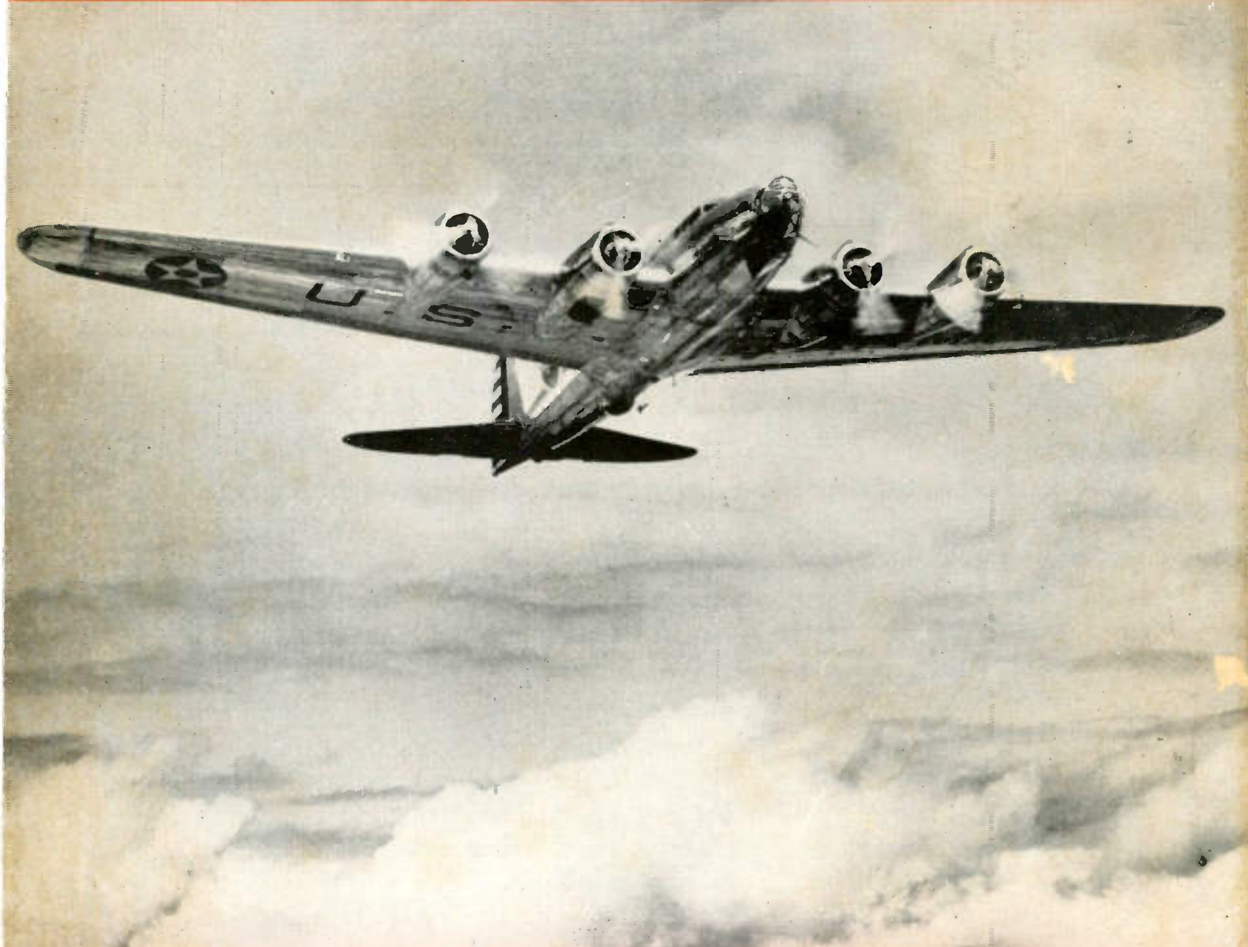
AMATEUR RADIO DEFENSE



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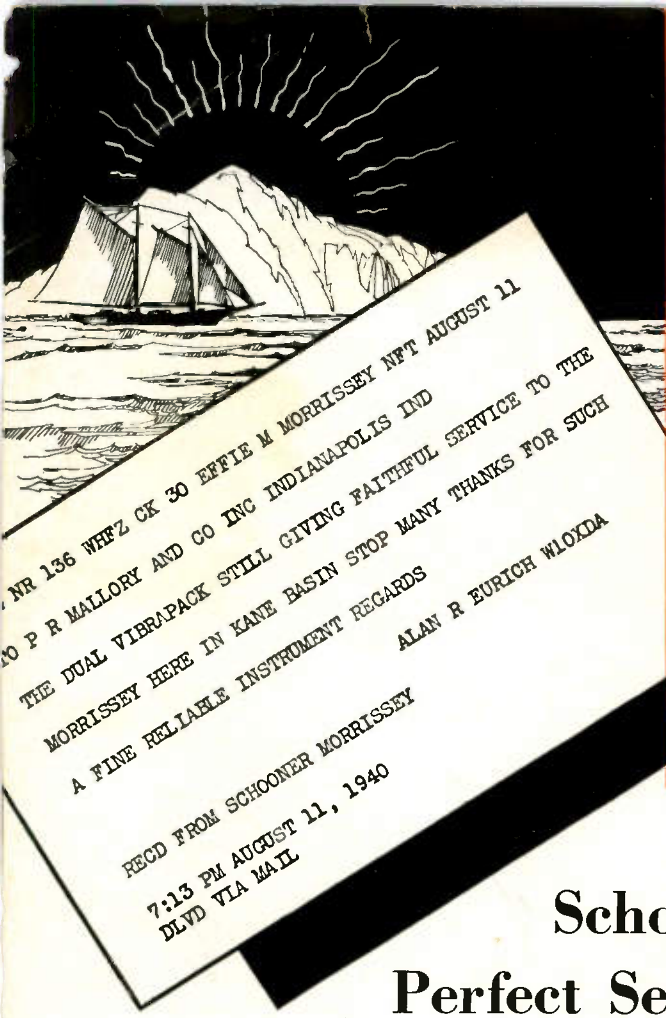

Vibrapack

(TRADE MARK REG. U. S. PAT. OFFICE)

Gives the Schooner MORRISSEY Perfect Service in the Arctic

The Schooner Morrissey, commanded by Captain Bartlett was almost in the shadow of the Pole when this tribute to Vibrapack was relayed.

Surely no power supply could be subjected to more rigid service. Yet in spite of ice and extreme cold, Vibrapack has unfailingly provided 100% daily service.

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VIBRATORS • VIBRAPACKS • CONDENSERS • VOLUME CONTROLS • ROTARY SWITCHES • SINGLE AND MULTIPLE PUSH BUTTON SWITCHES • RESISTORS • RADIO HARDWARE

the Cruise of an SX-28

Recently we received a letter from an owner praising the performance of an SX-28. The letter, five pages long, is too lengthy to re-print in its entirety so we are re-printing the paragraphs most interesting to communications performance.

"This letter will deal with the voyage from San Francisco to the Philippines, then to the Far East namely Shanghai and Hong Kong and back to the Philippines then down through the inside passage from the Philippines down through the islands past Thursday Island then down the Australian coast inside the Great Barrier Reef to Newcastle. From Newcastle to Brisbane then almost due east across the Pacific until we approached Pitcairn Island when we turned to about northeast and headed for the Canal, then from the Canal to New York with coast-wise ports enroute. Roughly, the total mileage for this trip was about 32,000 and involved a period of about six months.

". . . for about 3 months the ship was in tropical weather, the radio room was very hot, all port holes and doors were open almost continuously day and night. The Hallicrafter SX-28 was exposed to the elements almost as if it were outside, much of the high tropical humidity penetrated the room where the SX-28 was operating.

"We traveled through tropical heat of 120° into the cold slashing gales of the China Sea and remained in extreme cold weather, then back down to the tropical heat again . . . most receivers are prone to develop all kinds of troubles in these varying climates . . . I was busy, at times, repairing other sets breaking down due to the humidity, but the SX-28 went merrily along its receptive way.

". . . the SX-28 was almost continuously subject to vibration, one kind of vibration at one depth of load, another at another depth—increasing until the whole ship vibrates when the load was light. At times when receiving short wave the SX-28 was vibrating so that it was actually jiggling back and forth in short, quick jerks as the whole ship vibrated, yet no effect was noticeable on reception . . . I had all kinds of trouble with my regular equipment, yet the SX-28 ran the gauntlet unharmed and unaffected.

". . . my listeners of whom I had a regular public at news times have remarked 'the program would fade out and sparks would flip a switch and back in it would come with a bang' . . . the pay-off though is the code reception. With signals weak, static at Woolworth bargain counter proportions of jamming, and code signal interference the ANL circuit jumped into effect in an astounding way. . . . one remarkable comparison was XSG Shanghai who comes in with a bang all over a wide space on the dial on the 36 meter band. He was right on top of WCC and would blot him out. A twist of ANL and in comes XSG, a flick of the crystal control and in comes WCC with a bang and out goes XSG. . . . In Shanghai I was offered $350 in gold for my SX-28.

"I have opened receivers for repair of standard brands and found variable condensers covered with green whiskers from corrosion, coils broken in windings from salt corrosion, bus wires even eaten off inside insulation due to the same corrosion . . . so all in all I think it a high tribute to the Hallicrafter workmanship in this receiver that it has survived a period of two trips now and is still going strong."

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JUNE-JULY, 1941

★ ★ ★

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A.R.D.

AMATEUR RADIO DEFENSE

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

★

CONTENTS FOR JUNE - JULY

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Chats with the Editors

. . . Closer collaboration between members of Amateur Radio Defense Association and the various agencies of local, state and national government necessitates increased secrecy insofar as the magazine-reading public is concerned. Instructions in mimeographed form will be mailed hereafter to all active members of our Association, and no news of a confidential nature will be printed in these pages. This magazine is a propaganda organ, designed to influence the capable men of amateur radio to join A.R.D.A. By no other means would it be possible to carry our message of defense to the amateurs of the nation. The more magazines we sell the more amateurs we acquaint with our purpose. The technical standard of this publication is high; more and more people are buying it every month . . . more and more crack operators are enrolling in our Association. Consequently this little magazine is literally the "bait" to catch as many good members as possible. Each copy sold represents a net financial loss to the publishers, for it costs more to produce the magazine than the price at which it is sold. This loss is then equalized by advertising revenue from a few radio manufacturers who have seen fit to support our defense campaign. Thus A.R.D. is America's first and *only* non-profit amateur radio publishing venture, in the true sense of the word. Those who dispute these unimpeachable facts are profit-seekers or job-holders, rather than defense-minded Americans. Because no venture of this nature had been previously attempted in amateur radio, it is difficult for many to "get the point." But we "got the point"—a long, sharp dagger pointed straight at the hearts of Americans from across the Atlantic. So today we are signing-up thousands of skilled men who have signified a desire to answer the call to service in their home stations, ready to pound brass or bark orders into a microphone when the time is opportune. It's not what these men are doing today that counts—it's what they *can* and *will* do tomorrow, without long months of training under trying conditions. The simple fact that we already have a great army of skilled radio amateurs standing-by for Uncle Sam is in itself a preparedness measure of the first order. A.R.D.A. men are not jamming the air with superfluous trash—but if and when the call to arms is sent out you'll hear more about our Association in one day than you could hear normally in a year of relative inactivity. In the meantime you'd be astounded to know how many new transmitters these A.R.D.A. men are building now. The reason why this new gear is under construction is to make certain that we can engage in the kind of emergency service required of us when we go into action. A few dozen serious-minded, competent A.R.D.A. members in each locality can do a thousand times more for Uncle Sam than all of the lesser experienced hams combined. In fact, the untrained men of amateur radio can actually work a serious hardship upon those of proved ability. And you really can't train a man to be a good amateur in the mad excitement of a national emergency. WE OF A.R.D.A. ARE ALREADY PREPARED!

* * *

. . . Chairman Fly of the F.C.C. has this to say in regard to governmental ownership of broadcasting stations:

The United States has rejected governmental ownership of broadcasting stations, believing that the power inherent in control over broadcasting is too great and too dangerous to the maintenance of free institutions to permit its exercise by one body, even though elected by or responsible to the whole people. But in avoiding the concentration of power over radio broadcasting in the hands of government, we must not fall into an even more dangerous pitfall: the concentration of that power in the hands of self-perpetuating management groups.

* * *

. . . Although it is not the purpose of this magazine to discourage the beginner in amateur radio, it is as plain as A B C that an older man with a good job is an infinitely better prospect for the radio jobber than a host of newcomers who haven't yet earned their first sou. The circulation of this magazine is the smallest of any in the amateur radio field, yet each of our older readers is a sure bet to be a better prospect for amateur gear than dozens of youngsters combined. The proof is in a letter just received from one of our advertisers, Mr. Wayne Miller, who publishes a book on how to pass the commercial radio operator license examinations. He tells us that his advertisements in this magazine resulted in more sales than all of his other amateur radio magazine advertising combined. After watching our progress for six months, Mr. T. R. McElroy of Boston concluded that our magazine reaches men with buying power—men actually spending money today—and so he placed the largest single advertisement yet awarded us since publication began. Ted McElroy is a real old-timer, and the world's fastest radio telegrapher. His endorsement of our policy is a tribute of the first order. Additional faith in our campaign is evidenced by the P. R. Mallory & Co., Inc., of Indianapolis, makers of the *Vibrapack* and a long list of essential parts for amateur installations. This far-sighted manufacturer has placed in our hands a complete set of two-color advertising plates, two pages each month, for an entire year in advance.

It has been a mighty difficult venture to get this little magazine into its present stride. It came into the field at a time when the radio sky looked blacker than black, and it has been harder for us to sell advertising than to peddle the proverbial snowballs in hell. Our campaign to help keep the amateur on the air by proving his value to our Government has been successful only because a group of old-timers in the radio manufacturing industry hold to our belief that an all-out effort is mandatory in order to keep the entire amateur field from collapsing like a house of cards. Each new advertiser means a bigger and better magazine — and more copies to place into the hands of those best able to serve in their home stations when the crucial hour strikes. We are indebted to Bliley, Eimac, Hallicrafters, P. R. Mallory & Co., Inc., Hytron Corporation, Technical Radio, Inc., Wayne Miller, Meissner Mfg. Co., and T. R. McElroy for the support which made possible this enlarged issue of *Amateur Radio Defense*. Woefully lacking has been the help from others prominent in the amateur field, particularly the great Radio Corporation of America's tube division, whose custodian of the advertising budget has steadfastly refused to appropriate a single penny in cash for advertising RCA tubes to A.R.D.A. members, while all other amateur radio magazines receive a substantial volume of RCA business.

Some manufacturers fear the loss of editorial cooperation from other magazine publishers if they divert part of their advertising fund to this magazine. And some have gone so far as to state that our campaign to strengthen the radio defense of the nation is a "racket." Still others told us we had absolutely no "right" to come into the amateur magazine field. Little do they realize that we are amateur pioneers—that we published magazines for the amateur 'way back in 1917, even before our nation entered the first World War. A smear campaign is now making the rounds, and it goes like this: *"Weren't you, too, surprised to see another issue of A.R.D. in circulation?"* Or: *"We'll give 'em just one month more."* Worse yet, a bitter complaint came from a reader who tried to purchase this magazine from a certain radio store. The dealer had no copies on hand. The clerk told the customer we had discontinued publication. We told the customer the dealer did not pay his bills—and for this reason he was taken off our list. Then we complained to the dealer. He sent us a check, and told us he had discontinued stocking our magazine because there was no demand for it. So we wrote again, and asked him *"How come you finally sent us a check for all those A.R.D. magazines you sold when there was no demand for copies?"* HI!

We relate these incidents merely to let you in on a few secrets of this so-called ethical business of amateur radio magazine publishing. Trying to advance the cause of amateur radio, at a time when help is needed most, has been one of the toughest assignments of our lives. There would be no A.R.D. magazine in circulation today if we had to pay as little as $1.00 a year to a staff member. We spend for production only as much as we take in. The little magazine you hold in your hands will continue to be a welcomed visitor in your shack, its size and frequency of publication dependent solely upon the wee drops of financial cheer from a scant dozen unselfish and patriotic manufacturers short on the profit motive but long on recognition and appreciation of what the amateur has done for them.

* * *

. . . From *"The Arc"* we learn that W4ECW is the tallest man in the U. S. Navy—6 ft. 8-in.—and still growing! He eats more than any other gob, and the U. S. S. *"Broome"* uses W4ECW's extra rations as ballast.

* * *

NEWS from WASHINGTON

Municipality Offers Emergency Equipment to Amateurs

THE defense committee of a certain Massachusetts municipality contemplates the purchase, with town funds, of radio apparatus which is intended to be given or loaned to local amateurs for use in emergencies. The committee wants to know whether such service is compatible with Federal Communications Commission rules pertaining to amateurs. The Commission makes reply:

"It appears that ownership of the equipment would remain in the . . . Defense Committee and that the procedure outlined in your letter is contemplated to circumvent the prohibition in Section 12.62 of the Amateur Rules against issuance of amateur licenses to corporations or associations. From the information submitted it does not appear that acceptance of the radio equipment by local amateurs would constitute remuneration for their service in emergencies within the contemplation of Section 12.102 of the Amateur Rules. Attention is called, however, to the fact that it would be necessary for the amateur or amateurs operating this equipment to be in complete control thereof. In order that control may be vested in such operators, it is suggested that the equipment be leased to the amateurs at a nominal sum for a definite period of time, such as one year. Such lease agreements should contain, among others, a statement to the effect that sixty days' notice will be given to this Commission in the event of their termination, and copies thereof should be submitted with applications for station licenses. Operation of such apparatus must, of course, be carried on strictly in accordance with the Commission's Rules Governing Amateur Service.

"It is believed that police radio or special emergency radio stations licensed in the Town of.........................in its own name would possibly be of more benefit to the town in cases of emergency that would amateur stations furnished to individuals or organizations, as no control could be maintained by the town of the apparatus thus operated."

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

. . . Several letters addressed to the Commission object to a particular language not being among those recognized for use in telegraph messages. This is not due to any action by the Commission; it arises out of precedent of long standing in international telegraph practices. No "discrimination" is intended. The carriers long ago found it impossible to handle all languages, and agred to use the chief ones, eliminating in particular those with characters which cannot be transmitted on the machines in regular use for telegraphic purposes.

. . . A Missourian is informed that the Commission has no jurisdiction over the collection of damage claims or rental for use of right-of-way by telephone companies. He is referred to the local courts for possible action.

. . . **A Wisconsin sheriff is advised that interception and use of police radio communications by a private garage for the purpose of getting towing and repair jobs on wrecked autos is a violation of Section 605 of the Communications Act.**

. . . A New York firm writes the Commission about its differences with a broadcast station resulting from a sponsored program. The Commission has no say with respect to the rates charged for broadcast time, hence it can not litigate difficulties between program sponsors and station licensees arising through the use of commercial time.

. . . Because it functions largely as a licensing authority, the Commission cannot entertain an Idaho suggestion that radio sponsors who offer prizes be heavily taxed, or grant the appeal of a Texan organizing "prayer

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NEWS FROM WASHINGTON

(Continued from page 8)

bands" that national networks broadcast his program, or meet a Pennsylvania listener's urge that important national programs be presented over the facilities of a single major network.

. . . A North Carolina fan who is interested in daylight saving time for broadcast stations generally is informed that this is not in the province of the Commission, but is being considered by the broadcasters as a group. The National Association of Broadcasters is on record as favoring universal daylight saving to eliminate the present time confusion.

. . . Broadcasts of baseball games may be rebroadcast by high frequency experimental stations, an inquirer is told, subject to provisions of Section 4.113 of the Commission's rules which prohibits charge, directly or indirectly, for such rebroadcasts, and further stipulation about identifying the originating station or stations.

. . . "There is no rule or requirement of the Commission that individual applicants before it be represented by an attorney," a resident is advised, "and it is not possible or appropriate for the Commission to advise you whether or not you should employ counsel."

. . . Many inquiries have been received as to opportunities for employment with the Commission. It is pointed out that this agency is required to obtain new personnel and to fill vacancies from registers of the United States Civil Service.

* * *

AMATEUR LICENSES REVOKED

W8JOO Frank C. Shaw, Jr., Caledonia, N. Y. . . . Adopted orders suspending amateur radio operator license with Class B privileges, for the remainder of the license period ending January 30, 1942, and revoking amateur radio station license, because licensee has refused and failed to file with the Commission his response to questionnaire (Form 735) to establish his U. S. citizenship.

* * *

W9LMY Paul A. Dressen, Mitchell, So. Dak. . . . Adopted orders suspending amateur radio operator license with Class C privileges, for the remainder of the license term expiring July 23, 1943, and revoking amateur radio station license for station W9LMY, because licensee while engaged in the operation of his station, communicated by radio with station HR1AT, located in a foreign country, and failed to keep a proper log all in violation of the Commission's rules.

"Heil Hitler" Radio Station Seized

SEARCH by the National Defense Operations Section of the Federal Communications Commission for unauthorized radio transmission which trespassed on Government frequencies and purported to be in the service of "foreign agents" culminated in the arrest at Peoria, Illinois, of Charles W. Johnson, who identified himself as a senior student in electrical engineering at a certain mid-western institute. Johnson's home revealed illegal equipment, which was seized by a United States Marshall, and Johnson was charged with violating Sections 301 and 318 of the Communications Act.

The monitoring stations in the Commission's national deefnse operations were originally enlisted to trace signals from an unlicensed radio station, the operator of which called himself "Fritz" and frequently concluded his transmissions with "Heil, Hitler." No identifying call letters were used.

Listening-in procedure revealed this operator to have more than average knowledge of certain codes and ciphers. In fact, he claimed on the air to be a cryptographer for a signal unit in a German army of occupation. His general procedure was to broadcast that he was a foreign agent and to attempt to engage in communications between United States Government stations. In so doing, he declared that he was relaying information from foreign agents. On one occasion he implied that Government channels would be "jammed" by high-powered radio stations being constructed for that purpose. At another time he sent out a message in cipher which, when decoded, proved to be in German and related to certain foreign troop movements. In his transmissions "Fritz" made effort to obtain military information.

The following excerpts are typical of "Fritz's" communications:

"Staff plans are now coming in, but they are very detailed and long. Too much trouble to re-encipher again.

"Tell your cryptographer that this is a columnar position (Fritz proceeded to transmit the cipher message).

"I am a cryptographer. You must give me some information in exchange for this stuff. Give me the location of (gave several U. S. Government station calls.)

"This station is now in hands of enemy. Your insolence will not be tolerated by German troops. This station now in control of German Signal Corps.

"Name here is Hans VonKeitel, Heil Hitler.

"I want your codes and ciphers. Give

(Continued on page 64)

The Editor's CQ

HOW'S YOUR FIST?

AS THE *tempo* of the preparation for defense is being increased toward a *presto,* there are now strong indications that the martial music may soon approach a *fortissimo* of preparation for offense, judging from the President's proclamation of an unlimited national emergency. The question as to what may happen to amateur radio stations and operators in the event of the Battle of America is, consequently, becoming much more acute than when it was previously discussed in these columns. As no official statement has yet been issued, an answer to this question can be predicated upon no more substantial basis than that of the reasonable probabilities.

It thus seems reasonable to assume that there would be some stronger form of Federal control than now exists. It also seems likely that unnecessary communications would not be allowed to interfere with essential messages on all wave-bands. Idle amusements, such as "chewing the fat," would be eschewed. Their prevention might require a ban on any unsupervised operation, or at least a withdrawal of transmitting privileges from any insurgent who is reported by his law-abiding fellows.

This would not necessarily mean a complete black-out and lock-up of all amateur stations, many of which are so well-equipped as to constitute an invaluable auxiliary to established commercial facilities. Even if their owners are drafted for active service, they could be operated by other men in an emergency, provided that those men are thoroughly competent.

The need for this proviso is indicated by the fact that an army officer recently visited the station of a Minnesota amateur, solely to tell him that he had the only good fist in the vicinity. The officer had been appalled by the erratic keys of other code-practice transmitters. Few of the "teachers" could have copied their own stuff if they had been at the receving end. This was particularly the case on the 160-meter band, which is used for c.w. code in some parts of the country.

A hand telegrapher acquires a good fist only by years of practice. The hardest part of the practice is to get even spacing, comparable to that of machine sending. A hash instruction begets slipshod pupils whose messages are almost as difficult to unscramble as is an omelet. Some of the present courses in mind-reading should be deferred until telepathy ousts telegraphy as a reliable means of communication!

The foregoing leads up to the question as to what should be done with the good operators, which is of as great importance as what will happen to the good stations, in the event of war. The probability is that the precedent established by World War Won will be followed in World War 2-B-1-2, insofar as radio operators are concerned.

Prior to 1917, scores of young amateurs had also qualified for commercial licenses, but had not used them because the supply was greater than the demand, even in those noisy ox-wagon days of wireless when the thunder-crash from a spark-gap could be heard almost as far as its ether-borne signal. These licenses were then easier to get than is an amateur license today, inasmuch as the examinations were much less intricate. Furthermore, any lack of practical experience could then be supplied in weeks, whereas it now takes years to gain a corresponding proficiency in radio.

The holders of these "top" tickets were called into the army, navy and reserve services, where they manned shore, ship and commercial stations, which were taken over by the government. At some of the latter, eight or more men were often assigned to do the work normally done by two regular operators. The strain of the war work was such as to demand fewer hours per day and fewer days per week per man. The pay was often twice that paid to the former commercial operators. The training and experience were valuable and the loss of life was negligible.

These old-timers now constitute the backbone of A.R.D.A. They have kept in good practice, they are able and ready to serve when and where needed, and they are not subject to the draft. These past-masters of the key, and others who have acquired a

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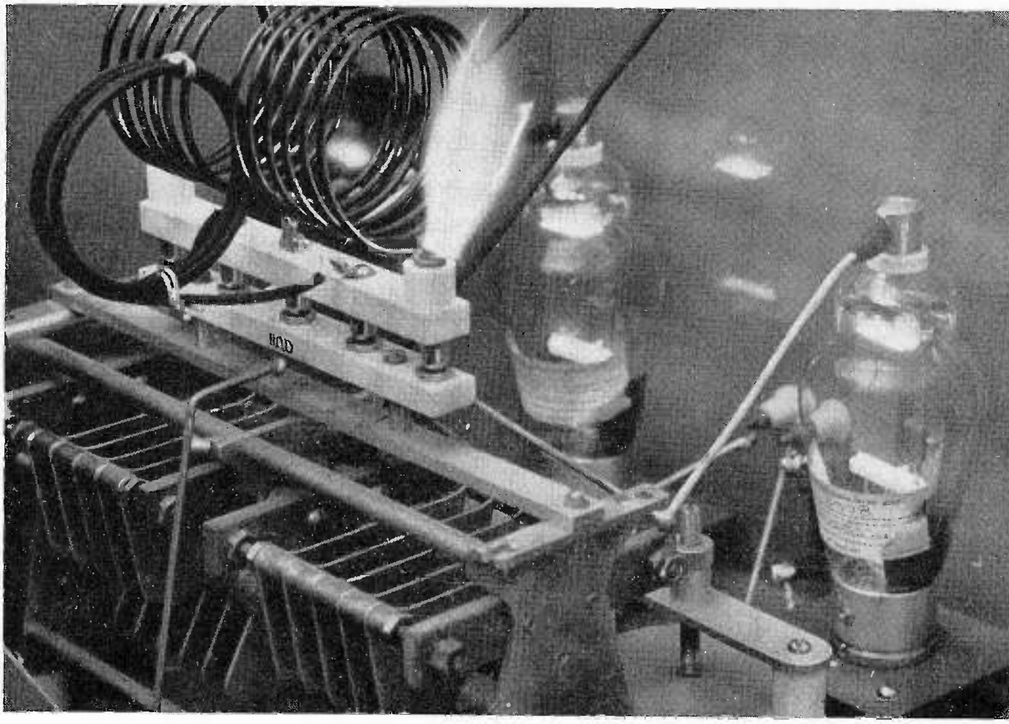

●FIREWORKS! This is a time exposure taken by our staff photographer, N. R. Farbman, W6SEM, from the light furnished by the r-f arc drawn from a pair of the new RCA-8005s in a push-pull modulated r-f amplifier.

A New Triode -- The RCA-8005 No Larger Than The 809-812 1500 Volts, 200 Mills=300 Watts Per Tube

Again Amatur Radio Defense is first with the news of a new tube—the RCA-8005 Triode. Its departure from the conventional is noteworthy. Only tentative data is available as we go to press, but experiments conducted by members of our staff prove the tube to be of unusual interest to the amateur and commercial radio designer.

★

AS this issue of A.R.D. was being made ready for press we received a letter from Mr. E. E. Spitzer of the Research and Engineering Department of RCA Manufacturing Co., Inc., telling us about the new RCA-8005 triode. Then followed a shipment of experimental tubes, with the customary "white label" reading as follows: *"This development tube* (8005) *is for laboratory and experimental purposes only, and is subject to return upon request. It is the property of the RCA Radiotron Division, RCA Manufacturing Co., Inc., Harrison, New Jersey."* These "development tubes" are sent to radio mazagine publishers, to engineers in radio plants where commercial equipment is designed, and to other persons who contribute information of timely and useful value to the manufacturer of the tube. If "bugs" are found in the tube, the manufacturer makes the necessary changes before the item is placed on the market for general sale to the public. Our development tubes were numbered 82 and 95, indicating that more than 100 tubes have already been placed into the hands of engineers competent to tell the manufacturer the things he wants to know about his new product.

The RCA-8005 is the kind of a tube we suggested to some of our friends in the tube manufacturing field as far back as October, 1939. It is of the same physical size as the 809 and 812, but due to a number of design features it is capable of considerably higher output than even such tubes as the 203A. The bulb is made of hard glass to stand the higher power dissipation. A metal shell ceramic insert base is used for the same reason. The plate cap is provided with a ceramic insulator to reduce voltage stress on the bulb. The plate consists of zirconium on molybdenum. This combination stands much higher temperatures than the zirconium on nickel used in the 812 and allows a big increase in dissipation rating without any increase in size. This anode is a very effective getter and also an efficient radiator. A 32.5 watt thoriated filament is used in the 8005, and the filiment operates with 10 volts at 3.25 amp. As a result of these features the tube has exceptional ability to take rough treatment. It will find wide application in all types of service, including diathermy applications.

For service as r-f power amplifier and oscillator, Class-C telegraphy, key-down conditions per tube without modulation, the d.c. plate potential is 1,500 volts max. and the d.c. plate current is 200 ma., max. The d.c. grid current is 45 ma., max., and the plate input is 300 watts. Plate dissipation is 85 watts, max., and for typical operation a single RCA-8005 will deliver 220 watts, approximately, with 7.5 watts of driving power.

Under actual operating conditions in a plate-modulated amplifier in the 20-meter amateur 'phone band the tube was found to give excellent performance, with all ratings held to the prescribed limits. A pair of these tubes was driven by an RCA-812, running lightly, and it is reasonable to assume that an 809 will deliver more than ample output to drive a pair of the 8005s for radiotelephone service.

