Amateur Radio DEFENSE

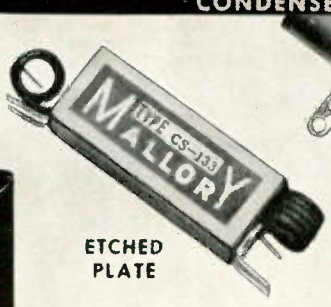
PUBLICATION OFFICES:
Monadnock Building
San Francisco . . . . California

A.R.D.

November, 1940
20 CENTS
Yearly Subscription $2.00

P.R. MALLORY & CO. Inc. MALLORY *Approved Precision Products FOR COMMUNICATION SERVICE

CONDENSERS



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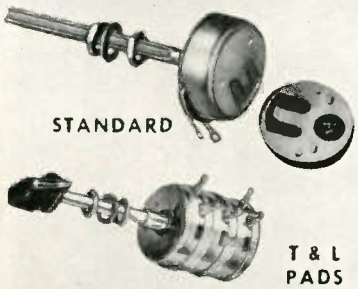

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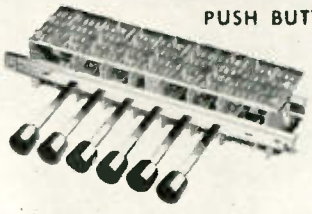

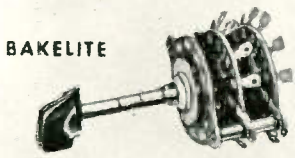

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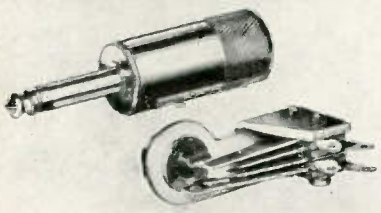

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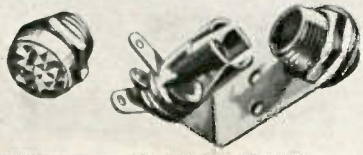

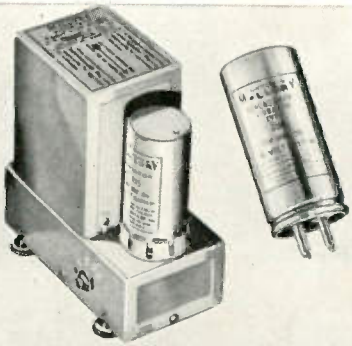

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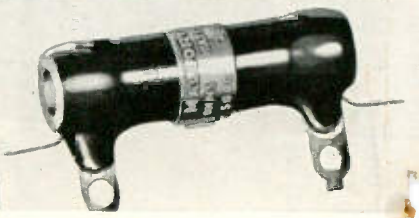

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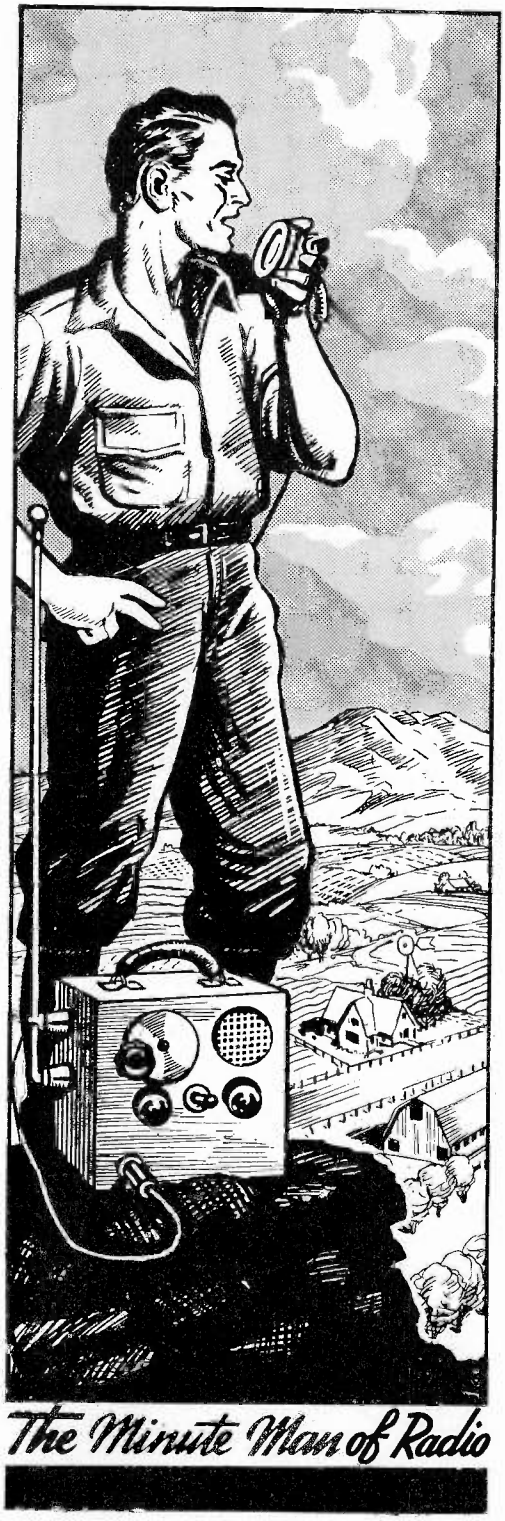
THIS MAN MUST REMAIN ON THE AIR



"He Also Serves"

A Tribute to the Radio Amateur

UNSEEN, unsung, "he also serves"
And from his duty never swerves!
Alert to ev'ry call for aid,
Dependable, and unafraid!

Regardless of reward or gain,
He reaches out o'er hill and plain,
To render aid where e'er he can,
Or chat a bit, like man to man.

On living, vibrant ether wave
He modulates his call, to save
The victims of disaster grim,
Who face the loss of life or limb.

His call "gets through" when others fail
To rouse the help for those who ail.
Through all the day and weary night
He guards against Fate's arrow flight.

With key or mike this "minute man"
Forever gives the best he can,
And only asks that we maintain
His services to lighten pain.

Must he, a patriot, proved and true,
Be barred, as is that spoiler crew
Who seek to wreck our nation's weal
And make us to a victor kneel?

Nay, God forbid! that such be done
To him who fights against the Hun
Whose rattling sabre sounds the threat
To what we've earned by blood and sweat.

For if we rule that he must go,
We quench the fires which foil our foe.
Heed well his plea, his simple prayer,
That he be kept upon the air!!

★

VOL. 1 ● NO. 1
NOVEMBER, 1940
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BUSINESS OFFICES

Monadnock Building
San Francisco, Calif.

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Chicago Advertising Representative:
C. W. Nelson
3606 Bernard Street

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Subscription Price: $2.00 per year in the U.S.A. and its possessions. Elsewhere $3.00 per year.

AMATEUR RADIO DEFENSE

Published Monthly
By
Pacific Radio Publishing Co.
In the Interests of
Amateur Radio Defense Association

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CONTENTS FOR NOVEMBER

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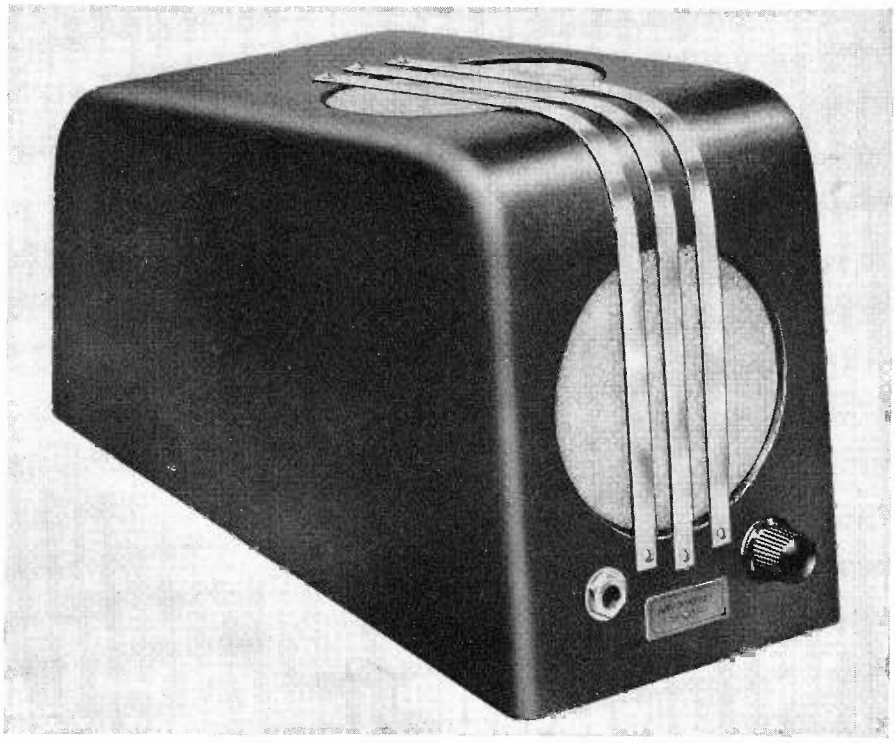
Attention C-W Men!

SHIP OPERATORS – AMATEURS



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Most Revolutionary Development in Amateur Radio Since the "Rock-Crusher" Was Discarded!

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.

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"A FAMOUS NAME FOR TWO DECADES"

QRA's of Staff and Contributors

Arthur H. Halloran, editorial director of *AMATEUR RADIO DEFENSE*, is a veteran writer on electrical engineering topics and an experienced organizer of cooperative effort. Since graduating from the engineering department of the University of California, he has been chiefly engaged in editorial work. He was managing editor of *Journal of Electricity*, 1907-1919; editor *Radio* magazine, 1921-1932; organizer and president Pacific Radio Trade Association, president S. F. Electrical Development League, member of Electrical Jury of Awards Panama-Pacific International Exposition; Chief of Electrical Exhibits Golden Gate International Exposition; lecturer on television for Extension Division University of California; author of *Television With Cathode Rays*; recently technical writer and lecturer with Farnsworth Television & Radio Corp., and is a member of the Institute of Radio Engineers. His hobbies are bass-fishing, motorboating and mathematics.

★

H. W. Dickow, managing editor, has been an active radio amateur since 1906. He joined the Radio Corporation of America as a commercial radio operator in 1913; was one of the first San Francisco operators to volunteer for service in the U. S. Navy during the first World War. He was later placed in charge of KHK for the Navy, then served as radio inspector for the U. S. Emergency Fleet Corporation. He founded "*Pacific Radio News*" in 1917, suspended its activities during the first World War, reentered the radio magazine publishing field shortly after the reopening of U. S. amateur radio stations, and became associated with Arthur H. Halloran in the publication of "*Radio*" magazine. In recent years he has cooperated with Frank C. Jones in the radio textbook publishing field. He is the founder of the Society of Radio Pioneers, past-president of the S. F. Radio Club, Inc., and an active radio amateur. He signs W6JYN.

★

Frank C. Jones, technical editor, W6AJF, is among the foremost developers of short-wave circuits and equipment for amateur, commercial and Governmental use, having acted as consultant for numerous broadcast and police radio systems, expert witness in radio litigation; in charge of engineering for Gilfillan Bros., Inc., and Echophone Radio Mfg. Co., 1927-1930. He is the "answer man" for thousands of radio amateurs. He originated the idea of the midget superheterodyne receiver, and he developed the cathode regenerative crystal oscillator, the cathode-coil "super-gainer" receiver circuit, and cathode modulation. His notebook is crammed with worthwhile ideas which have been freely submitted for amateur use and which will hereafter appear exclusively in these columns. In this issue, for example,

he tells how to increase the power output of an r-f amplifier and put more power into the antenna, at no additional cost. After graduating from the University of California he was in the Engineering Department of the Pacific Tel. and Tel. Co. for several years, and then "went on his own" as a

radio engineering consultant. Because of his unselfish contributions to the advancement of the art, his willingness to give expert help, and gracious modesty, he is, without doubt, today more beloved and respected by the amateurs than is any other living authority.

★

Clayton F. Bane, W6WB, could command an important technical post with any radio magazine publisher, yet his heart is in the commercial radio manufacturing industry, where the beat-note of an oscillator holds more appeal than the aroma of printer's ink. For many years he was a top-flight commercial artist, and this experience has served him well in the design of commercial radio transmitters and receivers, as witness his unique aircraft transmitter illustrated in the advertising pages of this issue. "Clayt" is one of our feature engineering writers, and he will have something of timely interest in each issue hereafter. This month he tells what a radio manufacturer expects of you when you apply for a job. He minces no words, makes his issues plain. Old-time amateurs know him for his record-breaking c.w. achievements in earlier years, and for his excellent contributions to the technical press. His enthusiasm as a radio amateur knows no bounds. He founded Technical Radio, Inc., five years ago and today his plant is a bee-hive of activity, manufacturing equipment for governmental, marine, police and commercial broadcast and telegraph services. Look for his exclusive series of engineering articles in future issues of this magazine. He talks the amateur's language, knows what you want. He will show you how to apply many of his commercial developments to your amateur equipment.

★

Clyde C. Anderson, W6FFP, knows as much about engineering as he does about drafting. Of all draftings yet published in the amateur radio press, none have received more enthusiastic praise than his. Much of the success of a technical manuscript depends upon a correctly drafted circuit diagram, one that is easy to follow and check. A glance at Andy's circuit draftings in this issue, also the professionally executed graphs and curves in the Engineering pages, will make you wonder why he chose radio engineering as a career rather than circuit drafting. He is in the broadcast division of the Pacific Tel and Tel.

Co., and several of his original ideas for telephone communication have already been accepted as patentable. Amateurs of 1919 recall him as the first to contact the Antipodes on 160 meters with 5 watts. "Andy," as he is affectionately known to amateurs the world over, has also contributed a number of important circuit improvements to the amateur fraternity. One of these is the high-C push-pull self-excited oscillator which created a stir in 1925. His hobbies are rock gardening and drafting, both "hard" subjects to master.

★

F. D. Wells, W6QUC, is editor of the Engineering Forum, a monthly feature of this magazine. He is a commercial radio engineer, associated with Technical Radio, Inc. To the amateurs on the 10-meter band he is known as "Fran," to his associates he is a veritable store-house of technical information. Tucked away in his library is an engineering notebook containing reams of copy devoted to circuit improvements, short-cuts and other time- and money-saving ideas. He guards this information as zealously as the Navy guards its lead-

covered code books on its warships. Slowly but surely we will wear him down, coaxing secrets from his technical treasure-chest. He starts his department with a few columns from Page 1 of his notebook. Before you know it, the once-confidential data in his book will be no more secret than an amateur's contact with his YL on the 160-meter band. The help of the engineering fraternity in contributing material for his column is solicited. Send your technical suggestions to F. D. Wells, care of this magazine.

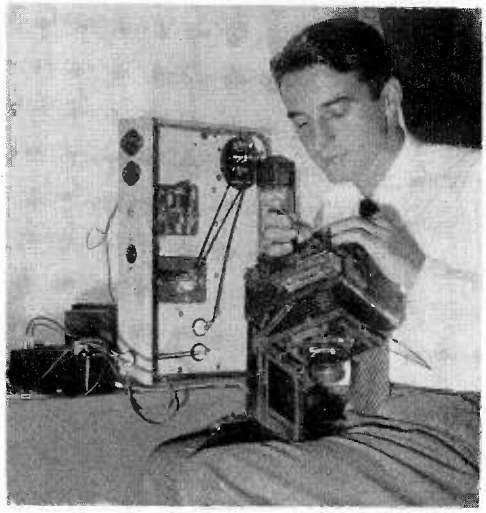
★

Robert M. Ellis, W9YSA, Sales Engineer for P. R. Mallory, Inc., is the author of a series of technical information on Vibrator Power Supplies.

He is an old-timer in radio, and countless amateurs know him from the early days of the pioneer Silver-Marshall Corporation, where he acted in the capacity of Service Manager. He was superintendent of Air Oil Company's field organization for two years previous to his association with Silver-Marshall. Later he served as Technical Correspondent for P. R. Mallory, Inc. His hobbies are amateur radio, photography and golf; his pet peeve is golf! Married—has two junior YL operators, 11 and 15 years young; gets his biggest thrill out of amateur radio in connection with circuit development and layout design. The *Vibrapack*, which he treats in his series of articles, is one of the vital accessories to radio defense equipment. He tells how and what it is, how it works, and how to choose the proper emergency power unit for your particular job. Part II will appear in the next issue; it deals with circuit applications for Vibrapacks. Every defense-minded reader will welcome this timely information from the pen of Robert M. Ellis.

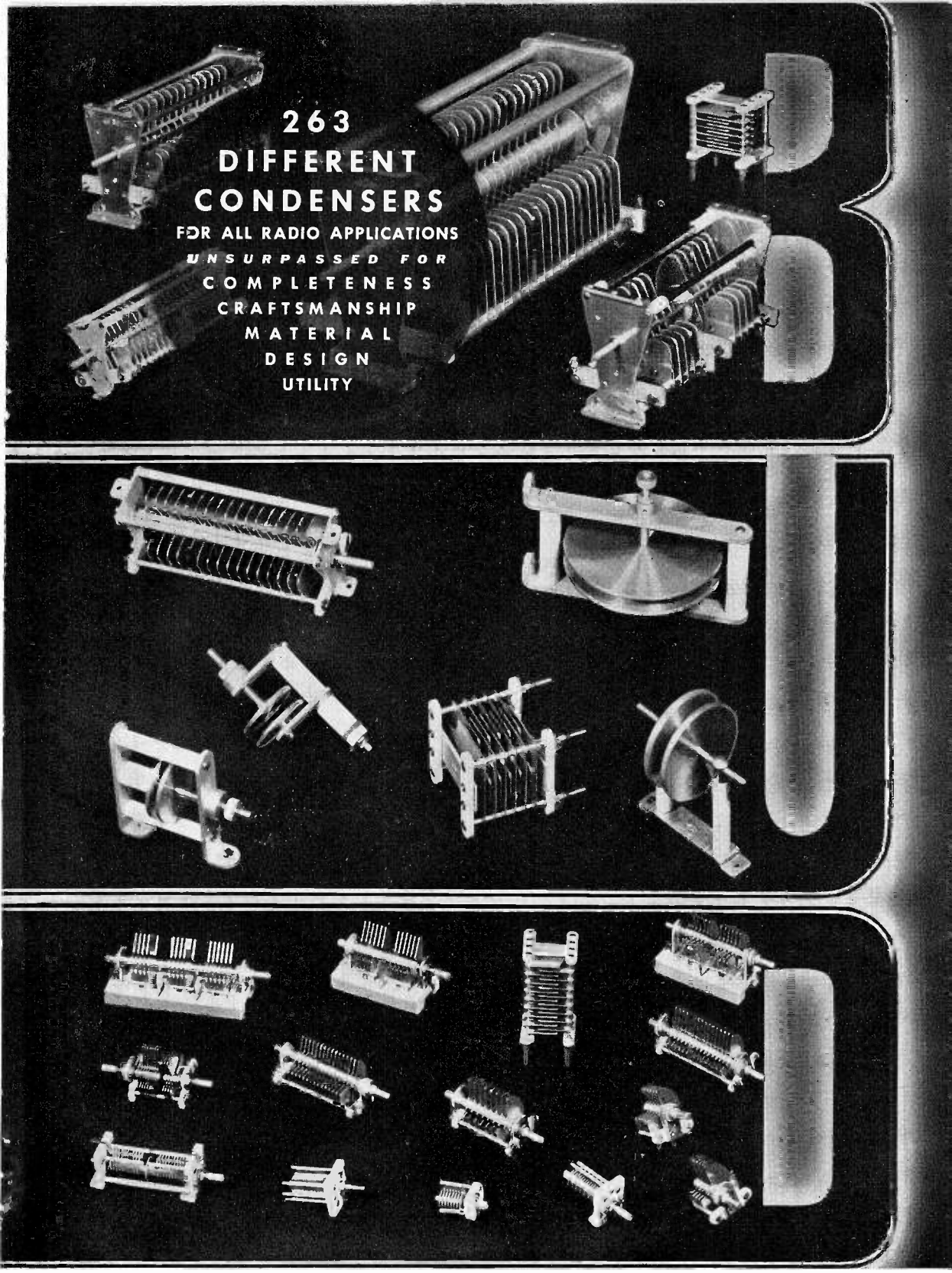
★

N. E. Farbman, W6SEM, is our staff photographer—a vital cog in the wheel of magazine production. In order to get good "shots" of radio equipment, the photographer should be an experienced amateur, so that the objects he photographs will look like radio equipment, rather than like a pair of Ethiopians fighting in a tunnel at midnight. "Farb," as we know him in person and on the air, is a rather unusual fellow—unusual in that he mastered the code in two weeks, secured his license in less than a month, and immediately went into radio the hard way on the 10-meter band. His home is a veritable ham's paradise, contains eight rooms, seven commandeered for radio, one reserved for the YF, in a typically considerate amateur manner. What once was a dining room is now a machine shop, with lathe, drill press, grinders, polishers, etc. The butler's pantry serves the more noble purpose of a dark-room for his cam-



era work. The maid's room has been elevated to the status of a high-class storeroom for spare parts and tools, and the cozy sitting room overlooking the flower beds is the radio room de luxe. In the kitchen where pots and pans once hung to dry, you will find panels, chasses and relay rack for a new transmitter freshly painted, hanging from the culinary hooks. Photographs of his "paradise" will appear in the next issue of this magazine, showing what a recently-married amateur can get away with. One year hence another group of pictures will be shown, and in the meantime you can speculate on the chances of W6SEM taking over the last remaining room in his home for radio and moving the YF to the penthouse—or whether the OM will eventually land in the basement with his "junk"—even as you or I.

(Continued on page 60)



BUD RADIO INC

BUD

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Two ceramic insulators

ALIKE IN APPEARANCE

...but in performance there's a vast difference

When Eimac tubes first appeared on the market, their unusual design features were rather unique. The odd shaped, crystal-clear bulb, cylindrical elements, new non-sag filament support, wide spacing of grid and plate leads—all were "ear-marks" of the Eimac tube. But there were other features (not visible) which became apparent only when the tubes were put into service. Low inter-electrode capacities, increased electrical efficiency, complete freedom from tube failures caused by gas released internally and ability to withstand momentary overloads as much as 400% to 600% without damage—these are the hidden capabilities which are responsible for Eimac's vastly superior performance.

Eimac tubes are no longer unique in appearance because the purely physical details have been adopted by others (a fitting testimonial of superiority) but they are *still* unique in their most important feature—namely;OUTSTANDING PERFORMANCE.

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The Editor's CQ

A Call To Action

WHY

AMATEUR RADIO DEFENSE is being published to foster a greater use of amateur radio operators and equipment in the defense of our nation. Its primary purpose is to create a better understanding and encouragement of the amateur's ability to meet emergencies arising from disruption of normal communication facilities by acts of war. This purpose, incidentally, is not being effectively accomplished by any other agency.

Whilst no SOS has been sent from our "ship of state," the weather signals are adverse, and every member of the crew is anxious to do his part when and if a storm breaks. Preparedness for the worst is the watchword of the day. Such preparedness should be founded not only on a lively anticipation of forces and events which may threaten, but also on a knowledge of probable lines of weakness and the means for strengthening them.

