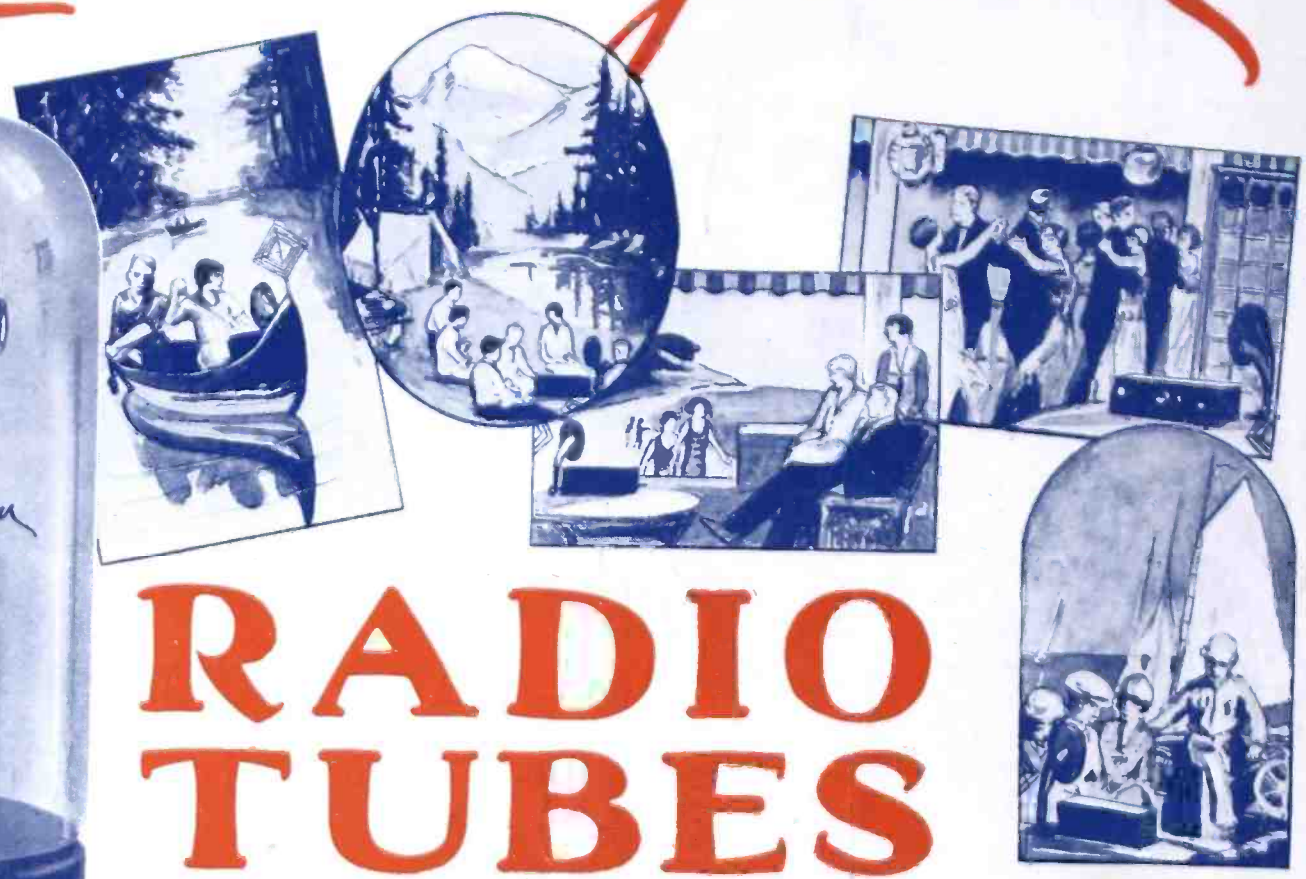
SEPTEMBER, 1924 25 CENTS

RADIO

(Reg. U. S. Pat. Off.)

Cunningham



RADIO TUBES

Bring World Events to Far-Distant Vacation Lands

BACK-COUNTRY isolation melts into world contact as you tune-in on music, drama, and the final battles of the Presidential Campaign.

Make your camp, your cottage, your yacht the center of hospitality and entertainment.

Perfected Radio will do it, and Perfected Radio means the use of Cunningham Radio Tubes. The Cunningham dry battery detector and amplifier tube, type C-299, makes it possible for you to treble your vacation pleasure by use of a portable receiving set. The special filament in this tube, using a current so low that it may receive its supply from standard No. 6 dry batteries or even from ordinary flashlight batteries, makes possible this far-reaching application of Radio.

The receiving set you now have can be readily adjusted to use this tube and be a source of use and pleasure on your vacation trip. Your dealer can give you useful suggestions for the purchase or construction of a highly efficient portable set.

CUNNINGHAM TUBE PRICES

C-301A—5 Volts ¼ Ampere filament.....$4.00
C-299—3 Volts .06 amp. Dry Battery Det. and Amp.....$4.00
C-300—5 Volts Gas Content Detector.....$4.00
C-11—1.1 Volts .25 amp. Dry Battery Det. and Amp. Special Base $4.00
C-12—Similar to C-11 with standard base.....$4.00

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Any other use will be an infringement.

DATA BOOK

Cunningham 40-page Data Book fully explaining care and operation of Radio Tubes now available by sending 10c in stamps to San Francisco office.

C. F. Cunningham Inc.

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at Last!! a Cello-Tone Headset

TOWER'S Scientific

Perfect Tone Mates

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Plus a few cents Postage

Frank S. Tower

TOWER'S GIFT TO THE WORLD!

Reproduction of All Radio in Cello-tones

For years Frank S. Tower played the cello, the richest-toned instrument in the world, giving concerts and recitals throughout Europe and America. With the soft, sweet "cello-tone" clearly in mind, he has successfully manufactured the TOWER'S scientific headset, which accurately reproduces all radio in the same liquid tones.

TOWER'S scientific, lightest of all in weight, offers higher resistance, with elimination of distortion. Longer cord (full 5 ft.). Every set tested and approved by licensed radio operators. Every set covered with our money-back guarantee.

Order today by post card and we will ship immediately by Parcel Post C. O. D.

Our $200,000.00 company stands squarely back of every headset.

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98 Dept. E Brookline Ave., Boston, Mass.

Scientific

RADIO

Established 1917

Published Monthly by the Pacific Radio Publishing Co.

ARTHUR H. HALLORAN, *Editor*

LAWRENCE MOTT, *Associate Editor*
GERALD M. BEST, *Technical Adviser*
H. W. DICKOW, *Advertising Manager*

Branch Offices:
New York City—17 West 42nd St.
Chicago—157 E. Ontario St.
Boston—52 Irving Street.
Kansas City, Mo.—1102 Republic Bldg.

Rates:
Issued Monthly, 25c a copy. Subscription price $2.50 per year in the U. S., $3.00 per year elsewhere.

Correct Addresses:
Instructions for change of address should be sent to the publisher two weeks before the date they are to go into effect. Both old and new addresses must always be given.

Advertising:
Advertising Forms Close on the First of the Month Preceding Date of Issue.

Entered as second-class matter at the Post Office at San Francisco, Calif.

Address all communications to

Pacific Radio Publishing Co.

Pacific Building, San Francisco, California

VOLUME VI SEPTEMBER, 1924 NUMBER 9

CONTENTS

Forecast of Contributions for October Issue

G. M. Best will have two articles in addition to his "Queries and Replies" which are universally recognized as containing reliable information. One article will deal with the construction of a two-stage choke coil amplifier set costing less than $40.00 and giving distortionless reception at high efficiency. The other will give the characteristics of audio-frequency transformers at various frequencies.

C. M. Jansky Jr. will continue his valuable series of articles on radio communication with some specific application of principles already developed. During the summer months, Prof. Jansky, as assistant consulting radio engineer for the Signal Corps, has been devoting his time to research work at Camp Alfred Vail, N. J.

Constructors of home-made sets will be interested in O. B. Scott's details of the design and construction of the regenerative reflex, as well as in E. F. Kierman's directions for winding duo-spiderweb coils for use in the simplified Reinartz circuit.

Bernard Steinmetz explains several methods for obtaining negative potentials for grids of vacuum tubes.

Jerome Snyder has a helpful article on the theory and use of the hot wire ammeter.

The transmitting amateur will find some unusually good suggestions in several articles. F. Dawson Bliley tells how to get down to the lower wavelengths now available for amateur use. L. W. Hatry discusses the design of the reversed feed-back transmitter. M. Wolf describes a simple method for determining percentage modulation in radio telephone sets. F. Bowman passes on some good stuff about a successful loose-coupled transmitting circuit. William Jackson describes an ideal chemical rectifier.

Harry Diamond analyzes the nature of static and its elimination.

Edward W. Smith presents a simple discussion of the essentials of a good audio-transformer and circuit arrangement whereby the output can be improved in quality.

F. L. Ulrich has an interesting article on a short wave DX receiver oscillating as low as 50 meters.

The fiction feature will be "A Royal Hiatus," a story with a hundred chuckles. You will also get a good laugh out of "A Jazzed Up History of Radio."

THE GREBE SYNCHROPHASE

TRADE MARK

"It is only when the cold season comes that we know the pine and cypress to be evergreens."
—Confucius

In the coming cold season be not surpassed by thy neighbor—set the pace with your Grebe Synchrophase.

Doctor Mu

A BROADCAST Receiver that marks another long step forward in radio design and establishes a new set of standards in craftsmanship.

Write for literature

A. H. GREBE & COMPANY, INC.
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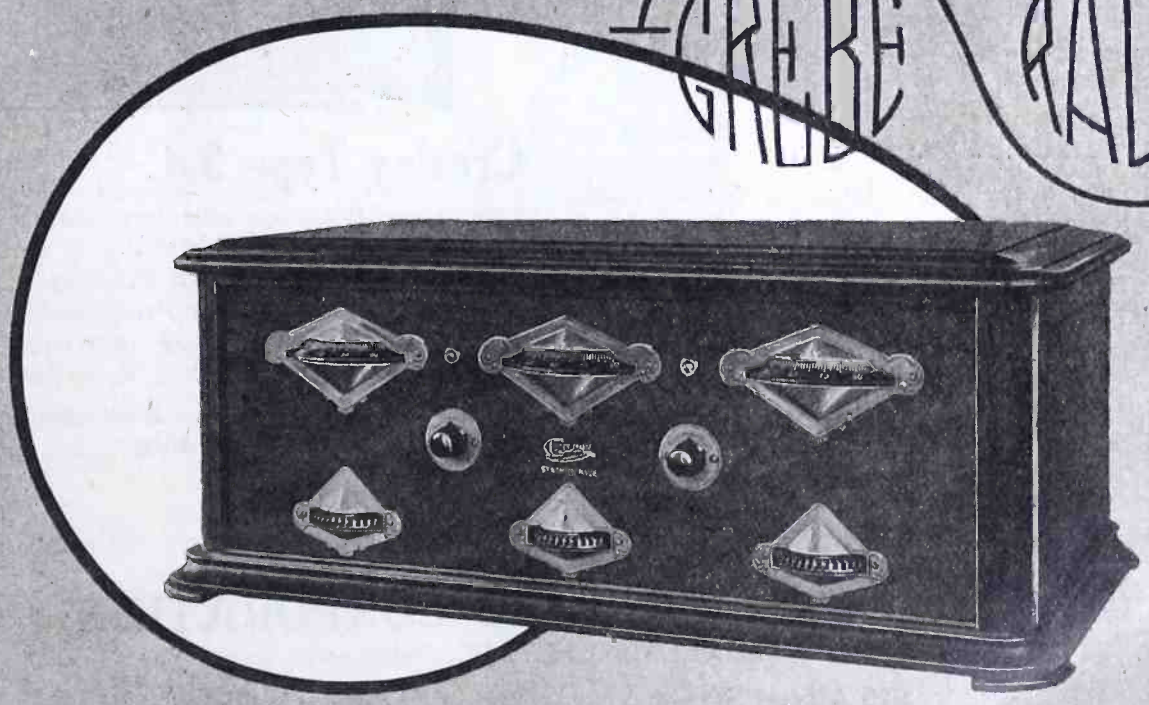
GREBE RADIO



For Long Distance Reception

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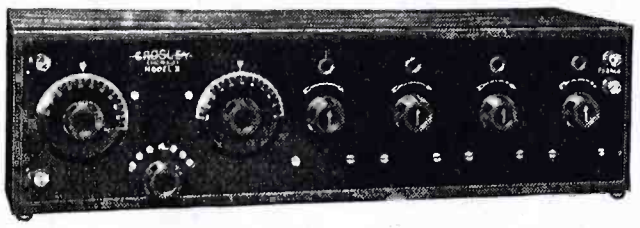
CROSLEY

The Crosley Radio Corporation owns and operates Broadcasting Station W L W

Better-Cost Less Radio Products

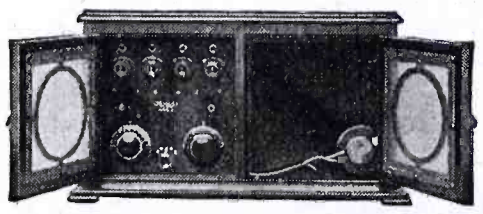
Tuned Radio Frequency Receivers



Crosley Model X-J The famous Crosley four-tube receiver consisting of one stage of radio frequency amplification, detector and two stages of audio frequency amplification. Probably the greatest single feature of this receiver is its remarkable selectivity. It will tune through powerful local broadcasting stations and bring in distant stations clearly and with great volume. One of the most popular receivers on the market today..... **$55.00**

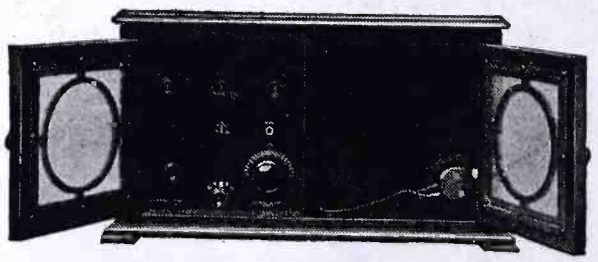
Crosley Model VI A two-tube receiver with a reputation for long distance with pronounced clearness. It consists of one stage of Crosley tuned radio frequency amplification and a detector. This Crosley combination multiplies the receiving range of the set..... **$24.00**

Crosley Super VI This two-tube receiver is so coupled up as to combine both the Tuned Radio Frequency and the regenerative detector. Perfect regeneration, control of tuned radio frequency amplification with minimum reradiation and increased range..... **$29.00**



Crosley Model X-L This beautiful Consolette Model is an addition to any home. It is the same receiver as the Model X-J except as to arrangement of panel and the consolette cabinet with its built-in loud speaker and separate compartment for dry cell "A" and "B" batteries and other accessories..... **$120.00**

A beautiful stand to match this X-L is supplied at an extra cost of only.....$25.00



Crosley Type 3-C This receiver consists of an Armstrong regenerative detector and two stages of audio frequency amplification, making it suitable for long distance reception on a loud speaker. (This set does not contain Tuned Radio Frequency Amplification.) It is built in the same style as to cabinet, etc. as the Model X-L described **$110.00**

It matches perfectly the floor stand described for the Model X-L costing only.....$25.00

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Write for Complete Catalog

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POWEL CROSLEY, JR., *President*

919 Alfred Street **Cincinnati, Ohio**

10% WEST OF ROCKIES. PRICES QUOTED ARE WITHOUT ACCESSORIES.

The PAUL REVERE of TODAY

TWENTY miles in a single night. That was the wonderful broadcasting achievement of Paul Revere as he galloped from village to village, waking the countryside with the cry "the British are coming."

Just one-hundred and fifty years ago he made that broadcasting record. Today news flashed in any part of the country is heard almost instantly, not a mere twenty miles but thousands of miles away.

In every part of the United States Crosley Radio Receivers are bringing in far distant stations clearly and distinctly. Up to the minute news, concerts, music, lectures, are yours to enjoy right in your home when and from where you choose if you own a Crosley.

Keeping always at the head of the procession in improvements and innovations, the Crosley Radio Corporation has made it possible for every one to possess the maximum efficiency in radio reception at the minimum cost.

The Crosley Trirdyn 3R3 illustrated below is, in the opinion of many experts, the best radio receiver ever offered to the public at any price. The experiments of over 200 experts have shown that in ease of tuning, sharpness of signals and nicety of calibration, the Trirdyn cannot be excelled. Local stations may be easily tuned out even if very close to you, and far distant reception almost instantly brought in.

The Trirdyn 3R3 illustrated below is a 3 tube set incorporating tuned radio frequency amplification, regeneration and reflex. It has been proven to give the efficiency of a 4 or 5 tube set. And yet it is priced at only $65 without batteries, tubes and headphones. The Trirdyn Special, set in a special solid mahogany cabinet which is made to house all the necessary accessories may be had for only $75.

Before you purchase a radio receiver listen in on a Crosley Trirdyn.

For Sale by Good Dealers Everywhere

Crosley Trirdyn 3R3 . . . . $65.00

Other Crosley Models

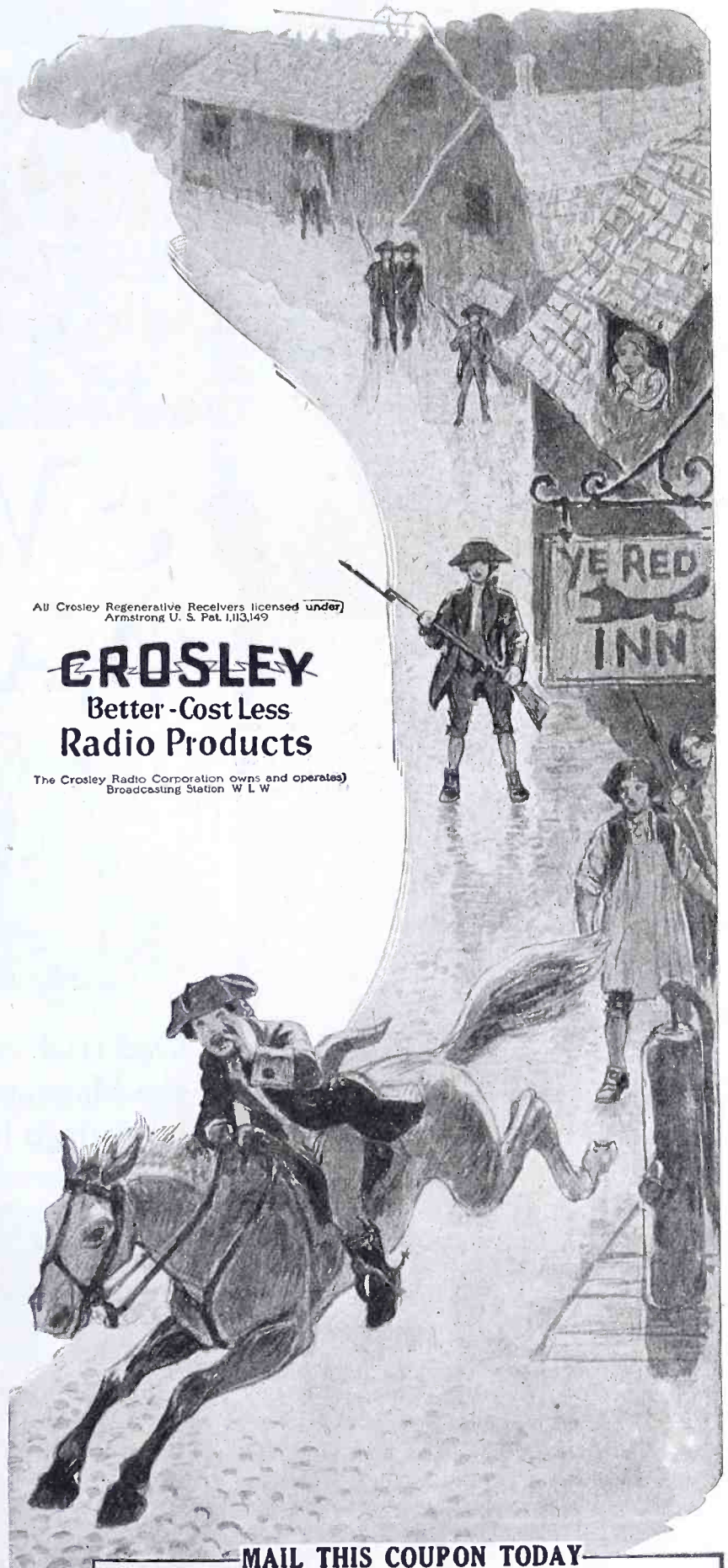
CROSLEY 50	A one tube Armstrong Regenerative Receiver. Price, less accessories $14.00. A two stage amplifier Crosley 50-A may be added to it for only $18.00 thus making a three tube set.
CROSLEY 51	The two tube Armstrong Regenerative set that became the biggest selling receiver in the world in just 24 days. Price, less accessories, $18.50. By adding the Crosley 51-A a one stage amplifier at $14.00 a three tube set may be formed.
CROSLEY 50-P	The Crosley 50 in neat strong portable quartered oak cabinet for only $18.00.
CROSLEY 51-P	The Crosley 51 in compact leatherette portable case completely self containing at $25.00.
CROSLEY 52	A new Armstrong Regenerative 3 tube set assuring loud speaker volume on distant stations under almost any conditions. Price, without accessories $30.00.
CROSLEY X-J	One of the best known and most popular 4 tube receivers on the market. A radio frequency set at $55.00 without accessories.
CROSLEY X-L	A rearrangement of the 4-tube Crosley X-J set in a beautiful mahogany console cabinet. Price, without accessories $120.00

The Crosley Radio Corporation

Powel Crosley, Jr., President

919 Alfred St. Cincinnati, O.

Prices west of the Rockies 10% higher



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Gentlemen: Please mail me free of charge your complete catalog of Crosley instruments and parts together with booklet entitled "The Simplicity of Radio".

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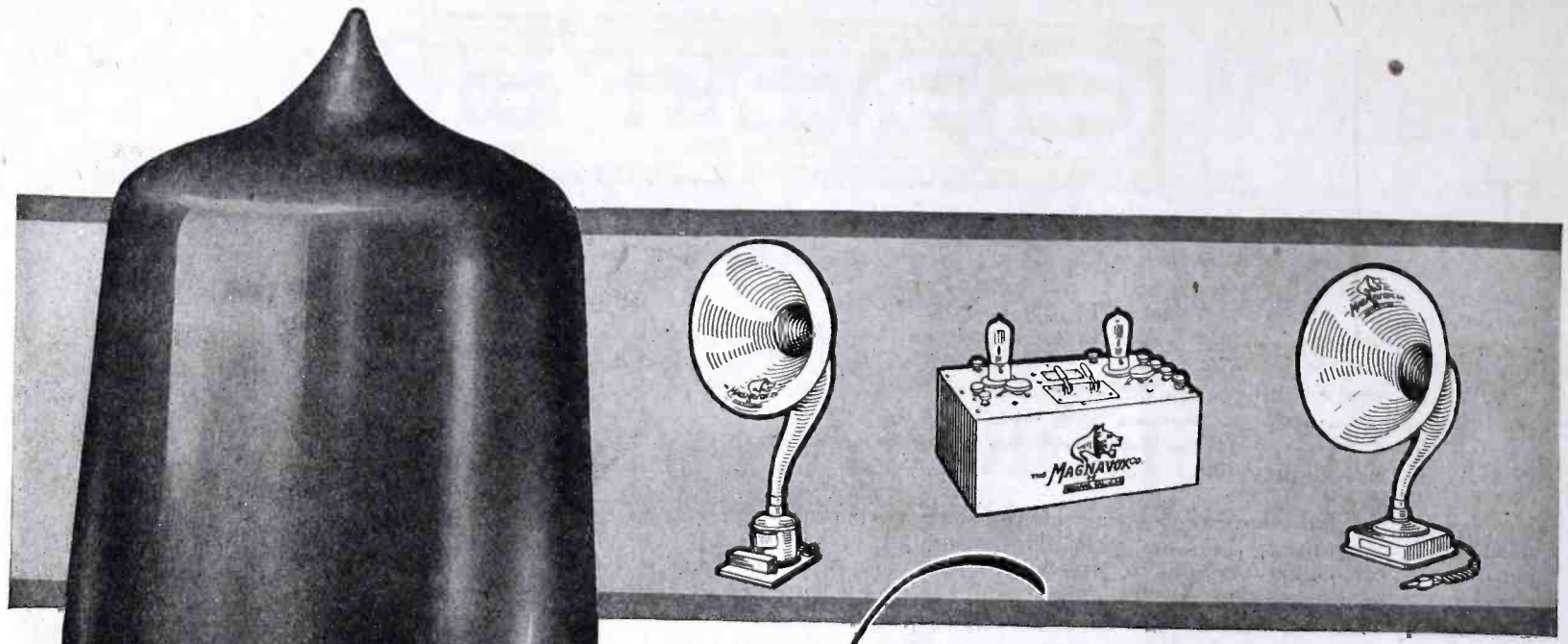
Address _____



Now a MAGNAVOX Tube

THE engineers who developed the famous Magnavox line of radio reproducing and amplifying equipment have now produced a *vacuum tube* equally distinctive and successful in its own field.

One trial convinces the most exacting user that the Magnavox will replace ordinary tubes to great advantage in any receiving set.

Magnavox Products

Reproducers of electro-dynamic and semi-dynamic type, for all vacuum tube receiving sets; $25.00 to $50.00

Power Amplifiers for audio-frequency amplification, one, two, and three-stage; $27.50 to $60.00

Combination Sets combining a Reproducer and Power Amplifier in one unit; $59.00, $85.00

Vacuum Tubes: A storage battery tube of new and approved design for all standard circuits . . . $5.00

Magnavox Radio Products are sold by reliable dealers everywhere. If unacquainted with the Magnavox store in your vicinity, write us for information.

The name Magnavox is your assurance of quality and efficiency.

THE MAGNAVOX CO., OAKLAND, CALIF.

NEW YORK SAN FRANCISCO

Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

$5.00

MAGNAVOX RADIO VACUUM TUBE TYPE A is a storage battery tube for use as audio frequency and radio frequency amplifier in all standard circuits. Highly recommended also for detector use. This tube is not critical of adjustment either as to plate or filament. Filament consumption one quarter of an ampere.

The most notable feature of the new Magnavox Radio Tube consists in eliminating the grid.

Unlike the ordinary storage battery tube, Magnavox Tubes give the electrons an unobstructed passage between filament and plate, with the result that the Magnavox has less than one half the internal capacity of other tubes of similar type.

9R

GAROD

ANNOUNCES THEIR NEW POWERFUL NEUTRODYNE MODELS THE GEORGIAN AND THE V

The Garod Georgian

Rich brown burled walnut, with door-panel borders of inlaid ebony and holly —5 tube model—built-in loud speaker—battery compartments and accessory drawer. Will grace the finest drawing room—provide the best in radio reception. Size 35½" long—16⅝" deep—42½" high.

$400.00

The public wants Power

Power—to produce great volume.

Power—to bring in distant stations.

Power—to work through local stations.

Power—to moderate or intensify volume.

Power—to render the original quality of tone transmitted.

Power—to select programs.

Power—to get the best out of the program.

These models have power plus—and then more power. They are full voiced—with tonal quality of exquisite timbre. They can be controlled to meet the capacity of the small living room, or manipulated to take full advantage of the acoustic possibilities of the large hall.

In every respect, they are worthy of bearing the name GAROD.

We are now ready to enter orders, and grant jobbers of standing, exclusive non-conflicting territories, where open.

The Garod V

Genuine mahogany highly finished cabinet—graceful 15° sloped genuine mahogany panel—carved feet—five inch dials—double reading Weston volt-meter—5 tube model. Size 34⅛" long—13¾" deep—11⅜" high.

$195.00

The Garod RAF

The receiver that made GAROD famous. Added mechanical improvements—4 tube model—with which you are familiar. Size 19½" long—7⅞" deep—10" high.

$135.00

GAROD LICENSED BY INDEPENDENT RADIO MANUFACTURERS INC
NEUTRODYNE
UNDER HAZELTINE PATENTS NOS. 1,450,080 AND 1,489,218 AND OTHER PATENTS PENDING
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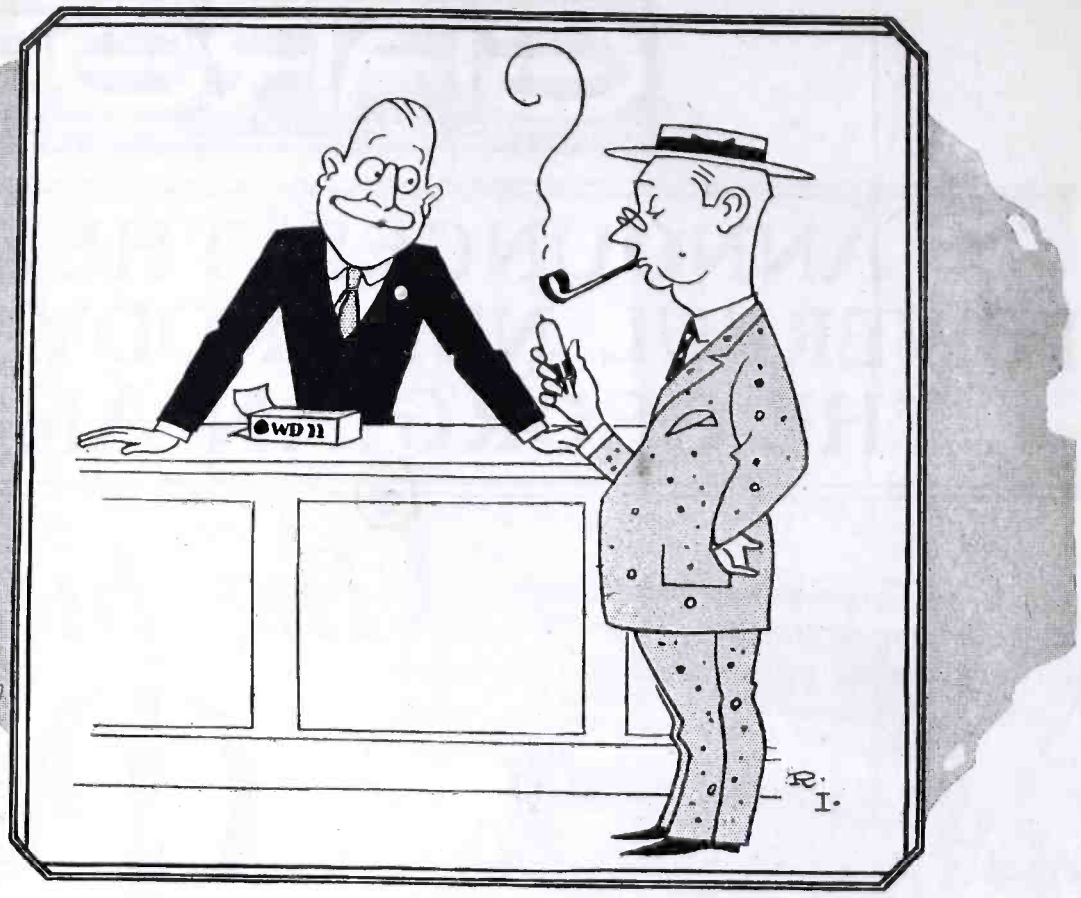
SEE OUR EXHIBITS AT

First Radio World's Fair
Madison Square Garden, New York
September 22 to 28, 1924

Third Annual Chicago Radio Show
Coliseum, Chicago, Ill.
November 18 to 23, 1924

The GAROD Corp.
120 Pacific Street, Newark, N. J.

Radiotron
WD-11



Don't Buy *Just Tubes!*

If you go into a reliable store and ask for a vacuum tube, you will probably get a genuine Radiotron, because most reputable dealers carry nothing else. And most buyers mean "Radiotron" when they say "tube." But the wise man *says* "Radiotron." And he takes the precaution to look for the name on the base, and the RCA mark on the glass. Those names have a history of invention, research and development back of them that has resulted in the production of the finest tubes possible today. And they have a history of *best performance* right within every fan's experience. That's why knowing fans buy by the name: Radiotron.

This symbol of quality is your protection.

It isn't a genuine WD-11 unless it's a Radiotron.
It isn't a genuine WD-12 unless it's a Radiotron.
It isn't a genuine UV-199 unless it's a Radiotron.
It isn't a genuine UV-200 unless it's a Radiotron.
It isn't a genuine UV-201-a unless it's a Radiotron.

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Sales Offices: Dept. 59
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10 So. LaSalle St., Chicago, Ill.
433 California St., San Francisco, Cal.

Radiotron

REG. U. S. PAT. OFF.

RADIO

Established 1917

Volume 6 SEPTEMBER, 1924 Number 9

Radiotorial Comment

TO amateur and novice alike should be sounded a warning to be careful in buying from the gyp radio dealers. The gyp was originally a gypsy horse-trader, here today and gone tomorrow, ever in search of new victims. Radio, like other new industries, has attracted many such sharpers and swindlers ever ready to capitalize public ignorance or carelessness. They are but one step removed from the street peddler of cheap fountain pens and near-silk socks.

They have a big bag of tricks, all intended to deceive and to bring profit to none but themselves. By means of extravagant claims, low prices, and selling on appearance rather than performance, their primary appeal is to curiosity and gullibility. Much of their stock consists of seconds and obsolete material. When asked for standard articles they generally try to sell something "just as good."

Unquestionably, bargains in radio equipment are frequently to be found, especially in lines whose manufacture is to be discontinued. Many legitimate dealers have clearance sales so as not to carry over slow-moving goods. But these are not sold under false pretenses.

Generally it's his own fault if a victim is caught. He lets his cupidity override his caution. He forgets that the "caveat emptor" of the ancient Romans applies to the modern gyp. So we repeat: "let the buyer beware."

THE opening up of several bands of shorter wavelengths for C. W. transmission comes as a most welcome surprise to the radio amateurs. The complete text of Commissioner D. B. Carson's letter of authorization appears elsewhere in this issue. It is to be noted that the restrictions of silent hours on these bands below 80 meters is no longer to be enforced.

Recent experiments have shown that these short waves are far more desirable than the longer wavelengths hitherto assigned to the amateurs. Their use will give an added interest and impetus to amateur transmission and help to encourage more to enter the game.

These concessions should be regarded as a reward for the praiseworthy manner in which the amateurs have acquiesced to previous restrictions. They indicate that the government officials are fully alive to the value of amateur experimentation. Even virtue sometimes is thus additionally recompensed.

SEVERAL letters have been written to the editor objecting to statements regarding the wastefulness and inefficiency of resistance-coupled amplifiers as published on this page in the July issue. Some of the writers even accuse us of deliberate mis-statement of fact so as to favor transformer manufacturers by "knocking" the resistance-coupled amplifier.

A careful reading of the editorial in question fails to reveal any basis for such accusation, as it was stated that resistance coupling will be satisfactory to those content with more perfect reproduction of local music until such time as the radio engineers further improve the amplifying transformer.

Furthermore, the fear or favor of no advertiser has ever influenced what appears in these columns. The endeavor has always been to present facts which will help the reader. That no brief is held as to the perfection of the present audio-frequency transformers may be gleaned from the report of the tests published elsewhere in this issue.

They are far from perfect, and yet the wonder is that such excellent results are secured with apparatus that has been developed while the radio art is so young. The next few years will witness remarkable improvements in transformer design, not the least of which will be the use of permalloy as a core material, enabling one transformer and tube to do the work of three.

The admittedly improved quality of reproduction secured with resistance coupling is obtainable only at the expense of considerable increase in *B* battery voltage so as to deliver sufficient current for operation of tubes at their point of highest efficiency. A large part of this energy is consumed as heat in the resistors, so that, to equal the volume of sound from a two-tube transformer-coupled amplifier, it is necessary to employ three stages of resistance coupling. This is due not only to the loss in the effective plate potential, but also to the large reflection losses between the plate of one tube and the grid circuit of the next tube.

We are therefore forced to the conclusion that, with the available tubes having a relatively low plate impedance and amplification constant, resistance-coupled amplifiers are uneconomical and inefficient.

Until such time as pending improvements are made in transformers, a properly designed choke coil coupled amplifier will be found more efficient and fully as distortionless as resistance coupling. Directions for construction will appear in an early issue.

The Brasspounders of Nippon

An Explanation of the Japanese Telegraph Code and An Account of the Operators' Difficulties

By Volney G. Mathison

THOMAS Brown, Jr., radio operator of the good ship *Aunt Columbia,* is away out in mid-Pacific. He has sat up all night and far into the wee hours waiting for his chance to slip a message across a two-thousand-mile bulge of the earth to the coastal station at San Francisco, telling the home office about the cargo in the capacious hold of the *Aunt Columbia,* number of passengers on board, probable date of arrival, and much other important information.

At last, after hours of weary calling and waiting on the part of Thomas Brown, Jr., KFS or KPH comes in with a "Q-R-V—go ahead." With a heart-felt sigh of relief, our brass-pounder eagerly reaches for his key and hammers out his message. But, alas, and also, alack, upon throwing his aerial switch back onto his three-step receiver to get the hoped-for "Received all OK" from the distant land station, he now finds his head phones filled with the high shrill note of a powerful nearby transmitter making a noise something like this:

"JAB, JAB, JAB, JAB, de JOK, JOK, JOK: Zokgwq5l ?mzyspznb—st yz93yzpwwerpzqk! Oggwetyhkagdryic hmptyz ?klgst zzystvwlpzokman5jp2totq jwxgmzweptgsopm——"

"Blank the blank blank blank of a blankety-blanked son of a blank blank Jap!" raves Thomas Brown, wrenching his sweaty phones off his aching ears and slamming them down on his gummy desk with such a bang that he breaks a piece off one of the hard rubber ear caps. "How in hellsbells is a guy gonna do any work with them low-down rotten, yellow, slant-eyed son of a sea-cooks burnin' up th' air with that blasted dash-dash-dotta-dash-dot-dot junk, night an' day, day an' night, from Yokohama to 'Frisco, an' back again! They do it for pure cussed meanness; I wish we'd have a war; I'd grab a gun an' go after 'em tomorrow!" —and so forth and so forth.

What Thomas Brown Jr. of the good ship *Aunt Columbia* doesn't realize is that some poor sweating devil of a Jap, whom nature intended to run wild in a rice field with a breech-cloth and a straw hat, is sitting cooped up just like Thomas Brown in a hot radio shack somewhere on the Pacific, cursing no less fervently in his own Nipponese way as he strives with a brush and a bowl of ink to put down in difficult Japanese characters the meaning of the maddening jumble of dots and dashes which are so infuriating to his Occidental brother.

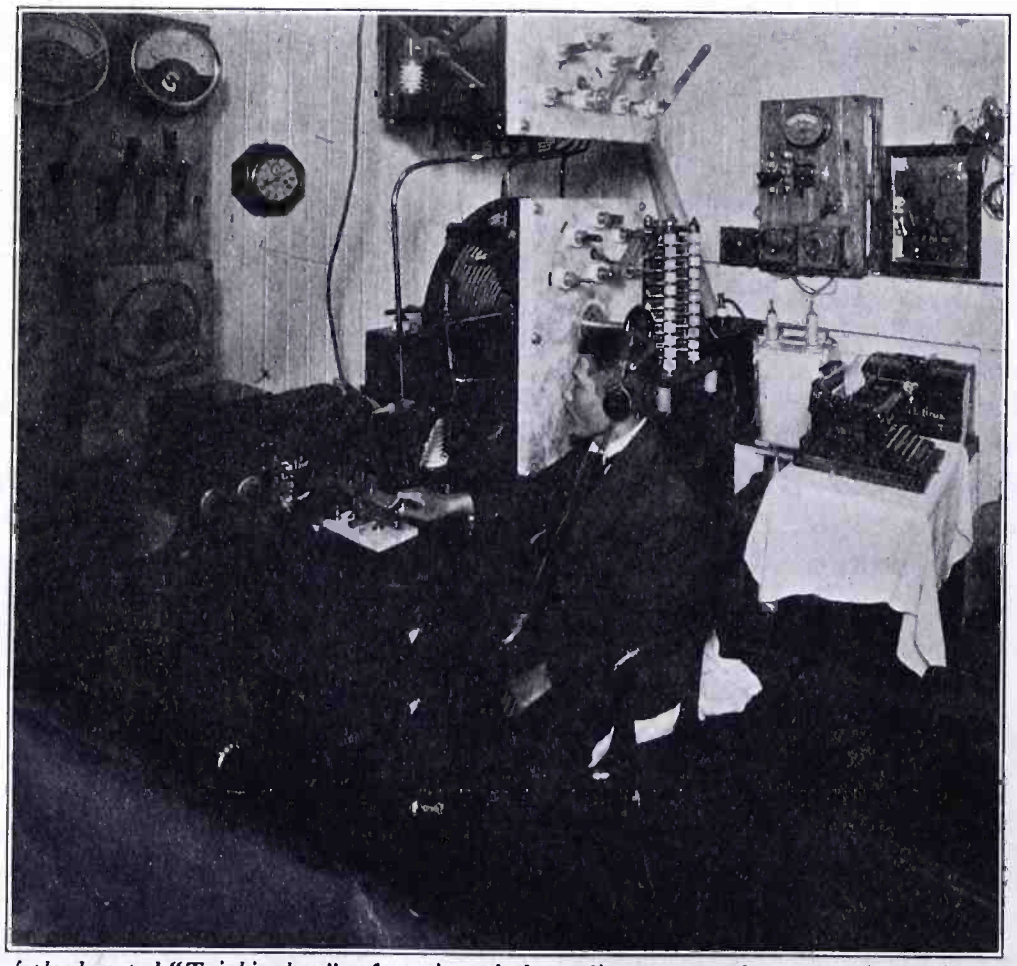
To the layman, the transmission of telegrams in an apparently letterless or non-alphabetic language like Japanese appears almost an impossibility. However, as every naval and commercial radio operator who has ever sailed on the Pacific has found out to his sorrow and anger, it can certainly be done. The method used does not seem to be understood by one American radio man out of a thousand. Like Thomas Brown of the *Aunt Columbia,* the average perspiring key-puncher, sitting in his two-by-four coop on a hot tropical night listening with bad grace to the complicated combinations of shrill dots and dashes emanating from the Jap ships, assumes that the infernal yellow devils have got up an ungenerous secret code by which they are enabled somehow to communicate among themselves and with which they can jam the ether with senseless signals the moment they hear an American code slinger trying to slip a couple of messages through edgewise.

It is my aim to try to present in an interesting manner something of what Mr. Takomoto Nogo, the Japanese "Sparks" of the *Nippon Maru,* is up against; and, in order to do so, it is first necessary for me to tell a little about the Japanese language.

I have already sort of insinuated that Japanese writing is letterless. This, however, is not strictly correct. Unlike Chinese, upon which much of modern Japanese has been built, the language of Nippon has been systematized into a phonetic syllabary represented by forty-seven symbols. In addition to these, there are twenty-six diacritical marks, which, with the exception of one very important one, are dispensed with in telegraphing. We do not have here a true alphabet, but a system of grouping syllables together. By use of the symbols and marks, all Japanese sounds, and hence all words in the language, can be reproduced.

Since the Japanese characters are taken from the Chinese, all Japanese writing is highly mystifying to a Chinaman, who at once recognizes the symbols, but can make nothing whatever of their combination.

This is not by any means the only system of writing used in Japan, but it is the only one that can be telegraphed.



One of the berated "Teishinshos." A section of the radio room on the Toyo Kisen Kaisha liner "Tenyo Maru," showing powerful 7-kilowatt quenched spark transmitter

イ -- ee	ワ --- wah	# -·--- wee	サ -·-·- sah
ロ ·--· row	カ -·-· kah	ヰ ·-·-- wee	キ -·-·· kee
ハ -··· ha	ヨ -- yo	ノ ·-·-· no	ユ -··-- you
ニ --·- nee	タ -· tah	オ ·-··· oh	メ -··-· zay
ホ -·· hoe	レ --- ray	ク ···- koo	ミ ··-·- mee
ヘ · hay	ソ ----· so	ヤ ·-- yah	シ --·-· shee
ト ··--· toe	ツ ·--· tsu	マ -··- mah	エ ·---· aye
チ ··-· tchee	ネ --·· neigh	ケ -·-- kay	ヒ ---·· shee
リ --· ree	ナ ·-· nah	フ --·· too	モ -··-· moke
ヌ ···· new	ラ ··· rach	コ ---- kwo	セ -·--· zet
ル -·--· roo	ム - moo	エ ·---- ach	ス ---·- soo
ヲ ·--- wawk	ウ ··- ugh	テ ·-·-- tay	ン ·-·-· n
		ア --·--- ah	

The Japanese syllabary, with corresponding telegraphic code groups and approximate pronunciation

Though it has always been despised by the scholars and high-brows, it is widely used by the common people and nowadays appears in almost all Japanese publications. It gives the sounds of the unfamiliar Chinese characters which have been immensely absorbed by the Japanese, and it is the only practicable medium for the expression of foreign scientific terms and meanings.

The other Japanese writing, which the radio operator is expected to understand, and which he may be called upon to translate into the phonetic system, is purely ideographic; that is, it employs symbols for ideas. It is necessary, as in Chinese, to learn from three to six thousand root symbols in order to use this system. This writing is absolutely unintelligible when spoken; it can be understood on paper only.

When telegraphy was first introduced into Japan, the main problem was to devise dot and dash combinations for the forty-seven symbols and one essential diacritical mark of the phonetic system. This code was originally worked out by Japanese and European wire-telegraph experts before the year 1900, but after the Russo-Japanese war it underwent some alterations.

It is a highly perfected but difficult code—difficult because, while in English and other Aryan tongues we had only from twenty-three to twenty-six letters to set into dots and dashes, in Japanese these are forty-eight. There were, of course, insufficient short combinations of dots and dashes to go around; so, in order to complete the code, it was necessary to use some long groups, eighteen of them containing five dots and dashes each.

In the illustration, I have represented the forty-eight Japanese phonetic symbols, their dot-and-dash groups, by which they are telegraphed, and their pronunciation—this last only approximately. Two of the symbols have exactly the same sound, but are written and used differently. These forty-eight characters have no equivalents in English.

I have also given the Japanese translation and dot-and-dash groups of a short radiogram. The "love and kisses" part of it is tamely translated into Japanese as "friendly compliments." This is about all the loving that can be done by radio in Japan, without the operator or somebody going to jail; because kissing and all mention of kissing is considered as almost the height of immodesty.

A brief inspection of the Japanese syllabary will convince anyone that the lot of the Japanese radio operator is not to be envied. Where the American operator deems it no small feat to learn to handle at commercial speeds our twenty-six-letter code, the Japanese has to learn a code of forty-eight dot-and-dash groups, and has to copy these down rapidly in separate unconnected symbols, some of which, as may be seen in the il-

"Home Friday. Love and kisses. Mary"

Home
tsu-koo
ツ ク
·--· ···-

Friday
keenyo
キ ソ ヨ ウ
-·-·· -·-·- -- ··-

Love and kisses
Yo-ro-shee-koo
ヨ ロ ツ ク
-- ·-·- -·-·- ···-

Mary
Hannah-ro
ハ チ コ
-··· -·- -·--

A radio message translated into Japanese. A Japanese would write the Oriental symbols vertically instead of horizontally

lustration, are rather difficult. Furthermore, the large influx of new words and thought into Japan, requiring more accurate means of expressing ideas, is causing a steady increase in the number of symbols and marks in use, and may eventually compel an expansion of the telegraph code.