Time did not permit tests in cathode-modulated amplifiers, but complete information will appear in the pages of our next issue. The technical staff feels that the tube will give a mighty good accounting of itself in the system of cathode modulation developed by our Frank C. Jones.

Tentative characteristics and supplementary data on the RCA-8005, as supplied to us by the manufacturer, follow here:

8005 Characteristics

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS—RCA-8005 TRIODE

Amplification Factor	20
Direct Interelectrode Capacitances	
Gride to Plate	5.0 μμf
Grid to Filament	6.4 μμf
Plate to Filament	1.0 μμf

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS
As A. F. Power Amplifier and Modulator—Class B

	CCS	IC & AS
DC Plate Voltage	1250	1500 appx. watts
Maximum Signal DC Plate Current φ	200	200 max. ma.
Maximum Signal Plate Input φ	225	250 max. watts
Plate Dissipation	75	85 max. watts
Typical Operation		
Unless otherwise specified, values are for 2 tubes		
DC Plate Voltage	1250	1500 volts
DC Grid Voltage #	–55	–70 volts
Peak A. F. Grid to Grid Voltage	290	310 volts
Zero-Signal DC Plate Current	40	40 ma.
Maximum Signal DC Plate Current	320	310 ma.
Load Resistance (per tube)	2000	2500 ohms
Effective Load Resistance (plate to plate)	8000	10000 ohms
Maximum Signal Driving Power	4	4 appx. watts
Maximum Signal Power Output	250	300 appx. watts

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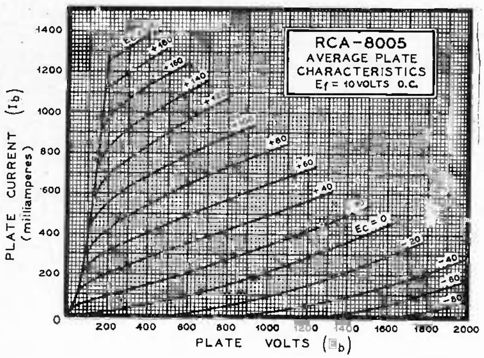
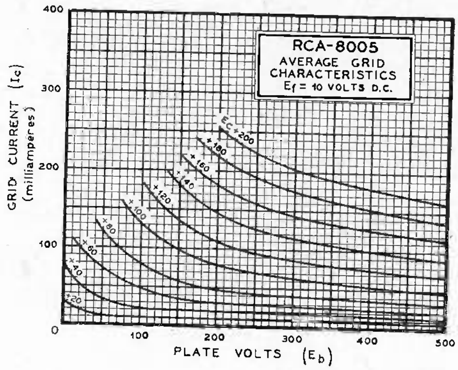




As R.F. Power Amplifier—Class B Telephony

Carrier conditions per tube for use with a maximum modulation factor of 1.0

	CCS	IC & AS
DC Plate Voltage	1250	1500 max. volts
DC Plate Current	100	100 max. ma.
Plate Input	110	125 max. watts
Plate Dissipation	75	85 max. watts
Typical Operation:		
DC Plate Voltage	1250	1500 volts
DC Grid Voltage #	−65	−80 volts
Peak R.F. Grid Voltage	85	90 volts
DC Plate Current	85	83 ma.
DC Grid Current ◇	2	1 appx. ma.
Driving Power ◇ o	5.5	5 appx. watts
Power Output	40	45 appx. watts

As Plate Modulated R.F. Power Amplifier—Class C Telephony

Carrier conditions per tube for use with a maximum modulation factor of 1.0

	CCS	IC & AS
DC Plate Voltage	1000	1250 max. volts
DC Grid Voltage	−200	−200 max. volts
DC Plate Current	160	200 max. ma.
DC Grid Current	45	45 max. ma.
Plate Input	160	240 max. watts
Plate Dissipation	50	75 max. watts
Typical Operation:		
DC Plate Voltage	1000	1250 volts
DC Grid Voltage ##		
From a fixed supply of	−195	−195 volts
From a grid resistor of	7000	7000 ohms
Peak R.F. Grid Voltage	350	350 volts
DC Plate Current	160	190 ma.
DC Grid Current ◇	28	28 appx. ma.
Driving Power ◇	9	9 appx. watts
Power Output	115	170 appx. watts

As R.F. Power Amplifier and Oscillator—Class C Telegraphy

Key-down conditions per tube with modulation oo

	CCS	IC & AS
DC Plate Voltage	1250	1500 max. volts
DC Grid Voltage	−200	−200 max. volts
DC Plate Current	200	200 max. ma.
DC Grid Current	45	45 max. ma.
Plate Input	240	300 max. watts
Plate Dissipation	75	85 max. watts
Typical Operation:		
DC Plate Voltage	1250	1500 volts
DC Grid Voltage		
From a fixed supply of	−115	−130 volts
From a grid resistor of	3800	4000 ohms
From a cathode resistor of	520	560 ohms
Peak R.F. Grid Voltage	240	255 volts
DC Plate Current	190	200 ma.
DC Grid Current ◇	30	32 appx. ma.
Driving Power ◇	6.5	7.5 appx. watts
Power Output	170	220 appx. watts

As Self-Rectifying Oscillator—Class C

	CCS	IC & AS
AC Plate Voltage (RMS)	1750	max. volts
DC Grid Voltage	–125	max. volts
DC Plate Current	125	max. ma.
DC Grid Current	25	max. ma.
Plate Input	240	max. watts
Plate Dissipation	75	max. watts
Typical Operation in Push-Pull circuit at 50 Mc.		
(Unless otherwise specified, values are for two tubes)		
AC Plate Voltage (RMS)	1750	volts
DC Plate Current	250	ma.
DC Grid Current	*35	ma.
Grid Resistor	2000	ohms
Tube Power Output	330	appx. watts
Useful Power Output (75% circuit efficiency)	250	appx. watts

NOTES:
- ϕ Averaged over any audio-frequency cycle of sine-wave form.
- ◇ Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate circuit efficiency is sacrificed. The driving stage should have a tank circuit of good regulation and should be capable of delivering considerably more than the required driving power.
- o At crest of audio cycle with modulation factor of 1.0.
- oo Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.
- # Grid voltages are given with respect to the mid-point of filament operated on a.c. If d.c. is used, each stated value of grid voltage should be decreased by one-half the filament voltage and the circuit returns made to the negative end of the filament.
- ## Obtained preferably from grid leak of value shown, or combination of grid leak with either fixed supply or suitably by-passed cathode resistor.

HIGH FREQUENCY RATINGS

Maximum permissible percentage of maximum rated plate voltage and plate input

Frequency Mc.		60	80	100
	Class B	100	90	83
Telephony	Class C Grid Mod.	100	90	83
	Class C Plate Mod.	100	75	60
Telegraphy	Class C	100	75	60
Self-Rectifying Oscillator		100	75	60

Published Curves:
Plate Voltage Plate Current Characteristic LP 1097
Plate Voltage Grid Current Characteristic LP 1098

BASING

RCA Pin:	1	2	3	4	cap
Element	G		F	F	P

W4MBR REPORTS

. . . Who has not read in news reports of the recent fire in the Communications Building at the Norfolk Navy Base? Well, here are some excerpts from a letter to the Editor of "*The ARC*" from W4BMR who was in the midst of all the action during the fire:

"Dear Doc,

I had a long letter written and ready to post but it went up in smoke with the big fire we had the other morning. I had come off watch at 8 a. m. and was trying to sleep when I smelled smoke. I jumped up and saw smoke curling up from an empty bed across the room. Pulling the bed away from the wall, I found that the floor underneath was afire. There were eighteen of us in the room and we ran to the locker room. After I gave the alarm, we poured soda foam over the fire and thought that we had extinguished it.

The entire place was full of smoke when the fire department arrived and my crew ran to the opposite end of the building where the radio equipment was kept; we saved as much of it as we could. In half an hour or less the entire building was in flames. All of my own that I saved was the clothes I had on and if my shoes had had spikes I would have been mistaken for a runner at a track meet.

Of course, there will be no replacement of our personal effects by the Navy, except uniforms. Meanwhile I'm in a barrel until I get another uniform.

No one knows the origin of the fire; the concensus of opinion points to bare wires caused by rats gnawing off the insulation. The building was an old one, built for the Jamestown exposition 1906.

I'm still handling the Navy 355 and 500 commercial circuit. The 355 circuit controls the Atlantic Fleet; the 500 is for C-O-S and messages from commercial ships.

Heard an S-O-S just the other day and spent about three hours directing help to a freighter that had blown a boiler and had a hole in the port side."

Morgan Heath, D. C. O.,

A Frequency Standard for the Amateur

- - Costs Only $15.00 Complete

★

This instrument provides a series of standard frequencies for calibrating a receiver or checking the frequency of an incoming signal. It is crystal-controlled, and has an adjustment for bringing the crystal frequency to exactly 100-Kc. Its cost is low and it is easy to build. It requires no transformer and occupies but little space.

★

By Frank C. Jones, Technical Editor

HOW often have you wanted to know the frequency of a received or transmitted signal in any portion of the short-wave or broadcast spectrum, and in the event of an emergency will you be able to monitor your signals and those of illegal transmitters It is becoming increasingly necessary to have a frequency standard on hand in order to definitely spot the frequency of an unknown signal, because the future need for such an instrument may be greater than at any time in the past.

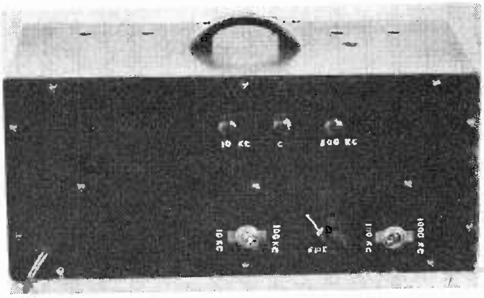
The frequency standard here described consists of a stable 100-Kc. crystal oscillator which connects to a 10-Kc. mutivibrator and amplifier. With the aid of a *Bliley* SMC-100 crystal it is possible to obtain output at approximately every 1,000-Kc. for rough checking, and also the exact frequencies, which are harmonics of 100-Kc. These 100-Kc. harmonics can be picked up on a sensitive radio receiver on the 100-Kc. harmonic points as high as 30-Mc; the harmonics appear exactly 100-Kc. apart. A multivibrator with a twin-triode tube delivers additional frequencies every 10-Kc.

The multivibrator is a resistance-capacitive type of oscillator which locks into step with the 100-Kc. oscillator as a controlling element. The multivibrator divides the 100-Kc. frequency into ten equal parts, and the output of the multivibrator can be amplified to make these 10-Kc. points available as test signals in a short-wave receiver.

A transformerless power supply not only conserves space but reduces the overall cost of the unit. The proper choice of tubes permits the series connection of all four tubes across the 115-volt line without need of a line resistor. The tubes require only 150-ma. of heater current.

The form of crystal oscillator adopted for the circuit is similar to that used in a high-precision type of frequency standard in which the crystal oscillates at 100-Kc. It consists of a modified form of *Colpitts* oscillator, shown in the supplementary circuit diagram, in which the frequency of the crystal can be easily shifted 200 or 300 cycles by means of a variable or semi-variable condenser. The r-f choke which is connected in series with the crystal acts as a high inductance and is an essential requirement for bringing the crystal into the desired tuning range, i.e., within a few cycles of 100-Kc. In the oscillator illustrated in the photographs a standard lattice-wound 30-mh. r-f choke was found to give the inductance needed to permit oscillation at exactly 100-Kc. Variations in crystals might require either higher or lower values of inductance in series with the crystal; for example, it may be necessary to use a 10-mh. choke in series with some particular crystals. The adjustable condenser brings the oscillator to exact zero-beat as heard at 5-Mc. in a radio receiver tuned to the *Bureau of Standards* station *WWV*. For most measurements this condenser will retain its setting for long periods of time, once properly adjusted.

The crystal can be made to oscillate at very close to 1000-Kc. by changing the oscillator

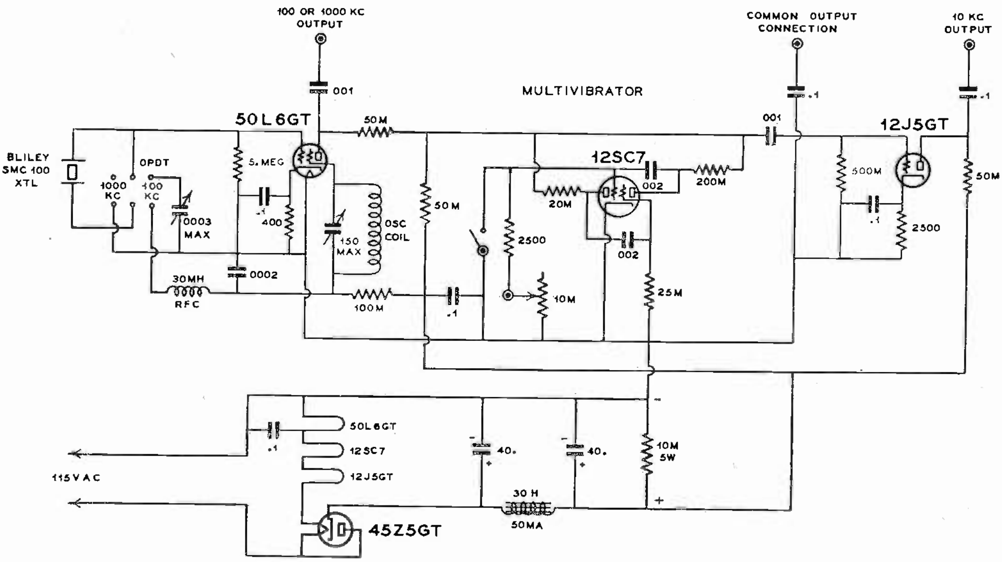


Front view of the Frequency Standard, showing switches for 1,000-, 100-, or 10-Kc. operation.

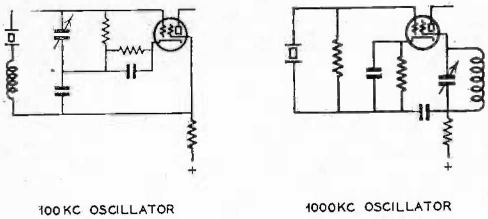
circuit to the form shown in the supplementary circuit diagram; in this case a tuned screen-grid circuit is required, and the crystal will then oscillate at 1,000-Kc., rather than at 100-Kc. The tuned circuit in the screen-grid of the 50L6GT oscillator tube consists of a small lattice-wound BC-type oscillator coil, tuned with an adjustable mica-insuated trimmer condenser which has a maximum capacity of 150$\mu\mu$f. This circuit is adjusted to a point which permits 1,000-Kc. oscillation when the d.p.d.t. toggle switch is thrown to the 1,000-Kc. position. This screen-grid tuned circuit has no appreciable effect when the toggle switch is thrown to the 100-Kc. position. The 1,000-Kc. frequency is approximate, and is useful as a spotting frequency at multiples such as 5-, 6-, 7-, 8-, 9-Mc., etc. The 100-Kc. frequency points provide exact references every 100-Kc., as well as at every megacycle. The frequency standard acts as a small radio transmitter which can be tuned-in on a radio receiver equipped with a beat-frequency oscillator.

The type of 100-Kc. crystal oscillator shown in the circuit diagram was found far more satisfactory, as regards signal strength, stability of oscilation and ability to make the crystal oscillate at exactly 100-Kc., than the more usual form recommended for use with a *Bliley* SMC-100 crystal.

A small portion of the 100-Kc. output is common to the plate supply of a 12SC7 tube



Wiring diagram of the Frequency Standard. Values of components are critical and should be adhered to rigidly by the constructor. These values were determined after painstaking research in the laboratory of the author.



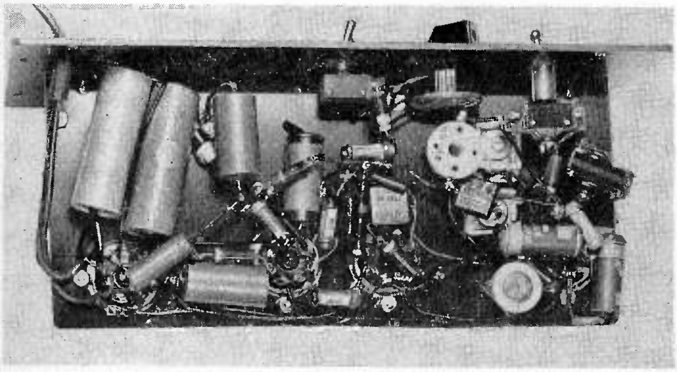
Supplementary Circuits

as a multivibrator. The arrangement shown permits the multivibrator to be locked into step easily at the desired 10-Kc. points by varying the 10,000-ohm grid-leak in the first triode section of the 12SC7. The entire grid-leak is short-circuited by a toggle switch when the 10-Kc. points are not desired. This tube has a sufficiently high amplification constant to obviate all fixed bias for operation as a multivibrator, or when short-circuted with no oscillation.

The plate-to-grid coupling condensers and grid-leaks were chosen so as to produce oscillation in the vicinity of 10-Kc., i.e., 10,000-cycles-per-second. The 100-Kc. crystal oscillator locks this value into exact 10-Kc. oscillation. A 12J5GT tube serves as a resistance-coupled 10-Kc. output amplifier, which not only increases the 10-Kc. output power but also isolates the multivibrator from external connections.

A 45Z5GT tube operates as a half-wave rectifier through a brute-force filter with a pair of 40μf., 250-volt condensers and a 30-h., 50-ma. filter choke.

The entire equipment is housed in a small hardwood box 5½ x 5½ x 12-inches, with bakelite panels for the front and inner shelf. The unit can be placed into a metal cabinet, if desired.

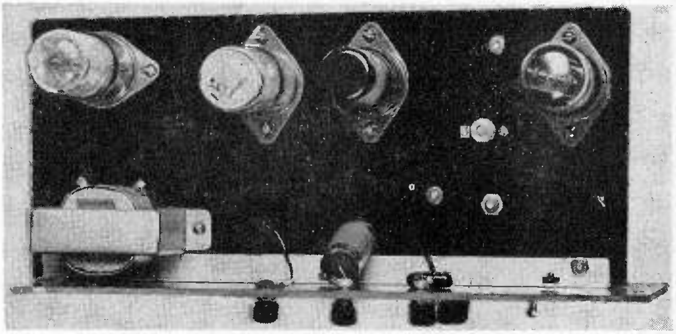


Under-chassis parts layout.

Operating Suggestions

When first testing the unit, the 1,000- and 100-Kc. oscillation points can be checked readily by tuning them in on a broadcast receiver equipped with an electric-eye or "*R*"-meter in order to indicate the presence of an unmodulated carrier signal. The 100-Kc. oscillator can be adjusted to zero-beat against any local broadcast station signal which happens to be operating on 600-, 700-, 800-Kc., or any higher frequencies which are multiples of 100-Kc. For precision-setting of the 100-Kc. crystal frequency it is desirable to use the *Bureau of Standards* 5-Mc. signal from *WWV*.

The multivibrator can be set on the 10-Kc. point rather than at 9- or 11-Kc., by counting the received test signal points on a short-wave receiver between any consecutive 100-Kc. points. Another method of checking



Looking down on the main inner panel of the Frequency Standard.

the multibrator frequency is to couple into a broadcast receiver in order to obtain zero or very low frequency beat notes with broadcast stations operating at frequencies such as 6-, 10-, 6.3-Kc. etc., between the 100-Kc. points. It will be found that most broadcast stations maintain their carrier frequencies to within approximately 10 cycles of the assigned *FCC* frequencies.

This unit was designed primarily for amateur service, but if extreme precision and entire freedom from drift due to temperature change is desired, a temperature - controlled oven-type crystal holder can be included, together with a variable air - dielectric frequency - adjusting condenser. The type of frequency standard treated in this text is very economical to build and the parts cost no more than the crystal proper.

The Shunt-Excited Antenna

A new slant on a feed method for the vertical antenna, and a simple multi-band "sky-hook" for those who must content themselves with a compromise antenna where space is at a premium.

By Frank C. Jones, Technical Editor

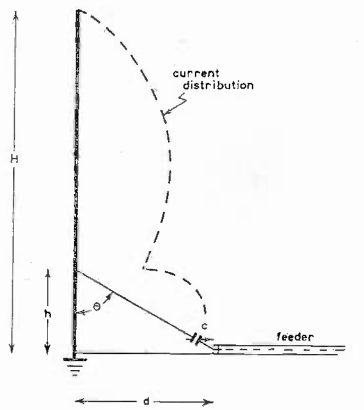
A VERTICAL antenna of almost any length can be connected to a good ground and shunt-excited by means of an inclined conductor. The arrangement shown in Fig. 1 is often used for broadcast transmitters and can be applied with equal success to short-wave service. Power can be coupled into an antenna of either resonant or non-resonant length by means of a small section at the base to serve as a coupling impedance. This impedance can be transformed to the characteristic impedance of a non-resonant line, such as a concentric feeder, by an inclined conductor and a series capacity. The value of H in the diagram can be any length from one-eighth wave to somewhat more than a half-wave in height. The distances h, d, are approximately equal, and in most cases these distances are approximately one-sixth of that of H. For connection to a concentric line in a typical quarter-wave antenna, h = .035, and d = .021 of a full wave. In this case, a terminating resistance at the lower end of the inclined conductor is 75 ohms, and the inductive reactance is 250 ohms. The latter can be cancelled-out by adjusting the variable condenser in series with the feeder to a capacitive reactance of 250 ohms. The capacitive reactance for various lengths of non-resonant antennas ranges from approximately 100 ohms up to 1,500 ohms. The value of capacity required can be calculated for any desired frequency from the expression:

$$C = \frac{1}{2\pi f X}$$

where f is the frequency in megacycles,
C is the capacity in microfarads,
X is the reactance in ohms.

The r-f voltage across this condenser is relatively low, so that a variable condenser with a plate spacing of 0.05- to 0.1-in. will serve for most transmitter designs. The capacity of this condenser will be quite small for the u.h.f. bands. For example, in the 2½-meter band the variable condenser will have a maximum capacity of 35$\mu\mu$f; this value is suitable for nearly any antenna length. In the lower frequency bands the variable condenser should have a maximum capacity of 220$\mu\mu$f.

The characteristic impedance of almost any type of non-resonant feeder can be

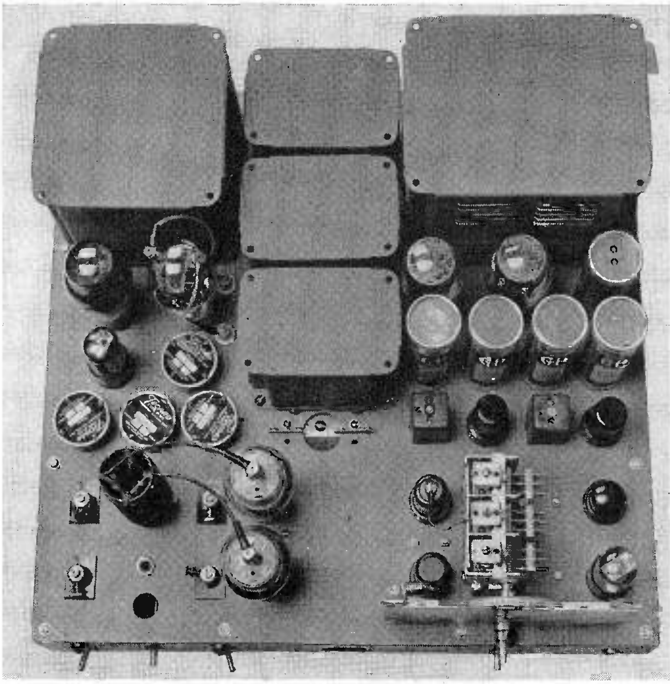


SHUNT EXCITED ANTENNA

matched properly by varying the connection point on the inclined conductor, i.e., the distance h. The capacity C can then be varied until the transmitter load becomes normal, and then the standing waves are minimized or eliminated from the transmission line.

This type of antenna has excellent possibilities for short-wave operation, since its low-angle radiation characteristics are excellent for lengths up to 0.055 of a full wave. An increase in the length of a quarter-wave vertical radiator to 0.55 will increase the radiated field 2.4-db. The radiation resistance of shunt-excited antennas is considerably at variance with that of series-fed vertical antennas. For example, an eighth-wave antenna has a radiation resistance of approximately 40 ohms; a quarter-wave antenna approxi-

(Continued from page 21)



Expert workmanship is evidenced by this transmitter-receiver for defense service. The final r-f amplifier has a pair of Hytron HY-59 tubes, modulated by a Hytron HY-31Z. The transmitter portion has four crystals, each on a spot frequency, yet the amateur may contend himself with but a single crystal.

Hytron Tubes in Defense Equipment

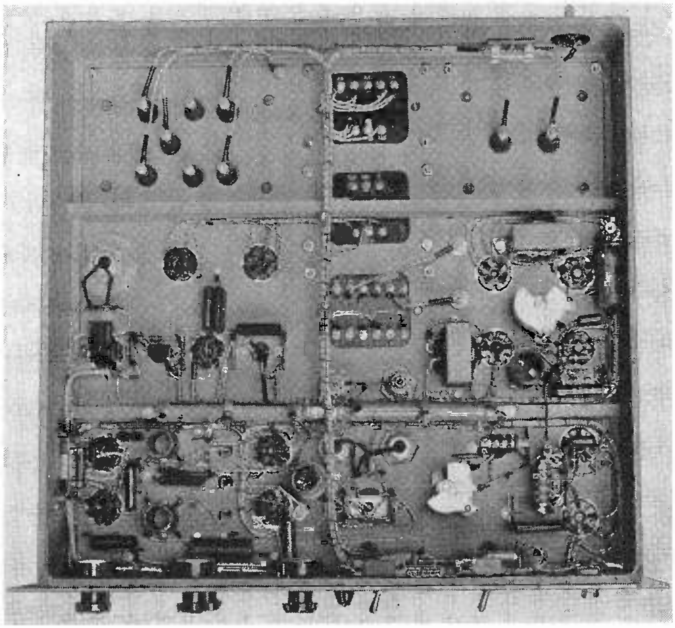
★

You can build an exceptional transmitter, or a combination transmitter-receiver, by copying the ideas of the commercial manufacturers. Just completed for spot-frequency communication, the combination set here described was built by Technical Radio Inc. It lends itself readily to amateur operation, and it is an answer to the problem of getting a lot of power from a minimum of tubes. Of particular interest is the very simple modulator with Hytron HY-31Z zero-bias tube.

★

By The Technical Staff

AMATEURS everywhere are getting new equipment under way in order to insure the success of the national defense program. Such equipment must be more sturdy and more reliable than the run-of-the-mill apparatus for the home station. It must stand up under adverse conditions—and, in most cases, be designed so that several spot frequencies will be available instantly. Commercial radio plants are busily engaged in the design and construction of such equipment for governmental and commercial op-



The professional version of the transmitter-receiver is built upon a heavy cast aluminum chassis, divided into six compartments on the under side. A more simple chassis construction for amateur service could be a conventional steel deck with suitable reinforcing frames below.

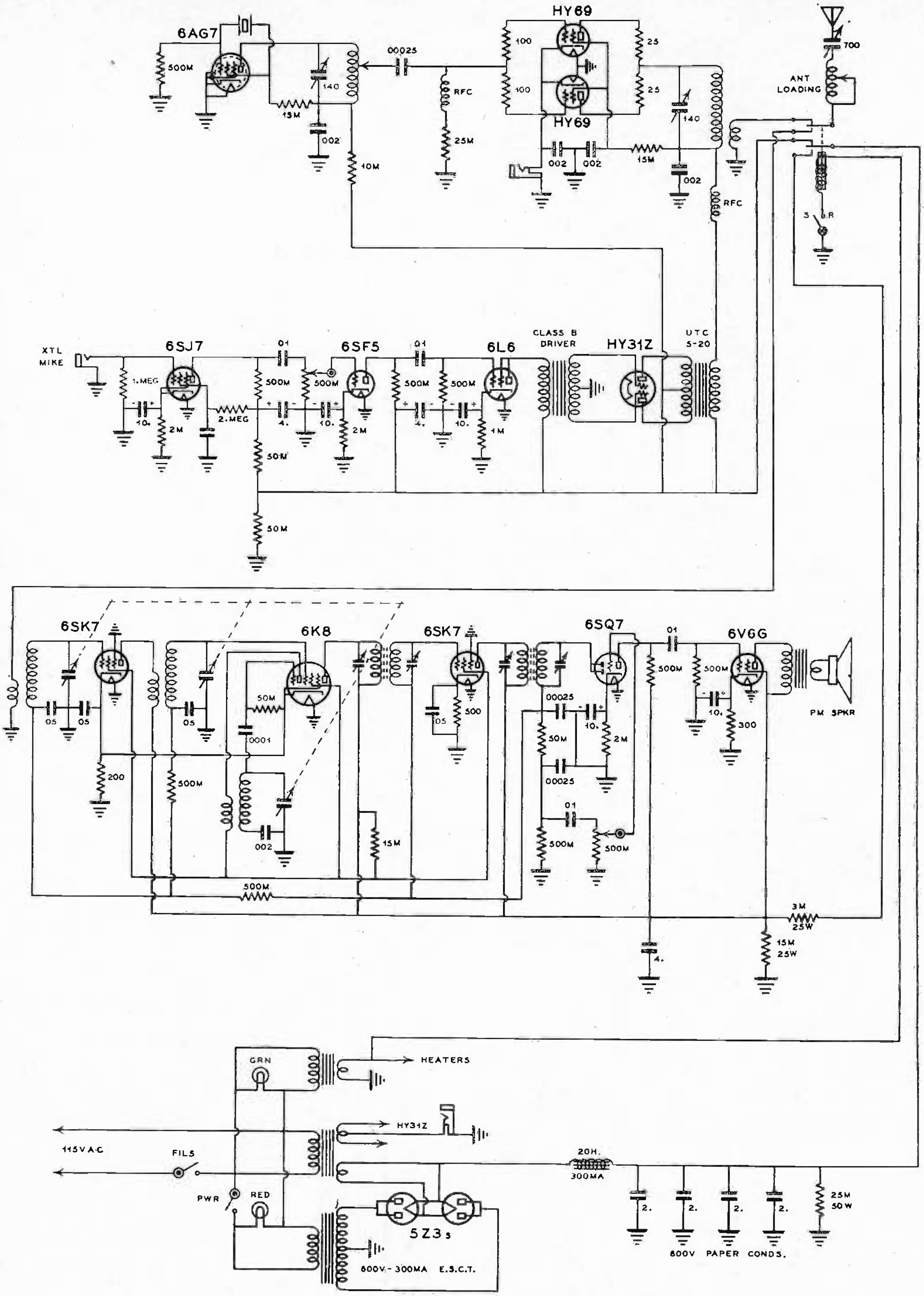
eration. The very same engineering, design and operating practices as apply to the commercial field hold true in the case of the radio amateur who is seriously preparing to do his part in the defense program. For the benefit of members of Amateur Radio Defense Association we present a deluxe transmitter-receiver, to be operated from the 110-volt a.c. line. Scores of municipalities are now getting ready to install emergency power plants to provide the regulation source of voltage for radio emergency gear. Police stations, fire houses, Red Cross posts, and other agencies are letting contracts now for equipment of this kind. In the event of a catastrophe there should be no need to "hunt" for 110-volts a.c. in the modern American community. For this reason there is a growing demand for new and reliable information on the design of defense equipment which, though small and compact, will be large enough, electrically, to perform a satisfactory job under the most trying circumstances.