Among the most vital and vulnerable of the nation's lines of defense are its commercial communication facilities. If crippled, they would hamper other defense measures just as effectively as they assist them when functioning normally. They are liable to interruption by flood, fire, hurricane, sabotage and bombardment. They constitute one of the physically weak links in the chainmail of defense.

To strengthen them, the nation has a reserve army of fifty thousand licensed amateur radio operators who stand ready and able to meet any threatening disaster. They have proved their ability and value in many past catastrophies. They have a proficiency and knowledge equivalent to at least two years of intensive training. They have learned the art for the love of it, and not for profit. They are more valuable behind a telegraph-key than behind a gun.

Less than twenty-five years ago a similar, but much smaller, body of men were the backbone of the U. S. military radio participation in the first World War, when many of them enlisted during the period while their stations were closed. Now, the Federal Government, realizing the aid they can render, is favorably disposed toward the legitimate operation of amateur stations in case of another war. The only present restrictions are that communication be confined to the continental area of the United States and its possessions and that the operators prove that they are not aliens. If the amateurs can prove that their service is essential there is good reason to hope that their stations will not be ordered to be shut down in the event of a new war.

Such proof today depends largely on the maintenance of interstate traffic schedules by various individuals and groups, including those conducted under the auspices of the U. S. Army and Navy. By their combined efforts they are maintaining regular day-and-night communication across the length and breadth of the land. But remarkable and commendable as these actions may be, they lack a common useful aim. They are not coordinated. They need that correlation of effort between working bodies which is technically known as synergy.

No existing agency is yet empowered to act as a synergist or, if you prefer, as a coordinator. Even the Federal Communications Commission, which is expressly charged with "carrying out the purposes of the national defense," has no power to organize and direct a defense network of stations in the homes of amateurs. Whatever is done must be accomplished by the voluntary action of the defense-minded amateurs themselves.

HOW

CONSEQUENTLY, we suggest that each operator who can conscientiously sign the Application for Enrollment printed elsewhere in this issue, and who is not drafted for military training, mail the Application as directed. Those best qualified among the enrollees will be asked to act as regional coordinators and enlisters of local coordinators, observers, listeners, mobile

unit operators, etc. When enough have volunteered, we suggest that they adopt a constitution and by-laws, elect national and regional leaders from their own number, and adopt the plan of procedure to be submitted in the next issue of this magazine.

This plan will call for close cooperation with the Army and Navy radio services so as to create a unified nation-wide system of amateur radio defense. It will propose that the organization shall eventually be directed by a constituted authority at Washington, such as the newly-appointed National Defense Communications Board. This is not for the purpose of regimentation but for the purpose of unified, intelligent and effective action. It will seek Federal recognition and support of a sincere effort to aid the government which protects us.

These suggestions are based upon scores of letters from older amateurs who, for reasons best known to themselves, are not participating in other amateur affairs. Comment on them and further suggestions are invited from each reader. These will be published in the next issue and the best of them embodied in the final plan to be submitted for adoption.

This Call to Action is addressed to those who want to earn the privilege of staying on the air by proving that their stations will be more valuable on than off when a war emergency comes. This is not child's play but man's work. It inculcates preparedness as the first law of preservation. America is at the cross-roads. Shall we follow the easy road of appeasement to serfdom, or shall we fight along the hard road of defense of our liberty? Yours is the answer.

"Thou, too, sail on, O Ship of State!
Sail on, O Union, strong and great!
Humanity with all its fears,
With all the hopes of future years,
Is hanging breathless on thy fate!

We know what Master laid thy keel,
What Workmen wrought thy ribs of steel,
Who made each mast, and sail, and rope,
What anvils rang, what hammers beat.
In what a forge and what a heat
Were shaped the anchors of thy hope!

. . . .

"In spite of rock and tempest's roar,
In spite of false lights on the shore,
Sail on, nor fear to breast the sea!
Our hearts, our hopes, are all with thee,
Our hearts, our hopes, our prayers, our tears,
Our faith triumphant o'er our fears,
Are all with thee,—are all with thee!"

H. W. LONGFELLOW.

Statement of Editorial Policy

A SUBSCRIPTION to the magazine "AMATEUR RADIO DEFENSE" does not enroll the subscriber in the AMATEUR RADIO DEFENSE ASSOCIATION.

ANYONE can subscribe to the magazine at $2.00 per year or buy it at 20 cents per copy, but enrollment in the Association is free and is open only to licensed amateur radio operators who apply for it.

THE magazine will foster the organization of the Association by publicizing its accomplishments and suggesting practical means for promoting the effectiveness of amateur radio. The magazine will continue to "carry on" as a dependable source of technical information and as an active crusader for amateur privileges, long after the present crisis has passed. Meanwhile, it is not the captain of the team, but the coach, an experienced pilot to direct the craft through perilous waters.

(Signed) *A. H. HALLORAN*, Editorial Director.
H. W. DICKOW, Managing Editor.
FRANK C. JONES, Technical Editor.

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.

. . . . *James Lawrence Fly,*
CHAIRMAN FEDERAL COMMUNICATIONS COMMISSION.

Graduate from U. S. Naval Academy and Harvard Law School, former Special Ass't U. S. Attorney-General, and T.V.A. General Counsel. Now Chairman newly-appointed National Defense Communications Board.

NEWS from WASHINGTON

EACH month in *"Amateur Radio Defense"* you will find the latest news from the Federal Communications Commission, from the standpoint of both the amateur and commercial radio interests. News comes thick and fast in times like these. And so we will hold one of the forms from the presses until the very last moment, in order to bring the latest and most complete news from Washington to you. Two days after the final flashes are received the magazine goes into the mails—carrying the news weeks ahead of others. Because nothing is more stale than stale news, we have geared our production to newspaper speed in a large printing plant operating on a 24-hour schedule.

2000-2050 Kc. Available to Amateurs Effective Nov. 1st

PURSUANT to agreements made at the first Inter-American Radio Conference, held at Havana in 1937, the Federal Communications Commission is shifting certain police and amateur frequencies, effective November 1, 1940.

Following negotiations between the Commission, the amateurs and representatives of the International Association of Chiefs of Police (IACP) and the Associated Police Communication Officers, Inc. (APCO), it was arranged for the amateurs to relinquish the frequencies between 1715 and 1750 kilocycles and to accept the frequencies between 2000 and 2050 kilocycles in exchange. Likewise, the police relinquish the zone police frequencies 2036, 2040 and 2044 kilocycles. In return, the police service receives the frequencies 7480, 7805, and 7935 kilocycles and three channels in the band 1715-1750 kilocycles.

At the present time, police radiotelegraph stations are not assigned any frequencies which are useful for long-distance daytime communication. The assignment of this 7 megacycle group of frequencies will provide the country with three necessary long-distance daytime radiotelegraph channels. In addition, the "day only" restriction is being removed from the 5 megacycle channel frequencies (5135, 5140, and 5195 kilocycles) which will permit three long-distance night communication channels.

It appears that in a few particular instances the prohibition of radiotelephone relays has resulted in an undue hardship. The rules are therefore being changed to permit the establishment of certain voice communication circuits involving relays upon proper showing of the need therefor and upon express authorization by the Commission.

Other minor changes involve the requirement that a 60-day notice be given the Commission prior to the termination of all inter-municipal agreements, together with modification of certain radio station log and frequency tolerance requirements.

Today the United States has more than 1000 police radio systems operating approximately 6300 mobile units.

★

Fly is Chairman of New Radio Defense Board

DEVOID of power to censor radio or other communications, or to take over facilities, an executive order was issued by President Roosevelt on September 24th creating the long expected Defense Communications Board designed to coordinate the relationship of all branches of communications to the national defense program. Initiated jointly by the various government departments and agencies having a vital interest in this phase of the preparedness program, the board is basically a planning agency without operating or procurement functions as such. It is charged with the important duty of charting the utilization and control of the communications systems in the best interest of national defense and in this task it will have the cooperation of various representatives of commercial broadcasting and communications companies as well as labor.

"This task of planning," the White House announcement said, "is not confined to radio broadcasting, but also embraces common carriers such as commercial radio-telephone and radio-telegraph as well as other telephone, telegraph and cable facilities.

"The board does not propose to interfere with the normal operation of broadcasting or

other forms of communications any more than is necessary for the national protection through correlated planning by the American communications systems, in both the domestic and international fields, to meet any situation the national interest may require."

The various branches of the communications industry will cooperate in an advisory capacity with the Board, which will be composed of James L. Fly, chairman of the FCC; the Chief Signal Officer of the Army, Chief of Naval Communications, an Asst. Sec't'y. of State, and an Asst. Sec't'y. of the Treasury, probably Adolf A. Berle, Jr., and Herbert Gaston, respectively. It is provided that where the activities of the Board impinge upon any functions of government departments representatives of such departments will be placed upon appropriate committees.

F.C.C. "Police Patrol" equipped with Hallicrafters SX-17 Super Skyrider. Several of these scout cars are in daily use, trapping "bootleggers" and checking other transmissions. Recordings of broadcast programs are also made and sent to Washington for checking purposes.

It was further declared in announcing creation of the board, that the cooperation of the radio industry was utilized in the preparation of the executive order. "With industry cooperation," the announcement said, "the board will appoint committees from every branch of communications—broadcast and other radio services, cable, telegraph and telephone as well as from labor groups. All plans involving the utilization of private facilities, or requiring industry cooperation, will be adopted only after consultation with such industry representatives and the particular private companies whose properties may be involved."

Chairman Fly was designated as chairman of the new board, with temporary chairmanship in event of Fly's absence going to either the Chief Officer of the Army or the Director of Naval Communications, whichever holds senior rank. The Assistant Secretary of the Treasury in charge of the Coast Guard was designated as secretary.—*Radio Daily.*

The executive order reads as follows:

EXECUTIVE ORDER

Creating the Defense Communications Board and Defining Its Functions and Duties

WHEREAS, coordinated planning for the most efficient control and use of radio, wire and cable communication facilities under jurisdiction of the United States in time of national emergency involves the consideration of the needs for communication of the armed forces of the United States, of other government agencies, of industry, and of other civilian activities; and

WHEREAS, such planning must be accomplished as a matter of preparation for national defense; and

WHERAS, the interest of national defense in the matter of control and use of communication facilities during any war in which the United States may become a beligerent is deemed paramount;

NOW, THEREFORE, by virtue of the authority vested in me as President of the United States, and by the Communications Act of 1934 (48 Sta. 1064), as amended, it is ordered as follows:

1. There is hereby created the "Defense Communications Board," hereinafter called the Board, consisting of the Chairman, Federal Communications Commission, the Chief Signal Officer of the Army, the Director of Naval Communications, the Assistant Secretary of State in charge of the Division of International Communications, and the Assistant Secretary of the Treasury in charge of the Coast Guard.

2. The functions of the Board shall be, with the requirements of national defense

as a primary consideration, to determine, coordinate and prepare plans for the national defense, which plans will enunciate for and during any national emergency—

a. The needs of the armed forces of the United States, of other governmental agencies, of industry, and of other civilian activities for radio, wire and cable communication facilities of all kinds.

b. The allocation of such portions of governmental and non-governmental radio, wire and cable facilities as may be required to meet the needs of the armed forces, due consideration being given to the needs of other governmental agencies, of industry and of other civilian activities.

c. The measures of control, the agencies to exercise this control, and the principles under which such control will be exercised over non-military communications to meet defense requirements.

3. The Chairman of the Federal Communications Commission shall be the Chairman of the Board. In the absence of the designated Chairman, the temporary chairmanship shall evolve upon the remaining members of the Board in the following order:

1. The Chief Signal Officer of the Army or the Director of Naval Communications, whichever may be senior in rank.

2. The Chief Signal Officer of the Army or the Director of Naval Communications, whichever may be junior in rank.

3. The Assistant Secretary of State in charge of the Division of International Communications.

4. The Assistant Secretary of the Treasury in charge of the Coast Guard.

In the absence of any regularly designated member, the agency which he represents may be represented by an alternate from that agency, designated by the head thereof, but such alternate shall not serve as Chairman. The Assistant Secretary of the Treasury in charge of the Coast Guard is designated as the Secretary of the Board.

4. The Board shall take no cognizance of matters pertaining to censorship. The Board shall study the physical aspects of domestic standard broadcasting and shall recommend such precautions, supplementary facilities and reallocations as it shall deem desirable under foreseeable military conditions. It shall also make plans for the speedy and efficacious use of all necessary facilities in time of military emergency.

5. The Board shall appoint such committees as may be necessary to carry out its functions and to provide for continuing studies and for contact with other governmental agencies and with the civil communication industry.

6. Except as otherwise instructed by the Board, committees appointed thereby shall have no power to make final disposition of any matter presented to them by the Board for study, but they shall express by written report their findings and recommendations. Minority reports may be submitted if deemed of sufficient importance to warrant further consideration by the Board.

7. The Board and the committees shall call for consultation such representatives of other government agencies and of the civilian communication industry as may be deemed advisable in obtaining full knowledge of the situation being studied, to the end that the needs of all may be considered and provided for in so far as the situation permits. Other governmental agencies are directed to cooperate in providing assistance required by the Board in its studies.

8. During any war in which the United States is a belligerent, or any national emergency, the existing Interdepartment Radio Advisory Committee shall act as a Committee of the Board, but only in an advisory capacity. While the Interdepartment Radio Advisory Committee is so acting as an advisory committee, all of its reports, recommendations, or communications normally prepared for submission to the President shall instead be submitted to the Board, for consideration from the standpoint of national defense and for disposition.

9. Reports containing the findings and recommendations of the Board shall be submitted to the President for final action through one of his administrative assistants.

FRANKLIN D. ROOSEVELT.

THE WHITE HOUSE,
September 24, 1940.

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Next Month--
"Amateur Radio's Part in the Defense Program"
....Don't Miss it

How To Put More Power Into A Low-Resistance Antenna

A practical method of eliminating the transformation loss between an r-f amplifier plate circuit and the antenna.

By Frank C. Jones

MARCONI antennas of the type used extensively in the amateur 160-meter band, and in commercial and governmental channels between the amateur 160- and 80-meter bands, usually have very low radiation resistances. A quarter-wave Marconi antenna has a theoretical radiation resistance to ground of slightly more than 36 ohms. If the antenna is less than a quarter-wave in length, the radiation resistance decreases rapidly and can often be as low as 4 or 5 ohms. This is particularly true for a base-loaded antenna. Top-loaded antennas can be designed with higher values of radiation resistance, yet the difficulty of design and construction of this type of antenna often eliminates the practicability of its use.

As an example, the radiation resistance of an antenna slightly less than a quarter-wave long, and with base-loading to resonate it to a quarter-wave, may have a radiation resistance of 30 ohms. Assuming zero resistance loss to a perfect ground system this value of 30 ohms must be increased to a value equal to that of the tuned plate circuit connected to an r-f amplifier in order to obtain maximum transfer of power from the r-f amplifier to the antenna. The tuned plate circuit is usually coupled to the antenna circuit so tightly that the parallel circuit impedance of that portion connected across the plate circuit of the tube is equal to the a.c. plate impedance of the tube. This is an automatic procedure obtained in the usual method of tuning the r-f amplifier and adjusting the antenna coupling to a point which loads the r-f amplifier tube, or tubes, up to the desired value of d.c. plate current.

The d.c. resistance of an r-f amplifier is equal to the d.c. plate voltage divided by the d.c. plate current. The a.c. plate impedance is approximately one-half this d.c. value for the average class-C amplifier. If an amplifier tube is operated at 1,200 volts plate supply and 100-ma. of plate current, the d.c. plate resistance will be 12,000 ohms. The a.c. plate impedance is approximately 6,000 ohms, and in a plate-neutralized amplifier this 6,000-ohm impedance is connected across one-half of the split tuned-plate circuit. Therefore, the total tuned plate circuit impedance will be four times the impedance across one-half of the tuned circuit, since the turns ratio is 2-to-1 in the r-f coil, and the tuned plate circuit impedance will be 24,000 ohms.

This value of 24,000 ohms must be transformed down to a 30-ohm circuit, in this particular example, which gives an impedance transformation ratio of 24,000 divided by 30, or 800 to 1. This is an enormously high transformation ratio and will result in considerable power loss in the impedance transformation. For example, if the tuned plate coil has 42 turns, a coupling coil with 1½ turns would be necessary to couple this tuned circuit into a 30-ohm resistance. Anyone familiar with 160-meter amateur transmitters will recall that the antenna coupling coil usually has from 4 to 8 turns in order to load the r-f amplifier up to the desired value of plate current.

For all practical purposes it is impossible to obtain sufficient coupling with only 1½ turns and the impedance-matching power loss at this point is very high. This same effect holds true even though the r-f amplifier is link-coupled by means of a 75-ohm line to a tuned antenna circuit, since the antenna in this example has an effective resistance of 30 ohms. The power loss in the additional antenna tuned circuit adds further to the r-f power loss, with the result that many r-f amplifiers are actually putting much less than one-half of the expected power into the antenna.

Grid vs. Plate-Neutralization in R-F Amplifier

THE transmitter illustrated herewith was first built with a plate-neutralized final amplifier using a split-stator plate tuning condenser. This r-f amplifier delivered a measured power of 40 watts into a 30-ohm dummy antenna, 52 watts into a 73-ohm dummy antenna and 70 watts into a 600-ohm dummy

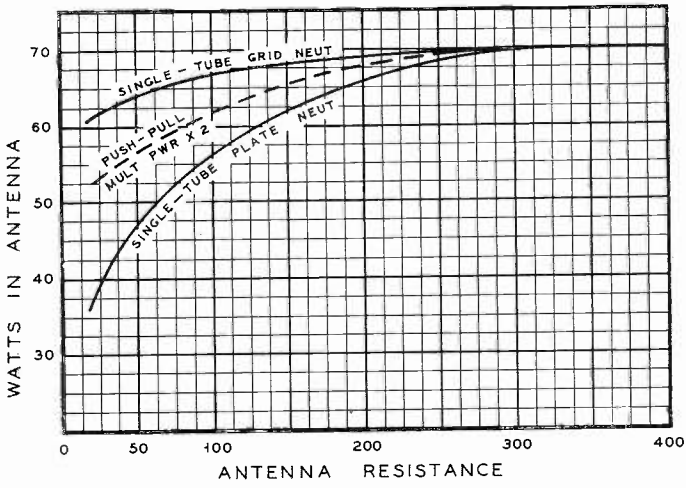


Fig. 1

The Curve shows clearly the increase in measured antenna power secured from a grid-neutralized r-f amplifier connected to a low-resistance antenna.

antenna. The power loss into the low-resistance antennas is due to the high transformation loss between the tuned plate circuit and the dummy antenna load. The r-f amplifier is operated from an 1,100-volt power supply with approximately 90-ma. of plate current for a fixed d.c. grid current of 7-ma. The d.c. plate resistance of the tube under these conditions is approximately 12,000 ohms, and the a.c. impedance somewhat less than 6,000 ohms. The plate is connected across one-half of the split-plate circuit, so that the total tuned parallel circuit impedance is some value between 20,000 and 24,000 ohms. This amplifier was used to plot the curves in Fig. 1, which show the single-tube plate-neutralized condition.

The r-f amplifier was then changed to a grid-neutralized system, with the plate circuit connected across the entire tuned plate coil. The tube was then loaded to the same value of d.c. plate current and the same d.c. grid current. Different values of dummy antenna load resistance were chosen to determine the top curve of Fig. 1 for a single-tube grid-neutralized amplifier. It can be seen that the plate-neutralized and grid-neutralized amplifiers produced the same power into the dummy antenna for all values of antenna resistance greater than 300 ohms. However, for low-impedance antennas, the grid-neutralized amplifier produced very much more measured power into the antenna than could be obtained from the plate-neutralized amplifier. For example, a little more than 62 watts could be put into a 30-ohm antenna, as compared to 40 watts from the plate-neutralized amplifier. This represents an increase of useful power into the antenna circuit of slightly more than 50 per cent.

The reason for the increased power output is due to the smaller transformation ratio between the antenna load resistance and the tuned plate circuit impedance. The tuned plate circuit impedance of a grid-neutralized r-f amplifier is only one-fourth as great as that of a plate-neutralized amplifier, so that the impedance transformation ratio is reduced by a factor of four times, or the tuned circuit impedance is only one-fourth as great.

The grid-neutralized amplifier requires four times as much total tuning capacity, and one-fourth as much inductance in the plate coil, in order to obtain the proper L/C ratio. A grid-neutralized r-f amplifier has the disadvantage of not being perfectly neutralized, and this holds particularly true for multi-band operation. It can be neutralized closely enough for plate or cathode modulation in any one amateur band, or in two adjacent amateur bands. For commercial applications where the transmitter is tuned to one frequency or operated in close-spaced bands of frequencies, the grid-neutralized amplifier can be used to great advantage when coupled to a low-impedance antenna circuit. This holds particularly true for radio transmitters designed for operation on small boats, or for mobile service, or even for low-frequency operation in the police radio bands.

The relative power supplied by a push-pull amplifier into different antenna load resistances for a constant power input to the r-f amplifier is shown by the dotted curve of Fig. 1. From this curve it can be seen that the power loss is only half as great as for a single-tube plate-neutralized amplifier, since the a.c. plate circuit impedance of the entire tuned circuit is only one-half that of

a single-tube amplifier. The power loss is greater than that of a grid-neutralized amplifier, yet the advantage of more perfect neutralization may offset this disadvantage. A study of these curves will indicate why many amateurs are not obtaining the desired results from low-impedance three-and four-element rotary beam antennas, which may have radiation resistances of from 6 to 12 ohms.

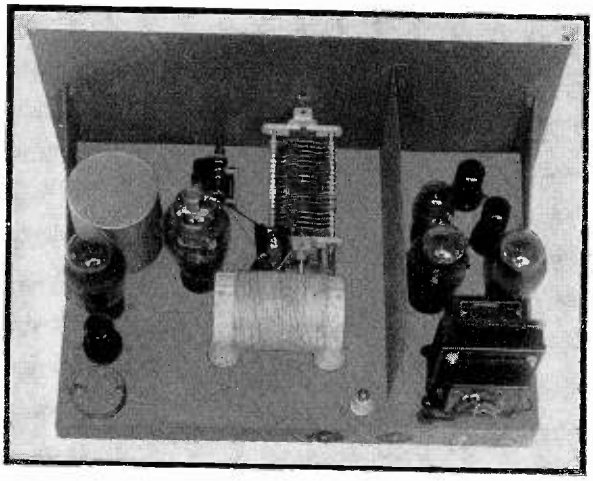
Considerably more power can be coupled into the antenna for a given plate input by re-designing the rotary beam antenna into some form which has a higher radiation resistance. One method of accomplishing this is to build the antenna into two parallel rods, connected together at the ends, and fed at the center of one of the rods. This multi-wire, or rod, antenna will have a radiation resistance approximately four times that of a single rod or wire. Similarly, a three-wire or three-rod antenna will have a radiation resistance approximately 9 times that of a single rod. It is not necessary to use multi-rod elements for the parasitic director and reflector elements. The theoretical gain and directive properties of the rotary-beam antenna will not be appreciably altered by these modifications.