In addition to learning to telegraph in the straight syllabic system, the Japanese student is expected to translate all other Japanese writings into this system, before he can telegraph. He must be familiar with the common spoken tongue, the polite tongue, and the ideographic system of four or five thousand symbols, which are too much for even a Chink, and many of which may be read three or four different ways, according to circumstances. Add further that all these kinds of written symbols are likely to be encountered on one page, and that there are four or five kinds of script, and it will be seen that the task of manipulating Japanese is excruciating.

Just sort of incidentally, as it were, the Japanese radio operator is further required to read, write, and speak English, and to be able to telegraph in English in the usual continental code.

This all appears formidable to the American, and it is hardly less so to the young Japanese radio student. The reader will vividly realize this when I state that Japanese students sometimes become despondent under the strain of trying to accomplish so much and commit spectacular suicide by leaping from lofty cliffs or casting themselves down into steaming volcanic craters.

These tragedies of Japanese technical student life are not the result of insanity, as we usually employ that word, for the despairing ones almost invariably leave behind intensely human farewell letters showing them to have been in full possession of their reason up to the last moment; nor is it the outcome of anything inherent in Japanese nature or in Buddhist teachings, as is imagined by some; but is simply due to the killing stress of endeavoring to emulate the Occident, of struggling to reach the standards of western acquirement hindered by a fundamentally different language and handicapped by sadly poor equipment, opportunities, and resources. Unless the student is in a naval or military school, he has to fall into the ranks of the poorly-paid physical laborers during a large part of the day or night, in order to earn his living and pay for his college tuition. Hungry, overworked, and often disappointed, he finds the struggle intolerable and so passes out into the darkness.

The successful Japanese radio student is usually granted a second-class commercial license, which is issued by the government, under a strict examination. After two years or more of sea service, the intelligent operator is usually ready to pass the tests for a first-class certificate. The obtaining of this document requires successful sending and receiving in the Japanese syllabic system at a speed of 100 symbols a minute, sending and receiving in English in the continental code at twenty words a minute, and much radio law and theory.

The first-class license is permanent; the Japanese radio operator never has to renew his certificate or take another examination; and, considering what he has been through, it would appear superfluous ever to require him to do so. Incidentally, the Japanese operator never posts his license in the radio room, which procedure is required by law under most flags, but, as one light-hearted Nipponese brasspounder rather quaintly explained to me, "I carry it around in my poahkee until I walk into my coffee."

The average salary of the Japanese sea-going radio man, if he holds a first-class license, is about 120 yen for third operator, 140 for second, and from 200 to 250 for the chief operator. A yen is about fifty cents; so, in cold dollars, the Japanese operators' pay is distinctly lower than the Americans'; but nothing like so much as some of the bloodless turnips behind certain of our American steamship payrolls are so fond of making out.

Furthermore, to a native Japanese in Japan (not to a foreigner!), a yen is virtually equivalent to a dollar to us in America—except in the case of imported luxuries. Looking at the matter from this angle, the Japanese radio operators are somewhat higher paid than are American.

In comparing the conditions surrounding the Japanese and American wireless operator, the observer cannot miss the fact that the Japanese commands a much higher rating on board ship. This is especially true in the case of the chief operator. While the second and third operators are messed with engineroom and deck officers, as is done on almost all American vessels, the chief operator is a pretty highly privileged person and eats his meals among the passengers in the first-cabin saloon, in company with the captain, chief engineer, and chief mate. He is a genuine officer and his salary is usually higher than that of any man on the deck outside of the chief mate. The American radio operator, on

Continued on page 46

A Navajo Family Listening to Radio on the Brink of the Grand Canyon of Arizona

Radio-Frequency with the Single Circuit Regenerative Receiver

Detailed Instructions for Adding One Step of Efficient Tuned Radio-Frequency Amplification to a Regenerative Receiver

By E. E. Griffin

WHEN adding radio-frequency to a set, naturally the first question of general interest is "What will it cost?" In the following method, since all the parts of the regenerative set are made use of, the cost of additional parts necessary should not total over ten dollars, if bought, and most fans can even reduce this; plus, of course, a small amount of labor, which the average fan enjoys.

The additional parts necessary are:

1 43-plate variable condenser, vernier type, with dial (.001 mfd., marked C_2).
1 50-turn honeycomb coil.
1 variable condenser, non-vernier, with knob. 11 plate (.00025 mfd., marked C_3).
1 tube and socket.

The .001 vernier condenser can be of any standard make. The 50-turn honeycomb coil is recommended, but almost equal results can be obtained with a homemade, straight-wound coil of 45 turns on a 2½-inch tube. The 11-plate condenser should be fitted with some sort of adjusting knob, but a dial is not necessary, as this condenser, once set, is not needed for general tuning. The additional tube should, of course, be the same as the tubes used in the set.

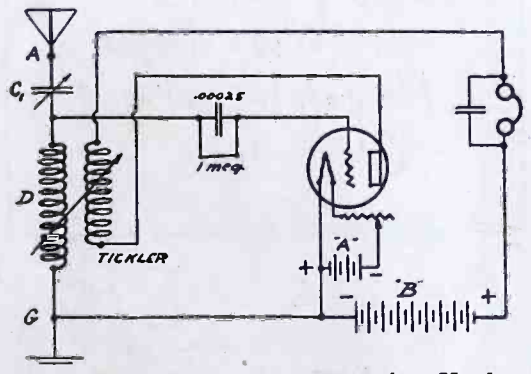


Fig. 1. Single-Circuit Regenerative Hookup.

Fig. 1 is a single-circuit regenerative detector hookup. Only detector and phones are shown in this diagram, as the addition of audio-frequency amplification does not affect the addition of radio-frequency. There are probably more receivers in this country using this circuit than all other types of receivers combined.

The first change necessary in the conventional regenerative set is the grid leak, which is generally connected around the grid condenser, as in Fig. 1. One side is disconnected, and connected to the positive side of the filament at the tube socket, as shown in Fig. 2. Some standard regenerative sets are already connected in this manner, in which case no change at this point will be necessary. The difference in operation between the two methods is so slight it is unnoticeable. However, using tuned radio-frequency of the type herein described, the latter method is necessary, as otherwise the grid of the detector tube will have a high positive potential, which would completely block its action as a detector.

The next step is to convert the open circuit of the regenerative set into the tuning device for the radio-frequency tube. Ascertain if condenser, C_1, is of the 23-plate or 43-plate type. Next, count the number of turns on coil D. If condenser is of the 23-plate type, there should be 55 turns of wire on coil D, with a tap taken off at the 50th turn; if of the 43-plate type, there should be 33 turns on coil D, with a tap taken off at the 30th turn. It will probably be found necessary to take this coil out of the set in order to remove the turns to leave the proper number.

If C_1 is of a capacity between .0005 and .001 mfd., the proper number of turns for coil D can be determined by rough interpolation; the greater the number of plates in C_1, above 23, the less the turns on coil D, up to 43 plates, which has only 33 turns. The exact total number is not critical, the two extremes given being sufficient to cover the broadcasting band.

The relation of the number of turns on either side of the tap, however, is quite important, the number from the tap to the end should be always 1/11th of the total number, when using a .00025 mfd. condenser for balancing.

Replace coil connecting upper end as it originally was and connect condenser C_1 around coil as shown by dotted lines, Fig. 2, leaving tap free. The tickler, or movable coil, is left unchanged, and serves the same purpose as before. The lower or tapped end of coil D is not connected to ground and filament lead.

To assemble the radio-frequency unit, it is advisable to use a small test board outside of the set, wiring the separate parts complete, then connecting to the set. In this manner familiarity with the circuit and knowledge of the use of the balancing condenser may be gained. A small board about 8 in. square, with the two condensers mounted at the back and the tube and coil at the front, is sufficient.

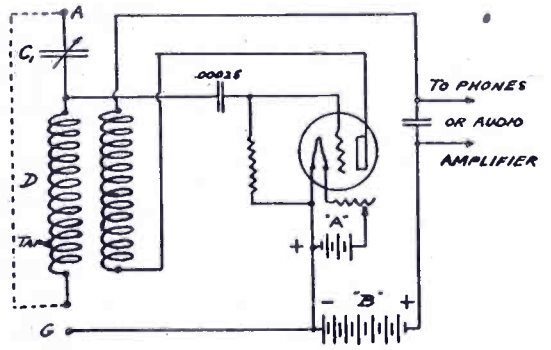


Fig. 2. Modification Preparatory to Adding R. F. Amplifier

First connect the .001 mfd. condenser C_2 in series with the honeycomb coil, placing the coil so that it will be at right angles to the tapped coil D and tickler coil when in the final position for testing. Then mount the tube socket, connecting the negative filament to the free end of the honeycomb coil. A binding post at this point will also serve as a ground connection. Next connect the tube grid to the point of junction of the coil and condenser C_2; also connect the 11-plate balancing condenser C_3 to the grid. About 1½ in. spacing between these units will help.

Make sure that all connections are tight, preferably soldered, as any undue resistance in this circuit greatly affects its sensitiveness. Connect the positive and negative filament posts of the socket to the corresponding posts on the detector tube of the set. In this manner the filament rheostat of the detector tube also controls the radio-frequency tube. Referring to Fig. 2, lead marked G, which was formerly connected to coil D, will serve as one of these leads.

Here it may be stated that the filament control of this radio-frequency tube is not critical, as in the case of the potentiometer method of control. Connect the plate of the radio-frequency tube to the junction of condenser C_1 and coil D, as shown in Fig. 3. Connect the free side of condenser C_3 to end of coil D. Connect the tap on D to 67½-volt positive B battery. If your set uses 45-volt B battery, this will be found sufficient, although slightly greater amplification will be found at

the higher voltage. Last, connect antenna to free side of 43-plate condenser C_2.

NOW we come to the most interesting operation, that of balancing the capacity of the tube. Place the radio-frequency tube in its socket and see that it lights with the detector tube. Set the condenser C_3 so that about one-third of the rotary plate area is in mesh with the stationary plates. This is an approximate setting and will be changed later.

Pick out some nearby broadcasting station, one of good signal strength, and tune it in loudest by varying condensers C_1 and C_2. It will be found that these two condensers tune independently of each other, similar to a very loose-coupled set. During this adjustment the tickler coil should be set at a position about half way between the oscillation point and zero.

With the two condensers C_1 and C_2 set at maximum signal strength, remove the radio-frequency tube and place a small piece of paper under one of the filament terminals, replacing the tube. The tube filament will not now light, but the signals will still be heard faintly, through the capacity of the tube. Now slowly adjust the balancing condenser C_3 until a point is found where the signal entirely disappears or is at its faintest, then adjust C_2 until maximum strength is obtained; likewise adjust C_3 for minimum. Do this several times until a point is found where the signal is entirely tuned out by C_3, but the open circuit is in tune with the incoming wave through C_2. This tuning of C_3 and then C_2, by the seesaw method, is quite necessary, as changing the capacity of C_3 slightly affects the period of the antenna circuit. The object is to get the least amount of energy through the capacity of the tube and at the same time have the open circuit exactly in tune with the incoming wave.

When this point is approximately found, note the position of C_3, remove radio-frequency tube and place the small piece of paper under the opposite filament contact and repeat the operation. Keep in mind that C_2 is adjusted for loudest signal and C_3 for faintest. Note again the position of C_3, and set it at a position about half way between the two points. Remove the small piece of paper from under the tube contact and set is ready for operation.

One setting of C_3 will be found sufficient for the average broadcasting wavelengths. However, if it is desired to tune to lower or longer waves, the tube will break into oscillation and C_3 must be slightly readjusted to stop it. The tube must be balanced for a certain antenna. Whenever the set is used on a different antenna, a slightly different balance will be necessary.

After becoming familiar with the operation of the radio-frequency unit on a test board, it should be incorporated as a part of a complete set, or a separate unit built to match the original set, but, as single-circuit regenerative receivers differ widely in construction and arrangement, it is left to the reader's preference.

The main points to be remembered are that all wiring of the radio-frequency unit must be good, leads as direct and short as possible, the honeycomb coil must be placed at right angles to the D coil and tickler coil, or else balancing will be difficult. Make sure that the balancing condenser C_3 has no tendency to shortcircuit between the plates, as accidental shorting of these plates puts the high voltage B battery across the tube filaments, as will be seen by tracing out the circuits. Also remember that, each time the wiring is changed, the balance of C_3 against the tube is thrown slightly off.

For those who have had no experience in the tuning of two-circuit sets, a word will not be amiss. The tuning control C_1 and tickler coil will bear practically the same relation as the original regenerative set, but the tuning of C_2 and C_1 are entirely independent of each other, and each must be tuned separately to the wave of the station desired. A certain setting on C_1 will always call for a certain setting of C_2. To this end, a tuning chart will prove helpful.

The sensitiveness of the set is surprising, a single wire placed along the moulding of one side of a room being quite sufficient antenna for reception of all stations formerly received on a large outdoor aerial. It will at once be seen that such a set, with dry cell tubes, makes an ideal set for that camping trip. The radio-frequency control has obviously many advantages over the potentiometer and reversed feedback methods, and is nowhere near so critical of adjustment in general use.

The complete circuit diagram of a four-tube set built from a standard regenerative receiver is shown in Fig. 3. For use on a small loop, the honeycomb coil is disconnected and the loop connected in its place, condenser C_2 being placed across the loop for tuning. The results obtained on a two-ft. loop are most gratifying.

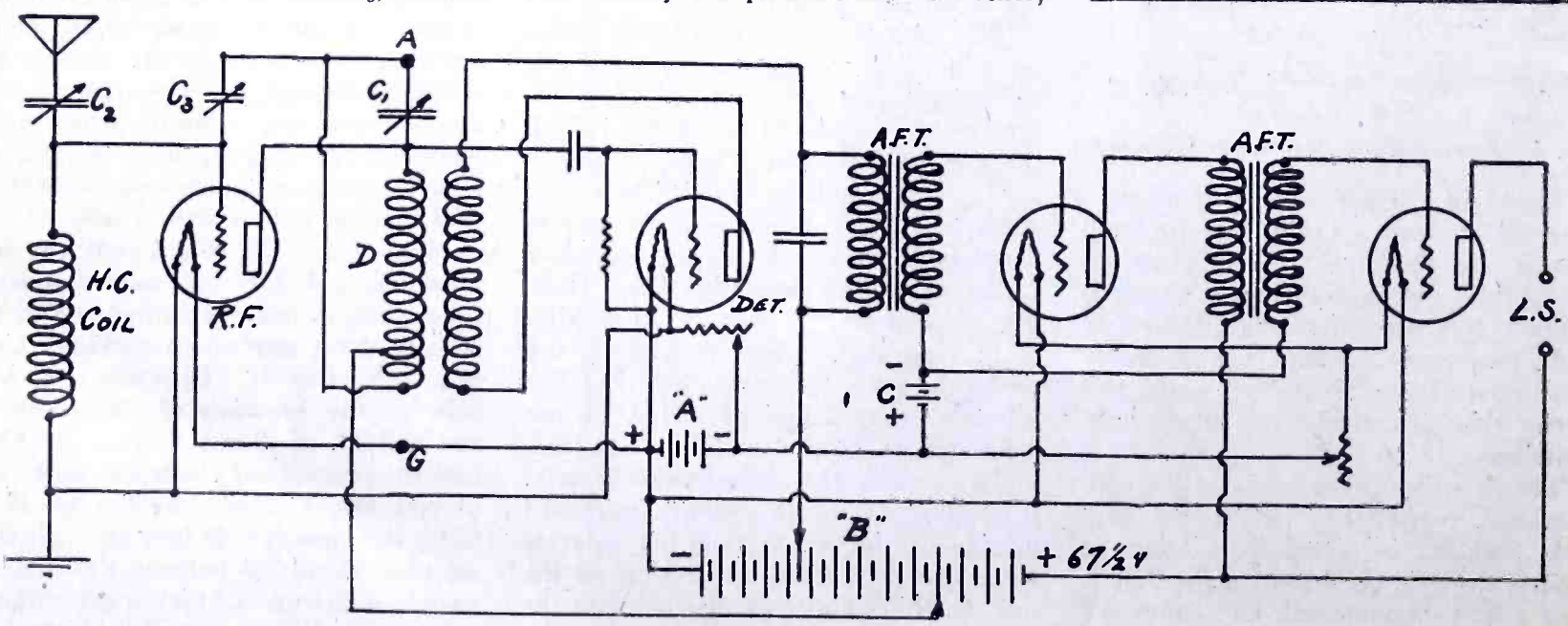


Fig. 3. One Stage R. F., Detector and Two Stages of Audio

The Vacuum Tube as a Detector

How a Grid Bias Battery or a Grid Condenser and Grid Leak Enable a Detector Tube to Function

By C. M. Jansky, Jr.

THE principles underlying the operation of a vacuum tube as a detector are very different from those under which the tube operates as an amplifier, as discussed in August RADIO. There are two ways in which a tube may be used as a detector: (1) by using a bias battery; (2) by using the so-called stopping condenser and grid leak. As the first method is easier to understand, although less used, it will be discussed first.

Consideration of the tube characteristic curves of Fig. 1 shows that for undistorted amplification with a grid *C* battery permitting operation from a point *P* near the center of the curve, the plate current should rise as far as it falls. But for operation as a detector the *C* battery voltage is adjusted so as to give the maximum difference between the amount of rise and fall. Thus for the detector circuit of Fig. 2 employing a tube with the characteristics of Fig. 1, with 22.5 volts on the plate, the negative voltage applied to the grid should be about 1 volt.

The principle of detection can be best explained by considering a damped wave radio telegraph signal. Fig. 3 (*A*) is a plot of such an incoming wave as a function of time. Fig. 3 (*B*) shows the total plate current which would flow while Fig. 3 (*C*) shows the component which would flow through the head set.

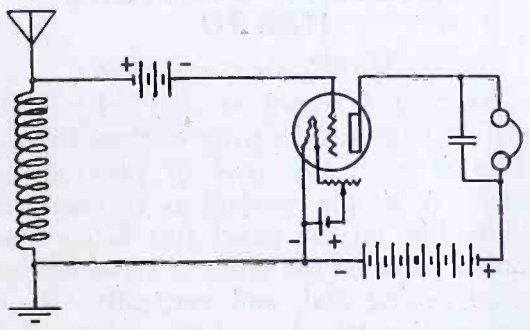


Fig. 2. Receiving Set Using Detector Tube With Grid Bias

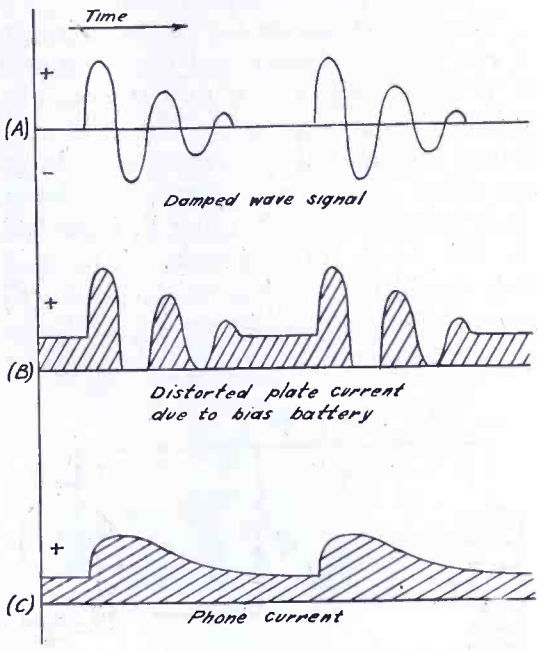


Fig. 3. Detection in Tube Circuit Using Grid Bias Battery

Rapid radio-frequency pulses as shown in Fig. 3 (*A*) and (*B*) can produce no effect on the receiving diaphragms because (1) the inductance in the receiver coils is too great; (2) the inertia of the diaphragms will not permit them to respond to such rapid pulsations. The receiving diaphragms can, however, respond to the grouped effect of each spark as shown by Fig. 3 (*C*) and the result is an audible note. The frequency heard will correspond to the number of oscillatory groups per second produced by the transmitter.

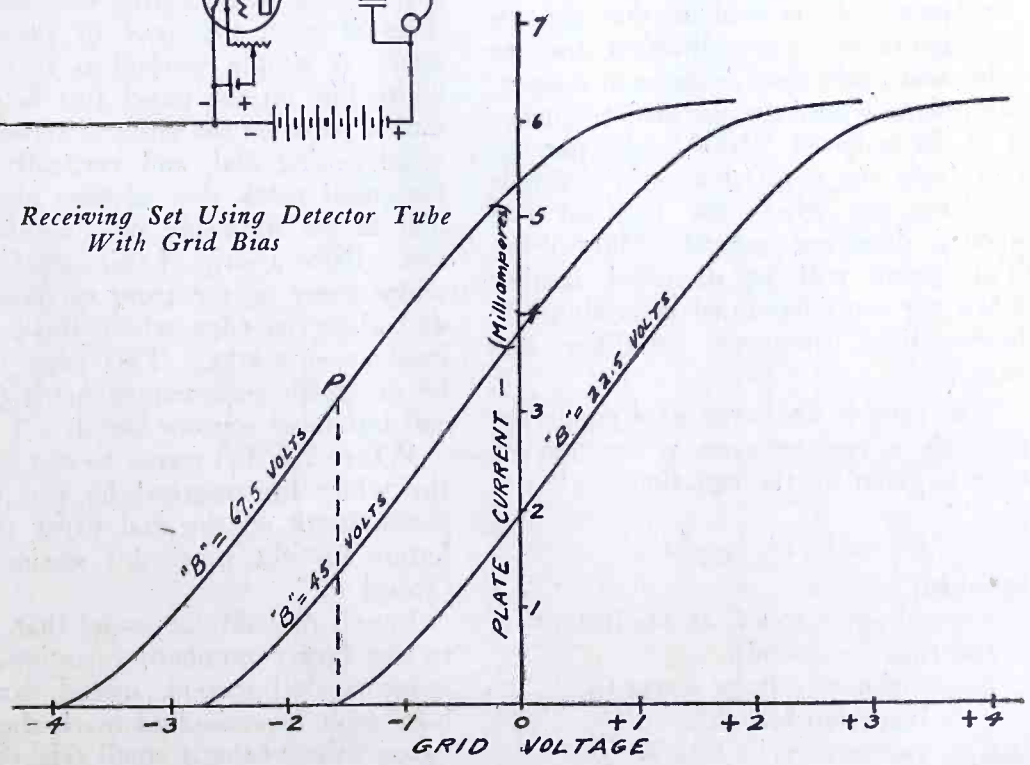


Fig. 1. Vacuum Tube Characteristic Curves

The principles involved in the detection of radio telephone signals are the same; the receiver diaphragm's following the envelope of the incoming radio-frequency wave. This envelope, in a properly modulated wave, should correspond to the modulations of the speech or music actuating the microphone at the transmitting station.

The usual method of using a tube as a detector is with a grid condenser and grid leak as in Fig. 4. The space between the grid and filament will pass current only from grid to filament and not from filament to grid. That is, electrons will pass from filament to grid but not from grid to filament.

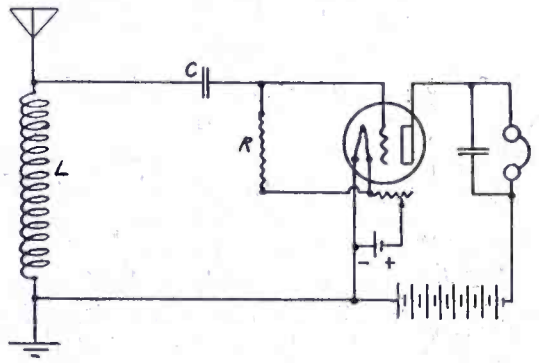


Fig. 4. Tube Detector Circuit With Grid Condenser and Grid Leak

(NOTE: This explanation of detection by the use of a grid condenser will not stand ultra-scientific criticism as detection does occur under other conditions but the author fears that a more technical discussion would tend to confuse the reader rather than to give him a clear understanding of this particular phenomenon which is less understood than almost any other taking place in the operation of a radio circuit.)

For the purpose of discussion let us assume that the incoming signal is identical with the damped wave signal shown in Fig. 3 (*A*). Fig. 5 (*A*) is a graph of the voltage across *L* as a function of time. During the half cycle when the top of *L* is positive with respect to the bottom the voltage across various parts of the circuit will be as shown by Fig. 6. The left side of *C* will be charged + and the right side —. This will leave the grid with a + charge with respect to the filament. As a + grid will attract electrons some of the + charge will be neutralized by electrons which come from the filament.

During the next half cycle, voltage relations will be as shown by Fig. 7.

Grid current will flow during each half cycle as shown by Fig. 5 (*B*). It will be seen that the grid is — with respect to the filament. However, the —

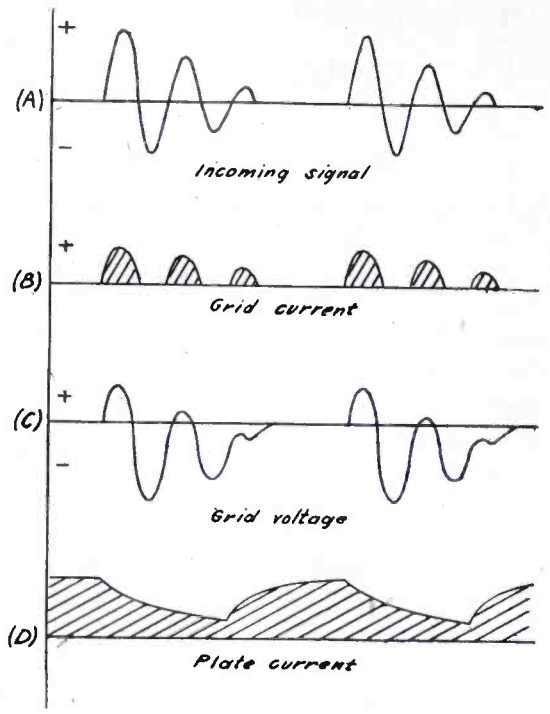


Fig. 5. Detection in Tube Circuit Using Grid Condenser and Grid Leak

potential will be more pronounced than would have been the case if electrons had not passed from filament to plate during the previous half cycle.

During the next positive half cycle electrons will again pass from filament to grid. The result of the variation of grid voltage from + to — is an accumulation of electrons on the grid and on the right side of *C*, that is, the accumulation of a negative charge. This accumulation will continue until the grid assumes such a — charge that no positive half cycle can make it + with respect to the filament. Fig. 5 (*C*) is a graph showing how this — charge is accumulated by the grid. Fig. 5 (*D*) shows the current through the phones as a function of time. The receiver diaphragms will vibrate to correspond.

Without *R* connected from grid to filament the electrons which have accumulated on the grid and right side of *C* would remain indefinitely and the grid would hold the — charge thus secured. However, between one train of oscillations and the next the excess electrons leak off to the filament through *R* and the grid returns to its normal potential. The "grid leak," as the resistance *R* is

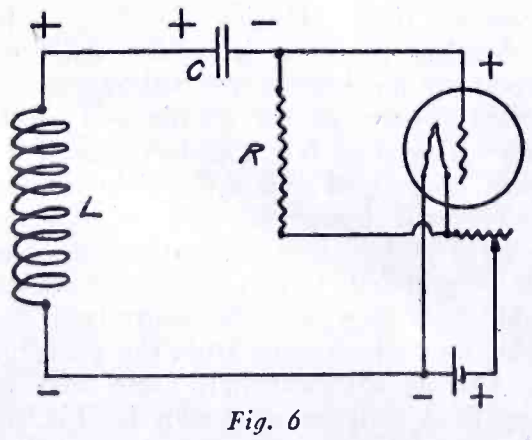


Fig. 6

called, is sometimes connected directly across the grid condenser, in which case the electrons pass through the tuning inductance.

The circuit containing the grid resistance should always be connected to the + side of the filament as indicated in Figs. 4, 6, and 7. When a tube is used as an amplifier the grid return should be connected to the — side of the filament. This difference is due to the fact that grid current is undesirable when a tube is used as an amplifier but it is necessary to the operation of a tube as a detector with a stopping condenser.

The correct values for the capacitance of the grid condenser and the resistance of the grid leak are of importance. In ordinary receiving circuits the grid condenser should have a capacitance large compared with the apparent input capacitance of the tube; that is, from 100 to 500 micro micro farads. The grid leak should have such a resistance as will permit the grid condenser to discharge rapidly enough to follow the highest

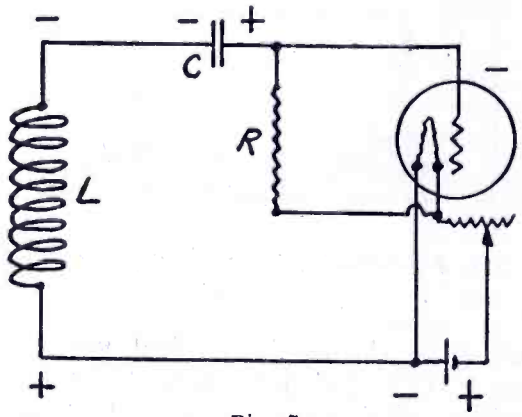


Fig. 7

audible frequencies met with in radio telephony, yet it should be sufficiently high to prevent the grid condenser from discharging appreciably between radio-frequency pulses. Correct values run from 1 to 5 million ohms.

(NOTE: It is evident that the requirements are quite different for the tube used as the first detector in a super-heterodyne where the rectified frequency is of the order of 50,000 cycles per second from the requirements in a simple receiving set where the rectified frequency does not exceed 5000 cycles. This point will be discussed further when we consider super-heterodyne or intermediate frequency amplifier circuits.)

The rate of discharge of a condenser through a resistance as a function of time is given by the equation:

$$e = E_0 \epsilon^{-\frac{1}{RC}t}$$

in which

e = voltage across C at any instant.
t = time in seconds.
E_0 = original voltage across C.
ϵ = Naperion base 2.7.
C = capacitance in farads.
R = resistance in ohms.

In time $t = RC$ seconds the voltage of the condenser will have dropped to $1/\epsilon = 1/2.7 = 36\%$ of its initial value. The constant $R \times C$ is called the time constant of a circuit containing a condenser of C farads in series with a resistance of R ohms. A circuit with a stopping condenser of 100 micro micro farads with a 1,000,000 ohm grid leak has a time constant of .0001 second, that is, a charged condenser with a capacitance of 100 micro micro farads will discharge through a resistance of 1,000,000 ohms to 36% of the voltage originally across it in .0001 second.

This is about the correct value for the time constant which should be used in the grid circuit of an ordinary receiving set. If the time constant of the grid circuit is too small distortion will result from loss of the higher audible frequencies. If the time constant is too large the signals received will be weak.

Good mica grid condensers can be purchased at low cost. Grid leaks of fixed values are also on the market.

Grid leaks can be easily made with a soft pencil and a small piece of smooth cardboard about 1 in. wide and 2 in. long. Put small bolts with washers through the cardboard near the ends. Before tightening bolts blacken cardboard under bolt head thoroughly. The bolts may be used to fasten the grid leak to a small piece of fiber or to the receiving set panel. The correct value of grid resistance is obtained by drawing lines with the soft pencil between the blackened areas which are connected with the bolts and which extend under the bolt heads.

"LOGGING" STATIONS HEARD

By HARRY A. NICKERSON

Keeping a record of dial settings is a great help in relocating stations heard. This is especially true of neutrodyne sets. A simple method is to mark a white line on the panel just below the lowest point on the circumference of the usual tuning dial, and vertically below the usual mark that appears above the dial as an indicator on manufactured sets. Paste a strip of thin, good-quality white paper on the front surface of the dial along its edge where there are no graduation marks. This paper should be of width sufficient to mark thereon call letters of stations heard.

Where the dial comes to rest opposite the white line marked by you on the panel, mark on the dial paper the call letters for the particular stations then "tuned in."

It will probably be found that, owing to the larger number of stations operating at 360 meters, special care will have to be exercised to mark their call letters in exceedingly small type to avoid crowding.

An Improved Reinartz Receiver

A Cheap Set that is Efficient, Selective and Flexible for Both Amateur and BCL Waves

By Cessford Kerr, 6 BHG

THE Reinartz circuit employed in this receiver makes possible a low-loss tuner that operates efficiently from 80 to 300 meters, and by a simple substitution of coils will receive the broadcast and commercial wavelengths. An antenna de-tuning device is introduced to minimize radiation from the set.

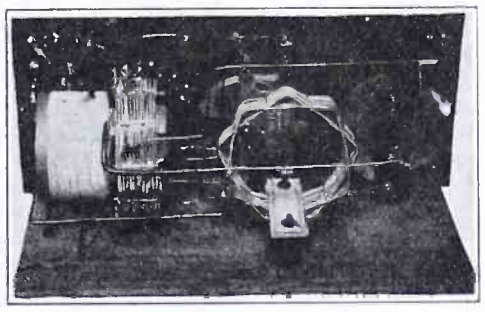
A short wave, low-loss tuner is of especial interest to the transmitting amateur, but it should also be of interest to the broadcast listener since some of the foremost broadcast stations now transmit on waves in the vicinity of 100 meters. It is possible with this set, at Salt Lake City, to tune the 94 meter wave from KDKA or the 110 meter wave from WGY, and receive them with comfortable audibility on one step of a.f. amplification, when they are totally inaudible on their regular broadcast waves.

To tune the very short waves without making the adjustment unduly fine requires an 11-plate secondary tuning condenser, having a maximum capacity of .00025 mfd. It is extremely important that this condenser should have very low losses and a low minimum capacity.

However, with this small condenser, it is not possible to cover the entire band from 80 to 300 meters with one coil. Since it became necessary, therefore, to tap the secondary it was made in two sections, placed at right angles to each other as shown in the rear view. This arrangement eliminates the chance for dead-end losses at this point.

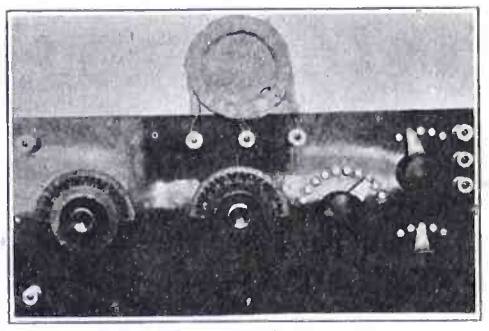
Dividing the secondary into two sections necessarily introduces a switch with its attendant disadvantages. However, this loss may be largely overcome by using a *good* switch, being careful that no long parallel leads are used in the wiring, and making sure that all connections are *real* electrical connections.

The short wave primary and secondary coils are of the "basket weave" type. To still further reduce the losses, the coils are mounted so that they are 1½ in. from the base board and fully 2 in. from any apparatus.



Rear View

Since it is not so important that the high frequency resistance of the plate circuit be kept low, the plate coil is wound with No. 24 D. C. C. wire on a 3 in. cardboard tube. Larger wire might be better but space does not permit its use. The coil consists of 60 turns tapped every 15 turns, although 45 should be enough. This coil is wound so as to leave about 1½ in. of unused tubing at one end. This portion of the tube is practically all cut away, leaving only enough cardboard to form a solid support for the primary and first section of the secondary. The plate condenser has a maximum capacity of .0005 mfd. and is connected with the rotary plates to the antenna. Likewise, the rotary plates of the tuning condenser should connect to earth.



Panel View

The form for winding the "basket weave" coils is made as follows:

On a heavy board, inscribe a circle 3¼ in. in diameter. At equal distances about the circumference drive nine large nails into the board. The nails should protrude about 1½ in. on the other side.

The coils are wound by weaving the wire alternately outside and inside the nails. Before removing the coil from the form it should be bound with thread at the points where the wires cross between the nails.

The primary and secondary coils are wound with No. 18 D. C. C. wire. No. 14 or 16 would be even better. The primary is wound in the same direction as the plate coil, and consists of 7 turns tapped at every turn. The tap at the seventh turn connects to the filament and ground. From this point the winding is continued for 16 turns to form the first section of the secondary. This coil is mounted on the protruding end of the plate coil form with the primary next to the plate coil. The second secondary section consists of 20 turns of No. 18 D. C. C. wire. The short wave range should be from 80 to about 160 meters, and the long wave range from 140 to nearly 300 meters.

If difficulty is experienced in making the set oscillate throughout its wavelength range without operating the detector tube filament at an excessive brilliancy a choke coil should be inserted, as shown in Fig. 1, between the phones (or primary of the first amplifier transformer) and the plate. This choke may take various forms. A single layer or honeycomb coil of about 75 to 250 turns, a small air core choke such as the Kellogg No. 501, or a doorbell magnet wound with 1000 turns of No. 32 enam-

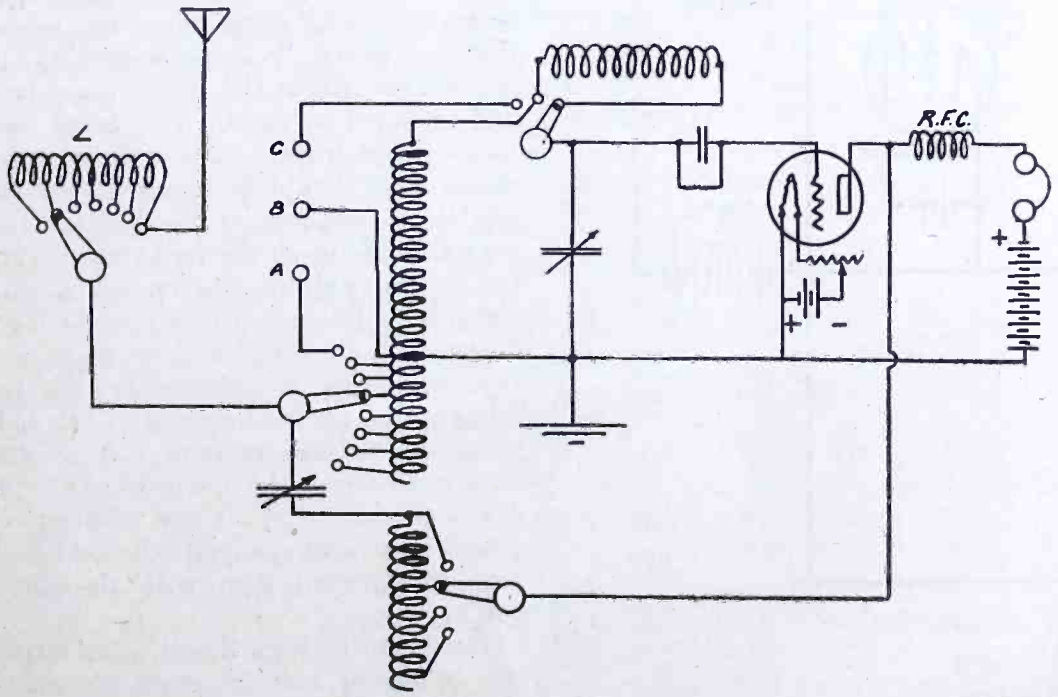


Fig. 1. Circuit Diagram

eled wire may be used. It is best to experiment until the best choke is found. In this particular set, the last named choke is used in conjunction with Western Electric phones or a Thordarson transformer.

When working properly, the tube should oscillate steadily throughout the wavelength range with little or no adjustment of the plate condenser.

If, at some setting of the tuning condenser, a point is found where the tube stops oscillating or requires considerably more capacity in the plate condenser to maintain oscillation than at points on either side, it is reasonably certain that at this point the secondary circuit is resonant with the antenna. Such a condition is undesirable in this receiver since the antenna circuit is semi-aperiodic. It would be more correct to say that the antenna functions as though it were aperiodic. In order that this condition may be attained, the antenna must be adjusted to a wavelength considerably outside the range of secondary tuning. It is for this purpose that the special antenna coil *L* (Fig. 1) is provided.

This coil is wound with 50 turns of No. 20 D. C. C. wire on a 3 in. tube with taps taken at the beginning, 5, 10, 20, 30, 40 and 50 turns. This number of turns should serve to keep the average antenna detuned throughout the amateur and broadcast range.

The coil switch is set at that point which will allow the set to oscillate freely and steadily throughout the range of the secondary condenser. When this adjustment is realized, the antenna will have no effect on the tuning, and the secondary wavelengths settings will always remain constant. Furthermore, the radiation from the receiver is *very* much reduced when the antenna is detuned in this manner.

This coil is built into a separate unit and is so mounted as to have no inductive relation with the secondary coils. The adjustment of the switch on the primary has no effect on the tuning. It is used merely to vary the coupling between primary and secondary.

The value of grid leak resistance need not be constantly variable, but should be carefully adjusted at first and then left alone as long as the same detector tube is used. When the tube starts and stops oscillating quite abruptly with variations of the plate condenser, the correct grid leak resistance is being used. If too high, the tube breaks into oscillation too sharply, thus making broadcast tuning difficult; if too low, the action is sluggish and unreliable.

The reader might be confused by the extra switch points shown on the panel. This receiver was originally built for another set of coils but at present only 8 points are used on the primary, and 3 on the secondary switch.

FOR tuning to waves above 300 meters an external set of coils is used. This coil system may take either of two forms as shown in Figs. 2 and 3.

The first and simplest of these is that originally described by Mr. Reinartz. It consists of a single coil—single layer, spider web, honeycomb, or any other type—tapped at approximately one-third of its turns. The smallest part, or primary, is connected between binding posts *A* and *B*, and the secondary between posts *B* and *C*. These three binding posts are those shown along the top of the panel. From 10 to 15 turns in the primary and 50 in the secondary will cover the broadcast band. Proportionately larger coils will cover all the higher waves. In localities where local interference is slight the ratio of primary to secondary turns may be reduced with a corresponding increase in signal strength. However, this broadens the tuning considerably and may bring the antenna into resonance with the secondary if carried too far.

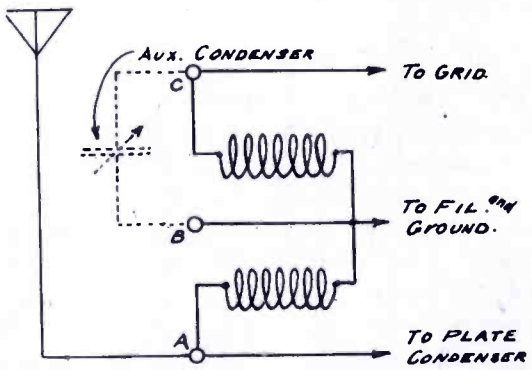


Fig. 3. Alternative Long Wave Scheme

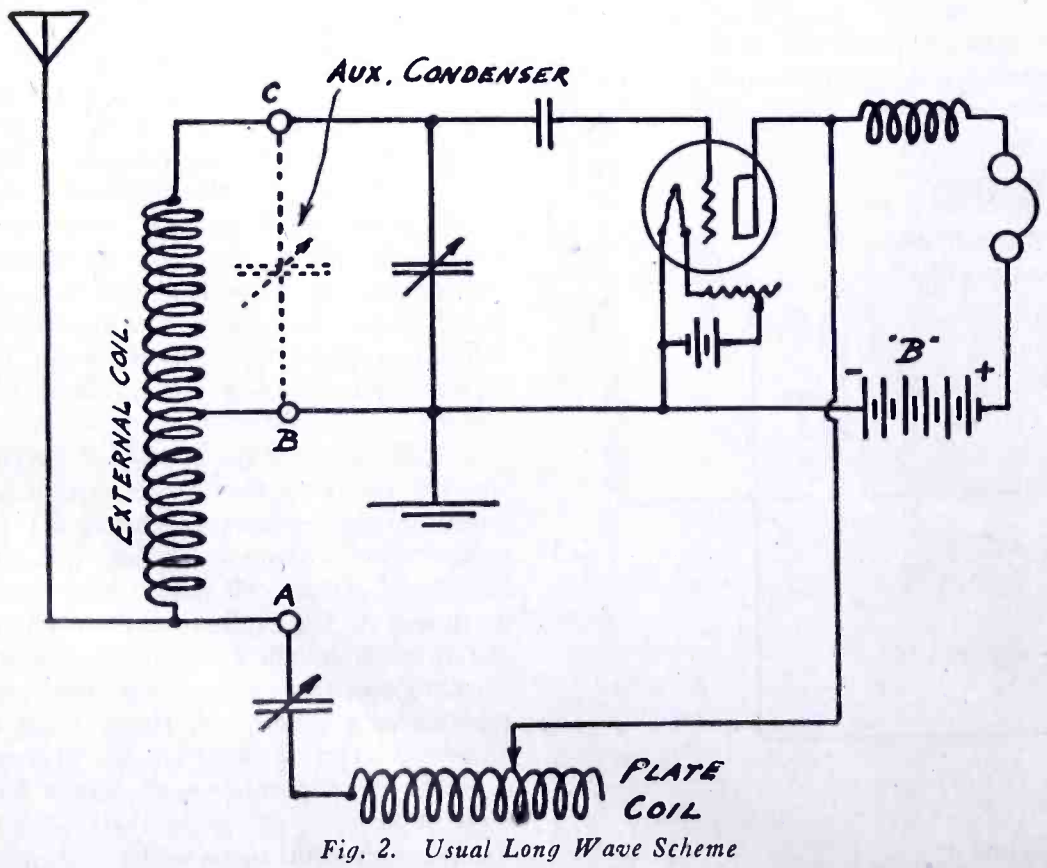


Fig. 2. Usual Long Wave Scheme

The second method, due originally to Mr. E. L. Lester, 5NK, is much superior to the first in all respects, and should be used especially when QRM is bad. It employs variable coupling between the primary and secondary. The variable feature allows fine adjustment of the primary coupling, whereas in the other method the coupling is variable only in steps by changing the ratio of primary to secondary turns. To use this hook-up, a two coil honeycomb mounting with the necessary honeycomb coils may be used.

If it is desired to tune only the comparatively short waves, say to about 1000 meters, a homemade mounting for spider web coils may be devised. This is shown in Fig. 4. It consists of a

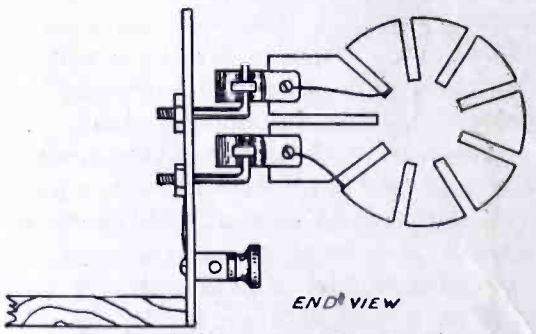


Fig. 4. Spiderweb Coil Mounting

small insulating panel arranged to mount on top of the tuner cabinet. It is fitted with the three binding posts to connect with those along the top of the tuner panel. Four pieces of No. 4 or 6 brass rod about 1½ in. long are bent and mounted as shown, two being used to mount each coil. The separation between coils should be about ¾ in. (or less, if the coils are not too thick). The separation between the two rods of each coil mount will depend on the size of coils used. The coils connect to the large Fahenstock clips mounted on them, and the connection is carried through the mounting to the binding posts. The coils should be marked in some way so that they will always be mounted with the same polarity. A larger number of primary turns can generally be used with this arrangement than with the single coil system.