The illustrations which accompany this manuscript were taken from a commercially-built transmitter-receiver, first designed for amateur operation in the home of one of A.R.D.A. members. Upon completion, the set was "snapped up" by interests we are not at liberty to name, and a few changes were made in the original amateur design so that the completed job could be quickly transformed for commercial frequency channels. The designer and builder of this equipment is Mr. Clayton F. Bane, W6WB, member of our technical staff.

The circuit diagrams show the job in its commercial form, yet there is nothing in this set which in any way makes it necessary for the amateur to redesign. The coils need only be wound for the frequency desired, and as few or as many crystals can be used as the individual requires. The commercial version operates on a frequency closely adjacent to the amateur 160-meter band.

The photograph of the bottom view shows four tuning condensers for the final r-f amplifier, yet the amateur would use one condenser only. The commercial version calls for a fixed-tune frequency and the variable condensers, when once adjusted, are permanently locked into position. The amateur would require a tuning condenser for the crystal oscillator stage, another for the final r-f amplifier.

Interest centers around the power supply, with its pair of 5Z3 rectifiers. Two of these were chosen so that heavy current could be



HY-69, HY-31Z Transmitter and One-frequency Receiver

handled without excessive voltage drop—and the conventional divider network is also eliminated, as would be required if a single 83 rectifier tube were chosen.

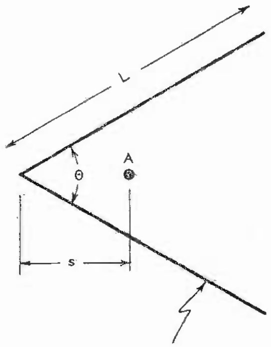
The commercial product has a simple carbon microphone input for the speech channel. The F1 Western Electric microphone is

(Continued on page 36)

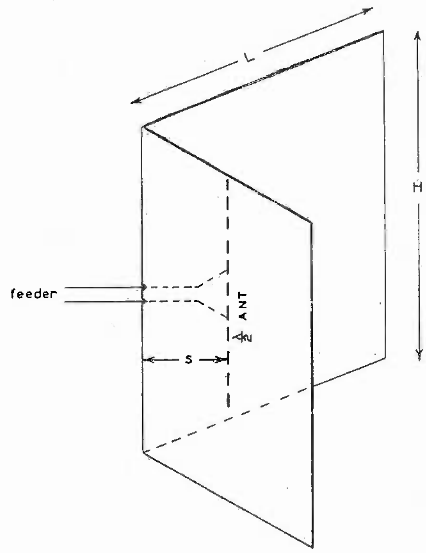
The Corner Reflector

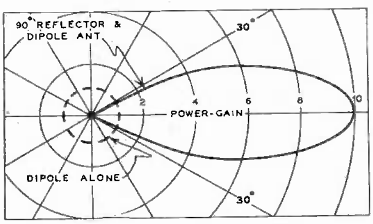
The u.h.f. experimenter will welcome this new data on antenna reflectors. It is a very simple idea, and the results will more than repay the modest effort put into an improvement of this kind.

FINDINGS disclosed by *John Kraus* in relation to the corner reflector indicate that this type of antenna system can be operated very effectively in the u.h.f. region in order to obtain high gain and directivity. The corner reflector consists of two sheets of metal, or two sets of conductors simulating sheets of metal, placed close to an antenna, so as to act as a reflector. A simple 90-degree or square-corner reflector has a theoretical field pattern and power gain of 10, as shown in the accompanying field-strength-pattern diagram. The two sides of the reflector should be slightly longer than the antenna, but these sides need not extend outward more than a full wave for all practical purposes. The antenna should be placed at a distance *S* from the corner of the reflector which will produce the desired radiation resistance characteristics. For example, with a 90-degree corner reflector, if *S* is a quarter-wave the radiation resistance at the center of a half-wave antenna will be approximately 30 ohms. If the distance *S* is increased to 0.35, *R* is approximately 70 ohms, thus permitting connection of a concentric feeder directly into the center of the antenna.



FLAT SHEET REFLECTOR





If the corner angle is 60 degrees, the value of *S* should be greater than for a 90-degree corner in order to have a reasonably high radiation resistance. In this example, if *S* is a quarter-wave, *R* is approximately 6 ohms. If *S* is 0.35, R is approximately 18 ohms. When *S* is made equal to 0.5 of a wave, *R* is approximately 70 ohms.

The theoretical power gain for a 90-degree corner reflector is 10db. The values for 60- and 45-degree corner reflectors are approximately 12db and 14db, respectively. The limits of *S* for a 45-degree reflector range from 0.5 to 1 wavelength. Similarly, the ranges for 60- and 90-degree reflectors are 0.35 to 0.75, and 0.25 to 0.7 of a wavelength, respectively. If vertical wires or rods are used in place of a solid metal sheet or screen for the two sides of the reflector, the spacing

(Continued on page 55)

R. C. Audio Oscillators

Features:

(1) Continuously variable audio-frequency,

(2) Sine-wave output with very low harmonic content,

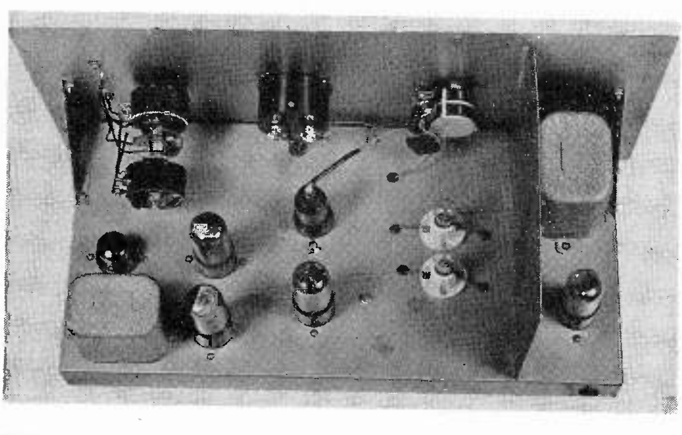
(3) Good frequency stability, practically independent of power supply variations.

By Frank C. Jones, Technical Editor

A TWO-STAGE resistance-coupled audio amplifier can be made into an oscillator by feeding some of the output voltage of the second tube back into the grid circuit of the first tube. This principle is used in multivibrators and in saw-tooth oscillators, and can be utilized to obtain sine-wave output by limiting the amplitude of oscillation. The same principle can be accomplished automatically by utilizing degenerative feed-back with *Mazda* lamps as part of the degenerative feed-back circuit. Oscillation is obtained by having the regenerative feed-back slightly greater than the degenerative feed-back. *Mazda* lamps have a resistance characteristic which varies with the amount of current flow through the lamps, so that an increase in current automatically changes the resistance and consequently the degree of degenerative feed-back. By proper choice of circuit constants it is possible to obtain excellent sine-wave output over a range of frequencies of from 20 or 30 cycles up to beyond audibility. The harmonic content can be held to less than 2 per cent, and the output voltage is very nearly constant over the entire frequency range.

The R/C oscillator illustrated in Fig. 1 incorporates a dual audio volume control as the variable element for changing the frequency over the range of from 60- to 20,000-cycles-per-second. The regenerative feed-back circuit consists of a *Wien Bridge* with two ½-megohm variable resistors and two .006μf. mica condensers. The *Wien Bridge* is very selective for different audio frequencies and makes an excellent frequency-determining circuit for R/C oscillators. The frequency can be changed by simultaneously varying either the two resistors or the two condensers in the *Wien Bridge*. The other two arms of the bridge are made up of a pair of small *Mazda* lamps in series, and a number of fixed resistors.

The simplest form of R/C oscillator, shown in Fig. 1, usually has a very slight degree of backlash in the variable resistor settings; this variation amounts to nearly one degree of rotation in a total arc of approximately 200 degrees. For this reason the dial calibration is not quite as accurate as in the case of an R/C oscillator with variable condensers included in the circuit, as shown in Fig. 2, yet for general purposes the fre-



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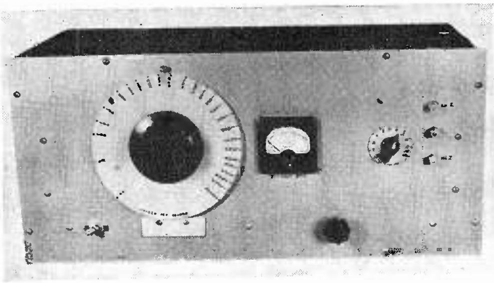
Interior view of the resistor-type R-C Audio Oscillator. The power supply is at the right, shielded from the balance of the instruments in the manner shown. The pair of 6-watt, 115-volt lamps are clearly shown in the foreground.



Front view of the resistor-type R-C Oscillator

quency setting of the simple oscillator, Fig. 1, is sufficiently accurate. These oscillators are extremely useful for many laboratory measurements involving bridge circuits, and for determining the frequency characteristic of audio amplifiers and loud speakers.

Either form of R/C oscillator, as diagrammed, may be connected to output audio amplifiers in order to isolate the frequency-determining circuit from the output circuit. In Fig. 1, two separate audio amplifiers are connected to the oscillator section through a 25,000-ohm volume control. One beam-power 25L6GT tube is connected as a moderately-high-gain tetrode amplifier for relatively high output into load impedances as high as 5,000- or 10,000-ohms. This stage has some shunt inverse feed-back connected from plate to grid, in order to improve the frequency responses over the range of from 60- to 20,000-cycles-per-second. Many audio-frequency measurements require a moderately low output impedance from the oscillator, and this impedance can be readily obtained by using a triode with cathode output coupling. The screen and plates of the 25L6GT are tied to the +B, and the output is taken from the cathode circuit. This provides unity inverse feed-back with the cathode impedance ranging from 200- to 1,000-ohms, depending upon the type of tube chosen; tubes with very high mutual conductance have desirable low values of cathode output impedance. The output circuit has no appreciable effect upon the grid circuit insofar as circuit reaction is concerned, since the grid circuit has a very high input impedance and is similar to an infinite-impedance detector of the type used in high-quality broadcast receivers. The cathode can be coupled through a relatively small transformer, such as a 500- to 200-ohm line transformer, into an attenuator—as shown in Fig. 1. A simple vacuum-tube voltmeter using a 6H6 with its diodes in series, and a 0-1-ma. d.c. milliammeter will indicate the value of audio voltage across the constant input impedance attenuator. This attenuator consists of two 200-ohm potentiometers on a common shaft; one is in series with the output line, the other in shunt. As the resistance of one is decreased the resistance of the other is increased, thereby maintaining a constant impedance towards the cathode circuit. This attenuator can be calibrated so as to read output voltages when the output circuit is connected into the high-impedance load. Calibration for low-impedance loads will still be sufficiently accurate for general measurements.

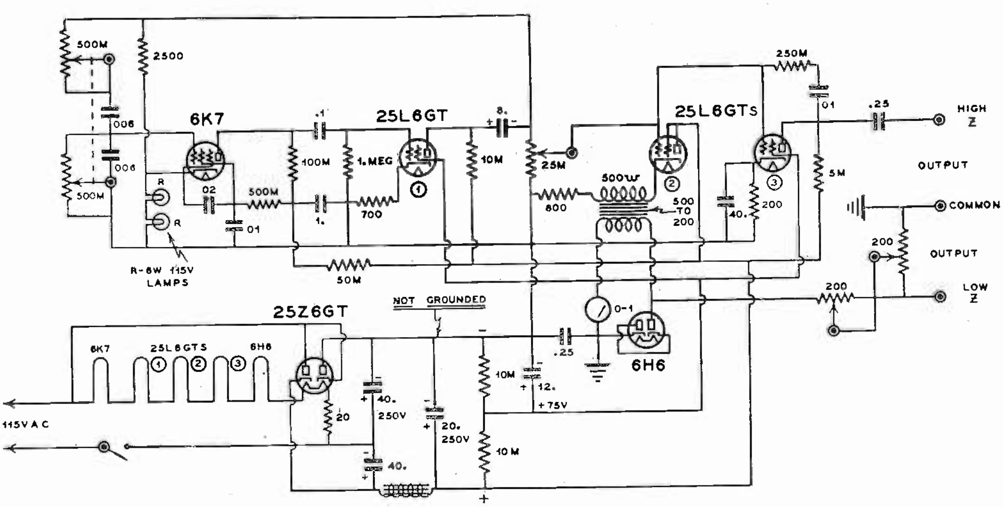


Fig. 1

60∿ TO 20,000∿ AUDIO OSCILLATOR

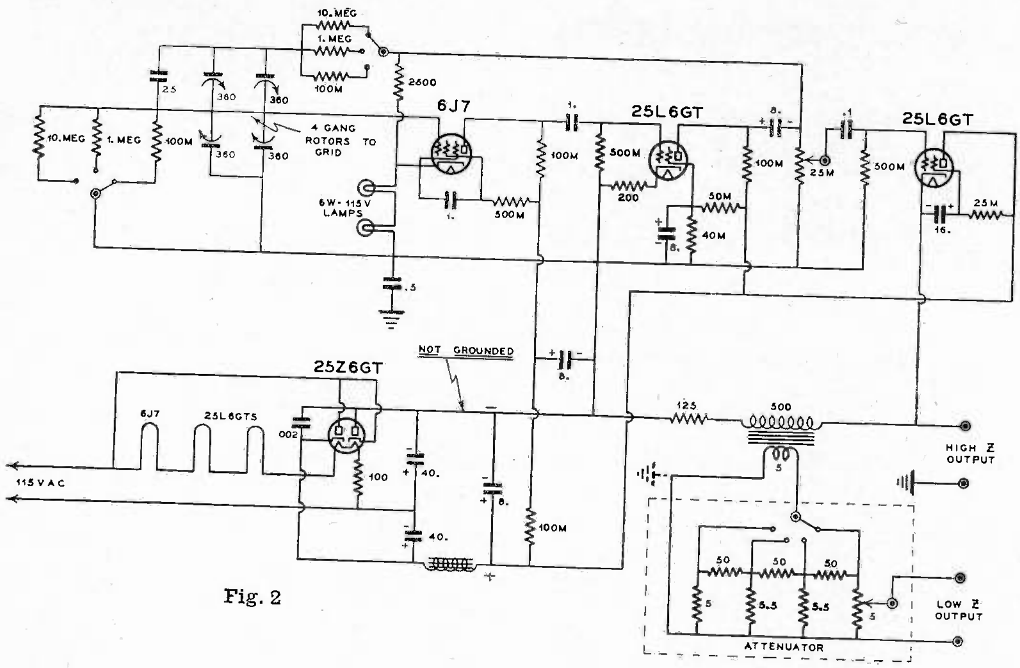
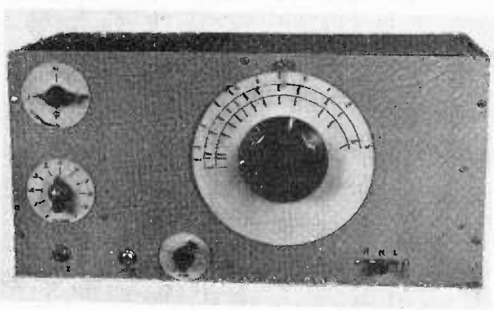


Fig. 2

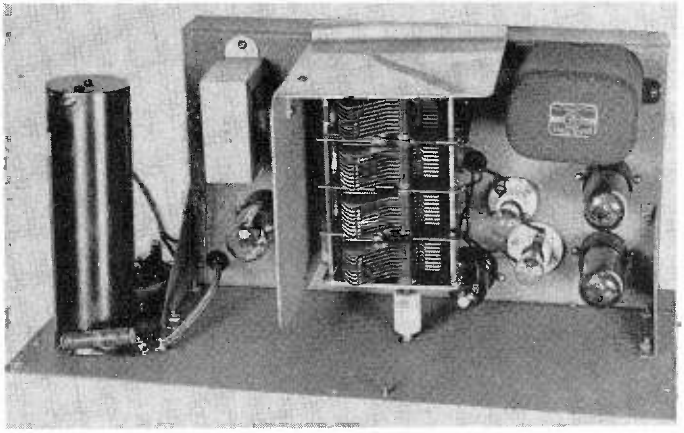
Both R/C oscillators include a 25Z6GT voltage-doubling rectifier in order to obtain a +B potential of from 175 to 300 volts from the 115-volt a.c. line.

The R/C oscillator shown in Fig. 2 has a 4-gang variable tuning condenser with its rotor connected to the grid of the input oscillator tube. The ratio of maximum-to-minimum capacity can not be made greater than 10-to-1, and it is therefore necessary to also vary the frequency-determining resistors in steps of 10-to-1 by means of a two-gang, three-position switch. This arrangement permits attainment of frequencies of from 30 cycles up to 30,000 cycles, or from 40 cycles up to 40,000 cycles. If the resistors, 10-, 1-, and 1/10-megohms, respectively, are accurate, the tuning dial can be calibrated on one frequency range and a multiplier of 10 or 1/10 used on the other two ranges. The R/C oscillator diagrammed in Fig. 1 is continuously variable over the frequency range of from approximately 60 cycles to 20,000 cycles. Both oscillators have a pair of *G.E.* 6-watt, 115-volt miniature *Mazda* lamps in series with the cathode of the first oscillator tube as part of the degenerative circuit. The amplitude of oscillation can be adjusted in any particular design by changing the value of fixed cathode resistance in the 25L6GT second oscillator tube. This resistance can be chosen so as to provide pure sine-wave output, as indicated on an external oscilloscope. This is a simple method for adjusting the degenerative feed-back to any desired value for a particular set of circuit constants, or physical layout of parts. Too much degenerative feed-back will prevent oscillation or cause unstable output voltage, as evidenced by a slow variation in audio-frequency output voltage. Insufficient degenerative feed-back will cause the output voltage to depart from the sine-wave condition, due to the presence of harmonics. With no degenerative feed-back the output is extremely peaked, varying from sharp impulses, to saw-tooth wave form, then to square-wave form, and finally to sine-wave form.



Front view of capacitor-type R-C Oscillator.

In the circuit of Fig. 1, practically pure square-wave output voltage is obtained with only a single *Mazda* lamp in the cathode,



Interior view of capacitor-type R-C Oscillator.

but with a different value of cathode resistance in the second oscillator tube than that shown in Fig. 1. Square-wave output is often useful for making audio-frequency and television measurements. This type of oscillator can be used to good advantage for these purposes by changing the two cathode resistors.

The output amplifier is shown with cathode coupling in Fig. 2. The maximum output voltage of from 15 to 20 volts can be obtained by direct connection to the cathode of this amplifier tube, or a low impedance output can be obtained by connection to the resistance-ladder-type of attenuator. The ladder-type is an audio-frequency micro-volter, giving voltage ratio steps of 10-to-1 on each switch position, and a continuously variable ratio on the output potentiometer. Any output voltage of from a microvolt, or so, up to approximately 1-volt, can be obtained from the low impedance output circuit. The cathode-coupled output amplifier in either oscillator illustrated provides no audio amplification but acts simply as an isolating amplifier and impedance inverter. The ladder-type of attenuator with very low impedance output can be connected into any output circuit impedance desired. This same attenuator circuit can be used in place of the output circuit, or circuits, shown in the oscillator of Fig. 1.

These forms of oscillators are becoming increasingly popular for laboratory use because of their low cost and excellent frequency stability. Variations in a.c. line voltage have practically no effect upon the frequency of oscillation, and there is negligible effect upon the output wave-form or amplitude of output voltage.

Photographs are shown of two of these oscillators; they have proven meritorious for service in the laboratory of this magazine.

Line-Voltage Regulator Also Provides Lightning Protection

. . . The automatic line-voltage regulator—a handy plug-in unit inserted between power cord and electric outlet, costing but a dollar list—is being used more and more as a lightning protection fuse in the Middle West and other localities subject to severe electrical storms, so reports Clarostat Mfg. Co., Inc., of Brooklyn, N. Y.

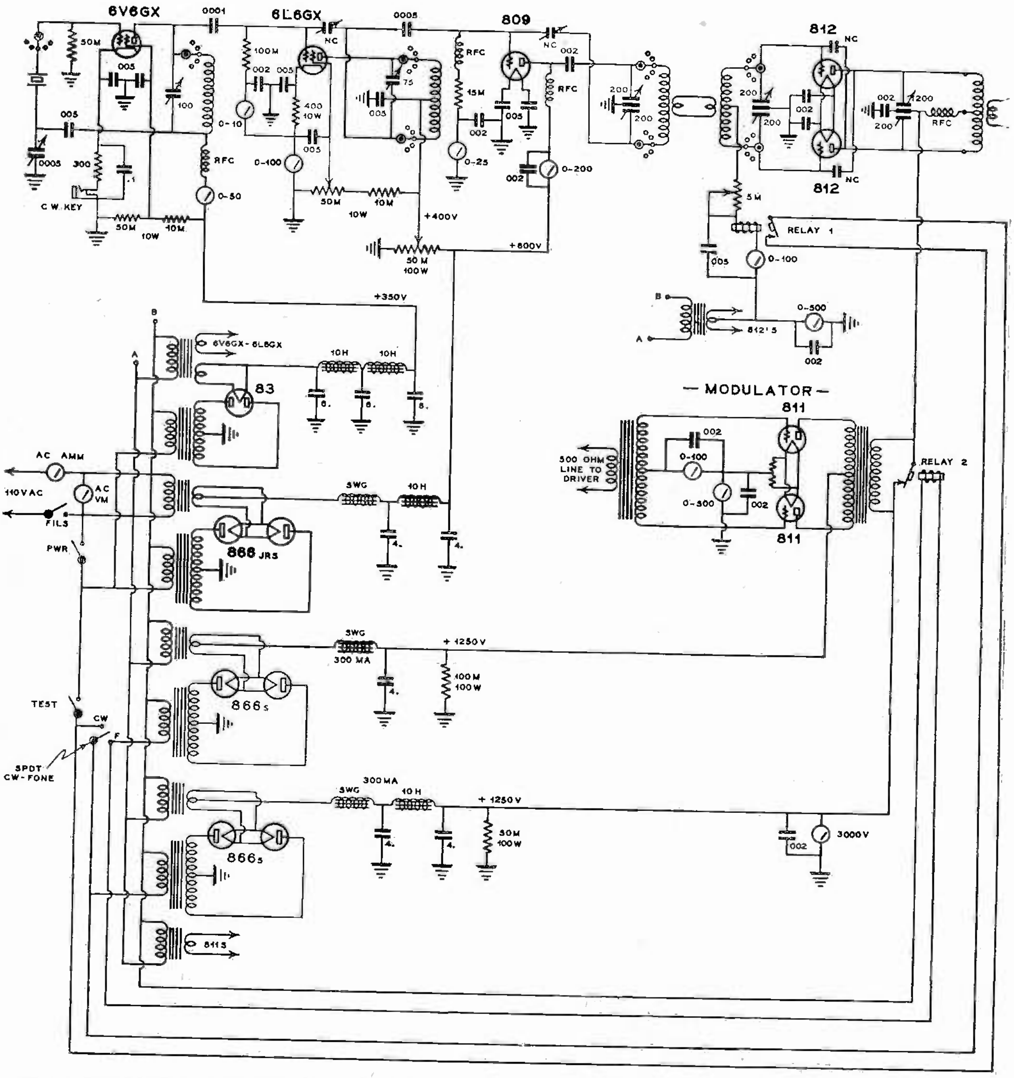
It seems that the main lightning threat is over long, overhead and therefore exposed power lines, in severe electrical storm localities. The heavy induced charge travels over the line and gets into the radio set, causing serious damage. By inserting an automatic line-voltage regulator between set and outlet, however, the heavy induced charge is stopped short of the set, sometimes at the cost of a melted regulator serving as a fuse, but even so that is a lot cheaper than having a wrecked radio set. Meanwhile, of course, the usual lightning arrestor is used to protect the set against any lightning bolt in the immediate vicinity of the aerial. The regulator also serves to maintain the set voltages within satisfactory and safe limits for good reception.

New Clarostat Line-Voltage Regulator

Circuit of the Month

★

IN last month's A.R.D. there appeared a treatise on a 'phone-c.w. transmitter constructed by Mrs. Betty Winsby, wife of Milt. Winsby, W6SSN. There have been requests from a number of readers for a complete schematic wiring diagram of this transmitter—not from the standpoint of curiosity, but rather because the 812 is a very popular tube among amateurs. From a penciled circuit sketch given Mrs. Winsby by her husband, and with all constructional and wiring notes plainly marked, our drafts-



Push-pull RCA-812 transmitter circuit and zero-bias 811 modulator. A popular circuit for the amateur who desired medium-high power output.

man has laid out a condensed and simplified version of the wiring arrangement and the several control relays. The circuit is conventional in many respects, and for the sake of simplicity the coil-switching units are indicated in the form of single coils only, the switch contacts denoting a band-switch arrangement for all stages except the final r-f amplifier.

The modulator and speech amplifier are also strictly conventional, and the circuit of W6SEM's modulator, shown in the March issue of this magazine, will give the reader all of the required technical and circuit considerations.

In Mrs. Winsby's transmitter there are two relays. Relay No. 1 is in the final grid circuit and is actuated by the final grid current, with the contacts closing the high-voltage supply for the final r-f amplifier when the grid circuit is of the correct value. It is therefore evident that the high voltage can not be delivered to the final r-f amplifier unless and until the exciter and driver stages are functioning correctly.

Relay No. 2 is for c.w. or phone service, and is of the "back-operated" type. When the transmitter is operated for c.w. the output winding of the modulation transformer is short-circuited. The inductance of the modulation transformer is consequently removed from the circuit, and good keying is the result. The armature of Relay No. 2 is operated by 110-v. a.c. when the c.w. 'phone switch is thrown to the 'phone position. This switch also allows the modulator power supply to be turned on at the same time the final r-f supply is connected through the armature of Relay No. 1.

Relay No. 1, during c.w. operation, functions so that its contacts are short-circuited, and the high-voltage can then be applied to the final r-f stage.

The circuit diagram also shows a "Test Switch" in the 110-v. line. This switch opens the circuit to the high voltage supply for the modulator and final r-f stages, so that the exciting stages can be checked without the high-voltage power supply being turned on.

The liberal use of meters made possible an arrangement whereby separate readings can be taken of plate or grid current in the oscillator, final r-f, and modulator stages.

The circuit also shows that none of the power supplies can be turned on until the filament circuits are first closed. This is a common safety factor which should be included in all amateur transmitters.

It can be seen that the r-f chokes have been held to an adsolute minimum in order to eliminate a possibility of parasitic oscillations. The transmitter, as diagrammed, gave excellent service under initial tests without resorting to circuit modifications. Readers interested in a transmitter designed around the 812-type tubes will find Mrs. Winsby's circuit arrangement entirely satisfactory in every respect, and our Mr. Frank C. Jones did not hesitate to put his stamp of approval on this excellent circuit design.

* * *

THE SHUNT-EXCITED ANTENNA

(Continued on page 31)

mately 36 ohms; a half-wave antenna approximately 19 ohms.

Other Applications

AN ANTENNA designed for 75- or 80-meter operation could be from 50 to 60 ft. high and connected at the base to a radial ground system, buried under the earth. A twisted-pair feeder can be connected to the 220$\mu\mu$f. variable condenser and then to an inclined conductor tapped on the antenna approximately 10-ft. above the ground connection. The *EO*1 or concentric feeder should have one side connected to the ground system, the other to the variable condenser, at a point approximately 10-ft. from the base of the antenna. This same antenna can be used for 160-meter operation by sliding the feeder connecting point upward a few feet, and then resetting the variable condenser.

It should be possible to use this shunt-excited antenna with a two-wire line, having a higher characteristic impedance, by merely increasing the feeder connecting distance *h*. An r-f ammeter can be connected in series with the feeder at the point where the variable condenser connects into the system, as an aid in tuning the antenna for maximum radiation.

* * *

Aluminum for Defense Freed by New RCA Recording Disc

. . . Many tons of aluminum have been freed for use in the National Defense Program by the success of the RCA Research Laboratories in perfecting a new 16-inch fire-resistant, paper-core recording blank for use in radio studios, airline terminals, and other locations where sound is recorded for "reference" purposes.

"The new blank provides a quality of reproduction that is unsurpassed by any other paper-core blank, no matter of what size," R.C.A. reports. "Many months of research preceded the perfection of the special type of paper used in the core. The result is an amazing flexibility which prevents warping and allows the disc to flatten out at the mere pressure of the cutting head."

The new 16-inch blank joins the smaller sized paper-core blanks previously announced by RCA Victor. and widely used in studio and home recording.

"TECHQUIZ"

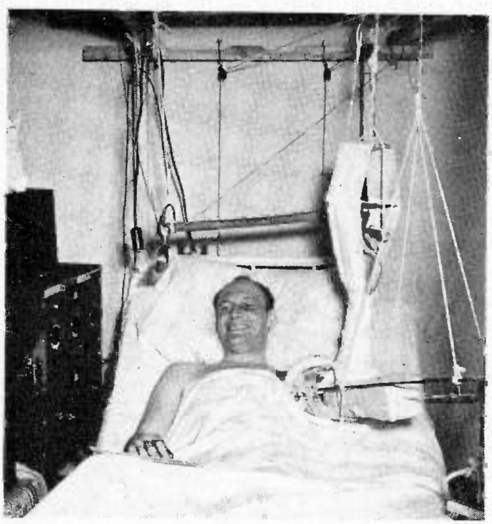
12 Contestants Solve Problem No. 3

(*The Correct Answer - - - 3.276 Ohms!*)

★

By C. C. Anderson, W6FFP

PROBLEM No. 3 of "Techquiz" brought a greater volume of solutions than any previous brain-teaser, perhaps because it wasn't quite as hard to solve as some of its predecessors. The largest single day's mail brought 24 solutions, yet only a small percentage of the contestants found the correct answer. Then followed a steady flow of mail, and the winning average began to climb. Towards the end of the month only one or two answers came in each day, yet all were correct. Thus it seems that those who came first finished last. Our old stand-bys are still on top—Wayne Miller retaining his perfect score, C. E. Thompson, W6UQ, also batting 1.000-Pct., and our old pal, Lieut. A. W. Greenlee, W4HGM, back in the running with a perfect score—while confined to his bed in a hospital at Pensacola after a crack-up in his U. S. Navy plane. The photograph shows "Bill" Greenlee in a happy mood after his thrilling experience. The apparatus tied to his arm is a "direction finder," a perfect replica of an antenna loop. Other gadgets suspended from the wall serve as his "automatic volume and gain controls," enabling him to move closer to, or farther away from, the microphone of his radio-telephone transmitter which sits faithfully beside him. In our next issue we hope to show Lieut. Greenlee once more at the controls of a plane, and the entire amateur fraternity is hopeful of a rapid and complete return to normalcy for W4HGM.



Lieut. A. W. Greenlee and his new system of A.V.C. and A.M.C.