Transmitter Circuit

THE transmitter circuit diagram, Fig. 2, incorporates a grid-neutralized r-f amplifier because much greater output can be delivered into conventional Marconi antennas in the 160-meter amateur band. This transmitter has a single RCA-812 in a cathode-modulated circuit with a pair of 6L6G tubes in class-AB$_1$ service for the modulator. The transmitter has a normal rating of 100-watts input and supplies from 60 to 65 watts of carrier power into the usual 160-meter Marconi antenna. The audio power is approximately 20 per cent of the class-C amplifier input power in order to obtain plate circuit efficiencies of more than 60 per cent for modulation levels up to 90 per cent. If full 100 per cent modulation is desired, it will be necessary to reduce the d.c. grid current to approximately 5-ma., with a corresponding reduction in power output to approximately 50 watts when the input is slightly less than 100 watts.

It was not found necessary to connect the grid circuit into a tap on the secondary of the modulation transformer, since the large grid-leak bias resistor has no large by-pass condenser across it. This 25,000-ohm grid-leak reduces the audio voltage applied to the grid of the RAC-812 tube to a fraction of that developed in the cathode or plate-return circuit. The modulator is resistance-coupled to a 6N7 stabilized phase inverter which, in turn, is resistance-coupled to a 6SJ7 high-grain pentode speech amplifier.

The values of coupling resistors and grid-coupling condensers were chosen so as to have a falling low-frequency characteristic suitable for voice communication. The input circuit to the 6SJ7 was designed for connection directly to a diaphragm-type crystal microphone, or to a 500-ohm line and pre-amplifier from a low-level microphone. The 25,000-ohm series resistor in the grid circuit of the 6SJ7 tube serves as an r-f filter to prevent r-f feed-back from the antenna or r-f feeders from getting into the input of the audio system.



R-F and Audio Components for the 812 Grid-Neutralized Transmitter. Note shield plate between audio and r-f stages.

The voltage on the speech amplifier and screen-grids of the 6L6G tubes is stabilized by a VR-—150 regulator tube which holds the screen-grid voltage at a constant value 150 volts less than that applied to the plate circuit of the modulator tubes. The screen-grid current in the 6L6G tubes varies several milliamperes during speech operation, so that a simple series resistor for reducing the plate voltage for a value suitable for the screen-grids is not a desirable practice. The screen-grid voltage will vary because the screen-grid current changes during modulation, with the result that less power output will be obtained from the modulator. The

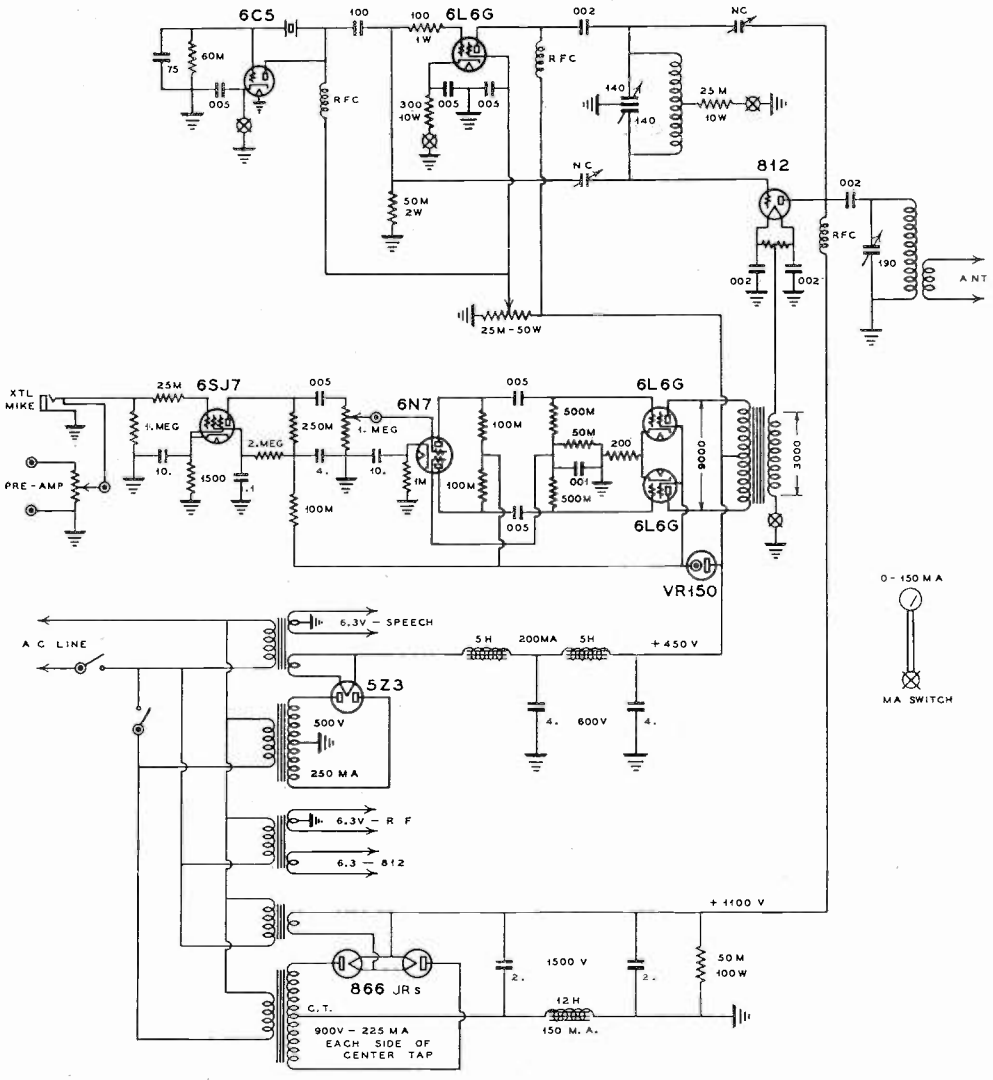
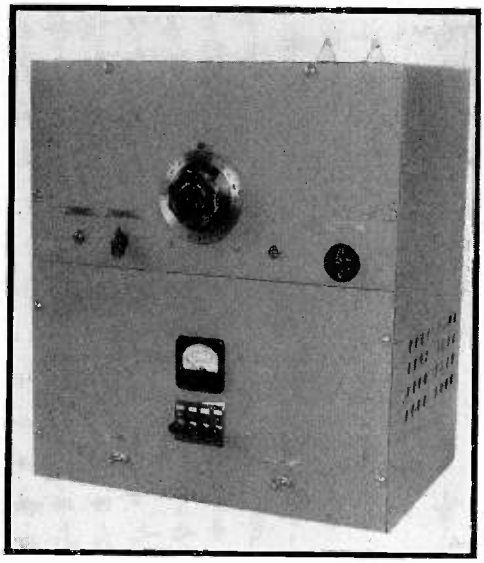


Fig. 2

Circuit Diagram of the Grid-Neutralized Cathode-Modulated Radiotelephone Transmitter discussed in this treatise.

VR-150 regulator is suitable for connection to power supply voltages ranging from 425 to 450 volts. A type VR-105 can be used in this type of circuit if the power supply delivers from 375 to 400 volts.

The r-f system consists of a 6C5 untuned Pierce crystal oscillator driving a neutralized 6L6G buffer or double stage. A parasitic oscillation in the 6L6G buffer stage was eliminated by connecting a 100-ohm resistor in series with the grid-lead of the 6L6G at the tube socket. This parasitic oscillation had a tendency to stop the Pierce crystal oscillator from going into oscillation when turning the power supply carrier control switch on and off. The parasitic-suppression resistor eliminated this effect, even when rather weak quartz crystal plates were used in the oscillator. The plate r-f choke in the Pierce oscillator should have an inductance of at least 10-mh., and the 6L6G plate choke not over 2½-mh., in order to avoid a low-frequency parasitic oscillation. Shunt feed is used in the final amplifier and buffer stages with similar r-f chokes, since the circuit eliminates the possibility of low-frequency parasitic oscillation in the 812 stage. The grid of the 812 is connected to the buf-



Front and Rear Views of the Complete Transmitter, an Ideal Arrangement for Amateur Service.

fer tuned plate circuit at the opposite end from that of the 6L6G plate, as shown in Fig. 2. The 812 stage has shunt plate supply feed in order to eliminate the possibility of d.c. plate voltage flash-over between the plate coil winding and the antenna coupling coil, the latter being wound over the lower end of the plate coil.

The transmitter was designed primarily for 160- and 75-meter operation, and with a possibility of using it for 40-meter c.w. also. The buffer plate coils are wound on standard 1½-inch bakelite plug-in forms and shielded from the plate coils by a 3-in. diameter removable coil shield. The 160-meter coil has 70 turns of no. 24 d.c.c. wire, close wound, with a connection taken at the center of the coil. The 80-meter coils has 38 turns of no. 20 d.c.c., 2-inches long, center-tapped. A similar coil of 20 turns would be suitable for 40-meter operation. The final plate coil for 160-meter operation has 33 turns of no. 16 d.c.c. wire, covering 3 inches of space on a 2½-inch plug-in porcelain form. A single coil can be used for the 80- and 40-meter bands with the tuning condenser set near maximum for 75- and 80-meter operation, and near minimum for 40-meter operation. This coil has 18 turns of no. 14 wire, 3 inches long, on a 2½-inch form.

Two power supplies are needed for the transmitter; one delivers 450 volts at a maximum current drain of 250-ma., the other supplies approximately 1,100 volts at 90-ma. plate current. The low current drain on the high voltage power supply permits the use of condenser input to the filter, together with a power supply transformer rated at 900 volts each side of center, and with 225-ma. current rating. The condenser input connection gives high output voltage, but limits the plate current drain to not more

(Continued on page 44)

Power Supply Units and Mallory Push-Button Switch.

Amateurs in the DRAFT

SEVERAL thousand licensed radio amateurs will eventually transfer their "*QTH*" to an army cantonment for a one-year training period under the provisions of the Draft. Those who are called for training are asked to keep us informed of their activities so that a page of "*Draft News*" can be made a regular monthly feature of this magazine. Your brother amateurs will be interested in your progress—and this is an opportunity to keep in touch with them, even if you cannot work them on the air. A complete list of all amateurs called for service will be published in these columns. We need your help to keep this information accurate and timely. Send photographs of yourself in uniform, and use the offices of "*Amateur Radio Defense*" as your mailing address, if desired. If radiotelegraph communication on the amateur channels will be at your disposal at training quarters, please give us the call letters of the station so that all other amateurs will know how and where to contact you via amateur radio.

"Amateurs in the Draft"
No. 1 of a Series

As an additional service to amateurs called for training under the provisions of the Draft, the publishers of "*Amateur Radio Defense*" will continue your subscription to this magazine throughout your period of training without additional cost after your original subscription has expired. We want to be first to make this offer because it is the patriotic duty of every American institution to cooperate whole-heartedly with the young men in whose hands the destiny of this Nation lies.

★

Navy Will Train Radio, Signal Men

The U. S. Navy has approved establishment of seven schools to train 4000 radio men and signal men for the naval reserves. Five of the schools will be at Charleston, S. C., Chicago, Indianapolis, San Francisco and the 13th District Naval Radio Station, Puget Sound, Wash. The two other will be at locations yet to be determined in the Third Naval Reserve District, consisting of Connecticut, New York, Northern New Jersey and Nantucket Shoals light ship, and in the 11th District—New Mexico, Arizona and Southern California.

★

Over-Seas News

WHAT has happed to amateurs in other parts of the world? Have you heard from any of them recently? What are they doing? If you are in receipt of information of general interest from your former DX contacts will you please send us a squib or two for publication in a new department which will be a monthly addition to this magazine?

We'll start the column this month with a first-hand report from a large radio export house dealing in amateur and commercial gear. No orders had been received from the London agent of late, and a letter was dispatched to inquire if bomb damage had been sustained to the Londoner's place of business. Sympathies were expressed. A reply came quickly: "*Thank you for the interest you have taken in our plight. Nothing serious has happened to us here in London. Our building was bombed out of existence and our stocks destroyed. But we are still doing business as usual.*"

. . . Which reminds us of the European broadcast we heard a few weeks ago. An English housewife emerging from a bomb shelter found her house in ruins, and then exclaimed: "Oi've lost me 'ome, but there's one consolation—I won't be a-payin' rent any longer."

★

Easy Determination of Off-Resonance Signal Strength

By Arthur H. Halloran*

BECAUSE signal strength is proportional to current strength, the problem of determining the strength of an off-resonance signal is identical with that of finding the ratio of the current I, corresponding to an off-resonance frequency f, and the current I_o, corresponding to the resonant frequency f_o. As will be rigorously proved later, this may be easily and accurately accomplished by means of the formula

$$\frac{I}{I_0} = \cos \phi \quad \ldots\ldots\ldots (1)$$

when the phase angle ϕ is defined by

$$\tan \phi = Q(1 - f_0^2/f^2),$$

where $Q = \omega L/R$ is the standard specification of coil merit. Eq(1) applies to an R-L-C series circuit. For a parallel, or anti-resonant, circuit the corresponding formula is

$$\frac{I_0}{I} = \cos \phi \quad \ldots\ldots\ldots (2)$$

when ϕ is defined in the same manner as for eq(1).

When the inductive reactance is greater than the capacitive reactance, the phase angle and its tangent are positive, and when the capacitive reactance is the greater, the phase angle and its tangent are negative.

For example, let it be required to find the relative strength of a signal which is 0.15 mc above or below resonance in a series circuit tuned to 7.15 mc, assuming that 125 is the Q of the coil.

For the signal below resonance we can write

$f_0 = 7.15$, $f = 7.15 - 0.15 = 7$, $(f_0/f)^2 = (7.15/7)^2 = 1.0433$, $1 - (f_0/f)^2 = -0.0433$, $Q(1 - f_0^2/f^2) = 125(-0.0433) = -5.4125$, from which we have

$$\tan \phi = -5.4125.$$

Upon referring to a trig table we find that $\phi = -79°32'$ and that

$$\cos \phi = 0.1816$$

which is to say that the off-resonance signal is 18.16% as strong as would be a signal on the frequency of resonance.

For the signal above resonance we can write

$f_0 = 7.15$, $f = 7.15 + 0.15 = 7.3$, $(f_0/f)^2 = (7.15/7.3)^2 = 0.9593$, $1 - (f_0/f)^2 = 0.0407$, $Q(1 - f_0^2/f^2) = 125(0.0407) = 5.0875$

from which we have

$$\tan \phi = 5.0875.$$

Upon referring to a trig table we find that $\phi = 78°53'$ and that

$$\cos \phi = 0.1928$$

which is to say that the off-resonance signal is 19.28% as strong as would be a signal on the frequency of resonance.

The method is reversible. For example, let it be required to determine at what frequency the signal strength in a circuit tuned to 28 mc is half that at resonance. The cosine of the phase angle is thus 0.5, for which $\phi = 60°$ and $\tan \phi = 1.7321$. For a Q of 125 we then have

$$125[1 - (28/f)^2] = 1.7321$$

which may readily be solved to give $f = 28.197$ mc, or 0.197 mc above resonance, and $f = 27.808$ mc, or 0.192 mc below resonance.

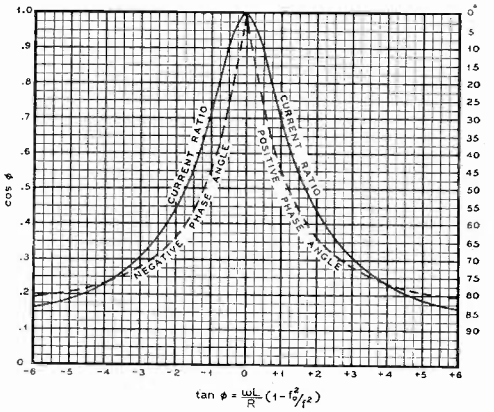


Fig. 1. Universal Resonance Curve, With Corresponding Phase Angles.

When the exactness provided by this method is not needed, approximate results can be obtained from the curves shown in Fig. 1, where values of cos ϕ, as marked on the left side of the chart, have been plotted against values of tan ϕ, as marked on the base line, to give the solid-line "current ratio" curve for positive and negative phase angles. The broken-line "phase angle curve," whose values are given at the right side of the chart, has also been plotted for convenient reference. This universal resonance chart, whilst drawn specifically for use with series circuits, is also applicable to parallel circuits when the current ratio is expressed as I_o/I instead of as I/I_o.

Editorial Director, Amateur Radio Defense.

Mathematical proof of the validity of these formulas has been deferred until the end of this presentation in order to emphasize the simplicity of the method. Any radio amateur having access to a table of trigonometric functions can solve any problem about signal strength or current ratios merely by following the procedure used in the illustrative examples. An understanding of the mathematical proof is not essential to the practical use of this unique method.

Values of the factor $(1 - f_o^2/f^2)$ can be figured for individual cases or can be obtained from trig tables by recognizing that it is equal to $\sin^2 x$ when $\cos x = f_o/f$ for f greater than f_o, or that it is equal to $-\sin^2 x$ when $\cos x = f/f_o$ for f less than f_o. ($\sin^2 x = 1 - \cos^2 x$). Table I gives approximate values.

Table 1

f/f_o or f_o/f	$1-f^2/f_o^2$ or $1-f_o^2/f^2$	f/f_o or f_o/f	$1-f^2/f_o^2$ or $1-f_o^2/f^2$
1.0	0.	.935	.1257
.999	.002	.93	.1351
.998	.004	.92	.1537
.997	.006	.91	.1762
.996	.008	.9	.1899
.995	.01	.85	.2758
.994	.012	.8	.36
.993	.014	.75	.4377
.992	.016	.7	.5
.991	.018	.65	.5773
.99	.02	.6	.64
.985	.0297	.55	.6975
.98	.0396	.5	.75
.975	.0493	.45	.7974
.97	.059	.4	.84
.965	.0687	.35	.8775
.96	.0784	.3	.91
.955	.088	.25	.9374
.95	.0976	.2	.96
.945	.1069	.15	.9775
.94	.1164	.1	.99

Proof of Formula for Series Circuit

Eq(1) for the series circuit is based on Ohm's Law for an a-c circuit, namely

$$I = \frac{E}{Z} = \frac{E}{\sqrt{R^2+X^2}}$$

where Z is the impedance consisting of a resistance R and a reactance X. As the reactance is zero in a resonant circuit, the current at resonance is expressed by

$$I_0 = \frac{E}{R}.$$

The ratio of the current in the non-resonant circuit to that in the resonant circuit is consequently given by

$$\frac{I}{I_0} = \frac{E/Z}{E/R} = \frac{R}{Z} = \frac{R}{\sqrt{R^2+X^2}}$$

From elementary trigonometry we have

$$\sqrt{R^2+X^2} = R\sqrt{1+X^2/R^2} = R\sqrt{1+\tan^2\phi} = R/\cos\phi$$

where ϕ is the angle whose tangent is X/R, whence

$$\frac{I}{I_0} = \frac{R}{R/\cos\phi} = \cos\phi$$

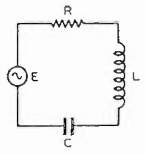


FIG. 2 - SERIES CIRCUIT

To determine the value of $\tan\phi = X/R$ we can write

$$X = (\omega L - \frac{1}{\omega C}) = \omega L(1 - \frac{1}{\omega^2 LC}) =$$

$$\omega L\left[1 - \frac{(2\pi f_0)^2}{(2\pi f)^2}\right] = \omega L(1 - \frac{f_0^2}{f^2})$$

whence we have

$$\tan\phi = \frac{X}{R} = \frac{\omega L}{R}(1 - f_0^2/f^2)$$

Proof of Formula for Parallel Circuit

The impedance of the inductive arm in Fig. 3 is given by

$$Z_L = \sqrt{R^2+\omega^2 L^2}$$

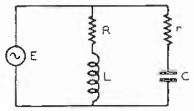


FIG. 3 - PARALLEL CIRCUIT

and the impedance of the capacitive arm, assuming that r is too small to be of practical importance, is given by

$$Z_C = \sqrt{r^2 - 1/\omega^2 C^2} = \sqrt{-1/\omega^2 C^2}$$

The total impedance of the parallel circuit is then found by solving for Z in the equation

$$\frac{1}{Z} = \frac{1}{Z_L} + \frac{1}{Z_C} = \frac{1}{\sqrt{R^2+\omega^2 L^2}} + \sqrt{-\omega^2 C^2} =$$

$$\frac{1 + (\sqrt{-\omega^2 C^2})\sqrt{R^2+^2\omega^2 L^2}}{\sqrt{R^2+\omega^2 L^2}}$$

The first step in the solution is to divide both the numerator and the denominator of the right-hand term of this equation by $\sqrt{-\omega^2 C^2}$ so that it becomes

$$\frac{1/\sqrt{-\omega^2 C^2} + \sqrt{R^2+\omega^2 L^2}}{(1/\sqrt{-\omega^2 C^2})\sqrt{R^2+\omega^2 L^2}} =$$

$$\frac{\sqrt{R^2+(\omega^2 L^2 - 1/\omega^2 C^2)}}{\sqrt{-R^2/\omega^2 C^2 + \omega^2 L^2/\omega^2 C^2}}$$

(Continued on page 58)

High Output 112-Mc. Mobile Transceiver with HY-75

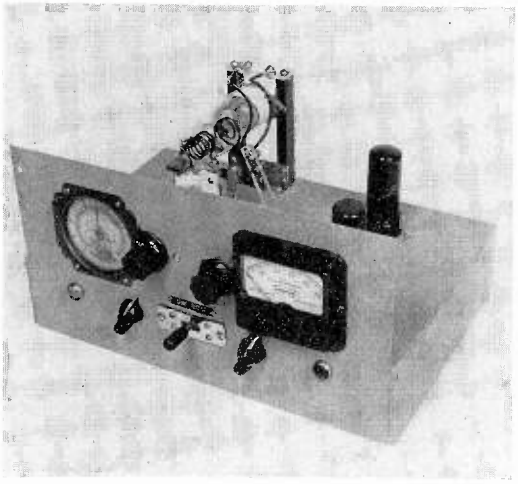
This Transceiver contains no radically new features, yet the circuit has been greatly simplified and a Variable Antenna Coupler has been added. It is one of the most sure-fire and dependable high-output 112-Mc. Transceivers yet built, thanks to the HY-75.

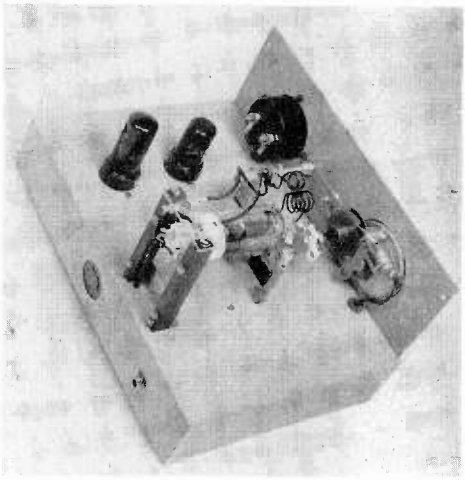
Montague T. Bancroft, W6NJW, and his 112-Mc. Transceiver

RELIABLE and dependable communication in the u.h.f. region is an essential feature of mobile equipment for emergency or defense service. Nothing is quite so embarrassing as a weak signal, particularly when life and property are at stake. Too many amateur transceivers of the low-power variety are inadequate for communication except under ideal conditions. It is safe to assume that such conditions will not always prevail when the amateur is called upon to perform a specific service. Dodging behind buildings, around hills and mountains, and in many other congested areas the u.h.f. signal is too often lost, or it becomes so weak as to be unintelligible.