As shown in Figs. 2 and 3, an auxiliary condenser may be connected across

Continued on page 62

Impedance Values of Audio-Frequency Transformers

A Report of Tests on Twenty-seven Available Transformers to Determine With What Vacuum Tubes They May Best Be Associated

By Gerald M. Best

FOR the best results in audio-frequency amplification the input, or primary, impedance of a transformer should be at least as great as that of the output impedance of the vacuum tube with which it is associated in an amplifying circuit. The purpose of the amplifying transformer is to step up the alternating voltage in the plate circuit of one tube and apply it to the grid circuit of the next tube. Due to the effective resistance of the vacuum tube itself, it is impossible for any practical transformer to deliver all of the available voltage.

But, as may be proven mathematically, a transformer whose impedance is equal to that of the tube working into it obtains from 50 to 70 per cent of the available voltage, while one whose impedance is twice that of the tube obtains from 66 to 90 per cent. However, if the transformer impedance is less than that of the tube, the useful voltage falls off rapidly. On the other hand, there are several practical limitations which make it undesirable to use too high a transformer impedance, particularly at the higher frequencies where losses are caused by the shunting effect of the capacities of the winding and tube.

Table I gives the impedance values of various makes and types of transformers as obtained by the bridge method described at the end of the article. From this table it is possible to select a transformer which has a primary impedance at least equal to or greater than the impedance of the vacuum tube to be used with it.

TABLE II
OUTPUT IMPEDANCE OF VACUUM TUBES

MANUFACTURER	Code No.	Output Impedance with 45V Plate, 1½ V Negative Grid	Output Impedance with 90V Plate, 4½ V Negative Grid	Output Impedance with 120V Plate, 9V Negative Grid
General Electric Co.	UV-199 or C-299	21,000	17,000	.....
General Electric Co.	UV-201-A or C-301-A	20,000	15,000	12,000
Westinghouse Mf. Co.	C11, C-12 or WD-11, WD-12	20,000	17,000	.....
Deforest	DV-2	20,000	13,000	.....
Deforest	DV-3	21,000	17,000	.....
Western Electric	216-A	17,000	12,000	6,000

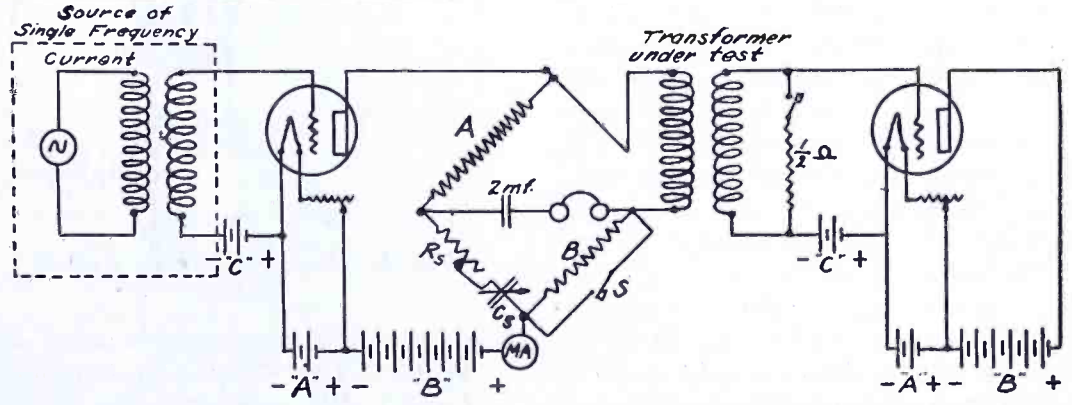


Fig. 1. Diagram of Connections for Impedance Tests by Bridge Method

Table II gives the output impedance under several different conditions of the tubes usually available.

As the transformer impedance varies with the conditions under which the transformer is used, these tests were made with the transformer connected in the plate circuit of a vacuum tube under working conditions of a two-stage amplifier. A frequency of 1000 cycles was used in each case. Fig. 1 shows the circuit used in the tests.

It will be noted that two sets of values are given in Table I, one when the transformer secondary was terminated only with a vacuum tube, and the other with the addition of a terminating shunted resistance of ½ megohm. By this latter expedient the primary impedance (and therefore the secondary impedance) will be much reduced, as shown by the measured values given in the table.

In cases where the addition of this shunted resistance reduces the value of the impedance to approximately that of the tube to be employed, its use will be found to give a marked improvement in quality. But, when the resulting primary impedance is less than the tube, it should not be employed.

Curve *B* of Fig. 2 shows the frequency characteristic of a typical very high impedance transformer when terminated by the vacuum tube only, and Curve *C* that of the same transformer terminated by the ½-megohm resistance. The improvement in quality is apparent. A subsequent article will give the results of tests on all these transformers at three different frequencies showing the variation of amplification with variation in frequency.

Continued on page 68

TABLE 1
IMPEDANCE VALUES OF INTERTUBE TRANSFORMERS

MAKE OF TRANSFORMER	Code No.	Turns Ratio	Primary Impedance with Secondary Shunted by 500,000 Ohms			Primary Impedance with Secondary Terminated by Vacuum Tube Only		
			Effective Resistance R	Reactance X	Impedance Z	Effective Resistance R	Reactance X	Impedance Z
Federal	65	.....	37700	24500	44900	18500	87700	89800
Stromberg-Carlson	3-A	.....	45800	8530	46500	124600	139000	187000
Radio Corp	UV-712	.....	5610	4260	7050	3450	11850	11400
Sampson		6-1	8950	5350	10420	4950	21200	21800
Jefferson		.....	44000	14380	45300	59700	135500	148000
Jefferson	Star	.....	30600	32400	44600	10650	61300	70000
General Radio	231-A	.....	9470	19600	21700	4880	25200	25600
Killark		.....	48500	19900	52500	40500	25100	47700
Kellogg	501	4½:1	31100	17750	35800	12600	83600	86000
Sterling	R-301	4:1	8560	14720	17000	4740	18500	19100
Marle	A-9	9:1	32600	8900	33700	35400	149500	153600
Marle	A-6	5:1	18200	11920	21800	16300	33600	37400
Marle	A-4	3¾:1	6470	19130	20200	9270	15850	18400
New York		.....	20900	11200	23700	25500	30100	39500
Dongan		3½:1	14550	9800	17600	10200	29000	30800
Dongan		6:1	15650	23600	28300	7070	32000	32700
United		5:1	14700	13780	20200	7150	28400	29200
Premier	Hedgehog	.....	5850	22400	23100	10700	17300	20400
Cotoco	4000	.....	25200	10950	27500	25300	57700	63000
Cotoco	Special	.....	15800	28800	32900	5750	36400	37000
Supertran		.....	30000	6270	30700	94200	13200	150000
Thordarson		3½:1	40500	23100	46700	28300	84600	88200
Thordarson		6:1	31600	18900	36800	18000	69000	71200
Amertran	AF-7	3½:1	47200	28600	55200	18750	113000	127000
Amertran	AF-6	5:1	12250	29800	32200	20000	92700	95000
Precise	285-A	.....	34200	9530	35400	73300	113600	135000
Modern	110	.....	8870	18800	20700	125000	163000	206000

A Single Control Regenerative Receiver

A Selective Set for Broadcast Wavelengths, as Simple in Construction as in Operation

By Paul Oard

THERE has been a growing tendency upon the part of radio technicians to stress the importance of the development of a receiving instrument which would incorporate but one tuning control, yet which would function as satisfactorily as those types which make use of from three to five controls in effecting changes of wavelength. The writer offers the circuit diagram of an instrument which meets such requirements to a satisfactory extent. But one tuning control is required, both changes of wavelength and regeneration being taken care of by the tuning control dial. Only one rheostat is used, whether or not amplification is used. With two stages of amplification, the circuit gives satisfactory results with regulation loud speakers, and, tube for tube, the circuit will afford results comparable to any of the standard single or three-circuit regenerative receivers now in use. By no means least in value is the sharpness of tuning and the ease with which interfering stations may be separated. The circuit is equally effective on voice or on continuous wave.

One thing should be borne in mind, this circuit is not for use on waves below 300 meters. Below this band, the filament of the detector tube must be burned at excessive brilliancy, the value of inductance in the circuit being insufficient to allow of regeneration.

The tuning element consists of a single variometer, of the type used in many three-circuit tuners, any one of a number of which now on the market will prove satisfactory. On average antennae, the circuit will tune between 300 and 600 meters, sufficient to pick up the majority of broadcasting stations.

No design of instrument arrangement is given, this being left to the constructor. No particular difficulties are present here, however, and the average material to be found in the radio workshop may be used. It is important that the finished instrument be well shielded, as it will be found very sensitive to body capacity if it is not. Leads should of course be short, and it is important that the rheostat should be one allowing of smooth, even variation.

If amplification is to be used, it is important that the amplifying tubes be of a type that will function over a broad band of filament brilliancy, as their brilliancy is dependent upon whatever voltage the detector rheostat is set. The UV-201A and C-301A tubes are highly satisfactory for this purpose, as they seem to work at all voltages between four and six equally well. The

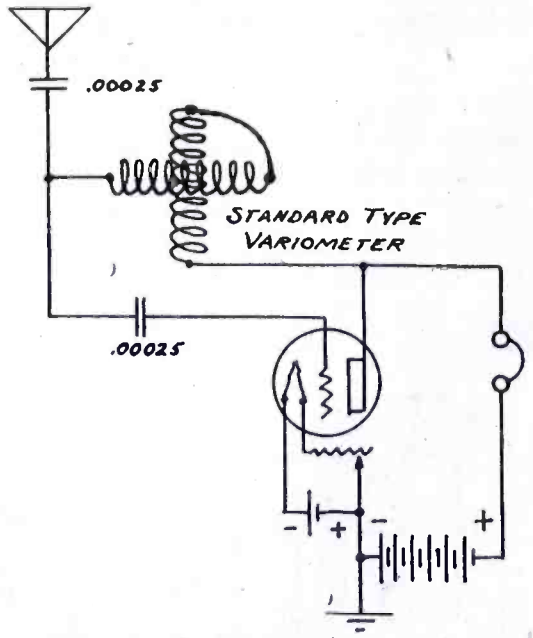


Fig. 1. Hookup for Single Control Detector

detector in this case should be a UV-200 or C-300. The WD11 "peanut," UV-199 and C-299 tubes may also be used, both for detection and for amplification, but, in the latter instances, with somewhat decreased volume.

The antenna series condenser is of very small capacitance, in the nature of .00025 mfd. The standard type of grid condenser is just the thing for this purpose. Nothing is gained by using a larger capacitance.

If amplification is to be used, the rheostat should be heavy enough to carry the current for three tubes. With the use of one UV-200 and two UV-201A tubes, 1½ amperes are drawn. The average rheostat will just about handle this amount, while one with a heavier winding will allow some margin of safety.

Fig. 1 shows the circuit with detector tube only, and Fig. 2 the circuit with two stages of amplification. The primary of the first amplifying transformer should be shunted with a small condenser—a grid condenser is O.K. In Fig. 2 an "off-and-on" snap switch may be placed in each amplifier filament circuit, or filament jacks may be substituted to allow the current to be switched off when the amplifiers are not in use.

Once that an instrument making use of the circuit has been constructed, tuning offers little difficulty. The variometer dial is rotated, with detector brilliancy set fairly high, until the carrier wave is picked up at its loudest point. The detector is then cut down until signals are clear. Caution should be observed, however, as this circuit is a persistent oscillator, and will radiate strongly to neighborhood receiving instruments. As before stated, the sharpness with which the circuit tunes is remarkable, and it will be found possible to tune in one station after another, once the detector is set, with only this one dial.

The circuit diagrams are self-explanatory. A single-wire antenna of not more than 100 ft. in length will be found right for reception, and a height of from 30 to 40 ft. will give gratifying results.

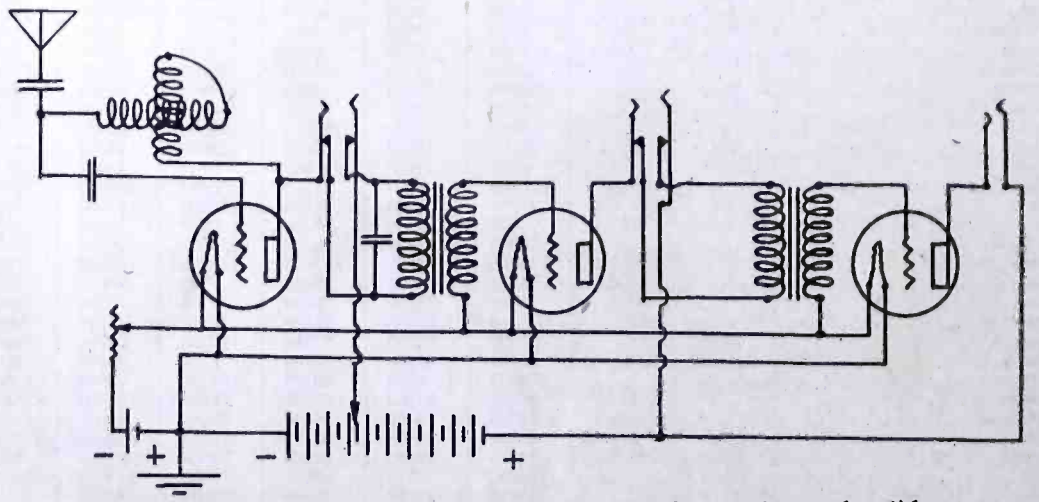


Fig. 2 Hookup for Single Control Detector and Two Stage Amplifier

A Variable "B" Battery

By David P. Gibbons

IF all real estate men are optimistic, then the Los Angeles realtor can only be described as a super-optimist. Certainly the gentleman who founded Citrolia was one. A flat, barren stretch of rocky soil near the foot of Mount Baldy, about twenty miles from the city, was to him "the ideal suburban development," and, with the object of making the desert boom, he staked it off into lots and plots, marked them off with gaudy flags and bunting, and then tried to pass them off on a gullible public through the liberal use of newspaper half pages and superlative adjectives. He built a two-by-four station on the electric line that ran nearby and surmounted it with a triumph of the signpainter's art that proclaimed that here was "Citrolia—the suburb superb."

The flags fluttered fruitlessly for a time and faded forlornly; the few feeble flowers planted around the wooden platform by the track faded dejectedly, and the florid advertising faded suddenly and completely; leaving nothing of Citrolia but the tiny waiting room which comprised the little depot.

A mile further up the slope of the mountain was Miller's Camp, a cluster of miniature bungalows whose occupants gave the interurban trains their sole excuse for an occasional pause of a few seconds at Citrolia. Usually they didn't even hesitate, and the one from which Denny Dwyer swung himself early one winter evening barely slowed down sufficiently to allow him to hop clear, before rapidly disappearing in the gathering darkness.

A chill breeze was blowing and he didn't particularly relish the hike to the little shack a half mile above Miller's Camp, where he and his friend Joe Knapp were spending a month's well-earned vacation after two years of continuous wireless operating over many a mile of the well-known billowy deep.

Stepping into the gloom of the little waiting room, he began rolling a cigarette, laying beside him on the bench the few packages he carried and which represented his purchases during the day in Los Angeles,—two new radio magazines, a supply of smoking materials, a couple of newspapers, and a new 45-volt *B* battery.

As he struck a match, he was startled by a movement beside him and a sharp, high-pitched voice asking "Vill you pliss gif me a light?" He had not noticed the other occupant of the bench and, as the match flared up he glanced curiously at him while he held the flame to the stranger's cigarette and then lit his own. The single quick glance did not reveal much of his companion—a dark soft hat concealing the upper features, — a heavy jaw with a thick black mustache, and a large white hand, with one of the fingers missing, which held a cigarette with a long paper mouthpiece.

As Denny gathered up his bundles and started to go, the stranger asked "How soon the train to Los Angeles he come?" His pronunciation of "Los Angeles" added one more to the sixteen different wrong ways of pronouncing that name.

"There's one that stops here that ought to be along in a few minutes," answered Denny. The other muttered his thanks and Denny set out on his uphill hike towards Miller's Camp, idly speculating on the identity of the foreign-looking stranger and his business at Citrolia, as he was personally acquainted with every member of Miller's Camp and there were no other houses nearer than Pomona, five miles away. The road ended at the Camp and from there he followed a rough trail that led to the two-room bungalow where he and Joe were taking life easy. When he arrived Joe had a cheerful fire glowing in the sheetmetal stove, and was engaged in the unwelcome but unavoidable task of washing the dishes, concluding which, the two partners settled themselves comfortably and were soon immersed in the new magazines.

Like all radiobugs, their method of reading a radio magazine was thorough and exhaustive, not a line nor a diagram nor an "ad"

"Denny was pointing at it in open-mouthed astonishment."

escaping a critical scrutiny, and their comments were both frequent and caustic.

"Here's a bird," remarked Denny, "who claims there's no such thing as a noisy *B* battery! Can you beat that?"

"Yes," answered Joe, "a goof here says he brought a dead *B* battery to life by heating it in the oven!"

"Well," said Denny judiciously, "there might be something in that idea. 'Spose we try it with that old one in the set?"

The "set" referred to represented their combined junk piles and was scattered in apparent disorder on a large table in a corner. The different parts were wired together in a maze that would have wrung a cry of anguish from any of the embryo Marconis, whose superhumanly neat receivers adorn the picture pages of our popular periodicals. Disconnecting the old *B* battery, Denny gave it the heat treatment as directed and was rather surprised when replacing it to find it had recovered at least some of its original pep.

"Guess we'll save this new one for a couple of days," he said, as he placed it under the table. "I scratched the date on the wax when I bought it today, and I want to see how long it will last."

He tuned in KHJ just as a song-plugging tenor was tearfully bemoaning his utter lack of bananas. This seemingly world-wide stoppage of the banana industry had long since lost its news value to both Joe and Denny. Five months previously Denny had been apprised of the shortage by a group of Pierrots at Manly Beach in Sydney, and a month later at Zamboanga a couple of callous young Moros repeated the sad tidings with evident relish while they paddled their canoes round his ship and dived after the "ha'pennies" and "thruppeny bits" which the crew had been unable to get rid of at the last moment in Australia. Joe was in London at a music 'all when the news of the disaster leaked out through the carelessness of a solemn English comedian, and a week later, in a beer hall on the Scheedam-Scheedijk in Rotterdam, he listened once more to an account of the universal famine in the succulent fruit of the tropics as rendered by a group of heavyweight Dutch ladies who composed the local orchestra.

The singer, at least, seemed to be enjoying himself and was piling on the agony by repeating the chorus, when he was interrupted by the hearty voice of the announcer saying:

"Friends of Radioland, we have just received a startling news item of local interest," and he then proceeded to give the details of a sensational robbery of a quantity of radium from the home of the well known scientist, Professor Mayora of Pomona. The professor, who was a specialist in the medicinal use of radium, returned to his home from the university at about five o'clock that evening to find his Chinese servant lying unconscious on the library floor and the package with the precious element missing from a small wall safe which had been broken open. The announcer continued:

"So far there is no clue to the identity of the criminal, as the Chinaman, whose skull is believed to have been fractured, has not yet regained consciousness. The value of the radium is placed at $20,000, and the glass vial containing it was enclosed in a small hardwood box, lined with several layers of sheet lead. And now, Friends of Radioland, our good friend Senor Matamoros Chihuahua will give you the news of the day in Spanish."

This the sonorous senor proceeded to do in a resounding cascade of vowels and consonants that must have put quite a severe strain on the microphone in the studio, while Denny turned the knobs to see what else was on the air.

The Catalina radiophone was still in operation and could usually be relied on for a few minutes entertainment whenever a broadcaster's program fell flat, so tuning it in they heard the operator getting a connection to the St. Catherine Hotel on the island, and give the parties the signal to go ahead and talk.

"Hallo! iss dat Mister Pedersen?" came a high-pitched male voice, and another voice, slightly weaker, answered from the island, "Yes. That you, Ivan? How did you make out?"

On hearing the first speaker Denny became suddenly alert and distracting Joe's attention from the reading in which he was absorbed, he said in a rapid whisper:

"Say, that's the guy I told you about that was waiting for a train into town as I came up."

Joe, unimpressed, said "Think so?"

"I know it," asserted Denny. "You don't hear two voices like that in one day. Listen!"

A slight interruption on the line—they did occur occasionally—caused the man addressed as Pedersen to repeat the question:

"How did you make out?" and both Joe and Denny were listening closely as "Ivan" with the odd foreign accent replied:

"Yess. I got id, but I haf some trubbil ven I—"

"Never mind that!" sharply cut in Mr. Pedersen. "Don't talk over this phone. People can hear you. Come right over on the first boat in the morning and bring it with you. The money is waiting. Understand?"

Ivan signified his agreement, and a moment later both hung up their receivers.

"Kinda funny," remarked Denny, hearing that fellow on the air after talking about him a few minutes ago. Couldn't be any mistake about that voice, could there?"

"Hardly," agreed Joe, "It's what you might call a highly individual voice alright."

Denny swung the dials back to KHJ's wavelength and a canary trilled as Uncle John announced: "— further particulars of the Pomona radium robbery. The Chinaman, recovering in the hospital, told the police he had been cleaning up in the library when the door was cautiously opened and a heavily built, well dressed man entered and without warning rushed towards him and hit him a crushing blow on the head with some heavy weapon which he drew from his pocket. The injured man's description of his assailant is fairly complete and includes the fact that the robber had a rather sallow complexion and a thick black mustache. Fingerprint experts who have examined the safe declare that the burglar had the middle finger of the right hand bandaged or missing, and the police are confident that his capture and identification will be swift and sure. The University authorities, nevertheless, have offered a reward of $10,000.00 for the recovery of the missing radium."

After a forecast of the next evening's program, the announcer concluded his day's work with an emphatically cheerful "Goodnight, everybody!"

"Goodnight!" repeated Denny, and then addressing Joe, who had again become absorbed in his reading, "Hey! did you get that? Ten thousand dollars reward and we know the robber! All we've got to do is hunt up that fellow I met at the station, turn him in and collect the cash!"

Joe was more skeptical and less liable to be stampeded by the enthusiasm of his partner.

"Oh! that's all, is it?" he countered, "Well, that's all about twenty thousand other listeners-in have to do, too. Besides, where do you get that 'we' stuff? I'm not personally acquainted with your criminal friend, you know!"

"Don't you want some of that wad of easy money?" Denny demanded reproachfully. "If you and I grab this fellow we'll go fifty-fifty!"

"I'll take fifty centavos for my share right now," said Joe, failing to get excited. He proceeded to throw more cold water on the other's ardor by telling him, "You may be an A1 wireless operator, but you were never cut out to be a Sherlock Holmes or a Craig Kennedy. Better leave that kind of monkey business to the people the Lord created and the city pays for that particular purpose."

Denny subsided, but was unconvinced. He felt positive that the man who had asked him for a light in the little waiting room at Citrolia was the thief who had assaulted the Chinese servant in the home of Professor Mayora and stolen

Continued on page 50

Radio Construction Pointers

A Series of Practical Suggestions for Applying Scrap Material to Useful Purposes

By Paul Oard

Making Insulated Wire

BARE copper wire may be so insulated as to serve the same purpose as enamelled wire in the constructor's workshop, through a simple process. The bare wire is laid out and stretched to remove kinks. A small amount of shellac, well thinned with alcohol, is placed in a tin or earthenware dish. A small piece of cotton is used to press the wire down in the dish, the constructor walking slowly along the length of wire until the entire length has been coated. By regulating the pressure of the cotton wad against the wire, the thickness of the coating, as well as the smoothness of application may be regulated to a nicety. After allowing to dry, a second coating may be applied for heavier insulation.

While such a job will hardly be the equal of the factory made product, it will prove satisfactory for experimental work. If one can secure a small amount of lacquer, such as is used to coat brass and silver to prevent tarnishing, and applies it carefully to bright shining wire, a really neat and effective job may be accomplished, the bright copper showing through the lacquer, which will afford insulation sufficient for receiving inductances, or wherever low voltages are used. The use of such insulation in radio receiving circuits is open to the same objections that apply to enamelled wire, but for many circuits it will suffice.

Likewise, copper or tin foil may be coated with shellac instead of using mica or paper as a dielectric in small fixed condensers, as in grid or by-pass jobs. The capacitance for a given area of plate surface will be very high in such an instance. This is not suitable for high voltages.

Soldering Tinsel Cord

IN THE course of time, telephone receiver cord tips let go and the experimenter is faced with the necessity of soldering them back into their rightful place. This looks easy, but is not. The cords are composed of tinsel, which stands neither the heat of the iron or soldering fluxes.

Push the cord back about an inch and carefully wind the tinsel with a short length of No. 36 bare copper wire. That removed from a Ford spark coil is satisfactory—if enamelled or insulated, this may be removed by passing through an open flame. Apply a mild soldering flux to the completed job, heat the cord tip and remove the broken piece of tinsel, put a drop of solder in the tip, and place the newly-wound cord end in the tip while the solder is still melted. This is the method used on most factory jobs and, if properly done, is as good as new.

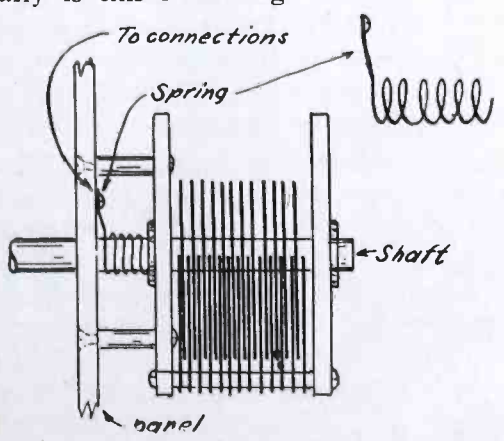
Terminals for Flexible Cord

STRANDED lamp cord finds an important place in many wiring jobs, as in portable sets, and for *A* and *B* battery connections and for pigtails. As a rule, however, a neat job of soldering is difficult as the insulation frays at the ends, and the strands of fine wire refuse to take the solder well due to slight corrosion from the sulphur in the rubber coating.

A neat and effective method of finishing the ends of such wire is to wind from 4 to 6 in. of No. 22 bare copper wire, soft drawn, around each terminal. Start ½ in. from the point where the insulation is removed, wind first over the insulation, and continue, over the bare stranded wire. The finished job is given a coat of solder. The frayed end is now covered over, and the job looks much like a standard cord tip. Furthermore, such a terminal will last much longer than if the ordinary connection had been made, as the wire can not bend sharply at the point where the insulation had been removed, as the jacket extends back over the insulation itself, gripping it securely. The solder serves to make a solid metal terminal, binding the turns together effectively.

A Self-Cleaning Contact

PRACTICALLY every constructor knows that a spring contact on a rotating shaft, as the rotor of a condenser or variometer, will sooner or later give trouble due to dirt working in between the point of contact, or to corrosion of the metal at this point. Especially is this so in regenerative circuits when adjustments are at a critical setting.



A Self-Cleaning Contact

A form of contact most commonly used to offset this is the familiar pigtail connection, but while this is effective, it is open to the objection that stops must be used to prevent rotation beyond a certain point.

A contact that permits constant rotation and which is thoroughly self cleaning, is illustrated in Fig. 1. A few inches of spring brass or hardened copper wire, of about No. 18 gauge, is wound tightly around the rotor shaft for about ⅜ in. One end is left straight for an inch or so. The spring coil is removed from the shaft and with a pair of round nosed pliers is made somewhat smaller than the diameter of the shaft. It is then forced back on the shaft, the straight end being so fastened that some resistance is offered.

Due to the fact that the convolutions of the spring form a screw thread, there will be a constant wiping action as the rotor shaft is turned that will tend to keep the shaft bright and clean. Only wire that possesses plenty of spring and tension should be used. On condensers that do not have sufficient projection of shaft at the back, the spring may oftimes be secured at the front between the main panel and the condenser end plate.

A Substitute for Spaghetti

OPTICAL houses handle a small white rubber tubing that is used to slip over the frames of eyeglasses. This material, which is not costly, makes a good substitute for spaghetti or empire tubing.

A Swab for Removing Soldering Flux

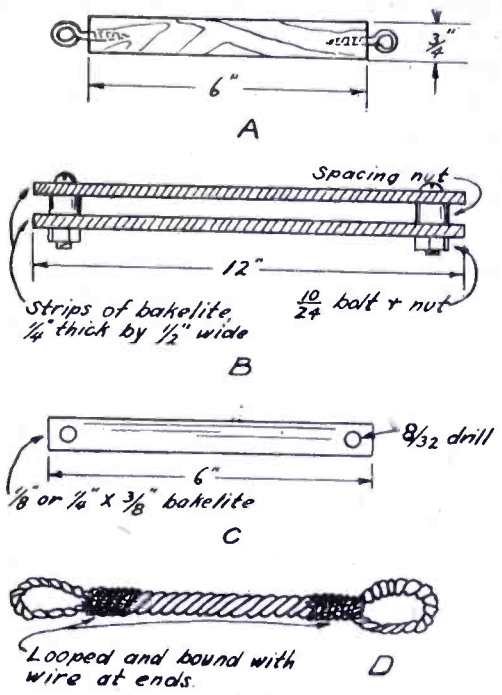
WHEN using a soldering flux of the grease type, which contains a certain percentage of acid that will in due course of time cause corrosion of metal parts behind the panel, it is advisable that all excess flux be removed. A package of "pipe cleaners" sold by tobacco shops, make excellent swabs for this purpose. After removing all visible flux, dip the swab in alcohol and brush the soldered joint vigorously. This will take care of corrosion.

Home-Made Insulators

THE construction of insulators, both for receiving and transmitting apparatus, offers little difficulty. It is not generally known that locust wood is used by one of the largest commercial

radio transmitting companies in the guy cables of their antenna masts. Dry wood is for the most part a fair insulator, the only problem being to keep it dry during wet or foggy weather. Wooden insulators that will render efficient service may be constructed on the following plan.

A strong screw eye is secured in each end of a piece of hardwood 6 in. long and about 1 in. in diameter. Hoe, rake and shovel handles furnish excellent round stock for this purpose. After making up the necessary number, they are boiled in linseed oil for a half hour or so. Such a treated insulator will



Home-Made Insulators
A, Hardwood Strain Insulator. B, Bakelite Antenna Insulator. C, Receiving Antenna Insulator. D, Rope Insulator.

take care of itself nicely in rainy wet weather. This is preferably used as a strain insulator in the guy wires of transmitting equipment. The screw eyes should have deep long threads and be firmly set in the wood, otherwise grief will result.

A strain insulator, suitable for installation in transmitting antennas, may be made from two strips of 1/4 in. bakelite, 1/2 in. by 12 in., fastened together as illustrated. Such an insulator possesses excellent insulating properties and will stand a strong pull. The constructor may elaborate on this idea to meet varying conditions.

Strips of 1/8 in. bakelite 3/8 by 6 in., with an 8/32 hole bored at each end make excellent insulators for light single wire receiving antennas. Use 1/4 in. bakelite for heavier wire and long spans. The bakelite should be polished on a buffing wheel if possible. One large commercial company makes use of considerable of their scrap bakelite in this manner.

Rope clothesline, of the quarter inch variety, in 1 to 2 ft. lengths, boiled in paraffine wax or linseed oil, makes a good insulator for receiving antennas. The ends are looped and bound tightly with wire.

Proper Care of Storage "A" Batteries

By H. A. Fischer

The average radio fan thinks of a storage battery as an awful monster that should be kept in a cage with wild animals. He believes that it will eat rugs, gnaw holes in the floor, and inconvenience everybody. Yet, if properly installed, it is his best friend, for storage battery tubes give louder and clearer signals without the inconvenience or expense of changing wornout dry cells. A Saturday afternoon spent in arranging battery equipment is time well spent.

The most necessary accessory is a charger for changing the house alternating current to direct current for the storage battery. It is not only less expensive than charging at a battery station, but also the battery can be charged intermittently so that interesting programs may not be missed.

If the radio set is installed on the first floor, the battery and charger can be placed directly underneath and feed wires run through the floor. Erect a swinging shelf from the cellar beams underneath the set, mounting an upright board to hold the change-over switch

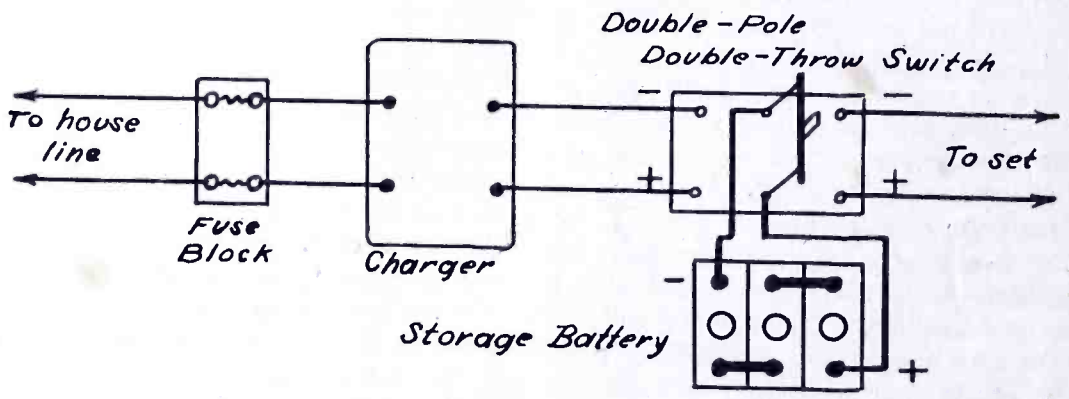


Fig. 1. Battery Charger Hook-up

and fuse-block, unless it is decided to have this close to the set.

Fig. 1 shows a circuit diagram with a double-throw, double-pole switch whereby the battery may be either in use or on charge.

A well-kept battery needs only charging and a monthly addition of distilled water. This may be purchased from a battery-charging station or may be made with improvised equipment found around the kitchen. A teakettle of boiling water, a length of clean garden hose, a clean can and a pan of cold water constitute the "laboratory equipment" necessary to produce distilled water. Assemble this outfit as in Fig. 2.

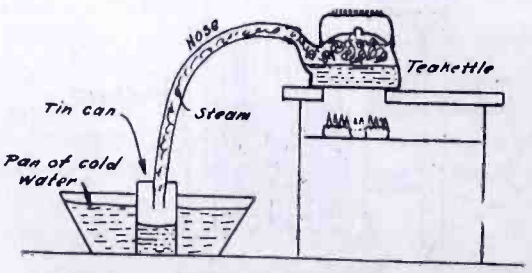


Fig. 2. Distilled Water Plant

The top of the plate should always be covered with about 1/2 in. of water, this being added before rather than after charging, so as to get a correct hydrometer reading as to the state of the battery.

The hydrometer is a glass syringe having a rubber suction bulb on the upper end and a small rubber tube on the other end. Inside the syringe is a glass float weighted with shot at its lower end. The upper part of the float is calibrated and marked for reading. To take a reading, draw enough of the solution into the hydrometer so that the float floats freely. The reading shown gives the state of the charge, which is somewhat as follows in the case of a lead battery:

1275, fully charged; 1250, 80% charged; 1225, 60% charged; 1200, 40% charged; 1175, 20% charged; 1150, exhausted.

When the test shows a reading below 1175 it is time to give the battery a recharge, until, by successive readings of the hydrometer, it shows full charge. Test each cell separately and be sure to return the acid withdrawn into the hydrometer into the cell from which it was taken.

The vent plugs on top of the cells should be removed while charging, to allow the gases generated within the cells to escape freely.

Batteries should not be allowed to freeze, as this may do permanent internal injury to the cells. The following table gives the freezing points at various states of the electrolyte:

1100	freezes at 18 degrees above zero
1125	freezes at 13 degrees above zero
1150	freezes at 6 degrees above zero
1175	freezes at 3 degrees below zero
1200	freezes at 16 degrees below zero
1225	freezes at 34 degrees below zero
1250	freezes at 60 degrees below zero
1275	freezes at 83 degrees below zero

Keep lighted matches away from cells while charging, as the gases may ignite. Keep the battery in a dry place and wipe away moisture which collects on top during charging. If the terminals corrode or bluish-green deposits collect on

Continued on page 64

A Homemade Synchronous Rectifier

This Gives High Voltage Direct Current from 60 Cycle, 110 Volt Alternating Current

By Geo. Becker, Jr., 6BIP

THIS "sink" was constructed by the writer two years ago and has given good service since. The motor is simple and can be made with few tools if the constructor has access to a lathe. The cost of the motor will depend on the amount of "junk" the ham has in the old box. It should not exceed $10.

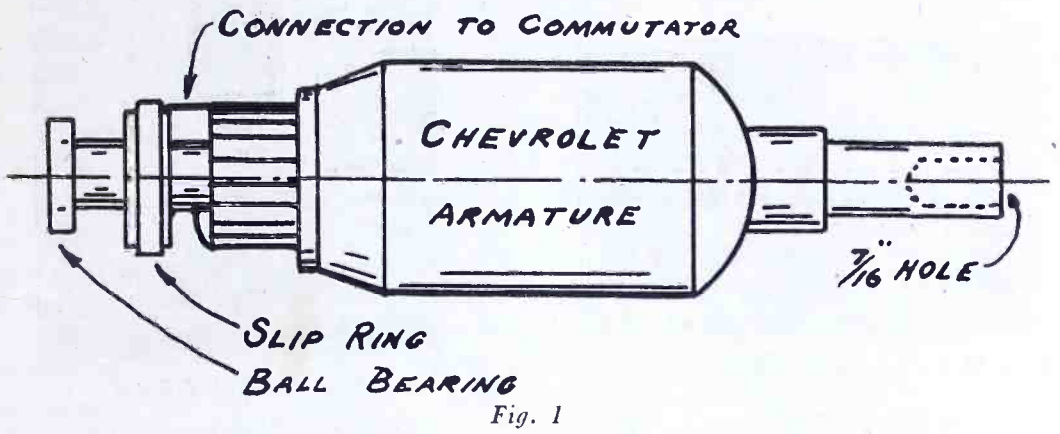


Fig. 1

First get a Chevrolet generator armature, which is ideal because it has an even number of segments in the commutator, the shaft on the commutator end is fairly long, and the other end has a 7/16-in. hole in which the disc can be easily mounted. Standard Ford or Chevrolet ballbearings can be used to make it run easier.

Then turn up a piece of Formica ½ in. thick, 1½ in. in diameter, and bore it for a press fit to the commutator end of the shaft. Get an old bronze bearing with an inside diameter slightly less than 1½ in. and a wall thickness of about 3/16 in. Bore it out in a lathe, making it a press fit for the Formica core. Press the ring on the core and, before pressing ring and core on the shaft, solder a short piece of wire on any one segment of the commutator and ground it on the shaft. The reason for this will be seen presently. Now press the ring assembly on the core, up to a point 3/16 in. from the commutator. Set up the armature between centers in a lathe and turn the ring down carefully. Connect the segment exactly opposite the grounded one to this ring. See Figs. 1 and 2.

Fig. 2

The stator can be built up to any design, but, if the builder has the field of an induction motor, the job is simplified greatly. For best results, the tunnel should be as close a fit as possible. Only two field coils are used; see Fig. 3. Under the assumption that the builder has such a field, we proceed to saw out all the poles, or teeth; but four on opposite sides of the frame. See Fig. 3. The field coils should next be form-wound and taped before putting on the projecting poles; 250 turns on each coil

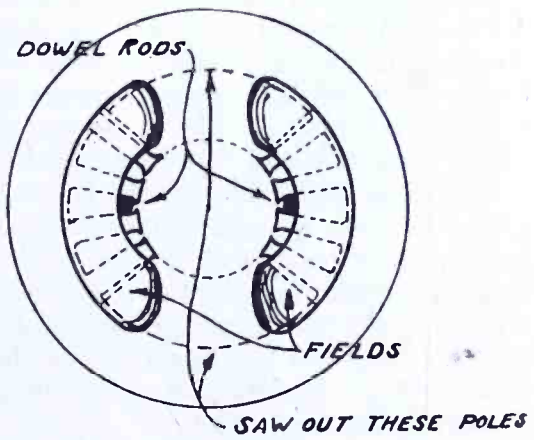


Fig. 3

of No. 22 D.C.C. The two coils are connected in series and the terminals to the 110-volt supply.

If the field has no base, one can be made easily as per Fig. 4. A box is made as deep as the stator is thick, with a snug fit on the sides. Molten lead can then be poured in the space between the stator and the side of the box. See Fig. 4. After the lead has cooled, the box can be knocked away and the stator and casting removed. This makes a very solid mounting for the stator and is to be preferred to wood blocks. The whole field assembly can then be held firmly to the base by a strip of metal passed over the top and screwed down on each side.

The coils should be mounted on the projecting poles and held in place with small dowel rods passed over the coils

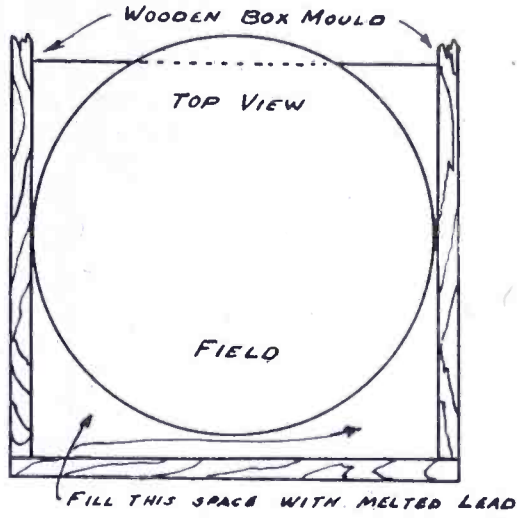


Fig. 4

and through the middle slot of the pole pieces.

Bearings and base can be made of pine, though oak or other hard wood is preferable. Fig. 5 shows an optional design of the bearings, but the builder can use his own ideas about these, as the only requirement is that they be rigid.

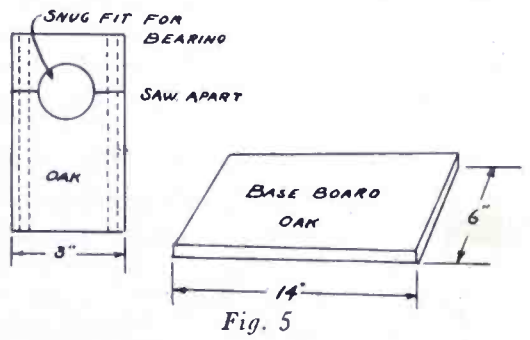


Fig. 5

Mount them to the base with through bolts so there will be no danger of shifting when the power is applied.

The disc for the high voltage will be next considered. Get a piece of Formica 6 in. in diameter, ½ in. thick, and roughly saw it round and mark the approximate center. Next chuck a piece of cold-rolled stock about 1¾ in. in diameter and long enough to allow about 4 in. to project. Turn up a shaft as per Fig. 6, 7/16 in. in diameter and 3 in.

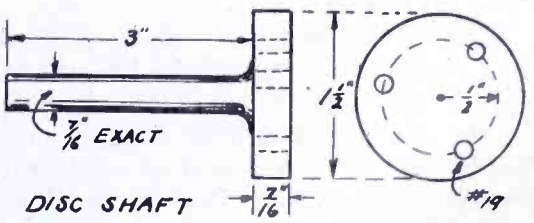


Fig. 6

long, with a flange ½ in. thick and 1½ in. in diameter. Do this very carefully, as the face of the disc must run perfectly true. Drill three holes for the mounting screws on a radius of ½ in., using No. 19 drill for 8-32 machine screw. Drill

three holes to correspond in the Formica disc and bolt the disc to the flange. Chuck the shaft and roughly turn the Formica disc true, being careful not to bend the shaft. The hard bronze ring that acts as the commutator can be cut from a sheet, or, better yet, turned from a large-cored piece of bearing bronze. It should be 1/8 in. thick and about 3/4 in. wide. It must be faced off on both sides and, when finished, should be 5 1/2 in. outside diameter and 1/8 in. x 3/4 in. Mount it on the Formica disc by means of six 8-32 machine screws passed through the disc and screwed into the

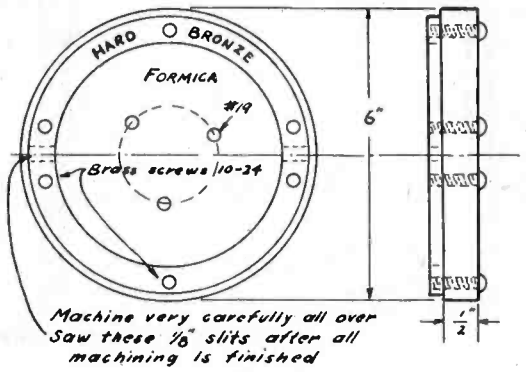


Fig. 7

bronze ring. The screws should be spaced as per Fig. 7 and countersunk on the back of the disc.

Next, get a piece of Formica in rod form 1/2 in. by 2 in., or use three or four 1/2-in. pieces, bore it out to a press fit for the shaft 7/16 in., and turn the outside and face the ends. Make two rings of bronze 1/2 in. wide, 1/8 in. thick, and inside diameter a press fit for the Formica core. See Fig. 8. Press the rings

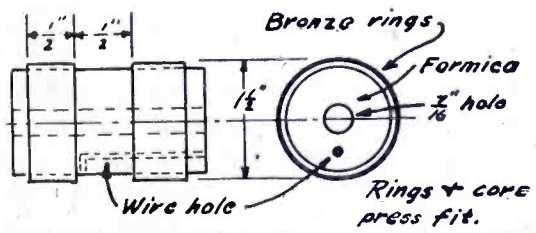
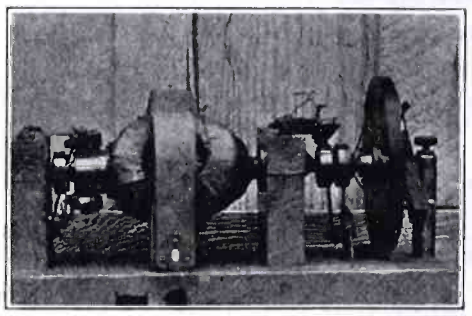


Fig. 8

on the core, one on each end, and press the assembly on the disc shaft. Don't bend the shaft. Press it on to within 1/4 in. of the flange. Bore a hole through the core so a wire can be run through to the second ring. Press the shaft in the 7/16-in. hole in the end of the armature, after first putting on the ballbearing. Pin the disc shaft in the armature shaft with a through pin and set the whole thing up in a lathe.

The commutator end can be gripped in a chuck or placed on the live center and driven with a dog. The bearing on the disc end should be clamped in a steady rest as near on line with the centers as possible. Proceed to turn everything to a finished surface, especially the disc and bronze ring. Turn the whole disc so as to balance it. After everything is turned to a whisker, remove the disc and armature from the lathe and saw the 1/8-in. slots in the bronze ring at exact opposite points on a diameter. Connect the slip rings to the bronze ring on the disc, one ring to each segment. This may be done by soldering the connecting wires to the screws that hold the bronze ring on.

Selection of the brushes is left to the builder and the contents of his "junk" box. The pictures will give an idea. Their purpose is as follows: Two brushes ride on the armature commutator and are shorted together permanently. They must be 5/16 in. x 3/4 in., or even wider. Two 1/2 in. x 1/2 in. carbon brushes feed the high voltage to the slip rings on the disc shaft. Two strip brushes collect the d.c. from the disc. One 1/2 in. x 1/2 in. carbon brush feeds the d.c. exciting current to one segment on the motor commutator; the other side coming out through the shaft.