PROBLEM No. 4

What is the reactance of a condenser at the frequency of 1,200 kilocycles if its reactance is 300 ohms at the frequency of 680 kilocycles?

. . . Problem No. 4 should not be difficult to solve. We anticipate many new contestants and we hope the old stand-bys will retain their present high scores. Send your solutions as quickly as possible.

* * *

Easy, wasn't it? So here is the "Box Score" for the month:

Miller, Wayne	1.000 Pct.
Greenlee, A. W.	1.000 Pct.
Thompson, C. E.	1.000 Pct.

New Contestants, Correct Solutions but have answered one Problem only:

R. B. Lincoln, W2NOO	0.333 Pct.
Joe Leon Padilla, W6TQI	0.333 Pct.
W. J. MacMillen, Somerville, Mass.	0.333 Pct.

EARLIER CONTESTANTS

Alanzman, John, W8OFW/W8VOG	0.333 Pct.
Atkinson, Clifford, Jr., W5GOC	0.666 Pct.
Bolvin, C. J., WPDO/W8LVV	0.333 Pct.
Donald G. Buck, W8CDM	0.333 Pct.
Dunlap, Geo. S., W9OGG	0.666 Pct.
Friesen, Vernon O.	0.333 Pct.
Lundy, C. E., W6CY	0.333 Pct.
MacFarland, Bob, W5BKS	0.666 Pct.
Nadeau, Ralph U., W1ICS	0.666 Pct.
Roby, J. W., Jr., W5HTI	0.666 Pct.
Scairpon, Jim, W2KAV	0.333 Pct.
Schor, F. W.,	0.333 Pct.
Searles, Paul D.	0.333 Pct.
Springer, John A., W8BCY	0.666 Pct.
Welch, J. R., W6WC	0.333 Pct.

Ham calls CQ. YF decides to return to Mama.

Ham builds FB b.c. receiver. YF hesitates.

Ham presents b.c. receiver. YF changes mind.

Ham calls CQ. YF enjoys b.c. music. Everybody happy.

How to Keep Your YF at Home

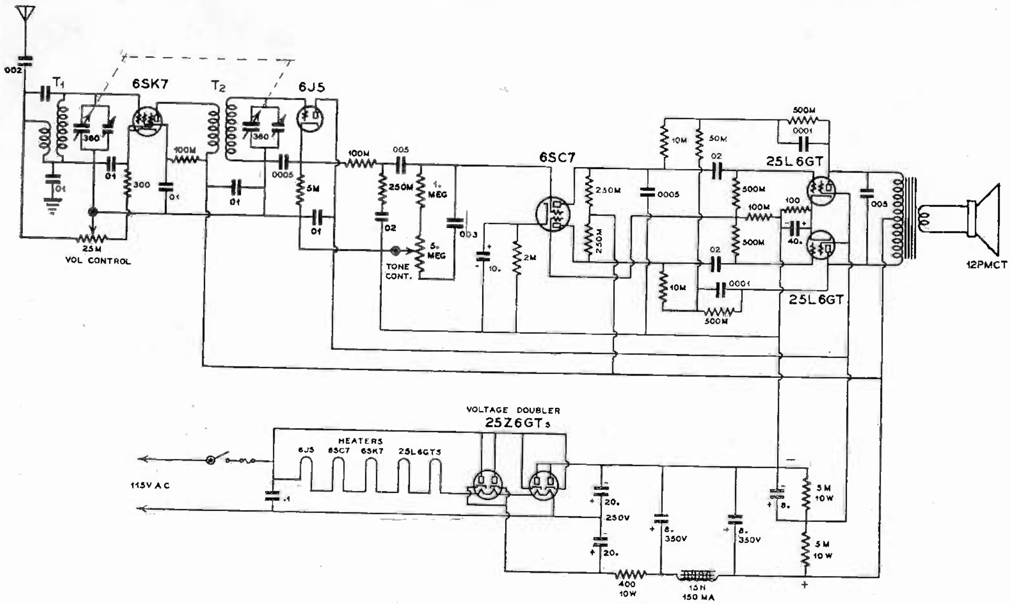
It's been so long since the average amateur or his wife have heard a really-good sounding b.c. receiver that the time is opportune to tell how such a set can be built. Here is some new audio data from the laboratory of Frank C. Jones that will give you a modern conception of music at its best.

Build a "Mewsick Box"

★

THIS is a story to which no amateur radio technical writer would affix his name . . . for it has long been dubbed suicidal to publish broadcast receiver information in a strictly amateur radio magazine. Maybe it's because the amateurs get so many pink slips as a result of interference to nearby b.c. receivers that they are down on the common music listener—or maybe it's because every amateur got his start with an asortment of junk-store salvaged parts from ancient b.c. sets (and these parts are still found in many ham receivers) that the urge to discourage broadcast information in the amateur radio press came about. Or it may be that the amateur feels he antedates the b.c. listener by so many years that he refuses to stoop to his level. More and more hams, however, have come to the stark realization that music throbs the savage breast or beast, whichever it was that Confucius said, and it has been found from many a Galloping Poll that scores of people (particularly women) still listen to music. The fact that many a radio amateur has acquired a wife is ample reason why this story should be written, together with undisputable statistics which show that scores of wifes have left—or are ready to leave—the abodes of their radio husbands. Wives can be snared into staying at home with a ham, if the proper technique is employed. As the ham spends more and more hours at the key, the urged for the wife to pack up and return home to mother is becoming alarmingly general. Some hams have tried to hold their wives by feeding them candy, only to ask them to stop chewing so loudy because the weak DX signals couldn't be copied through the crunch of peanuts and jaw-breakers. Others have tried to soothe a belligerent wife by buying new clothes for her framework, but this approach has its shortcomings because a heavy investment in apparel means fewer ham radio parts—and that won't do at all!

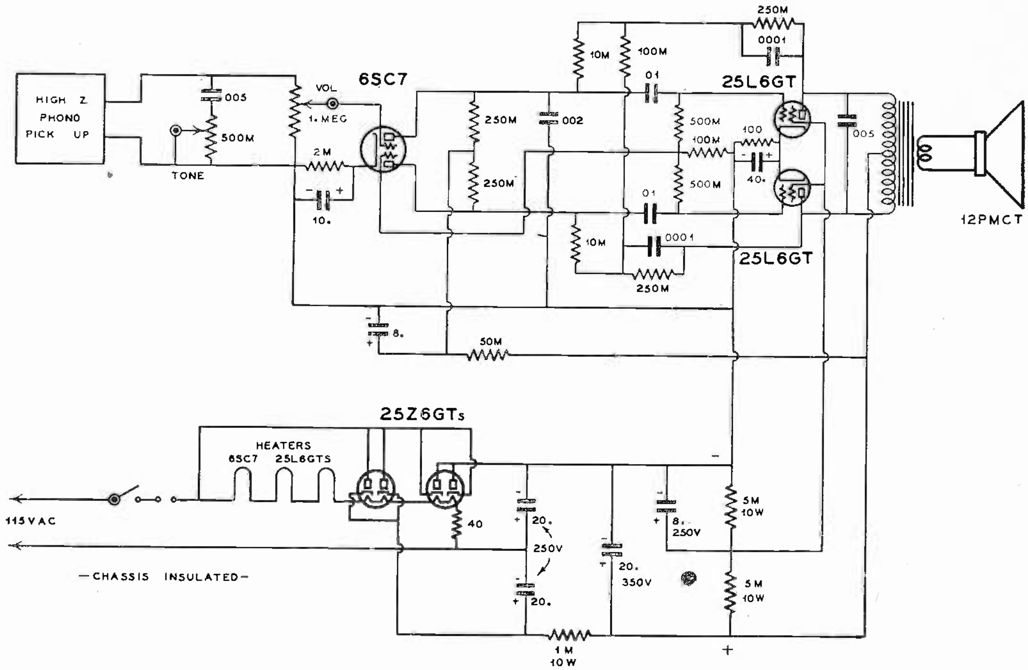
There is an answer—one which gives the ham a radio slant on how to keep his wife at home, yet still makes it an almost surefire means for preserving complete peace and harmony in an otherwise troubled household. The success formula revolves around an astounding, beautiful-toned radio receiver—one which sounds so much better than the average store variety that your wife will throw out every b.c. re-



Schematic wiring diagram of t.r.f. tuner, audio channel and power supply for up-to-date speech and music reproduction. The electrical constants of the audio circuit are critical and should not be changed.

ceiver now in your home and use only the one you buid for her. So this manuscript is written to sell you the idea of getting back to the workbench in order to construct a piece of equipment that makes all of your previous ideas of sound reproduction sound like a garbage pail filled with tomato cans. Build such a b.c. audio channel—hook it to a simple t.r.f. tuner—get a *good* loudspeaker of the *Jensen* high-fidelity type, and you'll make your wife so happy that she not only won't leave your home, but she'll bring a lot of other swell YLs to visit your place to hear the Music Box you made for her.

The tuner and audio system under treatment in this text is not new. Nothing is new in radio, because it was once said that even the Scots must have used wireless communication long ago, because no wires were found in Scotland. The tuner should be of the t.r.f. type, rather than a superhet, because high-fidelity is a prerequisite in the design of the complete ensemble. The tuner shown in the circuit diagram has been treated at length in the early radio press, more recently by our worthy contemporary "*RADIO*," but the music you get from the loudskeaker is determined largely by the improved audio circuit connected between the tuner and the speaker. Therein lies the secret of this very-fine-sounding Music Box. The receiver was discovered in the dining room of Frank C. Jones' home. We were taking photographs at Frank's place a few weeks ago, where we shot 21 pieces of laboratory equipment he had just completed for description in this magazine. Our ace photographer, N. R. Farbman, W6SEM, did the shooting—while I held the reflector lights in place. When we finished the job we rambled through Frank's home to see if buried radio treasure could be found. Then we ran into Mrs. Jones—and the b.c. receiver Frank had built for her. We turned on the set, and we heard some of the best music we ever listened to. We asked Frank to write a story around the receiver circuit so that other hams could build a set just like it, but Frank threw up his hands and told us we were listening to a b.c. receiver, and not a ham communication set. All of us were so impressed with the quality of reproduction that we decided to build sets just ike it, so Frank gave us the circuit diagram and told us to write the story ourselves. It is only by this means that the reputation of our Technical Editor was preserved for posterity, and for this same reason ever the assistant office boy refused to divulge his name as the author of this manuscript. But this much can be said: if you want to build a b.c. tuner, audio channel and phonograph amplifier, here is information of top-notch caliber . . . written from technical notes and circuits by Jones, but we are not supposed to mention his name.



If you are interested in recorded music only, here is an excellent circuit diagram for a phonograph amplifier. Frank C. Jones has put this circuit through many tests in his laboratory and his stamp of approval goes on this circuit "as is."

Technical Considerations

THE tuner has a single-stage r-f amplifier with a two-gang variable condenser, 365$\mu\mu$f. per section, and two standard commercial-type coils of the r-f transformer variety. The antenna winding of one coil is of the high-impedance type. The volume control varies the bias on the r-f stage and also shunts the antenna input for strong local signal reception. With an antenna approximately 30- to 40-ft. long the receiver gives satisfactory reception from local stations within a radius of 20 or 30 miles. The detector is of the infinite-impedance type, with cathode coupling to the 6SC7 high-gain phase inverter. A resistor-condenser network is connected to the input circuit of the 6SC7 in order to insure excellent bass response. The tone control circuit has the effect of reducing the high frequencies at one end, and emphasizing the bass—while at the other extreme end of the control the opposite condition prevails. The variable condenser trimmers are adjusted for maximum signal response on a broadcast station towards the high-frequency end of the band. The selectivity is sufficient only for local signal separation, and providing the stations are at least 5 miles away.

The 6SC7 phase inverter has an amplification constant of 70, which results in more audio gain than is actually required, but also provides a problem in a.c. hum elimination. Hum developed in the 6J5 detector cathode circuit can be held to a minimum by resorting to a fairly low value of cathode resistance. Hum in the phase inverter circuit can be minimized by using a high degree of inverse feed-back in the audio amplifier, or by tapping the grid coupling condensers across only a portion of the 6SC7 plate resistors. The amount of a.c. hum which can be tolerated depends upon the normal audio volume required for an average room, the sensitivity of the loudspeaker to 60- and 120-cycles, particularly the former, and whether or not bass reflex is incorporated into the cabinet design. With bass reflex design the 60-cycle hum is emphasized, and it is desirable to connect the .02μf. grid coupling condensers part way down on each plate resistor. For example, each single ¼-meg. resistor in the circuit diagram (in the plate circuit of the 6SC7) can be changed to two 100,000-ohm resistors in series, with the grid condensers connected to the center-taps. The r-f by-pass condenser of .0005μf. should connect directly to the plate of the 6SC7.

The push-pull 25L6GT amplifier will deliver more than 10 watts of audio power without a great deal of distortion when operated with higher than normal plate voltage. The method used in this receiver was to operate the plate voltage at between 160-175 volts, and then to reduce the screen voltage to a value which kept the plate dissipation to somewhat less than 5 watts per tube. The inverse feed-back circuit greatly improves the audio-frequency response, and in practice it performs more satisfactorily than inverse feed-back circuits applied from the output transformer secondary back into the 6SC7 cathode circuit. The 25L6GT beam power tubes have a very high mutual conductance and are subject to parasitic oscillation, but the parasitics can be easily damped-out by utilizing a parallel impedance feed-back circuit from plate to grid. The type of loudspeaker selected had a too-good frequency response for broadcast reception and it was therefore necessary to add some capacity into the inverse feed-back circuit. This addition resulted in a reduction of monkey-chatter and heterodyne whistles without appreciably affecting the audio response to frequencies as high as 8,000 cycles. The complete audio channel was connected to a variable audio oscillator, and the circuit constants were varied until the desired characteristics were obtained.

The power supply consists of a pair of 25Z6GT tubes with their elements in parallel, connected in a voltage-doubling circuit. These two rectifier tubes give ample current-carrying capacity and also build up the total heater voltage drop to a value which permits series connection directly across the 115-volt line.

If a transformer power supply is to be chosen, it is suggested that a type 6N7 phase inverter be substituted for the 6SC7, in order to reduce the gain and a.c. hum level. Type 6L6 tubes can then be substituted for the 25L6s. Type 6V6 tubes could also be used with ample audio output for normal home requirements.

The cabinet for this receiver was designed with an enclosed rear cover in order to utilize the bass reflex principle. Approximately 2-in. below the loudspeaker opening there should be a 3-in. x 12-in. slot, cut into the speaker baffle, to provide an additional opening through the front grille of the cabinet. This latter opening should have approximately one-half the area of the loudspeaker opening, and should be the only other opening in the cabinet. A suitable cabinet can be built from ¾-in. and ⅞-in. mahogany, which is heavy enough to avoid cabinet resonance.

* * *

HYTRON DEFENSE EQUIPMENT

(Continued from page 24)

connected to a small mike transformer and it, in turn, is fed directly into the grid of the 6L6 driver tube. The circuit drafting was changed in such a manner that the amateur can use a crystal microphone, rather than the cheaper carbon type. Crystal microphones for amateur operation have of late been priced so reasonably that very few amateurs will contend themselves with the carbon type. It is interesting to note from our technical mailbag that many requests are being received for a crystal microphone circuit to use in conjunction with the several previously-published circuits which originally specified the carbon type.

A Hytron HY-31Z is used in the modulator. This is a twin-triode tube, selling at a very low price, and it has proved exceptionally capable for service as a modulator in the transmitter under discussion, as well as in numerous other commercially-built sets of the *Tecrad* design. The HY-31Z has a 6.3 volt filament at 2.25 amps. Plate potential is 500 max. DC volts; plate current 150 max. DC ma.; grid current 30 max. DC ma. The plate dissipation is 30 max. watts (CCS). Average amplification factor is 45, and the mutual conductance is 1800μmhos. The two plates connect to caps at the top of the tube envelope. Later issues of this magazine will bring the reader additional modulator data on this versatile *Hytron* HY-31Z, for it holds wide possibilities in many services for the amateur. This tube drives easily as a modulator and it delivers ample audio output to drive a pair of HY69s—in fact, it was found necessary to reduce the audio in the transmitter under discussion because difficulty was experienced from overmodulation.

The driver for the HY-31Z is a 6L6, as previously noted, and it was selected because it is the only tube suitable for handling the fully applied plate voltage specified for this transmitter.

The power supply delivers approximately 500 volts and provides a clean carrier with only one filter choke and one 8μf. condenser of the medium-voltage rating type. However, for the sake of absolute safety it was deemed advisable to use filter condensers of lower voltage ratings, and therefore it was decided to connect four 2μf. 800-volt condensers in parallel.

Although not shown in the photograph, the transmitter includes an antenna loading system with a tapped coil and variable condenser so that a single-wire antenna of almost any length could be made to resonate easily. This loading arrangement is also a part of the receiver input circuit.

Radio-Frequency Insulating Materials

This is a most enlightening non-technical manuscript on the relative merits of the many types of insulating material now available to the radio engineer and amateur constructor. Written in an unbiased manner by Dr. Harner Selvidge, Consulting Engineer for the American Phenolic Corporation, it tells you in a refreshing manner the whole story on insulating compounds. You will profit from this information.

By Dr. Harner Selvidge

RADIO engineers are constantly being confronted with the problem of isolating various conductors carrying radio-frequency energy. Electrical isolation would be simple were it not for the fact that mechanical support is usually also required. Unfortunately, air, our best insulator, offers no mechanical support, and so the engineer is usually faced with the problem of designing an insulator that will have both desirable electrical and mechanical properties, and usually one of these requirements will have to be compromised to meet absolute minimum requirements in the other. Fortunately, developments in the design of insulating materials have kept abreast of the rapid strides taken in the radio field in the past decade, and the excellent low loss dielectrics that have been developed in the past few years have been an important factor in the increasing use of the ultra high-frequency spectrum as well as improving efficiency of apparatus at longer wavelengths.

Definition of Electrical Properties of Insulators

WHEN an insulating material is placed in an electric field an electric charge is stored in the volume of the dielectric. If the field is set up by an alternating voltage the charge will be reversed every half cycle. As a result of molecular friction within the dielectric there will be a certain amount of heating of the material and this heating represents energy extracted from the field by the dielectric. In a very poor dielectric at high frequencies this internal heating may be so great as to cause the insulator to explode. The exact nature of the atomic structure of a material which determines whether it is a dielectric or a conductor is rather complicated, and authorities are not in complete agreement as to the exact explanation of some of the effects observed. However, we do know from experience that certain materials and certain processes give dielectrics with desirable or undesirable characteristics, and most of the design of insulating materials today is done on an experimental rather than theoretical basis.

Power Factor. In electricity the term power factor is defined as the cosine of the phase angle between the current and voltage in a circuit. The term is also applied to dielectrics, and we refer to the power factor of an insulating material as an indication of its quality. The reason for the use of the word power factor in this sense is explained in the following paragraph.

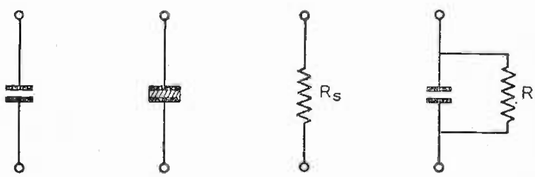


Fig. 1

Consider a perfect condenser as shown in Fig. 1a. This would consist of two metal plates with no insulation but air between them. In such a case the current in the condenser would be exactly 90 degrees out of

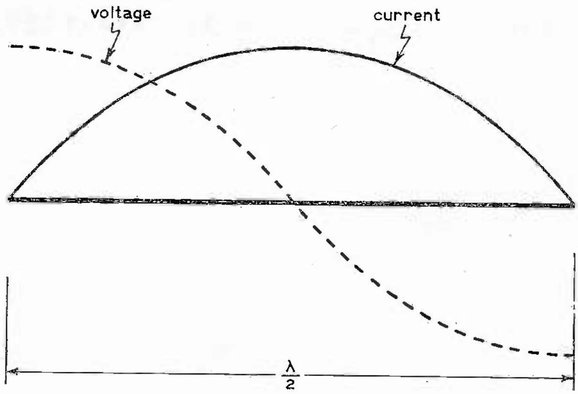


Fig 2. (Referred to on last page of this text)

phase with the voltage across the condenser. Now let us place a slab of some insulating material between the plates of this perfect condenser, as in Fig. 1b. This condenser will have some energy loss on account of the dielectric. This loss can be represented by a resistance either in series with the perfect condenser, Fig. 1c, or in parellel with it, Fig. 1d. Now in a circuit having both resistance and capacitance, the voltage is no longer 90 degrees out of phase with the current but is less than that value, depending upon the relative size of the resistive and capacitive elements. The poorer the dielectric, the smaller will be this phase angle, and the larger will be the power factor, since the cosine is larger for smaller angles. The actual value of the resistances representing the dielectric loss in a condenser are given by the following equations:

$$R_p = \frac{1}{(2\pi fc)\ (\text{power factor})}$$

$$R_s = \frac{(\text{power factor})}{2\pi fc}$$

If the angle θ between the voltage and current is large, power factor = cos θ = $(90° - \theta°)/57.3$. That is the angular deviation from 90 degrees expressed in radians. For ordinary insulating materials this value of power factor will range from .08 to .0002. The larger the value of the power factor, the poorer is the dielectric. For most dielectrics the power factor increases somewhat with frequency, indicating that the losses increase at higher frequencies.

In the past it has been the custom of some persons to arbitrarily multiply power factor values by 100 and call the resulting figures "power factor in per cent." This has no theoretical justification or meaning and has resulted in a great deal of confusion because one is never sure when he sees a value for the "power factor" of a dielectric whether it is the true power factor, or whether it is expressed in per cent and this fact was omitted from the title. Fortunately, the practice of expressing power factor in per cent is becoming less common but this possible ambiguity must be watched for.

Dielectric Constant. If the condenser is made with a dielectric other than air between its plates it is found that the resulting capacitance of the condenser is greater than if air had been the dielectric. The ratio of these two capaictances is called the dielectric constant of the material in question. For example, consider a condenser consisting of two parallel plates having a capacitance in air of 20 mmf. If, when the space between the plates is filled with a solid dielectric material, we find the capacitance to be 60 mmf., the dielectric constant of this material is 60/20 = 3.0. Unless it is desired to construct a condenser with a large capacitance in a very small space, the dielectric constant of an insulator used in condensers should be as small as possible. The dielectric constant usually changes relatively little with frequency.

Loss Factor. We have seen in the preceding paragraphs that a good insulator has a low power factor and low dielectric constant. The product of the power factor and the dielectric constant is called the "loss factor" and is the simplest way of expressing the quality of a radio-frequency insulating material in the form of a single number. The best insulator is the one with the smallest loss factor. However, here again care must be taken in comparing published values for loss factor since in some cases the power factor may be in per cent, giving a loss factor that must be divided by 100 in order to be compared with loss factors which include power factor *not* in per cent.

Dielectric Strength. The dielectric strength of a material is the maximum voltage a unit thickness of the material can withstand without breakdown. It is usually expressed in volts per mil, although the measurements are made on thicker pieces. This value will vary considerably, depending upon the method of test and the frequency of the applied voltage as well as the thickness of the sample used, so these should be specified if possible. The dielectric strength is usually much less for radio-frequency voltages.

Arc Resistance. The arc resistance (sometimes called "flashover") of an insulator refers to its ability to withstand sparking over the surface of the material. Sparks playing over the surface will ultimately carbonize the surface and cause the material to break down. The arc resistance is usually expressed in seconds, this being the time required for surface breakdown caused by an arc between standard electrodes under certain standard conditions.

Surface Resistivity. Surface resistivity is a measure of the surface leakage of an insulator. This is determined largely by the humidity, the leakage mainly being in the moisture film on the surface. It is measured by the resistance between the opposite sides of a centimeter square on the surface, and the humidity conditions should be specified.

Volume Resistivity. This is a measure of the actual direct-current resistance of the insulating material itself. It is expressed in ohms per centimeter cube and is the resistance between two electrodes separated by the insulator, the measurement being made in such a fashion that the surface leakage is eliminated.

Water Absorption. While the amount of moisture a dielectric will absorb is strictly speaking a mechanical property, it is included in the list of electrical properties because it has a very important effect on all the electrical properties. Every one of the above defined electrical properties is adversely affected by moisture absorption so this characteristic of an insulating material should be carefully scrutinized if it is to be exposed to high humidities.

Definition of Mechanical Properties of Insulators

Specific Gravity. The ratio of the weight of a given volume of the material to that of an equal volume of water (at 4 degrees C.) is called the specific gravity of the material.

Tensile Strength. Tensile strength is the maximum number of pounds per square inch of cross-section required to cause failure of the material in tension.

Compressive Strength. Compressive strength is the maximum number of pounds per square inch of cross-section required to cause failure of the material by compressing or crushing.

Coefficient of Linear Expansion. The elongation of a sample of material caused by heating is indicated by the coefficient of linear expansion. It is usually expressed in parts per million per degree Centigrade.

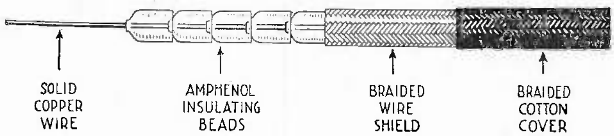
Softening Point. The temperature at which a material softens will vary widely, depending upon the method of measurement and the definition of softening that was used. This tends to make numerical values of softening point temperatures arbitrary and useful only for approximate comparisons. However, this characteristic of an insulating material should be checked if the material is to be used in places where it is subject to high temperatures. Sometimes a "distortion point" is also specified. This is the temperature at which material can be easily distorted and will be a somewhat lower temperature than that at which the material noticeably softens.

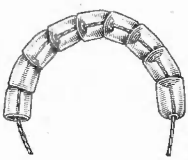
Measurement of Properties of Insulators

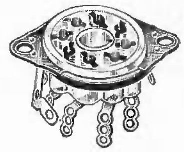
As WAS pointed out in some of the preceding paragraphs, there may be wide differences in the results of tests on similar materials if the tests were not carried out in the same way. For this reason it is urged that anyone who is confronted with the problem of measuring the properties of insulators (or any other material) consult the publications of the American Society for Testing Materials (A.S.T.M.). This organization has published "Standards" and "Tentative Standards" for the testing of all kinds of materials and if these methods are used it is only necessary to mention the A.S.T.M. standard number along with the results, and any reader can then refer to this standard and know exactly how the data were obtained. The standards are constantly being revised and are kept up-to-date.

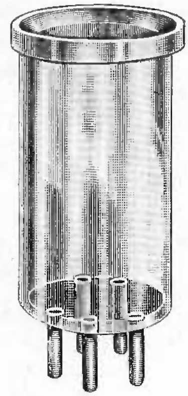
Practical Insulation Problems

Coils. For maximum efficiency in radio-frequency circuits we want our inductances to have as high a Q as possible. The factor









Various items manufactured from low-loss Polystyrene insulating material by the American Phenolic Corporation. Upper view shows details of transmission line. To the right is the Amphenol Polystyrene u.h.f. coil form. Below, left—bead spacers for low-loss lines; right—Amphenol u.h.f. socket, also of Polystyrene.

Q is a measure of the quality of a coil and is given by the expression

$$Q = \frac{L\omega}{R_e}.$$

It will be seen that a coil with a high Q has a large ratio of inductive reactance ($L\omega$) to effective resistance R_e. Like the case of the capacitance previously referred to, the losses in the dielectric material located in the field of a coil can be represented by an increase in the effective resistance that appears at the coil terminals. That is, this energy that goes into heating of the insulating material is lost, just as though it were dissipated in a resistance in series with the coil. The inductance will usually be used in a tuned circuit and the result of this effective resistance added by dielectric loss is to reduce the resonant rise in voltage across the tuned circuit and to broaden the resonance curve, thus decreasing the circuit selectivity. Usually these two effects are undesirable.

Such losses in an inductance may be reduced by using the best possible dielectric material for supporting the coil and by using as small a volume of insulation as can be tolerated and still maintain the necessary rigidity. In the event cement or dope is used to hold the coil turns in place, it should be as low-loss as possible. If the insulating form on which the coil is wound is subject to moisture absorption care should be taken to have it thoroughly dry when the coil is wound, and then it should be dipped in some sort of coil dope or wax that is impervious to moisture. Care should be taken that all the initial moisture is removed by baking or else the moisture-proof coat will seal the remaining moisture in, where it can do the most damage to the electrical properties of the coil. If the material of which the coil form is made has a high coefficient of thermal expansion, the inductance of the coil will change with temperature.

Capacitors. Generally there are two insulation problems connected with capacitors: First, the mechanical separation of the plates by some insulating supports, and, second, the use of insulating medium between the plates. The latter will perform the dual function of keeping the plates separated electrically and at the same time increase the value of the capacitance that is possible to get in a certain volume. We sometimes speak of the power factor of a capacitance just like the power factor of an insulator. A perfect capacitance would have a power factor of zero, and the amount of the power factor is an indication of the losses in the capacitance. These losses are almost all in the dielectric material supporting the plates. As in the case of the inductance they can be minimized by using the best possible dielectric, and as small a volume as is permitted by considerations of mechanical strength and voltage breakdown. In an air condenser there is a rather strong electric field existing at the edges of intermeshed plates as well as between them, and for lowest loss the dielectric supports should be kept out of this intense field.

Where it is desired to get a large capacitance in a small space a solid dielectric material is used between the electrodes. To get a large capacitance a material with a large dielectric constant is required. Unfortunately, this means that not only will the loss be increased by the large dielectric constant, but most materials with high dielectric constants also have a large power factor, making the resulting loss factor very large. Since the magnitude of the capacitance de-

(Continued on page 45)

Adding A Transformer To The Transformerless Pee-Wee

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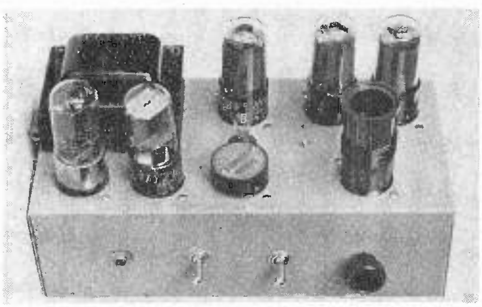
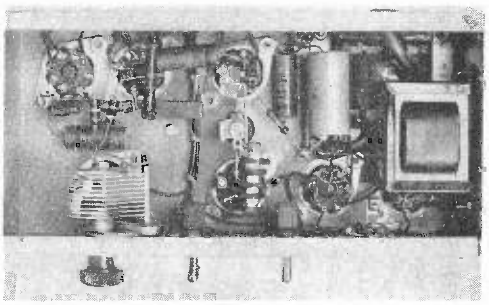
The much publicized "pee-wee" transmitter for transformerless operation has its drawbacks, as this manuscript proves. You can build a better midget c.w. set by following the technical details recommended by the laboratory staff. The information is short and sweet, otherwise it would consume more space than the actual transmitter itself.

