrier frequencies and both signal frequencies will be the same as they were at the input and no additional waves or other frequencies which were not in the original waves will have appeared.

"Again, if a device with non-linear transmission characteristics, such as a square law detector, is inserted in the circuit, the situation is altered. The output wave is now the square of the sum of the two input waves and many additional waves of different frequency are produced. Among them will be the harmonics of the carriers, the beat note between the carriers and a large number of the modulation products of the signals—not only those which were present in the original signals but others which were not, such as the sums and differences of the modulation frequencies, etc. With this phenomenon you are undoubtedly familiar from your experience with broadcast reception and your knowledge of radio receivers. The same principles apply in the case of radio waves of different frequency radiated to a receiver from two broadcast stations at different locations. Each wave reaches the receiver unaffected by the other unless there is some region of space through which both signals have passed which has non-linear transmission characteristics. While the conditions for such are not normal ones they do sometimes occur. Two examples will be given. The signals of one broadcast station may modulate the signals of another when under certain conditions—which are again unusual—both pass through portions of the ionosphere having non-linear transmission characteristics. A certain type of cross-talk interference is observed in broadcast reception caused by rectification of broadcast signals in the house wiring systems. This may occur when the wiring leads are loose or in some cases broken. The signals of other broadcast stations beyond the tuning range of the receiver when rectified in these leads may have components within the tuning range of the receiver, thus capable of causing interference."

* * *

A CALIFORNIAN asked the Federal Communications Commission to do something about interference to his radio reception caused by a flasher used by a neighbor on his Christmas lights. The Commission advised that under the law it has no authority itself to interfere in such local matters, but suggested that a number of states and municipalities do have ordinances intended to curb radio interference of this type.

The Editor's CQ

Why Another Association ?

SOME who have not carefully read the first three issues of this magazine are asking "why another radio association?", meaning the Amateur Radio Defense Association, when any of the pre-existing associations can be employed to accomplish the ARDA objectives. The answer was implied, though perhaps not explicitly, in what has been previously published in these pages: ARDA members do not belong to these other associations. To insist upon their belonging would be like sending college graduates to primary school. They can work to better advantage in an association made up of their own kind, unhampered by the slow progress of beginners.

For ARDA consists of veteran brass-pounders whose code-sending is too fast for the average amateur radio operator to copy. Their equipment is the finest that experience can build and that money can buy. They are not "high-hat," for an amateur is always an amateur at heart and ever-willing to help the less-informed, but they prefer to associate and communicate with those who are equally well-qualified. They are not rookies who need to be trained in the technique of handling emergency traffic, but constitute a reserve army of competent radio defenders.

As most of them had served in the first World War, they were quick to recognize the dangers due to aggression in this second World War, whose first battles in which U. S. forces may participate may be fought before many recruits can be trained. As they are already prepared to operate their existing communication facilities until such time as new operators can be trained and new facilities can be provided to meet the emergency, they decided that they could serve most effectively through the agency of a new association. So they organized ARDA as a new, non-competitive association.

ARDA is not designed to compete with the pre-existing associations in the radio realm any more than was the Kiwanis Club designed to compete with the Rotary Club in the business and professional world. Such organizations should be considered not as rivals contesting for selfish ends, but as emulators who seek to excell in attaining parallel objectives. The objectives may overlap, as may also the means for attaining them, but so long as no ulterior or selfish motive is involved there can be no valid accusation of competition. When others adopt the objectives or methods of an originator, he is entitled to pride in this recognition of his wisdom and foresight in undertaking a task which calls for the cooperation and coordination of all those who best can work and best agree.

Consequently, ARDA welcomes the news that another radio association has seen fit to adopt the ARDA plan of enrolling men qualified to act as radio defenders. "Imitation is the sincerest form of flattery." Whilst the plagiarism, the use of an idea without giving credit to the originator, is to be regretted, ARDA claims no patent on a plan which so adequately meets the common need in these perilous times. It is sincerely to be hoped that some of these new enrollees from a less competent group of men will measure up to the high standard of ARDA membership, and thus also be available for immediate service in the emergency.

Our great National need is now for unity of purpose and effort in defense preparation against possible aggression. No petty feeling of envy or jealousy, no yapping by small-minded men, should be allowed to interfere with the work of big-minded men. The first step toward such unity depends upon a spirit of tolerance. The big minds, who plan the defense, must tolerate the little minds, who help to execute the plan. Likewise, the little minds must tolerate the big minds. Tolerance has been well said to be "the only real test of a civilization."

So, having explained the reason for its existence, and having justified that existence by providing a plan that is acceptable to others, does it seem too much to ask that ARDA be at least tolerated until it can also put its plan into execution? "Live and let live," even if you cannot live and help live, still seems to be a good motto for all men.

Plate Circuit Considerations For R-F Amplifiers

Entirely new and original data, from the author's laboratory, showing how the grid circuit drive for a modulated amplifier can be reduced considerably—and without sacrifice in R.F. power output and linearity. Many other plate circuit problems are also treated in this informative discussion.

By Frank C. Jones, Technical Editor

All illustrations in this article were supplied through the courtesy of Eitel-McCullough, Inc.

A CLASS-C amplifier can be operated under normal load conditions in accordance with the tube manufacturers' ratings and a certain power output and efficiency can be expected. In many practical cases it is desirable to operate the amplifier under other conditions of load, or grid circuit drive, yet very little information has been published as to how this can be accomplished effectively.

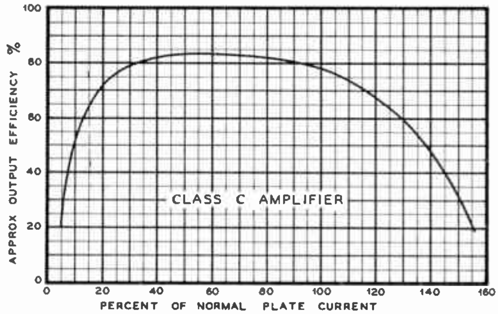


Fig. 1

In the curve of Fig. 1, the approximate output efficiency is plotted for various percentages of normal plate current. This curve can be applied to nearly any triode in either single-ended or push-pull amplifiers. At 100 per cent of normal plate current the output efficiency is approximately 79 per cent. In practice, this value may be somewhat higher or lower, in which event the entire curve will be shifted upward or downward. It can be seen from the curve that the output efficiency increases somewhat as the plate current is reduced, by lowering the amount of antenna load. Below a certain point the output efficiency drops rapidly, and above normal load the output efficiency also drops quite rapidly. The output efficiency is the ratio of output power to input power in the plate circuit. Sometimes the plate dissipation rating of the tube is a limiting factor as regards the desirable operating efficiency, but in most cases the plate current rating is the limiting factor. Many amateurs and engineers operate their class-C amplifier tubes with from 60 to 80 per cent of the normal value of plate current. Since the plate circuit efficiency is very high at this value of plate current, the plate dissipation is very low—and even tantalum-plate tubes may show very little color.

Plate-modulated class-C amplifiers can be operated with less than normal d.c. grid current ratings, if the antenna load and d.c. plate current values are likewise reduced. The curve in Fig. 2 may be applied to plate-modulated triode tubes with amplification constants of from 10 to 20. At normal d.c. grid currents the amplifer can be operated at normal plate current, as shown by the 100 per cent values on the curve.

If it is desired to run the plate current above normal, it will then be necessary to increase the grid current above normal in order to maintain the amplifier in a condition suitable for good linearity of modulation. If the amplifier lacks sufficient grid drive to reach the 100 per cent values of grid current, which would be those listed by the tube manufacturers, it is still possible to obtain excellent plate modulation linearity by reducing the plate current, as shown in Fig. 2. It is necessary, of course, to maintain the grid-bias voltage at a value of twice cut-off.

The curve in Fig. 3 can be applied to high-mu triodes in order to determine the permissible value of plate current for any value of d.c. grid current. The curves in Figs. 2 and 3 are particularly useful at very high frequencies, where it is often difficult to secure enough grid drive from moderate-

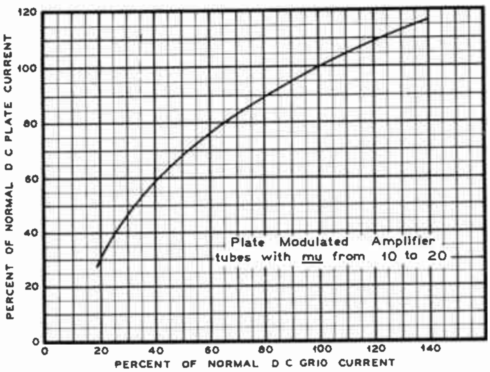


Fig. 2

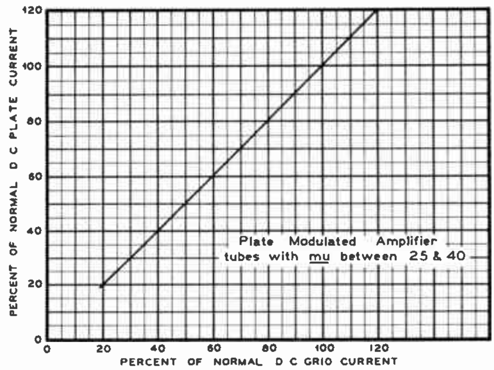


Fig. 3

sized driver stages. A high-mu tube requires a greater reduction in plate current for a decrease in d.c. grid current, as compared to medium- or low-mu tubes. These two curves are subject to some modification, since the grid current ratings as given by different manufacturers for a given type of tube may be subject to slight variation. In general, the curves can be applied to nearly any type of tantalum- or carbon-plate tube.

High-mu tubes in plate-modulated r-f amplifiers often show a small downward kick of d.c. plate current during normal voice modulation periods. When the performance of these amplifiers is viewed on an oscilloscope there is an undesirable amount of non-linearity, which is very difficult to correct. One method is to increase the d.c. grid current to very high values, sometimes as much as 200 per cent of the normal grid current rating of the tube, or tubes. This applies particularly to some high-mu tubes operating with relatively low plate voltages. It was found in the laboratory that the linearity could be improved greatly, so as to give a practically perfect oscilloscopic pattern, by

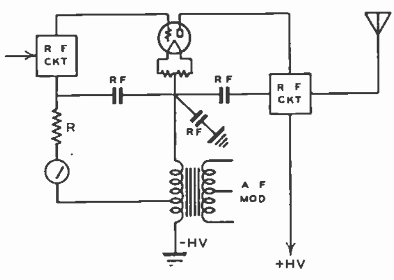


Fig. 4

feeding a small amount of a-f voltage from the plate-modulated circuit back into the grid circuit. This resulted in better performance than the application of some plate modulation to the grid driving stage, as has been recommended in the past. The circuit of a cathode-modulated amplifier, Fig. 4, becomes a plate-modulated amplifier when the grid-leak return circuit connects to the filament side of the modulation transformer winding. In this case the audio-frequency power input for 100 per cent modulation must be 50 per cent of the d.c. input to the plate circuit. If between 100 and 200 volts of audio power is applied to the grid circuit, by tapping the grid near the filament end of the transformer winding, this amplifier can be made to give practically perfect modulation with any type of high-mu tube. This circuit requires a connection of the audio power into the negative high voltage lead, instead of into the positive high voltage lead, which is usual practice. The circuit is similar to a cathode-modulated stage, the only difference being in the amount of radio power used, and also the amount of r-f grid drive. The r-f grid drive and modulating power are the same as those recommended for normal plate modulation.

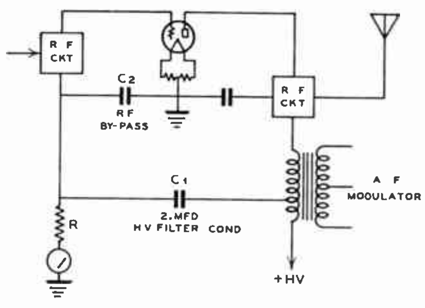


Fig. 5

In the more usual form of plate modulation, the modulation transformer winding is connected in series with the positive high-voltage lead, as shown in Fig. 5. A small amount of audio voltage can be easily applied to the grid circuit by connecting a condenser C_1 (Fig. 5) from the grid end of the grid-leak R to the modulation transformer winding at a point near the $+B$ terminal. This condenser C_1 must withstand the total plate voltage and d.c. grid-bias voltage, and should therefore be of the type similar to that used in the high-voltage filter circuit.

If an oscilloscope is available, the grid tap on the modulation transformer can be found readily. If insufficient taps are available, it is possible to connect a slider-type wire-wound resistor in series with condenser C_1 in order to provide a variable adjustment for finding the best value for good linearity of modulation. With the circuits in Figs. 4 and 5, it is desirable to run the d.c. grid-bias voltage at from 3 to 5 times cut-off, and the d.c. grid current at any value of from 75 to 100 per cent of the normal rating of the r-f tube, or tubes. Some manufacturers recommend operation of high-mu tubes with from 7 to 9 times cut-off for plate modulation, and it is therefore a simple matter to run this value to 5 times cut-off. With the circuit in Fig. 5 the audio modulating power is approximately the same as for ordinary plate modulation; however, the grid circuit drive can be reduced to a value approximately ¼th to ½ as much as would otherwise be needed for equivalent linearity without the grid feed-back condenser C_1. This type of operation is conducive to longer tube life, since operation with excessive d.c. grid current may greatly shorten the useful life of the tube, or cause tube failure.

The circuits in Figs. 4 and 5 can be applied to any single, parallel, or push-pull amplifier. The r-f circuits are shown in block form.

These circuits were applied to a typical r-f amplifier with a pair of Eimac 35T triodes, resulting in much lower grid drive, and the oscilloscopic pattern was practically perfect up to 100 per cent modulation with no sacrifice in r-f output. This original data is the result of a series of tests made by the author for the Eitel-McCullough Co. for the newer Eimac tube data sheets.

General Discussion of Plate Circuits

SOME amateurs operate their tantalum-plate tubes with the plate running white hot; others are satisfied with a more conservative color. The question often arises as to how a tube should actually be operated. The desirability to run the plate dissipation above normal or below normal is another common problem. The plate dissipation rating is established by the manufacturer as an average value which will produce a reasonable value of tube life expressed in hours of continuous or intermittent operation. It is perfectly safe to operate some types of tubes at above-normal plate dissipation with very little decrease in expected life, if the amplifier is one which has normal filament and grid circuit power and is free from parasitic oscillation of any kind. Some types of carbon-plate tubes can not be operated safely at above-normal plate dissipation, since there is danger of gas being driven out of the carbon anode, which in turn may cause failure of the tube. The limiting factor of power input is often not the plate dissipation, but rather the value of peak plate current. The peak plate current in an r-f amplifier is several times as high as the d.c. plate current indicated by the plate circuit meter. In a plate-modulated r-f amplifier this peak plate current is much greater than in a c.w. amplifier, and a plate-modulated amplifier is usually operated with slightly less d.c. plate current than an amplifier used for c.w.

A class-C amplifier with very high grid drive, and operating at high plate circuit efficiency, may be running at considerably below normal plate dissipation and yet have the peak plate current value up near the limit of the emission characteristics of the filament. An r-f amplifier operating under these conditions of very low angle of plate current flow has very high peak current during the short period of each plate current pulse which drives the tuned plate circuit of the amplifier. If the filament is carefully processed, and has ample emission characteristics, it is possible to operate the tube with very high peak plate current without endangering the tube. Such tubes can be used in a plate-modulated amplifier with d.c. plate current ratings the same as in a c.w. amplifier, if the circuit can be adjusted for good linearity of modulation. Operation of any tube with a too-high value of peak plate current and d.c. plate current may shorten the expected life of the tube, in which case it becomes a problem of economics. Sometimes it is more economical to operate small tubes with high input and relatively short tube life, rather than to employ larger tubes operating at normal or below normal ratings for longer life.

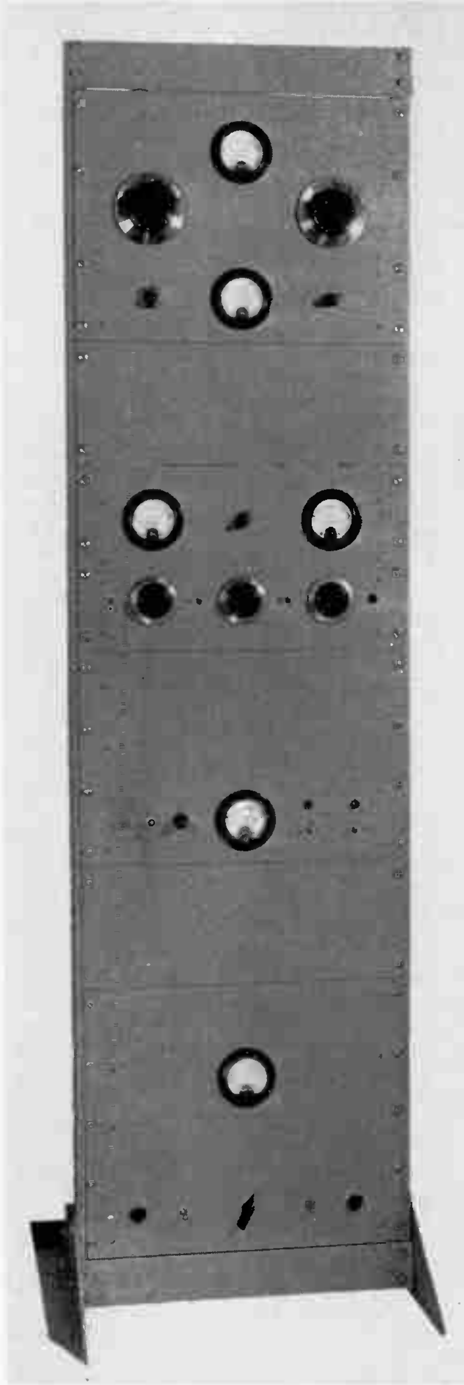
Nearly all modern transmitter tubes designed for operation at from 1,500 to 2,000 volts plate supply can be operated at any desired value of plate voltage without danger of tube failure.

Medium Power Cathode---or Plate-Modulated 'Phone---C. W. Transmitter with HK-254 R-F Amplifier

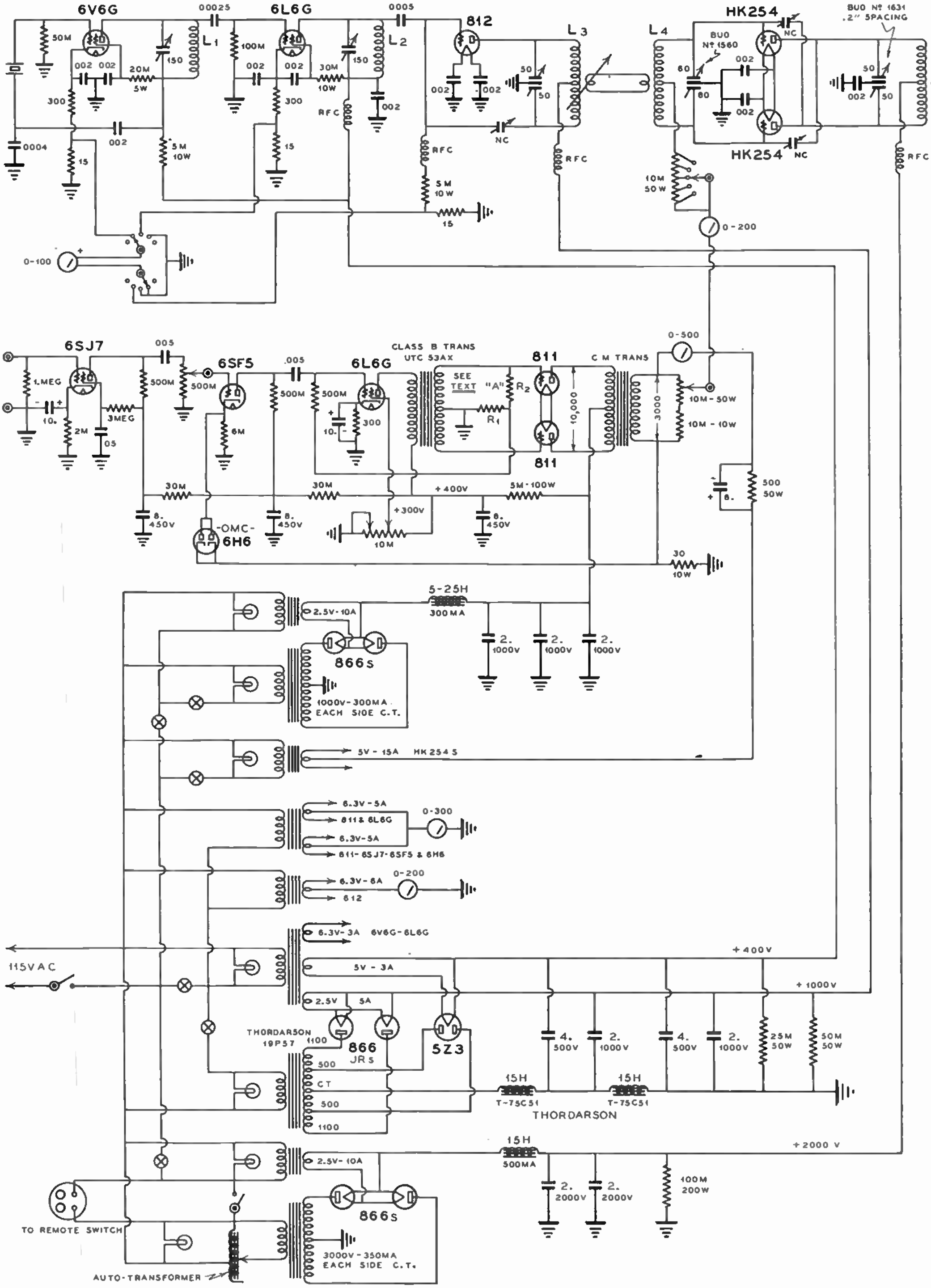
By F. D. Wells, W6QUC

THE technical staff of *A.R.D.* has been assigned the task of presenting, each month, a correctly engineered transmitter for amateur service. The series begins with a description of the transmitter now in operation at my home station, W6QUC. In the laboratory we have almost a dozen other transmitters, ranging from 500 to 1000 watts, and one will be described each month, by some member of the staff. The first transmitter under discussion has an input of 600 watts. The large schematic diagram shows all of the components, including power supply equipment. Values of all parts are plainly listed, and the trade-name of the manufacturer is given in cases where substitution of parts is not allowable, by reason of mechanical design.

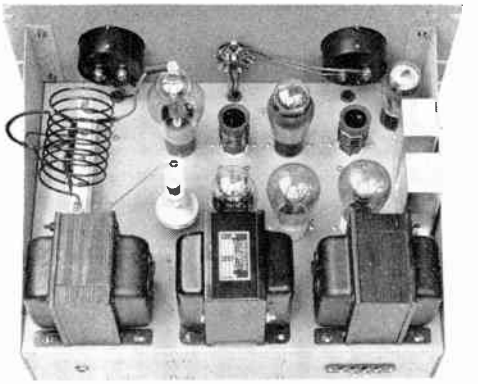
The r-f portion begins with a 6V6G harmonic oscillator and a 40- or 80-meter crystal, because the output from the final amplifier is on 10 meters. The oscillator drives a buffer stage with a 6L6G, and this stage can also be used as a doubler. The next buffer stage has an RCA-812, neutralized in the conventional manner. All stages are capacitively-coupled. The output of the 812 is approximately 90 watts on 10 meters, with 1,000 volts on the plate. The 6L6G has 400 volts, and the same power source, with a dropping resistor, supplies the 6V6G crystal

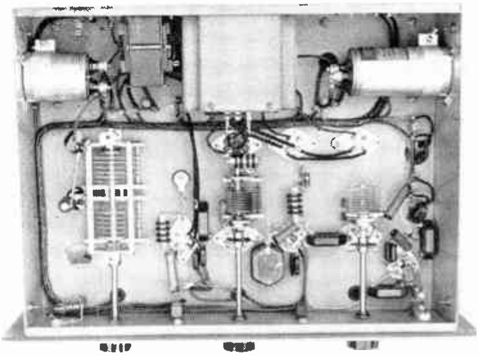


Semi-High Power, High Frequency 'Phone-C.W. Transmitter with HK-254 Gammatron Push-Pull Final Amplifier

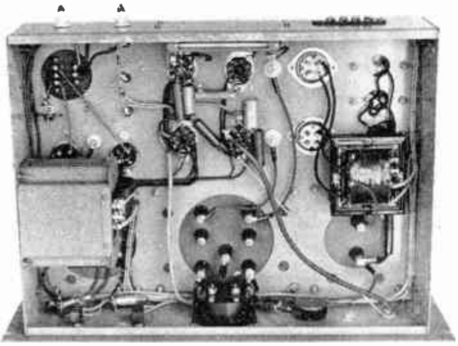


Complete HK-254 Transmitter Circuit, Including Power Supplies.





Top and bottom views of exciter, showing Thordarson dual-voltage power transformer and dual rectifier components. This deck is a complete c.w. transmitter, power supply and all.

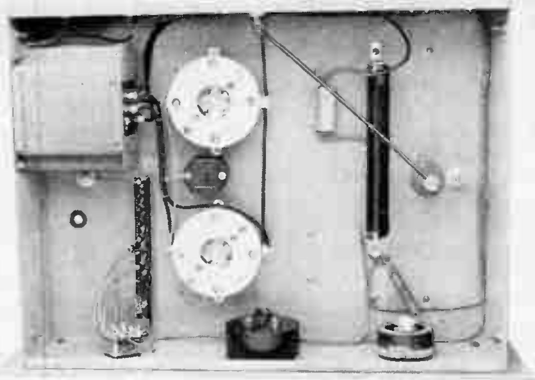


The modulator and speech amplifier, complete from microphone input to modulation transformer, and also including the power supply. UTC components used on this deck.

oscillator with approximately 300 volts for the plate. The 6V6G is an excellent harmonic oscillator, in that the crystal current is exceptionally low—so low that it will not light a 60-ma. lamp. Substituting a 6L6G for the 6V6G resulted in crystal current of approximately 40-ma.

The power supply for the exciter is arranged along the rear of the deck, making this combination a complete c.w. transmitter in itself. The plate supply transformer is the Thordarson 10P57, with tapped secondary, so that both 400 and 1,000 volts can be made available by using a pair of 866-Jr. rectifier tubes for the high voltage supply and a 5Z3 for the low voltage. Filtering is in the negative lead and consequently only one pair of filter chokes is required for both the high and low voltages. Separate filter condensers must, howver, be utilized.