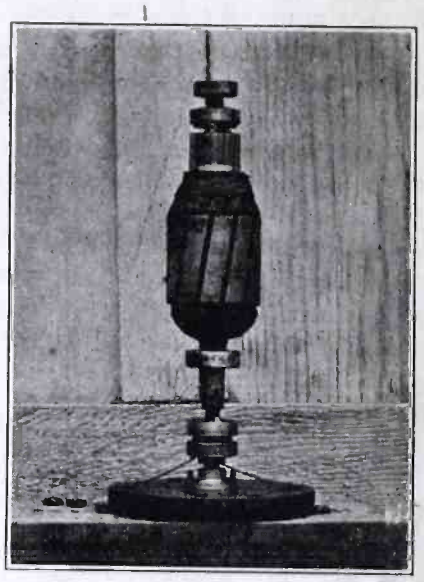
Assembled View of Synchronous Rectifier

For operation, 110-volt a.c. 60-cycle is connected to the field coils. The brushes on the commutator being shorted, the motor acts as a repulsion induction motor and comes up to speed rapidly, the speed being limited only by friction. When the speed reaches 3600 r.p.m., the exciting current is connected to the shaft and slip ring and thence to opposite segments of the commutator, where it divides and flows through the armature by two paths, producing two magnetic poles, a north and a south, at opposite sides of the armature. This rotating magnet falls into step with the a.c. and the motor acts sychronously. A.c. fed in at the two slip rings on the disc shaft can be taken off as pulsating d.c. at the disc.

This motor always starts right side up, no voltmeter and change-over switch being necessary. To find the approximate position for the commutator brushes, set them at right angles to the field coils and then either shift the brushes or the field assembly until the shorted brushes do not spark. The brushes lag slightly. To find the approximate position for the disc brushes, connect both the exciter and fields in parallel to a 6-volt battery and the armature will turn so that the poles in it and those of the field line up. Set the d.c. collector brushes about 5 degrees ahead of the center of each segment on the disc. Hook it up and press the key (low power) if the milliameter says, and reverse the d.c. leads to the plate and try again. It should work FB now.

Two cautions: Don't use an *A* battery to exciter. You'll be the one that's excited. There are voltages induced in the armature that'll make your tubes go west at a rapid pace. Don't use the same voltage as you did with the old "slop" rectifier.

Shift the d.c. brushes around till you get a position that delivers the high voltage without sparking. This rectifier does not look like a pin-wheel. After everything is adjusted, only a little oil and an occasional adjustment of the high voltage collector brushes is necessary.



The Assembled Rotor

I will be glad to furnish any additional information that anyone wishes. Write me care of RADIO.

HANDY HINTS ON RADIO

By D. B. McGown.

A common, but little suspected source of noise in a receiving set can often be traced to "microphonic" contacts in the filament rheostats. Be sure that all the moving parts of these instruments are clean.

If the landlord will not let you bore holes in the wall for a leadin, and a window is handy, paste a sheet of tinfoil on the outside of the window, and another on the inside. This will form a perfectly insulated series condenser, and a leadin as well, without damaging anything in the slightest.

If you are using a detector tube for reception, and after a while the signals get weaker, in spite of a good tube and new batteries, remember that the magnets of the headset may be getting weak, and if they are this will reduce the volume considerably.

Interference from battery-chargers, motor-generators, and similar apparatus often carries along the power lines for considerable distances, and sometimes causes trouble in places considerably remote from the source of trouble.

When using an oxide filament detector tube, such as a WD-11 or WD-12, or a Western Electric tube, after the tube gets very old, even though the filament looks pretty good, it may lose a good deal of its sensitivity, due to age and use.

A Good Filter for the Amateur Transmitter

Practical Details Regarding the Selection of Condensers and Inductances and their Proper Hook-up

Cassimer William Rados

THERE is a great deal of uncertainty and argument about filters to smooth out rectified a.c. into pure d.c. The more it is studied and experimented with, the nearer we come to the day when all amateur stations will use pure d.c. The filter question is not easy to settle and it is hoped that this article will help the average operator to get a good filter. With a little hard work and patience many so-called filters now in use would give real d.c. instead of ??. To the real amateur the biggest argument in favor of pure d.c. is that this kind of note is easier to copy when qrz, and will cut through qrn and qrm better than other notes. A transmitter using 5 watters with a pure d.c. note will often be reported and worked at greater distances than a 50 watter with an ordinary note.

To build a good filter knowledge of the parts is necessary. The two parts are the condenser and the inductance.

WHEN a condenser is put across the line it smooths out humps and holds up the voltage by storing up energy in electrostatic form. A condenser across the rectified a.c. before it goes through the inductance will almost double the voltage on the plate. (Fig. 1.)

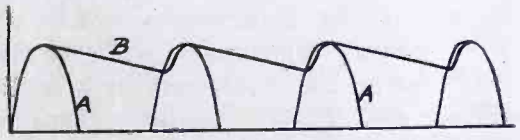


Fig. 1. Effect of Condenser. "A" is the curve of rectified a.c. and "B" the condenser curve

This is the reason that the antenna current goes up when we put a condenser across the rectified a.c. This alone would be reason enough for using it. But besides that, if the capacity is at least 5 mfd. it smooths out the curve considerably. This gives us a wave which approaches d.c. A condenser alone if from 50 to 100 mfd. will give almost d.c. but this much capacity is too expensive. We must use a cheap condenser.

In order to be of value as a filter condenser it must stand high voltage and have a large value of capacity. There are many different types of condensers used today, but we will consider only the cheapest ones.

The glass plate is easily made, never "blows" but is too big for the required capacity. It is also apt to have high losses if made incorrectly. It is not used to any considerable extent for these reasons.

The paper condensers are the ones in greatest use today. They are compact and cheap but "blow" at awkward moments. For transmitters using 5 watters with not more than 1000 or 1100 volts, the R. C. A. 1 mfd. 1750 volt d.c. condenser is ideal. On account of surges it is best not to use this or any other condenser at its rated voltage. When buying a condenser get the one with the highest voltage rating and do not expect a paper condenser to hold up very long if more than three quarters rated voltage is used. If the voltage of the transmitter is too high for the condensers they will have to be put in series. This is an expensive method but is safe. It has been my experience that paper condensers that have been "blown" can be put in series and used on same voltage, or they can be put across the line directly if lower voltage is used. Condensers used in spark coils will also work well. The disadvantage of the paper condenser is that it is expensive for large capacities.

To get a large capacity we must use an electrolytic condenser. However, they don't stand high voltage so that two in series have to be used for 800 to 1000 volts. As this gives a capacity of from 10-15 mfd. it is a desirable condenser. These condensers if punctured can be formed again and so used over and over. A recent article in RADIO gives complete details on construction of an electrolytic condenser. One made up in the following manner was used at 1BEL (50 watts, 1500 volts rectified a.c.) for a considerable time and worked very satisfactorily, giving no trouble and needing no attention. Six aluminum plates about 6 in. diameter were stacked, separated by glass rods. In between they were filled with a saturated solution of sodium phosphate. The plates were connected one to another (in series) and leads brought out from top and bottom plates. The whole arrangement was then immersed in oil.

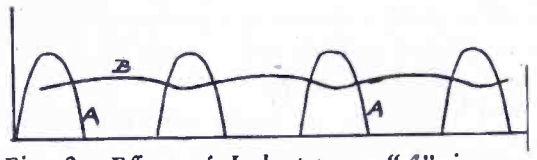


Fig. 2. Effect of Inductance. "A" is r.a.c. curve; "B" the inductance curve

On all filter condensers it is well to put a small fuse in series with the condenser. If the condenser "blows" the high voltage will not be short circuited long enough to damage anything. A fuse of about ¼ ampere is satisfactory.

THE inductance coil stores up energy in electromagnetic form which by the property of self induction fills in the gaps between bumps of a rectified a.c. curve. (Fig. 2.) As can be seen, using inductance alone, the effective voltage is cut down considerably but we have less strain on the tubes when a more uniform voltage is applied. To get enough energy stored in electro-magnetic form, a large value of inductance is necessary, at least 10 henrys.

At a well-known Eastern college station the voltage from the mercury arc rectifier was passed through 100 henrys in the positive lead, with 0.25 mfd. at

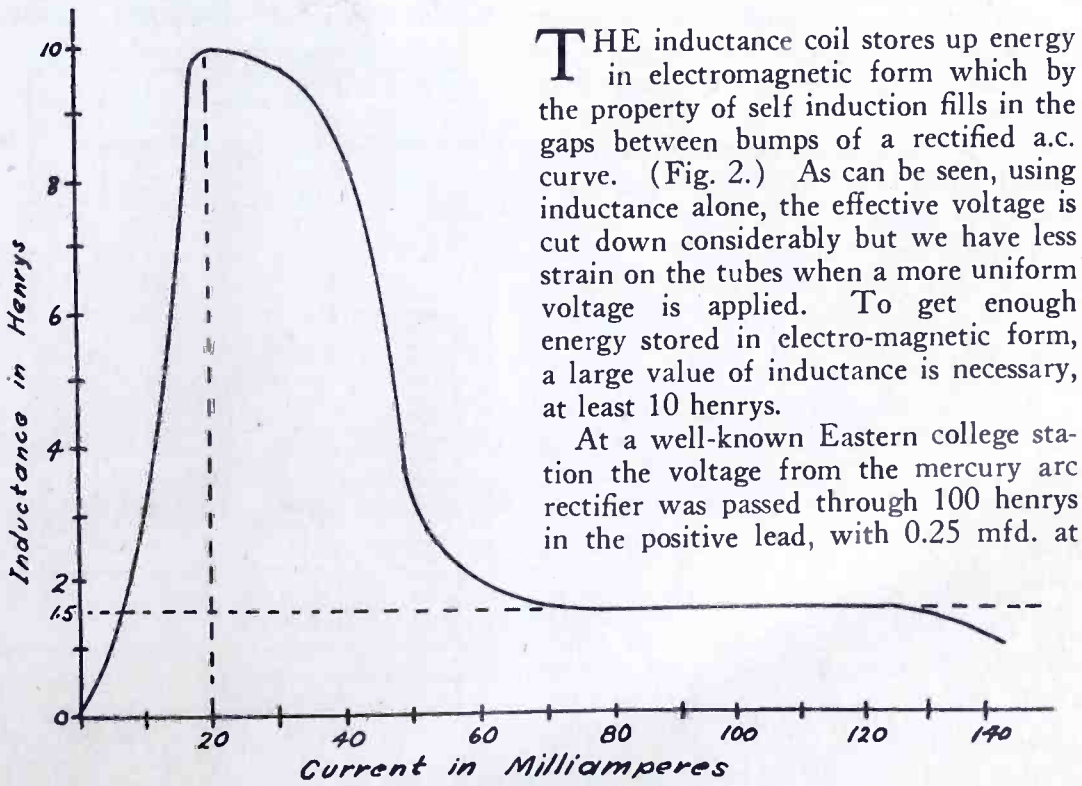


Fig. 3. Inductance Values of 1.5 Henry Choke

each end. This gave a pure d.c. note. Good chokes up to 30 henrys are easily available now and it is much better to buy one than to attempt to make a choke of that size. The values of homemade chokes are very apt to be 500% off from the "calculated" value. Everything that is associated with the choke—the size of air gap, the kind of core iron, the current through the coil, the insulation, etc. —all affect the value of the choke.

To show how widely the inductance varies look at Fig. 3. This is the inductance curve of a well-known single coil, 1.5 henry choke of Eastern manufacture. The rating of the choke was 1.5 henrys at 100 ma. With practically no current through it the choke measured 2 henrys. Then came the big surprise. As current up to 20 ma was passed through it the inductance value rose rapidly until at 20 ma it was 10 henrys! As the choke approached its normal current rating its inductance fell off until from 70 to 120 ma it was 1.5 henrys.

When such a variation exists in a choke designed by a radio engineer, you can see that the "calculated" values of homemade chokes are not very accurate. However, the following information is given so that a rough idea can be had of the inductance value of chokes.

(a) Acme 5 henry choke (special) core 5 in. by 5 in. and 1 in. square 6000 turns gave 5 henrys at 500 ma.

(b) 3 open core chokes, 4 in. long, ½ in. dia., 500 turns No. 24 dcc gave respectively 0.3, 0.4, and 0.5 henrys at 100 ma.

(c) A honeycomb 1500-coil with a closed core built around it gave 1.4 henrys at 100 ma.

To calculate inductance

$$L = \frac{4\pi^2 N^2 r^2 m}{10^9 l}$$

L = inductance in henrys,
N = number of turns,
m = permeability of core,
π = 3.1416,
r = average radius of coil,
l = length of core.
For a solenoid, $m = 1$.

Example—what is inductance of a coil 2000 turns on iron ring $m = 1000$, circumference is 150 cm. and radius 8 cm.

$$L = \frac{(4)\ (3.1416)^2\ (2{,}000)^2\ (8)^2\ (1{,}000)}{(10^9)\ \ (150)}$$

$= 67.3$ henrys.

In building inductances, use electrical sheet steel for cores, the thinner the better. Paint each piece with japan and tape core before winding the choke. The thinner the insulation on the wire the more wire can go into a given space; so use enameled wire if available.

The air gap, if too large, is very wasteful, and, if too small, the filter does not work very well. So make it variable (remember the old Thor spark transformers?) and vary it while testing until best results are obtained. Use fibre end flanges on the coils and wind full. Don't forget the holes in the flanges for the inside and outside wires. Solder lamp cord leads to the ends as shown in the sketch and tape the coil well. (Fig. 4.) Give the whole choke a coat of japan and dry thoroughly in an oven. It is best to get acquainted with a shop electrician or armature winder, as they are skilled at this kind of work.

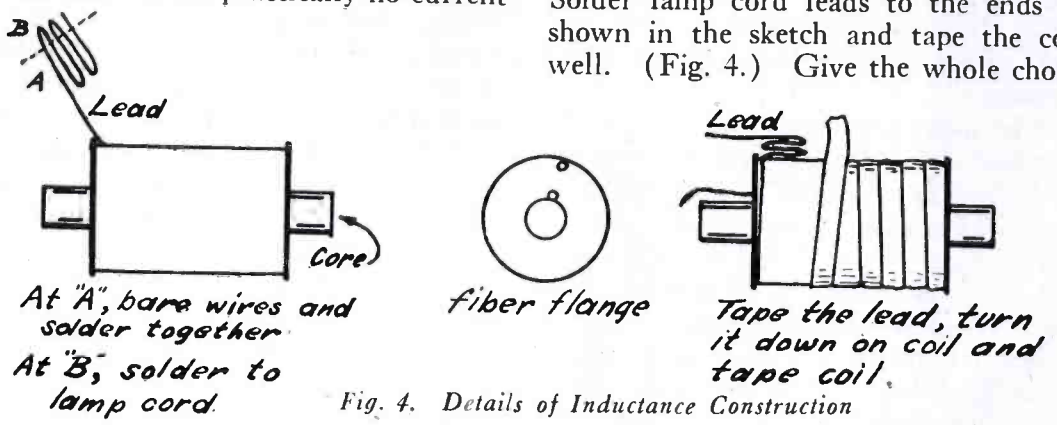


Fig. 4. Details of Inductance Construction

When the choke is finished, the best way to find out its inductance is to take it to some college laboratory. They will probably be glad to do it for you and may not charge you anything. This is the only reliable way, because, if 60 hams took the same specifications and built 60 chokes, there would probably be 60 different values of inductance!

THE good old standby is the π circuit, a condenser at each end and the inductance in between. (Fig. 5.). Use as much inductance and capacity as you can afford. A good value is 30 mfd. at the ends and a 30-henry choke in the middle. If you have several small chokes, connect them in series and place between the two condensers. If you have only one condenser, place it before the inductance. (Fig. 6.)

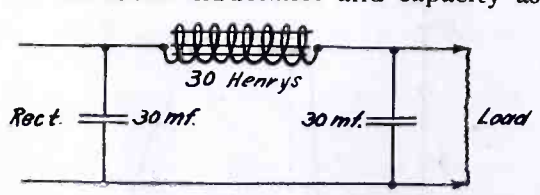


Fig. 5. π Circuit

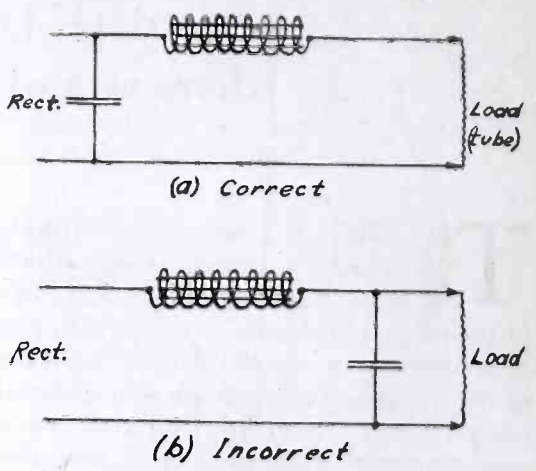


Fig. 6. Correct and Incorrect Placing of One Condenser with Inductance

The π filter is the best all around and can be used to smooth out a commutator ripple or to smooth out rectified a.c. Dr. Banks in July, 1923, RADIO also shows how it can be used with a synchronous rectifier.

The "modulascope," as invented by Mr. John L. Reinartz of 1QP, is a very simple device to determine the filtering. See Fig. 7 for sketch and diagram, details in QST. The "scope" will work almost at once when it is connected, but, if any difficulty is met with, crowd on the voltage and use *good* variable condensers as recommended by "kewpie." If you have a powerful transmitter, the "scope" will work by induction by merely placing it inside the helix.

After the "scope" is going, vary your air gaps, condensers, and chokes until the "scope" indicates pure d.c. Then test with neighboring stations on phone for any slight adjustments which may be necessary. Remember, while testing, to discharge the condensers by a screwdriver, etc., before handling them, or one of them might send you to the land of temporary sleep. After your filter is adjusted, lay in a supply of QSL cards—you'll need them.

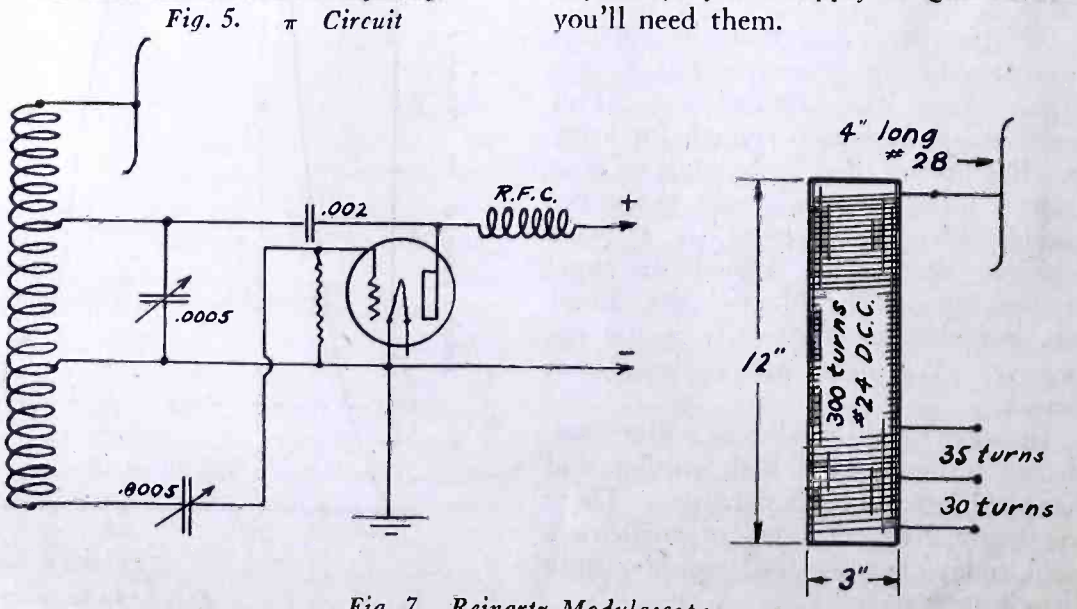


Fig. 7. Reinartz Modulascope

Secrets on Successful Operation of Transmitting Tubes

Impressions as to Why a One-tube Station Gets out Better than a Multi-tube Transmitter

By Don C. Wallace

MANY an amateur who has done wonderful work with one 50 watt tube has been practically lost since he increased power. With this in mind a close check has been kept for two years with the ultimate aim of helping transmitting amateurs improve their sets. This article is to be a collection of impressions created by experiences which have been gained in five years of C. W. operation, even back to the large 3 kw. tube set aboard the U. S. S. George Washington. The impressions, however, cover only the last two years since CW has become the prevailing method of amateur communication.

How many have noticed that the man with one tube is as loud or possibly louder than the man with two tubes. Notice the record holders, the stations that have made the great distances, and the stations that are best known for their consistent signals. Practically all of them are one tube stations. True some so-called 100 watt stations will also enter upon the list. Some night ask one of these 100 watt operators to take out one of his tubes. Nine times out of ten he gets no weaker. Some times he actually gets louder. Possibly more of the radiated energy goes out on one wave, possibly a greater proportion of the energy is going out on the main wave with less in the harmonics. We also find the one tube sets are sharper locally. 9ZT caused much more interference locally with 100 watts than with the present single 250 watt tube. This will also tend to support our statement that more of the actual output goes out on one wave and that one wave only.

At 9ZT using two 250 watt tubes, the locals complain of QRM and every ninth district station can apparently be raised with a short call and other districts with difficulty. With one tube in circuit the locals seldom even notice the station on the air, and all districts are equally easy to raise. Others have found the same thing true. Tests with 5ZA, 6KA, 5EK, 9BAF (day time) all indicate that one tube is distinctly as good as many, and usually the one tube is louder.

If one tube is better, why not overload it and use the second tube as a spare? In other words let us assume that the owner of a station has two good 50 watt tubes. Under ordinary operation let us assume each to last one year. Supposing he runs them in parallel, and they do last one year. Under our plan he would be just as loud by using one at a time, thus getting two years' use from these two tubes.

But he doesn't care about this—let us say that he will be content with one year's operation. The thing to do then, is to overload the tube, singly, so it will last but six months. Then the output will be greater and the total combined life of the two tubes will be the same. In the meantime his station has worked better and has become well known as one of the "big" stations. A few discerning amateurs have found this to be true—we want to pass it on to the rest. The whole thing in a nutshell is just this—use one tube, whether it be a 5, 50 or 250 watter. Then load that tube all you dare and all your pocketbook will stand (the life reduces with overload).

A safe plan is to build your transmitter as the new low loss tuners are built. Take everything out of circuit except that which is actually needed. Take out extra switches, wiring, and gear of all kinds. Space the inductance, meters, wiring, keep it all clear of the panel—don't even use a panel, but build a wooden framework upon which to mount the part. If this type of construction is good for a receiving set it most certainly must be good for a transmitter where the voltages are high and the currents likewise very high. A good place for all this extra stuff is the attic. Have it around, have extra condensers, tube, and anything else that has accumulated, but keep it in the attic. The radio table should be clear, the connections firm and solid and increased results will sure come to this type of station.

Practically all of the preceding material has been general. Now we will discuss the 250 watt tube in particular. The author has been asked by many—what is the secret of the 250 watt tube? Many good 50 watt stations dropped out

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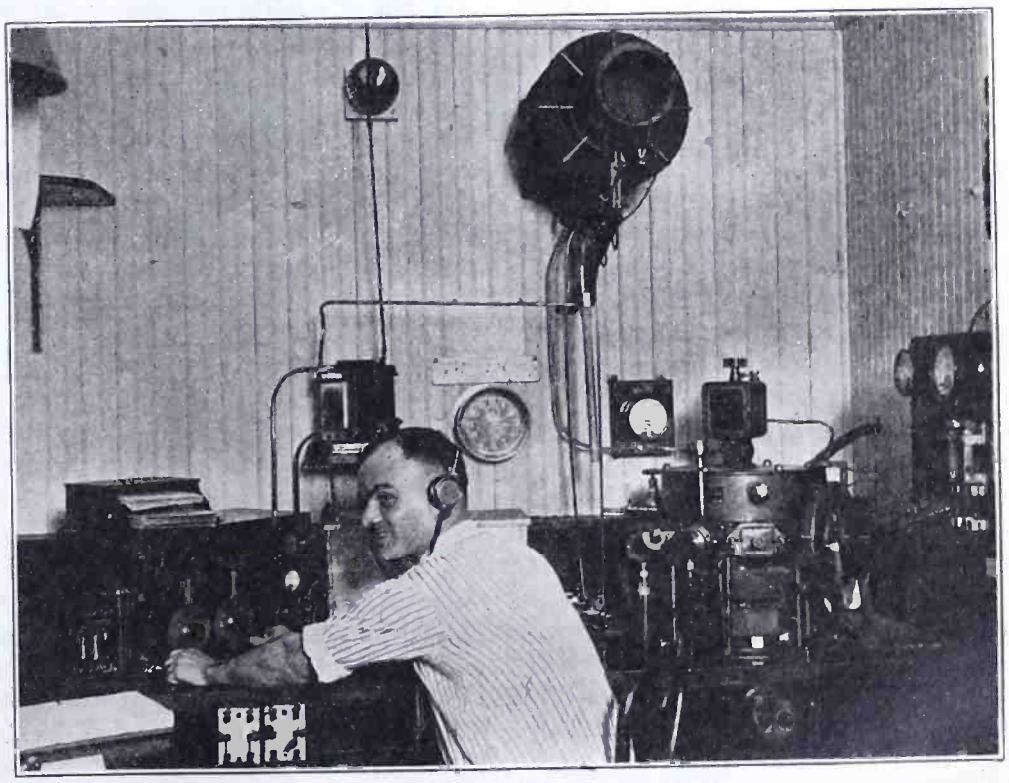


Radio Guiding New Mail Planes

H. L. Swart, Radio Engineer at the Radio Mail headquarters in the Post Office Department in the National Capital, with his 5-k.w. arc transmitter set which is on duty twenty-four hours a day. The flying field relay stations along the route, with headquarters at Washington, are all equipped with radio telegraph transmission stations. Operating on a working wave between 3500 and 3800 meters, these stations call each other on the 3998-meter wave, but shut down to listen every fifteen minutes, for emergency calls. This chain of radio stations acts as an aerial train dispatching system. It furnishes quick service for planes, transmitting advance weather reports and orders to stations where planes and pilots relieve each other on their cross-country flight.

Adjusting Your Super-Heterodyne

How to Find and Remedy Possible Trouble in the Homemade Instrument

By L. H. La Montagne

AFTER you have carefully wired up your super-het, as per specifications, you may find that it will not "perk" at first. Such troubles can usually be remedied if you know what to look for.

First be sure that your sockets and intermediate frequency transformers are all right. Test out each instrument for shorts, open circuits, or grounds with a

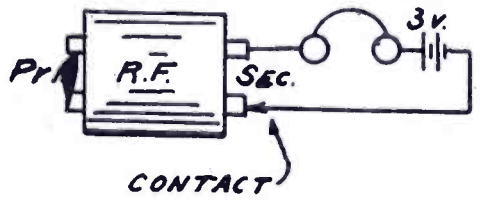


Fig. 1. Testing Secondary of I. F. Transformers. Primary Tested in Same Manner.

pair of phones and battery as in Fig. 1 or 2. The transformers should give a loud and distinct click when the circuit is made and broken through both the primary and secondary circuits. If shielded, test for grounds to the shield.

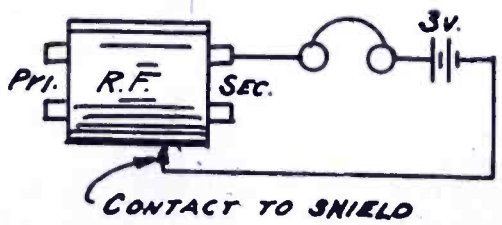


Fig. 2. Testing Secondary for Grounds. Test Primary in Same Manner.

See that the condenser terminals make good contact. A rubbing contact, if dirty, may not be good. In soldering, be sure that the wire isn't held mechanically but makes an excellent contact as well. Stray noises, very difficult to locate, frequently come from this source, especially if in the detector or oscillator circuits. Polish up all socket contacts with an ink eraser. Rub the tube terminals on a clean piece of paper or Bristol board. The lead oxide film isn't very deep and is easily removed. The thoroughness with which the various instruments are tested may mean the difference between success and failure.

Now let us suppose that you have assembled the set, and are ready for a try out. The writer has found that a meter in the positive *B* battery lead to all the tubes is one of the most helpful things for testing any set. The meter need not be calibrated, but may be a high voltage voltmeter minus the series resistance, as only comparative readings need be made.

The first thing to test is whether the *A* battery circuit is right. Place one tube in a socket, and see if it lights. If so, try this tube in each of the other sockets.

Next connect the *B* battery, without the meter for the moment, and short the filament leads momentarily by inserting a screw-driver between the socket contacts. If a large or unusual spark is produced, trace out the trouble. Make contact for an instant only or the batteries will be run down quickly. If the proper size voltmeter is available, it would be better to use it. If these circuits test all right, place tubes in the sockets, leaving out the audio-frequency ones for the time being.

Now plug the 'fones in the detector circuit, and connect the meter in the plus *B* battery lead to the set. Take readings for each tube, and if there is one that seems to give unusual values, discard that one for the time being. The tubes should all be tested in the same socket, as the position in the circuit will give varying space currents.

Test the potentiometer, if one is used by turning the arm until a click or hiss is heard in the 'fones, and noting the action of the meter as the tubes go in and out of oscillation, for future referance. If no click or meter kick is observed, check the r.f. wiring, and if ok check the contacts on the potentiometer. There should be a circuit between its three posts regardless where the arm is placed. This is tested out by the means of battery and 'fones, Fig. 3. A grating

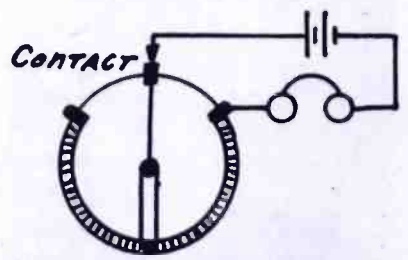


Fig. 3. Testing Potentiometer

noise as the potentiometer arm is turned indicates poor contacts on the wire, which should be cleaned by sanding lightly. If the r.f. tubes are oscillating, a distinct click will be heard in the 'fones if the grid of any tube is touched with the finger, and the meter will give an upward kick when the oscillations are stopped.

The next circuit to test is that of the oscillator. If the grid of the oscillator is touched a distinct click should be heard, and the meter should act in the same way as with the r.f. tubes, when oscillating. If the condenser is varied, a number of whistles should also be heard as it is turned through its various values.

The commonest faults of the oscillator are: two few turns on the plate feedback (follow directions carefully); reversed plate leads; shorted or open coils, or poor contacts; or poor by-pass condensers. With an open plate coil, no space current will be shown on the meter. Lack of oscillations is shown by little or no change in the meter when the grid of the tube is touched. The filament adjustment, while not critical, must be above a certain value for oscillations to take place. I have found that nine-tenths of the troubles in a super-het occur in the wiring of the oscillator circuit.

Now if the oscillator and r.f. tubes are working properly, tune in signals, and try out the tubes in various positions. Some tubes are good r.f. amplifiers, some good a.f. amplifiers, some good detectors, and some distinctly no good.

Don't overlook your grid leak or condenser or any by-pass condenser. They may be way off capacity, shorted or otherwise defective.

Cut out the by-pass condensers and then connect them one by one until the trouble is found. The only test for these condensers is a comparative one made by listening to the strength of signals. Any decrease in signals will show a defective condenser, wrong capacity or incorrect position. Your meter will generally show up a defective leak, especially if its value is low, for then a positive potential is put on the grid of the detector tubes, and an abnormal plate (space) current results. A little testing will show just what to expect. A reversed *C* battery will also cause a tube to show an excessive plate current.

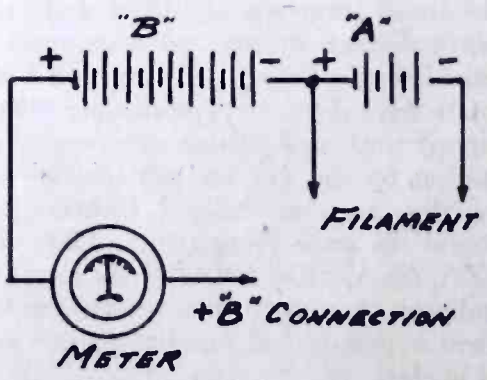


Fig. 4. Method of Connecting Meter

The actual tuning in is greatly simplified by the use of a meter. By noting the action of the meters as the loop (or

Continued on page 64

Second Harmonic Super-Heterodyne

A Simple and Helpful Explanation of the Principles Underlying this Non-interfering Circuit

By L. R. Felder

SUPERHETERODYNE sets working on the "second harmonic" have been the cause of wonder as to what is the underlying mystery. The second harmonic superheterodyne works on the same broad principle as all other types of superheterodyne sets. This principle was explained in June RADIO by the writer. Briefly, the incoming low wave (high frequency) signal is transformed into a high wave (lower frequency) signal, which is then more easily amplified by efficient high wave amplifiers.

The method by which the frequency is changed from low wave to high wave, or from high frequency to low frequency, involves the use of a radio-frequency oscillator and the principle of beats. In Fig. 1 we have a typical loop circuit tuned to an incoming signal of high frequency, let us say 950,000 cycles, which corresponds to a wavelength slightly higher than 300 meters. There is also shown a radio-frequency oscillator which is tuned to a frequency of 1,000,000 cycles let us say, and these oscillations are coupled to the loop circuit by means of the coupling coil *L*. The incoming signal oscillations and the locally-generated oscillations are therefore present in the same circuit and applied to the grid of the tube *D*.

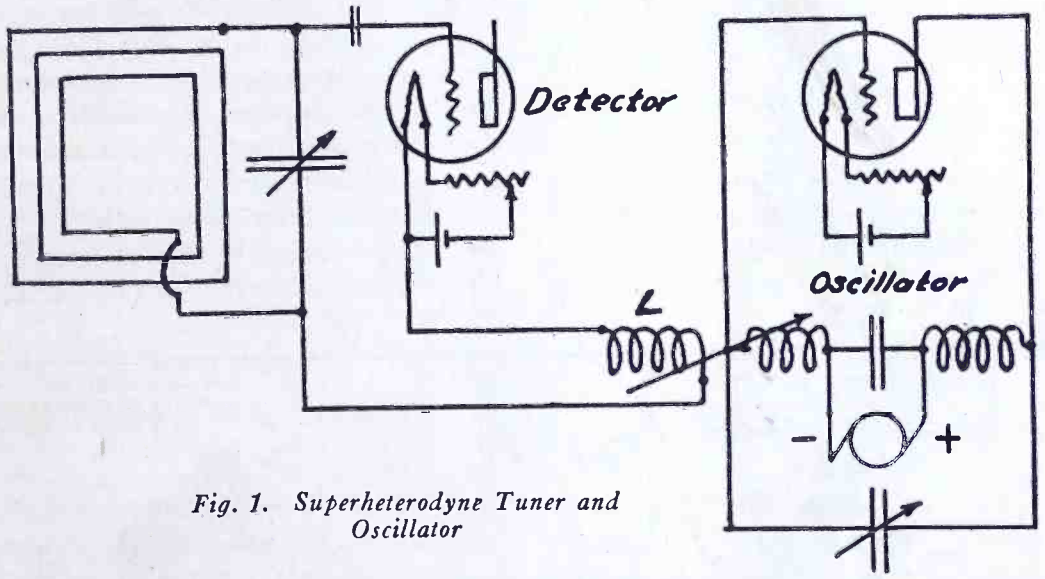


Fig. 1. Superheterodyne Tuner and Oscillator

These two oscillations, according to the fundamental principle of beats, combine to form another oscillation having a frequency which is equal to the difference. Thus we have a resultant oscillation having a frequency equal to 1,000,000 minus 950,000, or 50,000 cycles. In place of a signal having a frequency of 950,000 cycles (which is very difficult to amplify due to impossibility of building a good low wave amplifier) we have a signal having a frequency of 50,000 cycles which is a simple matter to amplify efficiently. The frequency transformation does not itself involve any change in the characteristics of the original signal. That is, the resultant 50,000-cycle signal has all the characteristics of the original 950,000-cycle signal which it is desired to hear.

It is thus apparent that the radio-frequency oscillations generated by the local oscillator must have approximately the same frequency as the received signal. In the above case the received signal has a frequency of 950,000 cycles, while the locally-generated oscillations have frequency of 1,000,000 cycles, only 50,000 cycles apart. Some receivers are built so that the difference in frequency is even less, say about 30,000 cycles. It will be seen that this difference in frequency is perilously near the audio-frequency range and this introduces audible radiation from the receiver.

Interference due to receiver radiation is caused by so much regeneration that the receiver acts as an oscillator and radiates these generated oscillations. Nearby receivers working on approximately the same wavelength pick up these oscillations and beats are set up between the incoming signal and the oscillations due to the regenerating receiver. The squeals and other interfering noises are the beats set up between these two oscillations.

In the superheterodyne circuit we have a somewhat more aggravated case of the same type. In place of the oscillating regenerative receiver we have a radio-frequency oscillator which is a miniature transmitter whose oscillations are radiated by the loop circuit.

The usual types of superheterodynes oscillate at about the same frequency as the received signal. If anyone in the immediate vicinity of a superheterodyne set is receiving signals of nearly the same frequency as the oscillator in the superheterodyne sets generates, and the loop radiates these oscillations, the possibility of audible beats with consequent interference being developed is considerably enhanced. There is no doubt that such interference does take place. However, the superheterodyne set is not sufficiently widely distributed for it to be noticed, and many supers use a radio-frequency blocking tube which helps cut down the interference.

To avoid possibility of such interference, the second harmonic principle was invoked. If a set could be made in which the radio-frequency oscillator generated frequencies far removed from the frequencies of incoming signals, then, even though the oscillations were radiated from the loop, no audible interference would be produced in other receivers because the frequencies were so far apart that the beat note was well outside the audio-frequency range. This could be done by making use of the second harmonic of the generated oscillations.

A vacuum tube oscillator does not ordinarily generate a single frequency for a given setting of the circuit constants. Thus suppose that the constants are so fixed that the oscillating circuit tunes to 600 meters, 500,000 cycles per second. Then the vacuum tube oscillator will generate radio-frequency oscillations of this frequency, but at the same time it will generate oscillations of double this frequency, namely 1,000,000 million cycles, three times this frequency, 1,500,000 cycles, and so on. The lowest frequency which it generates is that to which the oscillating circuit is tuned, in this case 500,000 cycles, and this frequency is called the fundamental or first harmonic. The oscillation of double the fundamental frequency which it generates is the *second harmonic*. Inasmuch as the oscillating circuit is tuned to the fundamental it is to be expected that most of the energy of the oscillator is in this frequency. The succeeding harmonics generally have less energy in them. Thus a radio-frequency vacuum tube oscillator generates oscillations of various frequencies which bear a certain ratio to the fundamental frequency, and what is most important to this discussion, the second harmonic oscillation gen-

erated by such an oscillator has a frequency of twice the fundamental.

Consequently it is possible to make the superheterodyne oscillator tune to a frequency far removed from the range of frequencies being received, and still secure our intermediate beat frequency of 30,000 to 50,000 cycles, and this without creating any interference. Let us consider the numerical illustration above. Suppose that we are receiving a broadcast signal of frequency of 950,000 cycles, which corresponds to a wavelength somewhat greater than 300 meters. And let us assume that we desire to transform this high frequency down to an intermediate frequency of 50,000 cycles. If we design the oscillator so that it tunes to a frequency of 500,000 cycles, corresponding to a wavelength of 600 meters, the oscillations will be sufficiently far removed from the broadcast range to avoid any interference due to direct radiation of these oscillations from the loop antenna or other antenna. However, 500,000 cycles cannot combine with the received 950,000-cycle signal to give us an intermediate beat frequency of 50,000 cycles which may be efficiently amplified. However, this is the fundamental frequency of the oscillations generated by the oscillator. The second harmonic of the oscillator has a frequency of two times the fundamental, or 1,000,000 cycles. The 1,000,000 cycles second harmonic can beat with the received signal of 950,000 cycles and form the required 50,000-cycle beat frequency. And this is exactly what the second harmonic superheterodyne accomplishes.

It should be observed that the fundamental of the oscillator also beats with the received 950,000-cycle signal. However, the beat frequency is so high that it is inaudible and so creates no interference. The whole idea is to make the oscillator so that, if it does radiate oscillations, their frequency is so far removed from received frequencies that no audible interference is created. At the same time provision must be made for enabling the intermediate beat frequency to be secured, and this is made possible by the presence of harmonics in the generated oscillations.

It is possible with a superheterodyne to find two positions of the oscillator setting at which any given station may be received, because the oscillator may be set 50,000 cycles above or below the received signal frequency and still a 50,000-cycle frequency will be obtained. Thus, suppose a 950,000-cycle signal is being received. If the oscillator is tuned to 1,000,000 cycles a beat frequency of 50,000 cycles will be secured, since it is the difference of 1,000,000 and 950,000. Also the same result will be secured if the oscillator is tuned to 900,000 cycles. It often happens that a station is heard at more than two settings of the oscillator dial, sometimes three, four or even more. The reason is that transmitting stations likewise may be radiating, not a pure wave, but one with harmonics. As a result, when the oscillator of the superheterodyne is tuned over its range a number of settings may be found where the same station is picked up, for at each setting of the oscillator control a beat is produced between the new oscillator frequency and a harmonic frequency of the transmitting station. The writer has heard a given station on as many as six different points of the oscillator scale. This is not usual, but occurs with transmitters which radiate a very impure wave.

To work on the second harmonic principle the oscillator must be designed to oscillate at twice the wavelength of the received signal over the entire wavelength range of the tuner. Thus suppose that the receiver is intended to cover a wavelength range from 300 meters to 500 meters. The oscillator should then be designed to cover the range from about 600 meters to 1000 meters, the second harmonics of which will then cover the same range of frequencies and wavelengths as is covered by the tuner itself. The circuit arrangements and connections are exactly the same as for the more standard type of superheterodyne circuit.

Remember that an amplifier without a *C* battery is not an amplifier at all, but simply a distortion producer, if more than 40 or 50 volts plate potential is used.

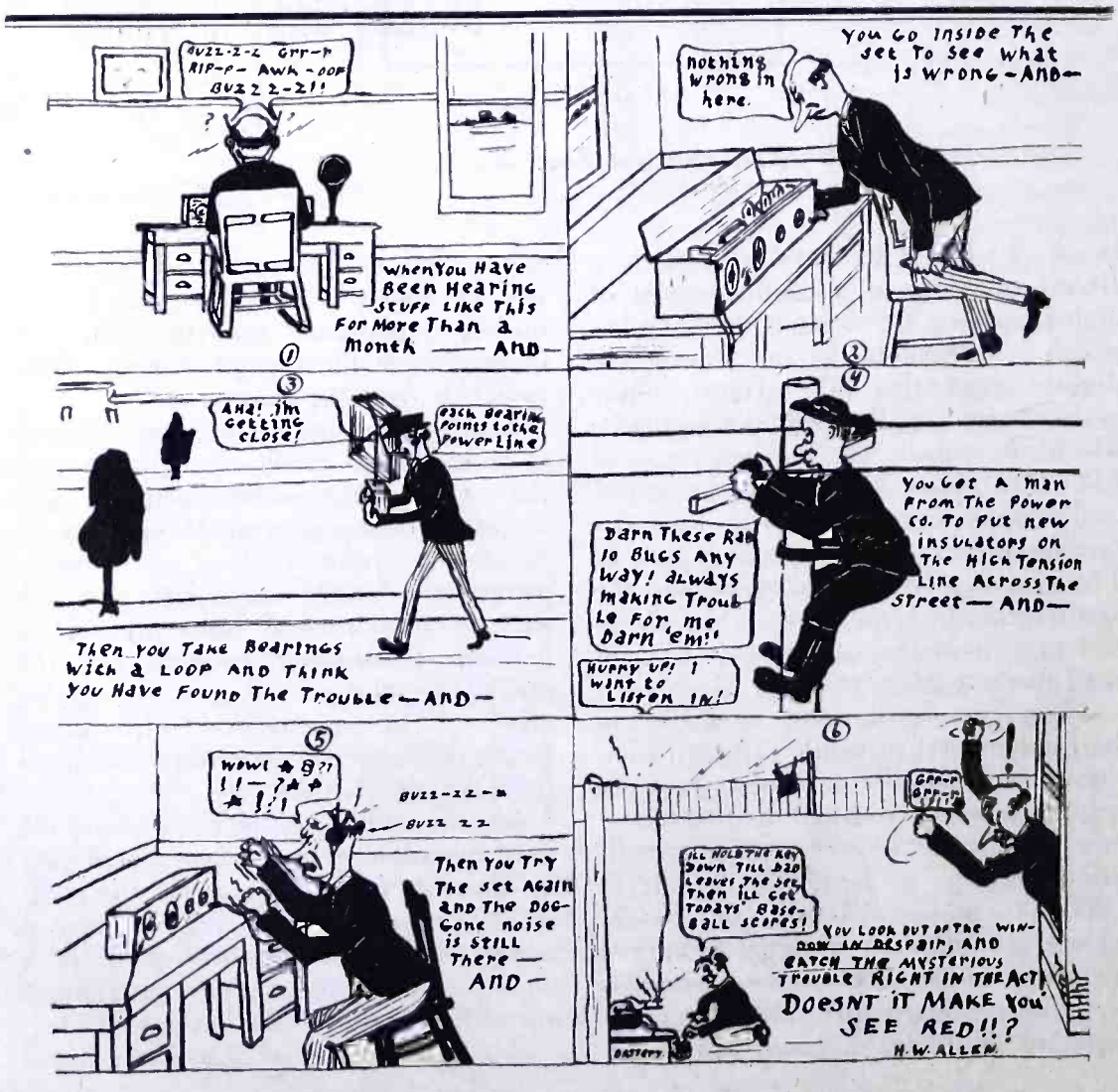
FILAMENT SUPPLY FROM 110 V. A.C.

By RAYMOND A. SMITH

The ideal radio receiver must be inexpensive, simple to operate and economical to keep up. The Harkness reflex circuit is both simple to operate and inexpensive to either buy or build, and, by using a.c. current supply on the filament, becomes economical to keep up. By using a filament transformer to step down the 110 volts to 6 volts for C-201 A tubes, the cost of either storage batteries or dry cells can be eliminated.

There are several types of transformers on the market, costing about $5 retail, the preferable type being that which has a middle tap.

The primary is connected direct to the 110-volt a.c. line without rheostats and the two main secondary taps connected through 30-ohm rheostats to the filaments of the tubes. The middle tap is connected to the grid return through the *C* battery. It is essential that there be a 30-ohm rheostat in each leg of the filament supply, as, by balancing these rheostats, the a.c. hum is eliminated, which will be very noticeable unless these two rheostats are carefully adjusted. When the music is off between selections, the hum can be faintly heard. This device cannot be used on a set with a tube detector but only with a set using a crystal detector.



Improvements in the 45,000 Cycle Super-Heterodyne

By G. M. Best

A LARGE number of suggestions for the improvement of the 45,000-cycle Super-Heterodyne, originally described in May RADIO, have been received during the past month. It is unfortunate that most of these suggestions call for the use of the UV-201A or C-301A tubes, which require a storage battery. The set was originally designed as a dry battery receiver, and the addition of a storage battery, with its associated rectifier or other charger, does not constitute an improvement, in the opinion of the judges of the contest.