★

THE principal advantages of the transformerless midget transmitter are its extreme simplicity, low cost, and general compactness. Something must obviously be sacrificed if all these conditions are desired, yet something can also be added which costs but little, but pays dividends in numerous ways. The addition is a small transformer to the transformerless transmitter; one of the little BC units will suffice. The inclusion of this transformer permits grounding of the chassis, keeps the 110-volt a.c. line clear of all external circuits, and it will then no longer be necessary to connect one side of the line to the key for negative keying in the cathode lead. Possibility of short-circuits and shock to the operator are also reduced considerably. It would therefore appear that the low cost of a small transformer is a worthwhile addition to the "pee-wee" circuit. Heavier current than normal can be drawn from the small transformer because only its plate winding is in service. Higher voltages are likewise secured, with a consequent increase in power output from the r-f portion of the transmitter.



Top view of miniature c.w. transmitter, showing small BC transformer, tubes, and final r-f plate coil.



Bottom view. Note midget 8μf. filter condenser and small size of other essential components.

The circuit gives all constants and values, and the photographs show the utter simplicity of a transmitter of this type. The oscillator includes a 25L6GT in a *Pierce* circuit and the output stage has two tubes of a similar type in parallel connection. The two rectifiers are type-25Z6GT. The combination of these five tubes with their filaments in series will be correct for operation from the 120-volt a.c. line.

The final tank condenser is grounded to the metal chassis and constructional problems are thereby simplified. This condenser has a maximum capacity of 150$\mu\mu$f. in order to enable it to cover the 80-meter band with comparative ease. The final stage is not neutralized. Low-voltage components can be used throughout, except for the filter condenser, which should be rated at 500 working volts. The new-type small tubular 8μf. condenser is satisfactory for this purpose.

(Continued on page 44)

10-20-Meter, 30-Watt Radiotelephone Transmitter

★

December A.R.D. carried the details for building a practical VFO unit. The response from readers has been exceptionally gratifying, and many have enthused over the splendid success achieved. A companion r-f and modulator unit for operation from this VFO has just been completed and is here described. The ensemble is now on the air at W6WB. It was built by Clayton F. Bane, from whom we received the technical details for the preparation of this manuscript.

A Staff Article

THE ittle transmitter herein described was originally designed and built as a companion exciter for the VFO previously shown in this magazine. This VF oscillator operated with output on 80 meters only, and consequently left somewhat of a gap for operation on the higher frequencies. The companion unit fills this gap, not only as an exciter with reasonable output down to 10 meters, but with a still further advantage in that it has its own modulator and may thus be used as a complete transmitter with either the VFO or a crystal for the frequency control.

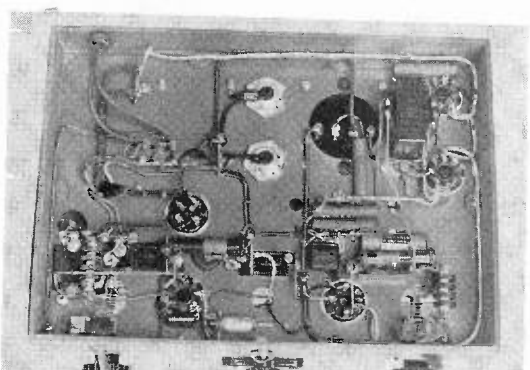
Mechanically the unit is very compact, being 12-in. long, 1½-in. high, and 10-in. wide. While this particular model was built on a cast aluminum frame with a sheet metal top, there is no reason why a conventional steel chassis can not be used. Keeping in mind the possibility of building it into a larger unit at some future time, no effort was made to provide a front panel. In laying-out the controls it would be well to keep symmetry in mind against the time when a panel might be added.

Basically the unit consists of a first stage with a 6L6G or 6L6GX, either a doubler or a quadrupler. The second or output stage is an 807 which always operates as a doubler. The modulator is simply a pair or 6L6G tubes in push-pull, directly driven from a high-gain microphone transformer in conjunction with a Western Electric type-F1 carbon mike.

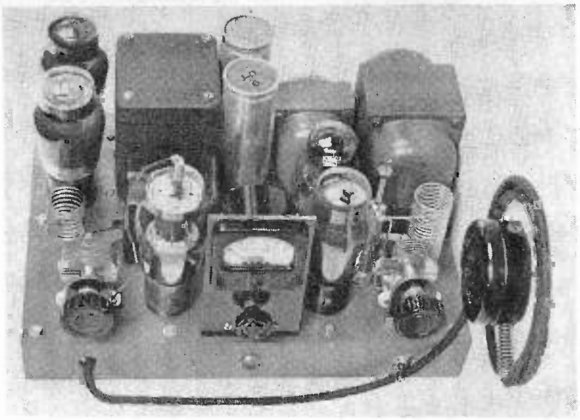
The power is provided by a transformer with filament windings for rectifier, modulator and both RF stages. Condenser input was chosen because it permits a greater output voltage than could normally be obtained from a small power transformer. Incidentally, a good paper condenser (preferably oil-filled) must be used on the input side. Electrolytics are not suitable for this application.

The transmitter follows convention rather closely in most respects and its operation is reasonably simple. Worthy of mention, however, is the omission of r-f chokes in both grid leads of the two r-f stages. Since both of these stages are always working as frequency multipliers they require high bias (large grid resistors). These large resistors offer reasonable impedance to the r-f voltages to the grid, and hence obviate the normal r-f chokes. The chokes should be eliminated if possible, since they are apt to give rise to self-oscillation.

For initial tuning-up the following comments should prove helpful: The first 6L6G works as douber for 20-meter output from the 807, and as a quadrupler when 10-meter operation is desired. While it is possible to



Bottom view of the 10-meter Transmitter. Note care exercised in layout and wiring.



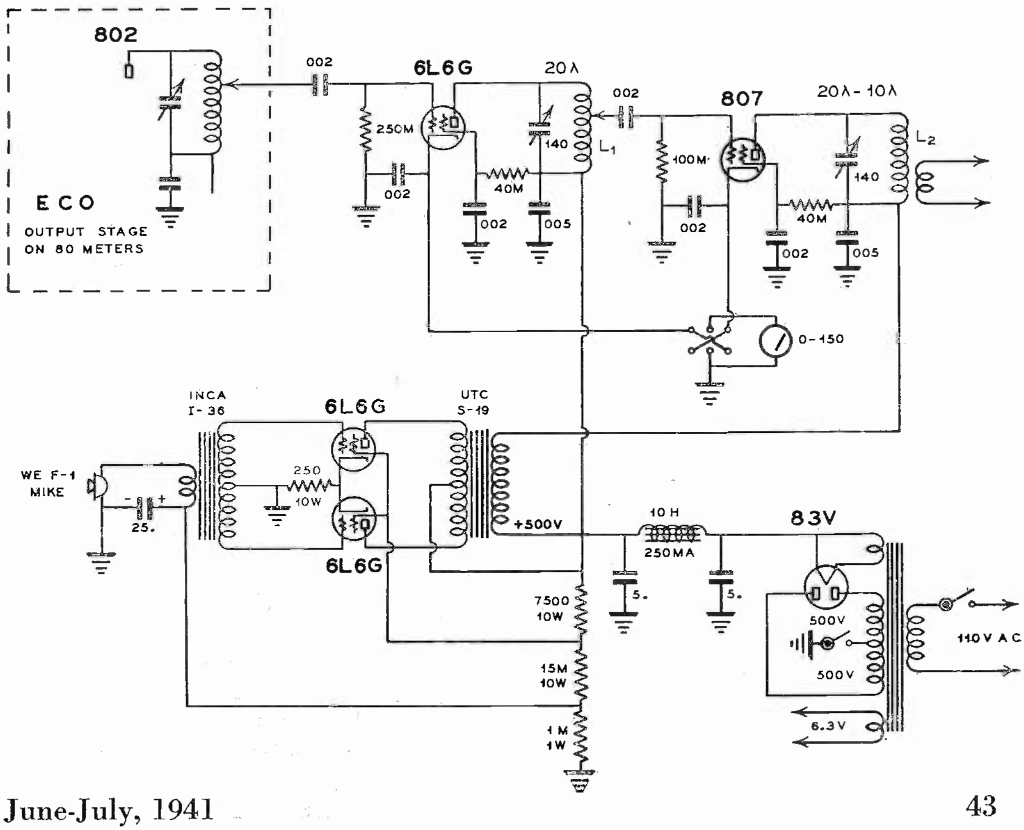
Low power 10- and 20-meter r-f unit and modulator for operation from VFO or crystal oscillator. All of the components are mounted on a chassis only 12-in. x 10-in. If you want a small 'phone transmitter, one which has been correctly engineered, here it is.

operate the 6L6G as a quadrupler for 20 meters and run the 807 straight through, it has been found that due probably to the small size and close spacing of components, oscillation is very apt to occur. This is eliminated by never attempting straight-through operation.

Capacity coupling is used throughout in the interests of simplicity. In the initial set-up it must be remembered that when the L/C circuit of the 6L6G stage is required to cover both 40 and 20 on the same coil, the shunt capacities cannot be excessive, else the circuits will not cover this 2-to-1 ratio. The tap to the 807 grid will have a decided effect on this shunt capacity and hence must be set so that proper dips can be obtained for both bands.

The same comment appies to the 807 output. If the coil is self-supporting, slight alterations of the inductance can be obtained by changing the spacing of the turns until both bands hit on the one condenser.

In setting up a transmitter of this type for



the first time it is essential that an accurately calibrated absorption frequency meter be available. For example, it is easily possible to triple in the first stage instead of quadrupling. The dip on doubling and tripling is very pronounced, whereas the dip on quadrupling is slight. Since the 807 will require very ittle grid drive, false dips in this stage are easily possible. Many times this stage will show a dip by multiplying from some one of the harmonics from the VFO which is at a much lower frequency. These harmonics apparently feed through the 6L6G stage. It is thus practically a waste of time to attempt operation without some positive means of identifying the output frequency.

It will be noted that metering is accomplished by switching the common meter to either cathode. Long leads in this metering circuit are very apt to give rise to oscillation and varied spurious effects. The individual cathodes *must* be by-passed to ground directly at the socket. In some cases, it wil be found that oscillation is traceable to common coupling through the filament circuits. The remedy is to by-pass the hot side of the filaments (the other side being commonly grounded) to either of the two cathodes or to ground. If oscillation trouble is experienced, try by-passing to various spots on the chasis from either or both cathodes. Common coupling through impedance due to long ground return paths must be broken-up to avoid oscillation on 10 meters. One sure way to determine whether you are making progress is to watch the meter as you try various ground points.

The modulator is a very simple affair since it is only intended for low power operation and must not take up too much space. Its inclusion is worthwhile if only to have a small transmitter available when making repairs or additions to the final output stage or as an auxiliary set for defense service.

A speech driver stage would be desirable, but space limitations prohibit its use. As the unit now stands, one must speak closely into the mike for proper modulation. For somewhat more speech gain a 1,000 ohm resistor (1 watt) can be connected from the socket side of the modulator cathodes to the bottom of the primary of the mike transformer (this connects to the 1,000 ohm resistor in the voltage divider). This addition wil give somewhat greater microphone voltage with consequent greater mike pick-up.

Other details of construction and layout can be had by reference to the photographs.

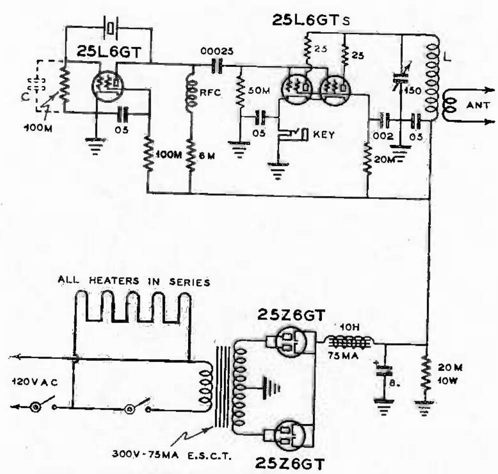
This little transmitter has given an excellent account of itself when operated in conjunction with the electron-coupled oscillator described previously. Operation is reliable and stable, and it is strongly suggested that even if the unit is intended as an exciter (it will work nicely on 40 meters by simply changing coils), the modulator unit and the press-to-talk system should be included. The pleasure to be derived from the unit as a complete transmitter will completely justify the small additional expenditure.

A TRANSFORMER FOR THE TRANSFORMERLESS PEE-WEE

(Continued from page 41)

Two toggle switches are mounted on the front side of the chassis; one is connected in the filament circuit, the other in the plate circuit. The final r-f tubes are connected in parallel and the cathode circuit is keyed for c.w. operation. Suppressor resistors are sometimes required if the final amplifier has a tendency to self-oscillate.

This small and neatly arranged transmitter is very simple to build and no special tools are required. It will give a good account of itself on any of the amateur c.w. bands, even though the power output is only 10 watts.



Simple circuit for a midget c.w. transmitter of improved design

R-F INSULATING MATERIALS

(Continued from page 41)

pends upon the physical and electrical constants of the solid dielectric material, particular care must be taken to prevent the entrance of moisture. If the dielectric has a large coefficient of thermal expansion the capacitance will also change with temperature.

Transmission Lines. There are three types of radio-frequency transmission lines in common use—open wire, coaxial, and twisted pair. In the case of the open wire line, the conductors must be separated from each other and held clear of nearby objects. The spreaders, being under little strain, may be small and light in weight. The supporting insulators usually have to be quite rugged to support the line when it is loaded with ice. Because of their exposure to the weather insulators for open wire lines should be of a type that will not absorb moisture. The losses in an open wire line may be made very low, provided high grade insulators are used.

covered with some material impervious to moisture to prevent water getting through the wire braid forming the sheath. It is, of course, an advantage to have the insulating spacers made of a material that will not absorb moisture.

Twisted pair lines are nearly always insulated with rubber and while they find considerable use at low frequencies on account of of their low cost, their rapidly increasing loss makes them quite unsatisfactory at high radio frequencies.

Tube Sockets. In tube sockets there are both mechanical and electrical problems to be met. Because of the fact that tubes are likely to be put in and pulled out of the socket by none too gentle hands, the mechanical details of mounting the socket on the chassis as well as mounting the prong contacts in the socket, must be given careful consideration. The direct-current voltage breakdown between adjacent contacts is usually well in the thousands of volts and is not a problem with the exception of high-voltage rectifier tube sockets for television receivers.

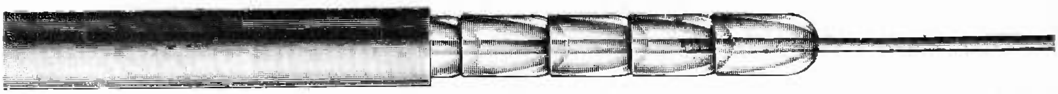


Fig. 3.

Coaxial lines are of two types, flexible and rigid. The rigid lines have an insulating spacer placed at intervals to keep the center conductor exactly in the center of the outside pipe. This line can be made to have very low loss provided the insulating spacers are of good quality. These spacers may take the form of disks, or sometimes triangles (see Fig. 3), the latter shape being chosen to cut down the volume of the dielectric to the least possible amount. In flexible lines the space between the coaxial conductors is almost entirely filled with the insulating material, and its quality becomes very important in determining the losses in the line. Some flexible lines have rubber insulation. The losses in these lines vary widely depending upon the quality of the rubber used, some being very poor. Losses in rubber insulated lines increase very rapidly at the higher radio frequencies. A better although more expensive type of flexible coaxial cable is made using interlocking beads of some solid dielectric material such as shown in Fig. 3. Such cables have less loss than those with rubber insulation at low radio frequencies, and the advantage becomes greater the higher the frequency. Rigid coaxial lines are usually filled with dry nitrogen gas under slight pressure to keep out moisture and flexible lines for outdoor use should be

The grid and cathode prongs on a socket are connected directly to the two terminals of the coil in the tuned grid circuit of the tube in the case of an RF or IF amplifier. This means that both the socket loss and the loss in the dielectric in the base of the tube are added to the losses of the tuned circuit, thus decreasing its Q. Some have argued in the past that why should a good low-loss socket be used when the tube base is "molded mud"? The answer is that with a good socket and a poor tube base the added loss is just half what it would be with a poor socket and poor tube base. The glass bases of the loctal types and the new miniature series give us much less loss than the molded bases used on other types.

Antennas. Antenna insulators usually consist of stand-off insulators to support more or less rigid structures, or strain insulators to support wires. While these insulators have rather obvious mechanical requirements to meet, they may or may not have to have low electrical losses. The loss in a dielectric of any kind results from the electric current that flows in it, and in order to have a current flow there must be a difference of potential. Thus if there is no voltage between the ends of an insulator, no current will flow in it and there will be no

(Continued on page 48)

Proper Operation of Screen Grid Tubes

The large beam-power tube offers wide possibilities in the design and construction of a c.w. or combination voice-telegraph transmitter for defense communication because it can be made portable, due to the generous saving in circuit components. A transmitter for high-power c.w. telegraph service can be built around the RCA-813 on a single metal chassis, power supply and all. The correct operation of this tube is detailed in the text which follows. This information supplements the constructional data published in the April-May issue.

By Frank C. Jones, Technical Editor

MANY amateurs have hesitated to purchase large tubes of the screen-grid variety because the beam-power versions are costly and especial care must be exercised in the circuit design before the actual construction of the transmitter is under way.

One of the advantages of the larger beam-power tubes is their high power sensitivity, which is a ratio of output power to grid driving power. The power sensitivity of an RCA-813, for example, ranges from somewhat over 100 up to approximately several hundred. The usual triode amplifier has a power sensitivity ranging from 10 to 30, which is approximately one-tenth that of a screen-grid tube. This means that a stage of amplification can be eliminated in the transmitter design, and the grid circut of the beam-power tube can be driven directly from a crystal oscillator or ECO unit.

High power sensitivity requires good electro-static shielding between the r-f output and input circuits in order to prevent oscillation. The usual design is to mount the tuned plate circuit above the metal chassis, and the control-grid tuned circuit below. It is also desirable that the tube shield extend part way up the tube.

The grid-to-plate capacity is less than 0.2$\mu\mu$f in an RCA-813, which means that no neutralization is necessary in adequately shielded and by-passed circuits. Elimination of neutralization adjustments simplifies the problem of operation on several bands, which is an especial advantage in a band-switching transmitter.

The control grid, corresponding to the normal grid of a triode tube, is screened from the plate by means of a screen-grid structure. The screen-grid is made positive with respect to filament, or cathode, and the power output and plate current depend upon the value of d.c. screen voltage. Some types of screen-grid tubes will deliver as much power output with low screen voltage and high control-grid current as would otherwise be obtained from high screen voltage and low control-grid current. If the grid circuit driver lacks sufficient power output to drive the beam-power tube in the 10- and 20-meter bands, it is sometimes possible to maintain a desired value of power tube output by increasing the screen-grid potential by an additional 50 or 100 volts. In this procedure, care must be taken not to exceed the manufacturers' ratings for maximum screen dissipation, which can be calculated by multiplying the d.c. screen voltage by the d.c. screen current.

Many screen-grid tubes are damaged by excessive grid circuit drive. Tubes of the RCA-813 type seldom require more than 5-ma. of d.c. grid current for any type of operation.

The input and output capacities of an RCA-813 are 16.3$\mu\mu$f. and 14$\mu\mu$f., respectively, which is several times as great as for a triode of similar power rating. It is therefore difficult to secure a reasonable L/C ratio in the 10- and 20-meter bands. The 813 can be used at maximum ratings up to 30-mc., but the actual r-f power available into the antenna circuit will usually be much less in the 10-meter band than in the low-frequency bands, such as 40 or 80 meters.

The screen-grid voltage should preferably be obtained from a separate low-voltage source. rather than from a series resistor. Or, the voltage can be obtained from a tap on the bleeder across the high-voltage supply. The screen-grid current may increase beyond its maximum rating with a series-resistor connection when the plate current is cut off, unless sufficient grid-bias is applied to cause screen current cut-off as well as plate current cut-off during the period when no r-f excitation is applied. The d.c. screen voltage in the series resistor method will rise to excessive values when the plate current is reduced to zero. This means that the screen-grid voltage supply should preferably be obtained from a bleeder connection, or from a separate low-voltage supply, in order to avoid excessive bias on the control-grid.

Screen-grid amplifiers sometimes seem to tune differently than the conventional triode amplifier circuits. A heavily loaded screen-grid amplifier will show scarcely any plate current dip at resonance; tuning should be accomplished by an indication of maximum output, as shown by a meter or a flashlight bulb in the antenna feeder system. A moderately loaded screen-grid amplifier can be tuned for the usual plate current dip at resonance. If the d.c. meter is connected in the center-tap, or cathode lead, the summation of screen-grid and control-grid current as well as plate current will be read, and the dip at resonance will be correspondingly less pronounced.

By-passing for radio frequencies is very important in high-gain tube circuits, since any feed-back developed across a common impedance will cause either regeneration or degeneration. Degeneration reduces the power sensitivity, and regeneration may cause oscillation or unstable operation. The mica by-pass condensers should be connected with very short leads from the tube socket and by-pass points to the common ground. The screen-grid by-pass condenser should have a value of at least .005μf., and very often oscillation difficulties can be eliminated by increasing its value to at least .01μf. The plate and screen by-pass condensers can be connected in series in order to minimize the by-passing effect at high audio frequencies in a plate- and screen-modulated r-f amplifier. This precaution is necessary only when the amplifier is to be modulated. It is possible to key the screen circuit or center-tap lead for c.w. operation. If the stage is keyed in the screen-grid lead it is desirable to use a high-voltage keying relay for the operator's protection.

The RCA-813 beam-power tube can be driven by any ECO unit capable of supplying at least 5 watts output. The actual grid driving power ranges from approximately 0.5- to 1.2-watts, but the external circuit losses may consume several times as much power as the actual grid circuit proper. For 160-, 80-, 40- and even 20-meter operation it is possible to use a 6A6 crystal oscillator-doubler as a driver. Operation in the 10-meter band can be accomplished by the addition of a 6L6 doubler stage, which will supply ample driving power to compensate for the higher circuit losses in the 10-meter band. Some method of adjustment for r-f grid excitation is essential in order to hold the grid current to the prescribed low value of 5- or 6-ma. A tuned grid circuit with semi-adjustable link-coupling to a separate exciter stage is highly recommended.

* * *

New RCA Tubes

RCA-6SF7—Diode—Super-Control Amplifier Pentode

RCA-6SN7-GT—Twin-Triode Amplifier

RCA-12SF7—Diode—Super-Control Amplifier Pentode

The 6SF7 is a multi-unit, single-ended, metal tube containing a remote cutoff pentode and a single diode detector. The tube is recommended for use as a combined i-f amplifier and detector. When so used in phono-combination instruments, the 6SF7 minimizes the difficulty from "play-through" from the radio set. The 6SF7 may also be used as a resistance-coupled a-f amplifier and will give the same high gain and voltage output as other similar pentodes.

The 12SF7 is identical with the 6SF7 except for its heater rating of 12.6 volts and 0.15 ampere.

The 6SN7-GT is a single-ended, twin-triode amplifier having separate cathode terminals for each triode unit. It is recommended for use in resistance-coupled circuits as a voltage amplifier or phase inverter. The 6SN7-GT has a T-9 bulb. From the circuit designer's standpoint, the 6SN7-GT with its separate cathode terminals for each unit offers much greater fexibility in application than do other twin-triodes having only a single cathode terminal.

* * *

New RCA Miniature Tubes

The RCA-45Z3 is a miniature, half-wave high-vacuum rectifier of the heater-cathode type. Designed specifically for service in a-c/d-c/battery-operated portable receivers it offers the advantages of small size and low heat dissipation. Its heater requires only 0.075 ampere at 45 volts and its output rating makes it capable of supplying rectified power for both filament and plate circuits in light-weight a-c/d-c/battery-operated receivers utilizing the miniature type tubes.

The RCA-3Q4 is a new, miniature type, power amplifier pentode suitable for operation with 90 volts on plate and screen. It has a power output of 270 milliwatts with 7 per cent distortion. The filament of the RCA-3Q4 has a center tap which permits economical usage of this tube in series-filament arrangements with other miniature tubes. The advent of the RCA-3Q4 makes possible the use of miniature tubes throughout in all classes of battery receivers.

R-F INSULATING MATERIALS

(Continued from page 45)

losses, no matter how poor the dielectric is. This is of particular interest in the case of antennas which have standing waves of voltage and current on them. Consider the case of a half-wave antenna shown in Fig. 2. The solid line shows the distribution of current and the dotted line shows the value of the voltage at various points along the antenna. It is seen that at the ends of the radiator the voltage is a maximum. This means that when an insulator is placed at the end of a half-wave antenna it should be a high quality dielectric because of the high voltage existing there. It will also be noted on the figure that at the center of the antenna the voltage is zero. Provided the antenna is not opened at this point for feeders, it may be connected directly to ground without any insulation and there will be no loss or leakage because the voltage is zero. Even if the radiator is broken and feeders are attached at this point, the voltage is still low and the insulation problem is not difficult. When a choice is possible, antenna insulators should be placed at points where the voltage is low, thus giving lower losses.

Properties of Solid Insulating Materials

This tabulation has been compiled from a variety of sources. They include measurements by the author, data furnished by the manufacturers of insulating material, and various similar tabulations published in handbooks, trade publications, etc. It will be noted that a range of values is given in many instances. This arises from two causes. First, many materials are manufactured in different grades each having somewhat different characteristics, and in the interest of brevity it was not possible to give individual listings to each variation in material. In the second place, it is found that insulating materials which are supposed to be identical may exhibit different electrical characteristics due to small structural differences, contamination by foreign matter, or unintentional variations in processing. This is true whether the materials are natural or manufactured substances.

Individual Characteristics of Solid Insulating Materials

Amber. A natural resin, light orange or yellow in color, sometimes transparent or nearly so. It is used mainly in insulating electroscopes where its very small leakage is desirable. It occurs only in small quantities and is very expensive. It is seldom used in radio work.

Cellulose Acetate. A plastic material widely used for slow burning "safety film." It is soluble in acetone and similar solvents and is unaffected by water and oils. Its large water absorption makes it unsatisfactory for radio use, particularly where exposed to high humidities. Its loss factor is about the same as the poorer bakelites.

Cellulose Nitrate. Quite similar to cellulose acetate except that it is highly inflammable.

Fibre. Vulcanized fibre is generally made from rags and has many of the characteristics of paper. Its main disadvantage is that it will absorb enormous amounts of water, making it unfit for many electrical uses. It is inexpensive and easily obtainable and is quite inexpensive. It warps badly when dried and swells when wet. The best quality is used for slot insulation in electrical machines and is known as "fish paper." The loss factor is the same as the poorer bakelites.

Glass. Pyrex and flint glass have considerably better loss factors than Crown (window) glass and are also better than any of the bakelites. They are likewise stronger and have smaller expansion coefficients. None of the glasses will absorb water but their fragility and the fact that they cannot be machined prevent their wider use in radio work. The main application has been in insulators for open wire lines and antennas. There is a tendency for the surface to weather slightly, resulting in its catching dirt and increasing the surface leakage.

Methacrylic Resin. This material is a synthetic resin, one form of which has been widely publicized under the trade name of "lucite." The methacrylate products made by different manufacturers vary considerably in their electrical characteristics as these resins can be made in many different forms, all appearing about the same mechanically. The loss factor will be about the same as the best bakelites, and the material will absorb moisture. These characteristics make it unsatisfactory for ultra high-frequency or outdoor use. It is generally made in a clear transparent form and is sometimes confused with polystryrene which has similar optical and mechanical properties but which is much superior electrically. The methacrylates are soft and easily machined and will not break or shatter easily. They have a relatively low melting point, which must be watched in some applications. They will transmit light around corners, giving spectacular optical effects.

Mica. A natural mineral material, mica is

(Continued on page 54)

Technical Correspondence from Readers

Stephen Girard Hotel
Chestnut St. W. of 20th
Philadelphia, Penna.

May 13, 1941

The Editor
Amateur Radio Defense
Monadnock Building
San Francisco, Calif.

Dear Sir:

I have just received the April-May, 1941, issue of your excellently edited and most interesting magazine and have noted with interest the article upon pages 24, 25 and 26 by F. D. Wells, W6QUC, entitled "At Last!—a harmonic oscillator that requires no regeneration—will not self-oscillate——and operates with almost any type of crystal. A boon to the amateur."

It is believed that two errors have occurred therein, inasmuch as between Figs 2 and 3, page 25, appears a note advising connection of pins 1 and 3 of the 6AG7 tube to ground, whereas paragraph 3, column 2, page 26, suggests connection of pins 1 and 2 of the 6AG7 to ground. Additionally paragraph 2, column 2, page 26, mentions an isolating by-pass condenser inserted between crystal and screen and suggests that this is indicated in figure 3, page 25. The position of the condenser is obvious, but it does not appear to be physically indicated in figure 3; while it might be more accurately referred to a "blocking" rather than a "by-pass" capacitor.

The basic purpose of the article is most interesting and as the writer understands it, seems to propose—for the first time in print to his knowledge—the use of the control grid, screen and cathode a tetrode tube as Pierce oscillator with RF output taken from the plate circuit, coupled to the oscillator elements of the tube only through, or primarily through, the electron stream.

At the moment due to not being permanently settled, the writer does not have access to his rather large file of witnessed and dated disclosures of inventions, but he is certain that he can show witnessed and dated disclosure of the basic system described by Mr. Wells which will prove to antedate your April-May, 1941, issue by approximately two years or more. The writer believes that, for the moment at least, credit for the conception of the idea should go to him.

He has done some experimental work with the circuit in question, employing 6L6, 6V6, 807, RK23 and other low power multi-element tubes with quite satisfactory results. He has not observed, however, the invariable absence of need, stressed in the Mr. Wells article, for the dotted-line capacitor "C" of figure 1 which in a Pierce oscillator circuit is a feedback coupling condenser often necessary in the case of tubes having low-grid-to-cathode capacity to promote oscillation, particularly with low frequency crystals. His experimental work upon this circuit was cut short by the demands upon his time of national defense work, which has not as yet permitted him to explore the possibilities of this circuit completely, but it appears to be meritorious and most useful. He now has a rather interesting piece of equipment in design and development based upon this circuit.

It is hoped that you will see fit to publish this letter, as it may be of interest to your readers.

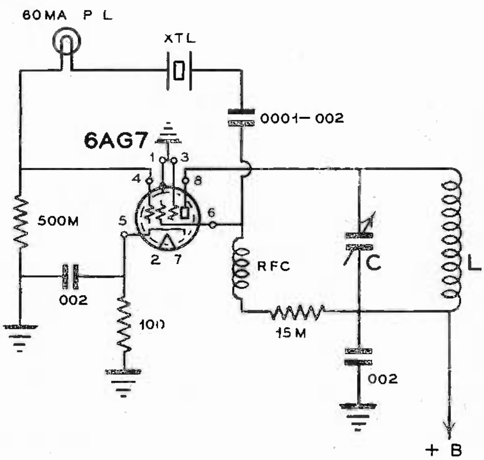
Cordially yours,
(Signed) McMurdo Silver.

CC: To Editors of: Radio Limited, Radio News, QST Magazine, Short Wave & Television Co., F. M. Publishing Co.