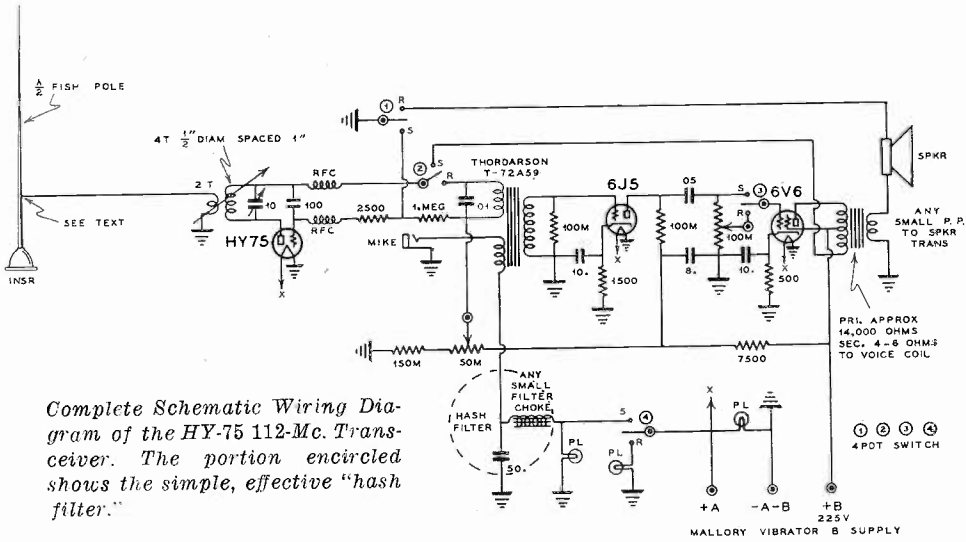
The problem can be solved simply and economically. More power is the answer. The average automobile receiver power supply will deliver ample current to drive a transceiver incorporating one of the newer and larger u.h.f. tubes of the *Hytron* HY-75 type. The greatly increased power output is secondary only to the dependability of the transceiver, and the many "R9 plus" reports will give the operator a new conception of u.h.f. at its best.

The 2½-meter transceiver under discussion was designed to fit snugly into the glove compartment of an automobile, set far enough back into the compartment so that the hinged lid could be closed, thus





Front and Interior Views, Showing Variable Antenna Coupler Details.



Complete Schematic Wiring Diagram of the HY-75 112-Mc. Transceiver. The portion encircled shows the simple, effective "hash filter."

removing the transceiver from public view. This is an important feature because many amateur u.h.f. installations have been stolen from parked automobiles. A recent case in Santa Cruz, Calif., revealed that six automobiles were stripped of amateur and b.c. gear in a single evening. Hide your equipment from view and you will protect yourself against theft. Dismantle the antenna when the car is parked, and thereby direct the attention of the would-be thief to someone else's automobile! A small u.h.f. antenna can be secured readily to the side of the hood, in such a manner that an insulated support will securely hold the antenna in place between the louvres on the hood—the removal of a wing nut or two will dismantle the assembly, after which the antenna can be locked into the automobile during parking periods when the car is not in service.

Glove compartments of most automobiles are lined with stiff paper of fibre; this lining can be removed quickly and easily so that the entire transceiver can be pushed up into the glove compartment, then secured firmly in place with two studs and side-bars, or mounted in any other manner, dependent upon the construction of the car's instrument board.

It is interesting to note that the HY-75 transceiver under discussion transmitted such a good signal, over distances of 50 miles, that R9 reports were a rule, rather than an exception. Power was taken from the broadcast received in the automobile, and the set's loud speaker was also employed. Any other source of power is suitable, if the values indicated in the schematic wiring diagram are used.

An excellent feature of this transceiver is the simple, effective variable link for coupling the antenna to the tank coil. The link is secured to a strip of polystyrene which, in turn, is attached to a panel bearing that protrudes through the panel, with a knob attached to the coupling link shaft for varying the degree of antenna coupling. By this arrangement the antenna is always coupled correctly to the tank coil and the transfer of energy at all points in the band of operation is always at a maximum.

You will not realize the marked improvement in overall performance of a transceiver until you incorporate this simple device into an instrument of your own. An angle bracket, secured to the transceiver chassis in such a manner that it will "pull" on the coupling shaft and make the control knob hard to turn will hold the coupling loop always in the exact position desired for proper coupling. Another simple addition to the circuit is a "hash" filter, which is discussed later. Pilot lights indicate whether the power is on or off, and whether the transceiver is in the send or receive position. A 4-pole-double-throw switch changes all circuits from send to receive in a single operation. The switch shown in the illustration is of the type commonly used on telephone switchboards, but any good 4-P-D-T switch can be used.

The size of the metal chassis for the complete transceiver depends upon the space available in the glove compartment of the automobile. The components are small in size, and in the particular transceiver under

(Continued on page 52)

Friendly Advice To Young Men Who Choose Radio Manufacturing As A Career

*By Clayton F. Bane**

FUNNY, isn't it, how many young men want to get into the radio manufacturing business? Again, perhaps it isn't so funny considering the ballyhoo—the glowing accounts of unheard-of governmental expenditures—advertisements promising jobs —photographs of snappily dressed individuals at their modernistic desks; inevitably the big slide rule, the work tool of the profession—so they would imply. This sort of thing has made such an impression on the young man about to launch into the business world that large numbers are seeking employment in the radio manufacturing field.

Regardless of the fact that most of us in this business have, at one time or another, wondered why we were prompted to get into it, we like it. We probably like it better than anything else we can think of, or we wouldn't be in it. This love of radio and its many varied and highly intriguing problems is a necessary adjunct if you decide to make it your life's work. There's romance of a sort in this business, but more often than not there's just plenty of good, hard work. The tools of the trade, advertisements showing the big slide rules notwithstanding, are more apt to be a soldering iron and a pair of diagonal cutters. Still interested? Read on.

The first question asked when you apply for a job is: "What experience have you had?" This isn't just a stock question to stump you. If the plant is a busy one, there will be no time to train you, if you haven't had previous training. The plant that isn't busy won't need extra men anyway. There is no substitute for experience, since your value to a manufacturer will depend almost entirely upon your ability to *produce*. If you are a radio amateur this may give you an advantage. It will depend upon whether you have designed and built your own equipment and are thus familiar with soldering, socket connections, circuit diagrams and parts layout. Your prospective employer will show no interest in the number of contests you have won, or how fast you can paddle a bug. Confidentially, if you could sneak into his plant and whistle "CQ," most of the gang would look up. Many are amateurs—after working hours.

The author—W6WB—whose achievements in commercial radio manufacturing are as noteworthy as his amateur accomplishments.

If you are fortunate enough to get a job without previous experience, prepare to start at the bottom. You'll need plenty of footwork and the ability to handle a broom is not to be taken lightly. From this point the rest is strictly up to you. You'll be with and around experienced men from whom you can learn a great deal. When someone tells you something, *listen*—don't be too ready to express your own opinions at the expense of missing valuable information. Your ability to get ahead will depend to a great extent upon your ability to *learn*.

At this point, someone is certain to say, "This may be fine, but I want to be an engineer." This will of course hold true if you are just out of college, particularly if you have a degree. A few outstanding students are taken each year by some of the large manufacturing firms and given training preparatory to employment in the organization.

*General Manager, Technical Radio, Inc.

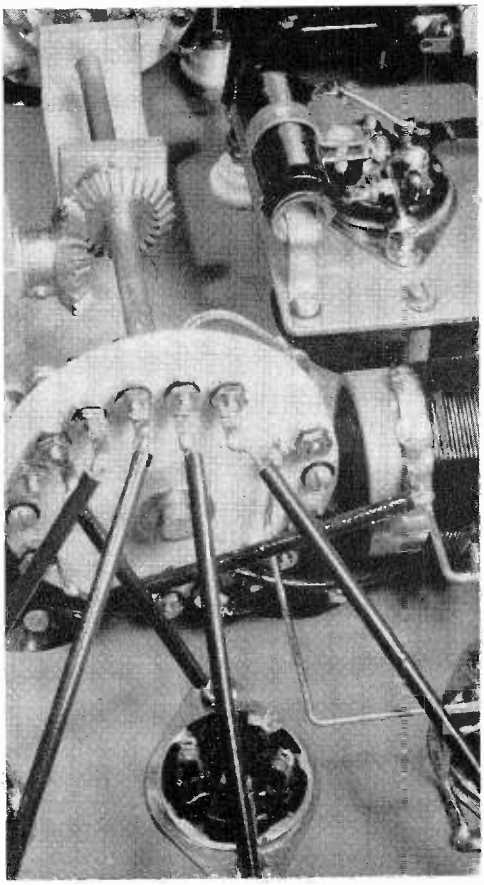
Naturally, we can't all be brilliant, and these men represent a very small majority. It is a lamentable fact that each year hundreds of young men are turned out of the universities with degrees which, as far as providing them with gainful employment is concerned, means nothing.

The term "Engineer," rolls off the vocal chords nicely and is apt to fill the individual who applies it to himself with a nice, cozy feeling. It does things to the ego.

Many who have been in the radio business for a long time will secretly admit that the title "Engineer" is a hard one to pack. It is a hard transition to pass from the theoretical into the practical. In school, a difficult subject simply meant more study. In business there is no time to study, particularly if an entire plant may be tied up waiting for your answer. In school a mistake means only a problem missed. In business, a mistake may be extremely costly to your firm. To err is human—we all make mistakes. The ability to look back on and guard against repetition of mistakes is part of this "experience" thing you hear so much about.

If you insist on being an engineer, my personal advice is to start at the bottom—learn to use tools—see equipment built from the ground up—learn the practical aspects so that when the day comes when you as "chief" put a piece of equipment on the drafting board, it will be practical—not a mechanical or electrical monstrosity! When you arrive at the point where you are actually engaged in engineering work, you will have forgotten about your degrees and the "greater than thou" attitude toward the men who work with you and who may have been less fortunate in their schooling. When you come up the hard way, you will win your chevrons on sheer merit. You'll know your job and the men who work with you will respect you for knowing it. Mind you, we're talking about engineers in manufacturing plants where *everyone* has to *produce*. The men in the research labs have an entirely different job.

The engineering end of the game is by no means confined to those who have had college training, yet there can be no doubt that the background necessary to obtain a degree from a university is very valuable. There are a number of really excellent schools which offer part correspondence and part resident training. Such institutions can provide the theoretical background and a limited practical training, but this must be augmented with experience actually gained on the job.



Typical example of engineering design for a band-switching unit in a commercial transmitter. From a photograph of Tecrad's marine application.

Speaking personally, I have found that young men coming from the public trade schools fit excellently into the manufacturing business. I attribute this to the fact that, for the most part, instructors in these schools are practical men and many have been in the business world and know the problems involved. Most boys coming from these schools have the idea impressed upon them that when they get a job they must *work*, that a job, no matter how humble, is a stepping stone to better things. Further, that in this way, and in this way only, can they gain experience. A sound teaching. The basic idea is to broaden the mind, not the hips.

(Continued on next page)

LOOKING on the brighter side of things (yes, even the radio business has a few bright elements), there is not the slightest doubt that now is an ideal time to gain employment in the radio manufacturing field. The Defense Program will call for a great deal of radio equipment of all types. This means that most plants, large or small, will eventually get a share of this business. Experienced men will get first call from the plants, but they are in the minority and many new men will undoubtedly be hired.

It is almost axiomatic that a really skilled man is rarely out of work. This means that time spent in preparation for a place in the radio industry will not be wasted. Those who hold key positions in the industry must be constantly on their toes—studying—looking ahead. There is no place in this business for a loafer.

A brief discussion of the various classifications of radio manufacturing may be helpful. Just what will be expected of you will depend to a great extent upon the size of the plant, the type of work performed and the number of men employed.

There is the plant wherein receivers only are made. In a great many of these, the wiring has been so systematized that it can be done by women. It resolves itself into a "Put the green wire between the number six socket connection and chassis." Such work requires little imagination or initiative—better let the girls do it. However, the preliminaries necessary to bring a radio chassis to the point where it can be wired requires numerous operations wherein the sheet metal worker, the plater, the painter, the machinist and the assembly man all have a hand in it. After it leaves the wiring bench it goes to the test men. The chasses must be put in cabinets and further assembly work completed. The set is then packed for shipment and finally shipped. All these operations require man-power. It can be seen that in some phases of manufacturing there are a great many operations which have no direct bearing on radio itself.

In the plant which manufactures parts only, the bulk of the work requires mechanical skill only. It is in the plants that build transmitters or complete equipment where individual skill is required in virtually every phase of radio. Skilled design engineers, test engineers, installation men, wiremen, assembly men, mechanics and machinists—all are needed for such work. It can be readily seen that such plants offer the best opportunities for getting ahead, because if you have ability along a particular line you will have a chance to specialize. The radio field is becoming so extensive that it is almost necessary to specialize along certain lines.

For example, a man might specialize in transmitter wiring—learn all the tricks and dodges of lacing and cableing, laying-in lead sheathed cables for power circuits, terminating and lugging, following complex relay and control circuits. Men who can do all of these things in an expert manner are never out of a job.

Or take the case of the test man. He must know all procedures for measuring and testing all types of radio transmitters and receivers. He must be thoroughly familiar with bridges, signal generators, vacuum-tube voltmeters, indicating instruments of all types, power output measurements at all frequencies. In addition, he must have an excellent knowledge of the equipment he is called upon to test, since it is normally his job to take the sets from the wireman and make them work. Such aggravating jobs as determining why relay number seventeen does not pull down, fall to his lot.

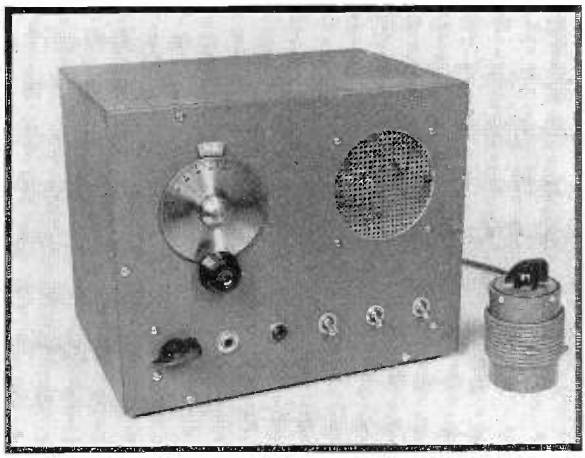
THE radio machinist is an entirely different breed from the conventional machinist. He must know all the tricks of making various regular and special parts—you know, those one-inch coils with fifty taps that the engineers conceive. He must be able to work in a large shop where every conceivable type of machine is available, or in a small shop where a lathe and a drill press are his principal standbys. He must be capable of working and fabricating iron, steel, monel, aluminum, brass and copper. He must be ready with an answer when someone hands him bakelite, mycalex, steatite or polystyrene. In brief, he must first be a good machinist and then learn all the additional tricks necessary to make him a first-class *radio* machinist. How do you think all this is learned? By experience—by working with other men who already know their trade and are willing to pass their suggestions along to you.

Consider what it means to be an installation man. In many cases this man is sent from the factory to install or supervise the installation of units in the field. He is generally on his own when in the field. A costly antenna structure may be put up on his say-so, and those things cost money. One wrong guess on a three-hundred-foot tower, and—poof! His job is to get *results*, regardless of the difficulties involved. Since he directly contacts the customer it is highly im-

(Continued on page 54)

A. C. Operated Frequency-Meter-Monitor For C. W. and 'Phone Checking

Here is an Instrument Every Amateur Needs. The Circuit is by Frank C. Jones, the Mechanical Construction by N. E. Farbman, W6SEM, Who Is Also Responsible for the Excellent Pictorial Illustrations.



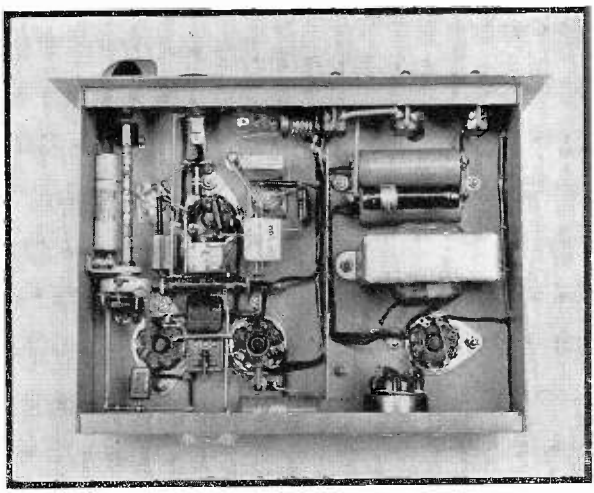
Front View of A. C. Frequency-Meter-Monitor and Pick-Up Coil. The Tuning Condenser Mounted Inside the Coil is Optional and Not Usually Required.

THERE has been a growing demand for circuit design and data dealing with the construction of a frequency-meter-monitor for headphone or loudspeaker operation. The latter necessitates the employment of a.c. because the drain on batteries would be too severe. Perhaps the only objection to a.c. operation is the fact that hum may ride-in on the carrier signal, or it may feed-back through the a.c. line. This condition can be corrected effectively by experimenting with various values of by-pass condensers, connected into the circuit during the time a particular signal is being monitored. The values of by-pass capacitances indicated for the instrument pictured and described in this text were found correct for the practical elimination of a.c. hum.

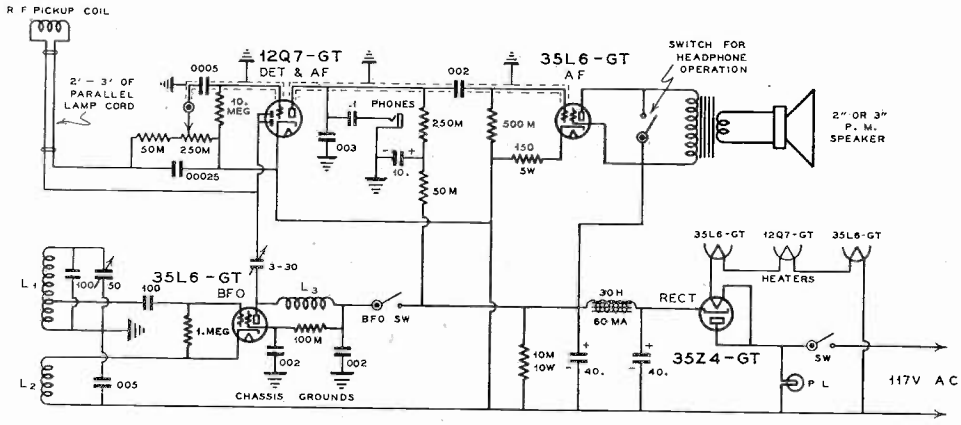
Many c.w. and phone operators are not content to monitor their transmitted signals with a headset; some insist upon loud-speaker operation, particularly for monitoring the code because a better indication of the characteristics of transmission is thereby had. The instrument here described can be operated in any manner desired, by the mere throw of a toggle switch for headset or loud-speaker operation, and an additional switch can be provided for using the monitor's speaker or headset in connection with the communication receiver in use at the station.

The stability of operation of this a.c.-operated device is exceptionally good; the type of tubes chosen for the circuit requires only 150-ma. heater current and the power consumption from the a.c. line is very low; furthermore, the heat losses inside the monitor cabinet are negligible.

The illustrations show the interior, exterior and under-chassis details clearly. The circuit diagram gives the values of all components required. The instrument has four heater-type tubes with the heaters in series directly across the a.c. line. With this connection the voltage drop across the four



Under-chassis View. Showing Shield Plate Between Power Supply and R-F Components.



Circuit Diagram of Complete A.C. Frequency-Meter-Monitor.

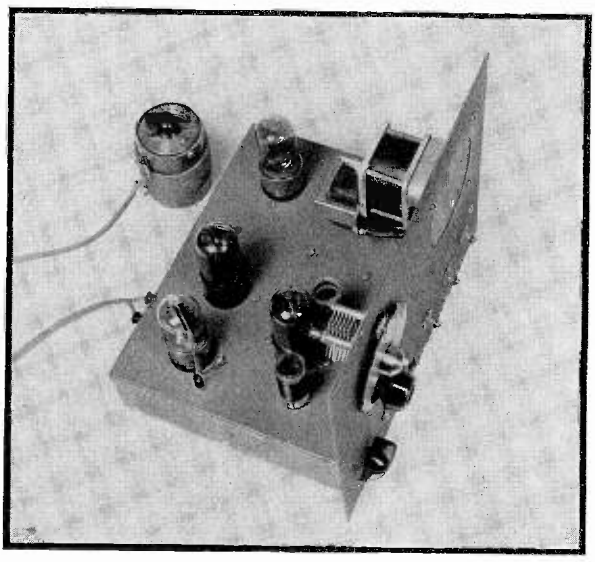
heaters is correct for operation from the 117-volt a.c. line.

The circuit includes an untuned diode rectifier whose output is connected to a two-stage audio amplifier and a small permanent magnet dynamic speaker. This portion of the circuit requires two tubes only, a 12Q7GT rectifier- audio- amplifier, and a 35L6GT power audio amplifier. A heterodyne note is obtained from a separate beat-frequency oscillator which is well isolated from the r-f pickup unit. This permits an excellent degree of frequency stability and a c.w. signal can therefore be monitored at any desired audio frequency without continuous readjustment of the oscillator tuning condenser.

The beat-frequency oscillator utilizes a 35L6GT connected into a stabilized form of electron-coupled circuit. The grid of the oscillator coil is tapped 15 turns from the grounded end of the coil in order to improve the frequency stability and to avoid the use of a very high capacitance in the oscillator tuned circuit. The coil has 33 turns of no. 24 enameled wire, close wound on a ¾-inch diameter *Amphenol* polystyrene form. The cathode coil has 12 turns of no. 24 enameled wire, wound on the same form and spaced about ⅛-inch from the secondary winding, and in the same direction.

The b.f.o. plate coil has 25 turns of no 24 enameled wire, 1-inch long, also on a ¾-inch diameter polystyrene form. This coil tends to emphasize the fourth harmonic of the b.f.o. for c.w. monitoring in the 20-meter band.

Only one set of coils is required for monitoring all of the amateur bands, since either the fundamental frequency or the harmonic frequencies of the b.f.o. will produce a beat note with the desired c.w. signal. The frequency stability of the oscillator is exceptionally good and it therefore serves the function for frequency measurement in a manner suitable for normal amateur service. Care must be exercised in the mechanical assembly, and the chassis should be sturdy and durable.