While there is no doubt that the use of the larger tubes, with their higher amplification constant and mutual conductance, will increase the amplification per stage in the intermediate frequency amplifier, not enough gain will be obtained to warrant the extra expense of the battery and charger. Of course, many already have a storage battery, and probably would prefer to use it instead of dry cells. In that case, great care in constructing the set will be necessary, and a considerable amount of shielding will be required, due to the larger amplification obtained. It would be advisable to shield the back of the panel, the baseboard section containing the oscillator coupler, oscillator tube and oscillator air condenser, and the inside of the cabinet.

The best suggestion of the month, for improvement of the dry cell set, is the addition of a four-spring telephone jack, on the panel, for the purpose of bringing out the voltmeter terminals in a manner so that a plug, with flexible cord and clips attached, may be inserted in the jack, and the voltmeter, which is disconnected from the filament circuit, may be used for measuring *C* batteries, or any other battery desired. This jack, and its connections, is shown in Fig. 1.

The jack may be a Federal 1423-W, or any other jack of similar number of springs, and contact arrangement. The two main springs of the jack go to the voltmeter terminals, and the two contacts are connected to the main filament leads in the set, so that normally the voltmeter is connected to the filament circuit. When the plug is inserted in the jack, the voltmeter is disconnected from the filaments, and can be used for any other purpose, up to its maximum scale.

AUGUST PRIZE WINNERS

In Contest for Improving Best's Super-Heterodyne

1st prize—$25.00—J. R. Balsley, 299 South Park Ave., Fond du Lac, Wis.

2nd prize—$15.00—D. B. McGown, 1247 47th Ave., San Francisco, Calif.

3rd prize — $10.00 — Clair Foster, Carmel, Calif.

Similar prizes are to be awarded each month and additional final prizes for the best ideas submitted during a six-months' period.

This voltmeter cannot be used for measuring the voltage drop across the biasing resistances suggested in the August issue of RADIO, as the voltmeter is a low resistance affair, and will give an erroneous reading if so used. The only way to measure the voltage drop across such resistances, without the use of an expensive high resistance voltmeter, is to measure the current flowing through the resistances, with a milliammeter, and compute the voltage by the well known formula $E = IR$, where E is the unknown voltage, I is the measured current, and R is the known resistance.

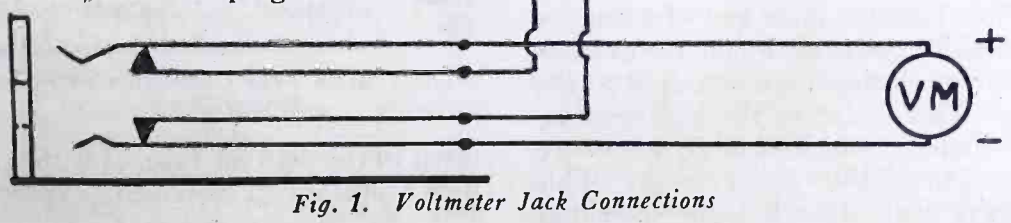


Fig. 1. Voltmeter Jack Connections

ANOTHER suggestion of merit, primarily intended for those who desire a large volume out of their audio-frequency amplifier, is the addition of a power amplifier, partly operated from a.c., in place of the last dry cell tube in the audio-frequency stages. The circuit for this amplifier is shown in Fig. 2. The amplifier consists of a UV-201A or C-301A vacuum tube and associated socket, a choke coil of 25 henrys or more (a G. E. Wayne Bell Ringing transformer primary winding will do), a 2-microfarad condenser, a small bell ringing transformer, two Cutler-Hammer 25-ohm variable resistances, and a 200-ohm potentiometer.

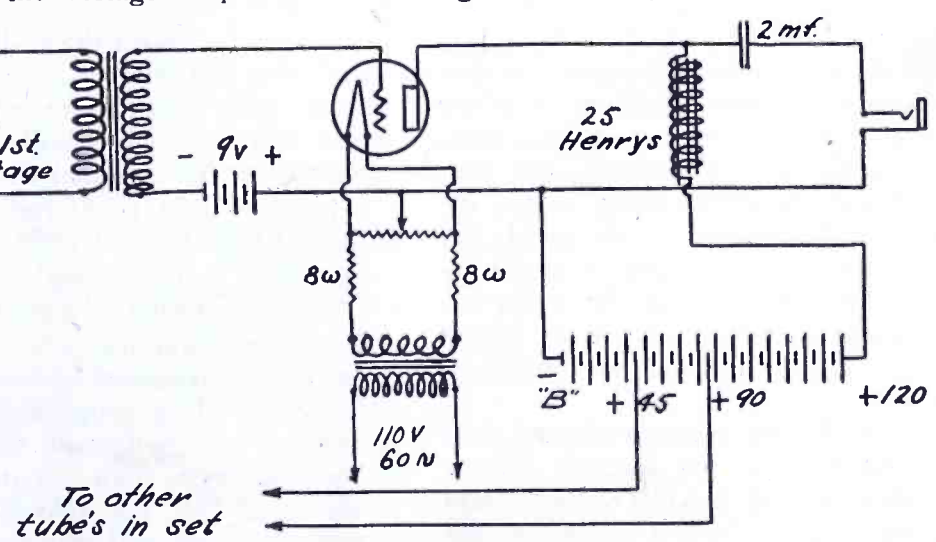


Fig. 2. Power Amplifier Hook-up

The plate voltage applied to this stage should be at least 120, for 9 volts negative grid potential. As there are several makes of bell ringing transformers on the market, with secondary voltages ranging from 6 to 10 volts, it is necessary to provide sufficient resistance in series with the filament circuit to reduce the voltage at the filament to 5 volts. If a 10-volt bell ringing transformer is used, with *A* tubes, these resistances should be 8 ohms each, and, as the Cutler-Hammer resistances are easily adjustable, this can be done very quickly. The 200-ohm potentiometer should be varied until no noise is heard in the output of the tube. The above arrangement will enable the user to handle power levels considerably in excess of

that permissible with the dry cell tubes, which have only 90 volts on the plate, and 4½ volts negative grid, without the addition of a storage battery.

FIG. 3 shows the re-arrangement of apparatus on the panel, as suggested by Mr. Clair Foster, and will no doubt be of interest to everyone. Mr. Foster suggests that, inasmuch as many do not like the binding post terminals brought out on the rear of the baseboard, it would be well to mount them on the panel, and he has accordingly lengthened the panel by 1 in., and the baseboard by the same amount. He has placed the Cutler-Hammer battery switch at the right hand end of the panel, where it is close to the battery binding post terminals. Three jacks have been provided in a convenient manner, so that the audio-frequency amplifier, in whole or in part, may be cut out of the circuit. In the original set, the phone jacks were placed one above the other, at the extreme right hand end of the panel, but in this case they have been arranged between the detector and the audio-frequency amplifier tubes, where the wiring will be very short and convenient of access.

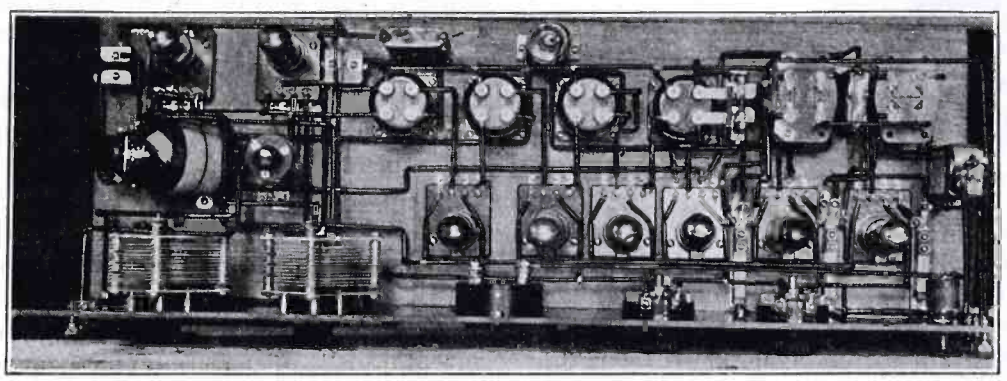


Fig. 3. Suggested Re-Arrangement of Parts

Several readers have complained that, after constructing the antenna adapter described in July RADIO, they could not use it due to lack of selectivity and noise on distant stations. This trouble is probably due to the use of too much amplification in the intermediate stages, lack of loose coupling of the rotor with the stator of the variocoupler, and lack of shielding of the cabinet in which the tuner is mounted. If the antenna tuner is to be used exclusively, sufficient amplification may be obtained by using only two intermediate stages of amplification, and, if extremely loose coupling is employed, no trouble from noise or interference from nearby stations should result. It would be best to shield the inside of the tuner cabinet with sheet brass or tinplate, grounding the shield at the ground binding post.

A good pair of telephone receivers is one of the most sensitive electrical recording devices known to science. Consider, then, how much more sensitive a good vacuum tube is when it operates these receivers satisfactorily.

THE GRID LEAK

By H. Bunch

It would be interesting to know just how many radio fans really understand the precise function of a grid leak, the correct values to use, and the correct way of connecting it into circuit.

At first sight, the grid leak seems to have no use, although we know that it would not be found in every detector circuit unless it had some important function to perform. Suppose we take it out; what will happen? At first nothing seems to happen. The electron tube continues to rectify as well as before, but in a short time signals begin to lose their original strength and gradually die away. Suppose we put the grid leak back; or, if you like, simply touch the grid terminal with your finger; and it will be found that the signals will return immediately at their original strength.

This should be proof enough of the high value of the grid leak in your receiver, so let us now consider what is its part in the operation of a radio set.

Incoming radio waves are impressed at very high frequency on our receiving antenna, which is connected in series with the aerial tuning inductance. This radio-frequency current is induced in the secondary circuit, one side of which is connected to the grid condenser. This condenser offers very little resistance to radio-frequency currents, but will block all steady direct currents. This condenser will allow the radio-frequency currents to pass; so these are next impressed on the grid.

The grid really controls the whole action of the tube. When the grid is at a negative potential, it does not allow the passage of any electrons between the filament and the plate. Rather, it has a tendency to push any free electrons back to the filament, but, when the grid is at a positive potential, it gives assistance to the plate in attracting electrons from the filament.

When both the plate and filament are at a positive potential, by far the greatest number of electrons are attracted to the plate. This is due to the high tension, or *B* battery, which may be anywhere from 20 to 60 volts in its circuit. This gives the plate a much higher potential than the grid, which has only the slightest fraction of a volt positive impressed upon it. We must remember, however, that the grid is at a positive potential, however small, and it is due to this fact that some electrons must be attracted to and held on the grid.

The electrons drawn to the plate have a very easy path to traverse. They pass through the *B* battery and the phones back to the filament; but what of those electrons that were attracted to the grid? There is no path for them, for, as mentioned previously, the grid condenser presents an impassable barrier to steady currents.

Without a grid leak, these electrons have to stay where they are, and, after the detector has been working for a short time, there is an excess of electrons accumulated on it, and, as these can find no way of escape, the tube is paralyzed; which accounts for our signals fading away.

Now, if we touch the grid terminal with the finger, the signals revive. What is happening now? The answer is simple. The stored-up electrons have now found a passage back to ground through the body, which is now acting as a high resistance leak. It would be very inconvenient, however, to have to keep our finger on the grid terminal all the time we are receiving, so the grid leak is interposed with excellent results.

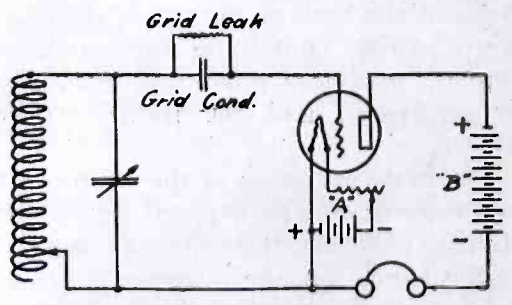


Fig. 1. Grid Leak Connection in Single-Tube Circuit

In a single-tube circuit, the grid leak should be connected across the grid condenser, as shown in Fig 1, and this should also be done when radio-frequency amplifiers are magnetically connected to the detector tube, as is the case when transformers are used. When a

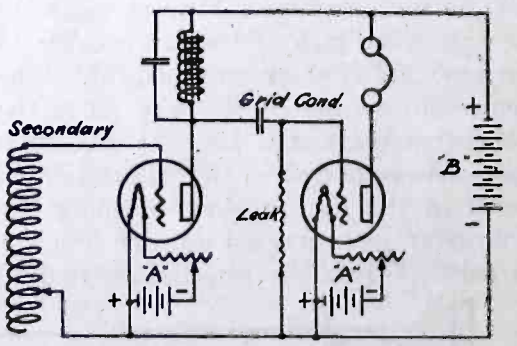


Fig. 2. Grid Leak Connection in Tuned Plate Circuit

Continued on page 72

A Transmitter that Solves the Local QRM Problem

How to Build a Small One Tube Transmitter Suitable for Local Work

By Franklyn S. Huddy, 1 II-1 ZS

MOST of us have at some time wished for a small, low-powered transmitter with which it would be possible to work local stations on C. W. or phone without causing interference either to other amateur stations or to members of the broadcast faction. The use of such a transmitter would be a distinct economy, as it would save our large tubes for long distance work. Aside from this, and the fact that it would reduce interference, such a transmitter would enable many stations to comply with the Federal law requiring all stations to use the least possible amount of power necessary to carry on communication over a given distance.

To be practical, such a transmitter should enable the operator to change the wavelength quickly and with as few adjustments as possible. The transmitter to be described will tune from 220 to 120 meters by the turning of one dial, and will give quite an even output over the whole band.

Furthermore, this transmitter will work with a ground, thereby enabling those who cannot erect counterpoises to use C. W. where it might not otherwise be possible.

The materials needed to construct this set are few and easily obtained. They are as follows:

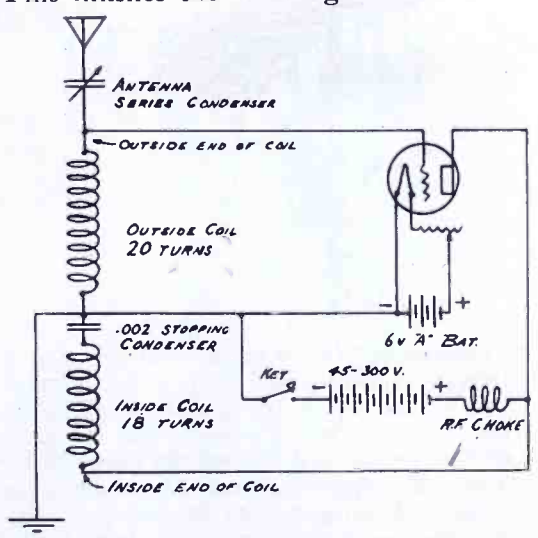
The plate supply consists of a 45-volt *B* battery. For greater distance, voltages up to 300 may be used, but for all ordinary purposes 45 volts is perfectly satisfactory.

The best tube to use is the UV-201A or C-301A. This will give more output than the usual hard tube, although the latter functions very well.

The condenser should be of the 11 or 23-plate type. Almost any condenser will do, but the better condenser you use the more output you will get, and, since the total amount of energy available is small, it is advisable not to waste any of it. A fixed condenser of .002 mfd. is also necessary. This may be a micadon or any condenser that will stand the plate voltage.

The inductance is the only part of the set which it is necessary to make yourself. The form upon which it is wound is made as follows: Cut a wooden disk ½ in. thick and 2⅜ in. in diameter. In its periphery, drill 17 holes 3/16 in. in diameter, ⅜ in. deep and ⅜ in. apart. The holes should be equally spaced. Obtain some 3/16-in. dowel and cut 17 pieces 2 in. long. These pegs are inserted in the wooden disk, and should fit just tight enough so that they may be pulled out easily when the coil is done. Some of the 5-and-10-cent stores sell these forms already made up and, if it is possible to purchase them already made, it will save time.

When the form is made, select any peg as a starting point and fasten one end of the wire to it. Then wind on 18 turns of No. 16 or 18 d.c.c. magnet wire, crossing over and under two pegs each time. This is the tickler winding. Start again and wind on 20 turns of the same wire and in the same direction. This finishes the winding.



Obtain some collodion at a drug store and put it where the wires cross in the coil. This will make the coil self supporting. The pegs should then be slipped out and the disk removed. The inductance is done and should be allowed to dry in a warm place.

The radio-frequency choke is made by winding 250 turns of No. 28 d.c.c. wire on a 3-inch cardboard tube. When this is done the set is ready to assemble and connect.

Connections are shown in Fig. 1. The main thing to remember is that the plate connection goes to the innermost end of the tickler, and the grid to the outside end of the outer coil.

Operation is started by lighting the tube and closing the key. Listen in your receiving set while you turn the antenna series condenser. If the set is oscillating —and it will be if you have connected it rightly—you will hear the wave of the transmitter as it crosses that of the receiver. If your receiver is calibrated, you can set the transmitter at any desired wave by listening on the wave you wish and tuning in the transmitter.

For phone work, either a loop or a microphone in series with the antenna may be used.

The interference caused by these sets is practically nil. The author transmits on an antenna which is directly over the receiving antenna of a B. C. L. The signals from the small set are inaudible in the B. C. L. receiver and do not interfere in any way.

As for distance which may be covered, that will vary with the power, the antenna, and the location. Using a single-wire receiving antenna 60 ft. high and 100 ft. long, and with 22½ volts on the tube, the author worked a station in the second district about 180 miles away. That does not mean that 180 miles can be expected as the range of the set, for the transmission was a freak. However, the little set will easily do local work, which, after all, is the purpose for which it is designed.

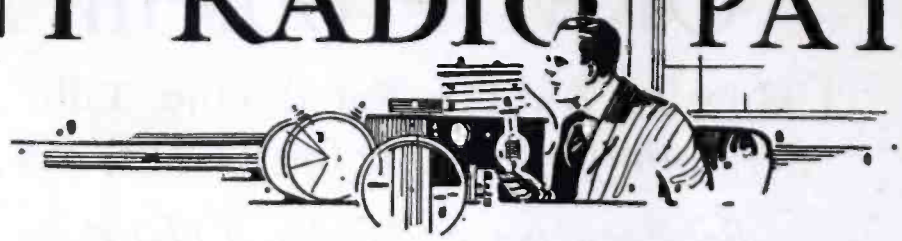
HANDY HINTS IN RADIO

In using oxide filament tubes, their filaments should be burned at as low a temperature as possible, even though it may be lower than the normal current rating as stated by the manufacturer. Tubes abused by being given too much filament current will last only a short while, and after a short period of abuse must be operated at the higher value to get them to operate at all.

A first class insulating paint for coil winding, panel finishing, etc., can be found in the pyroxlin lacquers which are attaining such popularity in auto finishing. If such substances are used, however, care should be taken to use them under conditions where they will be kept away from all fire as they are extremely inflammable.

Those of you who wish for "one knob tuners" should remember that while they may be perfectly possible, that it is impossible to get something for nothing, and if you reduce the controls of a set you are bound to lose out in something else.

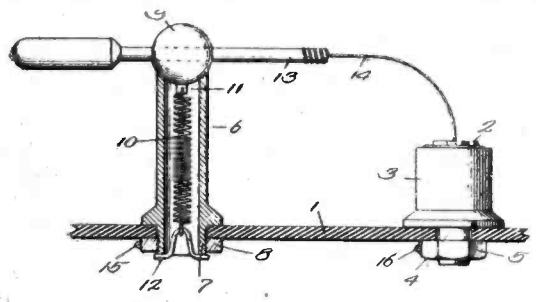
DIGEST OF RECENT RADIO PATENTS



Prepared by White, Prost & Evans, patent attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below. These patents are selected especially with reference to their possible application and use by the radio amateur.

H. G. Saal, Pat. No. 1,497,384. Radiant Energy Receiver.

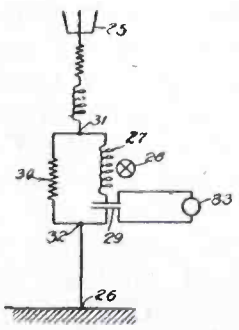
The crystal detector described in this patent is designed to provide ready and simple adjustment of the catwhisker *14*, which is fixed to a rod *13*. This rod in turn is in frictional engagement with a bore in the ball



9, so that axial adjustment may be thereby secured. The ball *9* is seated on top of the hollow post *6*, and is urged firmly into contact with its seat by the aid of spring *10*. In this manner the ball *9* may be angularly adjusted, and the rod *13* may be axially adjusted during the process of exploration.

M. I. Pupin, Pat. No. 1,494,803. Electrical Tuning.

This patent discloses a highly interesting scheme for making an absorbing circuit much more selective than by ordinary tuning methods. This is based upon the well-recognized fact that, the less the effective resistance is of the circuit, the sharper is the tuning; and Pupin proposes to render the effective resistance of a very low value for only a selected frequency. Thus, in the antenna circuit *25-31-32-26*, he purposely inserts a high

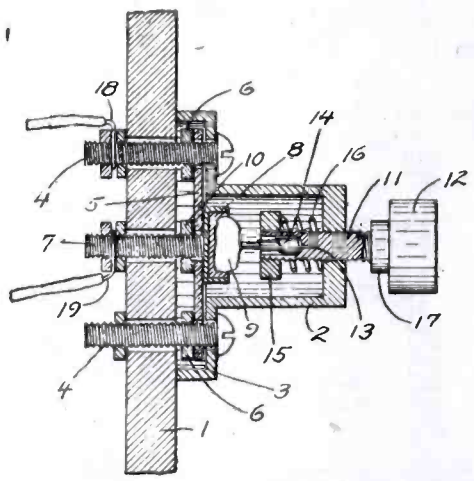


ohmic resistance *30*, whereby, if nothing further is done, the circuit is substantially ineffective for all frequencies. Shunting this resistance, however, is a circuit *27-29* including inductance *27* which may be the primary or stator of an induction motor type of dynamo-electric machine. By rotating the rotor *28* of this machine at the proper rate, the effective resistance of the entire circuit may be reduced, and this reduction exists only for a definite frequency. The translating device *33* may be in the form of phones or the like, and may be bridged across a condenser *29* that neutralizes the inductance *27*.

Not only is the tuning rendered extremely sharp by this method, but the e.m.f across condenser *29* is amplified by a very large factor—of the order of one hundred, as may be verified from theoretical considerations. The induction motor of course acts as a generator of the desired frequency, and its selectivity of course is due to the fact that such a generator, when rotated at the right speed, is ineffective to reduce the antenna resistance for frequencies differing even slightly from that which carries the desired signals.

H. H. Pickron, Pat. No. 1,485,524. Crystal Detector for Radio Instruments.

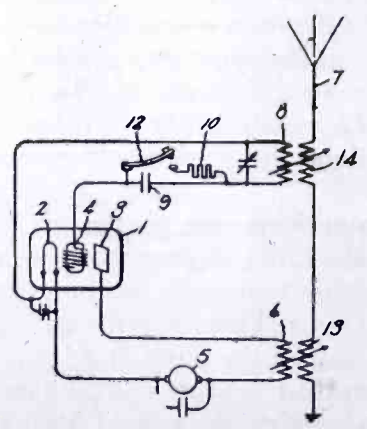
This patent describes a crystal detector that has a special form of explorer electrode



or "catwhisker" *14*. This is in the form of a telescoping spring made from a flat strip of metal, the active end being almost a complete circle. The mounting is such that the electrode may be pressed against the crystal *9* by rotating the supporting stud *11*, which is in threaded engagement with the casing *2*. Rotation also serves to scrape the crystal surface and thereby to renew the sensitivity.

W. C. White, Pat. No. 1,491,450. High Frequency Signaling System.

This patent describes a constant wave transmission system using an audion *1* having



coupled grid and plate circuits, for generating the oscillations. The plate circuit includes the coil *6* that is in the antenna circuit, and the grid circuit includes a coil *8* inductively coupled to the antenna. The grid circuit also includes the grid condenser *9* and high resistance leak *10*. Use is made of the well-known fact that, if the oscillator *1* is to be maintained in operation, an opportunity must be given for the negative charge that collects on the grid *4* to leak off. If, for example, the circuit of resistor *10* be interrupted, the tube will stop functioning, because the negative charge would accumulate. In this manner signals could be started and stopped, by simply controlling the circuit for the resistor *10*. Another way would be to provide an additional condenser *11* in the grid circuit, which may be shorted by a sending key *12*. This condenser, when not shorted, blocks the leakage of the charge from the grid *4*, through the grid circuit, and thereby paralyzes the tube until key *12* is operated. The source of oscillations is thus active only while signaling is in progress.

LETTERS TO THE EDITOR

Canada Has Quiet Hours

Sir: An erroneous statement was made in the August issue of RADIO by Mr. Laizure of Kansas City concerning quiet hours in Canada. He stated that no quiet hours were observed. I wish to say that quiet hours are compulsory and have been observed in Canada for the last year. Please correct this statement in your next issue.

Edmonton, Can. J. E. SACKER.

Screw Thread Detector

Sir: Permit me to quote an experience which may be of interest to radio fans and may stimulate investigation.

Recently, while listening on a crystal set, the crystal dropped out of the crystal holder and fell to the floor; the reception of music continued, although slightly fainter. On investigating the cause, I found the cat whiskers (of which there were five) were resting on the points of the threads of the screw in the cup of the crystal holder.

I placed the cat whiskers on various parts of the crystal holder, but detection resulted only when the whiskers were in contact with screw threads. This was done repeatedly, and the fact developed that a screw thread is a detector of radio.

This you may publish or use to stimulate investigation.

Ferry Bldg.,
San Francisco. OLIVER W. JONES.

Due to the difficulty in soldering a wire to a water pipe for ground, a better joint can be made by wrapping a strip of tin foil around a brightened circumference of the pipe and then wrapping several turns of your ground wire tightly around the tin foil. The tin foil will not oxidize and prevents both the pipe and the under side of the wire from doing so. C. L. TICE.
Yakima, Wash.

QUERIES & REPLIES ON C.W. PRACTICE

BY

Gerald M. Best

TECHNICAL ADVISOR

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25c per question should be forwarded when personal answer by mail is wanted.

Please print a simple "A" battery charger for use with alternating current. —J. W., Utica, N. Y.

A circuit diagram for a single-jar electrolytic rectifier was shown in Fig. 1, Page 36, of the August issue of RADIO.

I have drawn a sketch of an Inverse Reflex Circuit, adapted from the circuit published in an article by Paul Oard, in July RADIO. Are the connections correct? Would this circuit be an improvement for all-around reception? If three stages of audio-frequency amplification are too much, would it not be preferable to eliminate the last stage? Is there a so-called Grimes Inverse Duplex Circuit? —F. G. F., Los Angeles, Calif.

Your circuit diagram is O.K. except that three stages of audio-frequency amplification is too much with only 90-volt plate and 4½ negative grid potential. It would be better to eliminate one stage. Your circuit would have more audio-frequency amplification, but I doubt if it would receive more distant stations. The circuit is practically the duplicate of the Grimes Inverse Duplex receiver, which was described by M. B. Sleeper recently in a series of articles in RADIO.

Kindly publish the circuit diagram of the new Radiola VII-B, made by the Wireless Specialty Co.—J. C. L., Bridgeport, Conn.

This circuit is shown in schematic form in Fig. 1.

Please show how I may use a small outdoor antenna in connection with my Radiola Super-Heterodyne. An indoor antenna connected as shown by the manufacturer does not give me sufficient volume on account of the steel frame of the building I live in.—W. H. A., Seattle, Wash.

A circuit diagram for an antenna adapter is shown in Fig. 2. A good make of 180-degree coupler should be employed, with not over 10 turns in the rotor, which is placed in the antenna circuit. A 75-turn honeycomb coil makes a good load coil. Be sure to disconnect the loop antenna inside of the set before using the antenna adapter.

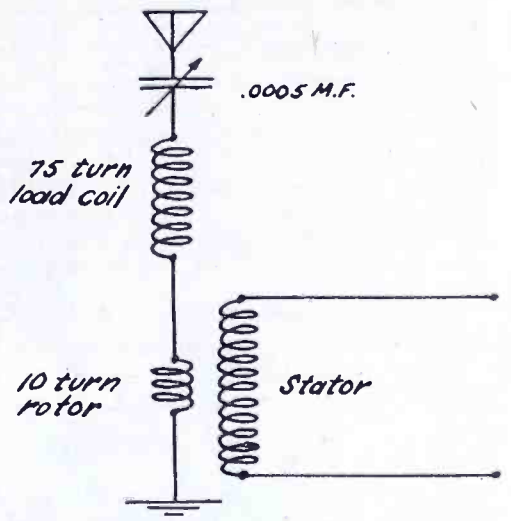


Fig. 2. Super-Heterodyne Antenna Adapter

Which is the best receiver for general reception, the Reflex Neutrodyne or the Grimes Inverse Duplex? What is the right size of loop antenna for the above receivers?—C. M. S., Jr., Steubenville, Ohio.

Both receivers are good for long distance reception. The Inverse Duplex set has fewer controls than the Neutrodyne, but uses about the same number of tubes. A loop antenna made up of 12 turns of wire wound on a frame at least 24 inches square, with wires spaced ½ in. apart, will give you good results up to perhaps 250 miles. I would not expect you to get as good reception with the loop as you will with a good antenna.

I would like to use a number of WD-11 tubes I have on hand in a Radiola Super-Heterodyne. Will any special changes be necessary in the set, besides adapters, in order for it to work properly?—F. A. A., Joliet, Ill.

The Radiola Super-Heterodyne is equipped with volume and filament rheostats designed for UV-199 tubes. The WD-11 tube draws .25 ampere per tube, and 6 tubes would consume 1½ amperes, a total entirely too great for the rheostats provided in the set. I doubt very much whether the set would function at its best with tubes other than those for which it was intended.

What is the purpose of the transformer in the base of the Western Electric 10-D loud speaker? None of their other loud speakers have such a transformer.—J. H. J., Los Angeles, Calif.

The transformer prevents a large loss of energy due to the difference in impedance between the output of the vacuum tube amplifier and the loud speaking receiver. The impedance of the average vacuum tube in the last stage of an audio-frequency amplifier is around 15,000 ohms, and that of the loud speaker is only 2000. Hence, it is necessary to provide a transformer with a primary impedance of 15,000 ohms and a secondary impedance of 2000 ohms, so that the maximum transfer of power can be obtained. Other Western Electric loud speakers are wound to a high impedance, the average being 14,000 ohms, and hence no transformer is required with them.

In tuning my honeycomb coil receiver to the long waves, what would be the best set of coils to buy, for wavelengths from 5000 to 12,500 meters?—H. C. R., Poughkeepsie, N. Y.

For an ordinary short wave antenna, the primary coil should be 500 turns, with the antenna condenser in parallel with the primary. The secondary coil should be 750 turns, and the size of the tickler will depend upon the tube, some requiring as much as 750 turns and others only 500 turns.

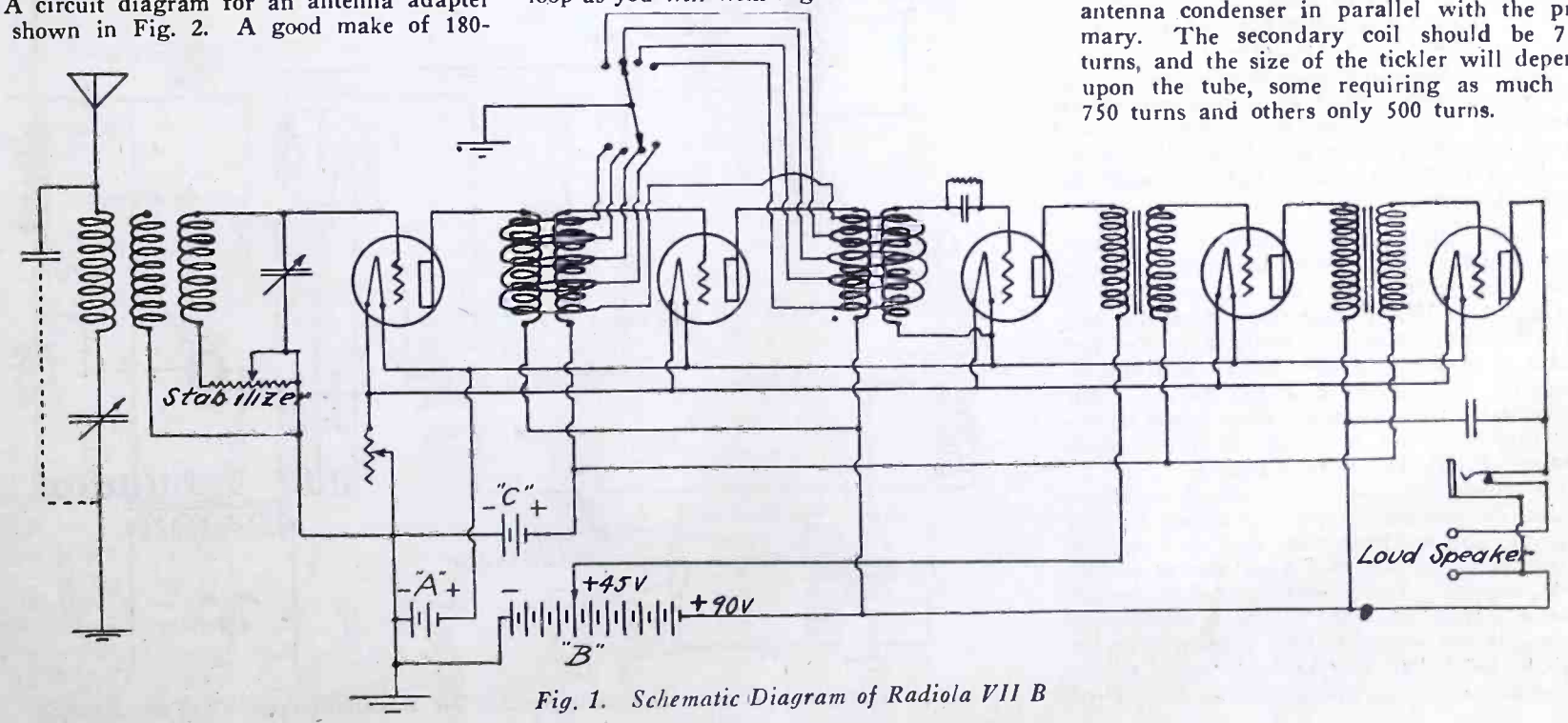


Fig. 1. Schematic Diagram of Radiola VII B

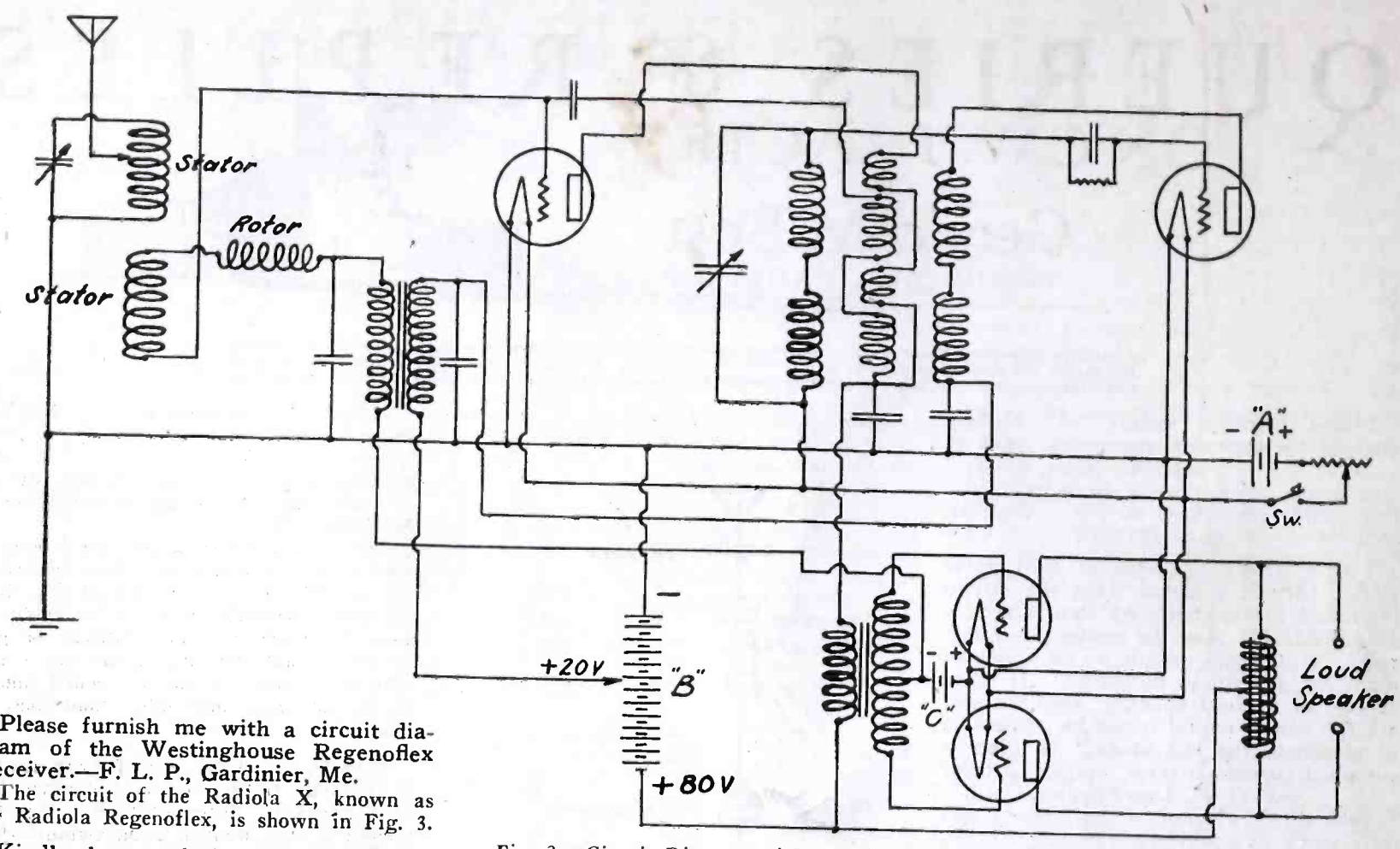


Fig. 3. Circuit Diagram of Regenoflex

Please furnish me with a circuit diagram of the Westinghouse Regenoflex Receiver.—F. L. P., Gardinier, Me.

The circuit of the Radiola X, known as the Radiola Regenoflex, is shown in Fig. 3.

Kindly show me how to install "C" batteries in my Haynes 7-tube Super-Heterodyne so it can be operated without positive grid potential.—E. C. S., Arbuckle, Calif.

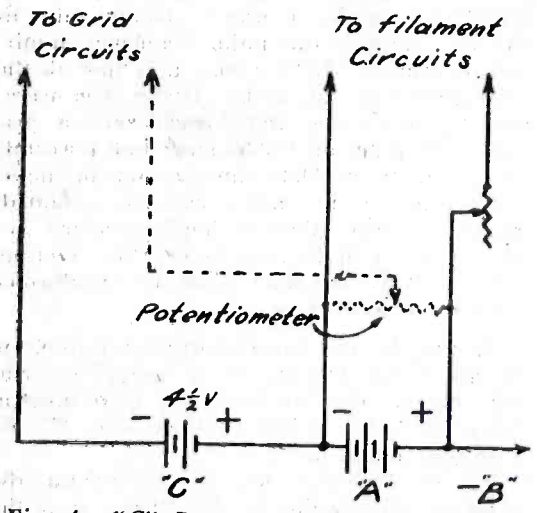


Fig. 4. "C" Battery Substitution for Potentiometer in Super-Heterodyne

Fig. 4 shows the potentiometer in dotted lines, and the method of connecting the *C* battery. The potential given depends upon your using 90 volts on the plates. If only 45 volts is used then the *C* battery should be only 1½ volts.

Please publish the circuit of a 5-watt transmitter using the Meissner circuit, and with which I can use either phone or straight C. W. Please show how the rectifier is connected. Kindly give me the data on building a 1000-watt transformer, tapped at 350, 500 and 750 volts.. Also give data for a separate step-down transformer for the filament of the 5-watt tube.—F. M. H., Brea, Calif.

A circuit diagram for a 5-watt transmitter, using the Meissner circuit, is shown in Fig. 5. You did not state what kind of a rectifier you wished to use, so I have shown an "S" tube rectifier. The proper power transformer for a 5-watt set with "S" tube rectification would be one wound to 1000 volts, with center tap at 500 volts. A core made up of silicon steel pieces 1½ in. wide and 5 in. long, piled so as to form a square window 1½ in. high, will be the right size. On this core wind 360 turns of No. 18 DCC wire for the primary. Over this winding, place 27 turns of No. 14 DCC wire for the filament secondary. A center tap should be provided at the 13½ turn. For the high voltage secondary, wind 3270 turns of No. 30 DCC or enameled wire, with a center tap at the 1635th turn. If you wish taps at 350 and 750 volts, take out leads at 1145th and 2453rd turns.

Please show a circuit diagram of the Erla 3-tube Reflex set, giving the proper value of "C" battery required.—A. S. V., Dayton, Ohio.

The Erla 3-tube Reflex circuit is shown in Fig. 6. If the plate potential is 90 volts, a 4½-volt *C* battery should be inserted in the grid circuit of the last tube. If the *A* battery is kept up to 6 volts, the drop across the filament rheostat will provide sufficient *C* voltage for the other two tubes.

Kindly publish a good circuit for a portable set. I would like to have this set work either from a loop antenna or an outdoor antenna.—R. C., Aurora, Ill.

The 3-tube Reflex circuit shown in Fig. 6 will make a good portable set, as it is the equivalent of four tubes and a crystal, in results, and does not require a great amount of apparatus. For use with a loop antenna, it will be necessary to disconnect the antenna coupler and insert the loop connections across the secondary air condenser.

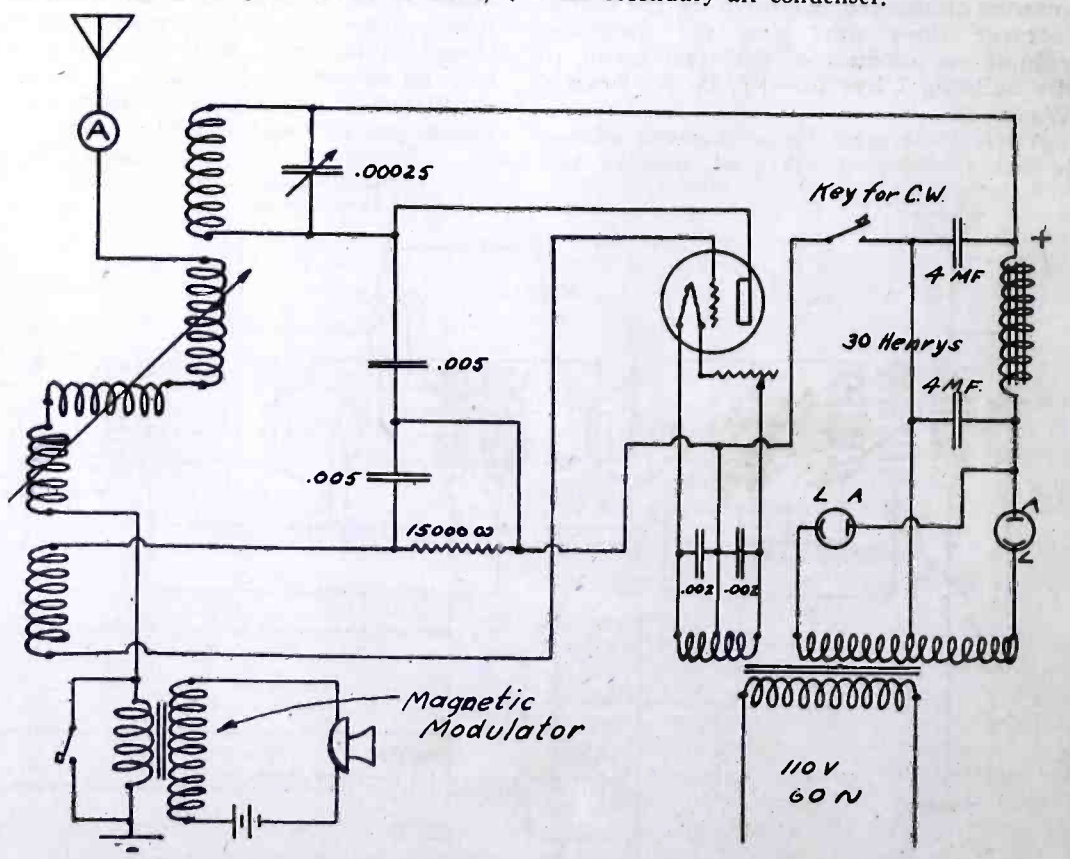


Fig. 5. Meissner Circuit Diagram for 5-Watt Transmitter with 5-Tube Rectifier

WITH THE AMATEUR OPERATORS

NEW WAVELENGTHS FOR AMATEUR TRANSMISSION

The following letter addressed to all Supervisors of Radio will bring joy to the amateur ranks:

Sirs: Effective this date, you are authorized to issue general and restricted amateur radio station licenses to permit the use of any one or all of the following bands of short wavelengths: 75 to 80 meters, 40 to 43 meters, 20 to 22 meters, 4 to 5 meters, in addition to the band 150 to 200 meters, provided application is made by the owner of the station, which station must be prepared to use the wavelength, or wavelengths, requested.

The use of continuous wave telegraphy only will be permitted on wavelengths other than 150 to 200 meters, and the antenna circuit must not be directly coupled to the transmitting circuit.

Silent hours will not be required of amateurs while using the wavelengths within the above bands below 80 meters, except where the transmitting station is so situated as to produce objectionable interference with other services.

Hereafter special amateur stations will not use wavelengths above 200 meters. They may be authorized to use the band of wavelengths from 105 to 110 meters in addition to the wavelengths within the bands authorized for general and restricted amateur use, where the special amateurs are engaged in conducting tests with government or commercial stations.

General, restricted and special amateur stations will be permitted to use the entire band of wavelengths from 150 to 200 meters employing pure C. W., spark and modulated forms of transmission.

It should be made clear to the amateurs that the authority granted above is necessarily tentative because of the rapid development taking place in radio communication and the bands of wavelengths authorized may be changed whenever in the opinion of the Secretary of Commerce such change is necessary.

Respectfully,

D. B. CARSON,
Commissioner.

Approved:
J. WALTER DRAKE,
Assistant Secretary of Commerce.

1BOM, D. L. DARLING, Greenfield, Mass.

Aerial—6-wire cone, 35 ft. long, of 7½ to 3 ft. diameter; supported by 75-ft. tree and 60-ft. pole; 60-ft. lead-in of 9-in. diameter.