The final amplifier is strictly conventional. It has a pair of HK-254 Gammatron triodes in a straightforward neutralized circuit. The filament transformer for the Gammatrons is mounted on this chassis to prevent voltage drop which would otherwise result from long leads. To permit optimum adjustment for cathode modulation, a tapped grid resistor is used in conjunction with an 11-point switch so that the grid bias can be varied at will. A potentiometer is mounted on the front panel and connected across the modulation transformer in such a manner that the amount of audio power fed to the grids of the 254s can be adjusted easily. With approximately 40-ma. grid drive, it is possible to run almost 600 wats input without exceeding the plate dissipation of the final r-f amplifier tubes. If plate mondulation is desired, the input to the final amplifier must



Two views of the final r-f amplifier deck, top and bottom of chasis. The grid circuit is shielded from the plate circuit by means of a large aluminum baffle.

obviously be reduced in order to secure adequate modulation. Both types of modulation were used, and both gave excellent results. The nominal output from a pair of RCA-811s is 100 watts when the plate potential is 800 volts, and this output is ample for cathode-modulating a pair of HK-254 Gammatrons with an input approximating 600 watts. However, by working the 811s into a low plate impedance, and driving them hard, sufficient audio output can be obtained to plate-modulate the final amplifier with inputs ranging from 400 to 500 watts. It would be better, of course, to increase the plate voltage on the 811s, but the 800-volt power supply was chosen for this transmitter because it was designed originally for cathode modulation. Futhermore, this small power supply conserves much space, and numerous parts; it has proven highly satisfactory during many months of service.

The modulator is complete from microphone to modulation transformer on one deck, which also includes the power supply. One power supply delivers all of the voltages required. A voltage divider, consisting of two resistors, drops the 800-volt output to 400 volts for the plate of the 6L6G. From this same divider, voltage is likewise obtained for the screen of the 6L6G, and also for the pre-amplifier stages. The speech line-up is a 6SJ7, 6SF5, 6L6G, push-pull 811s. Ample inverse feed-back is introduced into the 6L6G to lower the plate resistance, so that it becomes a good class-B driver. Provision is also made for AMC.

The high voltage plate supply is equipped with an auto-transformer, a tremendous convenience in tuning-up the final r-f amplifier, not to mention the safety features. A single-section filter with heavy-duty choke and one 4-mfd. high-voltage filter condenser proved adequate for the final. A 0-150-volt a.c. meter on the front panel provides constant monitoring of the power source.

The complete transmitter has four decks: the modulator, the exciter, the final r-f amplifier, and the final power supply. The panel attached to the exciter deck has two meters, one of which reads cathode current of the 812, the other—by means of a switch—reads plate current for the 6V6G and 6L6G, or grid current for the 812. There are two meters on the final r-f amplifier panel, one reads grid current, the other plate current.

Although originally designed for 10- and 20-meters, this transmitter has been successfully operated on 75 by shunting a fixed air condenser across the final tank circuit. The relay-rack, chasses and panels are in gray crackle.

Editor's Note: The next issue will contain a complete technical description of a high-power plate-modulated transmitter with new Raytheon screen-grid tube. The transmitter employes coil-switching for quick band change, and includes a host of mechanical features. It is designed so that the exciter stage, a completely-contained unit with power supply, can be operated as a medium-power c.w. transmitter, if desired.

* * *

. . . Regretfully we reply to many correspondents that the supply of back copies of this magazine is completely exhausted. More embarrassing is the fact that all subscriptions received after January 10th had to begin with the February issue, because the January number sold out in a few days. We have boosted our print order to take care of the increased demand.

B. J. Osborne, W6QBU (right), explains the mathematics of tower design to C. C. Anderson, W6FFP, who is jotting down notes for the engineering draftings which accompany the text.

Correct Design For Antenna Towers

Designed by a structural steel expert, who is also a prominent radio amateur, the antenna tower treated in this text is unquestionably one of the safest and least expensive of any yet brought to our attention. Lumber for a 72-ft. tower costs $17.00.

By B. J. Osborne, W6QBU

ONE of the greatest obstacles confronting the average amateur is the correct mathematical design of an antenna tower, neat in appearance rather than an eye-sore to the neighbors, and at the same time capable of withstanding the fury of the weather. Steel towers are expensive and difficult to build. A properly designed wooden tower can be made self-supporting, even if it has considerable height, and if its prime purpose is to support the rotatable elements of a beam array. When used for supporting one end of a horizontal antenna, it is good practice to guy a tower, even if it is only 30 feet above the ground or roof of a building. The lever-arm ratio of the height of the tower to its width at its base is a definite function which must be given careful consideration. For example, if a tower is 100 feet high and has a 10-foot base, the ratio is 10-to-1; a 50-lb. pull at the top will then exert a pull of 500-lbs. at the base. Often a single guy-wire can be attached to the top of the tower in the opposite direction to the "pull". This guy-wire is only required to withstand the strain exerted at the top of the tower by the pull of the antenna, in order to cancel the lever-arm effect.

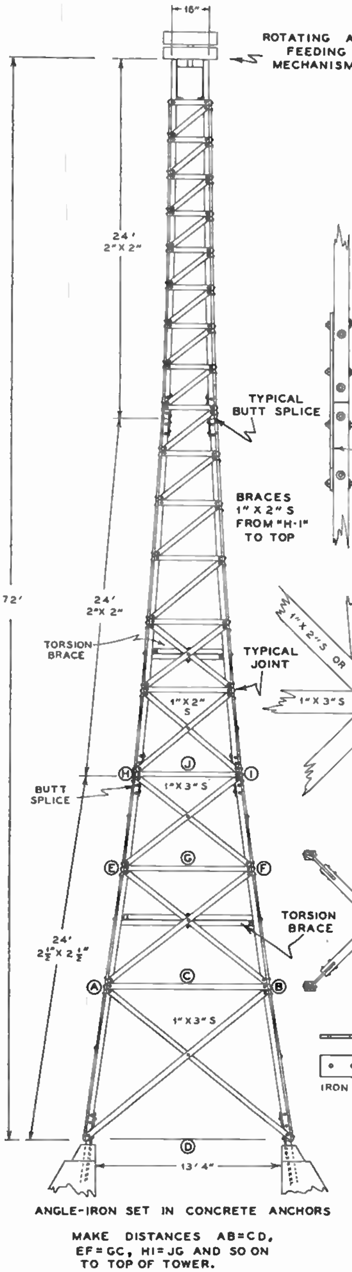


FIG. 1

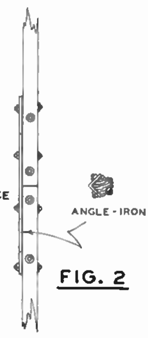


FIG. 2

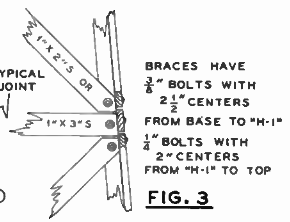


FIG. 3

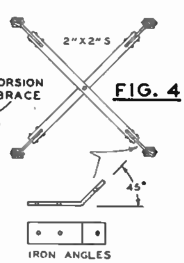


FIG. 4

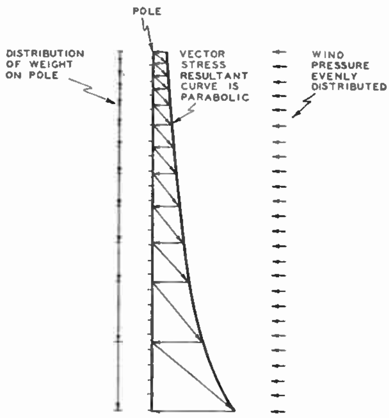


FIG. 5

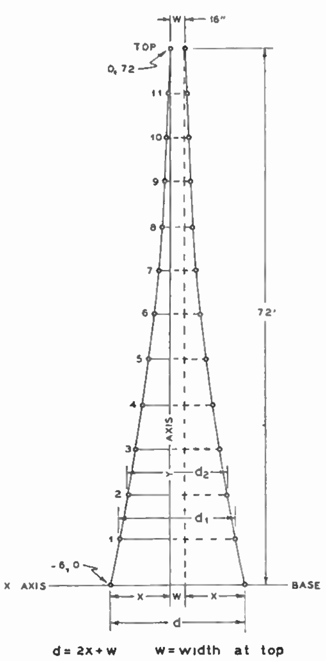
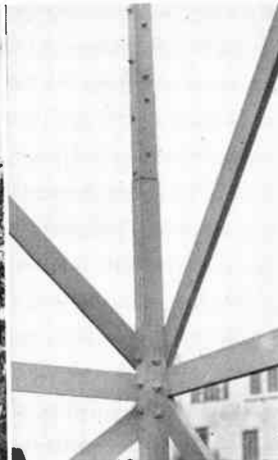


FIG. 6

Mechanical draftings showing all details of assembly for 72-ft. tower.

W6QBU's tower, complete except for rotary beam mechanism. Note ladder on right side.



Close-up of butt-joint taken from inside of tower and showing how the 2½-in. section joins the 2-in. member.

C. C. Anderson, our Engineering Draftsman, gets the tower information at the source.

On the other hand, a tower designed for the purpose of supporting a rotary beam array, or a horizontal antenna of moderate length, must primarily withstand only a definite wind pressure, and no guy wires are therefore required. Such a tower is described in this text. It is 72-ft. high, built of wood, and designed to withstand a 60-mph gale, which is equal in wind pressure to 15-lbs. per sq. ft., and the tower is sturdy enough to withstand in excess of 500-lbs. at its top. Four men were engaged in the assembly of the tower, "walking up" with the construction as it progressed.

The cost of a 72-ft. tower, excluding bolts, nuts, angle-irons, concrete base and paint, is approximately $17.00. This low cost for the wooden members is made possible by carefully planning the "lumber list" in advance, so that small sections can be ripped from larger pieces, as detailed later.

Design Considerations

ONE of the fundamental principles of architectural design is that the finished product must be pleasing to the eye; for this reason, curves are used extensively. Take a straight piece of wood or a thin strip of metal, for example—apply pressure to its center, and see how easy it is to distort the original straight-line plane. Then take the same member and forcibly bend it in the middle, holding tightly to the respective ends—and note that the rigidity has been markedly improved. A tall, vertical stick or pole—running straight up and down—is flexible, and unless it has a relatively large diameter at its base, and at the top, like that of a telephone pole, the vertical "stick" will sway and vibrate in the wind. However, a number of vertical "sticks", spaced widely at the bottom and converging at the top, and braced with a number of cross-members, can be made to have sufficient stability for all amateur radio requirements.

It has been generally accepted in engineering practice that the base of a tower should be from 15 to 20 per cent of its height. Consequently, a tower 72-ft. high would have a base measurement of from 10- to 15-ft., if the accepted practice is adopted. By the same token, a tower 36-ft. high, and one which the majority of amateurs would desire to build, should measure from 5-to-7.5-ft. at the base.

Because a curved structure is more pleasing to the eye, and also because if maximum stresses were applied to a curved structure and then a straight-sided one, the curved design will be found to withstand a greater stress. Furthermore, because a weight supported by a vertical member has forces bearing down upon it by reason of gravity, similar to the potential energy of a free falling body above the earth's surface, it is evident that a curve equal to this force would constitute the correct design to oppose this distribution of forces. The curve of a free falling body is parabolic in form, as illustrated in Fig. 5. For this reason, a parabolic equation is chosen as the fundamental design for the shape of the tower.

In addition to the parabolic distribution of weight on the tower, there is still another factor which must be considered—the wind pressure during a heavy storm. This pressure, however, combines with the vertical downward forces to merely increase the parabolic stress on the tower. In order to minimize the effect of wind pressure, small vertical members and braces must be used. This factor is beyond the scope of this treatise, yet it will suffice to state that the vertical members need not be larger than 2 x 2-in. square for the uppermost two-thirds portion of the tower. The lower members are 2½ x 2½-in. As can be seen from Fig. 5, the stress is greater in the lower one-third portion of the tower.

The Parabolic Equation

No matter the height of a tower one contemplates building, there is a definite parabolic equation which will solve for the parabolic curve of the structure of your choice. The fundamental equation for a vertical parabola is:

$$X^2 = 2PY,$$

where X = horizontal distance;
Y = vertical distance;
P = ratio between focal point and directrix.

To simplify this formula, write it as follows:

$$X^2 = KY,$$

where K is a constant which will be proven to be a ratio between the width of the base and the height of the tower.

In the design of the tower illustrated in Fig. 1 it was first decided that the height was to be 72-ft., and the base calculations were simplified by adopting an even fraction of the height of the tower; the resultant measurement was 12-ft.

The parabolic curve was plotted on the ground, and marked-off in such a manner that the longest distance Y was the height of the tower, or 72-ft. When the vertical height is zero, the X distance (or one-half the base measurement) is 6-ft., as measured to the center-line, which is called the Y-axis. Remember that only one-half of one side of the tower is now being plotted. See Fig. 6.

Before the actual parabolic curve can be determined, it is necessary to derive at the full parabolic equation suitable for this tower, thereby satisfying the points 6 and O, and O, 72 for the height of the tower.

In order to start the curve to the left of the Y (center) axis, X is made to equal -6; therefore, X + 6 = O, and if Y = O, then KY = O. In order to get back into parabolic form,

$$(X + 6)^2 = KY$$

It is also known that if the height is 72-ft., X = O.

K can now be solved by substituting this value in the above equation. Therefore,

$$(O + 6)^2 = 72K$$
$$36 = 72K$$
$$36 = K, \text{ or } K = \tfrac{1}{2}.$$

The equation for this parabola is now:

$$(X + 6)^2 = \frac{Y}{2}$$

Solving for X:

$$X + 6 = \sqrt{\frac{Y}{2}}$$

$$X = \sqrt{\frac{Y}{2}} - 6$$

The next step is to substitute, in this equation, the values for Y, and solving for X. The simplest manner is to divide the height into a few steps, say 6-ft. each, and making a Table with the corresponding values of X.

Table for Plotting Points Which, When Joined Together, Will Give the Resultant Curve

Point	Y	X
BASE	0-ft.	72-in.
1	6-ft.	51-in.
2	12-ft.	43-in.
3	18-ft.	36-in.
4	24-ft.	30-in.
5	30-ft.	25-in.
6	36-ft.	20-in.
7	42-ft.	16-in.
8	48-ft.	12-in.
9	54-ft.	9-in.
10	60-ft.	6-in.
11	66-ft.	3-in.
TOP	72-ft.	0-in.

It must be remembered that the tower has a parabolic curve on each of its sides, in addition to a certain width at its top for supporting the mechanism of a rotary array. If the top of the tower is made 16-in. square, as in Fig. 1, it is evident that 16 inches must be added to each place along the parabolic where a measuring point is plotted. The simple equation for finding the total distance at each point is:

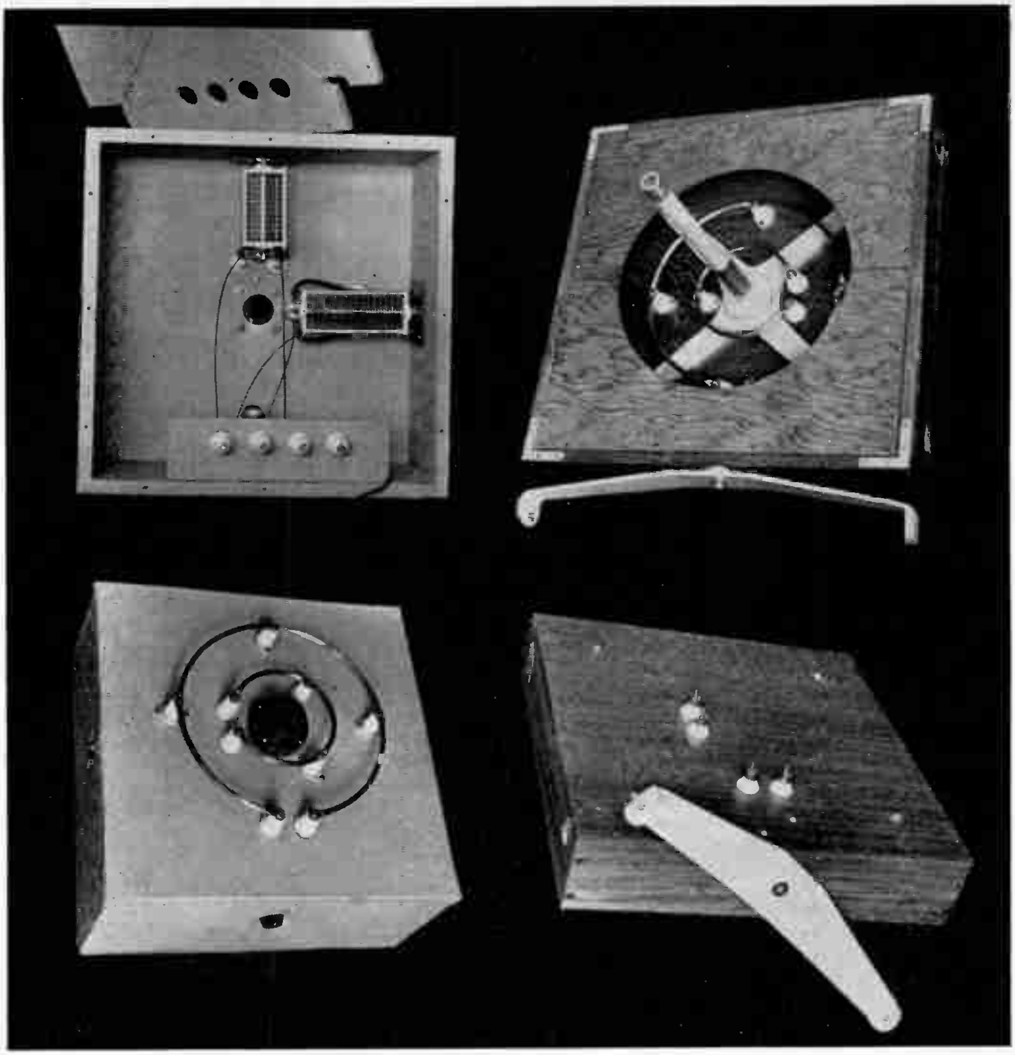
$$D = 2X + W,$$

where D = distance between outside portions of each plotted point of the curve;
X = the solved distances;
W = width of tower at its top.

The total width of the base is therefore:

$$B = 2X + W,$$

where B = base width,
X = 6-ft.



Rotary beam inductive coupling system for top-of-tower mounting. This device will be treated in a subsequent issue of the magazine. Several innovations in "compass boxes" will also be covered.

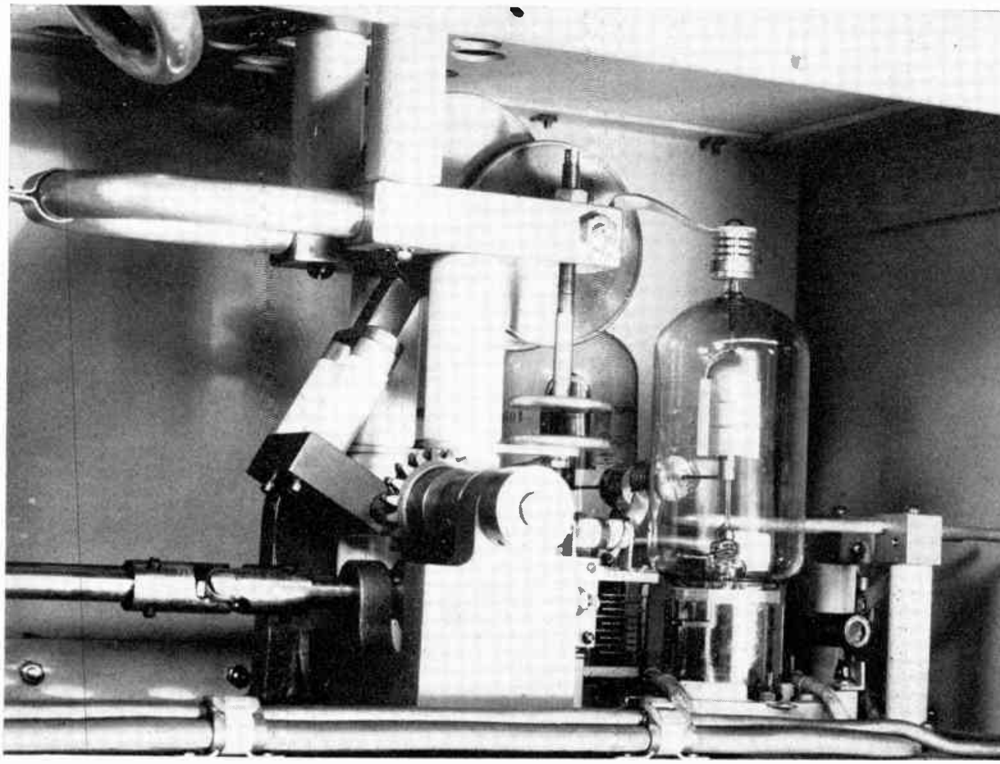
Therefore, B = 2 x 6 + 1.3-ft. (16-in.) = 13.3-ft.

After the points for each side of the curve have been calculated and marked off on the ground, an outline pattern is drawn, and from this outline the measurements for the cross-members are taken. Each piece of wood is then cut to correct size, and given an identifying number, because this tower is built from individual pieces, from the ground up—and not as a completely assembled tower lying flat on the ground.

Having first derived at the outline pattern of one side of the parabolic, the next step is to determine the location of the horizontal braces. Another architectural rule for pleasing the eye and giving greater perspective is to make the spacing between the horizontal brace sequal to the length of the upper horizontal member. Referring to Fig. 1 it can be seen that A B = C D, E F = G C, H I = J G, etc., up to the top of the tower. Draw these horizontal braces into the outline of the side. Then draw-in the cross-bracings.

Cross-bracing results in what is known as "three-link mechanism", and this mechanism is stable. If these cross-braces are left off, then A-B-E-F forms a four-link mechanism, which is unstable. You can prove this

(Continued on page 75)



High Power Gammatron UHF Amplifier

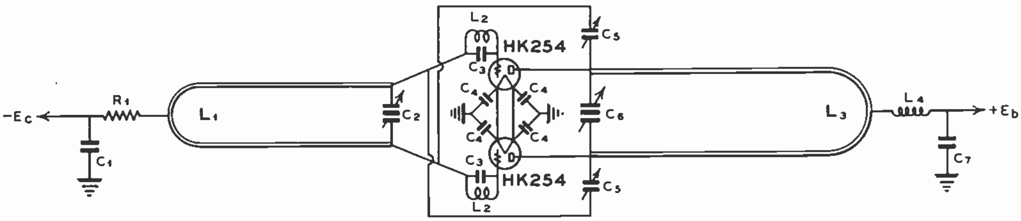
*By Winfield G. Wagener**

RADIO frequency transmitters in the ultra-high frequency regions are a continual surprise even to those who make them commercially. The final construction takes a different form for almost every application.

The photograph above shows the final power amplifier stage of a 125 megacycle transmitter built around a pair of Type HK-254 *Gammatrons*. The circuit is a conventional, cross-neutralized, push-pull amplifier. With a little care in the layout of the stage the two 100 watt tubes operate easily at a plate conversion efficiency of 70%. The driver stage consists of a single Type HK-254 acting as a doubler from 62.5 megacycles. The driver tube, even under these conditions, is loaded to about half its capacity. The doubler tube operates with a plate conversion efficiency of 55%. Because the commercial application of the transmitter requires that it operate 24 hours a day with 100% modulation continuously applied, the final tubes are not driven to full capacity. The useful power in the antenna itself, however, expressed in terms of the carrier power is well over the desired 150 watts.

In the upper left hand corner of the picture the output coupling link can just be seen. It hangs above the plate tank circuit in the proper position for coupling out the full rated output of the transmitter. The loose coupling required is an indication of the ease with which energy can be taken from the circuit. In fact, the energy is so ready to let go of the circuit proper and take off of its own accord, that considerable care has to be taken to keep it where it belongs. The plate tank circuit consists of a ¾″ bent pipe, silver plated to keep down losses that may result from the high circulating currents of about 15 amperes in the closed end of the loop. The circuit is tuned by a double variable disk condenser. The outside plates are stationary and mounted on the plate line. The middle or movable

* *Vacuum Tube Engineer, Heintz and Kaufman, Ltd., South San Francisco, California.*



	C_1	C_2	C_3	C_4	C_5	C_6	C_7	R_1
125 mc.	.001 mfd	30mmfd max dual	30 mmfd	.0001 mfd	5mmfd max	10mmfd max dual	.0001 mfd	1500 ohm 25 watt
60 mc.	"	"	omit	"	"	"	"	" "

	L_1	L_2	L_3	L_4
125mc	¼" diam tubing approx 6" long	10 turns on ½" diam	¾" diam tubing approx 6" long	25 turns on ¾" diam
60mc	Coil – 3 turns 2" in diam	omit	" " " 24" "	" " " "

Circuits and constants for HK-254 U.H.F. Amplifier.

plate is a thick disk which is inserted between the two outer disks to vary the capacity. It will tune over a range of about 8 megacycles. Because the movable plate is located on the center or neutral axis of the balanced plate circuit, it is at zero r-f voltage. This movable plate could have been mounted directly on the metallic shaft of the worm gear and so eliminate the insulation. However, to prevent possible shut-downs due to a stray insect flying into the condenser (and I don't mean the usual "bugs" that get into sets), the movable plate was mounted on ceramic stand-offs.

The grid circuit proper is hidden behind the tube and the cast bearing of the plate variable. It employs a standard split stator variable condenser to tune a short transmission line circuit of about six inches in length. The grid circuit is link-coupled from the doubler-driver by a half-wave concentric transmission line. The coupling link at the grid end can be seen readily and is a simple loop of ¼" tubing. The grid and plate circuits are both "floating" with no ground connections made to either the coils or split condensers. The balance of the circuit is maintained solely by the stray capacities to the metal compartment, which required the design to be kept perfectly symmetrical.

The filaments of the tubes are bypassed to the metal shelf directly at the terminals of the sockets. Ordinary bypass condensers are employed. Tuning of the filament circuits was found to be of no added value. Perhaps the almost negligible value of the internal plate-to-filament capacity of the tubes permitted this simplification.

The neutralizing circuit is conventional in almost all respects. One of the neutralizing condensers can be seen directly in front of the rear tube. It is carried on a threaded shaft from the plate tank circuit itself. By dropping a special insulated screwdriver into the slot on the end of the shaft from the compartment above, neutralizing can be adjusted with complete safety while the transmitter is operating and while observing the meters on the front panel. The lower plate of the neutralizing condenser is carried by a support half way up the pile of ceramic insulators supporting the plate circuit. The only added point that is different from low frequency neutralizing circuits, is that it was found advisable in this application to tune out the combined inductance of the grid lead of the tubes and the outside connection to the grid circuit. This was done by connecting fixed air condensers in series with the grid connections to the tubes. A small coil shunted around the condensers was necessary, of course, to allow the d-c grid current to flow. No shielding between the grid and plate circuits was found to be necessary.