Interior View, Showing Placement of R-F and Oscillator Coils, A-F Tube, and Loud-Speaker.

The r-f pickup coil for the diode circuit should be coupled loosely to the antenna feeders for c.w. monitoring, but coupled

(Continued on page 57)

Vibrapack Power Supply Systems for Mobile Transmitters

By R. M. Ellis, W9YSA

Complete Information on this Subject is Essential for Those Engaged in the Design of Portable Equipment for Radio Defense.

Part I

ONE OF THE most rapid growing phases of radio communication is in the field of portable and mobile radio transmitters. This field is not spectacular from the standpoint of equipment because most portable transmitters are of the low powered types and consequently present no involved engineering problems. Yet the effect of these small radio stations on our daily life and commerce is tremendous. Portable and mobile radio equipment makes possible effective law enforcement through instantaneous communication with police patrol cars, it tells airplanes when to land and guides them to their destination, and it provides protection to our forests by giving forest rangers means of reporting small forest fires before they become disastrous. When catastrophe strikes—when floods, fires and hurricanes take their toll of damage and destruction, wire communication may be disrupted. Then portable-mobile radio equipment sends vital messages for supplies and assistance. The military, naval and marine uses of portable radio equipment are likewise obvious and important. And the entertainment or pleasure value of portable or mobile radio equipment often times exceeds that of fixed station equipment, as many amateurs who have 10, 5, or 2½ meter rigs in their automobiles will gladly testify.

In the classification of portable-mobile equipment it is possible to include everything from a 1-watt "walkie-talkie" transceiver to a kilowatt rig AC operated from a gas engine power supply and moved by a truck. However, this discussion will be confined to portable power supplies for transmitters having inputs from five to sixty watts, which is generally considered the range where power may be economically obtained from a 6-volt storage battery.

"B" Batteries

Except for fixed station operation, where the bulk and weight of a storage battery is unobjectionable, small transmitters using 1¼ or 2 volt filament type tubes, and having an r.f. output of a watt or less, will probably obtain their plate power from "B" batteries. Such a power source has a number of definite advantages, such as complete absence of ripple, which eliminates the necessity of smoothing filters, almost perfect voltage regulation, low impedance and the instant availability of power. There is also the advantage that simple voltage measurement will give an estimate of the future available energy or life remaining in the battery.

However, as power is increased, a point is soon reached where "B" batteries become uneconomical. This power limit is necessarily much lower in phone transmitters which present a continuous load on the power supply, than in CW transmitters where the load is intermittent.

Transmitters with outputs above that of the very lowest powered types usually employ 6.3 volt tubes and in portable-mobile service a storage battery is required for filament heating power. This same storage battery can be used as a primary power source for plate potential if some means is provided to "step up" this low voltage to the required value. Such voltage transformation is commonly accomplished either by a motor-generator or rotary converter, or by a vibra-pack, or vibrator power supply.

Motor-Generators

THE motor-generator consists, as its name implies, of an electric motor coupled to a high voltage generator. This type of equipment is available in several forms—the motor and generator may be separate units, or they may be combined, using a single unit with a common field coil and a double-ended armature and with two commutators and two sets of brushes. Permanent magnet fields are also used by some manufacturers to reduce weight and current drain.

There are a number of inherent advantages and disadvantages to motor genera-

tors. In large sizes and under heavy loads this type of equipment is very efficient. Under light loads and in the smaller sizes, the ratio of power required for the turning of the armature, and overcoming its wind resistance, and the friction of the bearings and brushes may be high in proportion to the power delivered by the generator, so that the overall efficiency of the system may be rather low.

Two other characteristics of motor-generator power supply systems should be noted. After application of power, there is a very definite delay or time-lag before the system delivers normal output, since a small amount of time is required before the armature revolves at full speed. This time-lag may make it necessary in break-in phone operation to leave the motor-generator running continuously during the period of operation and to interrupt the high voltage circuit.

Another difficulty sometimes encountered in motor generators is poor starting characteristics under conditions of extreme cold as might be encountered in airplane-flight, or in police patrol cars operated in winter. Under these circumstances the stiffening of the bearing grease may greatly retard the rotation of the armature.

The better makes of motor-generators are reliable and will operate for extended periods of time without attention. Maintenance or repair may require the replacement of brushes and bearings; and the turning down, under-cutting, and polishing of the commutators.

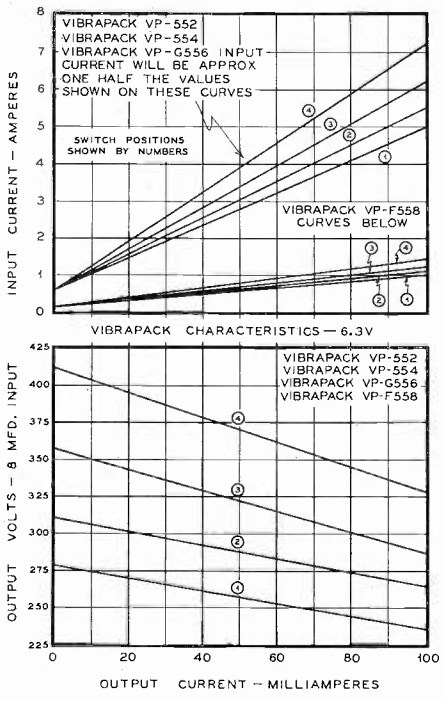
Vibrapacks*

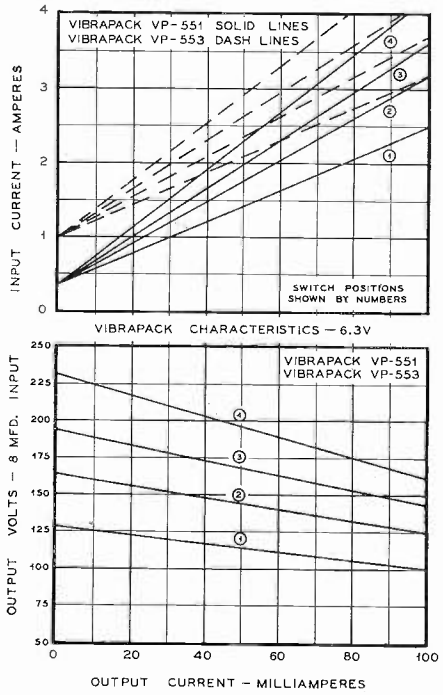
The second practical way of converting storage battery power to high voltage DC is by using a vibrator power supply or Vibrapack. Single unit Vibrapacks will efficiently operate electronic equipment requiring up to 30 watts plate input; 60 watts DC output may be obtained from the dual unit Vibrapacks. Single units are rated for outputs of 100 M.A. at from 125 to 300 volts; dual units have a maximum output rating of 400 volts.

There are a number of inherent advantages of such power supplies.

1. *High efficiency under all loads.* A large part of the input energy of a Vibrapack is transformed into useful power. The power required to maintain the reed in oscillation amounts to only approximately 1.7 watts, and thus the input current of an unloaded Vibrapack (excluding the rectifier tube if used) is only about ½ ampere for all single unit 6.3 volt types. Other losses, such

**Trade-Mark Reg.—P. R. Mallory & Co., Inc.*





STANDARD VIBRAPACK TYPES

Vibrapacks are available in the following stock sizes:

MALLORY VIBRAPACKS—TYPE VP

Catalog Number	Nominal Operating Voltage	Nominal Output Voltage	Maximum Output Current	Type	Approx. Net Weight
VP-551	6.3	125-150-175-200	100 ma.	Self-Rectifying	4½ lbs.
VP-552	6.3	225-250-275-300	100 ma.	Self-Rectifying	5½ lbs.
VP-553	6.3	125-150-175-200	100 ma.	Tube-Rectifying	4¾ lbs.
VP-554	6.3	225-250-275-300	100 ma.	Tube-Rectifying	6¼ lbs.
VP-555*	6.3	300	200 ma.	Tube-Rectifying	12¾ lbs.
VP-557*	6.3	400	150 ma.	Tube-Rectifying	12¾ lbs.
VP-G556	12.6	225-250-275-300	100 ma.	Self-Rectifying	6 lbs.
VP-F558	32.00	225-250-275-300	100 ma.	Tube-Rectifying	6 lbs.

*Special Dual Packs for high output.

as voltage drop from the resistance of connecting wires, hysteresis loss in the transformer, etc., are of course present, as would be found in any power conversion equipment.

Overall efficiencies vary with the load current, as indicated in the several Charts on this and the preceding page, which show typical operating characteristics.

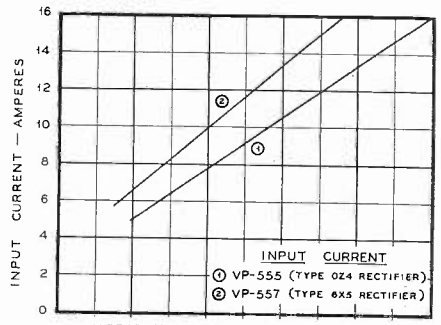
Efficiency is most desirable in a battery operated device because high efficiency means longer periods of operation between charging cycles of the battery.

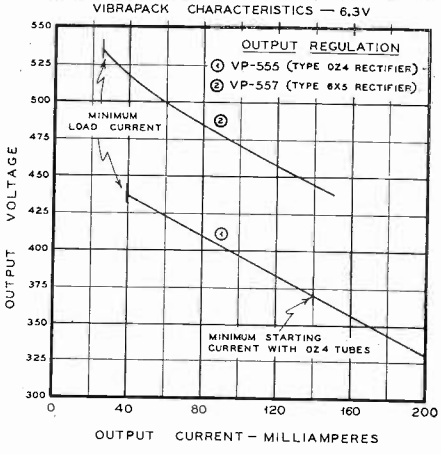
2. *Compact and light in weight*—These factors have lead to the widespread use of Vibrapacks for powering airplane equipment.
3. *Dependability*, as proven by thousands of Vibrapack installations in mobile police radio apparatus where 24-hour-a-day service is maintained.
4. *Low maintenance cost.* The only part of a Vibrapack which normally wears out or requires replacement is the vibrator. The replacement of a vibrator takes only a moment. No equipment is required.

A factor of interest is that the condition of a vibrator and a quantitive estimate of its future life can be obtained with modern vibrator testers, which superficially operate much like tube checkers. An occasional routine testing of vibrators will practically eliminate the possibility of failure in service.

Since reference will be made in the following paragraphs to specific Vibrapack types, it is thought best at this time to list the standard stock types and their characteristics.

Vibrapacks are equipped with complete, built-in RF noise suppression equipment. Type VP-555 also includes an efficient low frequency hum filter. Type VP-557 incorporates the first input filter condenser only. Other Vibrapacks do not include the high voltage hum filter.





Description

Vibrapacks have three principal electrical components—the vibrator which acts as a pole changing device to alter the low voltage direct current to a square wave form type of AC, the transformer to "step up" the voltage to the required value, and the rectifier to reconvert the high voltage AC transformer output to direct current. The rectifier may take the form of a thermionic or gas rectifier such as the OZ4 or 6X5; or rectification may take place by means of extra metallic contacts on the vibrator. This latter construction is usually called the synchronous or self-rectifying type. Vibrapacks with tube rectifiers are frequently called interrupter types. Essential accessory parts included in a Vibrapack are the buffer condenser, the importance of which will be explained later, the noise suppression chokes and condensers, and usually a voltage control switch which will permit adjustment of the output voltage to the requirements of the application.

How the Vibrator Works

Figure 2(a) shows the conventional transformer-rectifier systems in common use in radio receivers. Obviously, this combination will not operate from a direct current source since a transformer functions only by change of the magnetic field. Therefore to secure proper operation from a DC source some method of changing direct current to alternating current must be provided. A

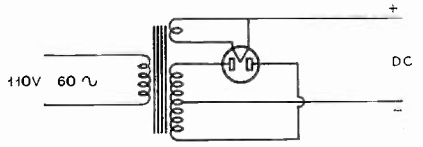


Fig. 2(a)

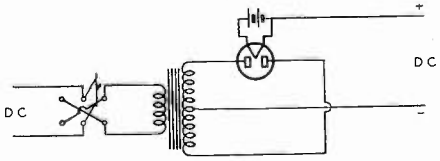


Fig. 2(b)

simple method of doing this would be to connect a double pole, double throw switch as a pole reversing switch, as shown in Fig. 2(b). Flipping the switch back and forth will produce an alternating current.

The wave form will be square, and there will be high voltage peaks from the inductive kick caused by the sudden collapse of the magnetic flux of the transformer. These conditions are corrected by the use of the buffer condenser.

With a mechanical method of driving the pole changing switch, it will be seen that the device will transform direct current from one voltage to another.

A more practical form is the circuit shown in Fig. 2(c), which uses a center-tapped primary winding having twice the number of turns. This gives the effect of a a simple single pole, double throw switch. This mechanism can be built as a vibrating reed, which can be driven by an electromagnet. Because a loaded tuned reed is used, the amount of power required to maintain mechanical oscillation in the reed is very small.

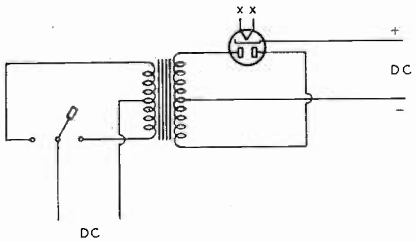


Fig. 2(c)

There are two ways of applying energy to a drive coil. A separate set of contacts can be installed on the reed as shown in Fig. 2(c), in which case the operation of the driving circuit is exactly the same as the circuit of a common household buzzer or bell. Fig. 2(d) shows the circuit used in Vibrapacks. This is called a shunt driver circuit and eliminates the complexity of the extra contact points, since one set of the regular interrupter points now performs double duty.

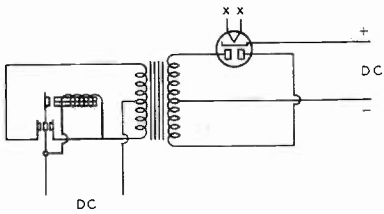


Fig. 2(d)

Timing Capacity (Buffer Condenser)

A timing capacity, or buffer condenser, is required in order to protect the circuit during the time that the reed is moving from one set of contacts to the other, in other words, the intervals t_2 and t_4 as shown in Fig. 4(a). If no capacity were used, when the contacts opened at 2 in this same figure not only would the battery voltage present on the contacts need to be "broken," but an

exceedingly high voltage of the opposite polarity would be induced in the transformer because of the collapse of the sustaining magnetizing current (and therefore flux) which would also have to be "broken." This would cause severe arcing and failure of the vibrator unless some other component suffered voltage breakdown first. Also, when the contacts closed at 3 the full battery voltage would be applied directly across the contacts, causing a spark to jump the gap just before the contacts closed, which is also detrimental to good contact life. By connecting a condenser across either of the windings of the transformer, and adjusting the capacity to the predetermined value, the oscillographic waveform trace illustrated in Fig. 4(a) can be changed to that shown in Fig. 4(b). The "off contact" intervals of time, t_2 and t_4, are no longer horizontal lines but are sloping, closing the gaps between points 2 and 3 and points 4 and 1. This is the "ideal" waveform for an interrupter-type vibrator, or a self-rectifying type vibrator operating on no-load.

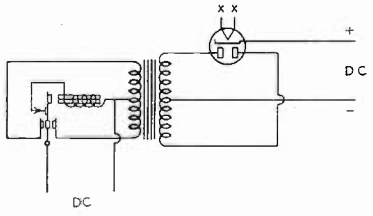


Fig. 2(e)

Figure 3 shows the mechanism of a modern vibrator of the type used in Vibrapacks.

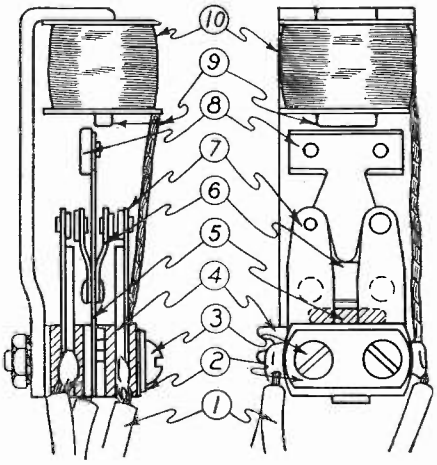


Fig. 3

The buffer condenser has become a "tank" in which is stored energy during the "on contact" intervals t_1 and t_3, and which discharges into the transformer winding during the "off contact" intervals t_2 and t_4 to supply energy to the transformer. This discharge is in the form of a damped oscillation in the circuit formed by the transformer winding inductance and the condenser; however, the first one-quarter cycle is never completed before the next pair of contacts close. The "ideal" waveform shown in Fig. 4(b) can be secured experimentally, but is not practical in production, because of the variations in the several components used in the circuit. Also, as the vibrator contacts erode, or wear away, the spacing between those contacts increase, increasing in turn the "off contact" time intervals t_2 and t_4 during which the reed must move from one set of contacts to the other. Because of this fact, a larger timing capacity is theoretically required with an old vibrator than with a new, and the additional capacity that is required to prevent "overclosure" of the voltage waveform must be included in the original design. Therefore, the desirable oscillographic waveform for an average condition for a new vibrator would appear as in Fig. 4(c).

With the circuit adjusted as described, the "closure" of the waveform shown in

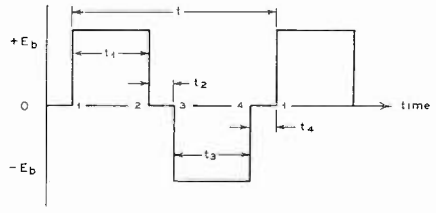


Fig. 4(a)

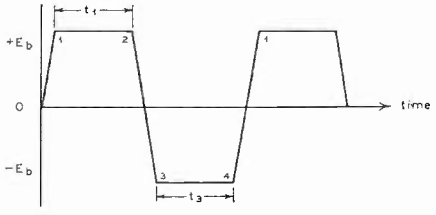


Fig. 4(b)

Fig. 4(c) is between 60% and 70%. That is, the distance vertically between the points where the contacts open and close, 2 and 3, is about 60% of the total distance between the two horizontal lines t_1 and t_2, with the

(Continued on page 50)

Engineering Forum

A department devoted to the interchange of engineering information for designers, amateurs and experimenters

CONDUCTED BY F. D. WELLS*

Readers of *'Amateur Radio Defense"* are invited to contribute suggestions for publication in this department. The cooperation of the radio engineering fraternity is particularly solicited. It is hoped that many new circuit innovations, short-cuts and helpful hints will first "see the light of day" in these columns. Questions of general interest will be answered here. Write the editor of this department and unfold your problems to him. Together with his fellow engineers in the radio fraternity he will attempt to make these columns highly instructive and profitable for you. Each item will be numbered in consecutive order, so that you need refer only to the *Item Number* when writing for additional information.

* * *

No. 1—Simplified Inverse Feed-Back

THIS is a method applicable to class-B stages operating from a single-ended driver. It requires either a single volume control, or two low wattage resistors, instead of tapped transformers or capacity-resistance networks. Since the driver tube for a class-B stage should have a low plate resistance, beam tubes such as the 6L6 or 6V6 are not very satisfactory, even though they are capable of producing a considerable amount of audio power.

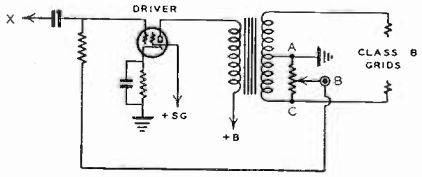


Fig. 1

Fig. 1 shows how audio voltage is taken from the secondary of the class-B driver transformer and introduced into the grid of the driver stage—out of phase with the input signal. Since there are two grid leads on the driver transformer, one grid must be chosen experimentally. If the wrong grid be chosen, regeneration instead of degeneration will occur, and the driver stage will go into violent oscillation. If a volume control be used in the circuit, the arm of the control *B* should be "closed" to *A*. With the system in operation the volume control should then be suddenly opened by a small amount and returned to *A*. If, during this interval, the class-B plate current kicks upward, the driver is regenerating—and the other grid should then be chosen.

The amount of degeneration is dependent upon how far the volume control is opened. Since the voltage fed in series with the driver grid resistor is out of phase with the incoming voltage at *X*, a greater amount of input voltage than normally required by a beam tube will be needed. If a volume control with a value of from 25,000 to 100,000 ohms is used, the load on the secondary of the driver transformer will be negligible in comparison to the load of the class-B grids. In addition to lowering the plate resistance of the tube, inverse feed-back reduces the harmonic content in the output of this stage. This system therefore permits the use of a 6L6G driver tube with class-B stages requiring up to 6 watts of driving power. Maximum plate and screen voltages should be applied when optimum output is desired. For amateur applications it will be found that a 6L6G operated in this manner will produce excellent voice quality when used as a driver for a pair of TZ40s or RCA-811s.

* * *

No. 2—Noise-Limiter Application

THERE has been much controversy on the subject of noise limiters and a universal conclusion has not yet been reached. For those who have accepted the shunt-type manually-adjusted noise silencer as the ultimate, the circuit in Fig. 2 will prove of interest because it obviates the need for an external source of bias for the shunting diode. In this connection it is well to state that the manually-adjusted noise limiter has

*Engineering Dept., Technical Radio, Inc.

an advantage over the automatic limiter, in that a steady noise source can be brought down to the signal level, very often permitting intelligible reception. In the automatic silencer, on the other hand, the limiting level is automatically set by the noise level itself. This, of course, does not apply to transient noises, such as automobile ignition, sign flashers, etc.

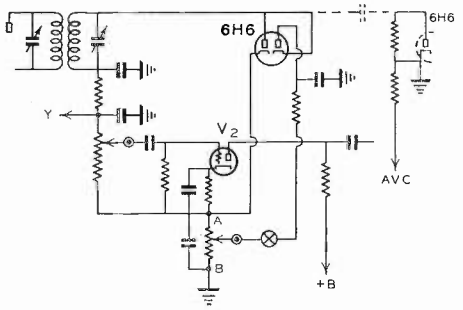
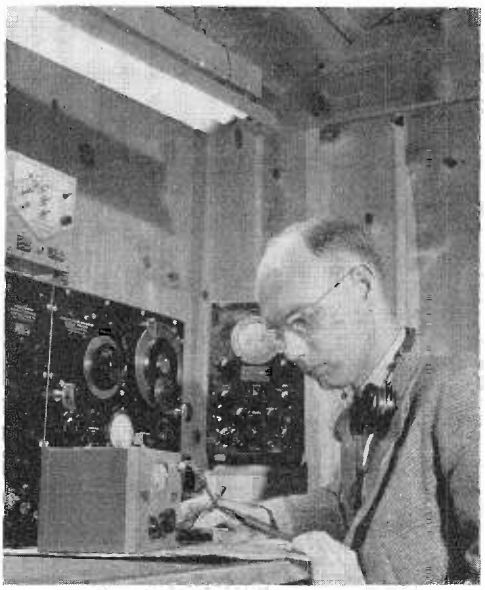


Fig. 2

Those now using a shunt-type silencer already have a 6H6 in the circuit, or a separate tube as a shunting diode, and a first audio stage usually follows this diode. The grid resistor, cathode resistor and cathode by-pass are connected to ground in a conventional circuit. In the revised circuit suggested in Fig. 2, these three circuit elements are disconnected from ground and tied to a common point *A*. The cathode current of the tube must now flow through the volume control *A-B* in order to find its way to ground. The result is a voltage drop across *A-B* which is used as a source of bias for the diode. The voltage developed at *A-B* effectively subtracts from the plate voltage of tube V_2, without impairing the action of the amplifier. It is difficult to determine the size of control for *A-B* because of the wide variation in constants of resistance-coupled stages. A value of 50,000 ohms seems generally satisfactory. The resistance of the volume control should be high enough to produce a drop of at least 15 volts for bias. It is desirable to insert a switch in series with the diode plate at point *X*, so that the silencer can be disconnected to prevent distortion when strong signals are received. If the receiver operates with *AVC*, and the source of *AVC* voltage is the point *Y* (Fig. 2) a change in the circuit must be made. As just stated, the point *A* is approximately 15 volts positive with respect to ground, and hence with no signal input the point *Y* is also 15 volts positive with respect to ground and 15 volts of positive bias would be produced on all of the grids which are controlled by the *AVC* circuit. Either a separate diode must be used for *AVC* operation. or the cathode resistors in the controlled stages must be increased in size until the correct potential between grid and cathode is obtained on each tube having *AVC* control. A cathode resistor of 2,000 or 3,000 ohms will usually produce sufficient counteracting voltage to bring the tube bias to a normal value in a pentode r-f or i-f stage.