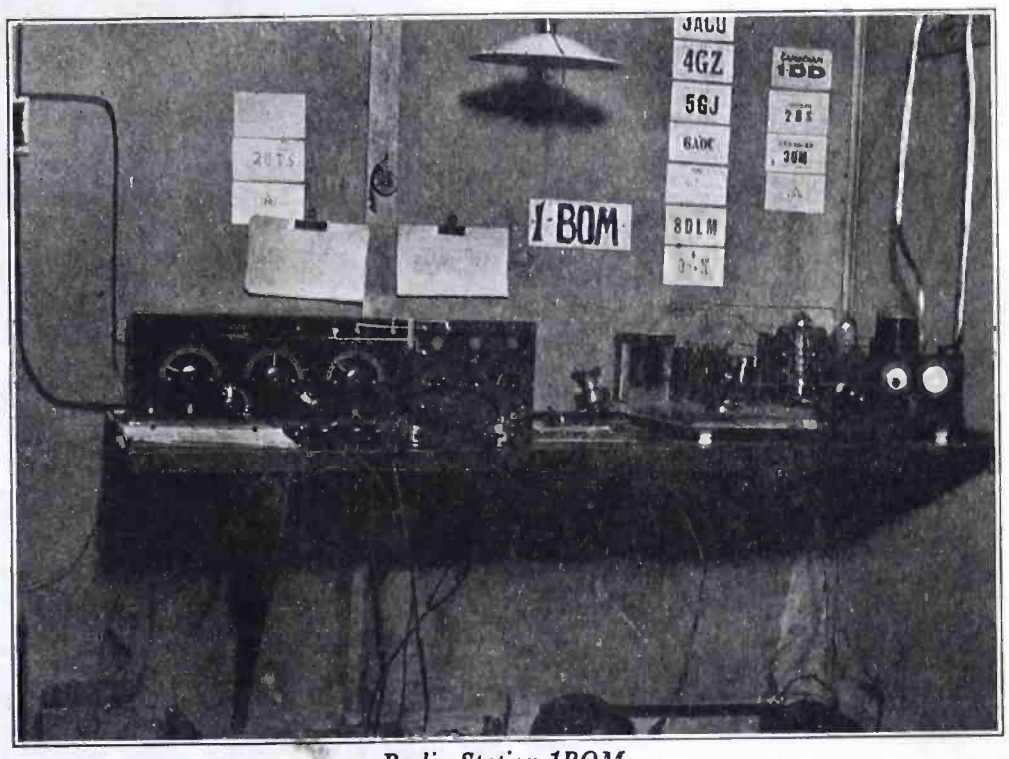
Counterpoise—Composed of 8 wires, each 65 ft. long, suspended directly under the aerial and 8 ft. above the ground.

Insulation—14 Electrose insulators 10½ in. (because unable to get Ohio brass). Both lead-ins enter shack as half-inch copper tubes through quarter-inch plate glass and run directly (without touching anything) to the set.

Transmitter—Usually two 5-watt tubes are used. (Two 50-watt tubes have been tried, but the voltage was insufficient to operate satisfactorily.) Hartley circuit is used, which, with the two 5-watt tubes, puts 2.4 amps. in the antenna at 175 meters. 700-v. C.R. a.c. filtered through 4 mfd. and double 1½ Hy. choke supply the plates, giving about 85% d.c. reports.

Receiver—Zenith receiver used last winter until "Q.S.T." published a description of "low-loss tuners." This proved more efficient, going lower in wavelength, ranging 90 to 230 m. W. E. and Baldy's phones, with two-step A. F. amplifier. Separate receiving aerial, with break-in system. Only one 50-watt tube was ever used at once, as power was low.

Transmitting—During winter of 1923-24, 1BOM has been reported from 44 states (every American district), 4 Canadian districts, and Porto Rico. A distance of 2600 miles worked. 11 west coast reports were received during March. Am usually on between 3 and 7 A.M., which may explain absence of European reports. Visitors and suggestions are most welcome. Cards are highly appreciated and I have tried to Q.S.L. same. Reports of 1BOM have also been received from England and New Zealand.



Radio Station 1BOM

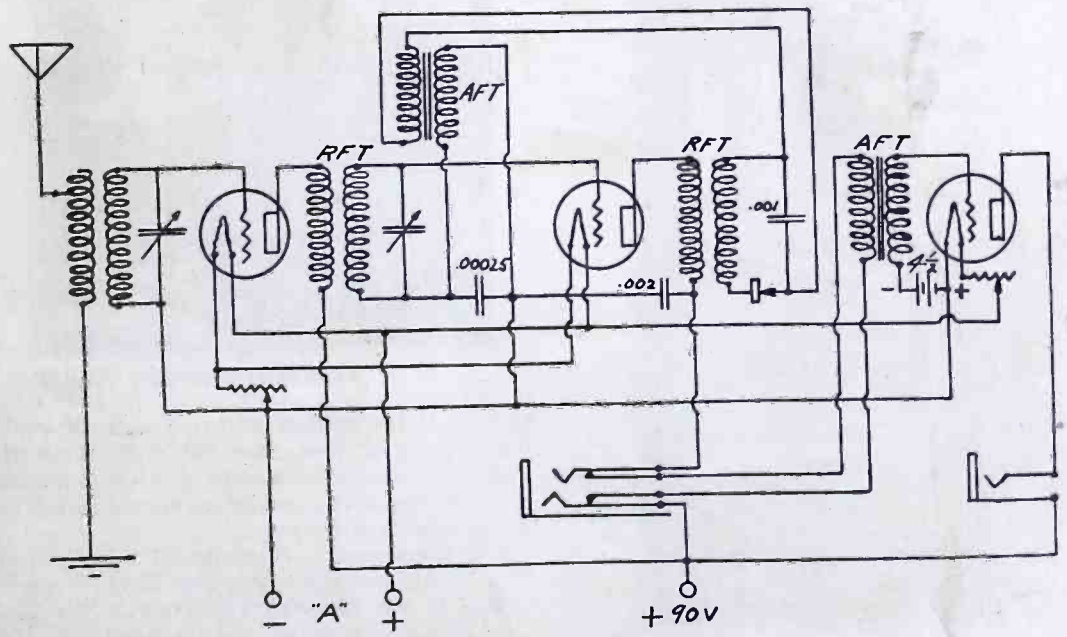


Fig. 6. Erla Three-Tube Reflex

NEWS OF THE AMATEURS

Probably more amateur stations have been operating this summer than during any previous summer in history. The use of shorter waves and more efficient receivers has enabled many of the amateurs to do consistent work in spite of the severe static. Even trans-continental and trans-oceanic work has been carried on. CB8, an amateur station in Argentine, succeeded in communicating with New Zealand, thus establishing a new world's record for amateur work.

Amateur interest in the foreign countries is growing with leaps and bounds. New stations are springing up in both European and the South American countries. It will not be long before the amateurs of this country will be able to communicate regularly with fellow amateurs of the most distant lands.

7AEB of ALASKA works on schedule with 7NO of Aberdeen, Wash. A goodly number of messages have been exchanged between Alaska and the States.

7PZ and 7RY are two of the most consistent stations in the state of Washington.

7AGF, F. W. Prince of Troy, Mont., has established a record for consistency. He hasn't missed a night on the air for two years.

7KV of Ilwaco, Wash., is erecting a new 75-ft. mast and hopes to establish some new records this winter.

7DM now has a 150-watt transmitter in operation. He uses storage *B* batteries for plate supply. This gives a pure d.c. note that carries extremely well.

Call 6KB has been assigned to L. E. Martin, 100 Olive Ave., Fresno, Calif.

Oregon has a few reliable amateur stations. Among those heard most often are 7ABY, 7MF, 7AJQ, 7ALD and 7JU.

The call letters 7SI have been issued to Miss Harriet Elsworth of Boise, Idaho. She is one of the few young ladies west of the Rocky Mountains to secure an amateur license.

7LN, L. Martin of Nampa, Idaho, has lowered his wave to 170 meters and finds that he can work much farther than he could on a wave of 200 meters.

Call 6BBV has been assigned to Jack Barsby, 518 W. 50th St., Los Angeles, Calif.

Call 3UQ has been assigned to Albert Kump, 31 W. Commerce St., Bridgeton, N. J. All cards appreciated and QSLed.

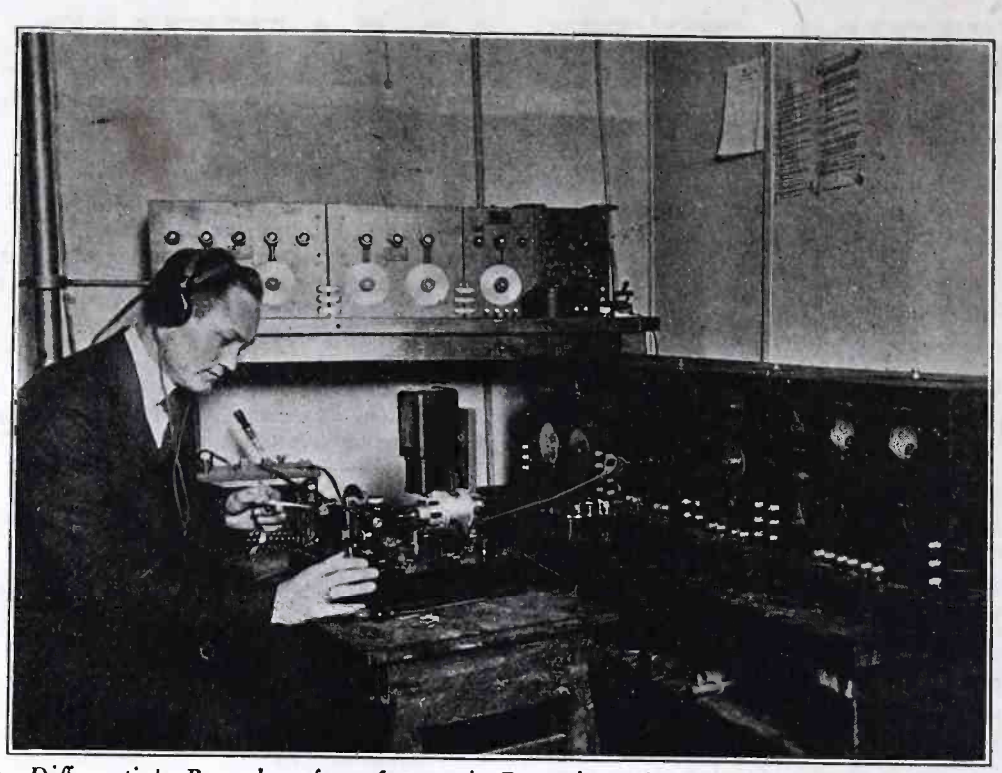
Station 6ATN has received verification of the reception of F. D. Bell, New Zealand, 4AA, on March 18, 1924, on a Grebe CR-3 and one step of audio-frequency. 6ATN has been reported by J. H. Worthington, Auckland, New Zealand, Roy Buclz, Kodiak, Alaska, and seven districts. Power: Two 5-watters and 400-v. d.c. from a battery dynamotor. Would appreciate report of anyone having verification of hearing a New Zealand station prior to March 18, 1924.

6ZD, Allen H. Babcock, has returned to San Francisco from the first Inter-American Conference at Mexico City, where he was the only American delegate to remain during the entire conference, as Ambassador Warren and Representative White were compelled to return to the United States before the deliberations were concluded. Because the agreements signed by the representatives of the other countries provided for the formation of a union to promote government ownership of communication facilities and to unduly regulate private systems, Mr. Babcock has recommended to Secretary Hughes that the United States should not sign the agreements, as they are in conflict with our national policies for the encouragement of private initiative. Mr. Babcock believes that one result of this conference will be to bring the government departments into closer relations with the amateur, whose activities are to be greatly encouraged.

9BAB, Carl Teten, 3931 4th Street, Des Moines, Iowa, will answer all QSL's.

7NX has been re-assigned to Arthur Chapelle, Woodburn, Oregon. Any one hearing his 10-watt battery plate-supply transmitteer please QSL. All cards answered.

5ANE has been issued to W. W. Merkle, 804 Parkman Ave., Selma, Ala. QSL wanted on his 10-watt C. W.



New Differential Recorder for Automatic Reception of Morse or Printing Telegraph Messages, As Devised by A. Hoyt Taylor, U. S. Navy Physicist

—Henry Miller News Picture Service, Inc.

RADIO STATION 9VK

Radio Station 9VK is owned and operated by F. H. Lester, 1155 Wisconsin Ave., Oak Park, Ill., and is devoted exclusively to experimental work.

The transmitter consists of four 50-watt tubes in "Sure Fire Ckt." somewhat modified, radiating 10 amperes on C. W., I. C. W., and fone 3 amperes. The entire set is panel-mounted with the exception of the plate transformer and the rectifier jars. The meters on the panel are filament voltmeter 0-15-v. a.c., plate voltmeter 0-2000-v. d.c., milliammeter 0-1000 milliamperes, and thermocouple ammeter 0-15 a. The switches on the panel are to change from low to high power.

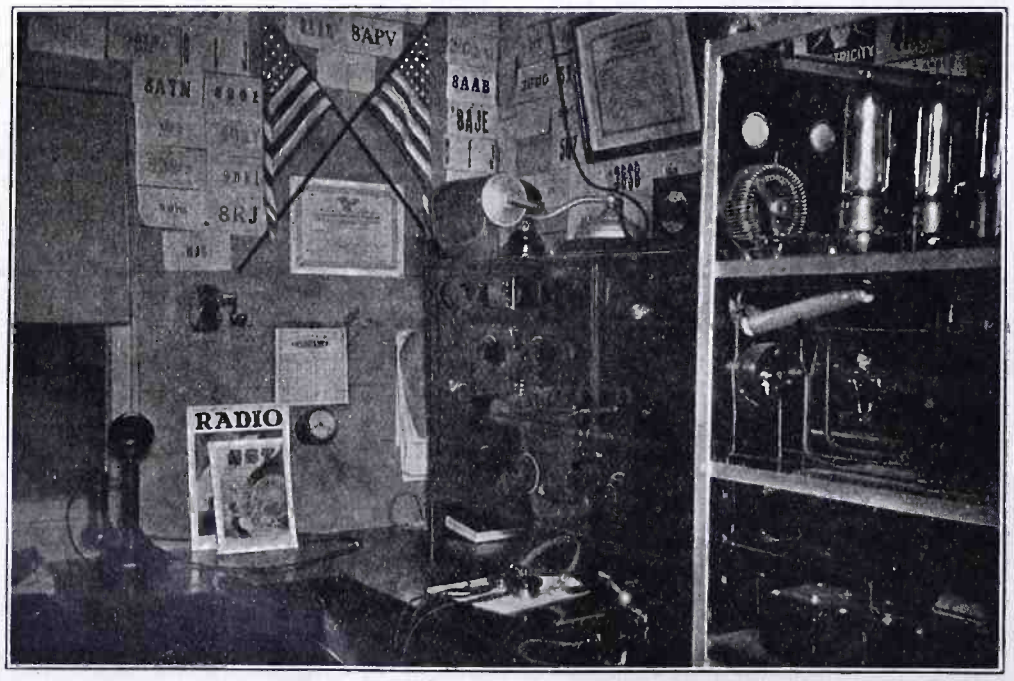
The plate voltage is rectified a.c. The rectifier consists of 48 jars, especially constructed for this purpose, filtered through a filter designed and built by the owner.

The receiving sets consist of a short wave set 95-200 meters, a three-circuit tuner, and a "honeycomb coil" set, and a two-stage amplifier which can be used on any of the sets. Western Electric and Brandes fones and Magnavox complete the receiving equipment.

The antenna is a four-wire, flat top, 70 ft. long by 50 ft. high, "T" type with fanned lead-in. The counterpoise is 60 ft. long by 30 ft. wide by 10 ft. high, fanned. There is some 1500 ft. of No. 14 solid copper wire in the counterpoise, which is constructed in screen fashion and connected directly to the transmitter, no grounds being used except for the receiving sets. Porcelain bar insulators are used exclusively.

The entire station has been designed and built by the operator. The short time the set has been in operation the signals have been reported in every district in the United States, Hawaii, Canada, WNP, and at sea. The operator is a member of the A. R. R. L. and also the A. R. R. L. Oak Park correspondent.

It would be appreciated very much to hear from all stations hearing 9VK's C. W., I.C.W. and fone signal. All correspondence will be answered.

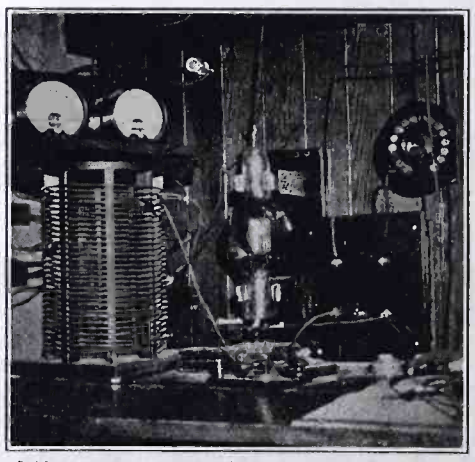


Radio Station 9VK

RADIO 8UF-8XBH

By F. Buck

8UF-8XBH is located at Clarkson College of Technology, Potsdam, New York. The antenna consists of a vertical cone 6-wire cage 5 ft. in diameter at the top and tapering



250-Watt Transmitter at 8UF-8XBH

to 6 in. at the bottom, with a 4-in. cage lead-in. The stick that does her stuff is 50 ft. high and stands on top of a 25-ft. support, so that this here scandal slinger resides 75 ft. up into God's clean air.

The counterpoise is composed of 11 wires 50 ft. long and directly under the bird cage.

The lil ole 250-watter you see in the picture shoves 4.5 amps. up the stack on 110 meters (8XBH) and 14 amps. on 180 meters

(8UF). The circuit is Hartley all the way from the antenna to the counterpoise. The plate supply is obtained from a line transformer which delivers 3000 a.c.; the plate current at this voltage is .25 amps. The plate and antenna meters may be seen above the inductance and the filament transformer to the right of the tube with the power rheostat on the wall above.

The receivers are a Westinghouse RC, two three-circuit tuners and a low loss tuner. With this tuner and one step, F8AB has been heard 20 ft. from a loud speaker. To the right of the two three-circuit tuners is a 50-watter in the IDH circuit. The plate voltage is furnished by an 800-volt M. G. and well filtered. The antenna current is 4 amps. on 150 meters. This set is used for short distance ham work, and also to broadcast the college basketball games.

A wave meter and a spare 250-watter complete the equipment. 8UF-8XBH has worked every district as well as France and England, F8AB and G2KF having been worked the most.

THE SIX-HUNDRED GETS IT IN THE NECK

By L. W. HATRY

Half a switch, half a switch
Half a switch retarded
From my four tubes
  The rampant six-hundred.

Over the light blockade,
Plumb through six lamps turned red
Blowed out six fuses fast
  Did the six-hundred.

"Forward! Be not dismayed,
Copper won't melt," I said;
I closed the switch and knew,
  Someone had blundered.
Four tubes made no reply
Theirs not to reason why
Theirs but to do or fry
As through all obstacles
  Came the six-hundred.

Chokes to the right of them
Chokes to the left of them
Chokes in front of them
  Chattered and hummed;
Warmed up as hot as hell
Boldly they glowed and well,
Did the four tubes, as volts,
And much amps as well
  Charged by six-hundred;

Flashed all the wires bare
Insulation burned in air
Gassing the fambly, where
They stood awestricken, while
  I stood and wondered;
Plunged in the battery smoke,
Right through my newest choke,
Spark gap and safety fuse,
Unfazed by plate like coke,
  Shattered and sundered;
Sparkled on as ever was,
  The lively six-hundred.

Sparks to the right of them
Sparks to the left of them
Sparks right inside of them
  Volley'd and thundre'd:
Warmer than hot as hell,
While clips and wire fell,
Th' transformer had gone as well,
Came through the jaws of death
The four tubes, clear as a bell,
Though not much was left of it,
  Left of the six-hundred.

I'll use a rusty spade
Bury the transformer I made,
  When all the gang wondered;
I couldn't do it right
And use the city's light
  To furnish six-hundred.

CALLS HEARD

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

By 5KC, V. Rosso, Plaquemine, La.

(4dx), 4fs, 4kl, 5es, 5fm, 5in, 5ka, 5mo, 5nw, (5oq), 5qh, 5qk, 5ro, 5sk, 5vo, 5xv, 5aam, 5aen, 5agl, 5aiy, 5ajh, 5amo, 5aom, 5xab, 6cgw, 8cy, 8fj, 8azh, 8dal, 9le, 9qw, 9xl, 9zt, 9acq, 9alb, 9amb, 9ayx, 9bkk, 9ccw, 9cip, 9dcr, 9dou, 9dpx, 9dwx, 9eht. Mexican: 1f, bx.

By 6ANY-6AOF, Box 98, Hilo, Hawaii, T. H.

4jj, 5cn, 5ga, 5gg, 6as, 6aak, 6aao, 6adt, 6afa, 6afm, 6agk, 6aic, 6ajf, 6akq, 6akw, 6alg, 6alu, 6alv, 6atf, 6atk, 6avj, 6awt, 6bw, 6bdb, 6bfw, 6bqa, 6bou, 6bvg, 6bwl, 6cbb, 6cbe, 6cdg, 6cdp, 6ce, 6cde, 6cgs, 6cgw, 6chx, 6cmi, 6cqe, 6cto, 6cul, 6gt, 6gu, 6ko, 6kw, 6li, 6mg, 6ne, 6nb, 6nk, 6nr, 6rn, 6ti, 6wp, 6zp, 7de, 7iw, 7akh, 7mf. Would appreciate reports on mi sigs. All correspondence ans'd. Qtc fer Hawaii should be routed via 6agk. Hawaiian quiet hour 9:00 p.m. to 11:30 p.m. pst.

By 7ALI, James Wallace, Mt. Vernon, Wash.

1bbo, 5ns, 5aaq, 5lr, 5qy, 6adb, 6agk, 6alc, (6alw), 6amm, 6atn, 6avj, 6avm, 6awt, 6bbh, 6bcp, 6bdt, (6bls), 6bwl, 6ccb, 6cek, (6cgl), 6cgw, 6chl, 6cjj, 6cka, 6cqo, 6crr, (6crs), 6gu, (6li qra?), 6nk, 6pl, 6pu, (6rf), 6rm, 6ry, 6ti, (6ub), (6xad), 6zco, (7aeb), 7mn, 8cwu, 8zwp, 9amb, 9caa, 9cil, 9ckd, 9cpu, 9dnh, 9dpx, 9mc, 9mf, 9zt,

Can.: 4av, 4br. Fone—6ry. 5-Watts CRAC-CW hr pse QSL if u hr me. Cards to above on request es gld to hr fm them.

By 6ALV, Alameda, Calif.

1xam, 3ccu, 4oh, 4yy, c4ab, c4dq, 5dw, 5lr, 5me, 5rg, 5ov, 5ajj, 5xt, 5xat, 5amo, 6ceu, 8er, 8tj, 8pl, 9mc, 9ql, 9aap, 9aau, 9abc, 9adp, 9ahz, 9aim, 9bdf, 9bkf, 9boz, (9caa), 9cju, 9cwj, 9cxp, 9dlm, 9dpr, 9drw, 9dte, 9dww, 9dwn, 9eae, 9eky, 9cjy. All hrd on detector and low loss Haynes DX receiver.

At 3APV, B. J. Kroger, 205 Taylor St., Chevy Chase, Md.

6aao, 6aaq, 6aay, 6abk, 6acm, 6adt, 6afa, 6afq, 6age, 6agk, 6ahc, 6ahp, 6ahu, 6ajf, 6ajh, 6ajj, 6ajp, 6ajt, 6ak, 6akw, 6akz, 6alk, 6alo, 6ame, 6ams, 6amw, 6aoi, 6aos, 6aou, 6ape, 6arb, 6arf, 6asb, 6aso, 6asr, 6aur, 6auu, 6ava, 6avr, 6avv, 6awq, 6awt, 6bbc, 6bbu, (6bbw), 6bcl, 6bcp, 6bcs, 6bdi, 6beo, 6bfg, 6bh, 6bic, 6bih, 6bjc, 6bjj, 6bjq, 6bjx, 6bjy, 6bkl, 6blw, 6bm, 6bmx, 6bnc, 6bnt, 6bnu, 6bpz, 6bqb, 6bqe, 6bql, 6bra, 6brf, 6brk, 6bru, 6bsg, (6bui), 6bum, 6buo, 6bur, 6buw, 6buy, 6bva, 6bve, 6bvg, 6bvr, 6bwe, 6bwz, 6cbb, 6cbd, 6cbg, 6cbi, 6cbu, 6cbw, 6cc, 6cco, 6ccy, 6cdg, 6cdn, 6cek, 6cfi, 6cfm, 6cfy, 6cfz, 6cgd, 6cgg, (6cgw), 6chc, 6chu, 6chv, 6cix, 6cjb, 6cjc, 6ckp, 6ckr, 6ckw, 6clr, 6cmr, 6cmt, 6cng, 6cnh, 6cnl, 6cse, 6cte, 6cu, 6ea, 6eb, 6en, 6fh, 6fp, 6gh, 6gr, 6gt, 6ja, 6js, 6ka, 6km, 6li, 6lu, 6lv, 6mg, 6mh, 6nb, 6nx, 6of, 6pe, 6pl, 6rm, 6rv, 6tc, 6tu, 6tv, 6vd, 6wt, 6xh, 6xp, 6xs, 6zag, 6zah, 6zar, 6zau, 6zba, 6zbk, 6zbl, 6zg, 6zh, (6zp), 6zw, 6zz, 7abb, 7aby, 7adg, 7adq, 7adr, 7aea, 7af, 7afe, 7afn, 7agr, 7agv, 7agx, 7ahi, 7ahv, 7aif, 7aim, 7aiy, 7ajd, 7ajt, 7ald, 7alk, (7bj), 7co, 7dc, 7du, 7fd, 7fq, 7fs, 7go, 7gq, 7gr, 7hg, 7if, 7ih, 7io, 7ip, 7it, 7iy, 7ks, 7kv, 7lr, 7lu, 7ly, 7mp, 7mx, 7nt, 7ot, 7qd, 7qc, 7qj, 7sc, 7sf, 7sh, 7to, 7tq, 7uk, 7we, 7wm, 7wp, 7xae, 7xba, 7ya, 7yl, 7zd, 7zu, 7zv, 7zx.

By 2WZ, 654 East 23 Street, Brooklyn, N. Y.

C. W. — (1ah), (1cg), (1ci), (1da), 1db, (1de), (1es), 1gb, 1gv, 1ka, (1my), (1oa), 1ow, (1pa), 1pl, 1py, 1qr, 1rb, (1rh), 1vk, 1xw, 1ul, 1um, (1zd), (1zg), (1zp), (1zt), (1zw), (1zz), 1aac, (1aal), (1abf), (1abs), 1aea, (1aeg), (1aei), (1aeo), (1aft), (1agt), (1aid), (1ajo), 1akz, 1amw, (1anh), (1anx), (1are), (1arf), (1aur), 1avj, 1avl, 1awl, (1awy), (1axa), (1aye), 1azr, (1bbe), 1bbo, (1bcc), (1bcu), (1bdx), (1bgt), (1bip), 1bjg, (1bjo), (1bkk), (1blb), 1blx, (1boa), 1bpp, 1bpz, 1bqk, 1bqi, (1bvb), (1bvl), 1bvv, (1bwd), 1bwj, (1bzc), (1bzp), (1cak), 1cba, (1ccx), 1ccz, (1cjc), 1cjd, 1cjg, (1cjm), 1cjq, (1ckk), 1cmp, (1cmx), (1cpc), 1cpf, 1cpo, 1cqk, (1ctw), 1cue, (1xax), (2bm), 3av, (3bm), 3bq, (3bz), (3dk), 3ek, 3fr, (3gc), 3hj, 3hs, 3mb, 3me, (3mf), (3mo), (3oe), 3oq, 3ph, (3qj), 3tp, 3ts, 3uq, 3xx, 3zg, 3zm, (3zs), 3abj, 3abw, 3acq, 3acr, (3adp), 3afs, 3aha, 3ahp, (3aoj), 3api, (3apv), (3auv), 3bdo, 3bdr, (3bmn), (3bno), 3bnu, 3boa, (3bof), (3bqp), 3bsb, 3btu, (3buy), 3bva, (3bvu), 3bwt, (3cbx), (3cdk), (3cdn), 3cgs, (3chc), (3cjn), (3ckh), 3cvc, 3xan, (4af), 4ai, 4bx, 4dx, 4dy, 4ea, 4el, (4fs), (4ft), 4it, 4jk, 4jr, (4js), 4kl, 4pk, 4pv, 4rr, 4sy, 4tn, 4ut, 4un, 4xg, 5ad, (5bj), 5in, 5ns, 5oq, 5pr, 5qk, 5uk, 5wo, 5aiy, 5akn, 5amh, 5apc, 5xaw, 6cgw, 6cqe, 8bf, 8bg, 8bq, 8bt, 8ci, 8ef, 8ej, 8fj, 8fm, 8fu, 8gp, 8gz, (8jq), (8ku), 8mc, (8rh), 8rj, (8sr), (8vq), 8xs, (8zw), (8aaj), 8aer, 8aes, (8ago), 8aig, (8aii), (8aip), (8ajn), 8ald, 8amd, 8apw, 8apy, (8avd), 8avl, (8aws), (8axd), (8ayb), 8bfe, (8bir), 8bit, (8bkh), (8bkm), (8blp), (8bnh), 8bos, 8bow, 8boy, (8bpl), 8brc, 8brg, 8bvd, (8bvr), (8byk), (8byq), (8cdc), 8cdx, 8cei, 8chp, 8chr, 8chv, 8cip, 8ckm, 8cmh, (8cmu), (8con), 8cnw, (8cwp), (8cwr), (8cyi), (8dae), (8dbl), (8dbs), 8dec, 8dem, 8dfm, 8dgo, 8dgv, (8dha), 8dhd, 8dim, (8dki), 8dme, (8dmt qra?), (8dnf), 8doe, (8dsc), (8dsn), 8dtc, 9ck, 9gp, (9gs), 9hw, 9kd, 9mf, 9pq, 9ta, (9uc), (9zt), (9aau), 9abt, 9ado, 9afi, 9afz, 9alb, 9amb, (9auc), 9aud, 9azx, (9baz), (9bcb), (9bed), 9bpd, (9bvn), (9bwf), 9bye, 9byj, 9caa, 9cco, (9ccw), 9cee, 9cfi, 9cfk, 9cfs, 9cfv, (9cgr), (9cho), 9cip, 9ckr, 9cmr, 9csa, 9csg, (9ctf), (9cvf), (9cxx), 9cze, 9czl, 9dbm, 9dct, 9dfz, 9dga, 9dhz, (9djz), 9dln, 9dma, 9dmj, 9dms, 9dpx, (9dqu), 9drc, 9dsa, (9dsl), 9dsz, 9dtk, 9dtt, 9dvw, 9ebh, (9efz), 9elb, (9eld), (9eli), 9xbb, nfk, (kftu).

I. C. W.—(1ck), 1kv, (1xu), (1anx), 1bbo, (1bpz), 3hd, (3gc), 3lg, 3zo, (3cdk), 5wo, (8ku), 8aer, 9arf, (nrg), vdm.

Fone—(1alj), 4dx, 8brc.

Spark—1aeh, 4fg, 5fv.

Canada C. W.—(1ar), (1bo qra?), 1bq, 1dd, 1dj, 1eb, 1ef, (1ei), 1aar, 2be, 2cg, 2fo, 3bq, 3fc, 3gg, (3he), 3ia, (3kg), 3kq, 3ly, 3ms, 3ni, (3oh), 3uj, (3vh), (3yh), 3ze, 3aec, 4cn, 4cr, 4hh, 5cp, 5gu, 9al, 9bc, 9hc.

Please qrk 2wz 50 watts. Will qsl to any who ask.

At 7AIX, by Sam Spittle, Astoria, Ore.

C. W.—5ux, 6abo, 6aga, 6agk, 6akz, 6alf, 6alg, 6amo, 6asv, 6awt, 6bcf, 6bcl, 6bcp, 6bea, 6bff, 6bgh, 6bjx, 6bmu, 6bgr, 6cej, 6cfz, 6cgw, 6che, 6cjj, 6cmi, 6cmu, 6cng, 6ji, 6jj, (6jp), 6oh, 6pl, 6xad, 7ahs, 7pj, 7ob, 7sl, 8dct, 8xs, 9agl, 9amb, 9auu, 9ayo, 9bis, 9bmu, 9bqy, 9cee, 9cii, 9cnt, 9dct, 9dug, 9eld, 9ss, waf.

Spark—7jm, fone (7akk), 7qc, kdka, Can. 4bu, 4dq, 4gt, 4hf, 4hh, (5an), 5bf, 5bj, 5gf, (5gg), (5go), (5hh).

Pse qsl if you hr my 5 watter. Will qsl on any of above.

By 8RY, Sullivan, Ohio, during July, 1924

1ci, 1ka, 1my, 1qr, 1abs, 1afc, 1alj, 1any, 1aos, 1are, 1arf, 1aur, 1axa, 1aww, 1bdx, 1bes, 1bie, 1bjg, 1blb, 1boa, 1bvr, 1bvv, 1bwj, 1bzp, 1cmx, 1ccz, 1cjm, 2bm, 2ev, 2pd, 2mo, 2mu, 2rb, 2sy, 2wz, 2auf, 2bqq, 2bsc, 2cac, 2chg, 2cvu, 2cyq, 3av, 3bm, 3du, 3fr, 3hs, 3mf, 3oe, 3pq, 3qj, 3qt, 3aap, 3acr, 3aoj, 3api, 3apv, 3vh, 3cdk, 3auv, 3auw, 3bay, 3bva, 3cbx, 3chh, 8cjn, 4dv, 4eq, 4fg, 4ft, 4js, 4lj, 4si, 4sy, 4tj, 5gp, 5in, 5ka, 5qh, 5ua, 5uk, 5wi, 5wk, 5aiu, 5ajh, 5amh, 5apc, 6lv, 6bcl, 6cgw, 9pq, 9tg, 9em, 9ado, 9agl, 9ahv, 9aks, 9alx, 9aub, 9aud, 9bcx, 9beb, 9bew, 9bkq, 9bmk, 9bnu, 9bwf, 9ccw, 9cpu, 9cuh, 9dhs, 9drr, 9eka, 9ela, 9eld, 9eli.

Special—1xu, 1xae, 1xak, 1xay, 2xab, 2xi, 3zm, 4xi, 4xz, 5xab, 5xaw, 5zas, 8xaq, 8xbp, 9xbb, 9xbd, ak5, nkf, whu.

Canadian — C1ar, C1bq, C1ef, C2be, C2cg, C3bd, C3bi, C3co, C3fc, C3gg, C3gk, C3kg, C3ly, C3ml, C3ni, C3ph, C3sp, C9al, C9bc, C9bg, vdm. West coast pse note tt 8RY is wkg pure DC note on 155 meters with Four Coil Meissner. QRV between 0630-0930 GMT.

By 5ANE, Walter W. Merkle, 804 Parkman Ave., Selma, Ala.

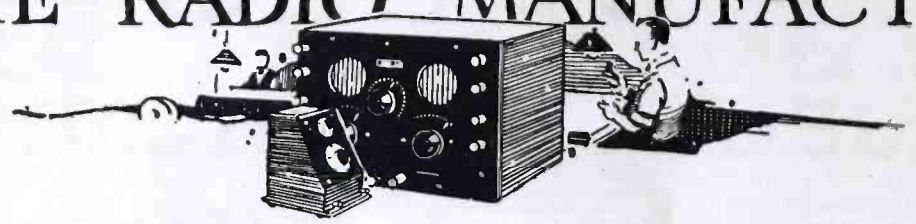
1ccz, 1bdx, 1ajp, 1gv, 2ayp, 2cee, 2crq, 2kx, 2nz, 3sh, 3oe, 3dop, 3zo, 3cd, 3be, 3bha, 3abw, 3bmn, 3anj, 3lg, 3mo, 3bua, 3oh, 3aow, 3cdk, 3er; 4's and 5's too numerous; 8bh, 8wy, 8bp, 8aip, 8vq, 8bkh, 8dec, 8dpp, 8kc, 8aap, 8bvr, 8apw, 8cpk, 8bks, 8dd, 8zz, 8cmc, 8brc, 8wa, 8bmt, 8avx, 8doe, 8bit, 8rj, 8dem, 8dhe, 8dwt, 8cy, 8bv, 9brc, 9chg, 9eld, 9cud, 9cco, 9cvs, 9dbf, 9brp, 9bvq, 9cdo, 9bkk, 9auc, 9acq, 9bkn, 9ako, 9cfi, 9dkk, 9bit, 9rd, 9um, 9ada, 9ao.

All crds from above answered. Hv u hrd mi 10 watt ACCW? QSL pse.

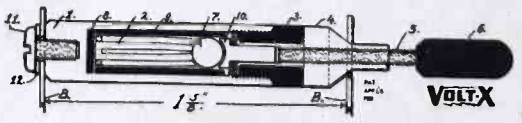
By 6CLP, Box 64, Empire, Calif.

1abf, 1nr, 1xae, 1xz, 2xi, 3xi, 5ail, 5ajh, 5amo, 5dw, 5in, 5js, 5ql, 5qr, 5vo, 6bnf, 6cjb (fone), 6crs, 6cjy, 6adh, (7abb), 7agf, (7agz), (7av), 7eo, 7fc, (7fs), (7gr), (7gv), (7jp), 7lg, (7ls), (7mf), 7mx, 7td, (7no), 7ox, 7wp, (7zw), 8brc, 8cei, 8daa, 8er, 8fm, 8ug, 8xbp, 8xe, 8yn, 8yv, 9aci, 9aed, 9aem, 9aii, 9aim, 9amb, 9ami, 9apz, 9azr, 9bdq, 9bkf, 9bob, 9bri, 9bsp, 9bw, 9caa, 9cai, 9caj, 9cbf, 9cee, 9cjm, 9cjt, 9cju, 9ckj, 9ctr, 9dem, 9dhy, 9dqu, 9dvw, 9dwk, 9dxq, 9dxy, 9ebh, 9edc, 9eld, 9eli, 9xax, 9sb, 9ss, 9su, 9yy, 9zt. Can.—3aa, 3bk, 3cr, 4aw, 4bk, 4dq, 4fz, 4gt, 5ct. Porto Rico—4je. All crds answered. Pse QSL my 5 watts.

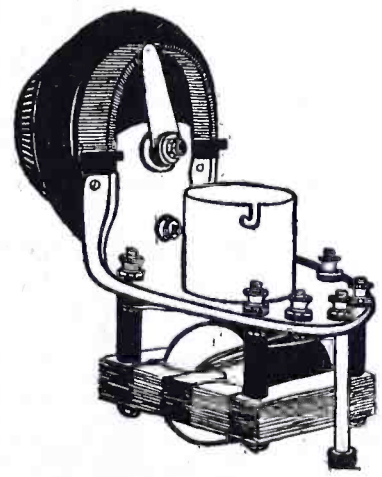
FROM THE RADIO MANUFACTURERS



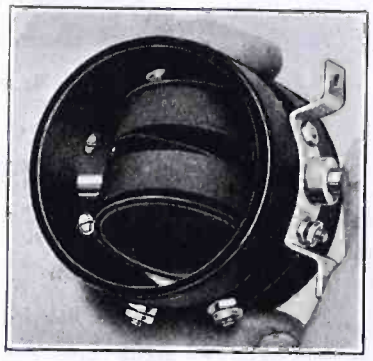
Filkostat compression type rheostats are now provided with a small nickel-plated switch whereby the *A* battery may be turned on or off without disturbing the adjustment of the resistance. This switch is attached to the regular Filkostat mounting screws on the front of the panel and requires no extra holes.



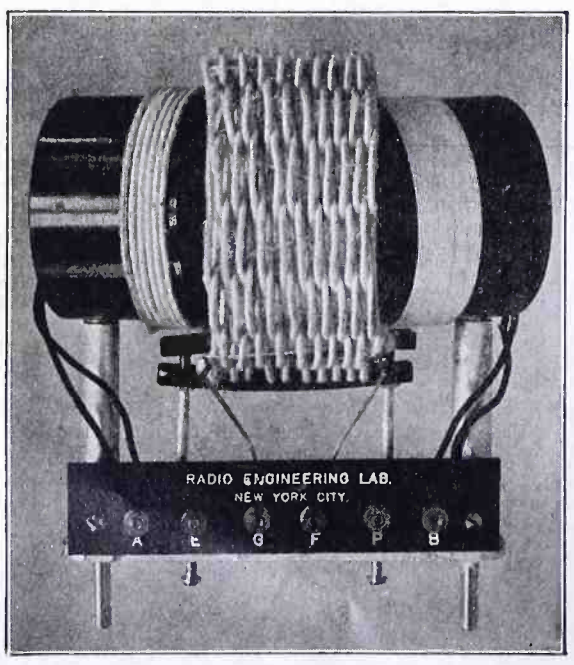
The Volt-X ball-bearing variable grid leak is a protected unit whose resistance may be varied from ½ to 15 megohms by turning an adjusting screw. The best operating point in conjunction with any tube may be found by trial once and for all. It is smooth in operation and claimed to not wear out.



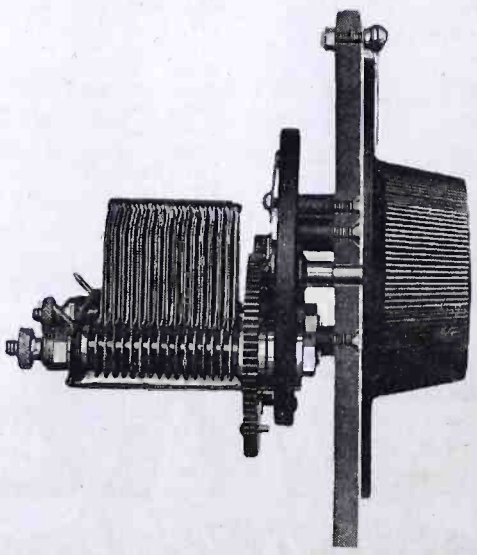
The Super-radio audio-frequency unit consists of a transformer, rheostat and socket all ready for panel mounting. Only two screws are necessary for mounting. Rheostats are supplied for either 8 or 30 ohms. All socket parts are properly marked to facilitate connection. The transformers have a turns ratio of 4 to 1. The unit is designed to save time, trouble and space in the assembly of any home-made set.



The new General Radio vario-coupler is designed for compactness, lightness and efficiency. Yet it has ample turns on both primary and secondary to cover the band of broadcast wavelengths from 150 to 600 meters. It has but two taps, one at the center and the other at the end of the primary coil, thus minimizing losses when used with a good condenser for tuning.



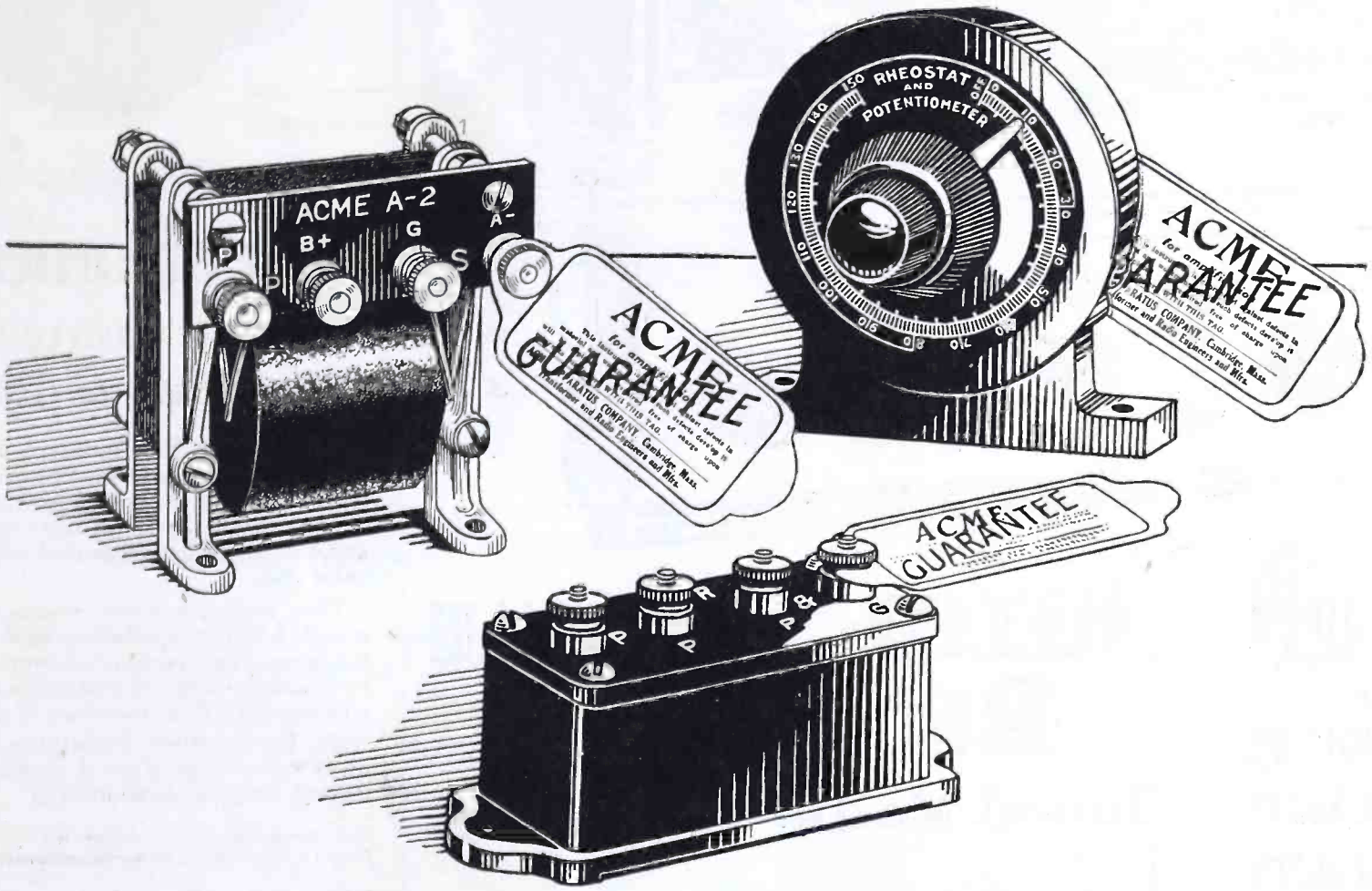
The Low Loss Tuner, for use in regenerative circuits with or without radio-frequency amplification, has been designed with minimum losses in the coils and mountings. The amateur type covers the band from 80 to 225 meters, and, by tapping the secondary coil, will cover the range from 45 to 110 meters. The broadcast type tunes from 250 to 550 meters. Together with appropriate low-loss condensers, this tuner gives greatly increased sensitivity and selectivity.



The Remler Variable Capacity Unit is a new condenser consisting of two sets of square brass plates, both sets being rotated about a common center so as to interleave through a 90-degree arc. A spur gear driving shaft gives vernier control of the twin-gear rotors and 360-degree dial motion. The maximum setting gives a capacity of .0005 mfd. and the minimum .000003 mfd., a ratio of 165:1. The wavelength curve is practically a straight line between dial set-

Continued on page 72

What ACME means *by a guarantee*



THERE are no ACME seconds. All ACME transformers are rigidly inspected. Take the coils on audio-frequency transformers, for instance, thousands of turns of small wire—one short circuited turn, and out they go.

Take the radio-frequency transformers, each one of them tested in a radio-frequency amplifier and if they don't give a standard amount of amplification at three different wave lengths (250-360-550 meters) out they go.

You may say, "Why the rigid inspection? The user can't make these tests," and we'll say "Insurance." Insurance on the product and insurance on the future. ACME has grown by making a superior product and making good should a defect in material or workmanship develop. Frankly, we can not afford to put out a single inferior article.

Acme Engineering Service

IF YOU think you are not getting the proper results with Acme Apparatus, write to the Acme Engineering Service, Cambridge, Mass. Send 10 cents for 36-page book—"Amplification without Distortion," which contains many diagrams and valuable hints on how to build a set and how to get the most out of it.