★

The Editorial Staff at work on W6FFP's Techquiz problem. They found the solution to Problem No. 1. Did you?

"Techquiz"

While you are waiting for those elusive Europeans to get back on the air, here is a new departmental feature to keep you busy. It is called "Techquiz" (technical quiz), and a trophy will be awarded the first reader who correctly solves a one-year series of technical problems.

Conducted by C. C. Anderson, W6FFP

PROBLEM No. 1 of *"Techquiz"* is illustrated in the drafting, Fig. 1 It is a relatively simple pproblem, if you know your *Ohm's Law.* The idea is to determine the actual resistance at points A and B, mathematically—and not by measurement. It would be simple for anyone to assemble a resistor cube of the type shown in Fig. 1 and then measure the resistance with the aid of resistor-box, but the editor of this department has carefully guarded against such procedure by specifying a cube of resistors of one ohm each. You can't measure the resistance at points *A* and *B*, unless you have in your possession a very expensive set of laboratory instruments. That's the purpose of this new department — *mathematics!* These "trick problems" will give you a thorough understanding of the application of *Ohm's Law*, and soon you will have in your hands an extensive group of notes to paste into your notebook.

There are 12 resistors in the cube of Fig. 1. Each resistor, as stated previously, has a value of one ohm. Trace the connections through the cube, and calculate the resistance from points *A* and *B*. Then send your answer to the editor, so it can be published in our next issue. We'd like to know how many readers of A. R. D. can find the correct solution, and your answers, *together with your mathematical calculations*, will be published. Explain your solution—step by step.

If, by some long stretch of the imagination, the correct answer is not forthcoming from our reader clientele, the editor will then give the solution next month. Each contestant who sends a correct solution will be awarded 100 points. At the close of the year, the contestant who solves the greatest number of problems correctly will be presented with a beautiful trophy donated by the publishers of A. R. D.

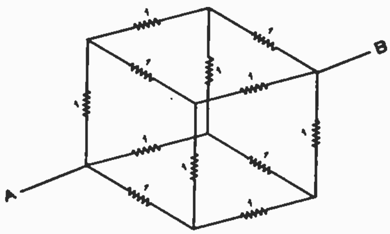


Fig. 1

Each month one problem will be presented, and each following month the correct solution will be published. Within the course of a year it will be possible to present almost every popular problem of resistance, capacity and inductance combinations, and from this information you will gain a better knowledge of the brain-teasers faced by circuit design engineers.

Clyde C. Anderson, W6FFP, our Engineering Draftsman, is responsible for this contest idea. He knows his circuits and he knows his mathematics. He has the answer to Problem No. 1 tucked away in his brain-cells, and he hopes a lot of readers of A. R. D. will send in the correct answer.

Technical Questions *and* Answers

Question: I am troubled with feed-back in my 'phone transmitter only when I operate on 10 meters. Will you please explain why this difficulty seems to become so bothersome on this particular band?

Answer: 'Phone r-f feed-back in the 10-meter band is more troublesome than in the lower frequency bands because any of the ground leads, or shielded leads, may approximate some multiple of quarter-waves in length. A ground lead about 8-ft. long would act as an insulator, and not as an r-f ground, and these "metallic insulators" are often used in commercial transmitters for u.h.f. service. The lower end can be grounded, yet the top end of a quarter-wave conductor will be at a high r-f potential if it is in the near vicinity of a radio-frequency circuit. This condition often applies to the microphone leads, and may make the microphone—or even the transmitter housing—"hot" with r-f which, in turn, may cause an audio feed-back squeal.

* * *

Question: Recent circuit diagrams in magazines and textbooks rarely show the conventional pentode oscillator tube in a crystal oscillator circuit. Why has this form of circuit been so generally disregarded of late?

Answer: The pentode crystal oscillator is still in general use for one-band operation. Other types give power output on harmonic frequencies, or sometimes function more satisfactorily with crystals of very high frequency at the desired fundamental frequency.

* * *

Question: When crystals are switched, either by means of a rotary or snap switch, should both sides of the crystal be cut in or not, or is it allowable to switch only the grid side? In a recent circuit diagram a notation was made to the effect that both sides of the crystal should be cut in or out. Why?

Answer: In the untuned Pierce Oscillator, the Trit-Tet, and in one form of the harmonic oscillator, both sides of the crystal are at r-f potential with respect to the transmitter chassis, or frame. For this reason, a double-pole switch should be utilized for changing from one crystal to another. The conventional form of harmonic oscillator, 6A6 triode, or pentode oscillators, are connected in such a manner that only one side of the crystal is grounded and as a consequence only the grid side of the crystal can be switched, by the conventional form of single-pole rotary or snap switch.

* * *

Question: Why is one side of a link line, between two r-f amplifier stages, sometimes connected to ground, and does the size and kind of wire for the link lines have any appreciable effect on the transfer of energy?

Answer: It is desirable to connect one side of the link circuit to ground in order to minimize undesirable capacitive coupling between two tuned circuits. Capacitive coupling passes harmonics more easily than the fundamental frequency—and should therefore be eliminated. The size of wire for the link circuit should be large enough to carry the r-f current without appreciable temperature rise.

Question: In the proper order, will you please list the reasons for downward kick of the antenna meter during modulation? No degree of antenna loading seems to cure this trouble for me.

Answer: Downward kick of antenna current during modulation may be caused by excessive grid current in a grid- or cathode-modulated transmitter, or a lack of gride drive in the case of a plate-modulated transmitter. Incorrect bias voltage, incorrect antenna load, r-f feed-back, and incorrect modulator impedance match are other causes.

* * *

Question: If the amount of grid circuit drive to the final amplifier shows a very decided drop under load, as against no load, and if this condition can not be corrected by using higher output from the buffer stage, what is the most likely cause of this unusually heavy drop in grid current in the final r-f amplifier?

Answer: The excessive drop in grid current under loaded amplifier conditions is likely due to an increase of grid impedance, causing—in most cases—less grid driving power from the buffer stage. Heavier coupling to a larger buffer stage will cure this trouble, but only if the grid of the amplifier tube or tubes is not producing secondary emission. The latter is normally indicated by a gradual drop in the d.c. grid current.

* * *

Question: Should a 6L6 or 807 buffer stage be slightly regenerative for (1) straight-through operation, (2) as a frequency multiplier? Please state reasons why.

Answer: A 6L6 or 807 buffer stage should have no regeneration, or as little as can be economically obtained for straight-through operation, in order to prevent a possibility of uncontrolled self-excited oscillation. Another reason is to minimize r-f feed-back through this stage, in order to isolate the frequency-controlling circuit from the high-power amplifier stage, or stages. Some regeneration is often found desirable in a frequency multiplier in order to increase the r-f output and efficiency of the doubler or tripler stage. The output frequency is higher, in this case, and is not apt to cause a moderate-frequency parasitic oscillation, or feed-back into the control oscillator.

* * *

Question: Is there an advantage in using a zero-bias tube as a doubler or buffer to drive a higher power stage? And are there disadvantages also? Please explain fully.

Answer: A zero-bias tube as a buffer or doubler requires less bias voltage than a medium-mu tube. A doubler should be operated at a value at least 6 times cut-off bias—and higher values permit better plate circuit efficiency. A zero-bias—or high-mu tube—meets this requirement, in most cases, more readily than a tube with lower mu. Failure of grid excitation will cause no tube trouble if the tube has a very high mu, particularly in circuits having little or no fixed grid bias—since the d.c. plate current will normally be limited to a value lower than that which would cause excessive plate dissipation.

Parasitic Oscillations

PART II

By The Technical Staff

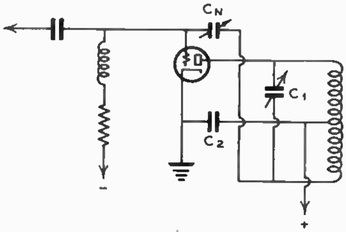
The Technical Staff appreciates the response received from Part I of this Series. It is hoped that Part II will be equally informative. The reader is asked to communicate with us if this series leaves some of his problems still unsolved.

• *Low- and medium-frequency parasitics were discussed in Part I, which appeared in the January issue. Many requests have been received for additional copies of last month's issue, but the supply is completely exhausted. Reprints of the complete treatise on Parasitic Oscillations will be made available later.*

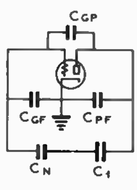
* * *

Ultra-High Frequency Parasitics

ULTRA-HIGH frequency parasitic oscillations are more prevalent than other forms, because the grid and plate leads in a neutralized amplifier act as a tuned-grid-tuned-plate oscillator in the u.h.f. region. These parasitics sometimes disappear when the grids of the r-f amplifier are driven to the point of saturation, as in a class-C plate-modulated stage. For this reason, cathode- and grid-modulated amplifiers sometimes show more evidence of certain u.h.f. parasitics than a plate-modulated transmitter.



ACTUAL CIRCUIT



EQUIVALENT ULTRA-AUDION PARASITIC CIRCUIT

Fig. 11

On the other hand, the higher plate voltage in a plate-modulated transmitter may often result in a stronger parasitic oscillation, in spite of the saturation of the grid circuit. The tuning condensers may act as inductances of fairly low resistance at very high frequencies, since the r-f currents circulate around the amplifier leads and through the rotor and stator elements of the tank tuning condenser. The carrier frequency coils always possess a certain amount of distributed capacity; at high frequencies these coils have a capacitive reactance—in other words, they act as small condensers. A condenser can therefore become an inductance, or vice-versa, at certain frequencies. This effect, together with the reactance of the neutralizing circuit leads, can often produce various forms of oscillator circuits, such as a tuned-grid-tuned-plate *Hartley*, *Colpitts*, or *Meissner* Oscillator.

A typical example is shown in Fig. 11, where the equivalent parasitic circuit is a form of ultra-audion, or *Colpitts* oscillator, with a resonant frequency dependent upon the length of r-f circuit leads and tube interelectrode capacities. The cure for a parasitic oscillation in this form of circuit consists of detuning either the grid or plate circuit, or to dampen the u.h.f. circuit by means of a parasitic suppressor connected in either the grid or plate lead.

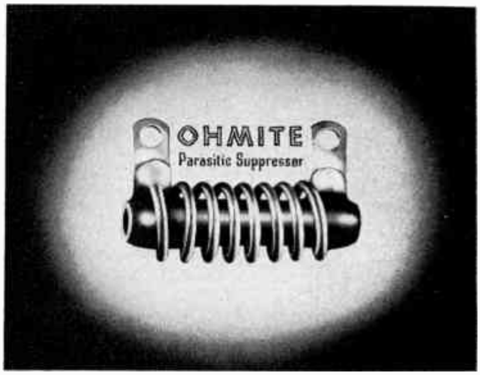
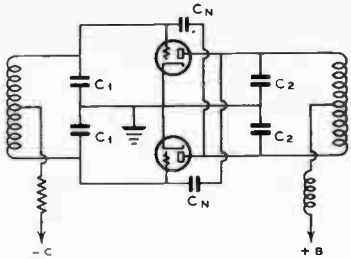
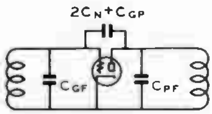


Fig. 12

Detuning is accomplished by a rearrangement of the mechanical layout of circuit components, in such a manner as to increase



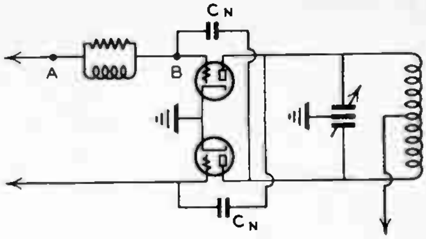
ACTUAL CIRCUIT



EQUIVALENT U H F CIRCUIT

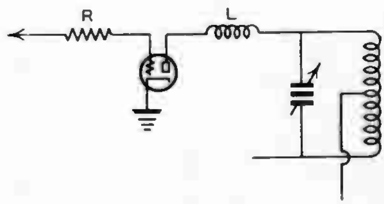
PUSH-PULL AMPLIFIER

Fig. 13



PARASITIC SUPPRESSOR

Fig. 14



PARASITIC SUPPRESSION

Fig. 15

the length of either the grid or plate leads.

A typical push-pull amplifier, such as the one shown in Fig. 13, has an equivalent tuned-grid-tuned-plate oscillator circuit in which the two tubes are effectively in parallel, and the neutralizing condensers and grid-to-plate capacities of the tubes act in such a manner as to produce more feed-back between the grid and plate tuned circuits. The inductance in the equivalent circuit is that produced by the grid and plate leads, through the rotor and stator of the tuning condenser, and back to the cathode or filament of the r-f amplifier tube or tubes.

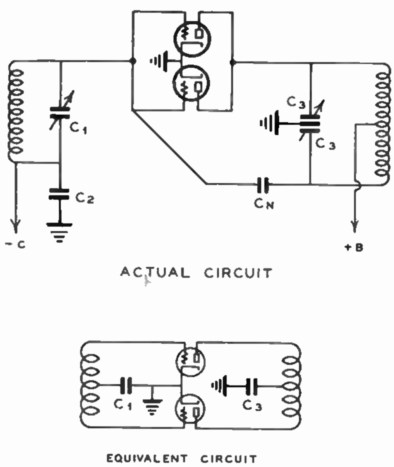
The equivalent capacity across each inductance is largely the grid-to-filament and plate-to-filament capacity of the equivalent tube. The carrier frequency inductances which act as small capacities at the ultra-high frequencies, as well as certain stray capacities, are in shunt to the grid-to-filament and plate-to-filament capacities. Again, the cure for this condition is to lengthen the grid leads, or to insert a parasitic suppressor in one of the grid leads. Sometimes it will be necessary to connect a suppressor in both grid leads, but the general rule is to connect it into the lead of one tube only.

The connection shown in Fig. 14 will usually eliminate the so-called "parallel u.h.f. parasitic oscillation," as well as push-pull u.h.f. oscillations, where each tube acts as a separate tube in a tuned-grid-tuned-plate u.h.f. oscillator. Sometimes the parasitic suppressor is connected in such a way that the neutralizing condenser connects directly to the grid of the tube at point *B* in Fig. 14, while at other times it is desirable to connect this neutralizing condenser at point *A*. Often the inclusion of a parasitic suppressor will unbalance the grid circuit drive to such an extent that one tube will become overheated, and show more color than the other. The grid circuit drive can usually be balanced by moving the by-passed "center point" a few turns toward one grid or the other, in order to equalize the r-f grid driving voltage on each tube. The parasitic suppressor introduces additional inductance in the circuit, thereby effectively detuning the u.h.f. oscillator circuit. A small resistance, across the inductance of this suppressor, provides additional damping which tends to prevent a parasitic oscillation at a somewhat lower frequency. This type of parasitic suppressor usually consists of from 6 to 10 turns of no. 14 wire, one-half inch in diameter, and spaced so that the winding is from 1- to 1½-inches long. The resistor is usually of the non-inductive carbon or wire-wound type, 50 to 200 ohms in value, and mounted inside the suppressor coil.

A simple resistance is sometimes used for suppressing parasitic oscillations; the resistor is connected as close as possible to the grid of the tube. The suppressor coil is sometimes connected in the plate lead, as illustrated in Fig. 15. The circuit applies for either a triode or screen-grid amplifier.

When only a resistor is connected in series with the grid lead, the bias value may sometimes change, or there may be an excessive reduction in grid excitation. For this reason a parasitic suppressor of the type shown in Figs. 12 and 14 is generally used in amateur radio transmitters.

A parallel tube r-f amplifier of the type diagrammed in Fig. 16 may have an equivalent circuit as indicated, in which the leads between the two grids, and also the leads between the two plates, become resonant inductances in the u.h.f. region. If the grid or plate leads to the tuning condensers C_1 and C_3 are arranged in such a manner that they will not be symmetrical in a u.h.f. circuit, this parasitic circuit will then become detuned sufficiently to prevent the oscillation. In spite of this unsymmetrical arrangement, there is still a possibility for parasitic oscillation if the two parallel tubes are considered as a single tube of the type shown in Fig. 11. It may then be necessary to insert a parasitic suppressor in the common grid lead, or in one of the equivalent grid leads. The process of parasitic suppression is one of cut-and-try, after the parasitic circuit has been located, as will be described later.



PARALLEL TUBE R F AMPLIFIER

Fig. 16

An amplifier may sometimes be designed with an ungrounded split-stator condenser as shown in Fig. 17. The equivalent parasitic circuit is also diagrammed. This circuit can produce undesired oscillations in an emplifier which has been regarded as well neutralized. The cure for this parasitic is to ground the rotor of the plate tuning condenser, either directly or through a by-pass condenser.

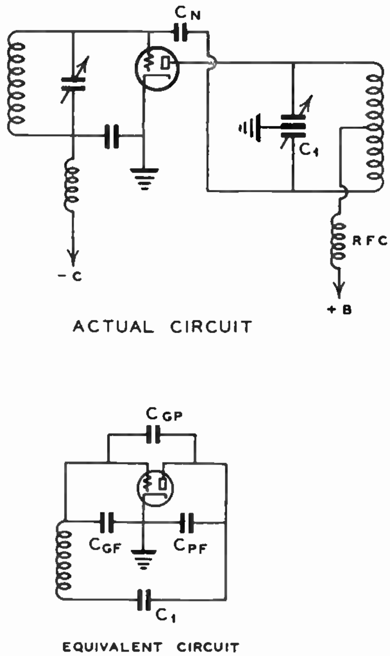
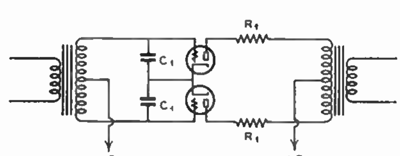


Fig. 17

High-frequency parasitic oscillations can occur in audio amplifiers as well as in r-f amplifiers. Transformer-coupled class-AB or class-B amplifiers or modulators are often subject to parasitic oscillation since the tubes are not neutralized and therefore may oscillate at some radio frequency determined by the distributed capacities of the transformer and the inductance of the leads. This difficulty can be cured as shown in Fig. 18, by connecting a small mica-type condenser from each grid to cathode or filament, and then connecting small 40- or 50-ohm resistors in series with the plate leads. In general, condensers C_1 alone will eliminate parasitic oscillations.



PARASITIC SUPPRESSION IN CLASS AB OR CLASS B AMPLIFIER

Fig. 18

Since the impedance of the grid circuit in a class-B amplifier is quite low, condenser values as high as .001μf. will affect the audio-frequency characteristic for voice communication. Values ranging from .001μf. to .005μf. are commonly used in class-B modulators. It is often desirable to connect a condenser of .003μf. or .005μf. from plate to plate in a class-B modulator in order to remove a parasitic caused by a high-frequency peak in the output transformer. This parasitic can give rise to undesired side-band splatter in a plate-modulated transmitter.

A "trigger" type of parasitic oscillation can occur in a plate-modulated transmitter, Fig. 19, due to audio-frequency coupling between the grid and plate circuits of the push-pull amplifier.

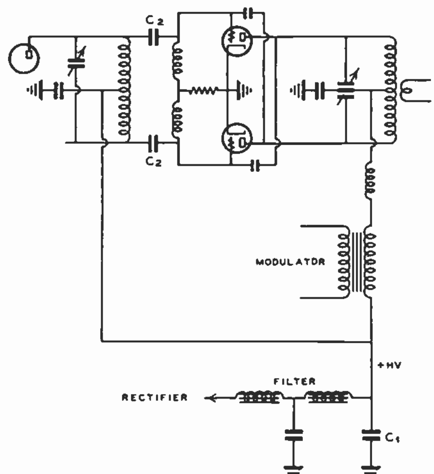


Fig. 19

Sufficient common coupling reactance across the filter condenser C_1 may produce enough audio voltage through the grid coupling condensers C_2 to cause the r-f amplifier to oscillate at an audio frequency, because of the inductance of the modulation transformer in the plate circuit. This form of parasitic results in poor tone quality, and in extreme cases may produce heavy side-band splatter and downward modulation, due to complete cutoff of the carrier between trigger oscillations. The cure is to use a large capacity in the last filter condenser C_1, and relatively small condensers, such as .00025μf., in the r-f coupling to the grids of the r-f amplifier. Condenser C_1 should have a value from 4μf. to 8μf., unless an additional filter section is connected in series with the buffer plate circuit.

A cathode-modulated transmitter may be subject to an audio-frequency parasitic oscillation, as shown in Fig. 20. The actual circuit has an equivalent parasitic circuit which may introduce an audio-frequency parasitic when the preceding buffer stage is detuned sufficiently to lower the r-f grid drive below the normal operating value.

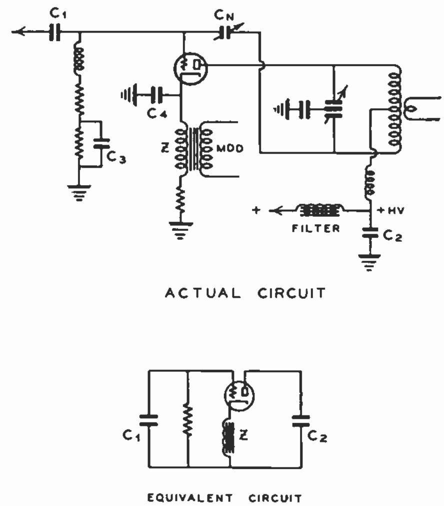
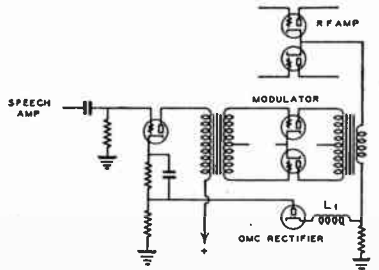


Fig. 20

There are two possibilities for parasitic oscillation at low frequencies in this circuit. One is due to the use of too small a coupling condenser C_1 in the grid circuit, which will permit a very high grid circuit impedance sufficient to cause a trigger-type of parasitic oscillation, and the other is a possibility of audio oscillation when the grid by-pass condenser C_3 happens to be of such a value as to permit obtaining an oscillation circuit in connection with the condenser C_2 and the inductance of the cathode modulation transformer. A large grid by-pass condenser, 4- to 10-mfd., in addition to the usual 2- to 4-μfd. filter condenser C_2, will usually prevent this form of oscillation. Condenser C_1 should have some value between .00025- and .001-μfd. in a capacitively-coupled cathode-modulated amplifier. In some cases it is possible to use a very small coupling condenser in the form of a variable capacity without encountering parasitic oscillation. These parasitic oscillations can be readily seen on the oscilloscope in the form of a very distorted trapezoid, and with additional projections on the sides, at high levels of modulation.

A peculiar case of low radio-frequency parasitic was encountered in a cathode-modulated transmitter with an automatic modulation control rectifier connected as shown in Fig. 21.



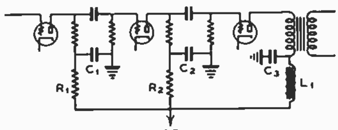
LOW FREQUENCY PARASITIC DUE TO PHASE SHIFT IN A F TRANSFORMERS AT HIGHER FREQUENCIES

Fig. 21

This parasitic oscilaltion was due to a phase shift in the audio-frequency transformers at the higher frequencies, which caused a feed-back through the OMC rectifier to be in-phase, rather than out-of-phase, at a relatively low radio frequency above the audio-frequency range. The OMC rectifier is connected normally so as to feed-back the over-modulation peaks out-of-phase over the voice frequency range. When keying this transmitter for c.w. operation, this parasitic took place because of zero or low cathode current in the r-f amplifier, reducing the delay bias on the OMC rectifier to such an extent as to allow parasitic oscillation.

The cure for this parasitic was to connect a high inductance r-f choke L_1 in series with the OMC rectifier tube. An inductance of 85-mh. was sufficient to completely eliminate the parasitic. It could not be eliminated by loading the audio transformers with resistors or condensers, without using values which affected the gain or voice quality.

Motor-boating in speech amplifiers is a form of parasitic oscillation which can be cured by L/C or R/C filters, as shown in Fig. 22.



RC AND LC FILTERS

Fig. 22

In most cases, an R/C filter is connected in series with the plate circuit of the first tube in the speech amplifier, rather than in all of the stages. The circuit is shown in order to illustrate the connection for these types of filters.

Parasitics in Screen-Grid Tube Circuits

Coupling between the grid and plate circuits of a screen-grid amplifier may cause parasitic oscillations in the vicinity of the carrier frequency. Lack of shielding may permit capacitive or inductive feed-back, and there is also a possibility of *framework link coupling* between the tuned grid and tuned plate circuits. The r-f by-pass circuits, particularly from screen-grid to cathode, should be as short as possible and have very low impedance. A series tuned circuit, resonant at the carrier frequency, is sometimes connected between the screen-grid and cathode common ground connection in order to secure a very low impedance. Capacities of .005μf. to .01μf. usually offer a sufficiently low impedance for this purpose without resorting to a series-tuned circuit. Ultra-high frequency parasitics occur in screen-grid amplifiers in which the screen-grid acts as an anode in a tuned-grid-tuned-plate oscillator circuit.

Long grid leads in crystal oscillators may allow a tuned-grid-tuned-plate type of u.h.f. parasitic to take place. A small parasitic suppressor coil can be connected in series with the plate lead in order to prevent this effect.

A voltage divider type of screen-grid supply should always be used in preference to a series resistor, so as to avoid a trigger type of parasitic oscillation in screen-grid amplifiers, or a chirping note in the case of a pentode crystal oscillator when keyed for c.w. transmission. Beam tetrode crystal oscillators are often subject to parasitic oscillations; the grid leads to the crystal and the return to the cathode circuit should therefore be as short as possible.

Tests for Parasitic Oscillations

An all-wave receiver equipped with a beat-frequency oscillator is highly useful for detecting parasitic oscillations of all kinds. The presence of a parasitic oscillation can usually be detected by listening to the carrier note from an oscillating receiver. Any roughness of tone usually indicates the presence of a parasitic oscillation. The final amplifier of the transmitter, in practically all cases, is the place where parasitics are most likely to be encountered. High plate voltage is very conducive to parasitic oscillation, because the tube operates as an afficient amplifier with a relatively high value of mutual conductance. High power r-f amplifiers normally require condensers and coils of large physical size, and these may require long r-f leads which form u.h.f. oscillator circuits, as was previously related.

The almost universal method of testing for parasitics is to remove the r-f excitation by disconnecting the plate supply voltage from the preceding stage or stages of the transmitter. The grid bias is usually made slightly positive, or zero in value, and low plate voltage is then applied to the amplifier under test. The plate supply normally used for low power buffer stages can often be connected to the final amplifier for making these tests. Nearly all modern tubes will withstand a temporary plate dissipation of at least 200 per cent of normal rating, and as much plate voltage as possible should therefore be applied (at zero grid bias) without endangering the life of the tube. These conditions are ideal for producing parasitic oscillations. Any flow of d.c. grid current indicates the presence of a parasitic. A neon bulb, tied to an insulating stick, can be used for locating high r-f potentials in the grid and plate circuits.