* * *



F. D. Wells, *W6QUC*, Engineering Forum *departmental editor, is an exponent of the happy philosophy that "your light is none the less for having lit that of your neighbor. He is contributing his own ideas and is inviting other engineers to do likewise. He welcomes questions from amateurs and will answer them to the best of his ability in the department he conducts.*

No. 3—Simple One-Tube Modulator for Small Transmitters

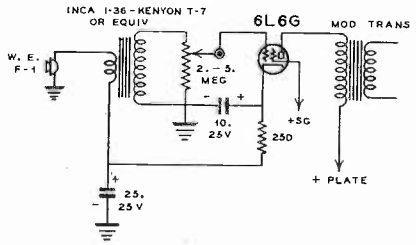


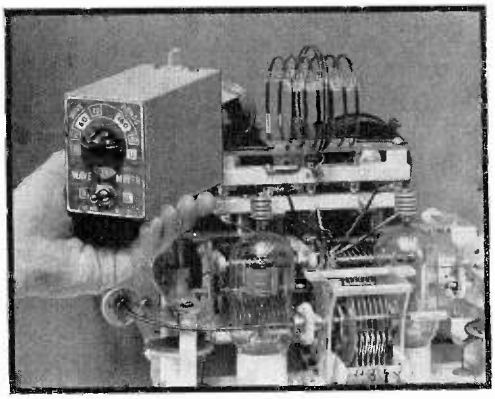
Fig. 3

IT IS not generally known in amateur circles that several manufacturers now have high-gain microphone transformers available

(Continued on page 40)

New Products

From the Radio Manufacturers



Bud Wavemeter

AN ABSORPTION-TYPE wavemeter is indispensible for checking new types of harmonic oscillators, particularly those which also produce the odd harmonics, to insure operation on the correct amateur frequency. The conventional amateur-type wavemeter consists of a tank circuit containing nothing more than a variable capacitance and a fixed inductance. *Bud Radio* of Cleveland, Ohio, has improved upon the simple wavemeter by utilizing a variable inductance and a variable capacitance, so that all amateur bands can be checked for wavelength by the mere throw of a switch on the front panel of the wavemeter case. Any band from 10 to 160 meters can be checked, as well as the odd harmonics which fall between these assigned frequencies. A flash-light indicator at the rear of the wavemeter case is a useful adjunct for denoting resonance. The illustration shows the new *Bud Wavemeter* in service, measurement of wavelength being made from a final r-f amplifier incorporating a pair of *Eimac* 35T triodes.

* * *

Jones Radio Bulletin

. . . The many amateurs who requested copies of "*Jones Radio Bulletin*" earlier in the year, and whose names are still in our "hold files" will receive "*Amateur Radio Defense*" in its place, because in this present publication all of the technical features which would otherwise have appeared in the "Bulletin" will find space in this newer magazine.

Engineering Forum

Continued from page 39)

for single-tube modulator circuits. These small transformers are used widely in police and other compact equipment. They have an impedance ratio of 10,000-to-1, and a turns ratio of 100-to-1. The success of the circuit in Fig. 3 depends upon the correct choice of microphone and transformer. The microphone must be a *Western Electric* type *F*-1 single-button unit, or one of equivalent resistance (approx. 50 ohms).

An outstanding advantage of this circuit is the elimination of the conventional microphone battery. The cathode current of the 6L6G flows through the microphone winding of the transformer, then through the microphone, and back to ground. Sufficient current flows through the microphone to produce more than ample excitation to the grid of the 6L6G, hence a gain control is desirable. It can be omitted if the voice level to the microphone is adjusted by merely talking farther away from the microphone.

Since the cathode circuit is coupled to the grid circuit through the transformer, audio oscillation or poor speech quality may result. This condition can be corrected by reversing either the primary or secondary winding of the transformer, so that a slight amount of degeneration rather than regeneration is introduced. With the gain control opened wide for average voice levels a swing of from 25 to 40 volts of audio can be developed across the secondary winding. If the plate potential on the 6L6G is 400 volts, and the screen 300 volts, this modulator will deliver enough audio power to modulate 20 to 25 watts of r-f input.

* * *

Help Wanted

. . . Photographs and descriptions, general and technical, of amateur gear for emergency and defense measures as used by radio amateurs are solicited for the pages of this magazine. Countless experiments are being conducted by amateurs everywhere, and the editor will be grateful to you for help in sending pictures and data on your pet ideas, mobile and for home-station service. Only with the help of the entire amateur fraternity can we hope to enlighten the less-fortunate who are willing and ready to do their part in the defense program. Do your patriotic bit by sending pictures and data to us as soon as possible.

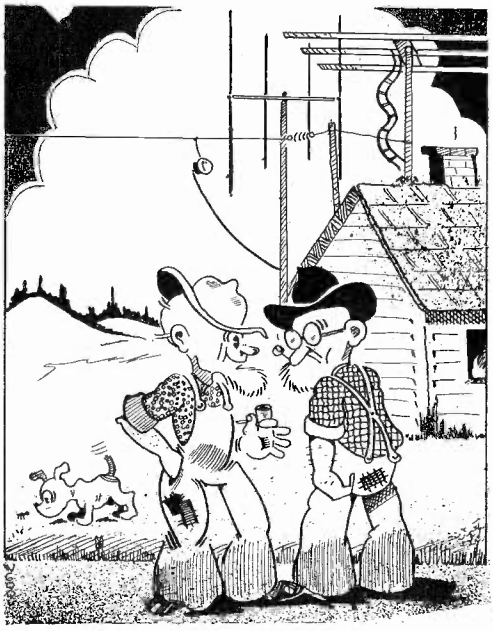
* * *

QRM and QRN

Cartoons by W6QQU. Humor by Amateur Contributors.

Evolution of the DX Hound

1920—*W.A.C.* (worked all continents)
1938—*W.A.Z.* (worked all zones)
1940—*W.A.A.P.* (worked all American possessions)
1941—*W.A.S.A.S.* (worked all streets and alleys)
1942—*W.P.A.*



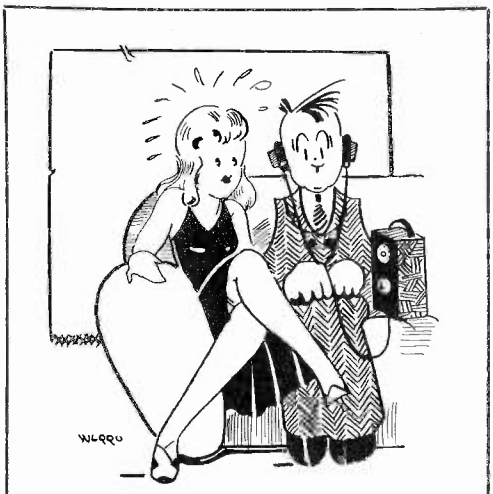
HY—"Whut's the feller do with that terrible looking contraption on his roof?"

SY—"He does right well with the thing; last week he snarled a dive bomber, two parachutists and six wild ducks."

◆

Phillip's Code

. . . It happened to W6QQU. Dozing in his chair with headphones hung loosely o'er his ears, a mosquito worked its way into the 'phones and buzzed merrily away. Still half asleep, W6QQU reached for his typewriter —pounded out three long code messages in a row—coludn't make sense out of any of them. "Heil heel! Just another Nutzi spy," said he. And then the mosquito stung him in the ear.



Gal: "You and your darned emergency net."

Double or Nothing

On a rural electric station in Ireland, according to an item in a recent issue of "Current Digest," is a sign reading: "*To Touch These Wires Is Instant Death. Anyone Found Doing So Will Be Prosecuted.*"

◆

True or False?

Conspicuously posted above an engineer's desk in a West Coast radio plant is a large placard with the following inscription: "*Quiet—Please! Genius at Work.*"

◆

Adding Insult to Injury

Out in California W6KPK is faced with a law-suit to compel him to remove his newly erected lattice-work antenna tower and rotary beam array. His excellently designed and constructed "sky hook" is referred to in the complaint as "An oil derrick with a revolving clothes-line at the top."

◆

. . . Who's Yehudi? "He's the ham who puts the buckets under your chassis when the grids begin to leak," says W6FFP.

◆

. . . Who's Yehudi? Tell the Editor. Your answer will appear in the next issue.

Technical Questions and Answers

A free service for readers of Amateur Radio Defense. Initial your questions. Your full name will not be published.

Question: Please explain in simple language why more grid current is required to drive an r-f amplifier for plate modulated 'phone operation than for c.w. telegraphy, and tell why the difference is sometimes very pronounced.

C. T. A., New Haven, Conn.

Answer: A plate-modulated r-f amplifier requires more grid current than one designed for c.w. operation because the operating conditions of the two amplifiers are not alike. In a plate-modulated amplifier the instantaneous plate voltage and plate current are varied up to values of as much as twice the d.c. value, because of the addition of audio-frequency power to the plate supply circuit. High-mu and even some tubes of low-mu require relatively high values of grid current in order to obtain an increase in r-f power output which is directly proportionate to the applied plate voltage. Some types of tubes require nearly twice as much grid current for distortionless plate modulation characteristics as when operated in a c.w. amplifier at a constant value of applied plate voltage. The physical difference in transmitter tubes, such as the size of grid wire and spacing between filament and plate elements, are partly responsible for this effect. A c.w. amplifier can be operated with low values of grid current since no distortion effects are present and the amount of grid current and grid bias are important only from the standpoint of plate circuit efficiency and power gain in the r-f amplifier.

Question: What is the proper use of the VR regulator tube for stabilizing the screen supply of a 6L6 amplifier, and how much more power output is secured when this method is employed?

G. B. B., Seattle, Wash.

Answer: The 400-volt plate supply for a 6L6 amplifier must be reduced to a value of 250 to 300 volts for connection to the screen-grids of the 6L6 tubes. If a series resistor is utilized for this purpose, the actual voltage applied to the screens will vary over a range of as much as 50 volts during the audio cycle, since the screen-grid d.c. varies from 5-ma. up to 16-ma. The screen-grid current increases as the audio signal is increased, with the result that the screen-grid voltage will be reduced, thus greatly reducing the maximum signal power output. A type VR-105 or VR-150 voltage-regulator tube has a constant voltage drop of approximately 105 and 150 volts, respectively, for values of current over the range of from 5-ma. to 30-ma. If one of these tubes is utilized in place of a fixed resistor in order to reduce the plate voltage supply to the desired value for connection to the screen-grids, the voltage on the screen circuit will be constant, assuming that the plate voltage supply has good regulation. From 10 to 20 per cent less power output is obtained from the resistor-dropping circuit than when the VR regulator tubes are employed. The VR-105 tube, connected in series with the power supply voltage to reduce the voltage for connection to the screen-grids and to the low-level speech amplifier tubes, may often eliminate the need for an additional 300-volt power supply. Two VR-105 tubes can be connected in parallel to increase the current carrying capacity if the 6L6 amplifier requires a small power amplifier driver stage.

Question: Why is it not possible to apply frequency modulation to any of the amateur bands? G. C. R., Santa Ana, Calif.

Answer: The technical reason for not using frequency modulation for amateur communication except at ultra-high frequencies is largely because of the high degree of distortion which takes place when fading is present. Signals received from long distances are subject to fading and the effects are not as noticeable in the form of distortion with amplitude modulation as with frequency modulation. This is entirely beside the point that the F.C.C. prohibits frequency modulation by law on any but the u.h.f. bands.

Question: How can I determine the approximate power loss in each tuned circuit in my transmitter?

D. F. G., South Bend, Ind.

Answer: The efficiency of a tuned circuit is equal to the circuit "Q" unloaded minus the loaded value of "Q" divided by the unloaded value of "Q". If a circuit has a Q of 100 without antenna load, plate circuit or grid circuit loads, and a Q of 10 when loaded by the following stage or antenna circuit, the circuit efficiency is equal to $\frac{100}{100-10} = .90$, or 90 per cent. The tuned circuit loss in each case will be 10 per cent of the power supplied by the transmitter tube. If the plate circuit efficiency of the r-f tube is 75 per cent, and the tube operates with 100 watts input, the tube output will be 75 watts. Ten per cent of 75 equals 7.5 watts, which would be lost in the form of heat and radiation in the tuned circuit.

In this example the overall amplifier efficiency would be 67.5 per cent instead of 75 per cent. At frequencies of 4- to 7-mc. the L/C circuit losses range from approximately 7 per cent to 15 per cent of the power output from the r-f amplifier tube or tubes.

Question: Recently I heard on the air that some of the Western oil producers are using pipe lines for carrier currents operating on high-frequency over long distances. I have been unable to find any data on this system in the technical press. Will you please let me know where it can be obtained?

WESLEY SCOTT, Police Radio W.P.F.I., Columbus, Ga.

Answer: We, too, have been unable to find the information you ask for. Does some reader of this magazine have the facts? If so, Mr. Scott will appreciate hearing from you. Will you drop him a line?

Question: Why does one of my 100TH tubes show more color than the other in my push-pull amplifier?

H. L. C., Sacramento, Calif.

Answer: When one tube in the r-f amplifier shows excessive heating effects, this may be due to the presence of a u.h.f. parasitic oscillation, or to unbalanced grid driving conditions. Parasitic oscillations can be eliminated by means of parasitic suppressors or by rearranging the length of the r-f leads. If one grid circuit has more applied grid driving voltage than the other, the tubes will not heat evenly since one tube would be operating at higher plate efficiency than the other. A single-section grid tuning condenser may cause this effect—because the stator capacity to chassis ground is usually less than the rotor capacity to ground. This difficulty can be cured by substituting a split-stator condenser for the single-section condenser in the tuned grid circuit.

Question: What steps should be taken to prevent an 807 screen-grid tube from oscillating in an r-f amplifier?

A. R. J., Miami, Fla.

Answer: This oscillation can usually be traced to parasitics which can be eliminated by connecting 50-ohm 1-watt resistors in both the control-grid and screen-grid leads at the tube socket. It is important to connect the parasitic suppression resistor in the screen-grid lead between the screen-grid and the r-f by-pass condenser. Oscillations at the approximate frequency of the amplifier circuit can often be traced to the lack of a common ground point for all of the by-pass condensers, a small amount of inductance in one of the by-pass condensers which prevents it from acting as a by-pass condenser, or to feed-back between the grid and plate circuits due to lack of proper shielding around the tube or between the grid and plate circuits.

Toughest nut for the F.C.C. to crack is the roving bootlegger who skips from town to town in his car, sending a few letters or characters from each location, the stuff directed at foreign agents aboard ship somewhere on the ocean. Two of these skip-Jacks are already in custody, thanks to the splendid work on the part of the F.C.C. Inspectors.

Frequency Modulation will soon be on the air from a prominent trade school in San Francisco, recently granted an FM permit. Educational data will be transmitted to classes in other local schools, and only those with FM receivers can pick up the broadcasts. Student listeners will no longer have to look ole Prof. Sourpuss in the face—they'll merely have to listen to him. Education marches on!

More Power Into a Low-Resistance Antenna

(Continued from page 22)

than 150-ma. This is ample for a single RCA-812 tube, cathode-modulated or as a c.w. amplifier.

Choke input to the filter on the low voltage power supply is an essential requirement in order to obtain good voltage regulation and high load current for the r-f exciter and audio system. With separate filament transformers it is possible to switch the carrier on and off with a single switch in the 110-volt leads to the two plate voltage power supply transformers. A single milliammeter, connected to a 4-position push-button switch, permits reading the cathode and grid currents in the r-f unit.

Power supplies and filament transformers are mounted on a standard 11-in. x 17-in. chassis behind a 10½-in. panel. The top chassis, also of the same size, behind an 8¾-in. panel, contains the complete r-f and audio system, separated by a baffle shield to prevent r-f feed-back into the speech amplifier tubes.

The 6L6G buffer stage can be neutralized by opening one lead to the milliammeter with the 6L6G buffer cathode push-button depressed on the switch, in order to cut off the d.c. plate supply to this stage. A ¼-watt neon bulb can be touched to the buffer coil side of the final amplifier neutralizing condenser as an r-f null indicator when adjusting the 6L6G neutralizing condenser and plate tuning condenser. Neutralization of this stage is not critical. The final amplifier can be neutralized by driving from 15 to 20 milliamperes of grid current into the 812, with the plate supply disconnected from this tube. The neutralizing condenser in the 812 stage can be adjusted to a value which will provide minimum r-f current in the 812 plate tuned circuit. The neutralizing procedure is similar to that of a plate-neutralized r-f amplifier.

During normal operation the cathode current of the crystal oscillator is slightly less than 10-ma., the 6L6G cathode current from 30- to 60-ma., the final grid current approximately 7-ma., and the final cathode current from 90-to 100-ma. The 6L6G buffer stage must be slightly detuned from the resonant dip in plate current in order to reduce the grid current to the 812 to a value low enough for effective cathode modulation.

★

Thordarson "Splatter" Chokes

FEATURES

1. Entirely eliminates "splatter."
2. Permits higher modulation percentage.
3. Gives sharper phone signal.

● The Thordarson "Splatter" chokes are designed to eliminate side band splatter. Splatter is not entirely due to over-modulation; the greater part of it is caused by over-driven modulators and audio distortion. If a transmitter is modulated by a 3000 cycle note the band width occupied by the transmitter is 6000 cycles. However, if the 3000 cycle note has an appreciable amount of third harmonic distortion the band width occupied by the transmitter is 18,000 cycles. These side band crackles are particularly bothersome to stations in the near vicinity since the phone transmitter can sometimes be heard 25 or 30 kilocycles each side of the carrier. **The Thordarson "Splatter" choke is placed between the modulator and the class C stage and it eliminates all bothersome side band splatter caused by audio distortion.**

DESCRIPTION

● The chokes consist of two windings, one of which is tapped. By means of the various combinations it is possible to obtain a great many inductance values as shown in the table. The choke is used in conjunction with three mica condensers. Fig. 1 in a low Pass M Derived Type Filter.

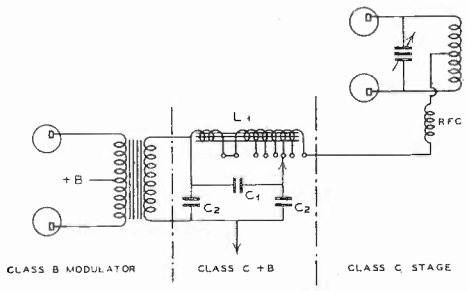


Fig. 1

● **Only when the filter is placed at the output of the modulators does it eliminate the source of audio distortion from the modulators. The regular band pass or low pass filter in the speech amplifier does not eliminate this source of distortion.**

USE OF THE CURVE

● The two curves, Fig. 2 and Fig. 3, eliminate the necessity of calculating the values of L_1, C_1 and C_2. Either curve may be used although the 3500 cycle cut-off occupies the narrower band with. To use the curves it is only necessary to know the class C load and for cathode modulation the load consists of the cathode impedance or the Class C voltage divided by the Class C current multiplied by the plate modulation factor.

Example: To find the filter values for a Class C load of 5500 ohms.

Procedure: The 3500 cycle filter occupies the narrower band width and it is to be preferred. Calculations will thus be based on the 3500 cycle cut-off Fig. 2. Draw a line from "5500 Ohms" on the base to the curves marked L_1, C_1 and C_2 as shown by the dotted lines. L_1 is found to be .024 henries, C_1 .006 Mfd. and C_2 .004 Mfd. Two C_2 condensers are required, one on either end of the choke as shown in Fig. 1. Whenever the exact values of inductance or capacity cannot be obtained the next lower values should be used for the 3500 cycle cut-off curve and the next higher values for the 5000 cycle curves.

Type	Max. Current DC	Volts Insulation
T-15C30	150	3000
T-15C31	300	5000
T-15C32	500	7500

VOLTAGE RATING OF CONDENSERS

C_1 may be the standard 1000 volt mica condenser. The rating of C_2 should be double the Class C voltage. If a Class C stage operates at 1000 volts C_2 should be the 2500 volt type.

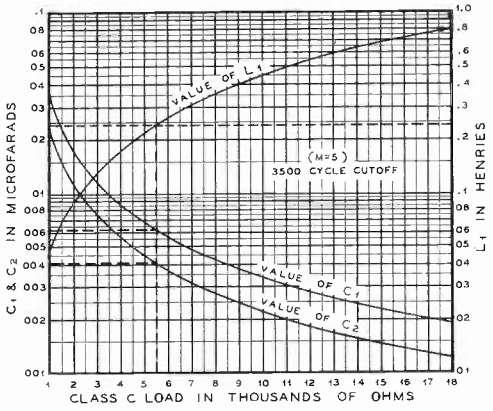


Fig. 2

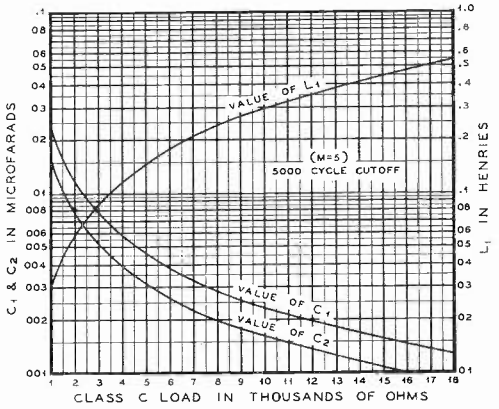


Fig. 3

ENGINEERING APPLICATIONS

Thordarson Cathode Modulation Transformers

• The Thordarson T-11M79, T-11M80 and T-11M81 transformers are designed for the new higher efficiency system of cathode modulation. The audio power required for this type of modulation is but 1/5 the Class C input which results in an RF efficiency of approximately 55 per cent. The plate circuit is modulated 40 per cent and the grid 60 per cent.