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~ *for amplification*

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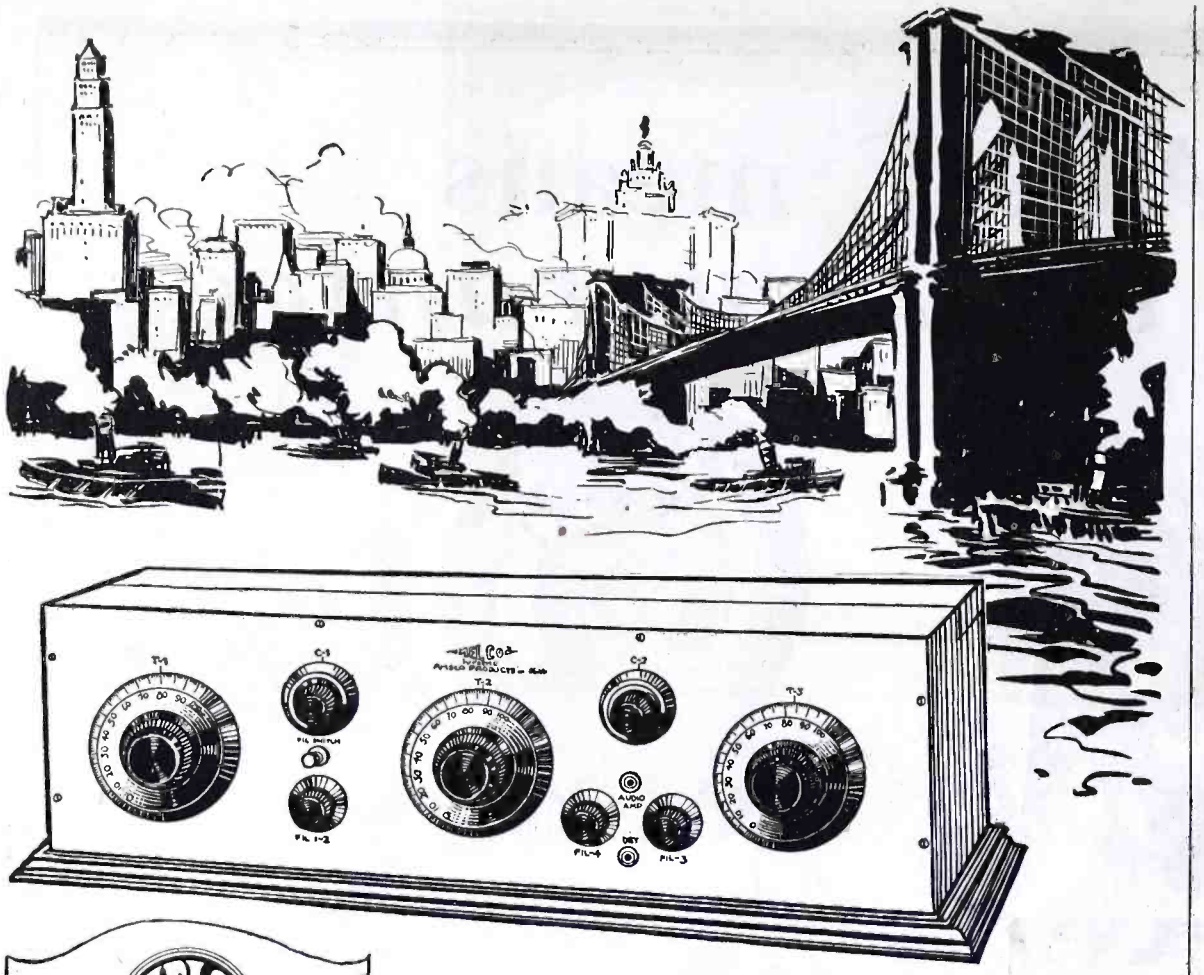
City ..... State .....



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DISTANCE
SIMPLICITY
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Tuned Radio-Frequency

Just as bridges link neighboring cities—so does the Melco Supreme link the happenings of even the most distant towns with your own fireside.

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RADIO MAP OF THE U. S. 35c

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Pacific Radio Pub. Co., Inc., San Francisco

A non-inductive
Potentiometer
that insures noiseless tuning

The Centralab Non-Inductive Potentiometer for panel mounting has no sliding contacts or wire wound resistor. Contact is made upon a resistor consisting of a graphite strip, by a patented rolling circular disc.

This potentiometer makes tuning noiseless. It permits the free flow of high-frequency radio current without choking or retarding waves. It makes possible the adjustment of the resistance, without steps, for the finest gradations. It does away with the need for a shunting condenser. Single hole mounting.

No. 110—400 *ohms (for ordinary use)* . . . **$1.50**
No. 111—2000 *ohms (for special applications)* **1.75**

Centralab RHEOSTAT	**Centralab** ADJUSTABLE GRID LEAK	**Centralab** BATTERY SWITCH
No. 206—6 *ohms*, **$1.25**	No. 106—**$1.25**	No. 300—**50c**
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Centralab

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FORD MICA COMPANY, Inc.

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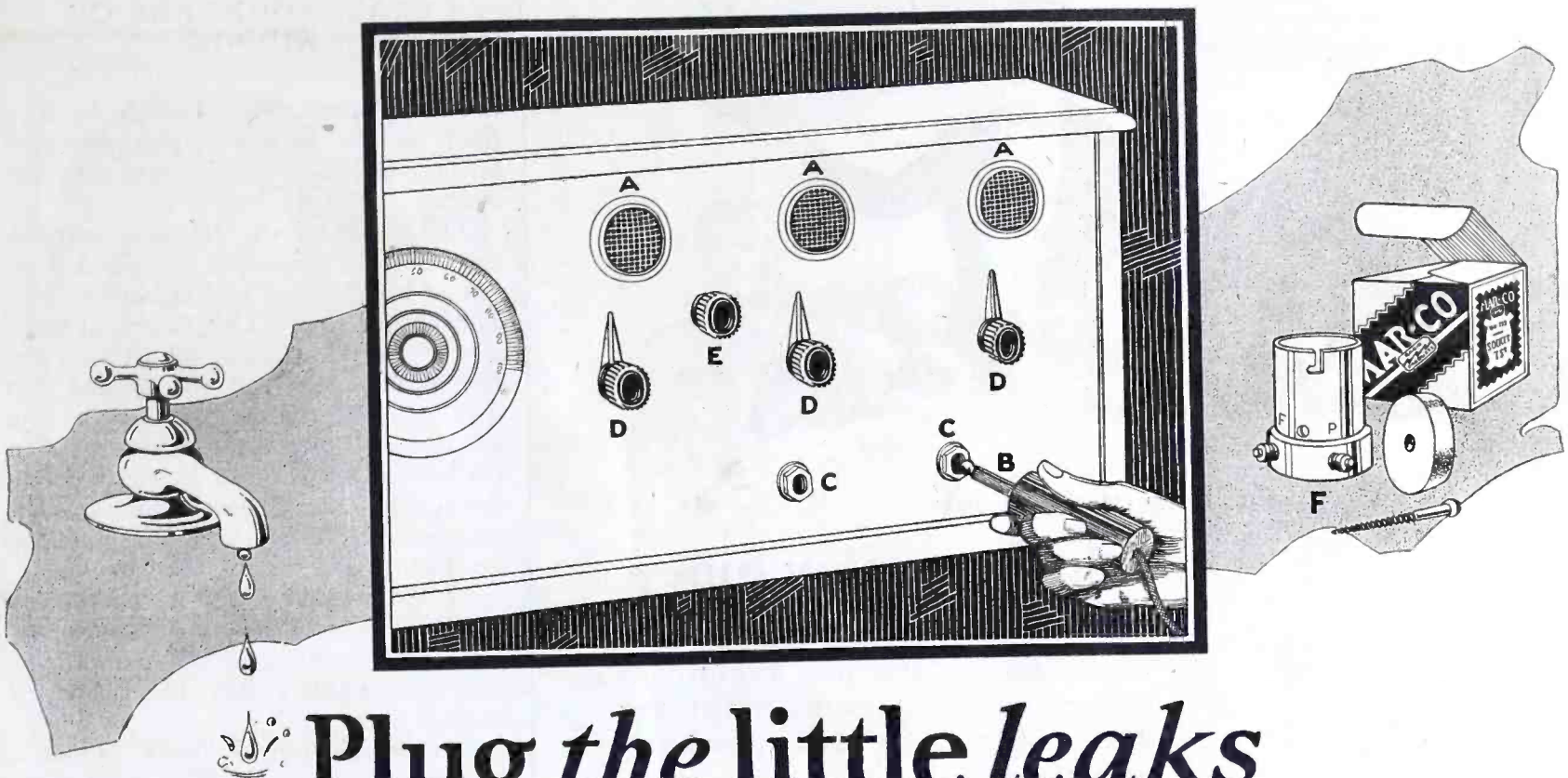


Plug *the* little *leaks* *and* save *the* DX *stations*

YOU EXPERIMENT with circuits . . . you study the design of your transformers . . . you select your tuning instruments with care . . . you keep your batteries fresh . . . and still you *just miss* DX stations you particularly want to get!

Why do you miss them? Why must others, using the same circuit, continue to make records you can't equal?

Is it because there are unexpected leaks in your equipment? Are some of the *smaller* parts—the "little things" you don't pay much attention to—are they draining energy away?

Why man, there's not the slightest little switch, the most unimportant little accessory, that doesn't influence your results. Every place where there's a connection offers radio energy a chance to escape. And every small part offers you an opportunity to make your results better . . . to make your DX list longer!

MAR-CO small parts will help you—if you'll *use* them wherever you can—and insist on getting MAR-CO when you buy. Skilled craftsmen make MAR-CO small parts . . . and they make them with the precision of scientific instruments. They make them to *stop* the little energy leaks . . . to add miles to your range.

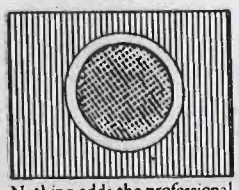
It will cost you no more, frequently less, to *say* MAR-CO—and you'll *know* you're getting leak-proof service!

MAR-CO

RADIO PRODUCTS

PLUGS · JACKS · RHEOSTATS · SOCKETS · SWITCHES · NEUTRALIZING CONDENSERS

A

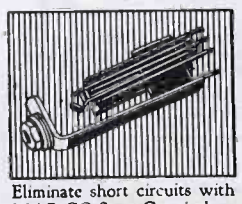


Nothing adds the professional touch to the home-made set like the striking beauty of MAR-CO gold-plated bezels 35 cents. Black finish 25 cents Nickel 20 cents.

B

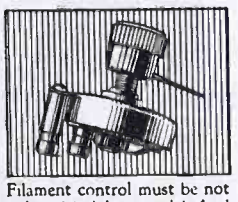
It's name sums up MAR-CO SHUR-GRIP plug. No tools needed to change tips *instantly*—to make leak-proof connections *permanently*. In flashing black and nickel for 75 cents.

C



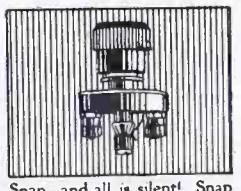
Eliminate short circuits with MAR-CO SHUR-GRIP jacks-Formica insulation, sterling silver contacts, hooked terminals for quick, leak-proof connections—60 cents to $1.00 and well worth it.

D



Filament control must be not only critical, but *steady*! And it is—when you use compact MAR-CO ARMOR CLAD 30 ohm rheostats—a big one dollar's worth.

E



Snap—and all is silent! Snap again—and reception continues *instantly*. Make your set *convenient*—tonight—with a MAR-CO filament battery switch, only 30 cents at your dealers.

F

MAR-CO U.V. 199 sockets, with pressure contacts, with Bakelite base, with single mounting screw and heavy felt cushion *supplied*—give REAL tube protection for 75 cents.

BRASS-POUNDERS OF NIPPON

Continued from page 12

the other hand, even though he is a chief on one of our largest passenger liners, is paid and rated below the third mate.

The status of the Japanese operator appears to be at once a cause and a result of his dignified and officer-like conduct aboard ship. The American operator is rushed through school in eight months or a year and goes aboard ship with a total lack of experience of the sea and its customs; whereas the Jap has been through the mill; he is pretty thoroughly educated, both from an Oriental and a Western viewpoint; and he has had to put in his time as junior, third, and second operator, covering a period of seldom less than five years, before he finally gets the prized and highly responsible chief brasspounder's berth.

It is enlightening to walk aboard a Japanese liner in port and find all three operators in the radio room sitting up to their necks in a litter of dismantled spark gaps and machinery, buckets of gasoline, coal oil, brass polish, and heaps of sandpaper, chamois and tools, putting their set into shape for the next trip. About the only way to catch us American key shakers on board is to meet our ships at the outer harbor with a speed boat. Once the American ship gets alongside—particularly if in a foreign port—you have about as much chance of finding the brasspounder on board as you have of catching whales in Sahara.

The radio equipment on most of the Japanese ships is getting obsolete; but such exceeding pains are taken with it, at least on the larger vessels, that apparatus fifteen years old looks like new and works better. You can see your face in every piece of metal and hard rubber. The standard Japanese shipboard transmitter is a seven-kilowatt, direct-coupled, quenched-spark set, of massive construction and fitted with a magnificent twenty-unit spark gap—all very closely copied from the most efficient German Telefunken equipment of fifteen years ago,—and, in view of the way it is kept up, there is small wonder that the Jap signals fairly jar the enamel off our receiver diaphragms every night on the Pacific.

The name "Teishinsho," often applied to Japanese radio equipment, is not a name of the system; it literally means "communication department," nothing more nor less. In Japan, all radio apparatus is built, installed, and used under extremely strict government supervision. Among the common folk no amateur transmitters are allowed of any kind whatever; receiving is no less unlawful; but lately permits have been issued to some powerful Japanese newspapers to

Continued on page 48

You'll find
YOUR SET
among the
FADA
Neutrodynes

FADA, the pace-setter of Neutrodynes, leads again, presenting a new 5-tube FADA Neutrodyne in de luxe cabinets, thus supplementing the famous FADA "One Sixty." There is also a new 5-tube FADA Neutrodyne at a price that is within reach of all.

Whatever your radio wants may be, you can now fill them with FADA radio. Appearance, 3, 4 or 5 tubes, price—there is a FADA Neutrodyne to meet your desires.

In the de luxe models all connections are at the rear and there is plenty of cabinet space for dry batteries. The FADA Neutrola and Neutrola Grand have self-contained loud speaker. Woodwork is handsomely inlaid mahogany.

FADA Neutrodynes give you the results you want—distance, selectivity, volume. They produce natural tone quality. A child can operate them.

See the complete FADA line before you make any radio purchase.

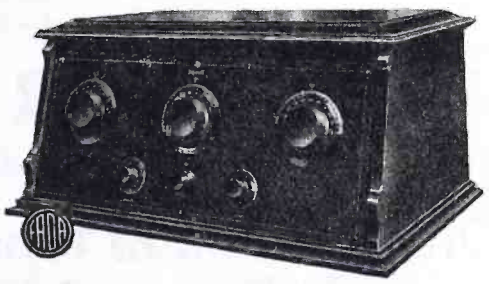
First public showing, Pacific Coast Exposition, San Francisco, August 16th to 21st.

F. A. D. ANDREA, INC.
1581 JEROME AVENUE, NEW YORK
Globe Commercial Co., *Pacific Coast Representative*

FADA *Radio*

FADA NEUTROLA GRAND

Model 185/90-A—This is the beautiful new 5-tube Neutrola, **Model 185-A**, mahogany inlaid cabinet, with self-contained loud speaker, mounted on the FADA Neutrodyne Cabinet Table, **Model 190-A**, making a de luxe radio unit. Desk lid conceals panel when set is not in use. FADA Neutrola Grand. Price (less tubes, batteries, etc.) $295. FADA Neutrola. Price (less tubes, batteries, etc.) $220.



FADA NEUTROCEIVER

Model 175-A—Handsome mahogany cabinet, inclined panel and roomy dry battery shelf. 5 tubes—2 radio, detector, 2 audio. Price (less tubes, batteries, etc.) $160.

The Complete FADA Line

In addition to the models illustrated, the new FADA line includes the following:

FADA 160-A—"The receiver that has taken the country by storm." Four tubes. Price (less tubes, batteries, etc.) $120.

FADA NEUTRODYNE CABINET TABLE. Model 190—A handsome mahogany base unit for either the FADA Neutroceiver or Neutrola. Price $75.

FADA NEUTRO-JUNIOR. Model 195-A—A 3-tube Neutrodyne with special circuit arrangement, one radio, detector, two audio stages. Price (less tubes, batteries, etc.) $75.

FADA RADIO PANEL. A panel-mounted FADA Neutrodyne, adapted for installation in prominent makes of talking machines.

Continued from page 46

install broadcast stations, and the government is arranging "soon" to permit the general installation of broadcast receivers—though with strict limitations as to type of apparatus to be used, which presumably will have to be so designed as to confine it to broadcast waves only.

A rather striking feature of the Japanese radio operator's position on shipboard is his unusual authority, which under certain conditions cannot be contradicted by the captain or even by the owner of the vessel. Every Japanese operator appears to be a naval reservist, or he is at any rate a government agent as well as a ship officer. He has nothing whatever to do with any commercial wireless company, but keeps all his records and accounts directly with the Japanese government and cannot be much interfered with by anyone else.

Numerous reports of the control exercised by Japan over many of her subjects in civil life, as in the case of these radio operators, have been a factor in bringing about our present drastic anti-Japanese immigration laws. The Japanese people must always be foreigners among us, simply because of the fact that the meeting of East and West in marriage is not acceptable to us, and never can be, if the white race is to survive. Mix yellow and white, and you get yellow—not white. The law is vital and just; but feeling about it in Japan is intense, and will be for a long time to come; therefore, unless we wish deliberately to build for a disastrous conflict upon the Pacific, it behooves us to continue to act decently, not belligerently. The American radio operator on the western ocean, through his myriad contacts with the Japanese over the air, has a part to play in this, to an extent not generally realized by either himself or the public; and we can play our parts best by trying not to forget that the Japanese radio operator is just a plain human being like ourselves.

Remember that Mr. Takomoto Nogo on the *Nippon Maru* has troubles of his own; he is almost sure to be married, with three or four hungry little Nogos to think about; he has his income tax and his indigestion; he pays outrageously high fire insurance on his paper house, especially since the Yokohama earthquake; and maybe he wouldn't go to sea at all if it weren't for the mortgage on his rice patch. Then pile on his desk a bunch of fifty or a hundred messages to send an abstract, some in English, some in French, and the rest in any one of a dozen kinds of Japanese; and the captain is a jumpy little fool who wants a lot of weather reports and compass bearings and everything; and—well Mr. Nogo has got to hit the ball.

"JAB, JAB, JAB de JOK, JOK, JOK: xxytoyw,yfs35damnstwpytrst!"

All Aboard!

[For the biggest Fall and Winter Radio Business in the history of the Industry]

IT IS generally conceded that the Radio business during the fall and winter of 1924-25 will be the greatest in the history of the industry.

The Chicago Evening American interviewed a number of leading manufacturers and jobbers and in almost every case received statements like those reproduced below:

> "Reports reaching us every week from our district offices throughout the country indicate that the coming Radio season will be the largest thus far experienced."
>
> Herbert H. Frost, Inc.

> "Everything is in favor of a very early fall business. The presidential campaign will do much to stimulate interest and result in early installation of sets."
>
> Music Master Corporation

Chicago, second greatest Radio market in America, offers manufacturers a golden opportunity. And the Chicago Evening American, the newspaper that publishes more Radio advertising than any other Chicago daily, is the medium that reaches the greatest number of prospects.

CHICAGO EVENING AMERICAN

First in Radio

A VARIABLE "B" BATTERY

Continued from page 22

the box of radium, and he was equally positive that it was the self-same party whom he had later overheard talking to an accomplice in Catalina over the radiophone. The robbery had occurred before five in the evening and it was about seven when Denny had returned from Los Angeles. This would have allowed the robber ample time to cover the distance from Pomona to Citrolia, and he had probably chosen the latter as being so much less open to observation. The description fitted his man exactly and both the voice and the snatch of conversation which they had received over the air strengthened his conviction to a certainty. If he could get over to Catalina in the morning and locate his suspect, he could easily make sure if the voice of the phone belonged to the foreigner of the waiting room and if the latter fitted the police description, he would merely notify the local police and collect the reward.

It all sounded smooth and easy and Denny, resolving to carry it into effect, if possible, went to bed and dreamed of a wonderful combination chicken plantation and coconut farm to be purchased with the reward, which he felt was as good as his already.

JOE refused to turn sleuth, deciding to go fishing instead and remarked significantly:

"I expect to catch plenty, too, everything seems to be biting pretty freely up this way today!"

Denny ignored the implication, and after arguing vainly to persuade Joe to accompany him he went off alone, telling Joe as he left:

"When I buy my new yacht if I need a brass pounder I'll look you up."

"You'll have to look up a long way then," Joe shouted after him, "I'll be tuning a harp when you buy a yacht."

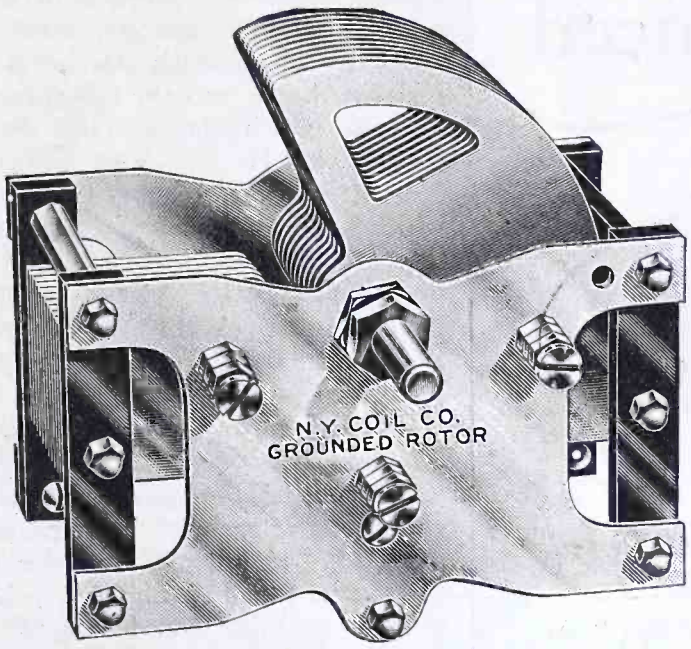
The first train with an all full sign flashed past Citrolia at high speed, the motorman, as he shot by, waving a friendly bye-bye in response to Denny's emphatic semaphoring for a stop. After a fifteen minute wait he caught the next, but was too late to catch the train from the Pacific Electric Depot that connected with the first morning boat to Avalon, and he pondered regretfully on the lost opportunity of accompanying "Ivan" and of following his subsequent movements.

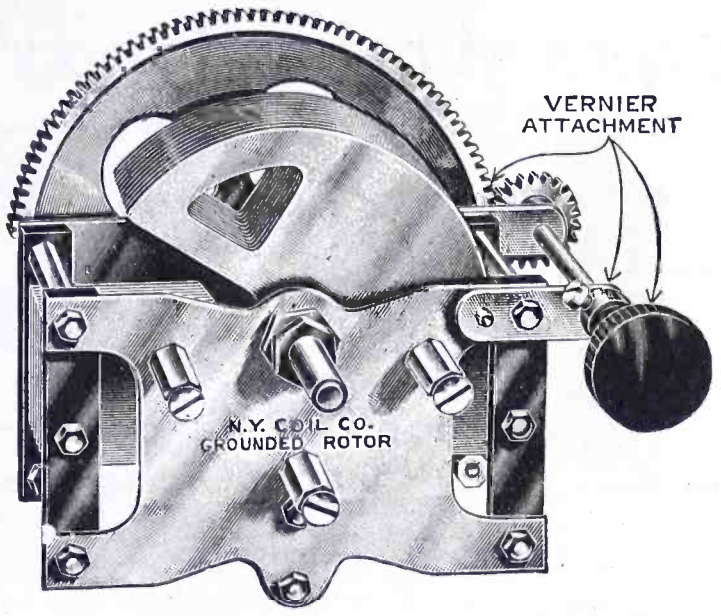
Arriving at the Catalina terminal at Wilmington he was wandering idly about when he observed the glass enclosed operating room of the new commercial station which had recently been installed in the immense waiting room. He recognized the operator inside as an old shipmate of his, and was about to enter when he saw that he was engaged in sending a message. Not wishing to

Continued on page 52

Why be Satisfied with a Jumble of Interfering Stations?

Install a New York Low Loss Grounded Rotor Variable Condenser in Your Present Set and receive the Full Pleasure of Broadcasting





OUR NEW LOW LOSS CONDENSER is in a class by itself — superlatively better — no other condenser manufactured incorporates so many vital improvements.

Adjustable cone type bearings, pig tail connections and stop, straight line capacity, geared vernier action (which may be purchased separately if desired)—only geared vernier that swings a 4-inch dial. **Dielectric of genuine hard rubber with wide spacing of plates.** In a word a precision instrument possessing the absolute minimum losses, the maximum obtainable efficiency, insuring greatest distance, sharpest possible tuning and wonderfully clear reception.

.0005 (23 plate) without Vernier $4.50

Geared Vernier attachment, complete, $1.50

Unequalled for Super-Heterodyne, Neutrodyne and all exacting circuits. ***September deliveries***

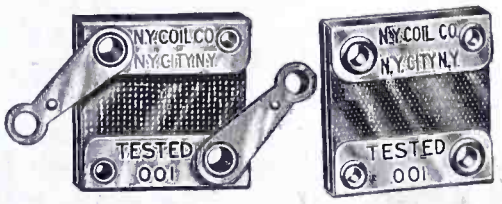
OUR SUPER-HETERODYNE KIT at $20.00, consisting of oscillator coupler, input, and three matched intermediate air-core transformers, makes up the best set known to date.

Other items of proven superiority: Distortionless Audio Transformers, Tuned Radio Frequency Transformers.

BY PASS CONDENSERS	
.05	$ .90
.01	1.25

PRECISION MICA FIXED CONDENSERS

"More Uniform Capacity"



Type B **Type A—No Clips**

Adapted by Leading Heterodyne Manufacturers on account of truthful capacity rating.

This is the only laboratory precision-built condenser on the market, yet sold at a commercial price. It is standard equipment with some of the largest and most discriminating set manufacturers.

Guaranteed for capacity and against leakage or breakdown.

The following sizes always in stock:

Capacity	Retail Price
.0001 Mfd.	.35
.00015 "	.35
.00025 "	.35
.0005 "	.35
.001 "	.40
.002 "	.40
.005 "	.60
.006 "	.75

.00025, with Grid Leak Mounting attached, 45c list. **Type C**

NEW YORK COIL COMPANY

338 Pearl Street, New York City, N. Y.

Pacific Coast—MARSHANK SALES CO., 1240 S. Main St., Los Angeles, Calif.

Continued from page 50

interrupt, he waited outside the glass partition until the message was finished. Unconsciously he listened to the sharp snap of the signals, his brain mechanically recording the dots and dashes and forming them into letters and words without any effort or volition on his part. His conscious mind was following "Ivan" across to Catalina Island when suddenly there seemed to leap from his subconscious mind the very word "Ivan" and after a moment's startled pause he realized that it was the signature to the message which the operator had just completed. He had some difficulty in concentrating his memory on the signals which the brain had automatically recorded, but finally succeeded in reconstructing the entire message. It ran—

"Hr nr 1 ck 14 Wilmington fld 10.15 pm date—To Pedro Legaspi, SS Hondagua—Gained object meet you on arrival accompany you Mazatlan—Sig Ivan."

He entered the operating room and greeeting the operator inquired casually when the Hondagua was due. The operator answered: "She gets in here tomorrow morning and leaves for South America and way ports tomorrow night. Just gave her a message," he continued, "handed in by a funny looking bird."

"What kind of a looking fellow? Spigotty?" Denny asked, trying hard to appear unconcerned.

"No, this guy was no spig," replied the operator. "Looked more like a Russian. Big heavy chap with a thick black mustache. Spoke bum English."

That was all the information Denny required just then and he soon made an excuse and left his friend. He was now more firmly convinced than ever that he was on the trail of the radium thief and decided that any action in the matter must be taken promptly if he was to earn that $10,000.00 reward, as the culprit was evidently about to lose no time in getting as far away from the scene as possible.

When the boat returned from the island Denny stationed himself by the gangplank and kept a sharp watch on the descending passengers but failed to see anyone remotely resembling "Ivan." He accordingly purchased a ticket and on the trip across concluded it would be advisable to have some expert assistance before proceeding further. As the donor of this assistance he selected his ex-army friend, Captain Watt, who in addition to being the uncrowned king of amateur radio DX hounds, was also the sole custodian of the dignity and majesty of Uncle Sam on Catalina Island in his capacities of marshal, justice of the peace, game warden, forest ranger, etc., etc.

Denny knew that the Captain was at his home on the island, having heard his

Continued on page 54

New! —A Calibrated Grid Leak!!

You set it for a specified resistance and adjust it for best results. You read the resistance in exact terms of the megohm through a peep-hole in the panel. (It's also equipped for table mounting.) Each FIL-KO-LEAK is individually hand-calibrated in the laboratory. Resistance element is constant and accurate, and is not affected by atmospheric conditions or wear. The FIL-KO-LEAK assures you smooth, gradual control of resistance. You will get both distant and local stations with greater clarity and volume than ever before, for when the negative bias on the grid of the detector tube is *precisely right* the tube neither "chokes" nor "spills over". The improvement will be most noticeable on the *weakest* stations.

$2.00

TERMINAL POSTS SPACED TO FIT THE STANDARD GRID CONDENSERS

Shown with condenser in dotted line

Every FIL-KO-LEAK is guaranteed to be perfect electrically and mechanically, and to be accurately calibrated over the operating range for all tubes (¼ to 5 megohms). This calibration is doubly checked before the instrument is shipped.

FIL-KO-LEAK

SCIENTIFICALLY CORRECT VARIABLE GRID LEAK

—With the $100 Guarantee

1.50

Bakelite Insulation Hermetically Sealed

Solid Brass Mounting Bracket

Absolutely warranted to protect your set from lightning, with a guarantee to pay you $100 or to repair your set, should it be damaged through faulty operation of the arrester.

The "umbrella" shield keeps dust, moisture, etc., from the insulation, preventing leakage losses from aerial to ground. This makes certain that all radio impulses reaching the antenna pass through your set, which assures maximum reception.

FIL-KO-A LIGHTNING ARRESTER

SCIENTIFICALLY CORRECT RADIO LIGHTNING ARRESTER

—With Battery Switch

Supremacy proven by every test

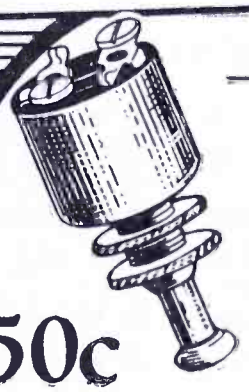
2.00

Carries the usual FIL-KO-PARTS unconditional guarantee.

The only compression type rheostat with a battery switch attachment. Combines the advantages of infinite control of filament current with the simplicity of an ordinary battery switch. And at no extra cost! If you want perfect control of any type tube in any hook-up—if you want freedom from tube noises—if you want DX stations you never heard before — maximum signal strength—longer tube and battery life--then you *must* use FIL-KO-STAT. Battery switch attaches to regular FIL-KO-STAT mounting screws. No extra holes to drill.

FIL-KO-STAT

SCIENTIFICALLY CORRECT RADIO RHEOSTAT



—Simple Sturdy Sure

50c

Carries the usual FIL-KO-PARTS unconditional guarantee.

A single-hole mounting "A" Battery switch that's easy to attach.

Wiping contacts assure clean, positive connection when the switch is in the "On" position. When the switch is "Off", the contacts have a positive break and are separated by highest quality insulating material.

The end terminals of the switch can be used for solder connections, or connecting wires can be held in place by the screws provided for that purpose.

The nickel knob and the entire housing are insulated from the terminals, so that any wires accidentally coming in contact with any part of the switch outside of the terminals themselves can cause no damage.

FIL-KO-SWITCH

SCIENTIFICALLY CORRECT "A" BATTERY SWITCH

Foreign Representatives
RADIO STORES CORP.
New York City
(Address all Mail to the Factory)

MADE AND GUARANTEED BY
DX INSTRUMENT CO

For Descriptive Literature Address Dept. R -924 at the FACTORY
HARRISBURG, PA
New York Office: 220 West 34th St.

Continued from page 52

powerful transmitting set in operation on several nights previously, and on arriving at Avalon he went directly to the Captain's house. After a cordial welcome he gave the Captain all the details of the robbery and then told him of his conclusions regarding the suspect. He was much relieved to find that Captain Watt was quite impressed with his story, and when the latter suggested that they proceed at once to the St. Catherine Hotel to hunt for Ivan and his partner, Denny felt an unwonted thrill of excitement and elation.

To the desk clerk at the hotel, the Captain repeated Denny's description of the fugitive and was informed that a man whose appearance he recalled, corresponding closely to the one described, had arrived earlier in the day and had taken a room on the fifth floor adjoining that of a Mr. Peterson, who had registered a few days before and had reserved both the rooms.

Declining the clerk's offer to phone up and see if they were in, the Captain led Denny to the elevator and getting off at the fifth floor they walked quietly along the corridor looking for the room numbers which the clerk had given them.

"I'll ask to see his passport first," said the Captain, pulling a shiny badge from his pocket and pinning it on his lapel. "Those foreigners are used to that, and when we get inside we can question him a bit."

As they paused outside they heard an indistinct muttering of voices within. The Captain knocked sharply on the door of Ivan's room, but received no answer. The voices had ceased abruptly and after waiting a tense moment he rapped again and receiving no response he tried the knob. The door was unlocked and he swung it open. They both stepped quickly inside only to find that the room was vacant, but muffled noises in the adjoining room indicated that the recent occupant had just vacated through the communicating door to which the Captain rushed.

He found it firmly locked and turned to dash out into the corridor when his attention was attracted by an exclamation of amazement from Denny. The latter was standing by a little table in the center of the room on which lay a brand new 45 volt *B* battery, which had evidently just been removed from its cardboard container, and with the brown paper, outside wrapper crumpled on the floor. Denny was pointing to it in open-mouthed astonishment and to the Captain's curt, "Well, what's the matter?" he replied:

"Say, Cap., this is my *B* battery. The one I bought yesterday in Los Angeles. Lookit here! Here's where I scratched the date on it when I bought it!"

They gazed at each other blankly.

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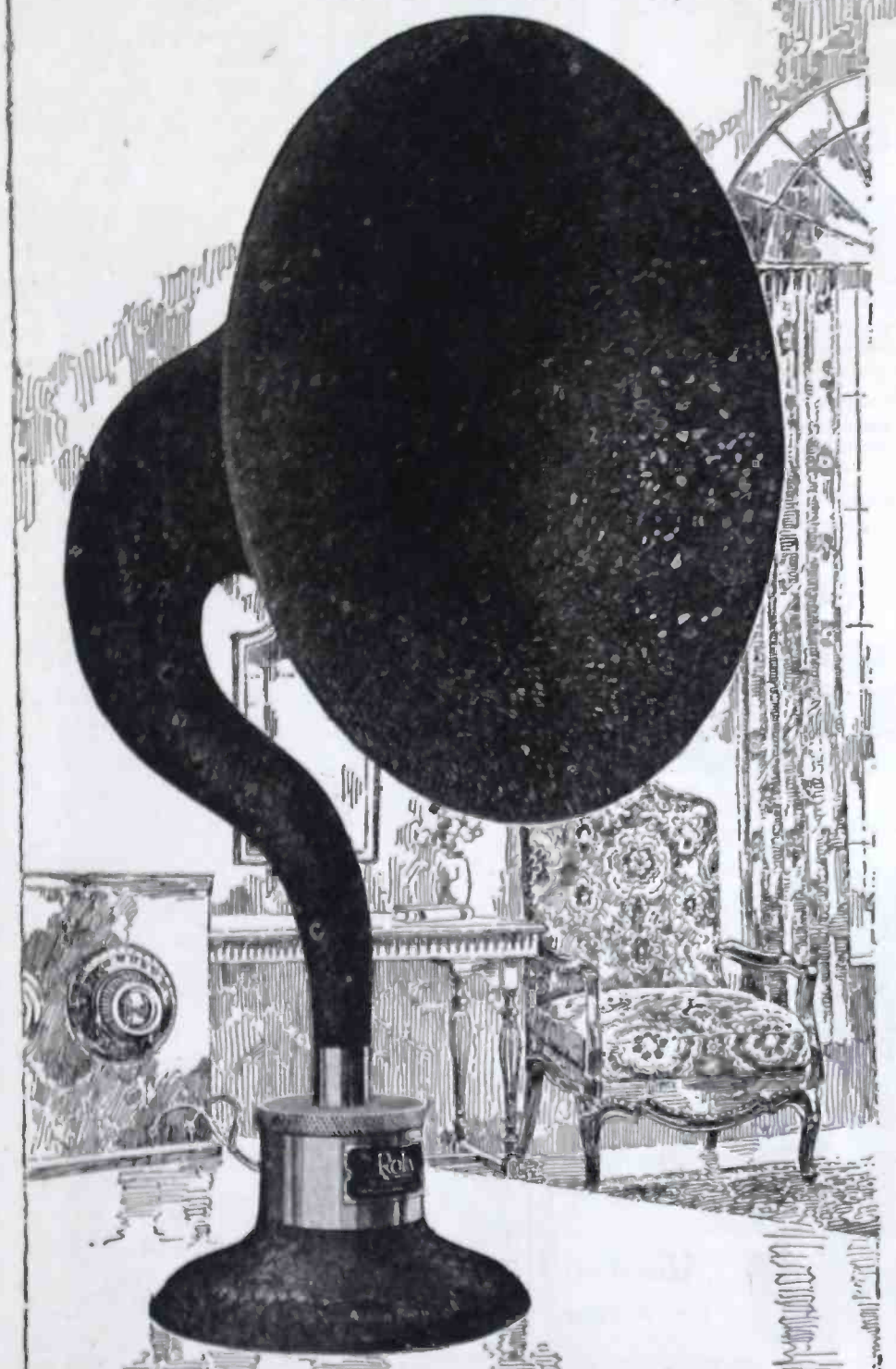
They said it couldn't be done!



The ROLA RE*CREATOR horn is exponential in taper and non-resonant at any audible frequency. The reproducer mechanism responds over a frequency range from 150-9000 which is greater than that achieved by present broadcasting stations. The sensitivity exceeds that obtained in best headset construction—an unparalleled achievement in loud-speaker design. The unit can be purchased separate from the horn and base, together with the necessary adapter for attachment to any phonograph.

The requirements of a perfect reproducer are but three:

1. *Tone-quality*
2. *Volume*
3. *Sensitivity*

But for years engineers have failed to obtain these three qualities in a single instrument.

Tone-quality? Exquisite tone-quality was obtained, but without adequate volume.

Volume? "Loud"-speakers were blatant—without tone-quality and usually insensitive.

Sensitivity? Sensitive reproducers chattered hopelessly on loud-reproduction.

Acoustic engineers finally said it couldn't be done.

—but Rola did it!

For here at last is a reproducer that has *all* of these essential qualities. And it marks a new era in Radio reproduction.

Here is a loud-speaker of such tonal perfection that comparisons are astounding. Of such sensitivity that any signal that can be amplified will be reproduced—adding many miles to radio reception. And yet capable of tremendous volume on power inputs — for it cannot chatter!

There's absolute proof in a demonstration.

Hear it at your dealer's.

Price complete with 14-inch horn and cord, $36.00

A Product of

THE ROLA COMPANY

SEATTLE, WASHINGTON · USA

Distributed nationally to the jobbing trade by

BAKER-SMITH COMPANY

Call Building · San Francisco

with offices in the principal cities

Rola

BAKER-SMITH COMPANY
L. C. Smith Building
Seattle, Washington

Dept. A

Gentlemen: Please send complete information regarding the new Rola Re*Creator.

Name _____

Street _____

City _____

My dealers name _____

Continued from page 54

"But I brought it home with me to the camp last night, and how did it get here?" he continued.

"You're sure it's the same?" barked the Captain.

"Certain," answered Denny, then as another thought flashed to his mind he grabbed the brown paper from the floor, "and I remember scribbling my name and address on this cover on the way home in the train!"

Quickly he smoothed out the heavy paper and found that a piece about six inches square had been roughly torn from one corner.

"That was where I wrote my name and—" he began to shout excitedly when the sharp slam of the door behind them through which they had entered caused them both to spin hastily around.

Someone was turning the key in the lock.

With a jump the Captain grabbed the knob, but was too late. They were securely locked in Ivan's room while the latter and his accomplice slipped quietly from the hotel to safety.

For a moment both were dumbfounded by the unexpected turn of events.

"The telephone," exclaimed Denny, rushing toward it.

"No use," said the Captain. "Those birds are too quick. They'd be well away before we could explain things downstairs. They can't leave the island, though, before tomorrow, and then they can't get away without our knowing it. But call the office anyway and tell them to send up a bell boy to let us out of here."

Denny did so and then he and Captain Watt resumed their inspection of the *B* battery on the table.

"I don't get you on this yarn," said the puzzled Captain, "you say you took the battery up to your place last night and left it there unopened. Then how in the name of all that's foolish does this duck get hold of it, and why?"

"That's exactly what I'd like to know too,"wailed Denny, as he racked his brain for an explanation of the mystery.

"Maybe you gave it to him as a present," sarcastically ventured the Captain, "when you met him in the railroad waiting room. Maybe you—"

"That's it!" Denny shouted. "That must be it! He must have picked up my package off the bench in the darkness, and I must have picked up a package belonging to him by mistake. I wonder—, do you think—could it be possible?"

"That's it!" it was the Captain's turn to fill in the blanks. "Sure as you're a foot high, you picked up the package of radium and took it along home with you! And say! those two fellows must have figured it out that way too. That's why they've taken your name and address from the paper cover!"

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Continued from page 56

As they speculated intently on the possibilities of this discovery they were interrupted by the bell boy unlocking the door.

"Let's get your partner on the phone right away," said the Captain, "and have him examine that package and put it in safe keeping."

"Can't do it," retorted Denny, "there's no phone line out that way!"

For a moment both were silent. Then the Captain demanded eagerly, "Any ham stations out there?"

"Sure is!" Denny answered jubilantly. "Joe and I just helped a young chap in Millers Camp rig up a five watter last week. I know his call. Let's try and raise him on your set!"

"Let's go!" said the Captain, and they hurried to the elevator.

As they emerged to the hotel veranda they were startled by the loud drone of an airplane and looking towards the beach they saw a hydroplane skimming with increasing speed away from the shore, and as they watched it lifted gracefully from the water and headed directly towards the mainland. The Captain turned and quickly entered a telephone booth in the lobby. He called the office of the airplane company, and the answers to his rapid questions confirmed his suspicions.

The fugitives had paid three times the regular fare for the trip across, with the privilege of landing wherever they directed the pilot.

"They're bound for your shack," the Captain told Denny, as they hurried from the hotel. "If we can't get word to Joe before they get there he's liable to be in a dangerous position. These crooks wouldn't stop at murder to get hold of that box of radium again. Let's run to my place!"

They arrived a bit out of breath, and in about ten seconds the motor-generator was humming, the big bottles glowing, the receiving set switched on, and the Captain's well known fist snapped out the call letters which Denny jotted down on a pad in front of him.

They held their breaths while the Captain slowly moved a dial on the receiver, and then both gave vent to a long "Ahh!" of satisfaction as the Captain's call was repeated in a fist that betrayed its newness in a slight hesitation and unsteadiness.

"Got him first pop out of the box!" crowed the Captain, as he waited for the other to finish his call. Then he sent slowly and distinctly: "Can you get a message to Joe Knapp?"

"Joe is here now," came the reply. "Do you want him on the key?"

"Yes, yes," the Captain shot back, and motioning to Denny to take his place, "You tell him!" he said.

Smoothly and rapidly and in the few-

Continued on page 60

"ROLLS-ROYCE" RADIO TUBES

Like their name, significant of quality. Durable and powerful. Bring in distance with a maximum of volume and clearness.

Type 200....5 Volts, 1 Ampere Detector Tube.
Type 201A..5 Volts, .25 Ampere Amplifier and Detector.
Type 199..3-4 Volts, .06 Ampere Amplifier and Detector.
Type 199..3-4 Volts, .06 Ampere With Standard Base.
Type 12..1½Volts, .25 Ampere Platinum Filament. Amplifier and Detector
"The Rolls-Royce of Radio Tubes." ALL TYPES..... **$2.50**
Type 202....5 Watt, Transmitters, $3.00

ALL TUBES GUARANTEED
to work in Radio Frequency. Especially adapted for Neutrodyne, Reflex and Super-Heterodyne Sets.
Shipped Parcel Post C. O. D.
When Ordering Mention Type
ROLLS-ROYCE TUBE CO. 21 Norwood St. (Dept. R) NEWARK, N. J.

GREWOL The PERMANENT DETECTOR $1.50

THE one part of your set in which there can be no trouble; the one part that requires no attention. Attach it—forget it! The most practical fixed, crystal detector—and the most attractive.

Sold by Good Dealers Everywhere or Direct Upon Receipt of Dealer's Name and $1.50

Patented May 15, 1923
Serial No. 1454997

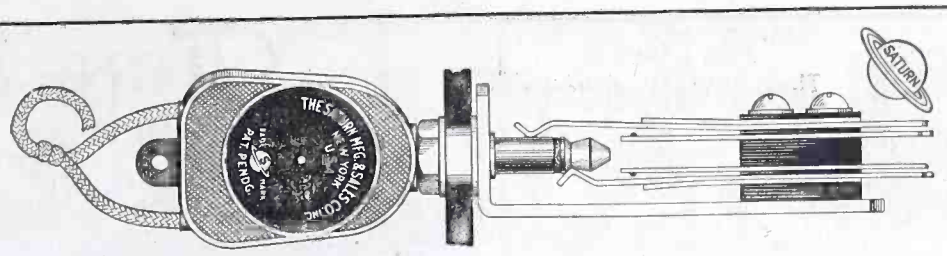
Infringement subject to prosecution.

GREWOL
2 in One Crystal

Two surfaces instead of only one. Double life, double value.

50c each

GUARANTEED BY
GREWOL MFG. CO.
NEWARK, N.J.



The *New* SATURN
Improved *Automatic* Radio Plug

A still better SATURN Plug—handier, more durable and greater value than ever at the new reduced price. Genuine Bakelite, no metal parts projecting to produce capacity effects or short circuits. Connected without a screwdriver or any other tool—just by inserting cord terminals. Strong automatic grip—instantly released by pressure on small release lug. Absolutely fool-proof. Efficiency unconditionally guaranteed. Reduced price 75c.

SATURN *Perfect Jacks*

Easy soldering terminals with crowfoot offset, tinned with non-corrosive solder flux compound. Rounded corner brass brackets, nickel plated. German silver blades with sterling silver contact points.