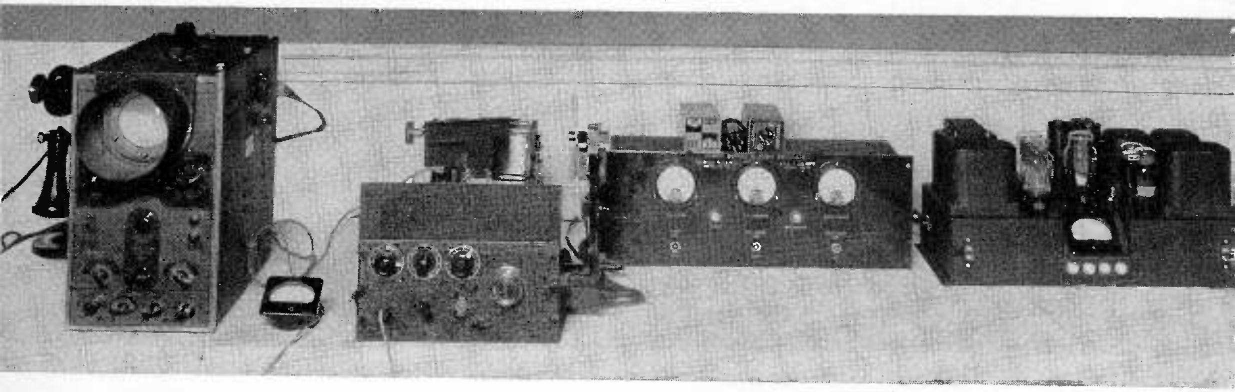
Editor's Comment:

. . . Mr. McMurdo Silver is known to the amateur fraternity as one of the outstanding pioneer circuit developers. His original circuits and other innovations have been widely used by the amateur for twenty years. The editors of A.R.D. are happy to learn that he claims originality in the discovery of the new oscillator circuit suggested by Mr. F. D. Wells of our technical staff, although it was believed by Wells that he had scooped the field. The fact that nothing had previously appeared in print in connection with such a tube in an oscillator circuit, and the further fact that Mr. Wells went about his work without previous knowledge of what other engineers were doing, is proof that he perfected this new oscillator without benefit of outside aid. It is conceded, therefore, that "great engineering minds in the radio field wander in the same channels." It may be fitting to name the new oscillator "Silver-Wells," but here's hoping we can stop right there! In his letter, Mr. Silver makes further reference to a typographical error in the text relating to the ground connections of the tube socket pins. The engineering drafting of the circuit as published in the last issue of A.R.D. is correct in every respect, but there was an error in typesetting the text. A final circuit diagram of the complete oscillator is shown. It differs not from the original, and it is published merely to show our version of this new oscillator in a form which will be adopted as standard for future application. The blocking condenser has been added, in line with Mr. Silver's suggestion, and this additional component will prevent the operator from being shocked (electrically) if the crystal should be accidentally touched while the power is turned on. The little condenser was not included in Wells' original circuit because, as he puts it: "Why finger the crystal holder while the transmitter is in operation?"

* * *



Circuit diagram of Wells Harmonic Oscillator with correct identification for tube pin connections. Many readers report exceptional success from this newest of oscillator circuits. Care must be exercised to select crystals with one "hump" only.



The Engineering Forum

Conducted by F. D. Wells

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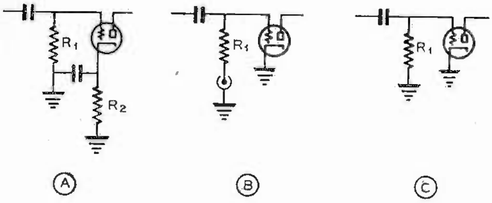
Item No. 15—Comparison of Bias Methods

THREE methods of bias are commonly used in audio circuits. The relative advantages and disadvantages of each, as treated in this discussion, will give the reader a general idea of why and when a particular method should be chosen. The information is by courtesy of Mr. James Sharp.



The circuits are marked *A*, *B*, and *C* in the accompanying diagram. Circuit *A* is probably the most widely used of the three. It consists of a resistor in the cathode circuit of the tube; the plate current which flows through this resistor produces a voltage drop and thus serves as bias for the stage. It is ordinarily by-passed with a condenser large enough so that its impedance at the lowest frequency to be used is considerably lower than the bias resistor proper. The grid resistor R1 ranges from 0.25- to 2-megohms. The cathode resistor R2 is of a value of 1,000 to 5,000 ohms for the average type of tube. Condenser *C* has a capacity of 10μf. for average frequency response in audio circuits. The advantage of this system is its ability to completely control the bias by adjusting the value of R2. Its disadvantages are: (1) The condenser determines the low frequency response, and hence good low frequency response calls for a large capacity with consequently higher cost. (2) The condenser is usually of the electrolytic type and this type is not entirely satisfactory for by-passing r-f. (3) The cathode of the tube is above ground, with the consequent possibility and probability of introducing hum into the circuit.

Circuit *B*: In this circuit R1 has a value of from 0.25- to 2-megohms in series with a bias cell. The cathode is connected directly to ground. The bias cell proper furnishes a source of voltage to operate the tube on the correct portion of its characteristic.

There are several advantages in favor of this circuit—(1) It obviates the need for the cathode by-pass condenser and by reason thereof it removes the hum problem and the non-uniform frequency response attributable to a condenser in this portion of the circuit. (2) Bias cells are more economical than a condenser and resistor. (3) The bias voltage adjusts itself to any changes in contact potential of the grid to cathode.

The sole disadvantage of this form of connection is that the bias voltage is either 1- or 1¼-volts, a value automatically fixed by the cell, but this is not usually an objectionable feature.

Circuit *C*: Resistor R1 has a value of 10-megohms. The coupling condenser connected to R1 should have very low leakage.

The advantage of this circuit is its utter simplicity, in that the fewest components are required, and it is not critical in operation. It is generally used in battery-type portables and low-cost receivers, where the size of the loudspeaker makes high harmonic content unimportant.

The disadvantages of this circuit are numerous: (1) Gas currents and leakage upset the bias considerably. (2) It is suitable only where very small signal voltages are encountered, since the distortion increases as the signal input increases. It is desirable to limit the swing to approximately 0.1-volt. (3) This circuit exercises no control of the bias, since it may be affected greatly by gas, leakage, and contact potential.

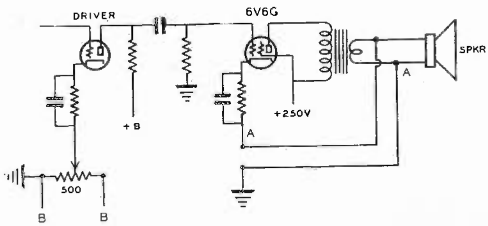
Item No. 16—35L6GT Application Note

THIS item was taken from current RCA Application Notes. The 35L6GT is a beam-power tube especially designed for use in a.c.-d.c. receivers. In many of these receivers the 35L6GT is operated with an unbypassed cathode bias resistor. Because the inverse feed-back provided by this unbypassed resistor reduces distortion, the load resistance can be made larger than the value recommended for fixed bias operation without causing distortion to become excessive. At the same time, the larger value of load resistance may give an increase in power output. The usual value for the cathode resistor is 150 ohms. Measurements indicate that this is approximately the optimum value. Experimentation has shown that power output increases with load resistance for values up to about 4,500 ohms and that further increases in load resistance cause increased distortion, but little increase in power output. From the foregoing it is evident that when moderate amounts of audio power are desired, the cathode by-pass can be dispensed with if the recommended plate impedance is increased to approximately 4,500 ohms.

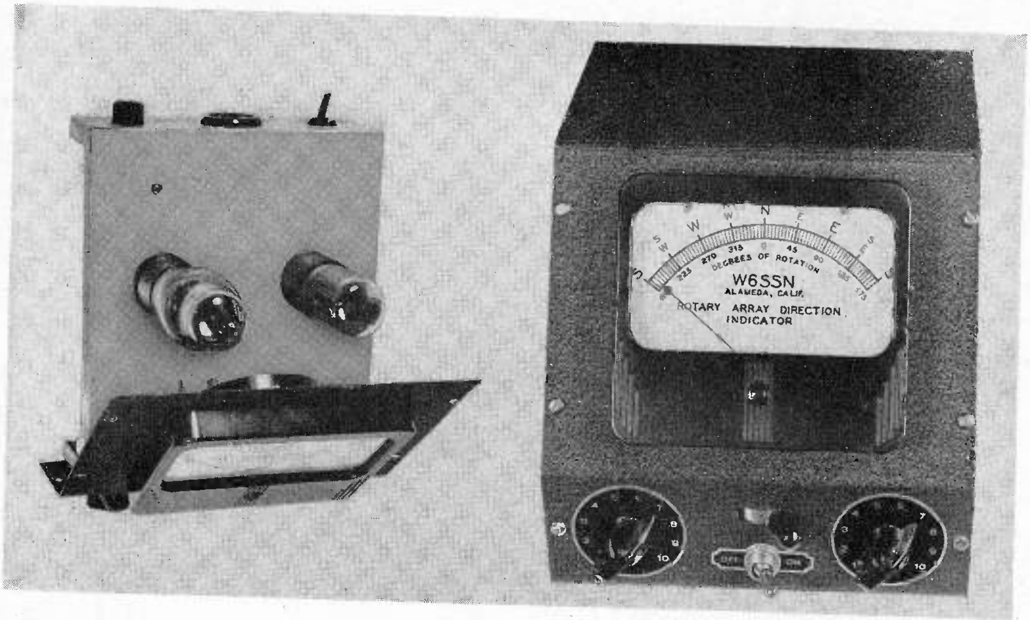
Item No. 17—Simple Inverse Feed-Back

INVERSE feed-back is highly desirable because it reduces the overall distortion and hum in audio circuits. It is only necessary to feed-back a small amount of voltage from the output stage into the audio system in the correct phase to produce degeneration. If, on first trial the entire system oscillates, the leads should be reversed, since an incorrect choice has been made and regeneration rather than degeneration has resulted.

A typical example of the simplified method, as shown by the circuit diagram, is a single-ended output stage, such as a 6V6, 6F6, 42, etc., driven by a triode. The principal feature is a simple method of obtain-



ing the feed-back voltage, i.e., the voltage developed across the voice coil of the loudspeaker. This voltage can be fed into the circuit at two points, either in the cathode of the 6V6, or in the cathode of the triode driver. The simplest method is to disconnect the cathode by-pass and resistor of the 6V6 from ground, then returning these components to ground through the speaker voice-coil winding as shown at *A* in the diagram. The disadvantage of the circuit lies in the fact that the amount of inverse feed-back is not controllable and might not be as great as would be desired. However, if the two leads from the voice coil are connected to points *B*, *B*, as shown in the diagram, the amount of feed-back can be controlled by the 500-ohm potentiometer. The amount of voltage in this connection is a great deal higher than necessary, and any percentage of inverse feed-back can be obtained. This innovation has been used by receiver manufacturers for some time and it may prove convenient for those who desire an improvement in quality without resorting to elaborate circuit designs.



Interior and exterior views of W6SSN's rotary-beam indicating device.

Indicating Device *for* Rotary Beam Antennas

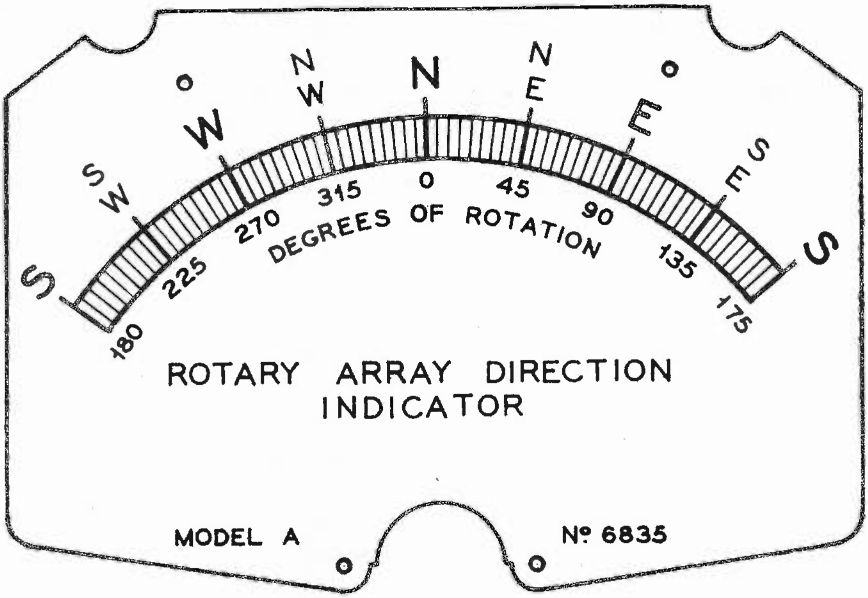
★

This is one of the more elaborate types of beam-direction indicators. It was built by Milt. R. Winsby, W6SSN, who insists upon the best. The indicator scale for the meter is printed in full size in these pages, so that it can be clipped from the magazine and used as a face for a similar scale for your own meter if you, too, want something as "ritzy" as W6SSN demanded.

★

IF you are building a tower or some other relatively costly structure for supporting your new rotary beam antenna, why not invest a few additional dollars in a reliable, accurate indicating device to denote the precise direction to which your beam will point? Many indicator systems have been decribed in the radio press and the device treated in this discussion is not entirely new. Like all things in radio, it is "a refinement on something someone else once built."

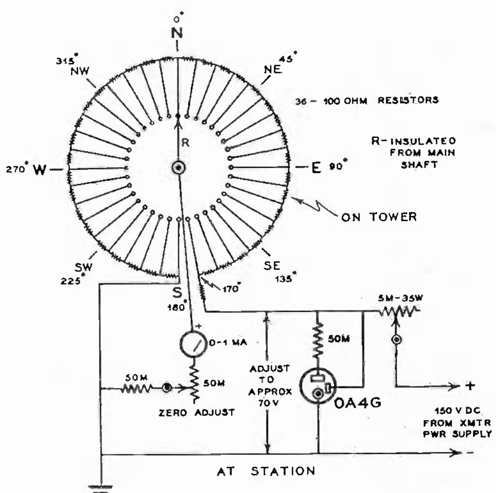
The indicator operates on the principle of a variable rheostat, with a large number of resistor elements arranged at the top of the antenna tower. The circuit diagram shows how these resistors are arranged. The rotating arm of the rheostat is attached to, and insulated from, the rotating driving shaft of the beam. The diagram shows that there are 36 resistors and 36 contacts, with the connecting leads brought into the station and to the indicating device. This method is not entirely accurate as to the exact direction in which the array points, the element of error being approximately 5 degrees, plus or minus. This is sufficient accuracy, however, to meet the requirements of normal amateur transmission or recep-



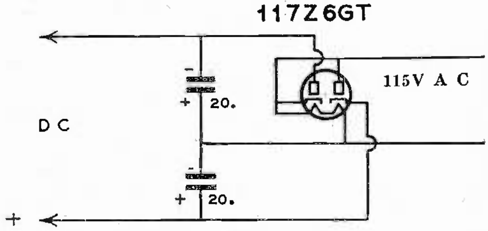
Paste this scale over your own meter.

tion. It was originally planned to use 76 contacts so that a reading on the direction-indicator scale could be had at each 5 degrees, but this was later changed to a less intricate method by using fewer resistors and contacts and yet maintaining a very satisfactory means of indication. The meter is a 4-in. *Triplett* square-type 0-1-m.a. d.c. milliammeter, to which is affixed the special indicator scale, reproduced in one of the sketches. The reproduction has been made full size, so that the reader can merely clip this scale from the pages of this issue and paste it on the face of a meter of similar size and specifications.

Fluctuations in line voltage will result in additional error of the meter reading, particularly when devices such as a refrigerator or other heavy-duty electrical equipment in the household is brought into service. To compensate for this error a type-OA4G gaseous triode of the relay-service variety is used as a regulator tube. The direction-indicator device is powered from a 117Z6GT in a voltage-doubler circuit, as shown in one of the supplemntary circuit sketches. Photographic illustrations show top and bottom views of the complete device. Further information on this equipment will be supplied by the author to any reader who requests it.



Resistor-box connections for indicating device.



Power supply without transformer. Simple and effective.

R-F INSULATING MATERIALS

(Continued from page 48)

widely used for insulation purposes where very thin pieces are required. High quality mica has an exceedingly low-loss factor, and a very large dielectric strength. Its most common use is in separating the plates in small condensers. Unfortunately, it cannot be obtained in large thick pieces and different samples of the same grade sometimes differ in their characteristics. It will stand very high temperatures, which is sometimes an advantage. It is rather expensive.

Mycalex. This is ground mica cemented together with lead borate glass and pressed into molds of various shapes. It is a grey granular material but in spite of its rather porous appearance it has a very low water absorption. Its loss factor is lower than the bakelites but not as good as most steatites. It can be machined with special tools. Like the ceramics, it is easily broken. It wil not stand as high temperatures as the steatites.

Marble. Formerly used extensively for switchboards, marble is seldom used in radio work today. It is very porous and may absorb large amounts of moisture, depending upon the way the surface is treated. Its insulating properties are adversely affected by the presence of conducting veins within the material.

Phenolic Resins. This includes many different forms of phenolic materials, the most generally known trade name being "bakelite." The finished material may be made either formed in sheets or it may be used to impregnate paper or fabric materials. The addition of the paper or fabric gives desirable mechanical properties but the loss factor is adversely affected. The lowest loss material is made by filling the phenolic resin base with ground mica. Phenolic resins will stand only moderate temperatures and will absorb small amounts of water. Their dielectric properties are not as good as hard rubber but they are superior mechanically since they will not corrode metals or deteriorate with age. Phenolic materials may appear alike and yet be vastly different in their electrical qualities.

Polystyrene. The newest of the radio-frequency insulating materials, polystyrene, has come into wide use with the advent of ultra high frequencies on account of its extremely low loss factor, being of the same order as fused quartz. Its moisture absorption is zero and it has an oily surface which tends to prevent the formation of water films and keeps the surface leakage low. It is soft and can be easily machined and is very tough and resilient, being difficult to break or shatter. It is crystal clear in its pure form and, like methacrylic resin, will carry light around corners. Its mechanical properties may be changed somewhat by the addition of various plasticizers, but this usually results in poorer electrical properties. It can be molded in many shapes and also is manufactured in thin films which are used to replace paper in condensers. Polystyrene softens at relatively low temperatures and this must be watched in some applications. It can be dissolved and cemented with a number of solvents and when the solvent evaporates, the original material is left with its excellent electrical properties. It is widely used as a coil dope for this reason. While it resists acids and alkalis, oils will attack it. Methacrylate and vinal resins as well as clear bakelite resemble polystyrene and are sometimes confused with it. Two simple tests can be used to identify polystyrene articles. First, they have a definite "ring" or "tinkle" when dropped on a hard surface. Methacrylates and vinals will give a dull "clack" when dropped. Second, when burned or heated with an iron, polystyrene has a sweetish odor reminiscent of geraniums, while the other materials have a very acrid smell. Polystyrene is moderately expensive.

Porcelain. Wet or dry process porcelains have loss factors about the same as the bakelites and they will absorb moisture, the amount depending upon the surface treatment. Even when this loss can be tolerated they are sometimes unsatisfactory on account of their relatively low tensile and compressive strengths. Usually a steatite material is well worth the extra cost from the standpoint of both loss and strength.

Quartz. Fused quartz has an extremely low loss factor and no moisture absorption. It will stand very high temperatures and is quite strong. However, it is very expensive and can be machined only with great difficulty. Its volume resistivity is the largest of any known solid material. It has an exceedingly low coefficient of expansion.

Rubber. Hard rubber has a loss factor about like the best bakelites but this property is seriously affected by high temperatures so its temperature range is limited. It will attack metals due to its large content of sulphur. It is attacked by oils. It is easily machined and was used quite extensively before the advent of the phenolic resins.

**Strictly speaking, a vacuum.*

Washington Reports on Television

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Adoption of National Television System Committee Standards Paves Way for Inaugurating Television Commerical Service July 1.

TELEVISION can make its nation-wide commercial debut on July 1 under the auspices of regulations adopted by the Federal Communications Commission.

Whereas a year ago the Commission found the television industry divided recent developments demonstrate the industry is "entirely in agreement that television broadcasting is ready for standardization." Accordingly, the Commission has adopted, in substance, the standards as proposed by the National Television System Committee at the March 20 hearing, as well as the rules and regulations submitted at that time.

These standards, observes the Commission, "represent, with but few exceptions, the undivided engineering opinion of the industry." They "satisfy the requirement for advancing television to a high level of efficiency within presently known developments."

This "go-ahead" signal fulfills the Commission's promise of last year that as soon as the industry's engineers were prepared to approve any single system the Commission would consider full commercialization. The showing made at the March hearing supported the Commission's previous action in declining to set standards when the industry was sharply divided and any attempt to have done so would have frozen the state of the art to the then unsatisfactory level of performance. The approved standards alleviate the problem of different receivers being required to "key" into varying competing transmission systems. The standards take cognizance of recent outstanding improvements in synchronizing signals which contribute materially to a more reliable operation.

The standards fix the line and frame frequencies at 525 and 30, respectively. The 525 lines provide for greater detail in the pictures transmitted than the 441 lines advocated a year ago. This change will be helpful in view of the trend to larger screens on current receivers.

Frequency modulation is required for the sound accompanying the pictures. Thus, television is now benefited by the recent developments of frequency modulation.

Other developments are provided for in the requirement that the standards be accorded six months of practical tests, at the conclusion of which further changes may be considered, with particular reference to color television. Program stations are encouraged to engage in experimental color work.

On the record made at the March hearing, the Commission fixes 15 hours a week as a reasonable minimum for program service.

On the plea that more than the seven lower channels in the present television band are needed for adequate development of commercial service, the Commission is making the 11 upper channels likewise available.

The television stations authorized by the Commission within the past 10 months for preliminary experimentation with programming, because of their geographical diffusion, provide the nucleus for a widespread television service, which will be augmented by the Commission expediting the transition of experimental to commercial operation.

The Commission adheres to the policy set forth in its report on the April, 1940, television hearing, which precludes more than three television stations being under the same control. This is to preserve the public benefits of competition in the use of the limited number of channels.

"Statistics of Communications Industry" Yearbook Placed on Sale by Superintendent of Documents.

FINANCIAL and operating data relating to common carriers and broadcast stations subject to the provisions of the Communications Act have been assembled in a single volume entitled "Statistics of the Communications Industry in the United States," which has just been placed on sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 25 cents a copy.

These statistics, compiled by the Accounting. Statistical and Tariff Department of the Federal Communications Commission from reports filed with the Commission, are being presented in yearbook form for the first time. The initial volume covers the year ended December 31, 1939.

The publication includes summary data, individual company data and inter-corporate relationships of telephone, telegraph, cable and radiotelegraph carriers, and financial and operating data relative to standard broadcast stations and networks.

The compilation replaces mimeographed material heretofore issued at intervals and is augmented by statistical tables formerly included in the Commission's annual report to Congress.

THE CORNER REFLECTOR

(Continued from page 25)

may be as great as one-tenth wavelength between the reflector wires. The lengths of the reflector wires should be at least easier to construct than a parabolic reflector. The antenna can be made to have a radiation resistance many times greater than that of a 3- or 4-element close-spaced beam, with the result that the antenna can be operated over a broaded band of frequencies, and it is much easier to connect this system into any desired form of feeder.

A corner reflector for 1¼- and 2½-meters can be made portable by using hinges at the corner in order to collapse the assembly when it is to be carried from place to place. A very simple and compact 2½-meter square-corner reflector can be built from three pieces of window screen or galvanized sheet iron, each piece being 2½-ft. square. One piece is used at the base of the square corner as a ground for the reflector and quarter-wave radiator. The antenna can be shunt-excited for connection to a two-wire or concentric feeder. An antenna of this design should have a power gain of approximately 8db over that of a simple quarter-wave antenna. Either vertical or horizontal polarization can be utilized with a half-wave antenna.

It Happened 25 Years Ago

History repeats itself. World War II is replete with news similar to that of World War I. The seriousness of the shipping situation is the same, although the modern army operates on principles entirely unlike those of earlier years. Reprinted below is some data of interest, taken from age-worn "wireless" magazines. If you like this kind of material we will print more of it. The editor will appreciate a card from you.

★

. . . John Augustine Nash was a Marconi Wireless operator aboard ship in the first World War. His vessel plied between Britain and the U. S. A. The awful sensation of intercepting a distress call from a sinking vessel in the war zone is related vividly in a poem which we reprint, in part, from the magazine *Wireless Age*, November, 1914. Unfortunately our file copy of this pioneer wireless publication is mutilated but some of the excerpts from "The Voice of the Night by operator Nash were salvaged. Here they are:

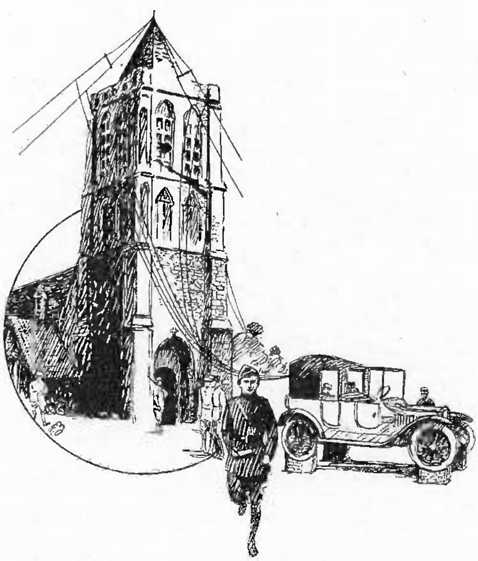
Awaiting the cheery buzz of traff',
I cuss the lagging clock;
I nod; and doze . . . When sudden comes
A rude and chilling shock!
The hum and drone of a distant call
Pounds hard with nervous stress,
The call that turns the heart to stone—
The beseeching S O S.

A shivering, creeping chill I feel,
That comes with silent fears;
I straighten, tense upon my chair,
The 'phones pressed to my ears;
For he's many, many miles away,
His signal almost drowned;
He sounds a call . . . and silence then
Succeeds the awful sound.

I hope with all my power to hope
In the silence so profound;
And, barely breathing, reach the switch,
When my hand drops quickly down.
He's in the Bay of Biscay,
Just where, he can not state;
But the ship seems badly wounded,
And he implores us all to wait.

So I turn and 'phone the pilot house,
And tell them all I know.
"God help them!" breathes the officer,
"No use for us to go."
"We couldn't, had we twice the speed,
Get over in a day;
The distance that's between us—
Nine hundred miles, I'd say."

And we're two nights out from England,
Steaming fast for home,
But in the head 'phones on my ears
No messages intone.
For awful is the scourge of war,
When proud and mighty ships
Must steal about with voices stilled,
Like thieves with silent lips.



The above illustration is from an issue of "The Wireless Age" almost 25 years ago.

In a Belgian village near King Albert's headquarters, wires are run from the spire of a church down to a limousine automobile, elevated on piles of brick, which generates the power for the wireless system.

Old-timers are invited to contribute to this department. How about some ancient photos of amateur equipment dating back to 1906, or earlier? We welcome this material for publication. *Ed.*

K6OQM's Surprise Party

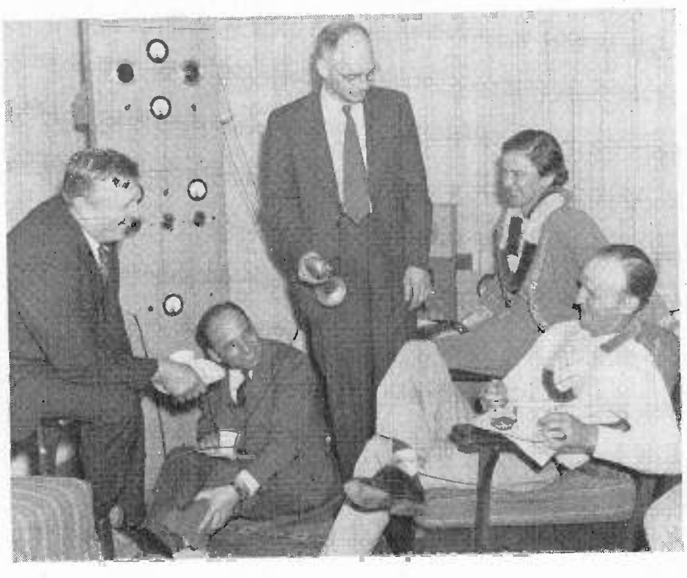
IMAGINE K6OQM's embarrassment—when, after several months of secretly planning a trip to San Francisco from his abode in the Hawaiian Islands—intent on walking into the San Francisco Radio Club and there, unannounced, give his 10-meter followers the surprise of a lifetime, his grandiose "scheme" blew up. Instead of surprising the club, the club surprised him. Not one of K6OQM's followers knew of his plans until, by chance, the passenger list of a Trans-Pacific liner was scanned by W6NQY—and the name of Ella Christensen, K6ROJ, appeared thereon. It was assumed that Paul Christensen was also aboard, and so the S. F. Radio Club laid hurried plans for giving K6OQM the surprise of a lifetime.

"Grass skirts" were made from the color sections of newspapers, cut into long shreds, and members of the club were transformed into "hula dancers." Hawaiian leis were made by W6UQ's daughters, and these "necklaces" were worn by members and also by the waitress who serves those who dine at the club. Then W6PUX labored on a huge sign of welcome which was stretched behind the speaker's table. The dinner menu was replete with Hawaiian dishes, "so that the visitor from Hawaii could enjoy something different, for a change."

So Paul Christensen, the famed 10-meter man from Kukuihaela, walked into the club rooms—and was met with an ovation that would make even a wedding celebration sound like a flat tube. The only person who was surprised was K6OQM himself, for every amateur in the club knew of his "plot" long before the ship arrived in port. Paul is a good-natured fellow, and the club members knew he could take a good-natured joke in a good-natured manner. He did.