A ¼- or ½-watt neon bulb, held in one's hand, or an ordinary wooden lead pencil can be used for detecting parasitic oscillations in low-power amplifiers. Arcs can be drawn with the pencil, and the points of high r-f voltage thereby located in the amplifier. A small pilot lamp with a turn of wire is sometimes useful for determining the portions of the circuit carrying high r-f currents. An absorption wavemeter is extremely useful for measuring the frequency of the parasitics, which are often in the u.h.f. region from one to ten meters. An oscilloscope is also a valuable aid for locating weak parasitic oscillations which might produce distortion or side-band splatter when the amplifier is operated with normal plate voltage.

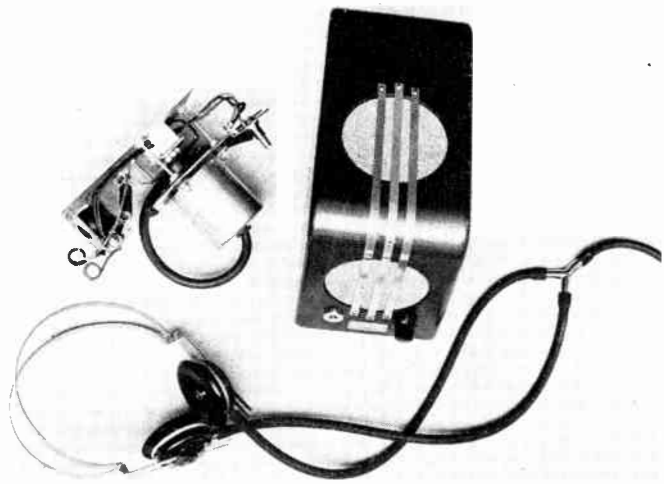
Low-frequency parasitic oscillations can be detected readily by means of the neon bulb or lead pencil test, because the r-f voltage is approximately the same at any point along the amplifier tank coil. It is just as high at the center of the coil, where connection is made to the r-f choke, as at the plate of the tube or tubes. Ultra-high frequency parasitics show indications of high voltage near the plate or grid of the tubes in the r-f amplifier, but give no indication of r-f at the center or nodal point of the carrier frequency tank coil.

Trigger-type parasitics can be most easily located with the aid of an oscilloscope connected to the various parts of the r-f and audio circuits. The r-f amplifier can sometimes be operated in such a manner as to cause the trigger-type of parasitics to remain steady; these parasitics can then be located by means of the lead pencil or neon bulb test.

When listening for the effects of parasitic oscillations, care should be exercised to eliminate the possibility of mistaking image interference in a radio receiver of the superheterodyne type for a parasitic oscillation in the transmitter.

The r-f amplifier under test should show no variation of plate current, nor any indication of grid current, when tuning the grid or plate circuits through the complete range of the condenser. This, of course, holds true only when no excitation from the crystal oscillator or buffer stages is applied to the final amplifier. The applied plate voltage to the final amplifier should be low enough to prevent excessive plate current when making these tests. If the amplifier has a source of fixed C-bias, this bias should first be disconnected, and the grid then connected to ground through a grid-leak in order to provide a condition most favorable for producing parasitic oscillations. If this is not done, certain parasitics may escape detection, and they may appear in a plate-modulated amplifier during peaks of modulation, at which time the plate voltage may be very high, or the grid voltage very low, thereby producing a condition favorable for parasitic oscillation.

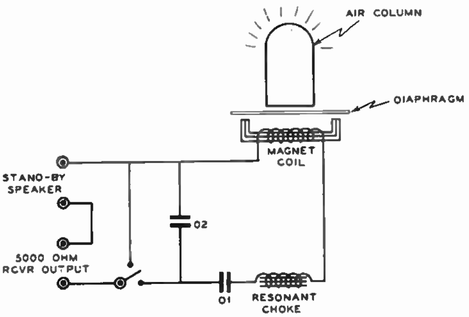
When a parasitic oscillation has been detected as being of u.f.h.-, medium-, or low-frequency, proper steps can then be taken to cure the trouble. Low-frequency parasitics can generally be eliminated by removing the r-f chokes, or by rearranging the values of these chokes, as previously discussed. Medium-frequency parasitics can generally be cured by proper shielding between grid and plate circuits, by perfect neutralization, and by elimination of all common coupling circuits, such as high resistance r-f ground leads in the amplifier, or metal framework coupling links. Ultra-high frequency parasitics can be cured by inserting parasitic suppressors near the grid or plate terminals of the tube. The elimination of one parasitic will sometimes permit another type to appear, in which case the test must be repeated, and the amplifier "doctored" to remove all cause of trouble.



Technical Details of the Meissner Uni-Signal Selector

This manuscript answers many questions relating to the technical design and operation of the new Meissner Selector, which rejects all frequencies except the one desired by the operator.

THERE are a number of well-known receiver output devices on the market for eliminating the heterodyne on 'phone signals, etc., and the introduction of the *Meissner Uni-Signal Selector* has consequently confused the amateur as to the purpose which this new unit actually serves. Other than the fact that it operates on the receiver output, it bears no similarity whatsoever to heterodyne filtering devices. In fact, it actually serves a purpose opposite to that of other instruments. Heterodyne filters usually consist of adjustable blocking circuits which pass all frequencies except the one to be blocked-out. The *Uni-Signal Selector*, on the other hand, *rejects* all frequencies except the one which it is designed to pass. In addition, this new device rejects background noise, which is not affected in any way by conventional heterodyne filters. The selectivity of the *Uni-Signal Selector* is so great that it is impossible to use this instrument for copying 'phone signals. When the device is connected into the circuit, it is possible to tune across the entire broadcast band without receiving a 'phone signal of any kind. Only the 1,000 cycle harmonics come through. everything else is cut off. In order



Complete circuit of the Uni-Signal Selector for conventional operation.

Air-column headphones of special type are also available, as detailed in the text. The illustration shows a pair of these special 'phones in use.

that the operator may also be able to hear 'phone and broadcast signals, the *Uni-Signal Selector* is equipped with a cut-over switch, so that the receiver output can be connected directly to a small dynamic speaker.

How It Works:

REFERRING to the schematic diagram, the circuit consisting of C-1, C-2, L-1, M-1 is resonate at approximately 1,000 cycles, and has an impedance of approximately 4,500 ohms across the input terminals. Coil M-1 is wound around the pole of an electromagnet, which in turn actuates a metal diaphram which is mechanically resonant at 1,000 cycles. The diaphram is sharply resonant at this frequency, having a band width of only 25 to 40 cycles (about 980 to 1,020 cycles), and strongly rejecting other frequencies. When signal current flows through M-1, the diaphram responds if the frequency of the signal current is within the range of the diaphram, otherwise it does not. In the case of off-frequency currents, only the 1,000-cycle harmonics get through.

The signal passed by the diaphram is too weak for use without further amplification, hence it is amplified by placing a resonated air column directly over the diaphram, the air column responding to 1,000 cycles. Sufficient amplification is obtained in this manner so that the unit acts as a loudspeaker. Sensitivity is slightly greater than that of a 5-inch dynamic speaker, especially so on weak signals. The power output corresponds to approximately one watt, so that on strong signals it is not equal to a dynamic speaker from the standpoint of power handling ability.

As the output signal is a sound wave (air vibration), there is no way in which to connect the device to a conventional pair of headphones. However, headphones of a different type work nicely with the unit, and these 'phones are of the air-column (stethoscopic) type. A length of rubber tubing, run from the top of the air column resonator to a "jack" on the panel, carries the signal for headphone connection. These air column 'phones consist of a rubber tubing dividing through a "Y" connector to two ear-pieces, attached at the "Y" point. A very clear signal, free from the usual tube hiss and roar, is consequently heard.

Operation on the Amateur Bands

SELECTIVITY is of such a high order as to open absolutely new vistas on the amateur bands. Instead of tuning over an overcrowded band, with overlapping stations, key thumps, etc., there are actually many wide-open "spaces" between stations—and *room for more*, believe it or not! It is actually possible to isolate a weak station completely blanketed by three or four locals on a standard-type speaker, and copy that station "solid," providing the station's note is sufficiently steady to stay, without drift or chirp, within the very narrow limits of reception of this new device. This specification, of course, also includes the receiver, which must be free from drift within the same limits. Despite this extreme selectivity, operation of the receiver is not difficult with a *Uni-Signal Selector* output, once the operator gets the knack of it.

Degree of Noise Elimination

HEAVY crashes of static are reduced to a light "tickling." Weaker "growlers" are eliminated almost entirely. Tube hiss, the No. 1 enemy of the c.w. operator, is completely gone, making it possible to advance the receiver gain control and bring in stations normally lost in the hiss. This device differs from the more familiar noise eliminators in that it operates on interfering noises having *less* than the signal amplitude, as well as the stronger noises. This is in contrast with "peak-limiting" devices which cut off the strong noises but have no effect upon the bothersome weaker noises.

Although it is unnecessary to use a crystal filter when the receiver output is connected to a *Uni-Signal Selector*, it is nevertheless a desirable adjunct. The Selector literally goes to work on the signal *after* it leaves the receiver. It is evident that any feature in the receiver which makes for better signal-to-noise ratio gives the *Selector* just that much more opportunity to pass a perfect signal along to the operator. The same holds true for noise filters within the receiver proper, so that the noise can be held down to a reasonable value at the output of the receiver, rather than allowing the noise to be built up to uncontrollable values. The *Uni-Signal Selector* requires no power supply for its operation. Only two wires connect to the receiver—the output leads. The device operates solely on the power of the signal proper, and no d.c. or a.c. exciting voltages are required.

Operation

IT IS important that the beat-frequency oscillator of a super-heterodyne be offset from resonance by the correct amount in order to give greatest efficiency when using the *Uni-Selector*. To do this, proceed as follows: Turn off the receiver's B. F. O. and tune in a steady signal, making use of the tuning meter or magic eye to make certain that it is tuned to exact resonance. A broadcast or similar type of signal may be used for this purpose. With the *Selector* in use as the output unit, turn on the receiver's B. F. O. and, without touching the main tuning dial, carefully adjust the PITCH CONTROL until the beat note has the frequency which comes through strongest on the *Selector*. Leave the pitch control in this position, as it is now at the spot where signals will have the maximum strength on the *Selector*.

Because of the extreme selectivity of this output unit, a very small movement even of the band spreader is sufficient to pass completely over a signal. Unless the receiver is equipped with a very good vernier knob, it would be advisable to install one.

A signal must be tuned to EXACT RESONANCE to be heard and extreme care must be used in the tuning, especially on weak signals. At exact resonance, the signal will come through the *Uni-Signal Selector* with the same volume as on a standard speaker unit.

TECHNICAL QUESTIONS AND ANSWERS

(Continued from Page 33)

Question: Operating with 500 watts input, the final tank coil in my plate-modulated 'phone transmitter becomes unduly hot on 10 and 20 meters. I have tried all possible combinations of C/L ratios, with negligible effect, and I have used everything from 1/4-inch copper tubing to no. 14 wire.

Answer: Excessive plate coil heating in the higher frequency bands indicates too high a C-to-L ratio, or poor placement of the coil with respect to chassis, tubes and condensers. On 10 and 20 meters, the maximum capacity of the normal tuning condenser, plus the tube capacities and stray shunt capacities—such as wiring—and also the neutralizing condenser capacities to ground, very often combine to increase the C-to-L ratio far in excess of the desired value. This results in a large circulating current in the tank circuit, and excessive heating of the coil will be experienced. Coils made from copper tubing may have better heat-radiating qualities, and prevent collapse of the insulation, but these coils are not a cure for the problem of too high a C-to-L ratio in the very-high frequency bands.

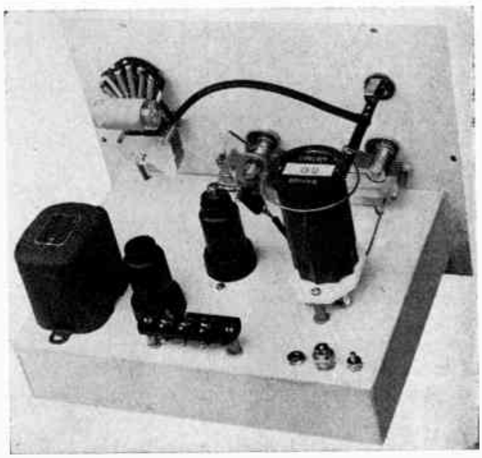
WHAT'S YOUR TROUBLE?

Send your queries to the Technical Editor. Your name will not be published.

A More Selective Battery-Operated Blooper For Stand-By Service

BATTERY-OPERATED receivers are still being built—many of them. Few improvements in circuit design have been shown recently, and little has been done to improve selectivity. Consequently we conducted a few experiments with a simple "blooper" to which was added a tuned antenna circuit, shown in the diagram herewith. This tuned circuit proved very satisfactory, and the selectivity of the little receiver is exceptionally good. It is further enhanced by reason of the variable coupling link, adjusted from the front panel by means of a ¼-inch round bakelite rod which rotates in a conventional jack, the spring of which presses firmly against the bakelite rod so that the coupling loop will remain in position for any chosen setting.

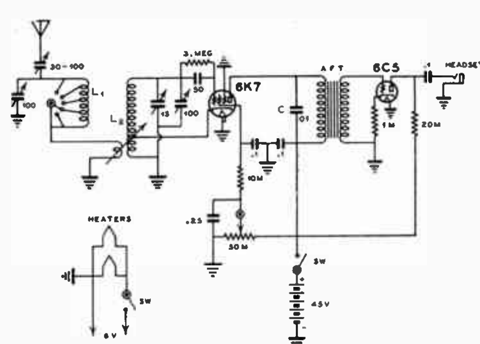
The antenna coil is wound on a ¾- or 1-inch low-loss form, the one shown in the picture being an *Amphenol* polystyrene coil form, ¾-in. dia. Taps are taken from each 5th turn along the winding, and carried to a multi-point rotary switch. Six or more taps can be taken, but not more than a half-dozen taps will be required. The coil has 30 turns of no. 26 d.c.c. wire, close wound. The antenna coil tuning condenser is an inexpensive BC-type 100$\mu\mu$f variable, and the 30-100-$\mu\mu$f condenser in series with the antenna lead proper is a standard trimmer unit.



Rear view of the little "blooper," showing details of tuned antenna circuit for greater selectivity and better signal strength. Connection to antenna coil, L_1, is by means of a pair of leads secured to the bakelite arm which rotates the coupling coil. This coil has one turn of wire. coupled loosely to coil L_2.

Band-spread tuning is achieved on the 15$\mu\mu$f condenser which in shunt with the 100$\mu\mu$f condenser across coil L_2. The winding data for this coil, for any of the amateur bands, is the same as that shown in the several amateur handbooks.

This little receiver gives very good results with a single 45-volt B-battery and 6.3 volts filament supply, either from a storage battery or from a small a.c. filament transformer. The B-battery can be secured under the chassis if the receiver is to be used for portable operation. The battery should be switched off when the receiver is not in service. A toggle switch on the front panel is provided for this purpose, also a similar switch for the "A" supply. Housed in a small metal can, this receiver is a compact, handy adjunct for the amateur who wants something in reserve for an emergency. The additional parts required for the antenna tuning circuit, and the additional labor in putting this adaptation into the receiver, will bring rewards in the form of increased selectivity and better signal strength—almost equivalent to that of a stage of r-f amplification ahead of the detector.



Schematic wiring diagram of highly-selective battery-operated "blooper." Values of components should not be changed. The audio transformer is a conventional 3:1 unit.

Taking The Curse Out Of Circuit Design By Aid Of Simple Charts

By Eddie Fiore

THOSE to whom mathematics is anathema (a curse. to you) should welcome the accompanying charts to be used in designing radio circuits. Although based upon mathematical formulas, no extensive knowledge of mathematics is required in using them. They give approximate results which are accurate enough for most practical purposes.

Fig. 1 is an oft-published chart which tells the size of coil and condenser required to tune a series or parallel circuit to resonance. It consists of three scales: That on the left is a scale of inductances, graduated from 1 to 200 microhenries. That on the right is a scale of capacities, graduated from 5 to 500 micro-microfarads. The right side of the center scale is graduated in wavelengths

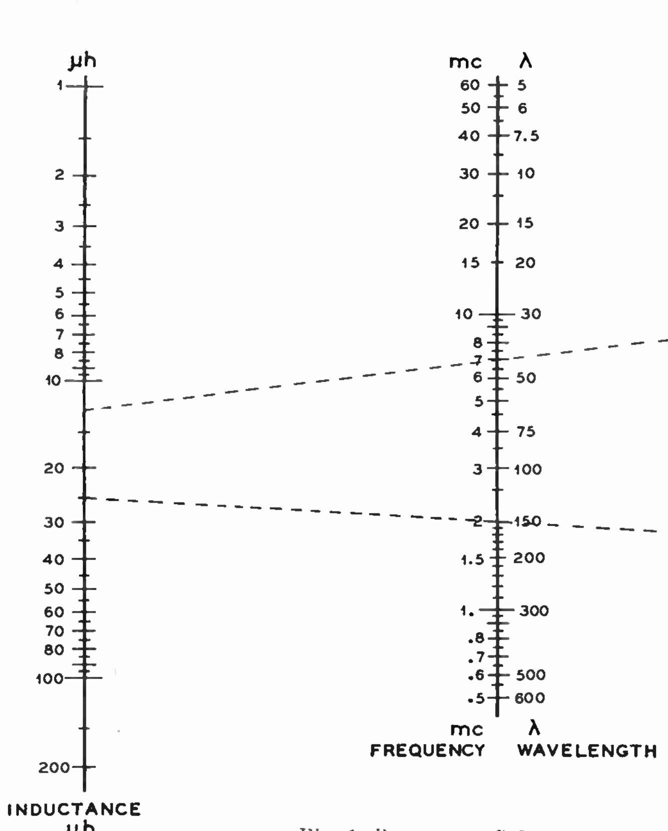


Fig. 1. Resonance Calculating Chart.

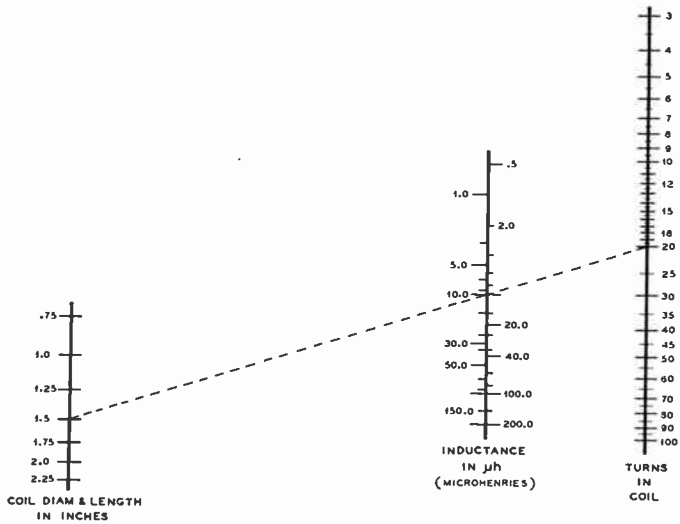


Fig. 2. Coil Calculating Chart.

from 5 to 600 meters, and the left side gives the corresponding frequencies from 60 to 0.5 megacycles.

When any two of the three factors,—inductance, capacity, and wavelength (or frequency)—are known, the unknown third factor may be found by connecting the two known factors on their respective scales with a straight-edge, and reading the unknown factor where the straight-edge cuts its corresponding scale. Two typical sets of examples are shown by the two broken lines across the chart.

For instance, let us find the size of coil needed to tune a 40 µµf condenser to 7 mc. The straight line connecting 40 on the right-hand scale with 7 on the central scale cuts the left-hand scale at about 13, whence 13 µh may be taken as the inductance of the coil. In the same manner, if 13 µh were given as the inductance and 40 µh as the capacity, the straight line connecting them will be seen to cut the frequency scale at 7 mc. On following the other broken line in the same way, it may be seen that a 250 µµf condenser and a 25 µh coil are resonant at 2 mc.

This chart gives the resonant frequency for various values of L and C, connected either in series or in parallel, in accordance with the formula

$$2\pi fL = \frac{1}{2\pi fC}.$$

which states that the resonant frequency is that frequency for which the inductive and capacitive reactances are equal. From it is easily derived the equation

$$f^2 = \frac{1}{4\pi^2 LC} = \frac{0.02533}{LC}$$

for f in cycles per second, L in henries and C in farads. When f is expressed in megacycles, L in microhenries and C in micro-microfarads it becomes

$$f^2 = \frac{25330}{LC} \text{ or } f = \frac{159.155}{\sqrt{LC}}$$

whence we have

$$L = \frac{25330}{Cf^2}\ \mu h \text{ or } C = \frac{25330}{Lf^2}\ \mu\mu f.$$

The results obtained by means of the formulas are more accurate than those given by the chart. For example, to calculate the inductance which is resonant at 7 mc with a 40 µµf condenser, we have

$$L = \frac{25330}{40(7)^2} = 12.92\ \mu h.$$

Inasmuch as the capacity of the condenser and the desired frequency are usually the known factors, the remaining problem is generally that of determining the diameter and number of turns in a coil which has the inductance given either by the chart or the

(Continued on Page 76)

Letters FROM A.R.D. Members

Mr. Frank Jones:

As one Ham to another, I want to tell you that I put up one of your "Poor Man's Beams," as described in the January issue of Radio Defense Magazine. I put it up for 20 meters, and the result has been so fine I just had to write and tell you about it.

Until I had read your article, I had been using a long wire, voltage fed. I think that out of five calls, either CQ or direct calls, I would get one answer. Now, with your beam, out of five calls, CQ or direct, I make three contacts, which shows how well your beam works. I made it up on the ground, feeders and all, and put it up and haven't made an adjustment since.

My power here is only 100 watts on fone, and as no doubt you know, that isn't anything on 20, but with your beam it is plenty.

I have also read your article on Grid Circuit Considerations and enjoyed it immensely, and feel I have a better understanding on grid drive now than previous. I'm looking forward to the rest of your articles on the workings of tubes, etc.

73 and cul,

Radio W6OAS GEORGE L. OLSON.

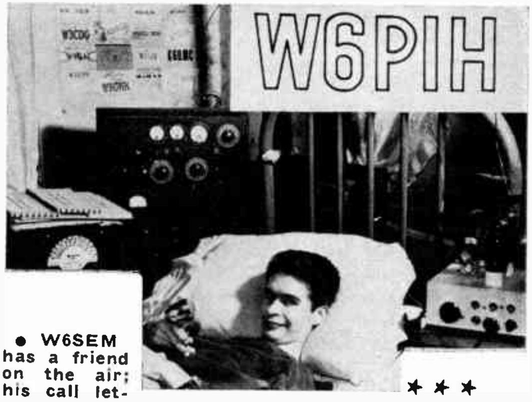
* * *

. . . To Mr. J. H. Stiles—who failed to give his address when he asked us to advise him if his local radio club could secure affiliation with A.R.D.A., also if we had membership pins available—we reply that the association is composed of individual members only, amateurs not subject to the provisions of the Selective Service Act, and general membership is not given to radio clubs. As the cartoon below illustrates, A.R.D.A. does not give membership certificates as a magazine inducement. A.R.D.A. certificates are awarded solely on merit, whether you subscribe or not.

. . . Day after day, as regular as clockwork, amateurs submit applications for enrollment in their own handwriting—on their own stationery—refusing to clip the application form from the pages of the magazine because of a desire to keep the issue intact. We have therefore been asked to insert the application form lossely into the magazine, but this entails a heavy expense. Painstakingly, each and every word of the printed text now a part of the enrollment blank has been copied in long-hand by many applicants. Hereafter we will mail as many blanks as required to those who apply for the same. Pass them along to defense-minded amateurs, and use them for your own purpose, if you do not wish to remove a page of printed text from the magazine.

* * *

. . . To Mr. W. F. Bonnell, W5CVW, Fort Worth, Texas—our humble thanks for a splendid tribute. We quote: **"Here is my subscription to your fine magazine and also my pledge for Amateur Radio Defense. Just happened to find the December issue in one of our radio stores and it certainly is one fine issue. At the rate you are going it looks like you will run out of copy before many more issues appear. I have never seen so many fine articles in one magazine, and certainly hope you keep up the good work."** Mr. Bonnell is a pilot with the American Airlines, a First Lieutenant in the Air Reserve, has a 400-watt station on 20, 40 and 80 meters, also portable equipment in reserve for defense, when needed. Commenting on his letter, the editors assure him that our files contain sufficient editorial material of exclusive nature to fill a magazine twice the present size for a long time to come.



● W6SEM has a friend on the air; his call letters are * * *
W6PIH is a shut-in, whose likeness and equipment are illustrated above. Said W6SEM: "These men could perform a distinct service for Amateur Radio Defense Association. They can be on watch for long hours, and they should be welcomed into our Association." The idea is a splendid one. Send names and addresses of all amateur radio shut-ins and we will supply them with copies of this magazine each month, free of cost. And, too, application forms for membership in A.R.D.A.

War Fright?

*By Louis R. Huber**

IT SOUNDS funny to us red bloods, but a lot of amateurs stayed off the air during 1940 through sheer war fright. This condition was encouraged somewhat by the proclivity of a certain "established" amateur organization for telling hams more about what they can *not* do than about they *can* do. Fortunately there are more amateurs who don't follow such advice than who do. Those who were scared, who sold their equipment in some cases, have now recovered—and they are trying to buy it back today at higher prices.

You know, it's a whole lot easier to be practical when you're not scared. The Italians found that out when the Greeks chased them through Albania. And our war-or-no-war editor tells us that the wise thing to do is hang on to your transmitting tubes. The grapevine has it that manufacturers are griping over thirty-day delays in tube deliveries right now; and longer delays are expected. There is another whisper—well-authenticated—that it won't be long before standardization in transmitter tubes will be forced upon the radio industry because of the war emergency. Uncle Sam is making sure that whoever makes the tubes, they'll be alike, anyhow! The same is likely to go for other pieces of equipment, too.

The war-or-no-war editor, seldom hesitant about prophecies, tells us flatly that America isn't going in this year. He says that if anyone is so scared he stays off the air these days, the lack of fun he gets out of ham radio serves him right. Why not war for us in 1941? Simply because we are not yet prepared, militarily. We won't chase the enemy with broomsticks or shoot airplanes with skyrockets. "Read the newspapers," says the war-or-no-war editor. "You can take President Roosevelt's word for it when he tells you we won't fight unless we are attacked, and that we won't send our boys to Europe." If the attack is imminent, says the war-or-no-war editor, the President will be the first one to take us into his confidence and tell us all about it.