CATHODE IMPEDANCE

• The cathode impedance of a cathode modulated amplifier is equal to the Class C voltage divided by the Class C current multiplied by the plate modulation factor which for this system is .4. The cathode impedance of a stage operating at 1000 volts and 100 ma. is $\frac{(1000 \times .4)}{(.1}$) or 4000 ohms. The audio power required is (.2 x 1000 x .1) or 20 watts which may be easily delivered by a pair of 6L6's operating at 360 volts plate and 270 volts screen with a plate to plate load of 9000 ohms.

• By means of the curve, Fig. 1, the ratio of the transformer may be quickly and easily found.
Example: To find the ratio for the above example (9000 ohms to 4000 ohms).
Procedure: Draw a vertical line from "9000 ohms" on the base of the curve to the load line marked "4000 ohms." The ratio of 1.5 is then found by drawing a horizontal line from this junction to the left-hand side of the curve. The correct transformer connections for a ratio of 1.5 are (from Fig. 2): for the primary, connect the modulator plates to terminals C and C; join D and D for the primary center tap; for the secondary, join 4 to 5, connect the cathode to 1 and ground 7. Whenever the exact ratios cannot be found the next lower ratio should be used. This reflects a lower value of plate to plate load across which the modulating power is more easily developed. The grid return is connected to the moveable arm of the 2000 ohm semi-variable 25 watt resistor which is connected between two of the secondary taps. The connections for this condition are shown in Fig. 3.

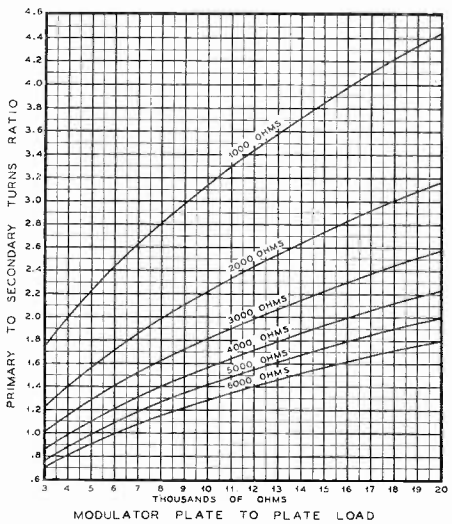


Fig. 1

Turns Ratio Primary to Secondary	Primary			Secondary Connect Cathode		
	Plate	B+	Plate	Join	to	Grnd
4.21	A	D-D	A	.....	1	4
3.58	B	D-D	B	.....	1	4
3.23	A	D-D	A	4-5	1	6
2.82	C	D-D	C	.....	1	4
2.75	B	D-D	B	4-5	1	6
2.67	A	D-D	A	4-6	1	7
2.59	A	D-D	A	4-7	1	8
2.27	B	D-D	B	4-6	1	7
2.24	A	D-D	A	4-5	1	7
2.20	B	D-D	B	4-7	1	8
2.17	C	D-D	C	4-5	1	6
1.91	B	D-D	B	4-5	1	7
1.91	A	D-D	A	4-6	1	8
1.79	C	D-D	C	4-6	1	7
1.74	C	D-D	C	4-7	1	8
1.69	A	D-D	A	4-5	1	8
1.63	B	D-D	B	4-6	1	8
1.50	C	D-D	C	4-5	1	7
1.43	B	D-D	B	4-5	1	8
1.39	A	C-C	A	.....	1	4
1.28	C	D-D	C	4-6	1	8
1.13	C	D-D	C	4-5	1	8
1.07	A	C-C	A	4-5	1	6
.855	A	C-C	A	4-7	1	8
.757	B	C-C	B	.....	1	4
.740	A	C-C	A	4-5	1	7
.630	A	C-C	A	4-6	1	8
.582	B	C-C	B	4-5	1	6
.555	A	C-C	A	4-5	1	8

Fig. 2

• For proper operation the grid return must be made to the correct point on the secondary of the cathode modulation transformer. The correct modulating voltage is more easily obtained by the use of a variable resistor between two of the secondary taps. In all cases the value of resistor may be 2000 ohms and the power rating 25 watts. The value of resistor is high enough so that it does not cause excessive loading on the transformer.

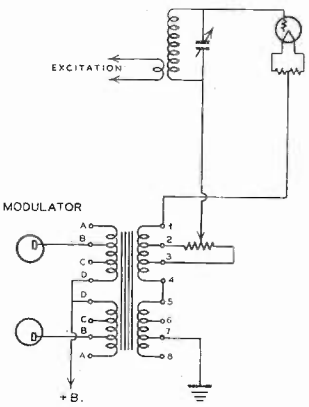


Fig. 3

• For best resutls an oscilloscope should be used for adjusting the grid excitation. The variable resistor should be connected between taps 1 and 2 and adjustments made. If sufficient grid modulating voltage is not obtained the position of the resistor may be changed to 2 and 3, 3 and 4, etc.

Type	Max. Audio Watts	Max. Sec. DC
T-11M79	40	300
T-11M80	100	400
T-11M81	200	600

Thordarson Filament Corrector Autotransformer

● The versatile filament corrector autotransformers are designed to operate with filament transformers to prolong tube life by supplying correct filament voltages to the tube sockets. In this respect they have two principal uses:

1. To correct for line voltage.
2. To correct for drop in the filament wiring.

DESCRIPTION

● The autotransformers as shown in Fig. 1 consist of a single tapped winding with the common end of the winding marked "C." One side of the AC line and one of the primary leads of the filament transformer are connected to "C." The other side of the AC line and the other primary lead of the filament transformer are connected to two of the other taps from 105 to 125.

● If a line voltage having a value of one of the taps is applied to that tap, (105 volt line connected to 105 volt tap or 115 volt line to the 115 volt tap) the autotransformer will deliver the voltages marked at the other taps.

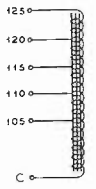


Fig. 1

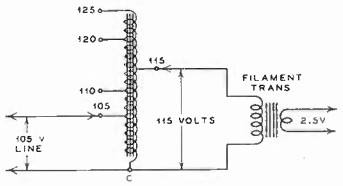


Fig. 2

● It is also possible to obtain voltages other than those marked on the taps by applying a different voltage to the taps. This is very helpful in obtaining a higher filament voltage to compensate for filament wiring drop. As an example, if a 115 volt line were applied to the 110 volt tap of the autotransformer the voltages from the other taps would be raised by the ratio of $\frac{115}{110}$. If a 115 volt filament transformer were connected to the 115 volt tap of the autotransformer, the voltage actually applied to the filament primary would be $\frac{115}{110} \times 115$, or 120 volts. The filament voltage would thus be raised by the factor of $\frac{120}{115}$ or 1.04.

● The two types, T-18V24 and T-18V25 will handle 60 and 150 watts of filament power respectively. T-18V24 may be used with individual filament transformers and T-18V25 for an entire transmitter.

TO CORRECT FOR LINE VOLTAGE

● In compensating for line voltage connect the line and the primary of the filament transformer to the corresponding taps on the autotransformer. As an example, if the line voltage is 105 volts and if the filament transformer has a primary designed for 115 volts the connections are made as shown in Fig. 2. It is also possible to reduce as well as to increase the voltage to the primary of the filament transformer. If the line voltage is 125 volts and if the filament transformer is designed for 115 volts connect the line voltage between C and 125 and connect the primary of the filament transformer between C and 115 volts.

TO CORRECT FOR DROP IN FILAMENT WIRING

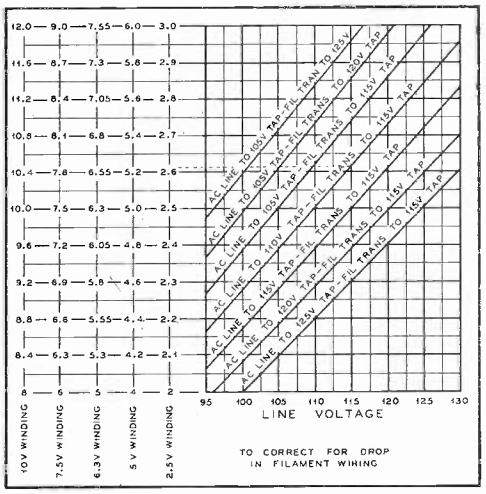


Fig. 3

● The autotransformers may also be used to correct for drop in the filament wiring so that the correct filament voltage is delivered at the tube sockets. For convenience in doing this the curve of Fig. 3 is used.

● Example: It is desired to obtain 2.61 volts from a 2.5 volt filament winding to compensate for the drop in the filament wiring. If the line voltage is 115 volts and if the filament transformer has a 115 volt primary the taps on the autotransformer are determined by the junction of a line drawn from "2.61 volts" and also a line drawn from "115 volts" as shown by the dotted lines. These two lines intersect on the curve marked "AC Line to 110 V Tap. Fil. Trans. to 115 V Tap." The 115 volt line is connected between C and 110 on the autotransformer and the primary of the filament transformer is connected between C and 115 as shown on Fig. 4.

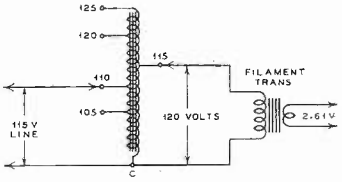


Fig. 4

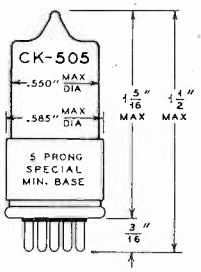
● It is also possible to correct for filament drop and also for low line voltage at the same time. Assuming that the desired filament voltage from the filament transformer is 2.59 volts and that the line voltage is 100 volts, the intersection of the two lines is the curve "AC Line to 105 V Tap. Fil. Trans. to 125 V Tap." Connect the 100 volt line to the 105 volt tap of the autotransformer and connect the 115 volt primary of the filament transformer to the 125 volt tap of the autotransformer.

ENGINEERING APPLICATIONS

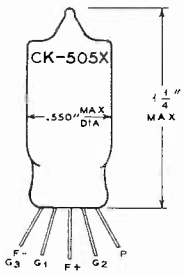
Raytheon CK-505,505X Pentodes

The CK-505 and CK-505X are miniature pentode type amplifier tubes designed for use as voltage amplifiers in applications where extremely small size and low battery drain are the primary tube requirements.

The CK-505 is equipped with a special miniature base. The CK-505X has tinned copper leads for direct soldering and is supplied with a removable standard octal base to facilitate retesting.



FULL SIZE VIEWS



VIEW WITH TYPE N? ON NEAR SIDE

MECHANICAL SPECIFICATIONS FOR RAYTHEON CK-505 AND CK-505X MINIATURE PENTODE AMPLIFIERS FOR LOW-DRAIN BATTERY SERVICE. THESE SPECIFICATIONS HAVE BEEN ADOPTED AS STANDARD, BUT THE CHARACTERISTICS ARE TENTATIVE.

INTERELECTRODE CAPACITANCES
(Approximate)

Grid to Plate	0.25	uuf
Input	2.5	uuf
Output	3.5	uuf

RATINGS

Max. Fil. Voltage (Dry Battery Supply)		
Volt. Must Never Exceed	0.78	volts
Mean Filament Voltage	0.625	volts
Maximum Plate Voltage	45	volts
Maximum Screen Voltage	45	volts

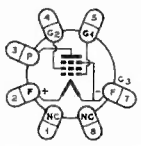
TYPICAL AMPLIFIER OPERATION—CLASS A

	Impedance Coupled	Resistance Coupled	
Filament Voltage*	0.625 d-c	0.625 d-c	0.625 d-c volts
Filament Current	0.030	0.030	0.030 amp
Plate Voltage	30	45	30‡ volts
Screen Voltage	30	45	30‡ volts
Grid Bias†	0	−1.25	0 volts
Plate Resistance (Approx.)	1.1	2.0	– megohms
Transconductance	140	150	– umhos
Plate Current	0.17	0.2	.020 ma
Screen Current	0.07	0.08	.007 ma
Voltage Amplification			15

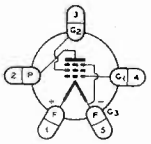
* The filaments of two tubes may be operated in series directly from a single small flashlight cell. If larger cells are used or if other factors cause the mean battery voltage to exceed 1.25 volts computed over the normal battery life, a series filament resistor should be used to reduce the mean filament voltage to 1.25 volts for the two tubes in series.

† Grid Circuit returned to negative filament. The d-c resistance in the grid circuit should not be less than 5 megohms.

‡ Supply Voltage. Plate Resistor: 1 megohm. Screen Resistor: 2 megohms by-passed with 0.01 uf. Coupling Condenser: 0.01 uf.



CK-505X MOUNTED IN A 7 PRONG SMALL SHELL OCTAL BASE



SPECIAL MINIATURE BASE CK-505

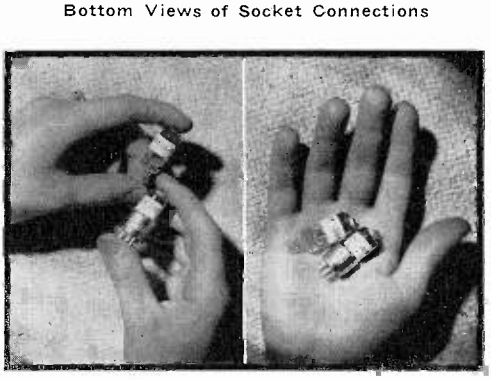
Bottom Views of Socket Connections

RAYTHEON CK-503, CK-503X

The CK-503 and CK-503X are miniature pentode type output amplifier tubes designed for applications where extremely small size and low battery drain are the primary tube requirements. The overall length of the CK-503 is approximately ¼-in. longer than the CK-505. The tube is designed to operate with low plate voltage into a magnetic-type of ear-phone.

CHARACTERISTICS

Filament Voltage	1.25 volts
Filament Current	33 ma.
Plate Voltage	30 volts
Screen Voltage	30 volts
Control-Grid Voltage	0 volts
Plate Current	1.5 ma.
Screen Current	0.35 ma.
Mutual Conductance	600 mhos.
Plate Resistance	0.15 meg.
Load Resistance	20,000 ohms.
Approx. Output	7 m.w.



The Miniature Size of the New Raytheon Series CK Tubes Is Depicted in the Illustration Above

If it's Results You Want—

$149.50 Complete with 14 Tubes, External Dynamic Speaker to Match and Crystal Filter

The New HOWARD "490"

Gives You "Plus" Performance all the Way!

- 14 Tubes
- 540 KC—43 MC
- 2 Stages R.F. Preselection
- Calibrated Band Spread
- Air-Tuned I.F. Transformers
- Variable I.F. Selectivity
- Temperature Compensated Oscillator
- Split Stator Ceramic Insulated Tuning Condensers
- Variable Fidelity Audio
- 8 Watts Push Pull Output
- Automatic Noise Limiter

A Communication Receiver that could truly be termed "tops" in every respect, the HOWARD Model 490 is the result of over a year's engineering and development. New standards of performance were set and are now available for the first time outside of laboratory equipment.

You will have—sensitivity that never knows "crowding"—selectivity that may be varied from crystal CW to wide band high fidelity—an audio system with flat response of 30 to 10,000 cycles—high or low frequency cutoff of a 1600 cycle peak—and all reproduced through a dynamic speaker having the best in both high and low frequency response.

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VIBRAPACK POWER SUPPLY SYSTEMS

(Continued from page 37)

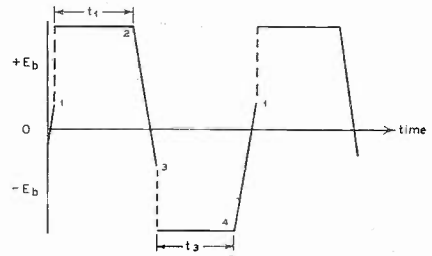


Fig. 4(c)

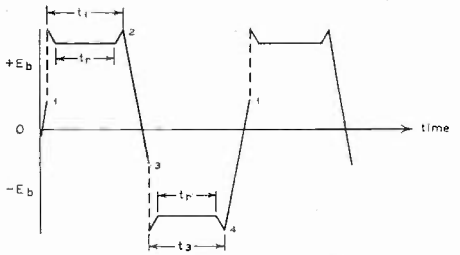


Fig. 4(d)

same conditions holding true for the points 4 and 1. This would also hold true, again, for the self-rectifying type of vibrator operating on no-load. "No-load" does not mean the removal of the first filter condenser, however.

The waveform picture of a properly adjusted self-rectifying vibrator operating under load is shown in Fig. 4(d). The short, regular peaks shown at the start and finish of the time intervals t_1 and t_3 are proper and do not create "hash" or circuit difficulties if they appear approximately as shown. These peaks are caused by the increased voltage drop in all of the "A" circuit when the secondary, or "B" load is connected, since the vibrator is so adjusted that the interrupter contacts close before the rectifier contacts and open after the rectifier contacts. In other words, the rectifier contacts are spaced slightly wider than the interrupter contacts, the load thus being interrupted in the secondary circuit where the current is measured in milliamperes, and the primary contacts then handle only the magnetizing current of power transformer. In a tube rectifier type power supply the primary contacts must handle the entire load of the power supply. From this it will be seen that there are definite benefits from self-rectifying construction other than the simplification of design and the elimination of extra parts.

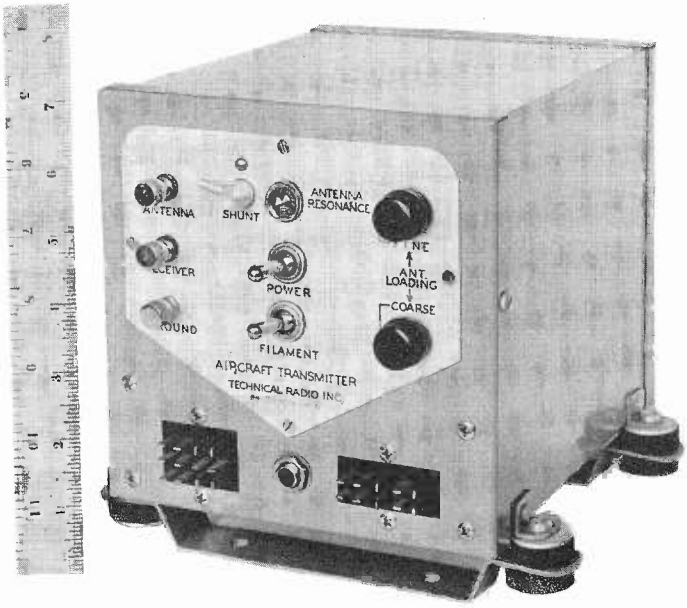
(*Part II will appear in next issue*)

TECRAD
AIRCRAFT EQUIPMENT

HAS LONG BEEN A STANDARD ITEM IN OUR COMPLETE LINE OF RADIO-TELEPHONE APPARATUS FOR COMMERCIAL AND GOVERNMENTAL RADIO SERVICES.

WE PRESENT THE MODEL TAV FOR YOUR CONSIDERATION. THIS UNIT, WHILE PRIMARILY DESIGNED AND INTENDED FOR AIRCRAFT, IS EQUALLY WELL SUITED TO OTHER APPLICATIONS WHEREIN RUGGEDNESS MUST BE COMBINED WITH COMPACTNESS.

A few of the pertinent points are listed for your consideration:



Small in size . . . actually not much larger than a 6 inch cube.
Self-contained power supply.
Lightweight . . . slightly over nine pounds complete with internal power supply.
Arranged for remote control . . .
Simple to set up . . . patch plug system allows ready installation or removal.
6 or 12 volt storage battery operation.
Low current drain on either model.
Power output 8 watts.
Built-in antenna loading network to match antennas as short as 20 feet.
Frequency range. Normally single channel. 2,000 to 6,500 kc. Can be supplied with relay switching for 3105-6210 or other similar frequencies.

Crystal control . . . reliable, clamped-air-gap holders. Crystals can be supplied for any frequency tolerance from .04 to .005 per cent.

Separate crystal oscillator is used . . . final amplifier is modulated.

Aluminum construction throughout.

Every possible precaution is used to prevent loosening of screws and components under vibration.

Licensed for governmental and aircraft use under patents of the AT&T and Hazeltine Laboratories.

Inquiries for special applications of this unit are solicited.

Our 5th year in the field of specialized radio manufacturing during which time we have served the U. S. Army, U. S. Army Engineers, U. S. Coast Guard, U. S. Lighthouse Service, U. S. Dept. of Justice, U. S. National Park Service, U. S. Indian Service, U. S. Forestry Service as well as hundreds of individuals and commercial concerns throughout the United States, Alaska, Honolulu and the Philippines.

TECHNICAL RADIO INC.

1083 MISSION STREET SAN FRANCISCO, CALIFORNIA

High Output 114-Mc. Mobile Transceiver

(Continued from page 27)

discussion it was necessary to use a chassis of far larger size than normal, merely to fill space in the glove compartment and to make for a snug all-around fit. It would be a simple matter to secure a small loud speaker to the under-side of the chassis, if desired.

Technical Considerations

THE transceiver circuit consists of a special u.h.f. type of tube, the HY-75 triode, in the r-f circuit followed by a 6J5 and 6V6 audio system. The HY-75 acts as a super-regenerative detector for receiving and is connected to the two-stage audio amplifier in order to obtain loud-speaker reception. For transmitting, the two-stage audio amplifier is connected to a single-button carbon microphone and the output of the 6V6 is utilized to plate modulate the HY-75 as a 2½-meter oscillator. Microphone current is obtained from the 6-volt filament supply through a "hash" filter which consists of a 50-mfd. 25-volt by-pass condenser and a 20- or 30-henry 60-ma. filter choke. This hash filter is essential in order to prevent the introduction of noise from the vibrator supply from finding its way into the microphone circuit.

The changeover from transmit to receive is accomplished by the 4-p-d-t switch. The input transformer has two primary windings, one for the plate circuit of the super-regenerative detector and the other for the low-impedance carbon microphone. The output or modulation transformer is a small push-pull tube-to-voice-coil unit of any standard make.

The 2½-meter antenna is usually cut so as to resonate in some portion of the amateur band. The antenna coupling at the resonant frequency is less than at other points in this amateur band for optimum results. If the antenna coupling is too great, the detector circuit will not superregenerate; if the antenna coupling is too loose the received or transmitted signal will decrease in intensity. It is possible to improve the received signal strength from 1 to 2 *R* points by careful adjustment of the antenna coupling. This may result in the actual success or failure to receive any u.h.f. signal.

The HY-75 tube is made to superregenerate by means of blocking grid-leak action and by adjustment of the plate voltage applied to the detector tube. In the transmit position the 1-megohm receiving grid-leak is short-circuited to ground, leaving only a 2,500-ohm grid-leak for transmitting. The plate voltage is increased by connection to the modulator and the tube becomes a 2½-meter oscillator of relatively high power output. The r-f chokes are of the small u.h.f. type designed for 2½- and 5-meter operation.

An audio volume control is connected into the circuit in the receive position in order to give loud-speaker reproduction. The r-f coil connected to the HY-75 tube should have four turns of No. 14 wire, ½-inch in diameter, one-inch long. The illustration shows a 5-turn coil, which later had to be cut down to 4 turns, in order that the tuning dial would register the middle of the band in the center position of the condenser setting.