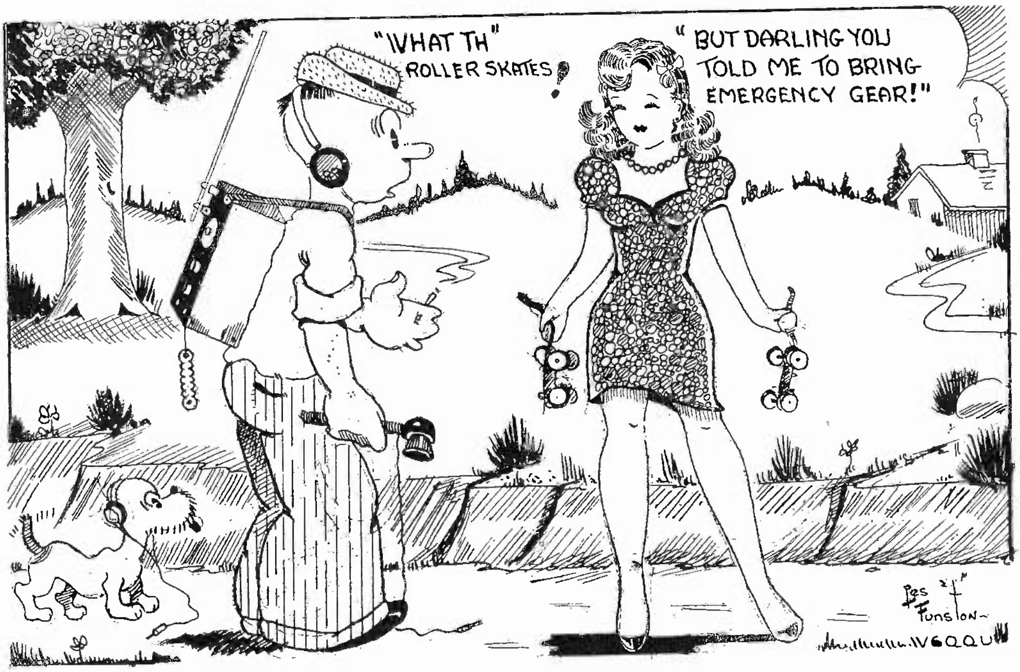
To add to Paul's surprise, a number of telegrams came to the club, welcoming him to San Francisco. These telegrams were fictitious, of course. One was from the "Governor," telling Paul that only two parties in the state knew of his coming—and these parties were the Democrats and the Republicans. Another telegram from the "Mayor" informed Paul that all citizens other than those in our cemeteries knew of his arrival. And then a telegram from "Mae West," reading as follows: "I'd like to have you come up and see me, but if you can't keep secrets better than your surprise visit to the S. F. Radio Club, you'd better stay home."

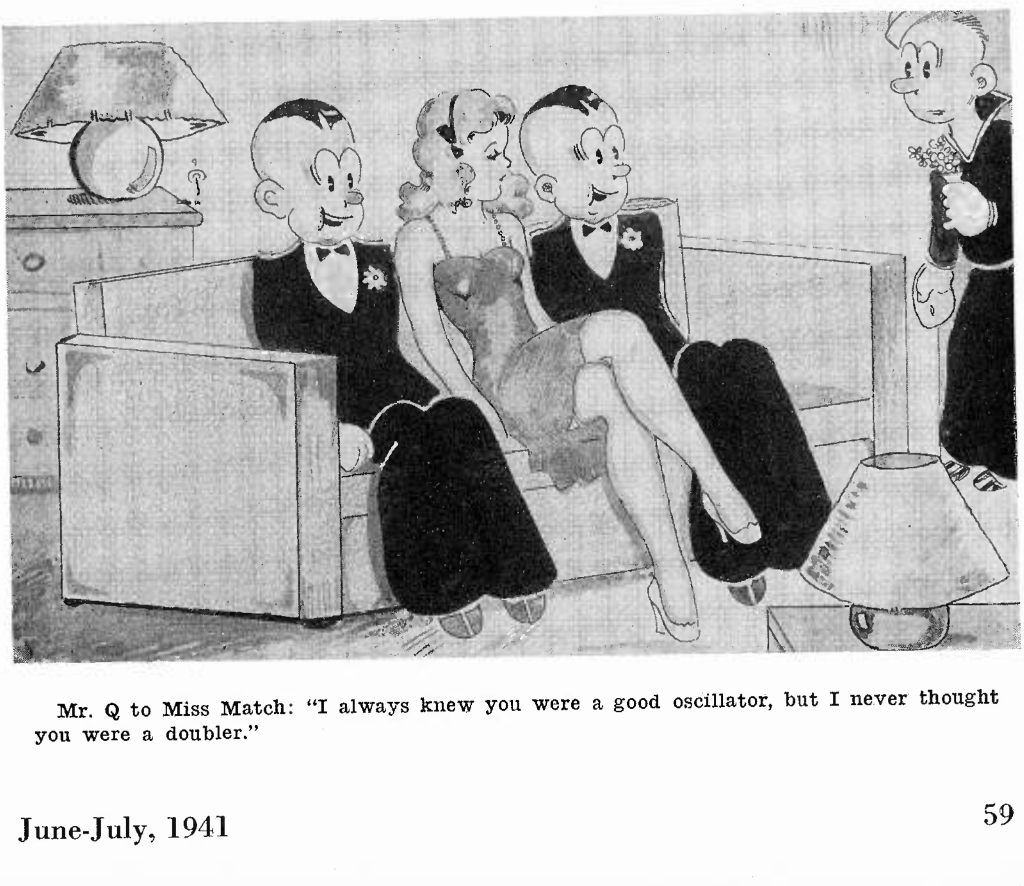
All of which proves that the sleuthing department of the club did an exceptionally fine job in keeping track of K6OQM, even when away from his home in the Islands. Paul is now in Seattle, a guest of one of his ardent 10-meter associates—and he won't return to the air for another 60 days. In the meantime, the 10-meter band is yours for the asking.



• After the "surprise party" we find Paul and Ella Christensen, K6OQM and K6ROJ, respectively, still chuckling over the affair at F. D. Wells' home. From left to right: Sam C. Van Liew, W6CVP, President of the San Francisco Radio Club, Inc.; A. W. Fonseca, W6NYQ, ex-president of the club; F. D. Wells, W6QUC (standing); Ella Christensen, K6ROJ — and Paul himself. A few days later Paul and Ella pulled stakes for Seattle, where they are guests of Bob Beebe, W7IGM, and Mabel Beebe, W7HXU . . . a foursome of radio hams who maintained an almost daily QSO on the 10-meter band.


QRM QRN
by W6QQU
WHAT KIND OF FOOD IS THIS STUFF?
"OH THAT IS SOME PRETTY GREEN SPAGHETTI I FOUND IN YOUR RADIO ROOM!"
30 DAYS IN JAIL OR 10 DAYS ON 160!
SELF EXCITED OSCILLATORS"
Special New-FREQUENCY SHIFTER
DO YOU THINK WE COULD BORROW THAT BALLOON FOR AN ANTENNA?
POP
BANG
BOY OH BOY 160 IS SURE QUIET!
PINK
BANG
ZING
EEK
EEK
ZING
NATIONAL GUARD





Mr. Q to Miss Match: "I always knew you were a good oscillator, but I never thought you were a doubler."

MEISSNER "SIGNAL SPOTTER"

GENERAL INFORMATION

● The Meissner "Signal Spotter" is a stabilized crystal controlled oscillator employing a type 6V6G oscillator tube and a type 6U5 resonance indicator tube. The instrument is a companion unit to the Meissner "Signal Shifter" and receives its power from the voltage regulated power supply of the Signal Shifter.

FOUR crystals may be plugged into the Signal Spotter and the desired crystal frequency instantly selected by the "Crystal Selector" switch. A separate two position switch, mounted inside the Signal Shifter in accordance with following instrutcions, enables the operator to switch to either "ECO" or "Crystal" excitation of the transmitter. In combination, the Signal Spotter and Signal Shifter form a complete frequency control system for the amateur transmitter; a system that leaves nothing to be desired.

INSTALLATION INSTRUCTIONS COVERING THE ADDITION OF THE SIGNAL SPOTTER TO SIGNAL SHIFTERS HAVING SERIAL NUMBERS LOWER THAN DS-2500

● Included with each Signal Spotter is a package containing a rotary switch, knob, female type plug and cover, shaft bearing, a short length of rubber tubing, rubber grommet, tie lug and lengths of color coded wire. This material is to be installed in the Signal Shifter in the following manner:

First, remove the twelve front panel screws and the four rubber "feet" which are screwed into the bottom of the Signal Shifter cabinet. With these screws removed, the chassis and front panel can be lifted slightly and withdrawn from the cabinet. Place the chassis on the work bench with chassis bottom up, permitting the unit to rest on the top edge of front panel and the back edge of the power transformer.

The Signal Shifter chassis is divided into two sections and a shield partition separates the two. A ⅜ inch hole, drilled in the shield partion, is required to mount the two position rotary switch. This hole is drilled in a position where it "centers" accurately with the front panel hole normally occupied by the pilot light jewel.

First, remove the pilot light jewel holder, together with the bulb, socket and mounting bracket. The two leads, connected to the pilot light socket, are clipped off at the points where they connect to the 6F6 tube socket. (The pilot light assembly is removed entirely from the Signal Shifter). With the jewel holder removed from the front panel, it is a simple matter to "center" the ⅜ inch hole, to be drilled in the partition, with the front panel hole. After "centering" the position accurately, the hole is drilled. It is recommended that a drill press be employed and the local machine shop can handle the actual drilling quite easily. It is not necessary to remove the shield partition for drilling! The drill bit is inserted through the front panel and chassis holes and down to the position where it comes in contact with the shield partition. While the Signal Shifter is held firmly in this position, the ⅜ inch hole is drilled. It is suggested that a strip of wood or steel be placed on the under side of the partition to support it during the process of drilling. This support can be clamped to the drill press bed and the partition rested on it while drilling.

A hole is also required in the back side of the chassis. This hole is ½ inch in diameter and is drilled in the position shown in "View No. 1." If burrs appear on the edges of the holes after drilling, they should be removed with a file.

The two position rotary switch is now mounted in the partition hole with its shaft running through the two front holes. The shaft bearing, supplied in the package of parts, is mounted in the front panel hole to support switch shaft. The bearing locknut goes between the front panel and chassis and sholud be held with pliers in this position as the switch shaft is inserted through it. The lock washer and locknut on the switch can now be tightened to hold the switch firmly in place against the partition. The front panel shaft bearing is now inserted and the locknut tightened to hold bearing firmly in position. The switch installation is completed by attaching the control knob to the shaft. NOTE—If switch shaft is slightly longer than necessary, the switch should be removed and the shaft cut to proper length with a hacksaw. Measure for proper length before cutting.

OPERATING POSITION

● The Signal Spotter and Signal Shifter are designed to be mounted "side by side," with the Signal Spotter on the left. They should occupy this positoin, either on the operating desk or behind relay rack panel on the transmitter rack. The two units are coupled together by plugging the Signal Shifter cable plug into the seven prong receptacle located on the back of the Signal Spotter. NO OTHER CONNECTIONS ARE NECESSARY. R.F. output is taken from the output terminals provided on the back of the Signal Shifter. ONLY ONE LINE IS REQUIRED BETWEEN THE SIGNAL SHIFTER AND THE TRANSMITTER.

INITIAL "TUNE UP"

TWO SEPARATE CHANNELS are available in the "Spotter," as follows:—

CHANNEL A: consisting of "X-tal 1," tuning condenser "C29," "X-tal 2," tuning condenser "C30," and "Coil L5."

CHANNEL B: consisting of "X-tal 3," tuning condenser "C31," "X-tal 4," tuning condenser "C32," and "Coil L4."

With a separate coil in each channel and with two channels available, the Signal Spotter can be set up to provide EITHER one or two band output. If one band output is desired, crystals for that band are plugged into the crystal sockets together with TWO SIMILAR COILS, the coils being plugged into coil positions "L4" and "L15." Coils must be used which correspond with the frequency of the crystals. EXAMPLE: "80 meter" coils are required when "80 meter crystals are used, etc.

ENGINEERING APPLICATIONS

If TWO BAND output is desired, one of the Signal Spotter "channels" is set up on one band and the other "channel" is set up on the second band. This provides a maximum of two crystal frequencies on each band. Coils must be used which correspond with the crystal frequencies. EXAMPLE: Assuming output is desired on "40 and 80" meters. Two "40 meter" crystals are plugged into one Signal Spotter "channel," together with a "40 meter" coil. In the second "channel," two "80 meter" crystals are used, together with an "80 meter" coil.

The initial set up of the Signal Spotter naturally will follow the requirements of the individual operator. Either ONE or TWO band output can be arranged. With a one band set up, a maximum of FOUR crystal frequencies is available. With a two band set up, a maximum of TWO crystal frequencies ON EACH BAND is available. It is not necessary to install crystals in all four available sockets. Unused sockets merely establish a "blank" position on the "Crystal Selector" switch.

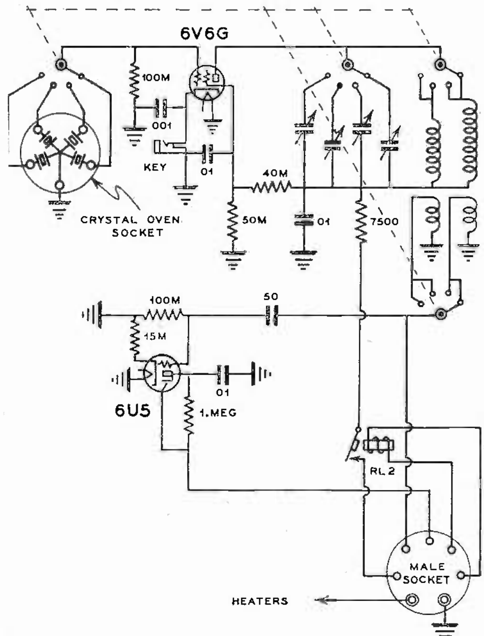
The Signal Spotter receives its power from the Signal Shifter. When the Signal Shifter "On—Off" switch is turned "On," all filaments in both units are lighted, together with a red pilot light on the Signal Spotter front panel. The two position selector switch, which has been installed in the Signal Shifter, is used to select the type output desired. Turned to the "Right," output of the Signal Shifter (ECO) is coupled directly to the transmitter line, with frequency established by the setting of the Signal Shifter dial. Turned to the "Left" position, the output of the Signal Spotter (XTAL) is coupled into the amplifier stage of the Signal Shifter and through it to the transmitter line.

The four position "Crystal Selector" switch on the Signal Spotter is used to select the desired crystal frequency. The numbered switch positions correspond with the numbers of the "X-tal's".

Tuning each crystal to resonance is accomplished by adjusting the tuning condenser, a separate condenser being available for each of the four crystal circuits.

Condenser "C29" tunes "X-tal 1"
Condenser "C30" tunes "X-tal 2"
Condenser "C31" tunes "X-tal 3"
Condenser "C32" tunes "X-tal 4"

With the two position switch on the Signal Shifter front panel in the crystal position (Left position), with the Signal Shifter "Auto—On—Stdby" switch in the "On" position, and with the "Crystal Selector" switch on the Signal Spotter front panel in position "1," condenser "C29" is rotated by screw-driver until a point of resonance is reached, as indicated by the resonance "indicator tube" located at the top of the Signal Spotter front panel. With the crystal NOT tuned to resonance, the shadow of the tuning "eye" will be closed. As the tuning condenser is rotated, the "eye" will gradually open until a point is reached where it SUDDENLY snaps closed. The "eye" should be adjusted to a "non critical" point. This point is usually found by "backing off" the tuning condenser a few degrees from that point WHERE THE "EYE SUDDENLY SNAPS CLOSED. The tuning "eye" can be compared with the ordinary milliammeter which is often used as a tuning indicator. Complete closing of the "eye" is the same as a large reading on a meter. Gradual opening of the "eye" represents



decreasing current and maximum opening of the "eye" represents the customary meter "dip" so often used as an indication of resonance.

After tuning the crystal to resonance, it is advisable to test for stability. This is done by flipping the Signal Shifter control switch from the "On" to the "Auto" position, rapidly repeating this action a number of times. Perfect stability is indicated when the "eye" immediately snaps to the same position each time the control switch is flipped "On". If the "eye" snaps completely closed when the control switch is flipped "On" or if the "eye" opening changes each time the switch is flipped, the circuit must be retuned. A final check on stability can be made by plugging a key into the jack provided on the back of the Signal Spotter chassis, and KEYING the crystal circuit. The action can be monitored in the station receiver and the crystal tuning condenser adjusted to the point where the signal is clean cut and positive.

OPERATING POWER IS SUPPLIED TO THE SIGNAL SPOTTER ONLY WHEN THE SIGNAL SHIFTER CONTROL SWITCH ("AUTO" — "ON" — "STDBY") IS IN THE "ON" POSITION! In the "Auto" position, power is automatically supplied to the Signal Spotter—Signal Shifter when the station transmitter is turned "On". For the purposes of alignment or determining frequency, the switch is turned to the "On" position.

Each Signal Spotter crystal is tuned to resonance in the same manner as explained in the foregoing paragraphs. Each crystal circuit should be checked for stability after completing the initial tuning adjustments.

OPERATION

• Since the Signal Spotter is coupled to the Signal Shifter, COILS WHICH COVER THE

ENGINEERING APPLICATIONS

MEISSNER "SIGNAL SPOTTER," Cont'd

SAME BAND MUST BE USED IN BOTH UNITS. If the Signal Spotter is set up for one band output, the same band must be employed in the Signal Shifter. EXAMPLE: With "40 meter" crystals and "40 meter" coils in the Signal Spotter, "40 meter" coils must be used in the Signal Shifter.

When the Signal Spotter is set up to provide TWO BAND OUTPUT, Signal Shifter coils must be changed when going from one band to the other, to correspond with the band in use in the Signal Spotter. EXAMPLE: Assuming "40 meter" and "80 meter" channels are set up in the Signal Spotter. When "40 meter" channel is in use, "40 meter" coils must be used in the Signal Shifter. To use the "80 meter" Signal Spotter channel, "80 meter" coils must be used in the Signal Shifter. Changing Signal Shifter coils permits instant selection of either crystal or ECO excitation on BOTH of the two available bands. However, the units can be set up to provide either crystal or ECO excitation on ONE BAND, plus two additional crystal frequencies on a SECOND BAND. In this case, it is only necessary to change one Signal Shifter coil (the six prong output coil), when using the two crystal frequencies on the second band.

Operation of the Signal Shifter—Signal Spotter combination is quite simple. When properly set up in accordance with foregoing instructions, the two position Signal Shifter switch is employed to select either ECO or crystal excitation. The four position Signal Spotter "Crystal Selector" switch is employed to select the desired crystal frequency. The three position Signal Shifter "Auto—On—Stdby" switch provides the means for adjusting transmitter frequency WITHOUT PLACING THE TRANSMITTER ON THE AIR. In the "On" position, power is supplied ONLY to the Signal Shifter and Signal Spotter. In the "Auto" position, power is supplied to the entire transmitter, including the Signal Shifter and Signal Spotter. Instructions for installation of the "Automatic" power line are clearly given in the Signal Shifter Instruction Sheet, a copy of which is included with each instrument.

Temperature Control Ovens for Crystals

• The stability of any crystal is primarily dependent upon temperature. Crystals are available that have a low temperature coefficient and are not as susceptible to temperature variation as other types having a high coefficient. Regardless of the type crystal used, accurate maintenance of crystal frequency is possible only by holding crystal temperature at a constant value. In commercial service, this is accomplished by the use of thermostatically controlled ovens, in which the crystal or crystals are placed. The ovens are well insulated and by means of a heater element, actuated by a precision type thermostat, temperature is held constant over a range of 1 or 2 degrees.

The Meissner "Signal Spotter" is designed for use with a Meissner Crystal Oven, Catalog No. 9-1046. Four crystals may be mounted in this oven, the oven plugging directly into the five prong socket located in the center of the four crystal sockets. An ordinary 7.5 volt filament transformer is used to supply heater current and this transformer can be mounted inside the Signal Spotter chassis. The 110 volt transformer primary is connected to the line by a cord which runs through the rubber grommet hole in the back of Signal Spotter chassis. The second pilot light, located on the front panel, is connected to the oven heater circuit and flashes on each time the thermostat closes. Approximately 15 minutes time is required to install the Meissner Crystal Oven and associated components.

NEW PRODUCTS FROM THE MANUFACTURERS

Power Resistor Decade Box Finds Many Uses

. . . Introduced several months ago, the Clarostat power resistor decade box has already become indispensable equipment in many laboratories, engineering offices, plants, maintenance departments and schools. It is reported to be saving many hours, days and even weeks in national defense activities, because of the ease with which it solves practical resistance problems under actual working conditions. Some users report saving the cost of the instrument in a few weeks.

This instrument is something radically new in resistance decade boxes. Instead of a mere measurement or resistance value, it actually provides a precise power resistor of anywhere from I ohm to 999,000 ohms, for actual use in a given circuit. It provides a power resistor handling up to 225 watts per decade. Merely adjusting any or all of the six rotary decade switches provides any resistance value within the enormous range. The reading for the inserted resistance is read from the decade dials, duly observing the multiplying factors indicated.

The power resistor decade box does away with time-consuming and usually uncertain resistance calculations. Much time is saved in deciding upon the best resistance value to use, by actual practice. The instrument is especially valuable in determining parallel resistance values, in voltage-dropping requirements, and for other practical functions. Instead of having a large collection of power resistors on hand, or waiting days to obtain different units, this one instrument instantly provides any required value, known or unknown, for a circuit. The instrument is made by Clarostat Mfg. Co., Inc., 285-7 North Sixth Street, Brooklyn, N. Y.

The War -- And The Radio Amateur

★

SOME say we are now at war, some say we have been at war for three months, and Churchill intimates that we have already declared war against Hitler, if we read our newspapers plainly. It seems that we will soon convoy our supplies to Britain, and then the shootin' will start. These fireworks do not necessarily mean that we will actually declare war. It's quite the thing to engage in an "undeclared" war in these modern times. There are three schools of thought among the columnists who term themselves "war experts." Most of these men know less about war than the average man-on-the-street, and the more one reads their stuff the less he knows. A prominent newspaper columnist, whose self-styled military title sounded almost as big as the army itself, was recently found to be nothing more than a cub reporter and office boy. The three schools of war-thought run like this: (1) we will declare war; (2) we will engage in an undeclared war; (3) we will convoy and run the risk of losing some of our ships on the way to the war zone. Because none knows with certainty which way the administration will eventually turn (although most of us seem to have the answer) the future status of the radio amateur gives wholly undue cause for alarm in many circles. It is not the purpose of this column to predict the course of the war, but rather to interpret current events as they directly affect the radio amateur.

Let's review the situation with calm and sincerity. The leaders of our administration have not yet publicly urged an outright declaration of war. We couldn't do more to harm Hitler than we are doing now, and a declaration of war by the U. S. A. seems to be taken for granted in Germany. As our production is stepped-up we will inflict greater harm upon Hitler & Co. We have gone into this fight to win. The radio amateurs have not been shut down, and the restrictions imposed upon them are as modest as they are sensible. Because there has been no disruption of amateur radio activity in these days of national emergency, and because no hint of any kind has been received from any quarter to warn us that further restrictions are to be imposed upon the amateur, doesn't the situation look more safe today than six months ago? We think so!

Off-the-record chats with those in the know reveal the understandable fact that the amateurs would have been shut down a long time ago if the operation of their stations proved injurious to the national welfare. The amateurs are behaving like champions in these times of uncertainty, and there has been far less "monkey business" in an entire year than we experienced in a single week during the first World War. We know of certain amateurs whose stations were seized —lock, stock and barrel, by Uncle Sam when last we fought the German nation, and we know that *tons* of ham gear were stored in government warehouses—where it remained until the war ended. Long before we actually engaged in the last war there were many serious infractions of the radio laws on the part of the amateurs, but all this has been changed—and the amateur of today is an altogether different breed than the ham of yesterday. Uncle Sam realizes this, full well.

Uncle Sam looks ahead. He needs 50,000 skilled radio technicians to complement the present force of men now undergoing training. He will need 500,000 when we reach our full armed strength. And this does not include the telegraphers. Do you think our Uncle Sammy is going to kill the goose that laid the golden egg?

A few weeks ago we enjoyed a visit from an old friend, W6AAR, J. N. A. Hawkins, and he told us a few things about the Messerschmitt plane now in the Vultee shops in Southern California. This plane was brought down over England and will soon be placed on exhibition in various parts of the U. S. A. It has six complete radio transmitters, two of which are frequency-modulated. All equipment is in duplicate. Obviously a "greenhorn" couldn't be placed in charge of such equipment. The skilled radio men required for the thousands of super planes we will build, the enlarged force of radio operators always assigned to transport and naval duty for service at sea in an emergency—in many cases twice as large as the peace-time force, calls for a huge number of men, and an even greater program of training. The amateur radio field is a storehouse of skilled technical and telegraphic manpower. Uncle Sam wants to strengthen this field — not weaken it! And because the amateurs have not *already* been shut down—we'll bet microwatts against kilowatts that we'll be on the air longer than Hitler. This is not a "pep talk"; it's our analysis of what the future seems to hold.

NEWS FROM WASHINGTON
(Continued from page 10)

them to me or else we will jam this net with hig rig.

"You will be in concentration camp. I am a cryptographer for this signal unit in

"I am on the *Admiral Scheer* and never dock. (When asked where he was located 'Fritz' said: 'Off coast of Madagascar.')"

When the signals were first intercepted, there was no indication of where "Fritz" was located. The task of hunting down his station involved the use of highly specialized equipment recently perfected for the Commission's national defense field forces. The transmitter was finally traced to Johnson's residence on North Sheridan Road in Peoria. When the officers entered Johnson tried to destroy his equipment but was prevented.

Besides having the close cooperation of various Federal agencies in this ether hunt, the Commission's field staff was personally assisted by United States Commissioner William H. Moore, United States District Attorney Howard L. Doyle, United States Marshalls Eugene Ahernds and C. T. Curry, and Chief of Police Leo F. Kamins of Peoria.

* * *

THE EDITOR'S CQ
(Continued from page 13)

good fist in the meantime, can take a trick in any governmental or commercial station without need for long training. They can train less proficient amateurs in much less time than would be required to train men who have not had the benefit of amateur experience. Seeing that time is now the essence of preparation, should they not be started to do what they are best able to do?

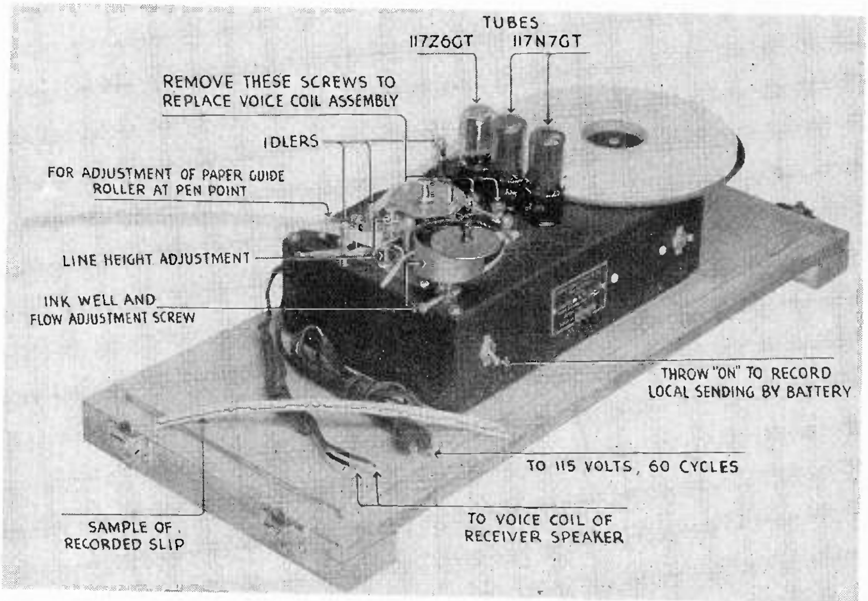
If you agree as regards this forecast for the immediate future of amateur radio, if you have not already joined A.R.D.A., and if you are fit for enrollment, why not join now? Thus you can help prevent the danger of the mailed fist ruling the radio fist.

SPRING - SUMMER - 1941, CATALOG

100 BROOKLINE AVENUE • BOSTON, MASSACHUSETTS

Description Of and Operating Instructions For

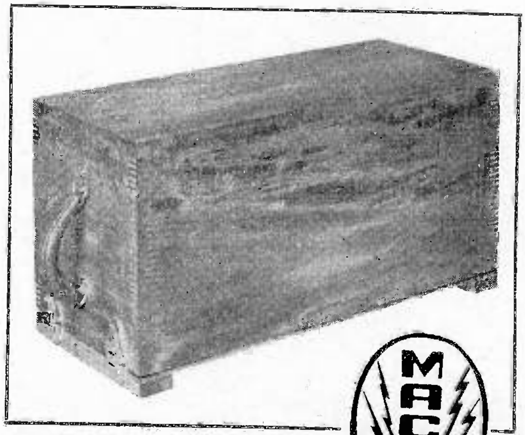
MODEL RRD-900 RADIO TELEGRAPH SIGNAL RECORDER



Model RRD-900 Recorder

PRICE $75.00 NET, F.O.B. BOSTON

This is a device designed to make inked recordings of transmitted dots and dashes of the radio telegraph code. Designed basically for making ink recordings of transmission of student operators for correction of sending errors. Poorly executed characters are indicated by visual reading and also by ear when inked slip is drawn through keying unit such as the G-813. Amplifying circuit and copper-oxide rectifier are built into the unit. Circuit diagram accompanies each instrument. Slip is drawn through recorder by tape puller such as the G-13.



CONNECTIONS

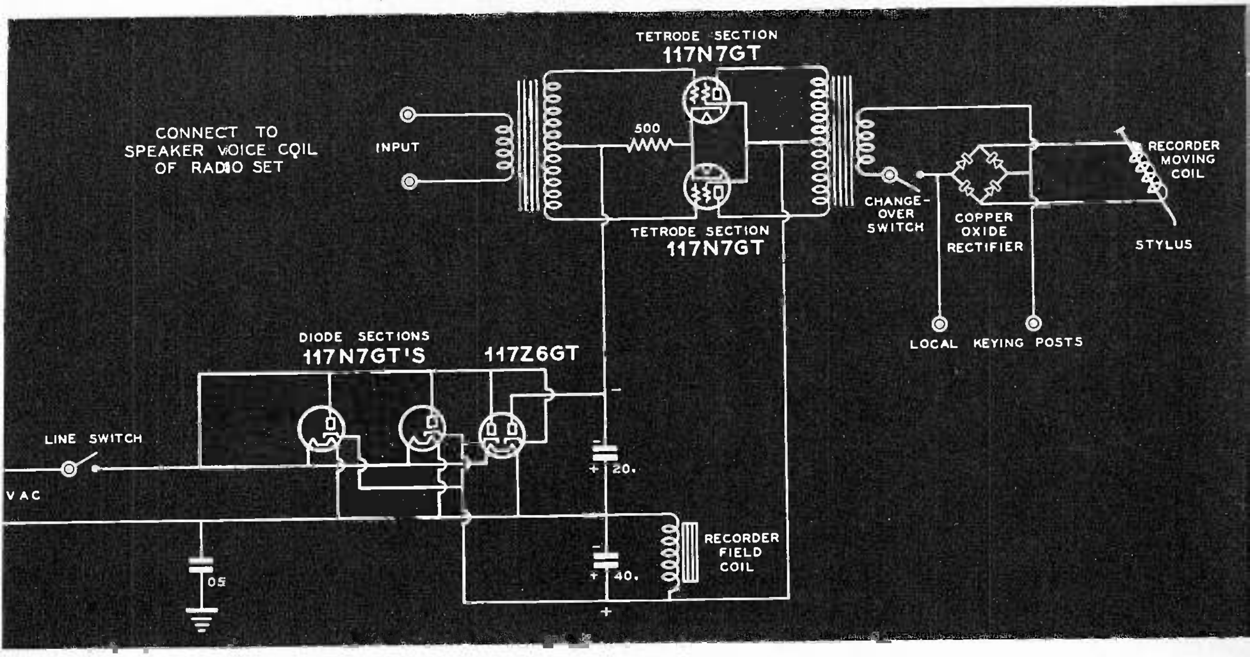
Line cord is to be connected to 110 volts AC. In order to record from a radio receiver, connect cord with tinned ends to an input impedance of six to fifteen ohms such as the voice coil of a speaker of a communication receiver or to the low impedance side of an output transformer. When recording local transmission connect about six to twelve volts of battery in series with the transmission key to the two binding posts at the back of the recorder.