As far as war goes, the national preparedness program is just getting under way now, but watch what happens six months from now! Things will really begin to roll then — and radio preparedness will roll right along with the rest of it. This does NOT mean amateurs will go off the air. Uncle Sam is too smart to shut off his best training department.

In the last world war, radio amateurs could offer the government only a passle of zinc spark gaps, Marconi rotaries, and kickback preventers; but today it is different. We have the Kalifornia Kilowatt, which blasts the diaphragms off many a foreign headset. Beam antennas add their sock. All this adds up to a lot of effective transmission and plans are under way in Washington to make use of it this time, because it's mighty worth while.

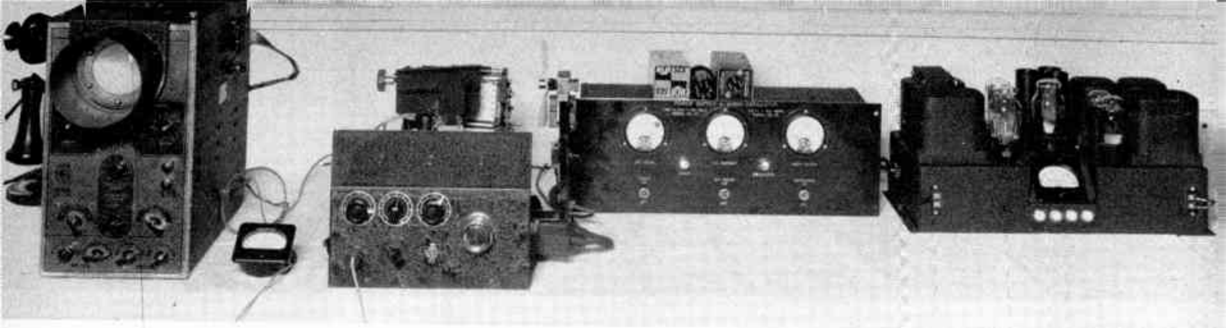
Some amateurs even go so far as to say they can already "feel" our full participation in the war; but the war-or-no-war editor held out his hand the other day and all he felt was a Draft!

Of course the amateurs in the reserve bodies—army and navy—will be the first to answer the call if and when it comes. Many of them already have been called up as a part of the defense program. But when the reservists leave for active duty, who is taking their places? You and me, of course!

And here's one of the hottest tips yet: the guy who probably will go OFF the air when things begin to pop is not the chap with a rarin'-to-go station, but the guy who can't prove his worth! So now's the time to be making the most of some mighty good opportunities. The fellows who can take it and dish it out and who keep their equipment in good operating order—they'll stay on the air (for Uncle Sammy) even if the guns begin to roar.

So—again our prediction—more or less normal operation through 1941. The wise ham will make the most of it!

**Associate Editor*



The Engineering Forum

F. D. Welis

This month the Forum Editor discusses the possibility of operating 6L6 tubes as class-B modulators. The reader is asked to correspond with the editor of this department, telling of the results secured after this adaptation has been given a trial. The idea holds possibilities, and further data will be published when additional information becomes available.

No. 10—6L6G Triodes

SINCE they were introduced a number of years ago, thousands of 6L6G tubes have come off the assembly line. A good proportion of these have found their way into ham shacks, where they are so prevalent that several are usually in the "junk box." The object of these paragraphs is to outline some less-publicized uses for the 6L6G in order that the dormant tubes may be put into service.

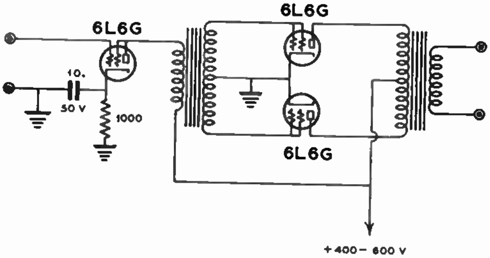
When used as triodes, the 6L6G fills a blank space in the list of available tubes; namely, a triode with a 6.3-volt filament, indirectly-heated cathode, and 20- to 25-watt plate dissipation.

There are two ways of connecting the tube:

1. As a high mu triode. No. 4 and 5 pins are tied together, connecting the screen and the control grid. These two are then used as the triode grid. No. 3, the normal plate pin, is used as the plate.

2. As a low-mu triode. No. 3 and 4 pins are tied together, connecting the screen and plate. These two are then used as the triode plate, and No. 5, the normal grid, becomes the triode grid.

The 6L6G high-mu triode requires no bias to keep the plate current within bounds. As a matter of fact, with 600 volts on the plate, and zero bias, the tube draws about 10 ma. This makes it a highly desirable tube for a buffer when some previous stage is to be keyed. It makes an excellent crystal oscillator, and can be used with quite high plate voltages without undue crystal current. However, the grid-leak must be very low in order to get substantial output. In one circuit the tube was used with an r-f choke from grid to ground, no grid resistor, 600 volts on the plate, successfully driving an 809 as a doubler. Should the crystal fail to oscillate at any time, there will be no injury



Class-B Operation of 6L6 Tubes.

to the tube, since the plate current would immediately drop to about 10-ma.

Recently some experiments have been made with the tube as a push-pull class-B audio amplifier. No attempt was made to choose parts carefully. A nondescript class-B driver transformer was used, output load impedance was adjusted to 10,000 ohms plate-to-plate, and a 6L6G low-mu triode used as a driver. (See diagram.) An audio oscillator was employed as a source of input voltage, and resistors were used to load the modulation transformer. With an oscilloscope connected to observe the output waveform, the following results were obtained:

Plate volts 415
Plate current 80-ma. (with drive applied)
Plate-to-plate load 10,000 ohms

Audio watts 22
Efficiency, approximately, 65%
Plate volts 580
Plate current 120-ma. (with drive applied)
Plate-to-plate load 10,000 ohms
Audio watts 50
Efficiency, approximately, 70%

No attempt was made to measure harmonic distortion. However, the wave shape was quite good at both settings. Although it might seem that 600 volts is a rather high potential to apply to 6L6G's, in this particular instance the plate dissipation per triode was 10 watts, and the plate current per tube was only 60-ma. There is no danger of injuring the tube under these circumstances, the only consideration being the possibility of insufficient voltage insulation. The main application of an audio channel such as this would be in a transmitter where the voltage for the final r-f stage was 600 volts, and it was desired to use an inexpensive medium-power modulator from the same source.

The 6L6G low-mu triode has a fairly low plate resistance, which makes it a suitable selection for a class-B driver when moderate amounts of audio are necessary. It is a good class-C amplifier and drives very easily. (Of course, when used as a triode in r-f service, 6L6G's must be neutralized.)

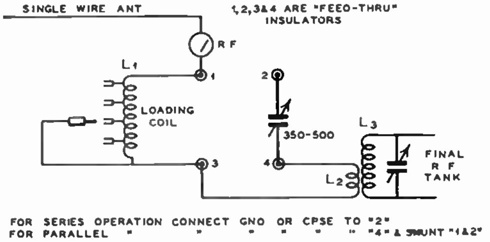
The following constants were used in an experimental circuit:

Grid resistor 15,000 ohms
Grid current 5-ma.
Plate volts 350
Plate current 70-ma.
Output 16 watts

If it is assumed that the limiting factor in a design shall be the plate dissipation of the tube, and a conservative figure of 60% efficiency is assumed, it is reasonable to expect that 50 watts could be run to a single 6L6G, or 100 watts to a pair of them in class-C r-f, but with reduced life. When used as triodes, there is no need for a screen-dropping resistor or screen by-pass. Also, the possibility of overheating the screen and producing a "gassy" tube is eliminated. The fact that neutralization is necessary should be no particular drawback, since the 6L6G as a beam-power tube must often be neutralized when used as a straight-through amplifier in order to give good stability. As far as drive is concerned, a single 6V6G as a crystal oscillator will amply drive a 6L6G low-mu triode.

Item No. 11—Series-Parallel Switching Circuit for Antenna Coupling Unit

In FRANK C. JONE'S discussion of proper L/C ratios for tank circuits there was included an illustration of an antenna coupling unit by means of which it is possible to use either series or parallel tuning. It is surprising to note the unusually large number of requests from readers for a complete circuit diagram of this seemingly simple device. True, the circuit is a "tricky" one. but your worries will be ended when you check the diagram herewith.



Series-Parallel Coupler Circuit.

The front panel of the coupler unit is fitted with four feed-through insulators. marked 1, 2, 3 and 4 on the diagram, and the connections for either series or parallel operation are shown below the drawing. The loading coil L_1 has about 15 turns of no. 12 tinned wire, spaced one diameter, and wound on a 3-inch form. Taps can be taken from as many coil turns as desired; usually five or six taps will suffice. Coil L_2 is the link around the final r-f amplifier tank coil. and has from two to four turns, depending upon the individual transmitter and the desired bank of operation. This universal coupler has proved satisfactory for all-band operation, all the way from 160 to 10 meters, with a single-wire antenna about 125-ft. long.

NEW TUBES

R.C.A. has made available the following new tubes:

RCA-1629—Electron-Ray Tube (Indicator Type)
RCA-8000—Oscillator, R-F Power Amplifier, Modulator

The 1629 is a high-vacuum, heater-cathode type of tube designed to indicate visually, by means of a fluorescent target, the effects of a change in the controlling voltage. The tube, therefore, is essentially a voltage indicator and as such is particularly useful as a convenient and non-mechanical means of indicating accurate adjustment of a circuit to the desired conditions. Because of its 12.6-volt heater and its 7-pin base, the 1629 is particularly suitable for service in aircraft radio equipment. In this equipment and other equipment subject to vibration and shock, the 7-pin base provides ample friction to hold the base in its socket.

The 8000 is a transmitting triode having a maximum plate dissipation of 150 watts under ICAS conditions.


QRM QRN
by Les Funston W6QQU
ANY WAR NEWS?
NO SIR CAPTAIN! BUT ONE OF THE DOGS AT KC4USA JUST HAD PUPS!
CALLING ALL EMERGENCY NET STATIONS! HELP!! AND I AINT FOOLING!
MAYBE I CAN MAKE A K6 CONTACT!
LOOKIT THAT HOLE IN MY NEW TABLE! HOW MANY TIMES HAVE I TOLD YOU NOT TO BUILD RADIOS IN THE PARLOR YOU IDIOT - NOW GET THAT BLANKETY BLANK RADIO JUNK OUTA HERE
GOSH DARLING I DONT SEE HOW IT HAPPENED!
OH OH MAMMY'S MAD!

---More QRM and QRN

By Phillip Space

...Said Johnny Bigham to his father: "Look what I got Pop, another new title—I'm *Official Broadcast Station* of this district now." Said Pop: "I'm afraid the title was given to the wrong member of the family—it rightfully belongs to your mother."

* * *

...This actually happened: Max Fisher, W6SZ's buddy, lives in a suburban village near San Francisco. The train on which he commutes passes the *Eimac* tube factory at San Bruno. Four commuters were bunched together, discussing the war, when the train passed the plant, and the commuters' arguments then revolved around the antenna atop the tube factory. It went like this:

Jerk No. 1—"What do they make - - ?" (Pointing at the Eimac antenna).

Jerk No. 2—"Oh, they make airplanes, complete planes, because I saw 'em flying near the plant."

Jerk No. 3—"Oh! no they don't—they make only the wings for the planes; I know, because one of my neighbors works there."

Jerk No. 4 — (Fellow with a voice like a mouthful of marbles.) "No, they certainly do *not* make airplane wings, they make raaddios. Look—see that aerial on the roof of the building? The thing with the *SHORTWAVES ON IT?*"

Jerks Nos. 1, 2, 3: "OH!"

Miss Match: Before you leave for the army camp in the morning, isn't there something thrilling you'd like to do tonight?

Mister Q: Y-y-y-yes, honey bunch, I'd like to work the Byrd Expedition at the South Pole on 160 meters.

Circuit Of The Month

This manuscript begins a series of monthly descriptions of low- and semi-high power amateur transmitters, for c.w., 'phone, or both. Eventually every conceivable type of transmitter from 50-watts upward will be diagrammed and treated in a technical manner. Paste the circuit diagrams in your note-book, and within a year you will have the complete data for designing practically any transmitter suitable for amateur service.

THE Technical Editor's mail has assumed large proportions and scores of questions are being received from amateurs. These letters have enabled us to determine what is required by the average amateur, in the form of small or large transmitters, and it is interesting to learn that a high percentage of questions revolves around a transmitter with a modest tube in the final r-f amplifier. The 807, 809, 812, T40, 35T, HK-24, and equivalent tubes are the most popular. Many amateurs who would normally build larger transmitters have recently decided to be content with a somewhat smaller job—until the war situation shows definite signs of clearing up. And even though the interest in high-power transmitters has declined, there is more activity than ever among those who want to build smaller transmitters.

We begin the series with a transmitter of medium power output, the circuit designed around the still-famous 6A6 dual-triode oscillator, for we are in receipt of a great number of letters asking if recent improvements or changes have been made to this

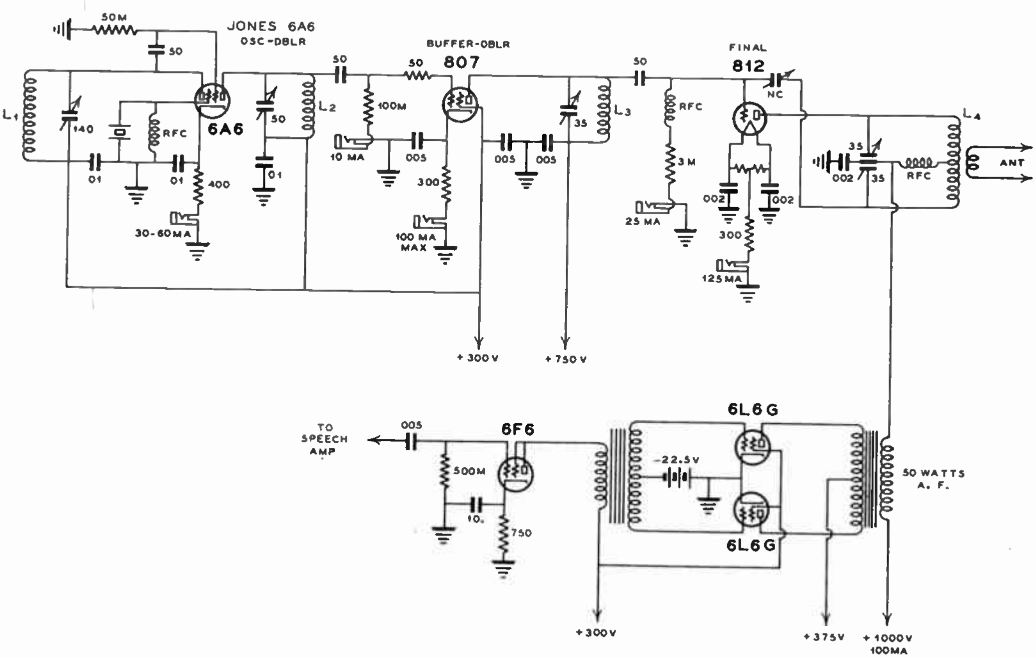
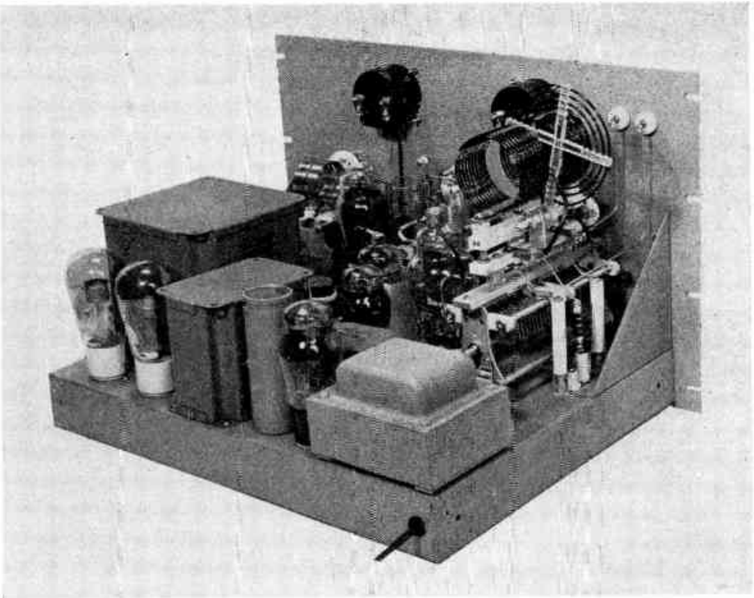


Fig. 1—Schematic wiring diagram, with circuit constants, for r-f portion of 100-watt transmitter—also a suitable low-cost modulator stage.

★

If the Circuit of the Month is to be used for c.w. only, the transmitter illustrated to the right will appeal to those who like to build professional - appearing equipment. This transmitter has two power supplies, one for the oscillator and 807 stages, another for the RCA-812 final amplifier.



earlier form of *Jones* oscillator. Study the schematic wiring diagram, and acquaint yourself with the general line-up. Now let's proceed with the technical discussion:

The Final Amplifier

A SINGLE RCA-812 is suggested for the final amplifier. However, a single-tube amplifier is not as easily neutralized for multi-band operation as a push-pull amplifier, nevertheless the neutralizing adjustment for two consecutive bands is satisfactory for the type of circuit shown. A split-plate circuit, with split-stator tuning condenser, preferably of the u.h.f. type, and with an air-gap of 0.27- or 0.184 per section, is recommended. In some cases it is desirable to let the rotor "float," rather than to connect it to ground through a .002μf. 2,000-volt mica condenser. If this type of amplifier is to operate in the 5- and 10-meter bands, care should be taken to arrange the plate circuit components so that the r-f leads will be very short, in order to secure a high L-to-C ratio. The final tank coil should plug-in across the tuning condenser, and with the shortest leads possible to the two stator sections. The grid circuit of the final amplifier is capacitively-coupled to an 807 buffer or doubler stage in order to minimize the number of tuning controls. Sometimes link coupling can be adjusted so as to give more grid current, but this form of coupling calls for an additional tuned circuit and more chassis space. The 812 can be connected to a 1,000- or 1,200-volt power supply, preferably to a 1,000-volt supply if the amplifier is to operate on 5- and 10-meters. In the majority of cases, an input of approximately 100 watts is desired; this can be obtained from a relatively small power supply, with either filter choke or condenser input to the filter circuit, since the load current will be approximately 100-ma. For an input of 100 watts, 50 watts of sine wave audio power will produce 100 per cent modulation. This represents a peak audio power of 100 watts, or approximately 25 to 30 watts of average power for speech input. A pair of 6L6G tubes, operated in class-AB_2, and a 6F6 triode power driver stage, will supply a peak output of 100 watts when connected to a power supply which delivers the voltages indicated in the circuit diagram.

The low voltage supply should be capable of delivering at least 250-ma. load current in order to supply the crystal oscillator, speech amplifier stages, and modulator. The modulator load will be 10,000 ohms; this load must be held down to approximately 3,800 ohms for the plate-to-plate load of the 6L6G tubes. A 50-watt modulation transformer will be satisfactory for the modulator output. The triode-connected 6F6 driver stage can be resistance-coupled to a two-stage amplifier for connection to a low-level microphone.

The Buffer Stage

AN 807 tetrode is suitable for the buffer or doubler stage; it will deliver approximately the same output, with the circuit constants shown, when used either as a buffer or doubler. It is desirable to connect the plate circuit of the 807 to a 750-volt power supply in order to insure sufficient grid drive from a 600-volt power supply. Short plate leads, and as much inductance as possible in the plate circuit, is essential for securing a reasonable amount of efficiency from an 807 stage when it is doubling to 5 meters. The shunt tuning condenser is sometimes eliminated, and a variable series condenser substituted so as to resonate the plate circuit of an 807 for 5-meter operation. The tuning range is rather narrow and requires exact adjustment of the coil turns in order to "hit" the 5- and 10-meter bands if series tuning is employed. Series tuning calls for an r-f choke in the +B lead, and a 50- or 100$\mu\mu$f condenser in place of the .005$\mu\mu$f mica condenser shown in the circuit diagram. A parasitic suppressor, consisting of a 50- or 100-ohm, 1-watt resistor is connected in series with the control grid in order to eliminate a common type of parasitic oscillation. A combination of grid-leak and cathode bias is shown, and with a rather high value of grid-leak, in order to insure proper operation of the doubler when the plate and screen voltage are as shown.

It is usually desirable to operate the 807 as a doubler in the type of circuit recommended here, since less shielding will be required between grid and plate circuits, and the danger of self-excited oscillation is practically eliminted. For 10-meter operation, the grid circuit of the 807 would be tuned to 20 meters, and the plate to 10 meters. For 5-meter operation, the grid would be tuned to 10 meters, the plate to 5 meters, with the final stage of the transmitter always working as an amplifier. If the 807 has a tendency to operate with too much plate dissipation or cathode current, the cathode resistor can be increased to 500 or even 1,000 ohms. The arrangement of parts and exact values of plate and screen voltage may require some modification in the value of the cathode resistor now specified in the circuit diagram.

The Crystal Oscillator

THE 6A6 twin-triode crystal oscillator has been popular over a long period of years, since it is fairly sure-fire in operation and requires no critical adjustments. It can be used with any type of 40-meter crystal, including the low-temperature-coefficient cuts. The form of oscillator circuit in the transmitter diagram of Fig. 1 uses one section of the triode as a crystal oscillator and the other section as a frequency doubler or quadrupler, since very little grid drive is needed for the 807 stage. The plate circuit of the second section of the 6A6 can be made to cover the 10- and 20-meter bands for 5- and 10-meter output in the final r-f amplifier, by means of a fixed coil and a fairly large tuning condenser. Somewhat more efficient operation can be obtained from a low-C tuned plate circuit in this quadrupler section of the oscillator. The arrangement in the main circuit diagram allows the use of a fixed coil for two-band operation, and the transmitter therefore requires only two sets of plug-in coils for the 5- and 10-meter bands.

Other Dual-Triode Oscillators

THE type of circuit in Fig 2 is a standard crystal oscillator-doubler with a 6A6, 53, or 6N7 dual-triode tube and the necessary plug-in coils. The circuit constants given in this diagram are suitable for any amateur band, up to and including 160 meters. With this type of circuit it is impossible to use the second section of the dual-triode as a straight-through buffer.

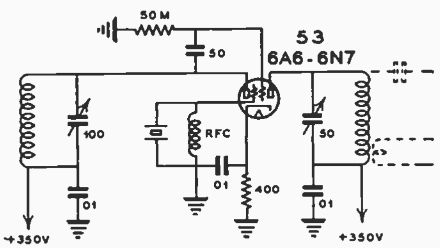


Fig. 2—Standard 6A6 oscillator-doubler circuit, the output of which is on the second harmonic of the crystal frequency.

The circuit in Fig 3 shows a neutralizing arrangement for the tube, in order to use the tube as a crystal oscillator and buffer or or doubler. The form of circuit in Fig. 3 would be desirable for a transmitter designed to operate in the 160- or 80-meter bands, with 160- or 80-meter crystals.

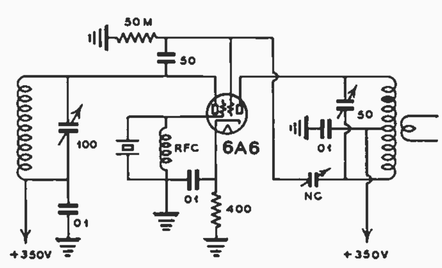


Fig. 3—Dual-triode oscillator with neutralizing circuit for the second section of the tube, thereby enabling the tube to function as a crystal oscillator and buffer or doubler.

F. C. C. Inspectors Locate Ingenious Illegal Transmitter

A MONTH'S search by the Federal Communications Commission for unlicensed radio equipment which broadcast "sure tips" to favored bettors while horse races were still being run was climaxed last night by the arrest of two men and the seizure of illegal apparatus at the Charles Town, W. Va., racetrack.

In early December Commission field men discovered that two portable transmitters were surreptitiously being put to such use. One transmitter concealed under the coat was employed by one of the men in the grandstand to communicate progress of the race to an accomplice in a rented tourist cabin near the track. The latter utilized the second set to flash the expected result to conspirators listening in at outside receiving stations. Under this system, some persons were able to make advantageous bets before the results of the race were generally known.

The method of operation, as determined by Commission inspectors listening in, was this:

At the start of the race a person could be heard whistling on a certain radio frequency, followed by the words "Oh Johnny" repeated several times, and then a few bars from such songs as "Beer Barrel Polka" or "Maryland, My Maryland" would be sung. As the race neared the finish the voice would suddenly cut in with a number, repeated until the race was completed. Immediately after this number was spoken, a stronger signal on another frequency was observed to repeat the same number perhaps 10 or 15 times, followed by such commonplace expressions as "testing" or "testing for modulation," and finally the words, "that is all." On checking the race results it was obvious that the number in question referred to the number of the winning horse.

By the use of highly specialized equipment and technique, the party in the grandstand operating the transmitter concealed on his person was finally located. This transmitter was adjusted to an ultra-high frequency and the microphone extended down into the sleeve of the overcoat worn by the operator. To speak into the microphone, he merely raised his hand to the back of his neck and appeared to be conversing with his look-out companion, or shouting for his favorite horse to win. To allay suspicion, he carried a program and consulted it between races.

The grandstand tip-off man had a clear view of the tourist camp in which the high-powered transmitter was located, and received acknowledgments of the reception of his transmission by light signals flashed by the operator at the tourist cabin. On one occasion, the operator in the grandstand remarked on the air that a clothesline obstructed his view of the light. This announcement enabled the inspectors to verify the exact cabin in the group where the presence of the high-powered radio transmitter had been previously located by a radio direction finder, even though the antenna was concealed. This transmitter was built into a trunk and when the lid was closed gave no semblance of a radio apparatus.

Arrests were made in cooperation with the West Virginia State Police and United States District Commissioner at Martinsburg, after evidence had been presented by members of the Commission's field operations section personnel—Charles Ellert, Supervisor of the Central Atlantic Monitoring Area; Assistant Monitoring Officer Earl M. Johnson, and Radio Operator Kenneth B. Menear.

* * *

There Still Is No Santa Claus

CHRISTMAS has passed, but a Louisiana woman feels that many children of the nation are dissillusioned about "Santa Claus" as a result of remarks made from time to time on the radio, and solicits the aid of the Federal Communications Commission in this connection. But the Commission is limited by statute from exercising power of censorship over radio programs. Inasmuch as station licensees have the initial responsibility for the selection of program material and are interested in the reaction of listeners to presentations, it is suggested that the woman convey her comments to the management of the net work which carried the references to which she objects.