A simple half-wave antenna, 4 feet long, is very effective for 2½ meter mobile operation. The antenna is coupled to the transceiver by means of a non-resonant single-wire line, connected approximately 7 inches from the center of the antenna. It is desirable to adjust this feeder point for the particular installation in every case, and no hard-and-fast rule for the tap-on point can be given. The antenna adjustments can be made by checking with another station at some remote point.

The plate voltage can be of any value from 200 to 300 volts. The output from this receiver is several watts in the 2½-meter band.

★

N. Y. A. Training Recruits for Defense Network

THE National Youth Administration has started training 10,000 youthful recruits to man 500 N.Y.A. radio club stations strategically located in areas to meet national gencies. About 10 per cent of the planned number of operators and stations are already functioning in 22 states. One such station in Georgia did heroic work last winter in maintaining communication with the outside world after regular means were destroyed by a hurricane. Station installation and training is under the general direction of Robert Burton, an experienced radio engineer. Material and funds will be supplied by the Federal Government and the assembly work will be done by the students. The majority of the recruits can become good operators after two years of such training.

★


BUD
SHEET-METAL PRODUCTS
DESIGNED FOR
Appearance-Utility-Versatility
BUD RADIO, INC.
CLEVELAND
OHIO

Friendly Advice, by Clayton F. Bane

(Continued from page 30)

portant that he has a pleasing personality and the ability to get along with everybody. Not an easy job.

At one time it was only necessary that radio equipment have plenty of gadgets and controls in order to satisfy the purchaser, speaking now from the standpoint of appearance. That era has passed. Radio transmitters and receivers must now have eye appeal — modernistic touches — and this brings a new man into the picture, the designer. He is a combination artist, yogi, engineer or what-have-you. It is his brainchild that greets the public eye (or offends it). Upon his ability to produce a piece of equipment outstanding in appearance will depend, to a great extent, the saleability of the product. Given a number of receivers equal in performance, anyone will naturally select the most attractive from the standpoint of appearance. Yes, modern design has entered the radio field.

Skipping over the functions of various engineers who may be specialists in certain phases, we arrive finally at the "chief." His job normally represents the top in the engineering profession. In a large plant, the chief may sit at a desk and act in a coordinating or advisory capacity. Naturally, final decisions are left to him. In a small plant, the chief's job is apt to be a nightmare, since he must double in brass. He not only must be able to meet the public, answer telephone calls all day, do part or all of the designing, but he must also know each and every phase of the work in the plant.

If the plant has limited machinery, he must take this factor into account when designing his product, and present only such designs as can be profitably built with the equipment on hand. In his spare time he can do all of the drafting (cursing the day when he admitted he could do it), and while he is resting he can write copy for instruction books, take photographs and think up new ideas for next season's models. They don't teach those things in school. Here again, experience is the keynote.

ONE final bit of advice. If you get a job in a plant engaged in Government business, look out for the fellow worker who breeds discontent. As a new man, you may be singled out as a suitable subject by individuals whose sole purpose is to slow-up or impede Government orders. Facts are facts, and we have reason to believe that

(Continued on page 56)

1941 "RADIO" HANDBOOK

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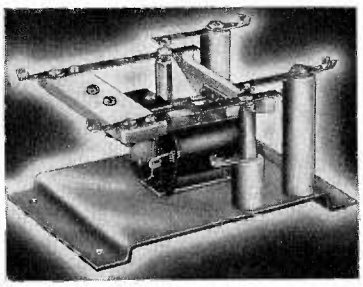
Friendly Advice, by Clayton F. Bane

(Continued from page 54)

such individuals may already be employed. If you are lucky enough to get a job, be thankful—and remember that perhaps a great number of other men applied for the same job and didn't get it. Keep strictly away from the malcontents.

In summary, it is almost axiomatic that a highly skilled man is rarely out of work. This means that time spent in preparation for a place in the radio industry will not be wasted. Those who hold key positions in the industry must be constantly on their toes—studying—looking ahead. There is no place in this business for dead-wood, men who aren't willing to dig-in and work for their place in the sun. True in all businesses, particularly true in radio manufacturing no one is going to *give* you anything. There is no lack of opportunity in radio. Avail yourself of it.

MEISSNER ANTENNA CHANGE-OVER RELAY



● A new relay designed for Amateur and Commercial use. Allows the use of the same antenna for transmission and reception. May also be used for making and breaking other R. F. circuits. Base and crossbar are of mycalex to keep losses at an absolute minimum. Has ceramic terminal posts. All contacts are widely spaced to prevent leakage and flashover. Actuating coil operates on 110 volts A.C. Relay measures 3″ x 3″ x 2″ high over-all.

Radio Club Charters

. . . There are hundreds of amateur radio clubs in the United States. Some are small, others have a membership running into the hundreds. How these clubs can participate in the defense program will be related in subsequent issues. Ask your secretary to write for a Charter Certificate.

Frequency-Meter Monitor

(Continued from page 32)

rather tightly for 'phone monitoring. The audio volume in the output of the small loud speaker is controlled by the potentiometer in the grid circuit of the first audio amplifier stage. The illustration shows a pickup coil with a small variable condenser mounted inside the coil and a tuning knob and scale fitted to the condenser. This arrangement gives some leeway in selecting the tone of the c.w. note for monitoring service, but this is a refinement not required by the amateur.

When operated as a 'phone monitor with the pickup coil placed close to the antenna feeders, the b.f.o. portion of the circuit is disconnected by throwing the plate supply switch. A 35Z4GT half-wave rectifier and large filter supplies plate power for the complete unit. In most locations it is not advisable to ground the metal housing of the instrument because a strong a.c. hum may then be introduced into the output of the monitor.

★

Amateur Radio Guards Nation Against Spies

Uncle Sam is collecting defense dividends for twenty-eight years of radio tolerance. Already he has received several "Fifth Column" tips from radio amateurs.

They're beginning to repay the Government for its policy of encouragement in sharp contrast to the restrictions, even prohibitions, imposed on their kind by other nations.

To date there has been nothing to compare with the pre-World War service of Charles Apgar of Westfield, N. J., whose vigil at W2MN, his home station, led to confiscation of the Telefunken (German) trans-Atlantic radio station at Sayville, Long Island, for non-neutral communication in 1915.

Three Government censors vainly watched Sayville, suspected of handling illegal traffic to aid Germany in the war. W. J. Flynn, chief of the United States Secret Service, heard of Apgar's ingenious arrangement to record radio signals, and sought the amateur's aid.

In three nights, using Apgar's recording to slow down Sayville's high speed signals so they could be read, Government agents gained sufficient evidence to close the station for sending tips on neutral shipping to German U-boats, and to intern its general manager and chief engineer.

FRANK TIFFANY
Associated Press Staff Writer

From the Mail Bag
of the
Federal Communications Commission

FROM Buffalo comes a request for the "answers" to the questions contained in the Commission's "Study Guide and Reference Material for Commercial Radio Operators." Such answers are not furnished. The questions contained in this pamphlet, as well as in the Commission's "Study Guide and Reference Material for Amateur Radio Operator License Examination," are purposely paraphrased to cover the scope of examinations without giving actual examination questions. In either case, the operator should qualify himself to know the answers.

* * *

A NORTH CAROLINA resident asks if he would have to get permission from the Federal Communications Commission to build a private telephone line to connect with a local telephone system. He is informed that such intrastate matters come within the jurisdiction of State public utility commissioners and, accordingly, is referred to the one for North Carolina.

EASY DETERMINATION OF OFF-RESONANCE SIGNAL STRENGTH

(Continued from page 25)

The numerator in the last term of this equation is

$$\sqrt{R^2+(\omega^2L^2-1/\omega^2C^2)} =$$

$$R\sqrt{1-\frac{\omega^2L^2}{R^2}(1-f_0^2/f^2)} = R/\cos\phi$$

when $\tan\phi=\frac{\omega L}{R}(1-f_0^2/f^2)$, as explained in detail for the case of the series circuit.

In the denominator, the factor $-R^2/\omega^2C^2$ has a value of less than 0.0001 Z in the ordinary circuit, and can thus be ignored without appreciably affecting the result. So, upon recognizing that

$\sqrt{\omega^2L^2/\omega^2C^2} = L/C = L^2/LC = \omega_0^2L^2$

where $\omega_o^2 = (2\pi f_o)^2$ when f_o is the frequency at resonance, the denominator becomes simply $\omega_o^2L^2$.

The expression for the impedance has thus been reduced to

$$\frac{1}{Z}=\frac{R/\cos\phi}{\omega^2L^2} \text{ or } Z=\frac{\omega_0^2L^2}{R}\cos\phi.$$

Upon defining the resonant frequency f_o as that for which $\omega L = 1/\omega C$, the impedance at resonance is found from

$$\frac{1}{Z_0}=\frac{\sqrt{R^2+0}}{\omega_0^2L^2}=\frac{R}{\omega_0^2L^2} \text{ or } Z_0=\frac{\omega_0^2L^2}{R}.$$

The current ratios, and thus the relative signal strengths, are thus given by

$$\frac{I_0}{I}=\frac{Z}{Z_0}=\cos\phi.$$

★

Cleveland Schools to Use FM

THE Cleveland City Board of Education has been granted authority by the Federal Communications Commission to change that school system's non-commercial education radio service from amplitude modulation to frequency modulation.

The specific grant involves the education board's station WBOE shifting from 41,500 kilocycles frequency, 500 watts power night and day, A3 emission, to 42,500 kilocycles and increasing day and night power to 1000 watts for FM transmission.

Extensive use has been made of the facilities of WBOE in serving 156 receivers in the Cleveland school system. The Board of Education states that the objective to be attained with FM is higher fidelity and less noise in classroom instruction and public education.

Radio Defense Board Maps Future Activity

Two meetings of the newly appointed Defense Communications Board have been held with a view to laying the groundwork and planning its activities for the future, FCC Chairman James L. Fly revealed at his press conference on September 30th. No definite meeting dates, he said, had been decided on and meetings for the future will be conducted at the call of the chair with next get together probably to be held October 7th.

In response to a question relating to published articles questioning the right of the FCC to make use of information received through its many monitoring stations throughout the country, Chairman Fly declared that the FCC has broader powers for the use of evidence thus obtained than any other government agency despite the recent Supreme Court decision with respect to wire tapping.

"Of course the Commission can make use of evidence so obtained," Fly said. "That is the main reason for the establishment of the monitoring stations."

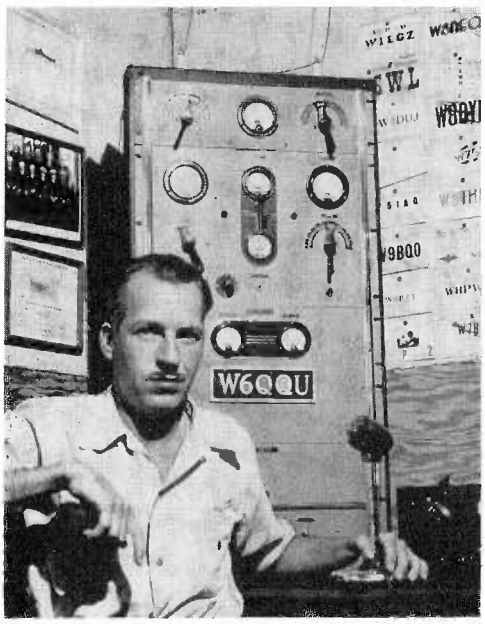
The Chairman said that the Commission has and will continue to use any information picked up by its monitoring stations when considering applications for broadcast licenses, or when revoking them.

—*Radio Daily.*

QRA's OF STAFF AND CONTRIBUTORS

Continued from page 8)

L. L. Funston, W6QQU, is our staff cartoonist. His handle is "Les." In order to introduce him to our readers we asked for the customary historical information, and here is what we received: "Started in radio in 1918 when nine years old, with Ford spark coil, helix, spark-gap, two-slide tuning coil, carborundum detector, and Murdock 75-ohm single fone hooked up to 200 feet of No. 14 hard-drawn aluminum wire. Grad-



uated to a c.w. rig using an old type grid and two-plate "J" tube, plate power supplied by transformer and "slop jar" rectifier. Lost a perfectly good bird dog when he decided to get a drink out of the lead-and-aluminum rectifier; guess it killed him because the dawg went through the basement and never came back. First big activity was when the army made a flight across the USA when I decided to rebuild the transmitter and then it wouldn't work. Got a mess of messages from the army and had to charge a helluva big fone bill to my ole man to get rid of 'em. Father made me quit radio for a short time when big buck Indian walked into my counterpoise and got knocked on his fanny. Spent over 20,000 hours brass pounding fer amateur, commercial and military services which accounts fer fact that I am on 160 fone exclusively now (phooey on c.w.) Was W7AEM back in 1927 but now operate W6QQU on 160 fone and have worked the whole durn country with 75 watts input. Received a silver cup from some unknown BCL listener who swears I am the biggest liar on the 160-meter fone band. Can send 32 words per min. on straight key and copy forty solid on mill. Hobbies are candid camera work (in burlesque shows) and raising pedigreed English bulldogs. Have a feerousious bulldog that answers to the name of CQ. Have trained three woodpeckers to drill holes in my panels. One of 'em drills eighth-inch hole and the other one makes quarter-inch holes. The third reams the holes out and countersinks them. Am married . . . the XYL is smart enough to yank the crystals outa my rig when she wants me to take her to a show."

★

The Cover

THE illustration on the front cover of this issue shows the mobile unit used by WLW engineers in recording recent U. S. Army maneuvers near Ogdensburg, N. Y. This Crosley Corp. professional accomplishment recalls the story of the bantam rooster who laboriously pushed into his henyard near Pasadena a large ostrich egg, crowed to call his harem of dwarfs, and said "I am not complaining but want you to see what your nighbors are doing." We hope soon to give equal prominence to some similar amateur feat. Among the WLW transcriptions were accounts of dive bombings, construction of a pontoon bridge under gunfire, roaring attacks by fleets of tanks, and demonstrations of the mechanized division's capabilities. The Army considered the test gratifying in that it showed the important part to be played by mobile radio units operating in conjunction in a national emergency.

★

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

A NEW JERSEY amateur inquires if it is permissible to (1) listen to short wave transmission from foreign stations and (2) if he can still exchange post cards with "ham" operators in Europe. The Federal Communications Commission advises that though amateurs in the United States are now prohibited from exchanging radio communications with such radio stations abroad, there is no regulation against listening to foreign broadcasts, or communicating with persons overseas by mail, telephone, telegraph or cable.

NEW MAGAZINE DEVOTED EXCLUSIVELY TO FM

ON OCTOBER 10th the inaugural issue of the magazine "*FM*" will be released. This new publication will specialize on Frequency Modulation from the standpoint of the engineer, experimenter, manufacturer, dealer and service-man. It is edited by M. B. Sleeper, one of the most able technical writers in the radio field. The publishers of *FM* point out that there are now more than 200 frequency modulation broadcasting stations projected, under construction, or on the air with regular, scheduled programs. Also of timely interest is a comment on the war and radio: "Because amplitude modulation signals can be picked up at great distances, it is possible that emergency requirements may accelerate the use of frequency modulation for broadcast programs. Among its other advantages, the definitely limited range of frequency modulation transmitters precludes their use for long distance aircraft direction finding. The importance of this factor is emphasized by the present European practice of silencing all broadcasting stations during enemy air raids." The subscription price of *FM* is $3.00 per year. The publisher is *FM Company, Box* 235, *South Norwalk, Connecticut.*

★

Radio Corporation of America has made available three new transmitting tubes and a receiving tube as follows:

RCA-833A—R-F Power amplifier, modulator.

RCA-1627—R-F Power amplifier, modulator.

RCA-8003—Oscillator, power amplifier, modulator.

RCA-12A6—Beam power amplifier.

The 833-A is a transmitting triode similar to RCA-833, but it has an improved construction and can be operated at higher output with forced-air cooling. The 833-A has a maximum plate dissipation rating of 450 watts (ICAS). It can be operated in class C telegraph service with a maximum input of 2000 watts (ICAS) at frequencies as high as 20 megacycles. The 833-A is directly interchangeable with the type 833 in circuits designed for the latter.

The 1627 is a transmitting triode the same as RCA-810 except that it is designed with a filament rated at 5 volts, 9 amperes. Other data are the same as for RCA-810.

The 8003 is a transmitting triode having a maximum plate dissipation of 100 watts in self-rectifying oscillator circuits such as those used in therapeutic applications.

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Editorial Forecast For December

TANK capacities for final r-f amplifiers have been discussed extensively in the amateur radio press, yet the L/C ratios for buffer and doubler stages, and for the antenna tuned circuit, have been woefully neglected. Frank C. Jones has kept a file of this information "on ice," constantly adding to it as newer findings were made. Now the material is ready for release, and you will read it in the next issue of this magazine. It is a technical contribution of the first order, for engineer and amateur alike.

★

THE editor is putting the finishing touches to a mathematical treatise on the power supply rectifier. It's the kind of information you have often tried to find in textbooks and handbooks—without success. There has been altogether too little data available on this subject, and so the editor has chosen to prepare the text himself. His library bulges with a wealth of unpublished technical information, much of which will see the light of day for the first time in the pages of this magazine.

★

BACK to Frank Jones again, it may interest the reader to know that his feature contribution to the current issue is the result of a difficult assignment from a police radio station confronted with low power restrictions in an area where coverage on the police band was inadequate. How Jones went about the task of putting more power into the antenna, with no increase in r-f amplifier input, is related completely in his manuscript, written so the amateur can understand it. For once the amateur profits while the "coppers" pay!

★

CLAYTON F. BANE, W6WB, is one of amateur radio's oldest and truest friends. Although engaged in commercial radio engineering and manufacturing he still finds time to get on the air with his amateur transmitter a few hours every night. We have persuaded *"WB"* to keep this magazine supplied with a steady flow of information. Three feature articles are ready for the type-setter, and we don't know which to publish first. We leave the choice to the reader: (1) A steady-as-a-rock *ECO* with a number of unique innovations, not to mention the low cost of the unit; (2) *The "Q" Receiver* — a stand-by device, tuned to a single frequency in one of the amateur bands, and which apparently is inoperative until another station on the same frequency gives you a call. To the defense-minded amateur this receiver is a boon; (3) A high power transmitter, 500-1,000 watts, for the uhf bands. Those who have experimented with high power in these bands will appreciate the need for constructive information on the subject. Now, Mr. Reader, which of these three features shall we publish first? Send a post-card to the editor immediately!

★

RENEWING old acquaintances we reach across the nation to shake hands with G. H. Browning of Winchester, Mass. It's good to have him with us in the pages of this magazine. He is compiling data for an article of *Frequency Control*, which will appear in the next issue, or at the latest in the January number.

★

EDITORIAL assignments have been accepted by several contributors already at work on the design of special mobile and home-station equipment for the thousands of amateurs who will be given membership in *Amateur Radio Defense Association.* The scope of this undertaking will be realized only after the next issue of this magazine is in your hands.

★

GRATIFYING is the support received from national advertisers whose loyal cooperation made possible the production of this new magazine. In the rush to press it was impossible for some to get copy to us in the time prescribed. You will find many more of the foremost names in radio in our next issue. When you write our advertisers why not *"PS"* them with this: "Glad to see your name in *Amateur Radio Defense;* your continued support will be appreciated by the entire radio fraternity."

For those who want the best

SETTING A NEW RECORD
for efficiency and performance

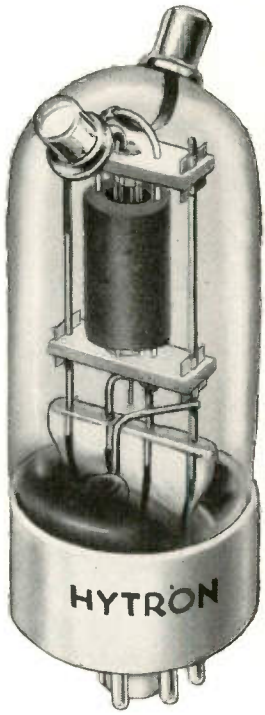
Hytron ultra-high-frequency tubes have been designed specifically for use at frequencies above 60 megacycles. Short, direct grid and plate leads to top caps keep series inductance of leads at a minimum. Close electrode spacings reduce transit time losses, and interelectrode capacitances are minimized through the use of small elements.

Since the introduction of the HY615 two years ago, Hytron U-H-F tubes have been the first choice of amateurs and engineers. Their greater efficiency means lower power drain, less expensive modulators and power supplies for the same power output as other larger tubes.

Actual Size

HY114 $2.00

WORLD'S RECORD ON 1¼ METERS held by W1COO, and W1AJJ using HY75 modulated by HY31Z (as of Sept. 8, 1940.)



Actual Size

HY615 $2.00

HY75 $3.75

INSTANT-HEATING TWIN TRIODE and R. F. BEAM POWER TETRODE

Designed especially for use in mobile and emergency-service transmitters where dependability, high efficiency and minimum power drain are paramount.

Instant-heating thoriated-tungsten filaments eliminate battery drain during standby. HY69 has 40-watt plate dissipation compared with 25-watts for equivalent HY61/807 cathode type—allows full plate input when plate modulated

These tubes perform efficiently when power-line operated—and are recommended for same. HY69 and HY31Z have 6-volt filaments—12-volt series on special order and at slight increase in price.

HY69
R. F. beam
$3.50

HY31Z
modulator
$3.50

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Microphones
for Efficiency and Dependability

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

Model 22X Crystal with Tilting Head

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

Model 22D Dynamic

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

Add $1.50 for 25 foot cable set.

Model 33D Dynamic

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

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

Deduct $1.50 for 8 foot Cable Set.

Model 33X Crystal

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

Deduct $1.50 for 8 foot Cable Set.

Model 44X Crystal Selective Directional

Now you can *choose* the sound you want amplify. Model 44X has 13-15DB differe tial between front and rear pickup, microphone can be considered dead at t back. Eliminates audience noise and bac ground disturbances. Reduces feedback ar reflections. Allows operation in accousti ally bad spots. Ninety-degree adjustab tilting head allows non-directional picku Unusually high level -58DB when use with standard 25 foot cable. Lines up to feet may be used with no frequency di crimination and a minimum loss of leve Range, 30-10,000, cycles. Finished in sati chrome, fits any 5/8-27 stand. Moistur proof crystal, automatic barometric com pensation, blast proof, mechanical-shoc proof.

Complete with 25 foot changeable cable set.....*List* **$27.5**

Model VT-73 Microphone Stand and Cable

Double your powe with VT-73, built e pecially for voice trans mission. Speech fre quencies emphasized b creating a rising curva ture of response be tween 500 and 4,00 cycles. Crisp, clear sig nals, even throug QRM. Combinatio microphone, handl and stand, weighs 2 ounces. Anti-resonan cable. Climatically sealed. Fully RF shield ed. Won't blast fron close speaking. Hig output -50DB. Finishe in telephone black and chrome.....*List* **$18.0**

Model 99 Dynamic

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

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

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

Write for Catalog AH Describing Complete Turner Line

The Turner Company

CEDAR RAPIDS, IOWA, U.S.A.

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