SWITCHES

The switch at the right front is the "on and off". The switch at the left front is to permit direct keying by local battery or recording from a radio receiver. When this left switch is thrown down it cuts out the output transformer of the driving unit permitting actuating of the voice call assembly by the local battery through the rectifier. When recording from a radio receiver this left switch should be thrown up.

VOICE COIL ASSEMBLY

This assembly consists of a specially wound voice coil fastened to a ball bearing suspended arm with a writing stylus at the outer end. Steel ball bearings are 3 /32″ diameter and may be purchased at any hardware store. Writing stylus may be removed for replacement by loosening the screw in the end of the arm. This also provides that the writing stylus may be turned end for end to give thin ink line when recording is desired for sight reading.

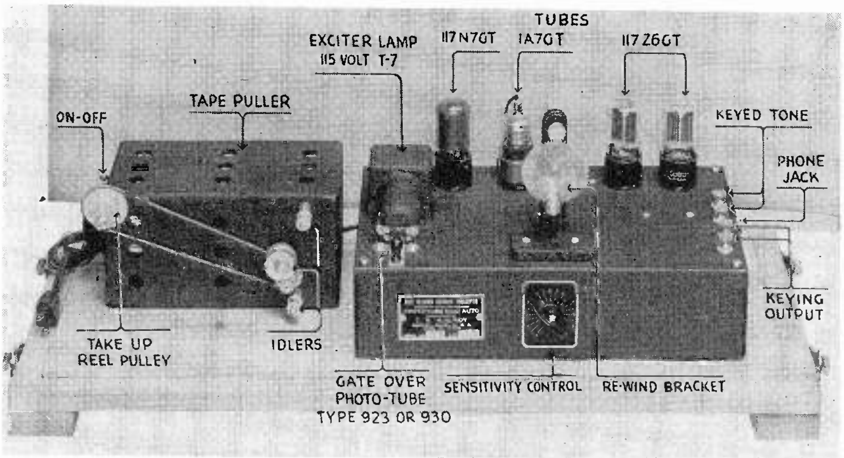


ADJUSTMENT OF THE INK LINE

Paper recording slip ⅜″ width is Army issue. Place roll of slip on bakelite disc. Feed end of slip around idler just behind the last of the three tubes. Then around back of idler at the writing point, then around revolving barrel at point of stylus and in back of farthest left idler (see picture). Revolving barrel may be adjusted for light or heavy ink contact by thumb nut at left rear. The ink well may be raised or lowered to regulate flow of ink. For fast signals raise the ink well. When used in connection with a keying unit, a black India drawing ink is required. When used for sight reading any good quality fountain pen ink produces an easily readable line.

McELROY MODEL G-813 RADIO CODE KEYING UNIT

Description Of and Operating Instructions For



Keying Unit, Model G-813

PRICE $75.00 NET, F.O.B. BOSTON

Designed for radio operator training schools of the United States Army. Consists of the units described in the following paragraphs. Units mounted on one base.

Dots and dashes are inked on regulation telegraph recorder paper slip 3/8" wide. These recordings resemble the conventional visually read slip, excepting the pen is heavier which results in an inked line about 1/16" thick and the ink used is a black India drawing ink. Paper slip is mounted on 400' 16mm, motion picture reels, each roll containing sufficient inked slip to operate the keyer at speed of 20 words per minute for one hour.

Paper slip is drawn through a guiding gate between an exciter lamp and a photo tube. The inked dots and dashes interrupt light onto photo tube, actuating a relay which keys any external tone source.

Practice tapes consist of a set of fifteen rolls prepared from master tapes furnished by Signal Corps School, Fort Monmouth, N. J. Best results will be obtained if the keyer is used in collaboration with Signal Corps School Pamphlet No. 53, Radio Operator's Manual, 1940 Edition.

TEST TAPE PULLER

Plug line cord into 110 volt AC outlet. Throw toggle switch of puller and it should start the rubber covered pulling shaft rotating. Vary speed by turning knob at left end of puller. Due to what we term the "Neal circuit", the speed of the puller remains very constant at any setting. Cover is left off the puller to permit air circulation. To the left of the on-off switch is a binding post for ground if desired.

TEST THE KEYER

Throw on the toggle switch at right rear side of keyer. Exciter lamp should light and tube filaments should glow. Work up and down the exciter lamp housing which is hinged at rear. Relay should actuate. If line voltage is unusually low or high it may be necessary to adjust bias of 117N7GT by turning control knob on front of keyer. Incidentally, if operator feels slight capacity shock when touching any part of unit, this may be remedied by reversing plug.

START KEYING

Place roll of practice slip on the re-winder. You'll notice there is a groove in the round end of the otherwise square shaft. This groove permits placing or removing metal reel but prevents reel from coming off the shaft except when taken off by the operator. Take the end of paper slip and feed it through gateway between exciter lamp and photo tube. Lift lamp housing and the two grooved rollers which are similarly hinged. Lay paper slip on the oval table, making certain the top inked line covers the tiny pinhole in this slide. No adjustment should be necessary as the tapes are all uniform. Provision for change is made, however, as will be seen by the two guide screws and two screws holding metal band piece. Releasing these screws permits moving of the pinhole slide if desired.

FEED SLIP TO PULLER

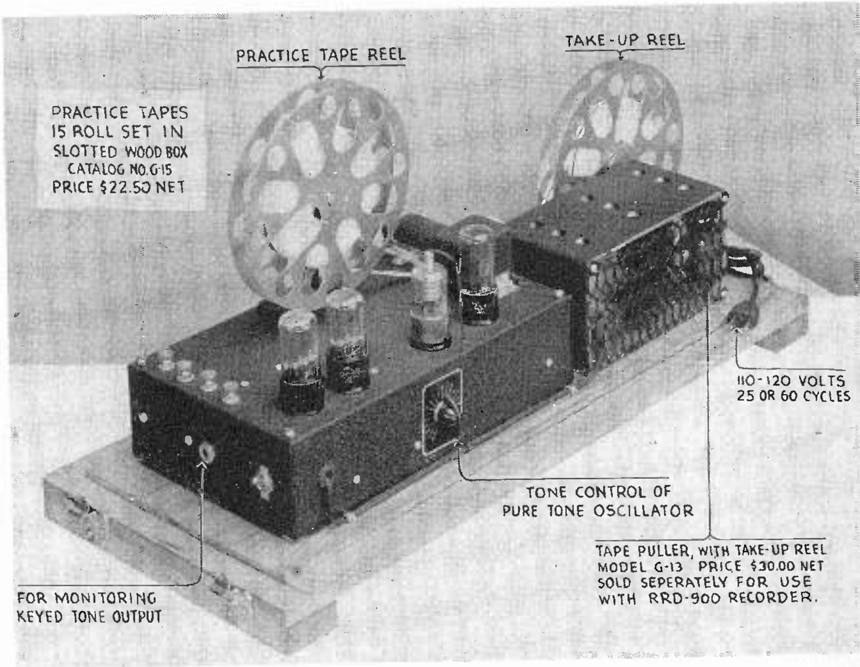
Take end of slip and draw it through keyer gate by hand. Pass over the top right roller and under the lowest roller and between large idler and rubber covered pulling shaft. This is accomplished very easily by starting the puller and simply holding edge of paper slip against rubber roller where it'll instantly be caught and drawn through and correctly centered. Place a metal reel on the take-up shaft which is same as re-wind shaft on keyer. Slip end of paper into slot in hub and start take-up by hand and then the spring belt will take up slip as it feeds from pulling shaft. Speed of shaft is governed as indicated in paragraph headed TEST TAPE PULLER.

GOVERNING KEYING SPEED

The inked slip is designed so that quite accurate speeds of transmission may be obtained. When 12′ of slip is drawn through gate in 1 minute the speed of each character is at the rate of 20 words per minute. Spacing of inked characters varies from greatest space on first roll decreasing progressively until normal spacing is produced on last few rolls. First roll will net 4 words, which is 20 characters, in one minute. Normal spacing nets the full 20 words or 100 characters per minute.

OUTPUT TERMINALS

As you face the keying unit you see four terminals in line at the right top of the keyer. The first two are keying terminals to key any external unit, such as a telegraph sounder or a blinker or any external oscillator or transmitter. The second set of terminals give out the keyed tone which is a pure tone oscillator of about 800 cycles. This tone may be varied by a control on rear edge of chassis. It will be a sine wave —or pretty close to it if not exact. On the right end of the chassis is a phone jack for monitoring output.

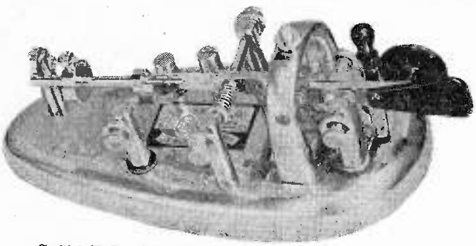


TUBE LINE UP & RELAY

As you face the keyer, the tubes are, reading from left to right: 117N7GT, 1A7GT, 117Z6GT, 117Z6GT. The relay is inside the chassis because we have selected what we believe to be the best unit for the job and it requires no attention, no cleaning, no adjusting. It is a Guardian single throw, double pole. One set of contacts keys the built-in pure tone oscillator; the other set goes to the first two terminals on right end of chassis and will key any external unit.

EXCELLENT MORSE AT MINIMUM EFFORT

NEW SUPER STREAM-SPEED



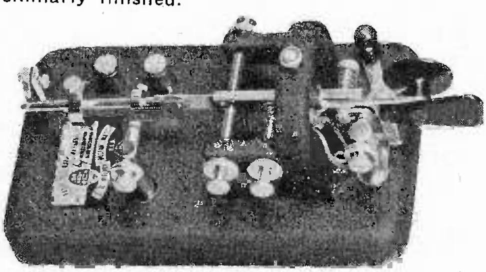
S-600-PC—Platinum Contacts....$11.85
S-600-SC—Silver Contacts ....$ 9.50

Into this gorgeous speed key has gone Mac's 30 years operating experience supplemented by the finest engineering ability in the radio-telegraph industry . . . with their combined efforts coordinated under the styling genius of one of America's outstanding design artists. See it! Handle it! You'll have to own it! Combining beauty and utility in a most striking fashion, this radically new, semi-automatic key is the last word in operating ease. Fast, rhythmical Morse is a real pleasure with this key.

- Streamlined base of special dense alloy. Wt. 4 lbs.
- Tear-drop shaped base makes it immovable on table.
- Heavily chromed with bluish tinge to prevent glare.
- Stainless steel coil springs and bearings.
- Beryllium copper mainspring and U spring.
- Bronze bearing screws.
- Bronze allow pigtail.
- Bakelite insulation throughout.
- Molded plastic dot paddle and dash button.

PROFESSIONAL MODEL: MAC KEY

Designed to conform with United States Navy specifications for "speed key." It is just what its name implies: A fine Professional Operator's model Mac Key. Base 3¾" x 6½" x ¾" thickness. Beautifully black wrinkled over Parkerized base casting. Carefully designed super-structure, similarly finished.



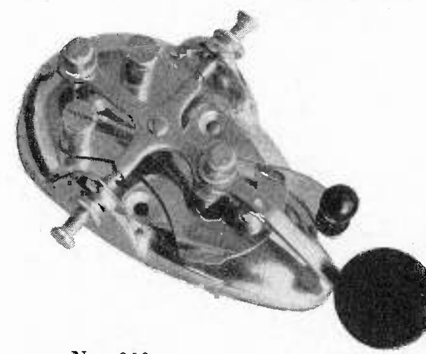
MODEL No. P500
$7.50 NET TO THE OPERATOR

Chromed parts, circuit closer, bakelite insulation, 3/16" silver contacts. A key that will thrill any radio or telegraph operator.

AMATEUR MODEL, SPEED KEY,
A-400 at $5.95

A genuine commerical or amateur radio operator's speed key of such quality that you'll find it difficult to realize the price is so low.

De Luxe Model: STREAM KEY



No. 300 at..............$2.85 net
No. 200 at .... 1.80 net
No. S-100 at............ 1.35 net

Beautiful tear-drop streamlined base with heavy bluish tinged chrome. All parts chromed. Finely balanced key lever. 3/16" contacts, designed especially for these keys. These pretty Streamkeys have a "feel" that makes good Morse easy for any operator. BB-300, ball bearing balanced lever; BS-300, bronze bearing screws. Same price. PROFESSIONAL MODEL, same key but base "black wrinkled." BB-200 or BS-200 same price. AMATEUR MODEL, rich black polystyrene base, same lever, and large contacts, circuit closing switch, bronze bearing screws. A beautiful and superbly balanced key at an absurdly low price because of enormous volume.

AC-DC AUDIO OSCILLATOR

MODEL No. A-700 — Net to Operator, $2.85
Minus Tube - Uses 117N7GT

An oscillator fully as good as my amazingly good Oscillatone, except smaller housing because no speaker. Electronically keyed, which means limitless speed and clean keying. Uses 110 to 120 volts, either AC or DC. Connect jumper wire across two rear terminals for speaker volume. Terminals: 2 right for key; 2 left for headphones.

BATTERY POWERED AUDIO OSCILLATOR

MODEL No. B-700 — Net to Operator, $1.80
Minus Tube and Batteries - Uses 1Q5GT

Same pretty plastic cabinet as Model A-700. A remarkably good audio oscillator giving a beautiful clear 1000 cycle note. Uses 1½ volt for A battery and 22½ volts or 45 volts B battery, depending upon volume desired. Terminals: 2 right for key; 2 left for phones or speaker. Rear terminals, left to right: B plus, B minus; A plus, A minus.

ACCESSORIES FOR McELROY EQUIPMENT

TRANSMITTING KEYS, MANUAL AND SEMI-AUTOMATIC

Chromed brass bearing screws 25c each; treated steel bearing pins 10c each; coil springs for straight key or speed key, 10c each; thumb paddle, dash button, straight key button, all 15c each; chromed brass weights, 25c each; rubber feet with rustproofed 8x32 screw assembled, 10c each; Beryllium copper silver treated, main spring for speed key, with rivets, 45c each; cord for speed key, $1.00 each; case for speed key, $3.00.

CONTACT POINTS

McElroy equipment uses two types of contacts. Coin silver rivets, sometimes called "Platinoid", 3/16″ head diameter, 1/16″ head thickness, shank length about 3/16″, shank diameter about 1/16″. Because we use hundreds of thousands of these yearly, we can sell them at very low price. Operator cost 10c each. We also have on hand for our own use and will sell at a low figure, genuine platinum contacts. Same dimensions as silver rivets, except made of copper treated steel rivets with the shank threaded 4x40 threads for screw-in application. Rivet faces are about .015 iridium platinum. Price $1.50 each.

RECORDER ACCESSORIES

Rolls of recorder slip, ⅜″, about 8″ diameter, the regular commercial rolls of slip, 30c each, small lots; 20c each 100-roll lots. Complete voice coil assembly for Recorder, price $5.00; this includes the bearing pin, the main arm, the voice coil and the writing pen. Copper-oxide rectifier, just as we use it, price $6.00. Condensers, resistors, etc., can be purchased at any radio store, so we do not list them. Ink may also be purchased locally. If recordings are made for use later in the Mac Auto, you should use Higgins Black India Ink, it sells for about $9.00 per quart. If you wish to record at very high speeds for eyesight reading, use any good quality fountain pen ink. Red ink is easiest on the eyes.

THE AMAZING OSCILLATONE

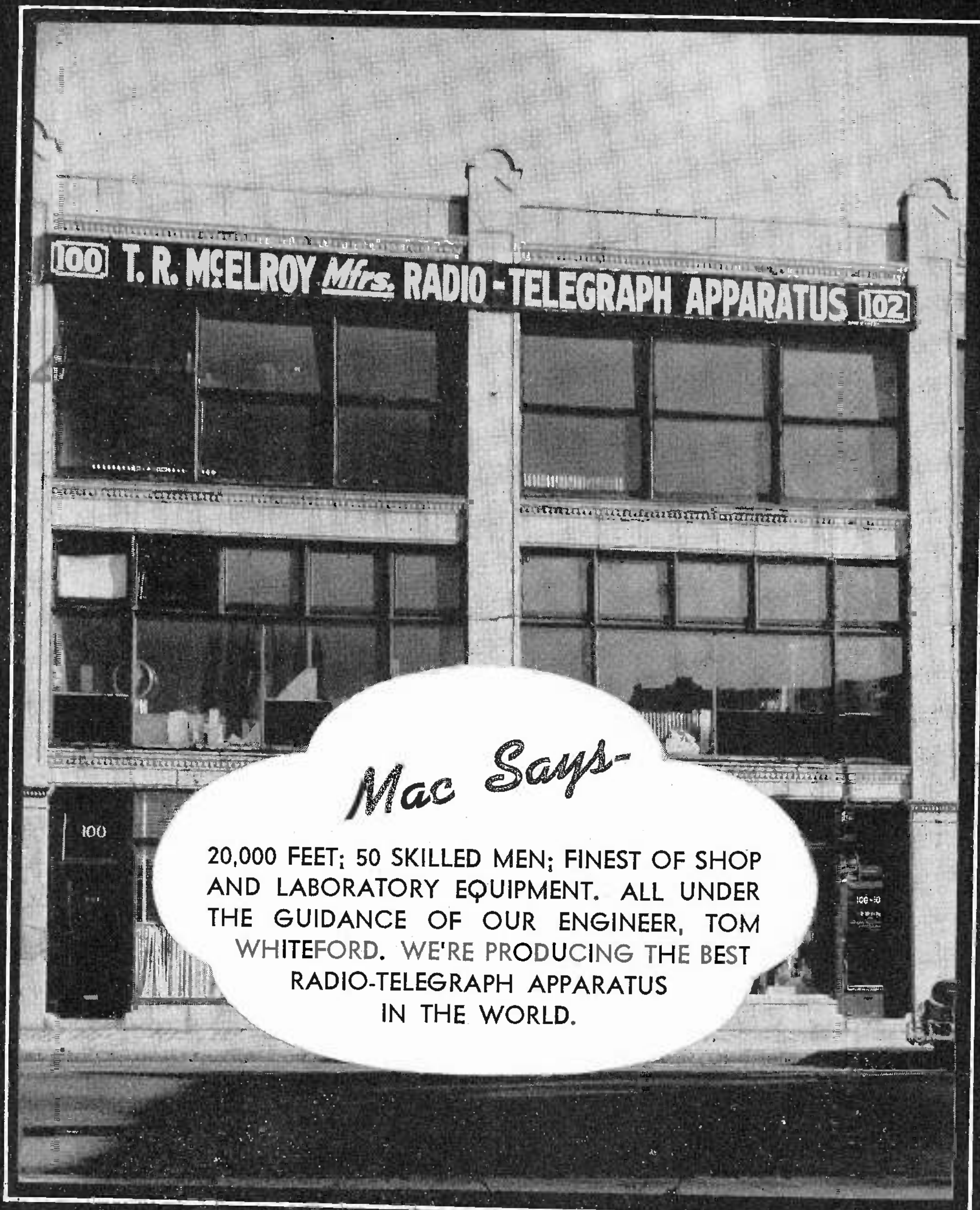
More than 10,000 oscillators built for operators during the past four years and one improvement after another has finally culminated in a genuine masterpiece.

- Beautiful plastic cabinet developed by the same artist who designed the "Super Stream-speed."
- AC-DC operation.
- Complete with built-in reproducer.
- Toggle switch gives choice of low or high volume.
- Choice of 600 or 1000 cycle note.

Truly an outstanding piece of equipment that belongs on every operator's desk.

MODEL No. S700 — NET TO THE OPERATOR **$5.95** MINUS TUBE Uses 117N7GT

OSCILLAFONE Model No. CR-700 at $2.85 net to the operator. An exceptionally fine quality speaker designed expressly for key-clickless dots and dashes. Housed in this same pretty plastic cabinet.


100 T. R. McELROY Mfrs. RADIO-TELEGRAPH APPARATUS 102
Mac Says-
20,000 FEET; 50 SKILLED MEN; FINEST OF SHOP AND LABORATORY EQUIPMENT. ALL UNDER THE GUIDANCE OF OUR ENGINEER, TOM WHITEFORD. WE'RE PRODUCING THE BEST RADIO-TELEGRAPH APPARATUS IN THE WORLD.

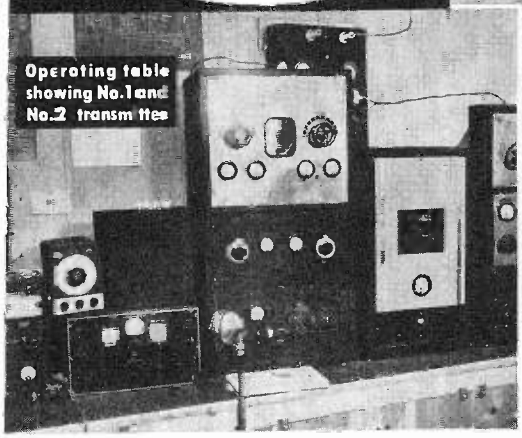
W6KW John R. Griggs

2-WAY, 75 Meter Phone Contact with KC4USB

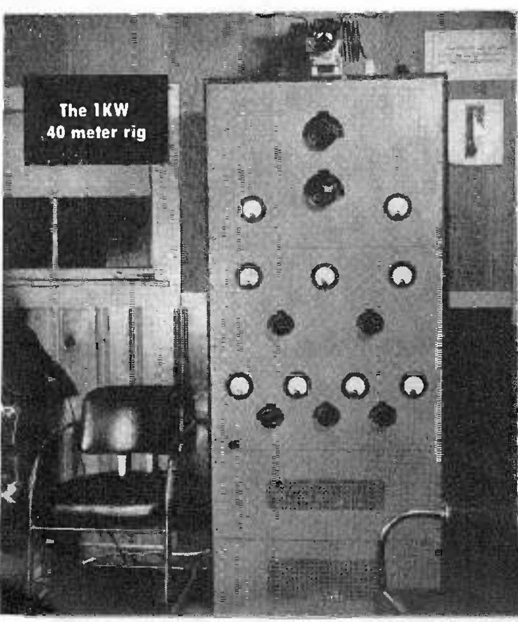
...and a regular schedule week-in, week-out with the Antarctic Expedition . . .

That's W6KW using

Eimac TUBES



Operating table showing No.1 and No.2 transmitters



The 1KW 40 meter rig

3 TRANSMITTERS in operation at W6KW — All Eimac Equipped

"Communication with the Antartic Expedition Stations KC4USA-B on a week-in, week-out, schedule during good or bad seasons, demanded the utmost from the vacuum tubes. That's why Eimac Tubes were chosen . . . and they delivered nobly. I think they are the most dependable tubes available." So says, John R. Griggs owner and operator of amateur station W6KW. Griggs has set something of a record with his 2-way 75 meter phone contact . . . over 7400 miles distance.

Letters and statements like this and others from the world's leading radio amateurs and engineers should mean much to you. These are not mere claims, they are the results obtained in actual service. The ever increasing list of top radio men who are adopting Eimac Tubes is proof enough that...

In the field of Electronics the overwhelming swing is to Eimac Tubes.

Get complete information from the nearest representative or write direct to the factory.

EITEL-McCULLOUGH, INC.

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

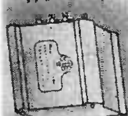
AMATEUR RADIO DEFENSE,
Monadnock Bldg., San Francisco.

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

Leaders in TRANSFORMER DEVELOPMENT and DESIGN

- Since the inception of the United Transformer Corporation, UTC designs have set a standard for the field.
- The major improvements in transformer design listed below substantiate that *UTC leads—others follow.*

1933
HIGH PERMEABILITY CAST SHIELD
(TOP AND BOTTOM MOUNT)



Used by UTC since 1933, the HIGH PERMEABILITY CAST SHIELD was a definite, forward step in high quality transformers.

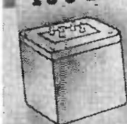
1933
HUM BALANCED COIL STRUCTURE

Used by UTC in practically all High Fidelity designs, hum bucking and hum balanced transformers are now accepted as standard practice in the transformer field.

1934
LINEAR STANDARD AUDIO UNITS

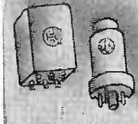
Flat from 30 to 20,000 cycles . . . a goal for others to shoot at.

1934
PORTABLE UNITS



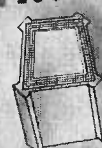
The UTC HIPERM ALLOY group of transformers were brought out to take care of portable high fidelity requirements.

1935
ULTRA COMPACT AUDIO UNITS



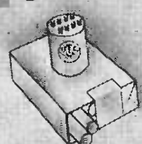
Developed originally for Aircraft and Hearing Aid Devices. In 1936, an entire series of these units were released for Broadcast Station applications. ULTRA COMPACT AUDIOS are HUM BALANCED, weigh from 4½ to 5½ oz. and are guaranteed ±2DB from 30 to 20,000 cycles.

1936
TRI-ALLOY SHIELDING



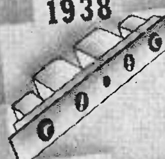
The combination of Linear Standard frequency response and internal TRI-ALLOY magnetic shielding is a difficult one to approach. That is why these units are used by G.E., R.C.A., Philco, Western Electric, Westinghouse, M.G.M., Walt Disney studios, and other discriminating organizations.

1937
OUNCER AUDIO UNITS



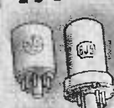
Extremely compact AUDIO UNITS for portable applications were a problem until the development of the UTC OUNCER UNITS. Fifteen types take care of practically all applications. Units not carrying DC are flat from 40 to 15,000 cycles. Another UTC-pioneered advance.

1938
UNIVERSAL EQUALIZERS



The UTC UNIVERSAL EQUALIZERS, ATTENUATORS, and SOUND EFFECTS FILTERS fill a specific need of the broadcast and recording field. Almost any type of audio equipment can be equalized to high fidelity standards.

1939
PLUG-IN AUDIO UNITS



The manufacture of UTC PLUG-IN components was commenced in 1937. In 1939, a simple octal base structure was developed. Fifteen stock items are now available in this housing similar to our OUNCER UNITS.

1940
NEW ITEMS

The UTC research laboratory will develop new items and improve standard designs in 1940. While some of these developments are described in our advertisements, many are applied to customer's problems. May we cooperate with you on your problem?

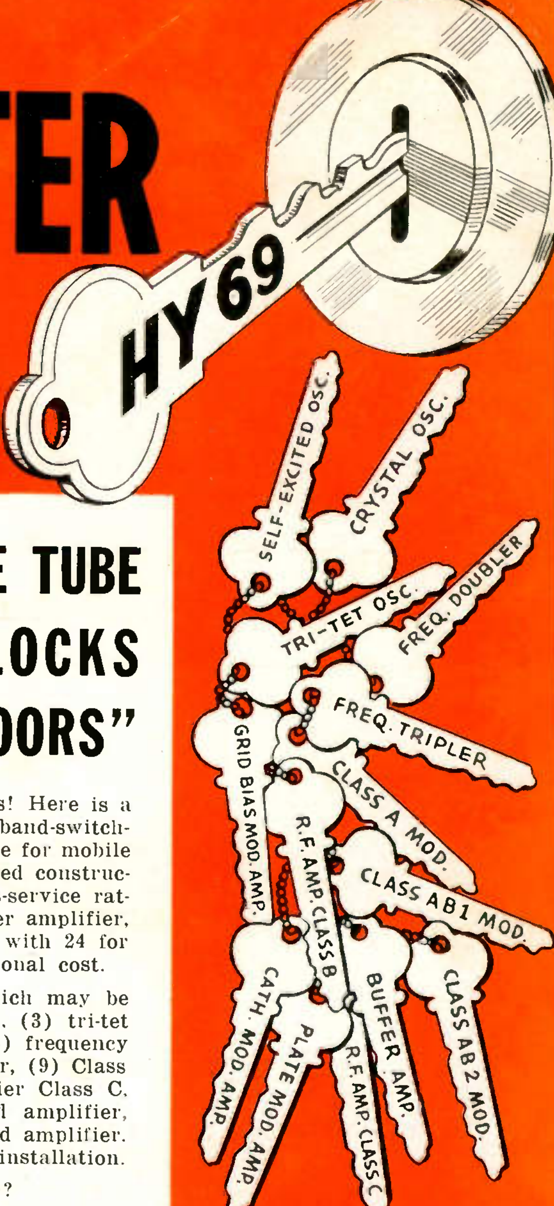
Imitation is the sincerest form of flattery

UNITED TRANSFORMER CORP.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"

LIKE A MASTER KEY



HY69
$3.50 NET

HERE'S THE TUBE THAT UNLOCKS MORE "DOORS"

The Hytron HY69 is your best buy in R. F. beam tetrodes! Here is a tube which is ideally suited for multi-band transmitters or band-switching units because it's so easy to drive. Also, it's first choice for mobile units because of its instant-heating filament, and its rugged construction, which insures reliability. On the basis of continuous-service ratings this tube, when used as a plate-modulated R. F. power amplifier, delivers up to 42 watts R. F. carrier output as compared with 24 for the cathode-equivalent HY61/807—without one cent additional cost.

Get acquainted with this amazingly versatile tube, which may be used as a (1) self-excited oscillator, (2) crystal oscillator, (3) tri-tet oscillator, (4) frequency doubler, (5) frequency tripler, (6) frequency quadrupler, (7) Class A modulator, (8) Class AB_1 modulator, (9) Class AB_2 modulator, (10) buffer amplifier, (11) R. F. amplifier Class C, (12) R. F. amplifier Class B, (13) grid-bias modulated amplifier, (14) cathode-modulated amplifier and (15) plate modulated amplifier. All these applications whether in a fixed station or mobile installation.

What more can you ask for an investment of only $3.50?

HY61/807 $3.50 net

The original R. F. beam amplifier (cathode-type). Shielded for R. F. applications and requires no neutralizing.

Plate voltage 600 V.
Class C output 37.5 watts.
Plate dissipation 25 watts.
Filament 6.3 volts at 0.9 amperes.

Recommended for use in existing equipment where change-over to HY69 tubes is not possible or not practical.

HY60 $2.50 net

The HY60 has a lower power drain than the HY61/807 and is also smaller in size, making it possible to utilize it in compact mobile units without sacrificing performance.

Plate voltage 425 V.
Class C output 16 watts.
Plate dissipation 15 watts.
Filament 6.3 volts at 0.5 amperes.

Delivers 30 watts of audio with only 400 volts on the plate, as a Class AB_2 modulator.

No neutralizing required—full ratings to 60 megacycles — less than 1/2 watt R. F. driving power — 40 watt plate dissipation.

HYTRONIC LABS.
23 New Darby St., Salem, Mass.

A DIVISION OF HYTRON CORP.

Manufacturers of Radio Tubes Since 1921