It Once Was DX

By Stanley W. Johnson, W6SZ

The editor of this department expresses thanks and appreciation for the large number of interesting items submitted for publication. Scores of amateurs are in communication, by mail, with our former DX associates, and it is to these men that the editor appeals for continued cooperation in the form of news items and photographs. With your help we can make this a highly informative department.

. . . **Here we are** . . . with a scoop . . . a head-on collision with pictures of what the well-dressed Ham is wearing abroad. See photos on facing page.

* * *

. . . **To start off** in high gear this month, we have red-hot news from **XVE5VE** of Trail, B. C., now Sub. Lieut. aboard H. M. S. heavy cruiser **Ajax**. Bill says this steel-spitting bulldog of the sea is the most excitingest thing he was ever on. On duty aboard the **Ajax** in three history-making battles, Bill tells me that things started off with a chase in the Mediterranean in hot pursuit of the elusive Italian fleet. "That got our fighting Irish up, running away like that." Incidentally, Bill WAS born in Ireland. Next came the R9PLUS engagement with six-inchers flying around, and once in a while through the **Ajax** like RF through a feed back hose . . . the stand up and sink 'em scrap with the 1620-ton Italian **Artigliere**, which was left wallowing in the sea with one funnel, not quite awash. Then the drive up to the entrance of Taranto Harbor, and the patrol duty while the Sunderland Flying Boats and air arm bombed hell out of one-third of the Italian fleet. Thrilling? Well—in addition, Bill's **Ajax** churned the Mediterranean into a white lather, protecting the **Ark Royal** at Cagliari during the very heavy air bombing raid in which the **Ark Royal** was ordered sunk, or else. "Talk about spitting steel . . . gosh, you should have seen the anti-aircraft fire . . . bombs showered all around us, sending up geysers of H20-four-twenty-meter wavelengths in the air . . . shrapnel, oh, sure! But you get used to that stuff; it either gets you, or it doesn't." So we see **XVE5VE** in the midst of the fray in the Mediterranean. Lots of gud luck, Bill, OM!

* * *

. . . **LY1S** and **LYIJ** . . . Swinging the beam up north to Lithuania, we see these two OM's playing a main part in the trend of events of their small but determined homeland. **LY1J** and **LY1S** last spring led the vanguard of the first Lith. troops which stormed and took by the acme of valor the capital of Lithuania—Kaunas. During this battle the government shortwave station at Vilno was knocked out of commission. Using a little Legerdemain on his xtals, **LY1J** soon had his own ham rig percolating in the govt. station's place, and handled all traffic until between bulletins and bullets he and **LY1S** were able to hold an autopsy on the government rig and patch it up to get it back into operation. Not stopping here, these OM's, as a flying squad of two, rounded up many of the **SP** Hams who were on the lam through Lithuania, and lined them up for lodging and grub. I am told that more than one of the **SP's** thought the jig was up when they were pounced-on by these two . . . only to find them to be oldtimers of ham radio, trying to befriend them . . . instead of Gestapo agents on a witch-hunt. Nice work, Julius and Pete!

* * *

. . . **VE5ZM** and his brother, **VE5AAD**, are both in England . . . **5AAD** in the Royal Canadian Air Force; Bill, **5ZM**, now a Pilot Officer with the RAF. Both are slinging plenty of lead, and—to date—stopping none. Bill says the RAF is an xdx paradise, as so many of the xdx men are in there pitching for G. In addition to his hair-rasing thrills and chills in the No. 1 spot in a flying arsenal, Bill is reported to be doing all right on the ground also. His MC-ing" ways haven't dulled a bit, and the swath he is cutting in the ranks of the G-YL's indicates an R-9 signal in this direction.

* * *

. . . **G2UT**—whose R-9-Plus sigs made more than one US Ham call for beefsteak to slap over a badly bloodshot Electric Eye, is on active dootie. His family, evacuees out of the home QTH due to the terrific barrage of shrapnel from bombings and generous sprinklings of fire bombs, will shortly be in W territory if **W4ECF** has his way about things. **4ECF** has been pouring the heat on **2UT** to send the family over here to him for the duration. We highly compliment and praise **4ECF** for his splendid effort in this regard. . . . These two chaps are a shining example of that warm bond of human friendship that amateur radio extends across 3500 miles of bleak ocean. Lots of gud luck to both of them and their YF's and kiddies.

* * *

. . . **As we go to press** . . . mail is pouring in from abroad, with high praise for the principles of the **ARD** and what it will mean to the U.S.A. in the event of emergency or disaster. War or no war, emergency or no emergency, the potential of safety proffered by a compact unit as the **ARD** is, we quote from **ZE1JH**, **"An indispensable, invaluable service that all countries should have, and none should try to be without."**

* * *

. . . **ZE1JH** . . . in part time service with the Southern Rhodesian Air Force, yet finds time to work on a two-band rotary beam in his garage. Says it will be finished when the "wah" is over. And whatsamatter here . . . Congrats on a fb Junior Op.—fighting weight 8 pounds, to he and Mrs. **ZE1JH**.

. . . **Not a man from Mars** . . . just our old friend and xdxer, **GM2UU**, Doug Lamb. The old Maestro of the Scotch Airlanes all togged out in the every day dress of an Air Raid Warden, complete with gas mask, elbow rubber gloves, rubber boots and klacker hanging at waist used for arousing deadheads during gas attacks. Note the "bee-keeper's" hood to keep the mustard gas out of the ears and off the nape of the neck. Thank Heaven, this full anti-gas uniform has never been subjected to dress rehearsal. That "W" on the tin hat stands for Warden . . . not women! As reported in December, Doug is the Chief Air Raid Precautions Warden for his district. An outstanding xdxer, whose sigs have been heard in the four corners of the earth, and whose equipment and operating ability is of the best, is now in charge of all the Home Guard, Police, Fire and Marine radio communications equipment and responsible for the operation of same. Still a ham at heart, Doug twiddles his HQ-120 when he has a chance, and has snatched himself a few earfuls of W sigs. Says that quite a few of the old dx gang from both coasts were coming through nicely during the last SS contest, and also some since then. All the "G" rigs were partially dismantled and all final "valves" handed over to the local R. I. in exchange for receipts . . . redeemable at the conclusion. Rx's may be operated whenever the OM has the time. With an eye to the day when this is over, Doug asks me to query the readers for a solution to a problem that was bothering him when the Austrian housepainter started going places . . . namely: How have you W's solved the problem of erecting a four-legged tower on a peaked or pitched roof? Write the editor of this column and let him know how . . . if you've been through the mill on this conundrum. Doug sends his best wishes to all for a Happy and Prosperous New Year. Special 73 to **W6FUO, K7HCX, W2JKQ, W6OCH, W2KR** and **W6IKQ.**

Excerpts from Letter from J. King Cavalsky VE5AL

"I have written some of the hams who are on service but up to the present there have been no replies—anything I have got is hardly information as there's a war on and no info of much use getting through.

"Amateurs in the air force leave here (Vancouver, B. C.) almost as soon as they get a uniform, and after about a week or two in the East they are sent to England. There they get land jobs unless they are in the age limit and then they can get a job on one of the big flying ships. From all accounts the radio operators on the bombers have been the heroes of the war, one of them getting the Victoria Cross, which is the highest honor that can be had in the British forces—they usually only give it to guys who are dead—hi! That's how scarce it is.

"Dud Meakin, one of our local amateurs, is in the air force and stationed in one of the training camps on the B. C. coast. So far he has been building transmitters and from all accounts they are a real success.

"Bian Naylor, VE5BI, has a commission in the air force. He was formerly with the R. I.'s office and on interference work. He has a private flying license but it isn't worth a burnt-out tube in the air force as his age is a little too much so when I spoke to him he gave me quite a recruiting talk as he is with that branch at present but expects to take over an instructing job as soon as he can be placed. He tells me that several Americans have joined up here, and there is still a demand for amateurs or service men. They start them out at leading aircraftsman's pay which ordinarily is not reached until the third year.

"George Schutke, VE5GS, reached the headlines about three weeks ago. He was the wireless op on the freighter "Leisioux" (I think that is how it's spelled) which broke up in a storm on the Atlantic about 500 miles east of

(Continued on page 76)

All You Want To Know About The Single-Wire-Fed Antenna

Probably all of the questions you have asked about the single-wire-fed antenna are answered in this manuscript, prepared by our Technical Editor, Frank C. Jones. This elaborate treatment of a particular type of antenna will be followed, next month, with identical data on another type. The purpose of this series is to discuss extensively one type only, so that you won't have to consult a dozen different texts in order to piece together a lot of hit-and-miss information.

THE single-wire-fed antenna is a half-wave resonant antenna, fed by a non-resonant single wire which can be of any length. The antenna proper is an electrical half-wave in length at its lowest, or fundamental, frequency of operation. The single wire feeder is usually connected at a point on the antenna approximately one-third the distance from either end, as shown in Fig. 1.

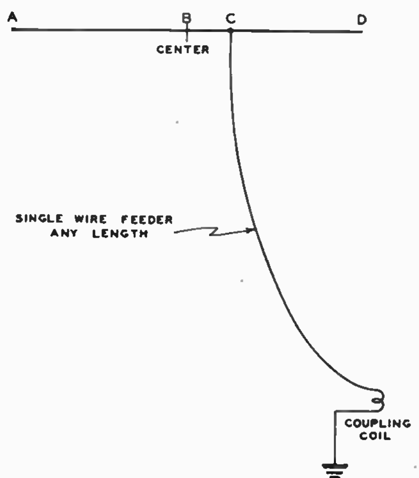
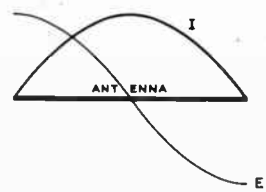


Fig. 1

Radiation takes place essentially from the antenna wire, rather than from the feeder. At the fundamental frequency the antenna has standing waves of voltage and current, as shown in Fig. 2. The current along the feeder, under ideal conditions, would be constant—and with no standing waves of voltage or current.

In the antenna proper, the r-f voltage is lowest at the center and highest at the ends, as shown in Fig. 2. The current is minimum at the ends and maximum at the center. A minimum point is usually called a *node*, and a point of maximum current is known as a *loop*.



HALF WAVE ANTENNA

Fig. 2

The impedance of the antenna varies from a minimum at the center, or current loop, to a maximum at the ends of the antenna. This impedance is very nearly non-reactive at the center, and for very high antennas it is practically equivalent to the radiation resistance, which would be 73 ohms. For lesser heights above ground, the radiation resistance at a current loop varies as shown in Fig. 3.

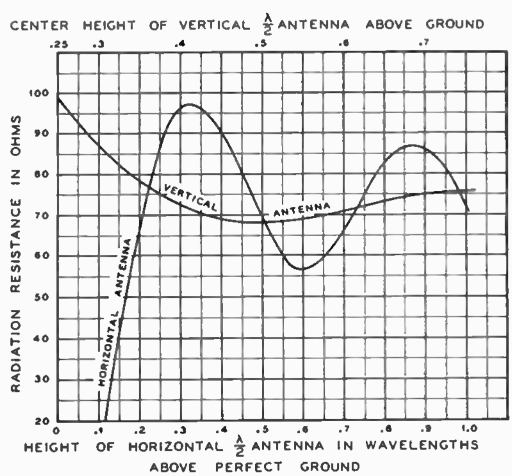


Fig. 3

The presence of earth affects the radiation resistance and also the terminal impedance at the feeder connection point. Nearby objects, such as telephone and power lines, or buildings, have a similar effect—which means that the correct feeder point can only be determined by experiment, if the standing wave effect is to be a minimum on the feeder.

THE ADVANTAGES of a single-wire-fed antenna are (1)—its ability to operate satisfactorily in nearly any installation, (2)—to operate on several harmonically-related amateur bands, (3)—the elimination of resonant feeders. It can be built cheaply and put into operation with a minimum of effort, as compared to other types of antennas.

Its disadvantages are concerned mainly with the radiation from the feeder. The antenna proper, which may be either a vertical or horizontal rod or wire, is usually suspended as high as possible above ground, and its function is to do all of the radiating. Radiation from the feeder may cause some cancellation of radiation from the antenna proper in certain directions, or there may be a waste of radiated power at very high angles above earth, and also an additional waste of power by radiation into nearby objects, such as buildings. In most cases the feeder radiation is not of great importance, except possibly in the case of harmonic operation. For harmonic radiation a compromise condition is possible; in this case the feeder radiation is minimized for all bands of operation, but not to the extent which can be made by experimental adjustment of the feeder tap-on point for any one particular band of operation. If the feeder tap on the antenna is adjusted to the point of minimum standing waves on the feeder, for operation on the fundamental frequency, the antenna will not operate very satisfactorily in the higher frequency bands. It is better to use a compromise tap point which will give satisfactory operation on several bands, without consideration of feeder radiation.

The antenna should be as high above ground as possible in order to radiate the greatest amount of power at angles close to the horizon. This applies particularly to horizontal antennas, in which the antenna gain at low angles is affected very greatly by the earth, as shown in Fig. 4.

From the curves in Fig. 4 it can be seen that the antenna should be more than a wavelength above ground if full advantage of the antenna is to be realized. Less height will merely result in less signal strength, for either transmitting or receiving.

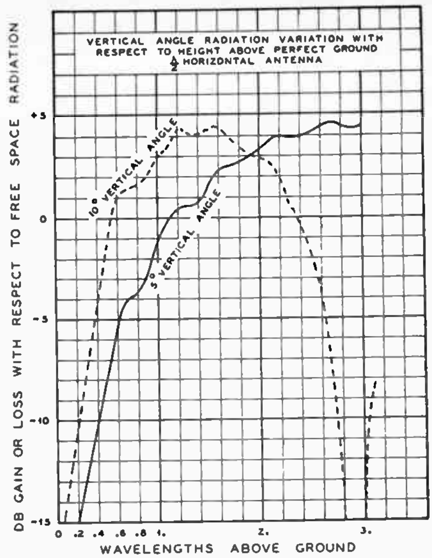


Fig. 4

A full wavelength in height for 10-meter operation is approximately 34 feet, while for the 20-meter band this height is approximately 67 feet. A compromise of from 50 to 60 feet is usually chosen for an antenna designed to operate in the 10-, 20- and 40-meter bands. Greater height is desirable, since the effective height in the 40-meter band would be less than a half wavelength, and the radiation at very low angles would be reduced by the presence of the earth. The cost of attaining greater heights may prevent the achievement of the full capabilities of a single wire antenna. This applies to any simple half-wave antenna, no matter the type of feeder connection chosen.

The curves in Fig. 5 indicate the amount of radiation obtained at different vertical angles of radiation above the horizon, for the case of a horizontal antenna whose height is a quarter-, half- or full-wave above ground. These curves are useful for determining the relative amount of radiation at different vertical angles for operation on the fundamental frequency or in the harmonically-related bands. For example, an antenna designed to have a fundamental frequency in the 80-meter band with a height somewhat more than 60-ft. above ground would have a quarter-wave height above ground. This same antenna operated in the 40-meter band would have a half-wave height, and a full-wave height for 20-meter operation. Nearly all long-distance transmission and reception

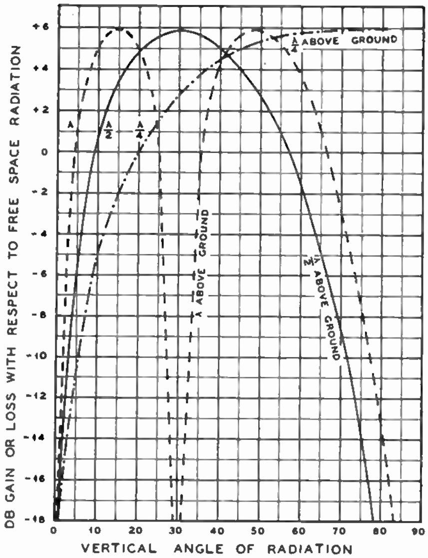
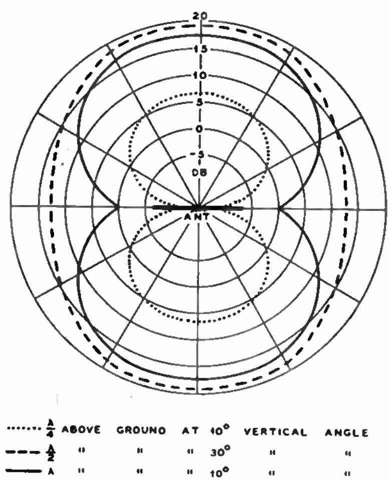


Fig. 5

can be accomplished most effectively with low angles of radiation, between 3° and 15°. Higher angles of radiation are sometimes useful for short-skip distances of a few hundred miles. Local transmission and reception is accomplished at approximately zero angle, or parallel to the horizon.

The radiation from a half-wave antenna has a circular pattern for a vertical antenna, and a modified figure-8 pattern for a horizontal antenna. The radiation at low angles is much lower from the ends of a half-wave antenna than in a direction at right-angles to the wire, as can be seen from Fig. 6.

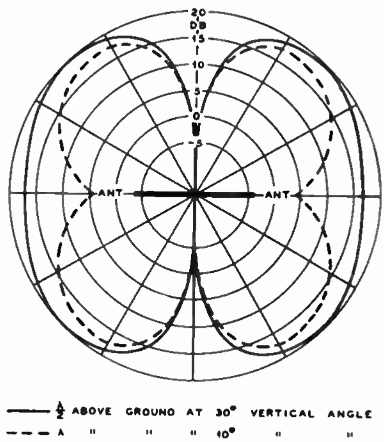


HORIZONTAL PATTERN OF λ/2 ANTENNA ABOVE PERFECT GROUND

Fig. 6

At zero vertical angle the radiation from the end of a horizontal antenna would be zero; however, at any other angle there is some radiation from the ends. This is shown in the dash-line curve, Fig. 6, proving that the radiation from the ends at a vertical angle of 30° is only 5 or 6 db less than that which occurs broadside to the wire. The dotted-line curve in Fig. 6 shows the relative radiation at a 10° vertical angle for an antenna fairly close to the ground. An increase in the height of the antenna permits a signal gain of approximately 10 db for the particular conditions shown in Fig. 6 at a 10° vertical angle. From these curves it is seen that the antenna wire should be erected so that the two main lobes of radiation will occur in the desired directions of transmission and reception, for operation on the fundamental frequency.

If advantage is taken of harmonic operation of this antenna, it may be desirable to orient the antenna wire so as to obtain maximum radiation in a desired direction in one of the harmonic bands.

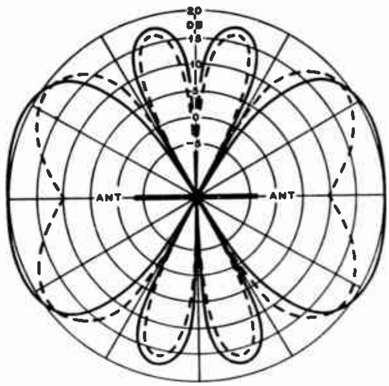


HORIZONTAL PATTERN OF 1λ ANTENNA

Fig. 7

Figs. 7 and 8 show the horizontal patterns for harmonic operation, in which the wire becomes a full wave, or two full waves, at the frequency of operation. The radiation tends to become more end-fire for harmonic operation, and with less radiation at right-angles to the wire.

In a practical installation the direction of the antenna wire may be be limited by the presence of trees, buildings or power lines, or the availability of supports for the ends of the antenna. The radiation patterns shown in Figs. 6, 7 and 8 will permit the operator to calculate the performance of his antenna, for either transmission or recep-



—— λ/2 ABOVE GROUND AT 30° VERTICAL ANGLE
- - - - λ " " " 10° " "

HORIZONTAL PATTERN OF 2λ ANTENNA

Fig. 8

tion, in any direction. The presence of minimums, or *nulls*, in the radiation patterns will help to explain why stations in certain directions can not be easily contacted with a certain antenna installation.

A vertical antenna should not be operated on its harmonics, since the end-fire effect will cause most of the radiation to be wasted at very high angles, or to be directed down towards the ground. There is always considerable loss caused by ground reflections, because the earth does not act as a perfect mirror. The signal directed down towards the earth will be reflected back up by the vertical angle equal to that of the direct ray—just as in the case of a light wave being reflected from a mirrored surface.

Length of the Antenna

THE antenna can usually be cut to a calculated length and made to operate satisfactorily at its fundamental frequency and also in the harmonically-related amateur bands. The length for fundamental or half-wave operation is slightly less than a full half-wave, due to the two end effects which each subtract approximately 2.5 per cent of a half-wave. The formula for calculating the length is:

$$L = \frac{468}{f},$$

where L is the length in feet,
f is the frequency in Mc.

The resonant length for harmonic operation is slightly different, since the end effect is less. Where two half-waves of standing voltage or current meet on a continuous wire, there is no end effect. The latter occurs only at the free ends of the wire.

The formula for calculating the antenna length for harmonic operation is:

$$L = \frac{492\ (k-.05)}{f}$$

where L is the length in feet,
f is the frequency in Mc.
k is the number of half-waves on the wire.

It is usually desirable to calculate the antenna for harmonic resonance at its highest operating frequency, since slight errors in length become a smaller percentage in the lower-frequency bands.

Typical antenna lengths, together with the resonant frequency are listed in the *Table*. From these lengths a value can be chosen which will permit operation in the desired bands at the approximate frequency in each case. The resonant response is broad enough in its characteristic so as to permit operation over an entire amateur band, especially for the case of an antenna which has its resonant peak in the center of the band. Operation slightly off-resonance will tend to increase the standing wave effect along the feeder, in most cases, but this factor is not a serious one.

TABLE

Frequency in Mc.	Length in Feet		
	Half-wave	Full-wave	Two-wave
3.5	134	274	555
3.6	129	266	540
3.7	126	259	525
3.8	123	252	511
3.9	119	246	498
4.0	116	240	485
7.0	66.75	137	277
7.3	64	136	276
14.0	33.5	68.5	139
14.2	33	67.5	137
14.4	32.5	66.5	134
28.0	16.66	34	69
29.0	16	33	67
30.0	15.5	32	65

Insufficient space sometimes calls for an antenna wire considerably less than a half-wave in length. It is much better to insert loading coils at or near the ends of the antenna, rather than at the center (or current loop). The antenna can be made resonant by the addition of inductance in this manner, even though the physical length is much less than a half-wave. So-called "end loading" is more effective. even with a half-wave antenna, since the most effective radiation takes place from the high-current portion of the antenna wire.

If the antenna is to be used for several bands of operation it is desirable to connect the feeder to a point one-third the length of the antenna from either end. If the antenna is 66-ft. long, for example, the feeder should be connected to a point 22-ft. from one end. This point of connection will permit satisfactory operation on the harmonic frequencies. If the antenna is to be used for one band of operation only, the feeder can be moved along the antenna wire a few inches at a time—in order to locate a point which will provide minimum standing waves of current or voltage along the feeder. Standing waves of current can be measured in the feeder by means of a small thermo-couple meter shunted across a few inches of the bare feeder wire. A more simple method of checking the standing waves is to use a small neon bulb, held near the feeder wire at various points along the length of the feeder. The standing wave ratio of 2- or 3-to-1 is low enough to be negligible. Sharp bends in the feeder should be avoided, and the feeder should drop away from the antenna wire as near a right-angle as possible, and for as great a distance as possible.

Coupling Methods

The simplest method of coupling a single wire feeder to a transmitter or receiver is shown in Fig. 9. The coupling link can be made variable, or the coupling can be varied by changing the number of turns in the coupling coil. Low-frequency operation may require as many as 6 or 8 turns in the coupling coil around the voltage node of the tank circuit coil, whereas operation in the 10- or 20-meter bands may require only 1 to 3 turns. It is desirable to have a good earth connection, since the earth becomes part of the antenna feed system with this form of antenna. If no ground connection is used, the various stray capacities to ground, and to the a.c. power line, will allow power to be coupled into the antenna. There is, however, a greater probability of BCL interference when no external ground connection is employed. A cold-water-pipe ground connection, or one or more metal rods driven into the earth, will give satisfactory results in almost every case.

A very simple coupling method is shown in Fig. 10, where the single wire feeder is connected directly to a tap on the transmitter plate coil, through a high-voltage mica blocking condenser of .001μf or .002μf. This prevents d.c. plate potential from reaching the feeder or antenna—which would cause a hazard to human life.

Fig. 9

Fig. 10

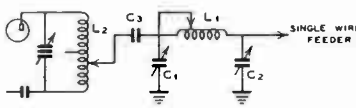


Fig. 11

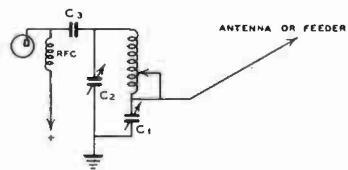


Fig. 12

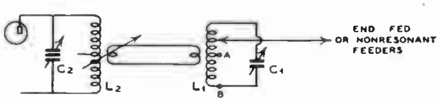


Fig. 13

The coupling systems shown in Figs. 11, 12 and 13 are widely used because of their advantages in eliminating undesired harmonic radiation in any particular band of operation. The pi-filter, Fig. 11, and the simplified pi-filter, Fig. 12, are more critical in adjustment for maximum harmonic elimination than the parallel-tuned circuit, Fig. 13. It is usually desirable to ground one end of the tuned antenna circuit, Fig. 13, when it is connected to a single-wire-fed antenna. The ground should not be used when this coupling method is connected to an end-fed antenna.

The antenna tuned circuits are always made resonant to the desired output frequency. The amount of coupling to the plate circuit of a transmitter should be varied to the point which loads the r-f amplifier to the desired value of plate current. The antenna tank circuit, feeder tap, link adjustments, etc., can be made to give maximum field strength from the antenna proper for any particular value of amplifier load current by coupling a simple diode field-strength meter and short test antenna to the main antenna. The test antenna should be parallel to the antenna wire, and as far removed from it as will provide satisfactory field-strength-meter readings. A small thermo-couple milliammeter or flashlight bulb, connected in series with the antenna feeder, is a convenient method for tuning external antenna tank circuits to the point which will give maximum feeder current, and consequently maximum antenna current in a non-resonant feeder system. This likewise holds true for moderate standing waves in the feeder system.

The single wire feeder usually has an impedance of between 500 and 600 ohms to ground, and can therefore be connected to either side of a current loop in the antenna. If the surge impedance of the feeder happens to be well matched to the antenna impedance, the standing wave effect in the feeder will be a minimum.

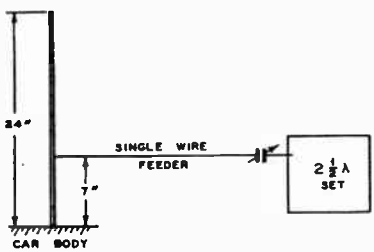


Fig. 14

Single-wire-fed antennas are sometimes used in u.h.f. communication for mobile operation. A quarter-wave rod, which would be approximately 2-ft. long in the 2½-meter band, or 4-ft. long in the 5-meter band, is sometimes grounded directly to the frame of the car, and a single wire feeder connected at a point varying from 7 to 14 inches

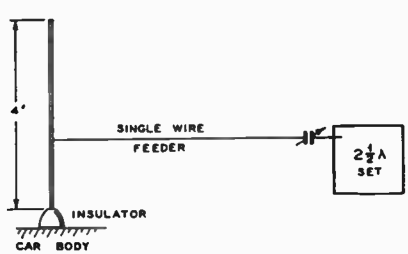


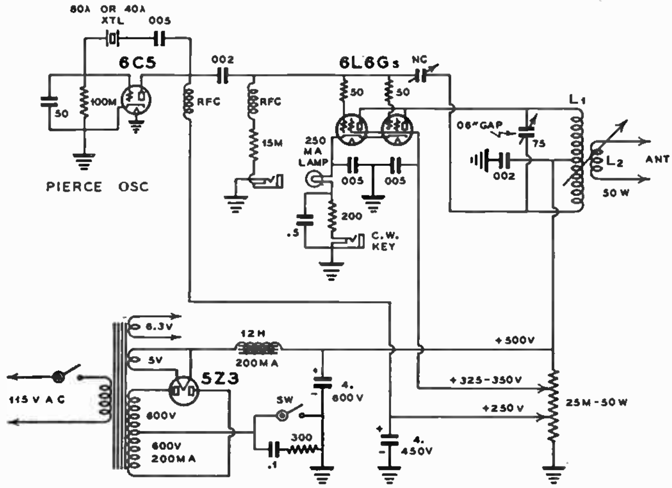
Fig. 15

above the base. It is possible to use a single wire feeder with a 4-ft. half-wave vertical antenna in the 2½-meter band by connecting the feeder to a point 6- or 8-in. from the center of the rod. The lower end of a half-wave rod must be insulated from the frame of the automobile. In any case, it is desirable to couple the single wire feeder to the mobile radio set through a small coil of 2 or 3 turns, and which has a variable coupling arrangement to the coil in the radio set.

* * *

"Radio Frequency Electrical Measurements" by Hugh A. Brown, M.S., E.E. Published by McGraw-Hill Book Co., New York, N. Y. Price, $4.00. The second edition of this popular text is suitable for college students, advanced amateurs and radio engineers. The theory and principles are explained in the fore part of the book, then follows the procedure of how the information for the text was derived at. Frequency measurements, antenna constants, tubes and amplifiers—voltage, current and power, waveforms, modulation, receiver and piezo-electrical quantities and field-strength measurements are treated generously. This book has almost 400 pages and is a useful adjunct to the library of any experimenter or engineer.

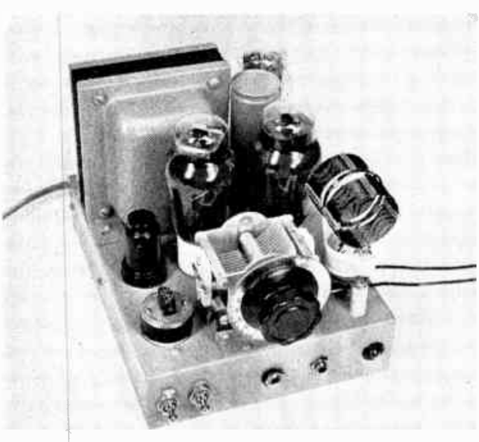
75 - Watt C. W. Xmtr With Power Supply On Same Chassis



An inexpensive, compact stand-by c.w. set, complete with power supply, on a single chassis. More than 75 watts input. An ideal small transmitter for the 'phone men who wish to keep up with their code speed.

By A. W. Fonseca, W6NYQ

MY PRINCIPAL interest in amateur radio has been confined to 10- and 20-meter 'phone, but the growing enthusiasm in amateur radio from the standpoint of national defense prompted me to keep up with the code. Rather than add a number of circuits, relays and equipment to my large 'phone transmitter, I deemed it advisable to build a complete c.w. transmitter on a single chassis, no larger than a cigar box, and this little set has given excellent results. I have worked almost everything worthwhile on the amateur c.w. bands, and I sometimes wonder if I don't get more actual enjoyment out of this "pee wee" than from the big 'phone job which occupies an entire corner of the radio room.



Complete C.W. Transmitter and Power Supply—ready to operate.

The circuit for the transmitter is shown complete in the schematic wiring diagram. It begins with a 6C5 Pierce Oscillator and a 40-meter crystal. This oscillator is suitable for any one of the amateur c.w. bands, by selecting the proper crystal and final amplifier plate coil. It is not suitable for harmonic operation. The oscillator drives a pair of 6L6G tubes to approximately 75 watts input. A "husky" signal is put into the antenna, and many R8-9 reports have been received from other amateurs clear across the U.S.A.

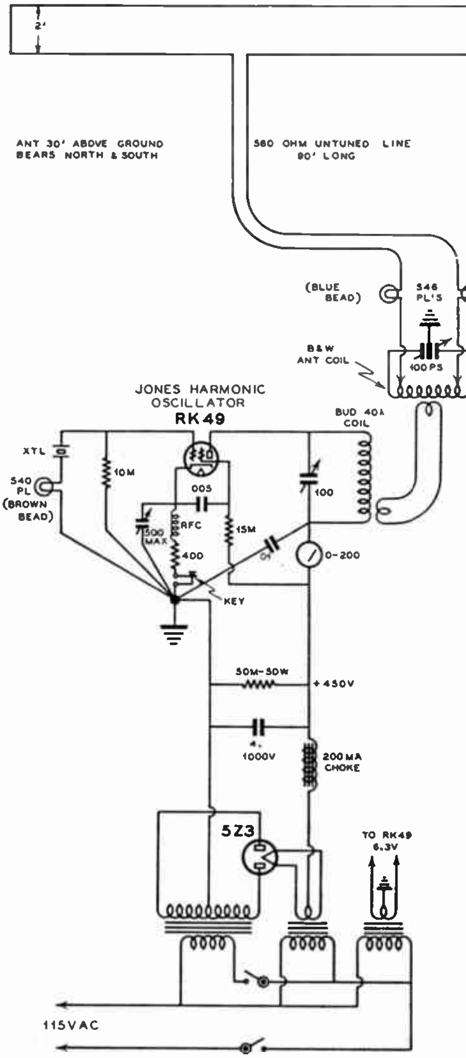
This transmitter has no meters. A 250-ma pilot lamp in the cathode circuit of the final r-f amplifier acts as a tuning and keying indicator. The plate circuit is tuned to resonance with the aid of this lamp; minimum brilliance denotes resonance. Obviously, the lamp is lighted only when the key is down. The grid circuit has a jack for plugging-in a milliameter in order to check the grid current, and a low-reading meter is required because the grid current is barely more than one milliampere. If properly built, this transmitter would not require measurement of grid current, and the milliameter is thereby obviated. A standard manufactured type of plug-in coil with center-tap is used in the final r-f amplifier. The newer coils, with adjustable antenna-coil in the center, are the type required. The neutralizing condenser is of the midget variety, and several kinds are available in radio parts stores. This condenser is mounted under the chassis. Two resistors, 50-ohms each, are connected into the grid circuit of the 6L6G final amplifier, as the circuit shows. No difficulty was experienced from parasitic oscillation after these resistors were inserted. They can be small in size, 1-watt rating is ample. The power supply is conventional and mounted on the same chassis with the r-f components. The filter choke is under the chassis. A toggle switch enables the 110-volt line to be switched on and off, and a similar switching arrangement is in the negative-B circuit to cut the high voltage on or off. A resistance-capacity combination shunted across the plate supply switch reduces the arc across the toggle switch contacts, and prevents this small switch from burning up, or from carrying an arc.

The bleeder resistor is fitted with two sliders, so that correct voltages can be secured for the oscillator plate and final amlifier screen circuits. Not more than 250 volts should be applied to the plate of the oscillator tube. The seemingly high potential of 500 volts on the plates of the 6L6Gs will not damage these tubes, because the transmitter is operated intermittently only.

* * *

Another Simple C.W. Transmitter

IN MANY cases the c.w. transmitter described in the foregoing text may be too large for some who want nothing more than a single-tube oscillator for telegraphic purposes. The acme of simplicity and sure-fire performance is the RK-49 oscillator diagrammed in the accompanying illustration. This is the circuit used by W6SFT, whose activities were detailed in December *A.R.D.* All U.S. districts and most of the U.S. Possessions have been worked with this little set. The diagram is self-explanatory by reason of the values shown for each component. The oscillator circuit is of the regenerative type, thus making it easy to operate on either of two bands desired by merely changing the coil in the plate circuit. For 160-meter operation on c.w. (where increased activity is noted of late) the tank tuning condenser should be larger than shown, but for operation on the other amateur bands there need be no circuit modifications.



One-Tube Harmonic Oscillator with Jones Cathode Regenerative Circuit for Two-Band Operation. A 40-meter crystal serves for two bands—40 and 20 meters, by merely changing the plate coil. Likewise, an 80-meter crystal will suffice for 80- and 40-meter operation, with proper plate coil in the final. The antenna is 68-ft. long, of no. 12 copper-clad steel wire. The feed-line is spaced 4-in., made of no. 14 wire. This antenna and transmitter circuit is in use at W6SFT, whose activities were reported in the December issue.

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.

NEWS FROM WASHINGTON

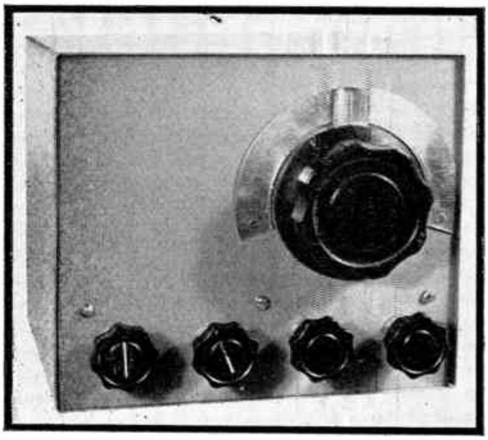
(Continued from page 12)

problem. During the calendar year a total of 705 standard broadcast stations (including networks) reported total time sales approaching $130,000,000, making a net income of nearly $24,000,000. They also listed a payroll of nearly $52,000,000 for nearly 25,000 employees. The report of the Commission's special committee on chain broadcasting was the subject of oral argument in December in connection with its consideration by the full Commission. Commission inquiry revealed some 200 domestic stations broadcasting in about 30 foreign languages. Commission action in five broadcast cases was upheld by the United States Supreme Court.

BROADCAST (International)—Broadcast service to Latin America was improved by reason of the Commission requiring power of at least 50 kilowatts for international program service. In this country 13 international broadcast stations were operative.

TELEVISION—Television is now making substantial progress with the cooperative assistance of that industry and the Commission. More than a score of stations geographically distributed throughout the nation have been licensed to experiment with various types of transmission with a view to reaching early accord on uniform standards which will enable television to move forward on a full commercial basis. Participating stations have budgeted a total of $8,000,000 for this practical experimental work. In conjunction with such effort, a National Television Systems Committee, jointly sponsored by the Radio Manufacturers Association and the Commission, has made a thorough study of the engineering phases of the situation which should be helpful in arriving at a general agreement. The continued rapid evolution of television is attested by developments in color reproduction, large-screen projection, and new service demonstrations.

MISCELLANEOUS RADIO SERVICES—Increased use of radio for miscellaneous services is noted. Police stations have increased to 6,300, aviation stations to nearly 2,000, and more than 1,000 stations are employed for forest conservation work. The Commission clarified its rules with respect to more than 450 special emergency stations. This class of station has demonstrated its ability to establish radio communication in time of emergency.



Housed in a metal cabinet only 6x6x7-in., the improved "Super Gainer" Receiver is nevertheless a full-size performer. The illustration shows the home-made vernier tuning dial, consisting of a standard dial-reduction drive coupling and 3-in. bakelite knob.

The "Super-Gainer" Brought Up-To-Date

OF ALL the simple receivers described in recent years, perhaps none has enjoyed more popularity than the *Jones Super-Gainer*. It is a superheterodyne, and has the additional advantage of containing fewer parts than other receivers less satisfactory in performance. Recently an improved version of this *Super-Gainer* was built by *James Welch, W6WC*, and the results were so pleasing that he asked us to pass the information along to readers of *A.R.D.*

The receiver can be operated from a 6-volt storage battery and a *Vibrapack*, or from any other supply which delivers 180 to 250 volts for the *B* circuit.

The line-up is a 6L7 mixer with a triode h-f oscillator. The output from the mixer is amplified by a 6K7 i. f. stage. The second-detector-audio-amplifier is a twin-triode 6C8G. The second detector is made regenerative by means of a small coil, shunted with a variable resistor, in the cathode circuit. This coil is not coupled to the 1,500-kc. i.f. transformer. The cathode coil is made by taking one section from a standard 2.5-mh. pie r-f choke, and then removing all but approximately ¼th of the total turns from this pie. If the coil has too many turns the receiver will tend to howl; if too few turns the second detector will not oscillate. Oscillation is essential for c.w. reception, and regeneration below the oscillating point is useful for increasing the sensitivity for weak signal reception. The receiver illustrated is equipped with coils for the 20- and 40-meter bands only, a single set of coils being adequate for covering these two bands in the range of from 17- to 6-Mc. This receiver will operate on any frequency, if proper coils are wound.

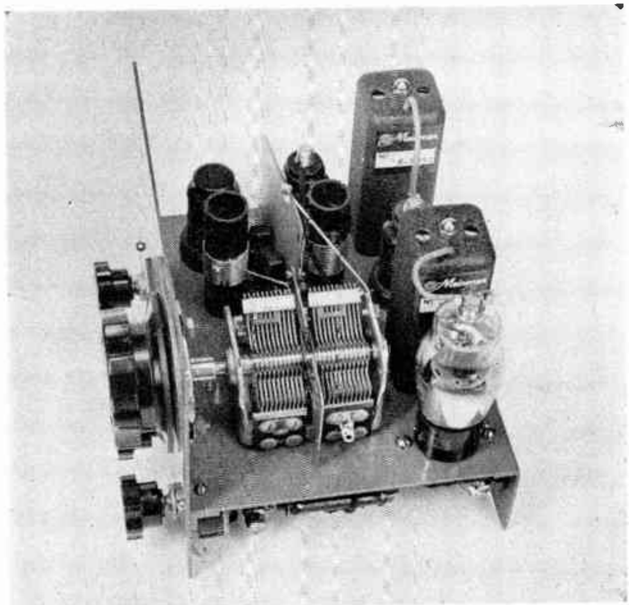
Care should be exercised to prevent the first detector from oscillating. The judicial use of regeneration in the 6L7 circuit will improve the image rejection and sensitivity of the receiver.

Coil Data

The coils illustrated in the photograph cover the 6- to 17-Mc. range, the most widely used for amateur and commercial services. L_1-12-¼ turn. No. 20 bare wire, ¾-in. long, with cathode tap ¾-turn from ground end of winding.

L_2-11-¼ turns, No. 20 bare wire, ¾-in. dia., ¾-in. long, with tap on second turn up from grounded end of winding.

L_3—Antenna Coil—4 to 5 turns hook-up wire wound around ground end of L1.



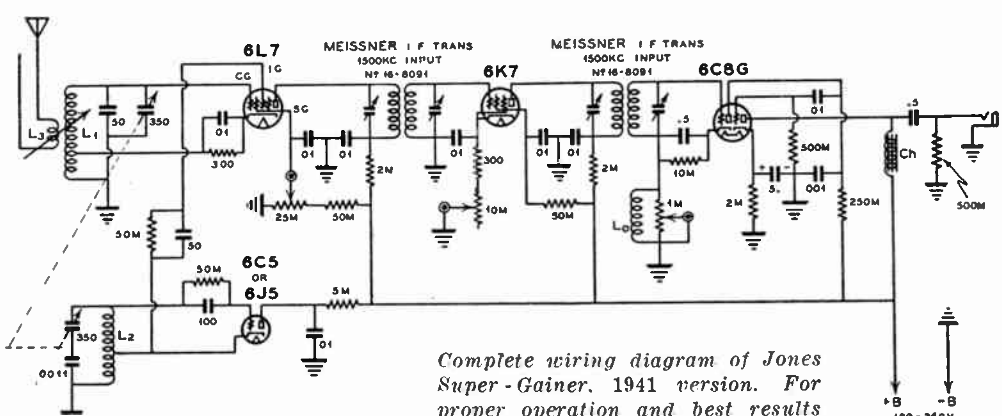
Looking into the Super-Gainer, all above-chassis components are clearly shown. The shield plate between the coils is grounded to the frame of the main tuning condenser. The 1,500-Kc. i.f. transformers are of the Meissner Mfg. Co. type, the catalog numbers being shown in the schematic wiring diagram.

Lo—Approximately one-fourth of one pie section from standard r.f. choke, such as type R-100.

CH—Output transformer. Can be primary of standard small dynamic speaker output transformer.

Cabinet—Standard 6x6x7-inch metal housing.

Controls on front panel—Main tuning dial on dual-section .00035 variable condenser; first detector regeneration control on 25M potentiometer in 6L7 circuit; 10M potentiometer in cathode circuit of 6K7; 1M potentiometer in shunt with L0. The remaining small control knob is for the on-off switch.



Complete wiring diagram of Jones Super-Gainer, 1941 version. For proper operation and best results there should be no substitution of circuit components.

ENGINEERING APPLICATIONS

TURNER DYNAMIC MICROPHONE

FEATURES

● High output level and exceptionally smooth frequency response. Removable cable. Swivel mounting to accommodate varying positions of the microphone. See Fig. 2 for frequency response.

ADVANTAGES

● Low impedance models available for extremely long lines. Output and characteristics remain constant over extremely wide ranges of temperature and humidity.

CONSTRUCTION
(See Fig. 1)

● Uses Alnico blue streak formula magnet which will lift 10 lbs. of iron. Magnetic material does not lose flux even after years of service. Uses aluminum alloy diaphragm die formed to cause 98% of compliance to be in vertical plane increasing the efficiency of the transducer. Complicated acoustic filter net work controls bass response and eliminates boomy sound prevalent in some dynamic microphones. Die cast case hermetically sealed to insure long life of interior. An internal hum-free transformer uses Mu-metal core of extremely high permeability permitting high primary inductance with small physical size. Low distributed capacity of the windings permits linear high frequency characteristics. Transformer loss at 100 cycles one decibel, at 10,000 cycles four decibels.

APPLICATIONS

● Ideally suited to broadcast studio, or remote use, amateur radio, or public address. Flat type of response reproduces music with extreme fidelity, as well as voice. Can be used with almost any existing amplifier as sufficient gain is incorporated. When used with amplifier for low audio gain, a pre-amplifier is necessary. A successful circuit for a pre-amplifier stage is shown in Fig. 3.

CIRCUIT CONSIDERATIONS

● High impedance models may be worked directly into the grid of an amplifier tube. The input resistance should be 250,000 ohms or more. Low impedance models should be connected to corresponding input of amplifier. Models available in 50 ohm, 200 ohm, 500 ohm, and high impedance.

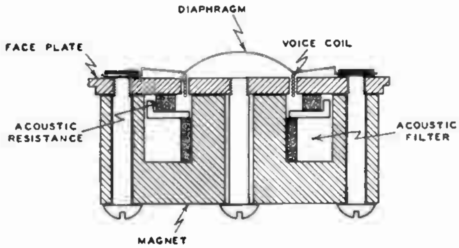


FIG. 1

Construction of the Turner Dynamic Microphone is clearly shown in the cross-sectional view above. The case is hermetically sealed to insure long life of the microphone unit.

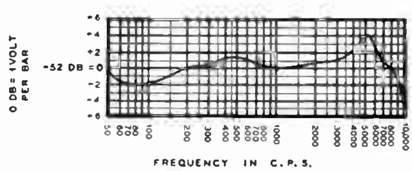


FIG. 2

Frequency response curve of Turner Dynamic Microphone. This curve shows that the unit is equally responsive to voice or music.

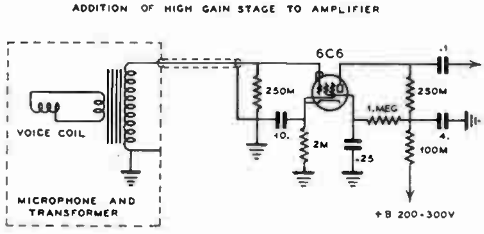


FIG. 3

If the gain of the audio amplifier is not sufficiently high, it is a simple matter to attach a pre-amplifier to the audio input. The circuit for such a unit is diagrammed above. It is essential that precautions be taken in the shielding, as indicated by the dotted lines in the diagram.

ENGINEERING APPLICATIONS

EIMAC 35TG TRIODE

● The small physical size and low interelectrode capacities of the 35TG make this tube particularly suitable for operation at very high frequencies, particularly in the range up to 100-mc. It is also suitable for service as a high power triode crystal oscillator, frequency doubler or tripler, class-B audio amplifier, and UHF oscillator. The tube has tantalum elements, fabricated and exhausted by the exclusive Eimac process, and is unconditionally guaranteed against failure as a result of internally-released gas. The grid and plate leads are secured in place by means of short, high-current carrying capacity connectors, and without internal element support insulators.

● The plate is designed to operate at a light cherry red color at its normal plate dissipation of 50 watts. The plate will show appreciable red color at 17 watts dissipation, and a very bright red at the maximum rating of 70 watts. The color of the plate will serve as a tuning indicator for determining resonance and degree of loading.

● The values of grid driving power listed in the Tables include the grid bias power loss and the net power loss used by the grid of the tube. The grid driving power does not include external tuned circuit losses, impedance mismatch losses, radiation, and dieletric losses which may be an important factor at very high radio frequencies. The value of the grid driving power, as listed, is nearly constant over a wide band of radio frequencies, but due to the aforementioned losses the apparent grid driving power may be several times that shown in the Table. Each tuned circuit has a loss of from 5 to 15 per cent of the power delivered to it and which is lost in the form of heat and radiation. An impedance mismatch may take place between a driver plate circuit and the grid circuit, since the latter may have a value of 3,000 ohms with no plate voltage applied to the driver stage, as against 5,000 or 6,000 ohms when operating fully loaded. If there is no regeneration in the neutralized r-f amplifier, and if the regulation of the r-f driver stage 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 plate voltage and antenna load are applied, as well as an actual decrease of available driving power.

● These characteristic grid circuit losses may 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 be expected by observing the actual plate dissipation in the buffer tube. This means that a buffer stage should have from 25 to 35 watts input to furnish 8 watts of grid driving power, even at moderately low radio frequencies. It may be necessary to double this driving power at 30-mc., and to triple it at 45-mc., due to higher circuit losses. A tentative rule for power input to a grid driver stage would be to multiply the tube values by 4 for frequencies between 4- and 10-mc., and by 9 for 45-mc. If the driver stage operates as a frequency doubler, these factors may require an increase of 50 per cent.

● The values of power output as listed in the Tables are those which would be delivered to the tuned plate circuit by the tube, and not those to be expected in an antenna or other load circuit.

Characteristics

Filament voltage	5 to 5.1 volts
Filament current (approx.)	4 amperes
Amplification factor	30
Grid-plate capacity	1.7$\mu\mu$f.
Grid-filament capacity	1.9 "
Plate-filament capacity	0.2 "
Base	Isolantite, UX 4-prong
Overall height	5½-in.
Maximum diameter	1¾-in.
(Grid leads extend outward ⅝-in. beyond this diameter)	
Plate lead diameter	0.070-in.
Grid lead diameter	0.070-in.
Normal plate dissipation	50 watts

The tube should be operated in a vertical position and with ample ventilation.

Radiation connectors should be used to cool the leads at the glass seals.

MAXIMUM RATINGS

	Intermittent Service Telegraphy of class-B Audio	Continuous Service Doubler or class-C Telegraphy
Plate dissipation (watts)	70	50
Plate current (ma.)	150	125
Plate voltage	3.000	3.000
Grid current (ma.)	35	45

F. C. C. RATINGS

Power output with high-level modulation .... 50 watts

TYPICAL OPERATING CONDITIONS
PLATE-MODULATED OR C.W. AMPLIFIERS

DC plate voltage	750	1,000	1,500	2,000	3,000
DC plate current	50	80	100	100	67
DC grid voltage	—60	—75	—125	—150	—225
DC grid current	45	45	45	40	30
Grid driving power	9	10	11	11	12
DC power input	37.5	80	150	200	200
Plate dissipation	15	25	45	50	50
Pct. plate efficiency	60	68	70	75	75
Approx. carrier output	22.5	55	105	150	150

EIMAC 35TG TRIODE — Continued

● Grid bias should be obtained from grid-leak bias for best linearity during modulation. Sufficient cathode or fixed bias should be used to protect the tube against excessive plate dissipation in case of failure of r-f excitation. Better linearity can be obtained if approximately 10 per cent of the a-f voltage is fed back into the grid circuit in a plate-modulated amplifier. Under these conditions the d.c. grid bias should be from 3 to 5 times cut-off, and the d.c. grid current need not be over 20 or 25-ma. Figs. 1 and 2 illustrate this feed-back circuit, which permits better linearity of modulation and operation with less grid heating and longer tube life.

C.W. AMPLIFIER

DC plate voltage	750	1,000	1,000	1,500	1,500	2,000	2,000	3,000
DC plate current	80	100	120	90	140	115	150	100
DC grid voltage	—50	—50	—100	—75	—300	—100	—400	—300
DC grid current	30	30	35	30	35	30	30	30
Grid driving power	4.5	5	8	6	16	7	18	15
DC power output	60	100	120	135	210	230	300	300
Plate dissipation	20	40	45	45	70	70	67.5	70
Pct. plate efficiency	60	60	62.5	66	66.66	70	77.5	76
Approx. power output	40	60	75	90	140	160	232.5	230

FREQUENCY DOUBLER

DC plate voltage	750	1,000	1,250	1,500	2,000
DC plate current	94	100	72	75	62.5
DC grid voltage	—200	—300	—300	—400	—600
DC grid current	10	30	25	20	20
Grid driving power	4	14	12	12	16
DC power input	70	100	90	112.5	125
Plate dissipation	42	50	50	50	50
Pct. plate efficiency	40	50	45	55	60
Approx. power output	28	50	40	62	75

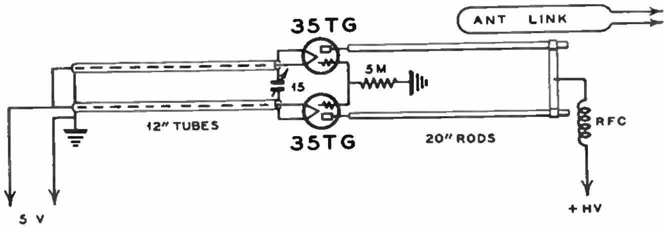
● The load circuit must be adjusted carefully to obtain these values of plate dissipation and efficiency. The tube should never be operated as a doubler with less than 6 times cut-off bias; higher values of bias will result in higher efficiencies.

CATHODE MODULATION

DC plate voltage	1,000	1,000	1,500	1,500	2,000	2,000
DC plate current	55	72	70	100	67	75
DC grid voltage	—200	—200	—150	—250	—350	—350
DC grid current	10	20	10	18	5	12
Grid driving power	3	7	2.3	7.5	2	6
Peak AF grid voltage	110	100	120	150	150	140
Peak AF cathode voltage	385	600	630	900	800	1,200
Avg. AF power (sine wave)	10.5	21.5	22	45	27	45
DC power input	55	72	112	150	133	150
Plate dissipation	29	25	62	52.5	60	52.5
Pct. plate efficiency	47	64	45	65	55	65
Approx. carrier output	26	47	50	97.5	73	97.5
Cathode load impedance	6.800	8.300	9.000	9,000	12,000	16,000

● Values are shown for 20 and 30 per cent A F power to DC power input, since 30 per cent ratio gives a modulation characteristic with better linearity. Less audio power requires operation at lower values of grid current, plate current, and plate efficiency. Fairly heavy antenna load is required. Values of current for push-pull operation will be doubled, and the cathode modulator load impedance will be halved. The peak values of AF voltage for sine wave conditions can be converted into RMS values by dividing them by 1.41.

EIMAC 35TG TRIODE — Continued



Typical 2½-meter tuned-plate-tuned-filament oscillator with pair of Eimac 35TG triodes. The plate circuit can be adjusted to the desired frequency by means of a slider, as indicated in the circuit diagram. The filament rods are tuned to a quarter wavelength by means of a midget tuning condenser. No coupling is required between the parallel-rod circuits. The antenna can be coupled to the plate rods by means of a hair-pin link, supported on stand-off insulators in such a manner that the coupling can be varied.

VOICE COMMUNICATION — GRID MODULATION

DC plate voltage	1,000	1,500	2,000
DC plate current	50	67	50
Total DC grid voltage	—100	—100	—300
DC grid current	5	5	1
Peak AF grid voltage	75	84	100
DC power input	50	100	100
Plate dissipation	35	70	70
Pct. plate efficiency	30	30	30
Approx. carrier output	15	30	30

● Carrier shift and non-linearity can be minimized by including a grid-leak resistor in series with the fixed bias source. No additional AF power is required for voice communication if the grid-leak is by-passed with a 1- or 2-mfd. condenser. Heavy antenna loading is required (coupling should be increased beyond the point of max. antenna current).

CLASS-B AUDIO AMPLIFIER (2 Tubes)

DC plate voltage	750	1,000	1,250	1,500	2,000
Zero signal DC plate current	100	50	40	35	35
Max. signal DC plate current	250	300	265	230	200
DC grid-bias voltage	0	—22.5	—32	—45	—67.5
Plate-to-plate load impedance	5,500	6,500	9,600	15,000	24,000
Power output	100	160	190	225	265

● A push-pull 2A3 driver stage may be used with a driver transformer having a

$$\frac{\text{primary}}{\frac{1}{2}\text{ sec.}}\ \text{ratio} = 1:3$$

UHF AND FM OPERATION

● Very low interelectrode capacities and short r-f leads in the 35TG make this tube excellent for UHF service as a frequency multiplier, neutralized class-C amplifier or oscillator. The plate input power should be limited to a value which will cause not more than 50 watts plate dissipation for continuous operation. The higher radiation, dielectric and circuit losses in the UHF region below 300-mc. usually prevent the attainment of high efficiencies. The apparent grid driving power is greater than at low frequencies, and the available r-f output into the desired load circuit is less. Reasonably high circuit efficiencies can be attained by the use of carefully designed parallel-rod or concentric quarter- or half-wave resonant lines in place of coil-condenser tuned circuits. The 35TG is much more desirable for UHF service than the 35T, due to the grid lead arrangement in the former. The 35TG is easier to drive than low-mu tubes, in UHF circuits, since it is less difficult to obtain low values of r-f grid peak voltage and high grid current than the reverse of these.

● The r-f currents in the grid and plate leads through the glass seals will be much higher in the UHF region, since the interelectrode capacities become a large portion of the tank capacities with a corresponding large portion of r-f tank current. This point must be observed when testing new UHF circuits, or conventional circuits having UHF parasitic oscillations, since excessive heating may cause tube failure.

It Once Was DX

(Continued from page 57)

Newfoundland. I've been expecting him home most any day but haven't any word as yet.

"AMATEUR RADIO DEFENSE is sure f. b. and it kind of makes you have an itchy hand to get back in radio again—got a hunch I'll be making up a receiver again and get back to speed just in case we need it and this war goes on long enough. And the good old U. S. A. won't be making any mistake if she keeps her amateurs under her wing, for in any emergency they are mighty useful people to know."

Note: Cavalsky was in the first World War, enlisting when he was under age and serving with the Seventy-Second Highlanders at Vimy Ridge and several other important campaigns.

* * *

. . . VE3IM . . . now in G . . . is an instructor with the Royal Canadian Air Force, getting the "YM's" to try out their fledgling wings.

* * *

. . . VK2EO and VK2FF are both in the Royal Navy . . . 2EO ashore at a naval base down under, and 2FF in the Mediterranean on a battleship.

* * *

. . . VK2NO, a Commissioned Lieutenat in the Signal Corps, still in the land of the Kangaroos.

* * *

. . . VK6NP last heard from captaining an outfit som'ers in G.

* * *

. . . VU2FO—our old pal and xdxer—now holding down a plenty hot spot in the Royal Corps of Signals som'ers in G, still listens in on 20 meters and wishes he could answer some of the fb W sigs he hears. "Patience, Laddie!"

* * *

. . . ZE1JM . . . of 20 meters now with the Southern Rhodesian Signal Corps stationed at Salisbury. All gear stowed with 1JH in BYO. Reg. 1JM, says that for 6 mos. they were under canvas on good old hard terra firma . . . now on mattresses in barracks. Says the Sig. Corps isn't just all pounding brass, to-wit: "Plenty of housewifely dooties. such as . . . washing, scrubbing, polishing, dusting, etc." And he says: Oh, yes! Guard DOOTY!" When not manicuring the barrack floors, they are pumping Morse on flags, heliograph, lamps, and using telegraphy and radio telephone.

* * *

. . . ZE1JZ . . . now Corporal Steve Wright—to U . . . Southern Rhodesian Air Force.

* * *

. . . ZS6BT is ready to jump up another "Knotch" from present rating of Lance Corporal in the South African Sig. Corps. "Go to it, Matey!"

* * *

. . . 73 for this time, and shoot me the dope on any xders you come across. . . . Mail to the attention of the DX Editor, ARD, Monadnock Bldg., S. F.—W6SZ.

ANTENNA TOWER DESIGN

(Continued from page 29)

for yourself with an experimental three-link brace, made by forming a triangle of three sticks, and then applying pressure to any side in an endeavor to distort the triangular pattern. Next try a four-link brace, and see how easily it can be unshaped or distorted. The double cross-bracing need not be used along the full height of the tower; in Fig. 1 this method of cross-bracing is carried to approximately one-half the total height.

It is important to relate that all measurements, as given, are for one side of the tower only. Because the tower has four sides, it is therefore obvious that four pieces of each material must be cut for each piece measured.

The material is bolted together by 3/8-in. carriage bolts, up to the point where the side members of the tower reduce in size to 2 x 2 inches; then 1/4-in. bolts are used.

Splicing of the side members is accomplished as shown in Fig. 2. A typical cross-joint assembly is shown in Fig. 3. Angle-iron pieces of the proper width are bolted to the tower where the butt splices are made. The torsion braces, of which there are two, are illustrated in Fig. 4; the details are self-explanatory. These braces are essential for counteracting torsion caused by the rotation of the beam antenna. The braces also made the tower more rigid, because additional three-link mechanisms are thereby added to the center of the structure.

Several coats of paint are applied to each piece of material before the tower is assembled. The concrete foundations for the four side members are fitted with angle-iron supports to which the base pieces are bolted.

The lumber for this tower is No. 1 common, straight-grained. It is purchased in wide pieces, then ripped to correct size. By this means, considerable saving in cost can be made. The cross-braces are cut from 1-in. stock, ripped to 1 x 2-in. The long, vertical side members are cut from 3-in. stock, trimmed to 2½ x 2½-in. for lower portion of the tower, and the 1 x 3-in. cross-braces are cut from 1-in. x 12-in. stock.

The photograph shows the completed tower, but without the rotary beam mechanism at the top. It must be agreed that the design and appearance are so pleasing that the neighbors will hardly suspect the owner of the tower to be an amateur. Why advertise to the world that you are a "ham", by building a "weak-kneed" contraption, when it is no more difficult to do the job right in the first place?

TAKING THE CURSE OUT OF CIRCUIT DESIGN

(Continued from page 45)

formula. This problem can be greatly simplified by using a single-layer coil whose length and diameter are approximately the same. Under this easily-obtained practical condition, the chart in Fig. 2 gives an approximate solution of the problem.

This chart also consists of three scales: That on the left is graduated from 0.75 to 2.25, corresponding to coil diameters of ¾-, 1-, 1¼-, 1½-, 1¾-, 2-, and 2¼-in.; these figures also represent the length of the corresponding winding. The scale on the right is graduated with respect to the number of turns, from 3 to 100. The intermediate scale is graduated from 0.5 to 200 micro-henries. When any two of the three factors,—number of turns, diameter (or length), and inductance,—are known, the unknown third factor may be found by connecting the two known factors on their respective scales with a straight-edge and reading the unknown value where the straight-edge cuts its corresponding scale.

The broken line across the chart, for example, show that an inductance of 10 μh is given by 20 turns on a 1½-in. coil. Reference to a wire table shows that 20 turns of No. 14, or any smaller insulated wire, can be wound within a length of 1½ in. If it were desired to obtain 10 μh from a No. ¾-in. coil, a straight line connecting 0.75 on the left hand scale and 10 μh on the intermediate scale will be seen to cut the right-hand scale at 28. The equivalent of 28 turns along a length of ¾-in. is 37 turns per in., which specification is met by No. 28 enamel wire, or smaller, as shown by the wire table.

Fig. 2 is based on the widely used formula

$$L = \frac{0.2d^2n^2}{3d + 9l} \text{ microhenries}$$

where d is the diameter of the coil in inches, l is the length of the winding in inches, and n is the number of turns. When $l = d$, the formula reduces to

$$L = \frac{dn^2}{60} \text{ or } n = \sqrt{60L/d}$$

Thus, corresponding to the previously calculated value of $L = 12.92$ and using a 1-in. coil, we have

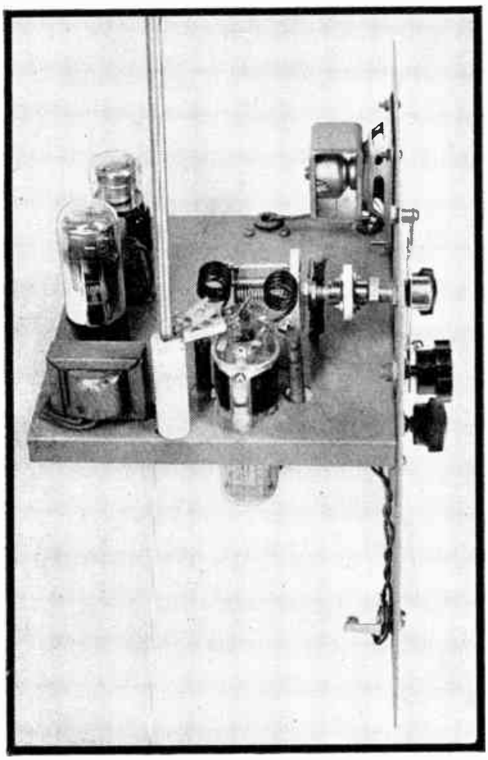
$$n = \sqrt{60(12.92)} = 27.8 \text{ turns,}$$

for which the wire table calls for No. 20, or smaller wire.

Three-Tube Portable 2½-Meter Transceiver

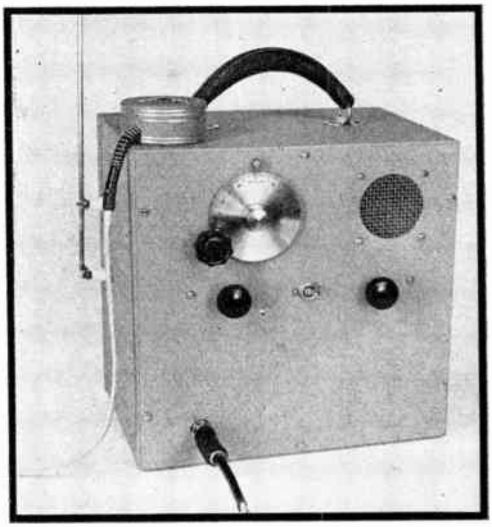
●

In some instances of portable 2½-meter band operation it is necessary to have a unit which is light in weight and has its power supply self-contained in a small carrying case. This consideration practically



The transceiver should be thoroughly tested before it is installed in its carrying case. A temporary antenna-rod assembly is illustrated in the photograph above.

dictates the use of 1½-volt filament-type tubes which are more microphonic and much less efficient than the equivalent 6.3-volt tubes. The 1½-volt tubes can be made to operate satisfactorily, yet they require more testing and experimenting in a 2½-meter



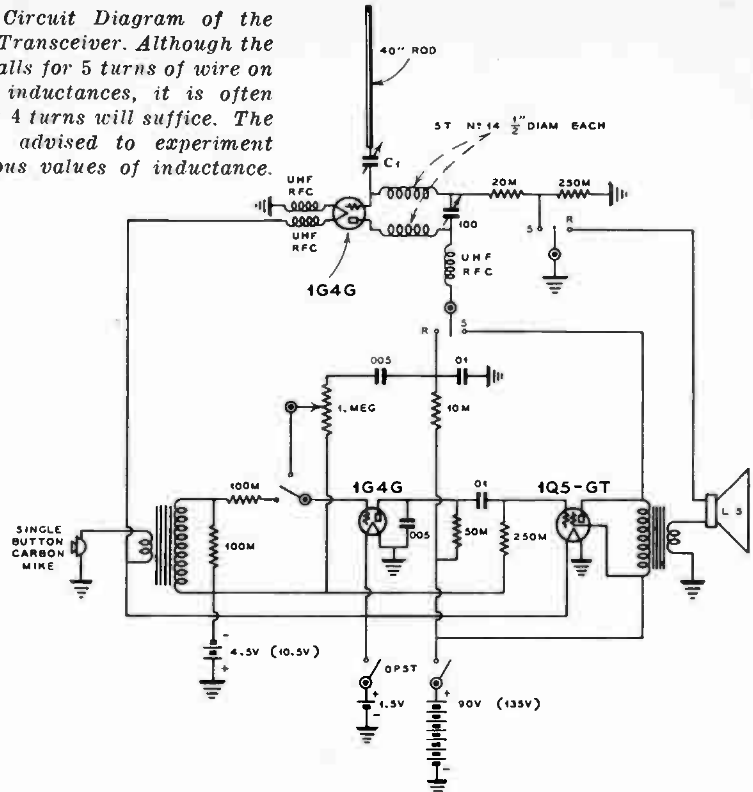
The complete 2½-Meter Transceiver in a deluxe carrying case which has ample space for holding the A-, B-, and C-batteries. The microphone is a standard Western Electric F-1 unit, in a special housing.

transceiver, in order to obtain satisfactory results. The transceiver illustrated in the photographs gives good service as a transmitter but is somewhat critical for operation as a super-regenerative receiver. A type 1G4G triode is employed in a circuit which is a modification of a parallel-rod system. The two coils in the grid and plate circuit, consisting of 4 turns of No. 14 wire, the coils having a diameter of ½ inch, are series-tuned in the 2½-meter band with a 100$\mu\mu$f variable condenser. This type of circuit is slightly less efficient than a well-designed parallel-wire or rod circuit but has an advantage in that far less space is required. This form of 2½-meter circuit will function extremely well with a 6-volt tube, such as a type 7A4. It is more efficient than a parallel coil and condenser circuit, which is sometimes used.

A quarter-wave 40-inch rod is loosely coupled to the grid of the oscillator tube through a small mica trimmer condenser which has its adjusting screw removed and its top plate bent outward at quite an angle from the lower plate.

The 1G4G tube acts as a modulated oscillator for transmitting, during which time the plate circuit is connected to the plate of the 1Q5GT modulator tube, and the grid-leak is reduced to 20,000 ohms. For receiving, the 1G4G tube acts as a super-regenerative detector, resistance-coupled to the grid of a 1G4G audio amplifier. The

Complete Circuit Diagram of the 2½-Meter Transceiver. Although the diagram calls for 5 turns of wire on the UHF inductances, it is often found that 4 turns will suffice. The builder is advised to experiment with various values of inductance.



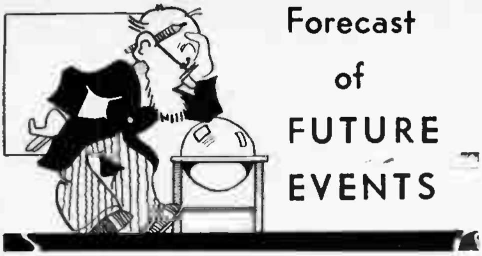
1Q5GT power pentode then becomes a second audio amplifier stage, connected to a small PM-type loudspeaker, mounted on the chassis of the set. The first audio amplifier connects to a small transformer and a single-button carbon microphone when transmitting, and to a 1-megohm audio volume control for receiving. The super-regenerative detector grid-leak of 250,000 ohms, in series with a 20,000 ohm resistor, must sometimes be of some other value in order to get the transceiver into proper operation when the unit is being tested for the first time. Slight differences in construction, placement of parts, or condition of tubes may require some small modification in circuit constants. It is more difficult to obtain satisfactory super-regeneration with the 1½-volt tubes than it is to secure good results for transmitting. The two-stage audio amplifier is primarily included for the purpose of obtaining sufficient audio output for loudspeaker operation. The microphone input transformer does not require as much step-up ratio as in the usual transceiver; this permits the use of a midget voice-coil-to-pentode-plate-circuit output transformer for service as a microphone transformer. The output and input transformers are both of the same type.

The 1G4G r-f tube is mounted upside-down through a hole in the chassis in order to have the socket terminals close to the tuning condenser. The two 4-turn r-f coils are mounted between the tuning condenser terminals and the grid and plate terminals. The two so-called 5-meter r-f chokes which are connected in series with the filament leads of the r-f tube are mounted parallel to the tube with the lower ends of these chokes extending through holes in the chassis, as can be seen in the photograph.

The send-receive switch is of the 4-pole-two-position rotary type, which changes the set from transmit to receive. The toggle switch for opening the battery circuit is a double-pole-single-throw type, which opens both the *A*- and *B*-battery circuits. The transceiver will operate from a 90-volt *B*-battery, but greater output and better super-regeneration will be obtained from a 135-volt supply. If a 135-volt *B*-battery is used, it will be necessary to increase the *C*-battery bias to 10½ volts, as indicated in the circuit diagram.

A single 1½-volt battery supplies current for the filaments of the three tubes, and also for the single-button carbon microphone. The *A*-, *B*- and *C*-batteries fit into the lower portion of the transceiver cabinet.

Forecast of FUTURE EVENTS



THE screen-grid tube, large or small, has long been a favorite among many amateurs. Pentodes and tetrodes also enjoy a wide following. Much can be told about the proper operation of these tube types, and much will be told in the forthcoming issue. Several tube experts, among them an engineer responsible for major improvements in pentodes and tetrodes, are putting the finishing touches to a bang-up technical manuscript. To cap the climax, our Frank C. Jones will add comment of his own. All in all, this should prove a mighty interesting bit of reading — because the information comes from men who know precisely what the amateur is up against.

* * *

TO make this multi-element tube material more than ever informative, we will give complete details for the design and construction of an ultra-modern transmitter with single-ended or push-pull pentode r-f amplifier. The output from Clayton Bane's E. C. O. (described recently), or from a manufactured Signal Shifter, such as the *Meissner*, can be fed directly into the final amplifier.

* * *

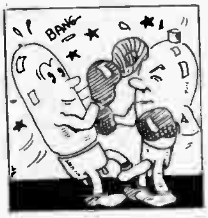
ANOTHER antenna type will be treated comprehensively by Frank C. Jones in the same manner as his treatment of the single-wire-fed antenna in this issue. He will make an all-out effort to cover every phase of all types of sky-hooks, but if, by chance, some of your puzzling questions still remain unanswered we will appreciate word from you by mail. The purpose of this series is to gather all information possible under one "roof", so that you won't have to hop-skip-and-jump to get the facts on the particular type best suited for your purpose.

* * *

THERE will be another *"Transmitter Circuit of the Month"* in the next issue. This material will revolve around the smaller, inexpensive transmitters. Eventually, every popular combination of transmitter tubes will be incorporated into a successful circuit, and by the close of the year you will have in your possession a valuable file of sure-fire transmitter data. Then you can buy almost any make or type of tube, or select a handful at random from your spare-parts box, and design a transmitter of your choice around these bottles. Breadboard models of each transmitter are being made ready so that each circuit can be scrutinized thoroughly before the information is passed along to you.

* * *

THE *Battle of the Elements* begins in our next issue. Not a battle between Spitfires and Messerschmitts in the stratosphere, but the ever-present battle among the proponents of the several materials useful for vacuum-tube elements. Some prefer a carbon anode, others swear by tantalum, and there is another group which insists that molybdenum or some trade-named plate material is best. It is to be a friendly battle, editorially and from the technical side, and no foul punches will fall. The information is being made ready for us by engineers who know their anodes, and each contributor will tell why he prefers a particular material.



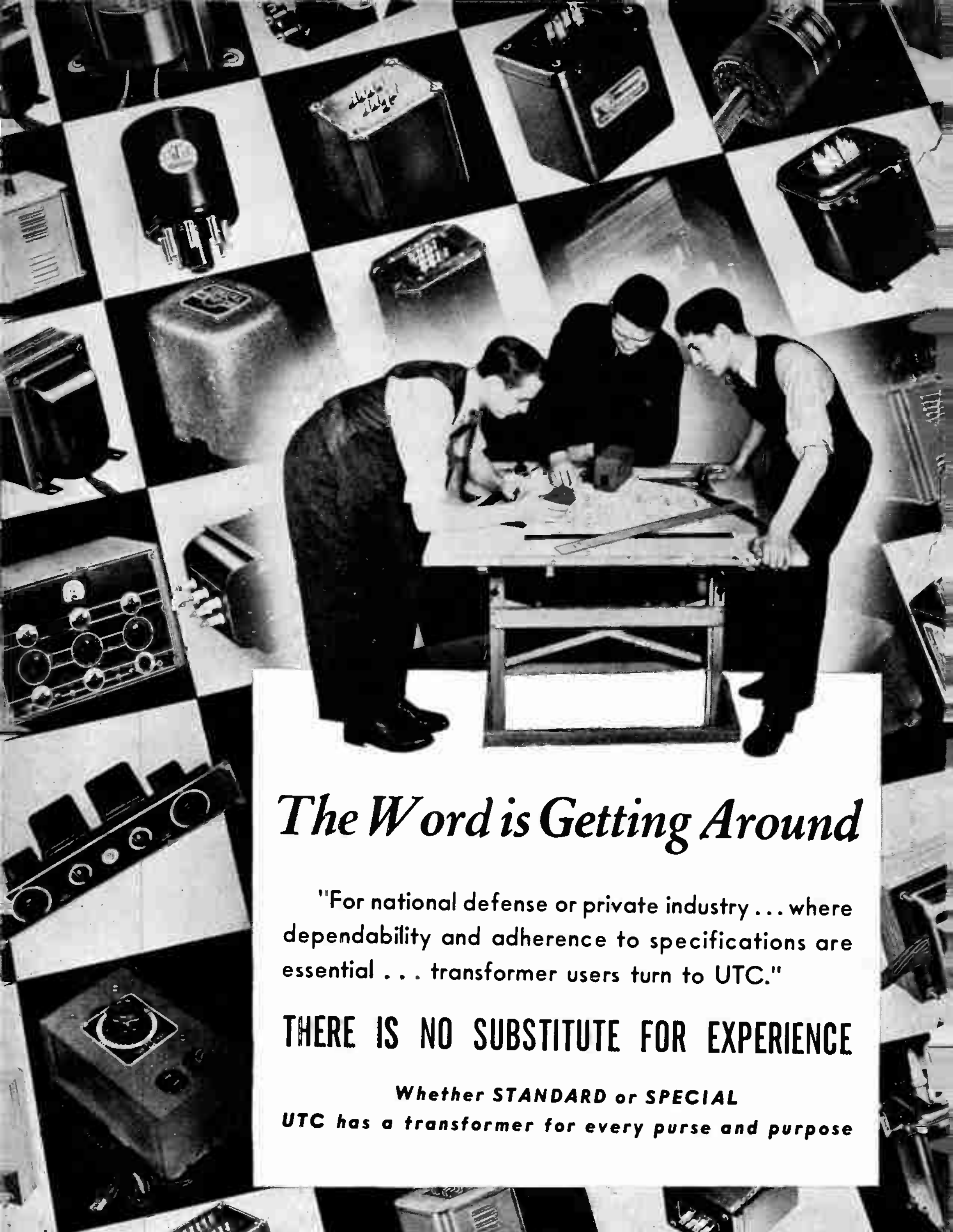
* * *

LATEST data on cathode modulation will be treated in March *A.R.D.*, together with a number of interesting circuit applications and better-than-ordinary constructional designs.

* * *

REGRETFULLY we announce that space did not permit the publication in this issue of W6SSN's rotary array adjusting device, nor the data on a complete transmitter now under construction by Mrs. W6SSN. The material will be published next month.

* * *



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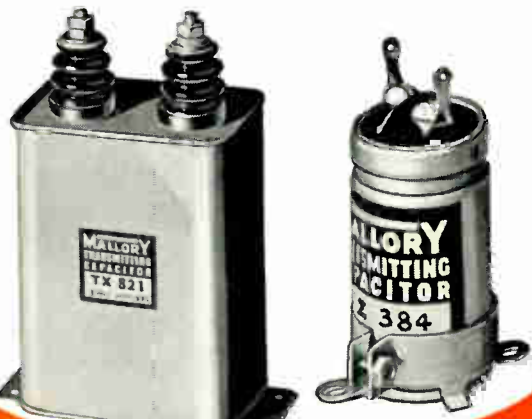

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Identical in appearance with 22X. Rugged construction; dependable performance. With 7 foot cable set List **$20.00**

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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**

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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**

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