The SATURN Battery Switch

A new SATURN Product, built of the same high grade materials and on the same standards of perfection as the SATURN Plug and Jacks. Perfectly balanced because of exclusive blade construction. Switch pulled out makes connection, pushed in, breaks connection. Fits any thickness of panel.
List price 75c

How to Buy SATURN Products

SATURN Products are sold by the great majority of radio dealers. If your dealer has none, send us your order, mentioning his name. Your satisfaction with every order absolutely guaranteed. *Write for our new circular.*

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Continued from page 58

est possible abbreviated words, Denny explained the situation to Joe and advised him to go up to their shack immediately, examine the package and if their surmises were correct to get together some of the menfolk of the camp to act as a reception committee for Ivan and his friend, in case they showed up there. "QRX, om," he finished.

"QSU," snapped Joe.

Ten minutes later Denny flashed a "Go ahead" signal in response to Joe's call.

"It's the radium, alrite, om," came the message. "We are all set for Ivan's arrival. Two shotguns, two air rifles, and an automatic. We'll take care of them."

And they did.

When a furiously driven taxi containing Ivan and Mr. Peterson halted in Millers Camp with screeching brakes, a willing bystander directed them towards the operators' shack, and with no pretense at concealment the two passengers jumped out and scrambled up the trail to the little building. No lights were showing and the place looked deserted, so throwing caution to the winds, the pair boldly approached and finding the door open, walked in.

As they stepped inside they were fumbling in their pockets for matches when the door was banged shut, lights flashed up and before they could collect their scattered wits, they were overpowered and bound hand and foot.

AND that is really about all there is to the story itself, because, of course, Ivan (his last name turned out to be "Offalkoff") was convicted and sent to jail, and so was Mr. Peterson, as his accomplice, and naturally Denny collected the $10,000.00 reward when he returned the radium to the University.

But I suppose you want to know what he did with all that money, and how he spent it, or what did he buy first.

Well, all that I know is that he and Joe — yes, he forced half of the $10,000.00 on his partner—have not been seen much lately outside of the laboratory which they added to the shack, but odd shaped boxes are arriving there quite frequently, and none of the boxes look as if they contained *B* batteries. It may be that they are on the trail of a genuine television machine, as when I last talked to Denny on the air—the modulation on his new set was awful—he made some indistinct reference to "seeing things nobody else can see."

Of course it may be as you perhaps suspect,—that—

But, anyhow, that's none of our business.

It Pays to Sell the Genuine!

For three years we have consistently advertised the advantages of quality binding posts with tops which don't come off.

We have been pioneers in the development and sale of well designed and beautifully finished posts which were scientifically made, conveniently packaged and sold at a reasonable price.

We have spent a considerable sum of money in telling the world about EBY quality and service.

This consistent policy has made it possible for us to lift binding posts out of the ruck of price competition and has given you an opportunity to sell EBY posts profitably as quality merchandise which does not deteriorate or go "out of style."

The public recognizes the superior workmanship and materials which go into EBY Posts.

EBY HAS SHOWN THE WAY TO BETTER BINDING POST BUSINESS

ENSIGN *plain*

Imitations and counterfeits are usually short lived. It always pays to sell the genuine and get the full benefit and advantage of a well-established name.

INSIST ON Genuine EBY Posts.

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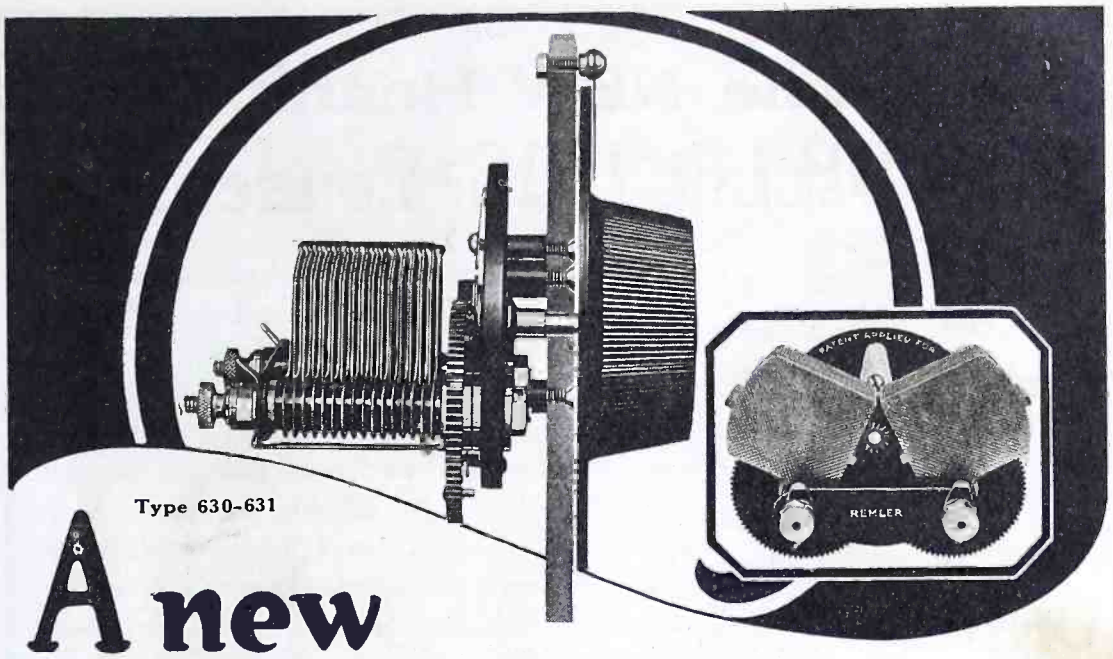
Make Money as a RADIO Demonstrator

Big Opportunity now to everyone who knows how to set up and operate a radio set—also to take orders on a price and term basis more favorable than regular dealers can offer. Your chance to get into the Radio business. Own a set or not, as you choose. Give all or part time to this work.

Write at Once

Give us this information: Age; Business; Do you own a Radio Set?; What kind?; How much time do you want to spend in this work?

Marshall Radio Products, Inc.
Marshall Blvd. & 19th St., Dept 99-36 Chicago, Ill.



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A new Variable Capacity Unit *built by* REMLER

Designed For Use in Any Circuit

Not merely New—but so improved in design and construction that competing equipment becomes obsolete.

Replace your old condenser with the New 1925 Remler Unit — and notice the improvement.

These features are the answer: Minimum Dielectric Loss—Twin Rotors with no Stator Plates—Close Tuning aided by insulation of both sets of plates—Complete Shielding—Lowest Minimum or capacity insuring unequalled tuning range—Maximum to Minimum Ratio 165:1.

No wonder this Remler Unit increases your range and selectivity! Rotation of 360° gives exceptional tuning on short wave lengths—Vernier Tuning over entire capacity through no-back-lash Bakelite Gears—Bearings 1½ in. long eliminate adjustments—Gearing meshes to permit mounting in gangs of two or more 90° limit of Rotor Sections allows pigtail connections throughout.

A PERMANENT RECORD of Dial Settings is easily kept by writing call letters or wave lengths on the renewable paper charts. Molded Bakelite knob screws over four inch dial.

No. 630—Remler Capacity Unit, Minimum .000003, Maximum .00035, Complete with dial $5.00

No. 631—Remler Capacity Unit, Minimum .000003, Maximum .0005, Complete with Dial $5.00

Dial Stop and Indicator are included, also drilling template.

Leading Radio Dealers throughout the United States are now ready to show you this Remler Quality Unit.

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"B" BATTERIES

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EVEREADY

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Rabat Junior (12 cells 24 volts) capacity 800 mil-amps, only, $3.96; Rabat Senior (2800 mil-amps), $9.60. Prices F.O.B. Cleveland, Ohio. If your dealer cannot supply you send direct.

The Radio Rabat Company
814 Bangor Bldg. Cleveland, Ohio

IMPROVED REINARTZ

Continued from page 18

the secondary when tuning long waves. This additional capacity makes it possible to cover a larger band of wavelengths with a given coil. A 23 or 43 plate condenser should be used.

When using the external coils, the primary and secondary switches are set so as to disconnect the short wave coils and connect the antenna, plate condenser, and grid with the binding posts *A* and *C*. As much of the regular plate coil as necessary to secure good regeneration or oscillation should be used. Although the plate coil is not in inductive relation to the external coils, its use sometimes helps to make the set oscillate freely.

A few notes on tuning music should not be amiss. The secondary and plate condensers should be varied simultaneously, keeping the plate condenser in such a position that the tube is just over the "edge" into the oscillating state. When the desired carrier wave is located, the capacity of the plate condenser is decreased until the tube stops oscillating, and then both condensers are carefully readjusted through a few degrees. In this way the maximum audibility can be obtained without allowing the set to oscillate more than a second or two when the carrier wave is first located. Obviously, this method of tuning reduces the QRM from receiver radiation to a minimum. High power broadcasting stations within a radius of several hundred miles can be tuned in without allowing the set to oscillate at all after they have once been located on the secondary condenser dial.

The Last Word
The *Best* Word
In Condensers
The
PROUDFOOT

Nothing like them on the market for accurate logging of stations! Group plate adjustment and finer vernier plate tuning are accomplished with one knob. Exact readings show on two distinctly separate scales. Once you find a station, you can always "tune in" in the future.

Losses Cannot Be Measured!

Stator plates are mounted on two rods instead of the customary three—this cuts inefficient capacities and losses to a negligible quantity. The vernier on the Proudfoot One-Knob Condenser turns a full 360°. Three spring wiping contracts insure positive connection. This eliminates the inefficient and easily broken pigtail.

For best results, install a Proudfoot today! 13 plate (M. F. C. .00025)—$3.75; 25 plate (M. F. C. .0005)—$4.50; 43 plate (M. F. C. .001)—$5.75. Accept no substitute if you want real results. If your dealer cannot supply you, write us.

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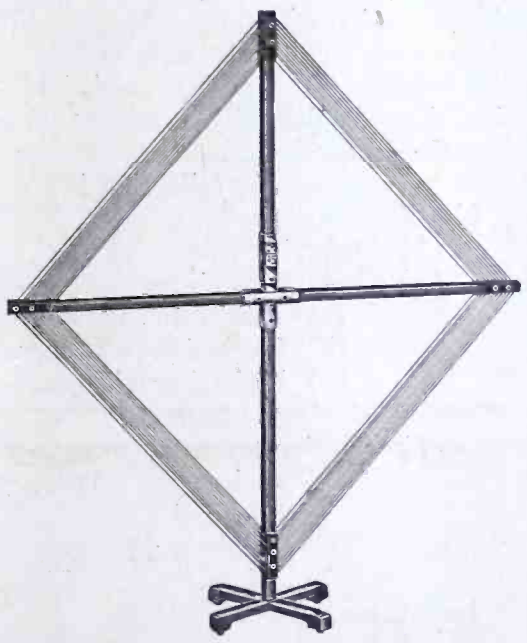

Distance and Clarity of Reception
Elimination of Interference
Convenience in Transportation
Operates on all Broadcasting Wave Lengths
Braided Pure Copper Wire Gives Maximum Efficiency
With Super Heterodyne—Reflex and Radio Frequency Amplification

Some POLLARD Points

Solidly constructed brass hinge with slip joint held in place by automatic latch to insure proper tension of wire when in use and relieve strain when folding for transportation or setting up.
Wires pass through hard rubber—no contact with the wood; consequently perfect insulation and no current losses. Double spiral winding insures maximum efficiency and directional qualities.
Frame and base satin finished mahogany. All metal parts heavily nickel plated.

Retail Price $10.00

Sold to the trade through recognized jobbers

Dealers *write for circular and terms, and if your jobber can not supply you, we will serve you direct.*

Radio Fans—*If you want the best loop you ever saw and your dealer is not sufficiently wide awake to supply you, send us your order with check or money order and we will mail direct, charges prepaid, to any point in the U. S.*

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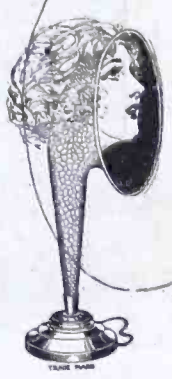
Atlas
TRADE MARK
RADIO REPRODUCTION *speaker*



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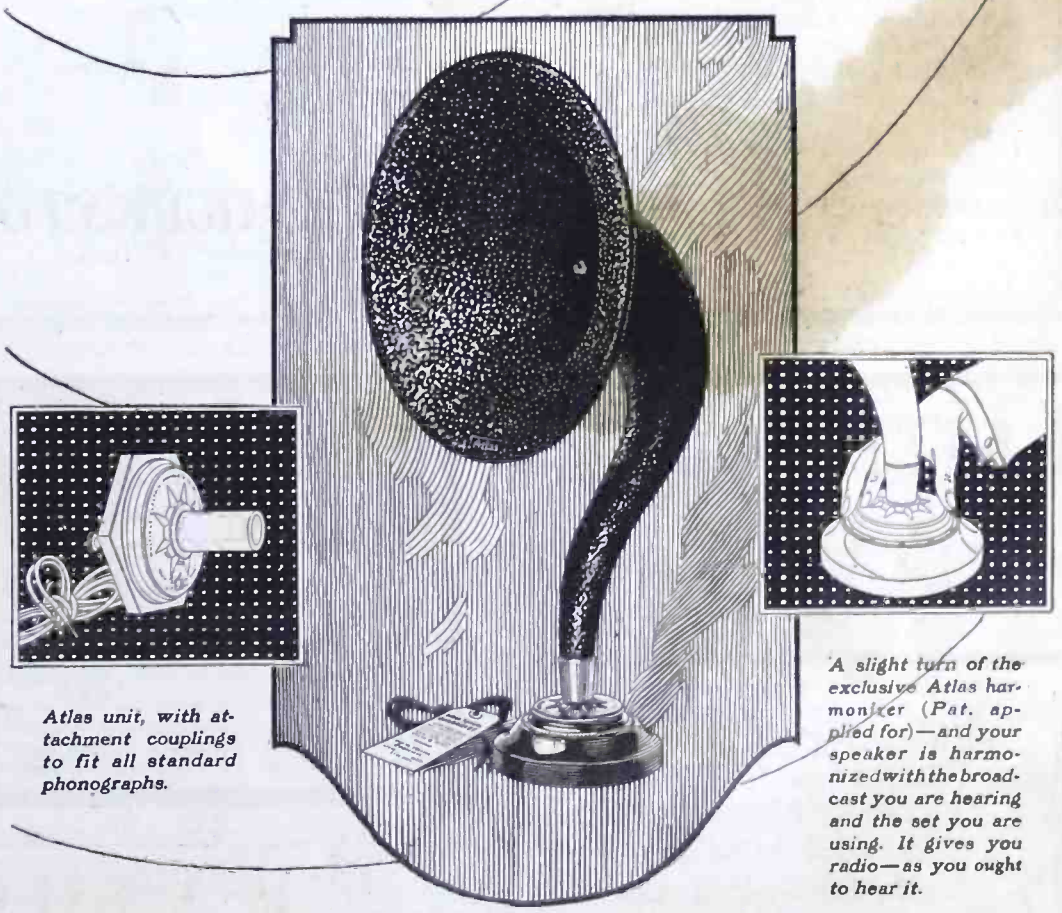


Atlas unit, with attachment couplings to fit all standard phonographs.

A slight turn of the exclusive Atlas harmonizer (Pat. applied for)—and your speaker is harmonized with the broadcast you are hearing and the set you are using. It gives you radio—as you ought to hear it.

New type Atlas with the strikingly beautiful bronze-brown ripple-finish goose-neck horn.

STORAGE BATTERIES

Continued from page 24

them, apply a bit of vaseline on the surface. Do not get vaseline on the point of contact between wires and terminals, as vaseline is an insulator and may cause trouble.

If your charger is one which has the battery leads marked, be sure to place the positive lead on the positive terminal and the negative lead on the negative terminal. This is to insure that the current passes through the battery in the proper way. In some chargers, especially those of the vibrator type, it makes no difference which way connection is made. Follow the instructions with the charger and you will not go wrong.

SUPER-HETERODYNE ADJUSTMENT

Continued from page 30

secondary) and oscillator condensers are varied, the resonance point may be determined. The meter gives a distinct dip as resonance is passed through, which may be easily recognized after a little practice. The relative dip of the meter will also indicate, more or less, the strength of oscillations at that particular setting. A small change generally shows weak oscillations. With a little observation, and general knowledge of the tubes under varying conditions, it should not be difficult to correct and adjust the faults that usually occur.

As a summary the following is given:

No plate current—
- (1) Defective tubes.
- (2) Open plate circuit—
  - (a) Poor tube contact.
  - (b) Opened transformer.
  - (c) Defective wiring.

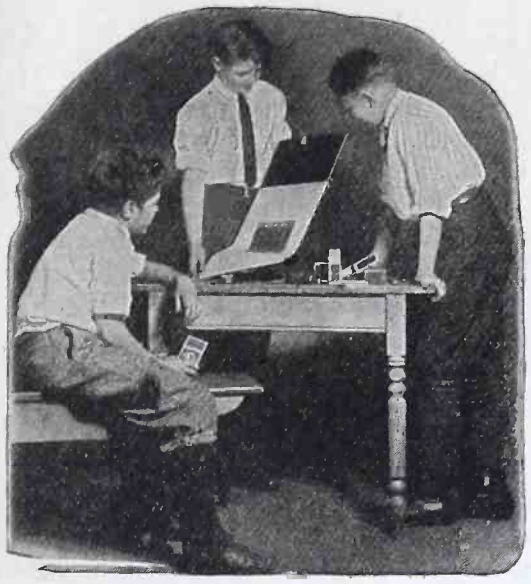
Abnormal plate current—
- (1) Positive potential on grid—
  - (a) *C* battery polarity reversed.
  - (b) Detector grid leak too low.

Low plate current—
- (1) Poor contacts.
- (2) *C* battery too high—follow instructions. See note.
- (3) *B* battery weak or filament low.

NOTE.—With correct *C* battery connections the plate current is very low, as compared to when it is not used. Test this out for yourself.

A buzzing sound—loud and persistent—shows an open grid circuit.

Remember that under the present regulations, amateurs are *entirely forbidden* to transmit between 8 and 10:30 p.m., which is the result of a proposal *by them* for the benefit of the broadcast listener (or BCL). How many of the latter would be willing to *voluntarily* agree, for the benefit of anyone, to keep off the air for two and a half hours during the best part of the whole day?



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MAHOGANITE
Radion Panels

give you both the supreme insulation and the beauty of polished mahogany. For Mahoganite is not a surface finish but a material which extends from one side of the RADION Panel to the other.

21 Stock Sizes
Mahoganite and Black

6x7	7x10	7x24	9x14
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6x14	7x14	7x30	12x14
6x21	7x18	7x48	12x21
7x9	7x21	8x26	14x18
			20x24

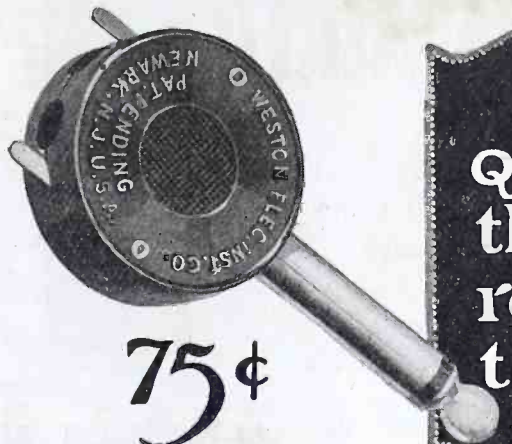
Look for this stamp on every genuine RADION PANEL. Beware of substitutes and imitations.

RADION
The Supreme Insulation
PANELS

Dials, Sockets, Knobs, Insulators

At all good Radio shops, or write to

AMERICAN HARD RUBBER CO.
11 Mercer St., New York



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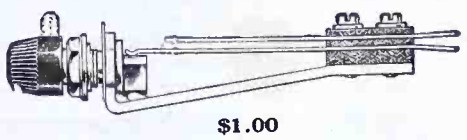

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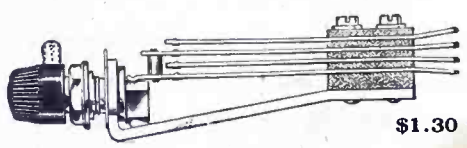

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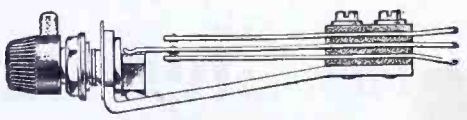

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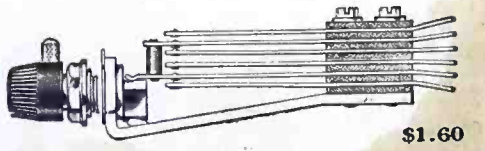

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More and more the demand for a reliable switch, without sliding contacts which wear and make poor contact has been filled by the Carter Jack Switch.

Simple to install, only one hole to drill, mounts like a Jack.

The "On and Off" feature shows clearly at all times the exact position of the switch.

The contact is made by pure silver contacts which do not corrode and cause trouble. A positive sure contact at all times.

For continued satisfaction always insist on genuine Carter products.

Coast Distributors: Atlantic-Pacific Agencies Corp.,
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Any dealer can supply

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5-PLATE CONDENSERS
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In return for your subscription to "RADIO" for one year. Full price $2.50.

"RADIO"
Pacific Building
San Francisco

OPERATION OF TRANSMITTING TUBES

Continued from page 31

of existence when a 250 watt tube was purchased. It never seemed to work as it should, never seemed to be as good as the old 50.

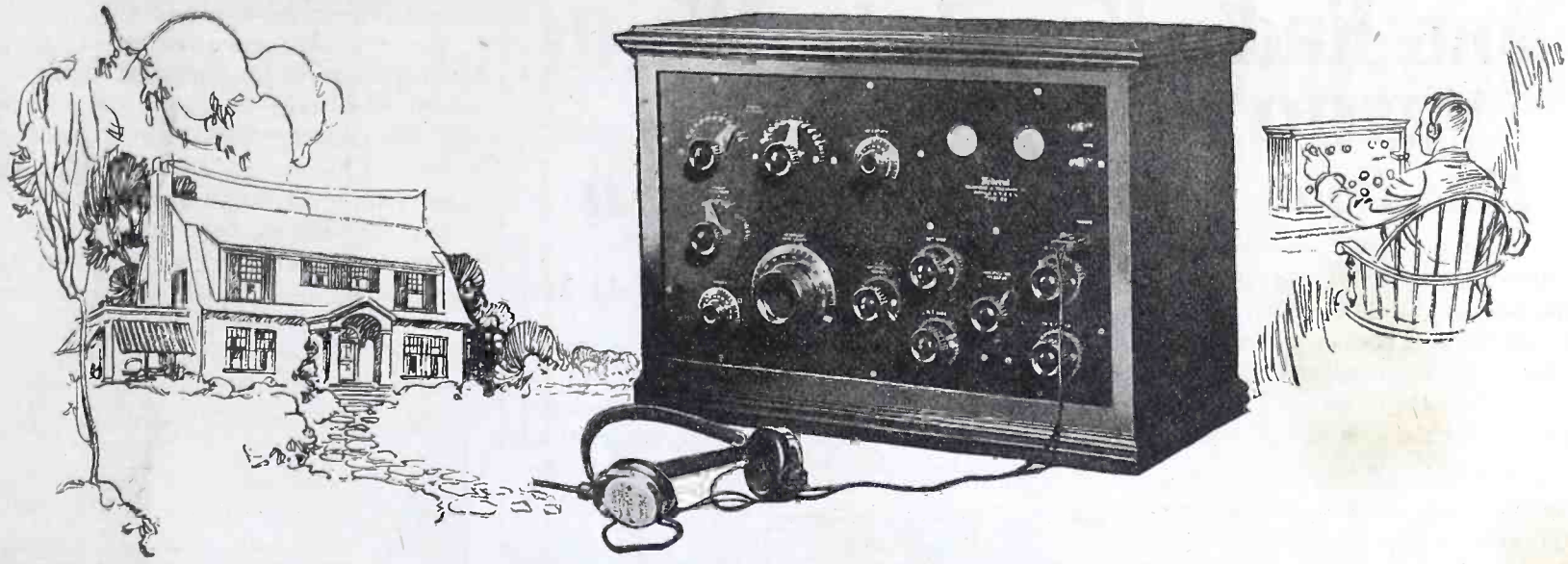
One of the reasons is that perhaps the 50 had 2000 volts on it instead of the normal 1000. The 250 watter does not deliver very much more energy to the antenna at 2000 volts than does the 50 watter at 2000 volts. Many times the 50 watter actually delivers more energy into the antenna, at the same plate voltage.

If, on the other hand, the normal voltage to the 250 watt tube is doubled (to 4000 volts), the antenna ammeter might decide to become very active. Right here, however, is the trick—if trick you wish to call it. The filament voltage of the 250 watt tube then must be raised to 14 volts or so. Its normal is 11 volts, and a great sigh of anxiety will greet this statement of 13 or 14 volts. 6KA and 6AWT will vouch for this statement, I am sure.

Apparently the 250 watt tube is the sturdiest of all the transmitting tubes. Apparently it can be overloaded with greater safety than the others, but unless the "spare" is handy 4000 volts should be considered as the extreme.

One bad custom exists among transmitting amateurs, that of putting the tube behind the panel, or that of screwing the socket close to the table. No free circulation is possible—the air gets heated and stays about the tube. If, on the other hand, the tube is mounted on a lattice work rack, with nothing under, over or very close to the sides, a clean sweep of air can leave the floor, pass the tube and go to the ceiling. No fan will be needed, nor is it desirable as it causes whirring noises, and the blast of air might open up the seal enough to soften the tube. On actual test, the plates were cooler in a rack of this sort even when a 25% greater milliampere input (at the same voltage) was given the tube. This is only one of the methods for making the "one" tube work.

Every man who has a tube set, or who contemplates building one, should spend as much money on the filter system as on tubes. The proportion holds true for the 5, 50 and 250. In this way, maximum output may be secured with the minimum of interference locally. This is really very important, and, in addition, the filtered note is louder at a distance of 1500 miles or more. The unfiltered types of notes may be louder locally and within a few hundred miles, but, at a distance, the purer the better. Anyone who is not willing to incur this expenditure should content himself with the next lower size of tube. The complete installation is the thing; it gives best satisfaction and best results.



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USERS enthusiastically proclaim the Federal "Fifty-Nine" as "Federal's Finest." The "Fifty-Nine" represents the accomplishment of an ideal after over a quarter century's patient striving. It gives all the beauty of Federal Tone, Selectivity and Distance Range, **plus** a simplicity of operation that opens the real thrills of radio to novice and professional alike.

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Atwater Kent	$104
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Grebe, C.R. 12	$175

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We specialize in the installation of complete equipment. Get our prices, they are reasonable. The Warner Guarantee goes with it.

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R3, Model D	$35
Magnavox M4	$25
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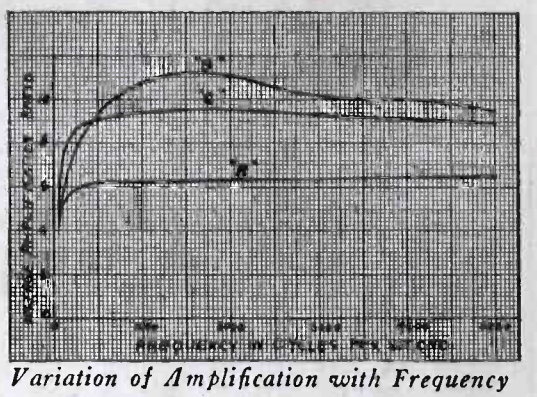
TRANSFORMER IMPEDANCE

Continued from page 19

For transformers used in the last or power stage of an amplifier, there is an added advantage in keeping the secondary impedance down to a moderate value. This results from the fact that, when the grid of a vacuum tube becomes slightly positive with respect to the negative end of the filament, as is likely to occur in the last stage, a small



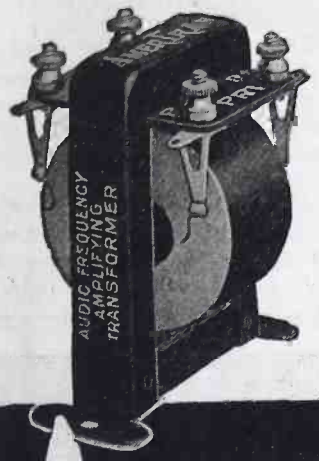
Variation of Amplification with Frequency

grid current flows, increasing rapidly in magnitude as the grid becomes more positive. If the secondary of the transformer had zero impedance, this current would cause no distortion, but, for a high secondary impedance, this current cannot flow rapidly back to the filament, and hence produces a partial neutralization of the impressed positive wave of voltage with resulting distortion.

THE balance of this article describes the methods and equations employed in securing these results. The complete circuit of the bridge is shown in Fig. 1. The impedance bridge network, consisting of branches A and B, R_s and C_s and the transformer under test, was placed in the plate circuit of the first vacuum tube so that the plate current would pass through the transformer windings. The presence of the variable standard capacity C_s as shown, and the 2 mfd. insulating condenser in series with the

Continued on page 70

STANDARD of EXCELLENCE
for audio amplification



Made in two types:

AmerTran AF-6 (Turn ratio 5) for use in the first stage.

AmerTran AF-7 (Turn ratio 3½) the companion transformer for use in further stages of amplification where AF-6 is used in the first stage.

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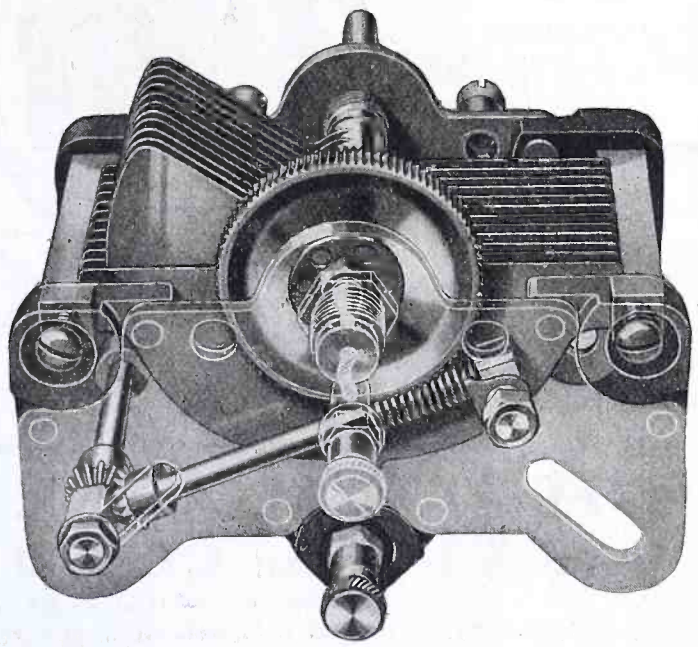

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Continued from page 68

receivers, prevents any direct current from flowing except in the branch containing the transformer and the arm *B*.

In practice, *A* and *B* were equal non-inductive resistances of 6000 ohms each and the resistance *B* therefore caused some reduction in the plate current through the transformer. This was compensated as follows: With the normal plate and grid voltages applied to the first tube and a sample transformer connected in the circuit, the switch *S* was closed. This allowed the normal plate current to flow and the magnitude was noted on the milliammeter in series with the plate battery. The switch *S* was then opened and the plate battery voltage raised until the current was restored to the normal value.

A single frequency current of 1000 cycles was connected by a transformer to the grid circuit of the first tube, and the secondary of the transformer under test was connected to the grid circuit of a second tube to simulate the operating conditions of a regular two-stage amplifier. Means was provided for inserting a grid leak of 0.5 megohms in this circuit for reasons already explained. A milliammeter was provided in the plate circuit of the first tube, both for reading the amount of direct current flowing through the primary of the transformer under test and to prevent overloading of the first tube by introducing too much current from the 1000-cycle oscillator.

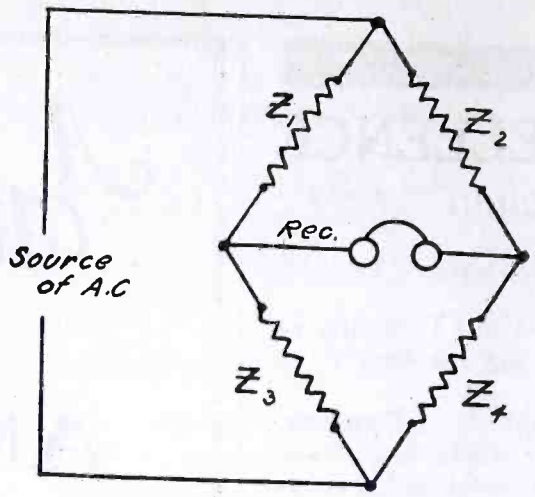

Fig. 3. Impedance Bridge

To measure the impedance of the transformer, the standard variable resistance R_s (1 to 20,000 ohms) non-inductively wound and capacity C_s (.001 to 1 mfd.) are

varied until no sound can be heard in the receivers. It is necessary to set both the resistance and capacity to the proper value in order to produce silence, and the settings are then quite sharp. The accuracy of the data resulting is plus or minus 5%, except in the case of very large impedances, which may be as much as 8% in error. Having determined R_s and C_s, the resistance and reactance components of the transformer may be determined from the mathematical relations in the bridge.

Given an impedance bridge having four impedances, Z_1, Z_2, Z_3, Z_4, arranged as shown in Fig. 3, the condition for balance; that is, no sound in the receivers, is the vector equation $Z_1Z_4 = Z_2Z_3$.

Each impedance may be written in the usual form, $Z = R + jX$, where X is its reactance component, whence for the case of Fig. 1:

$Z_1 = A + j0$ } (The unknown quantities)
$Z_2 = R_u + jX_u$ }

$Z_3 = R_s + jX_s$ } (The R & X components of the standards)
$Z_4 = B + j0$ }

Hence, $AB = (R_u + jX_u)(R_s + jX_s)$ (2)

Expanding, $AB = R_uR_s + jR_uX_s + jX_uR_s - X_uX_s$ (3)

Equating the real and imaginary parts, we have:

$$R_uX_s = -X_uR_s \quad (4)$$

and

$$R_uR_s = AB + X_uX_s \quad (5)$$

Solving the simultaneous equations (4) and (5), by ordinary algebra, we obtain:

$$R_u = \frac{AB\,R_s}{R_s^2 + X_s^2} \quad (6)$$

$$X_u = \frac{AB\,(-X_s)}{R_s^2 + X_s^2} \quad (7)$$

Equations (6) and (7) will determine the resistance component R_u and the reactance component X_u of the transformer, since all of the quantities

Continued on page 73

THE GRID LEAK

Continued from page 34

directly-coupled circuit is used, however, as in the tuned-plate circuit shown in Fig. 2, the leak should be connected as shown, between the grid side of the condenser and the filament lead. This connection should also be used when resistance coupling between high frequency and detector tubes is employed.

Grid leak values are elastic and very little difference in the strength of received signals will be noticeable in most standard circuits at any value between 1 and 4 megohms. It is much better, however, to utilize a fairly high grid leak value when weak signals are desired, and a low value when strong signals are being received.

REMLER CONDENSER

Continued from page 42

tings of 20 and 180 degrees, corresponding to wavelengths from 150 to 580 meters using a standard inductance of 50 turns. Panel mounting is facilitated by a template with three holes for mounting screws and one for the ¼-in. shaft. Less space is occupied than by the usual type of condenser.

The construction is unusually sturdy and the bakelite gears operate without back-lash. The gears of two or more units may be meshed for "gang" mounting with single control. The construction and design eliminates body capacity and minimizes losses so that weak distant stations can be brought in with ease. Pig-tail connections are used.

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Continued from page 71

in the right members of these equations are known. The total impedance of the transformer is then:

$$Z = \sqrt{R_u^2 + X_u^2}$$

It will be noted that to measure a positive (inductive) reactance X_u, a negative (capacitative) reactance X_s must be used; hence the use of the capacity C_s in the bridge.

The reactance C_s is:

$$X_s = -\frac{10^6}{2\pi f C_s}$$

where "f" is the frequency and C is expressed in microfarads.

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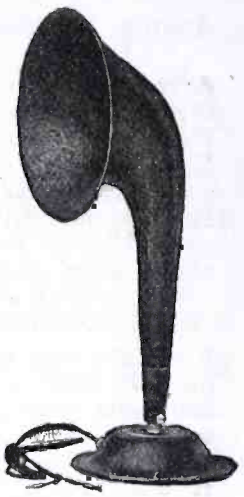

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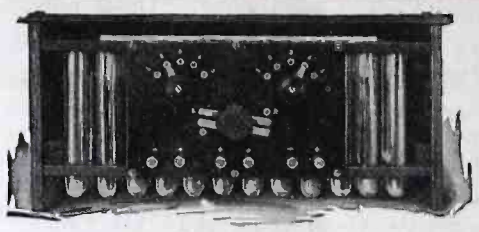

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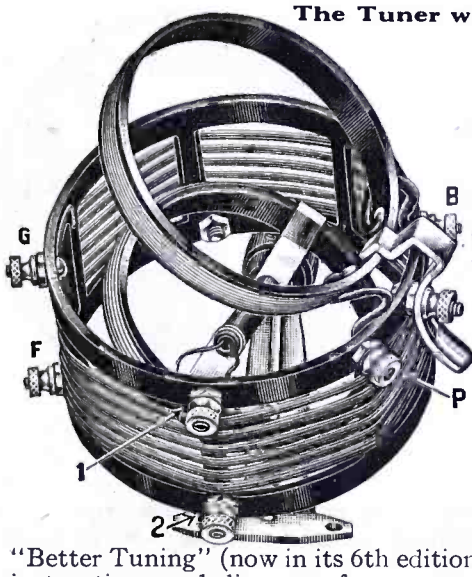

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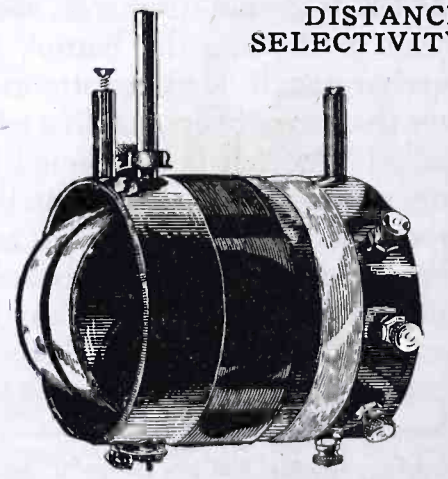

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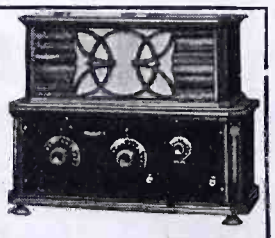

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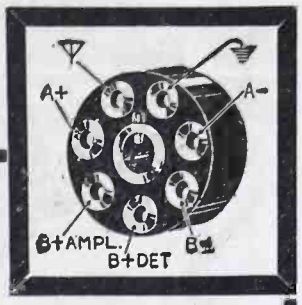

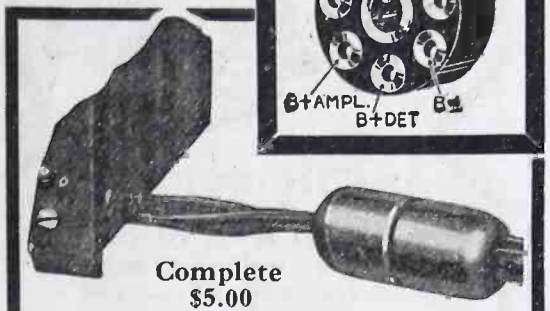

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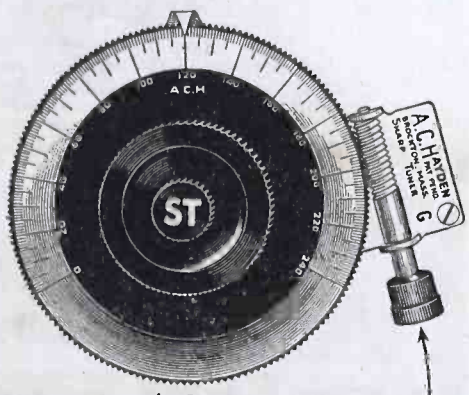

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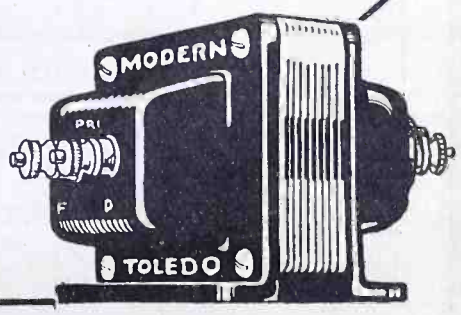

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ULTRADYNE (Super-Heterodyne) for sale. Complete with 8 tubes, loud speaker, batteries, and RECTIGON charger, $180.00. WILLARD, 1950 Hopkins St., Berkeley, Calif.

THE ARISTOCRAT OF AMPLIFIERS

Quality in Radio is No Less Marked Than Quality in people. The Resistance Coupled Amplifier is a Quality Product.

DAVEN COMPLETE AMPLIFIER KIT

3-Stage..... $13.50
4-Stage..... 17.00

KITS without sockets and condensers:

3-Stage..... $ 8.50
4-Stage..... 11.00

Read "Resistors, Their Practical Application in Radio Reception." By Zeh Bouck. Price, 15 cents.

Also read, "The How and Why of Resistance Coupled Amplification." Price, 10 cents.

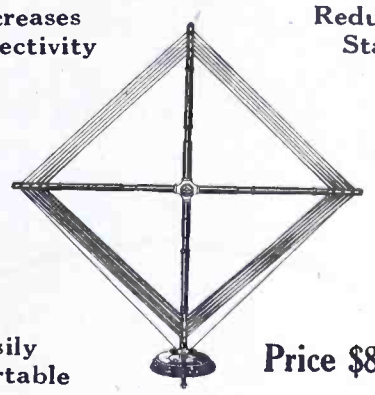
DAVEN RADIO CORP.
"Resistor Specialists"
9-11 Campbell Street
Newark, N. J.

These booklets may be obtained from your dealer.

DUO-SPIRAL

FOLDING LOOP

Increases Selectivity — Reduces Static



Easily Portable — **Price $8.50**

Patents pending

The highest development in a portable aerial. Compact, convenient and self contained. No outside aerial or ground wire necessary. Can be used **anywhere.** Brings in distant stations with remarkable volume.

The **Duo-Spiral** has a swivel base graduated in degrees for calibration. A convenient handle permits adjustment without body capacity effects. It has been adopted as standard equipment by leading manufacturers. Its handsome silver and mahogany finish harmonizes with the finest furniture. The folding feature makes it easily portable.

Duo-Spiral is made by the manufacturers of **Tiny-Turn,** the superior vernier control which makes perfect tuning easy. If your dealer is unable to supply you with either of these standard products, write us direct.

RADIO UNITS INC
1303 First Avenue **Maywood, Ill.**

The three most powerful circuits combined in one single receiver

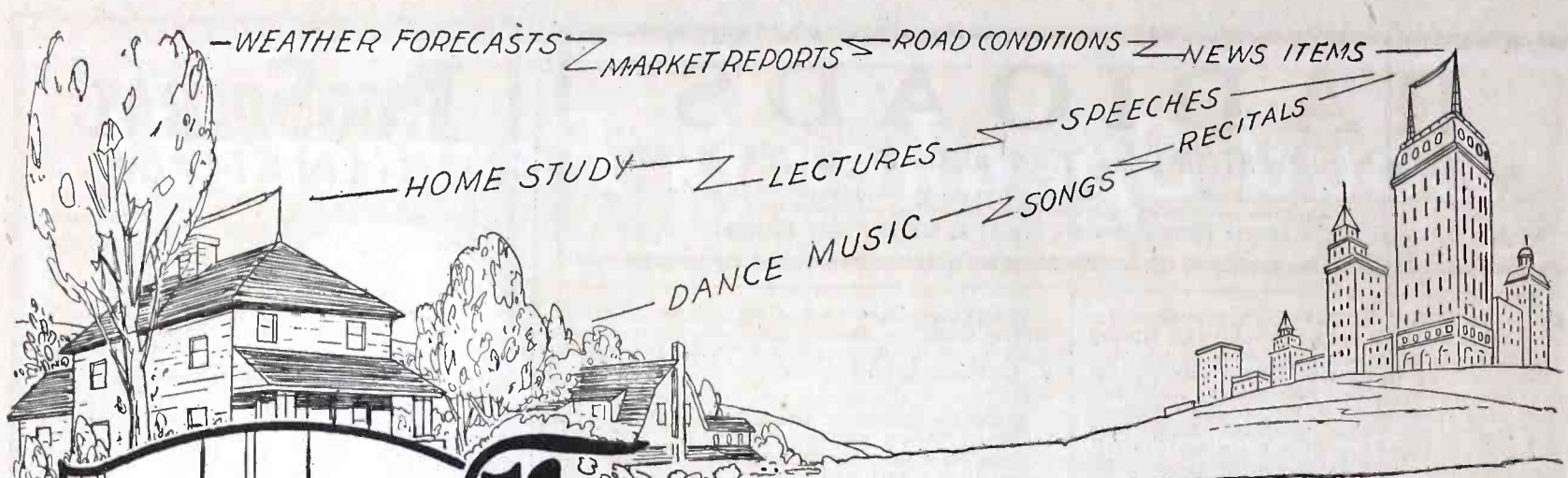
SEND 10 cents for booklet containing diagram and instructions for building this wonderful Shamrock-Harkness set.

SHAMROCK MANUFACTURING CO.,
Dept. 54, Market St., Newark, N. J.

SHAMROCK
FOR SELECTIVE TUNING

SHAMROCK MANUFACTURING CO.,
Dept. 54, Market St., Newark, N. J.
I enclose 10 cents (U. S. stamps or coin) for copy of "Shamrock Radio Builder's Guide Book," containing log record. Also diagrams and instructions for building 10 sets at prices ranging from $15 to $50.

Name_____
Address_____
Dealer's Name_____



For Sharper Tuning

Use Allen-Bradley Products

Selectivity depends upon the combined efficiency of all parts of your radio set. One poor device in your hook-up frequently offsets the effectiveness of the rest of the set. For this reason, only well-known, tested radio parts, such as Allen-Bradley products, should be selected for maximum efficiency and selectivity.

Bradleystat
PERFECT FILAMENT CONTROL

$1.85
For All Tubes

This remarkable radio filament rheostat, utilizing graphite discs, instead of coiled wire, stands supreme for noiseless, stepless control. It is standard equipment on many fine sets.

Bradleyleak
THE PERFECT GRID LEAK

$1.85
¼ to 10 Megohms

Proclaimed by Crosley, Kennedy, Amrad, Cockaday, Flewelling, and other leading radio experts, as the perfect grid leak. A range of ¼ to 10 megohms assures maximum efficiency for all tubes.

Bradleyohm
THE PERFECT RESISTOR

$2.00
No. 10
10,000 to 100,000
No. 25
25,000 to 250,000
No. 50
50,000 to 500,000
ohms

A highly-praised adjustable resistor for radio circuits. It is made in three sizes, and provides a marvelously smooth and noiseless variation that assures rapid adjustment to the point of highest efficiency.

Bradleyometer
THE PERFECT POTENTIOMETER

$2.00
for 200 ohm
$3.00
for 400 ohm

Another Allen-Bradley contribution to radio. Made in two sizes for all types of radio frequency circuits. No coiled wire to slip or break in operation.

Bradleyswitch
PERFECT BATTERY SWITCH

60c
for A or B batteries

A totally-enclosed convenient battery switch for A or B-battery circuits. Requires only one hole in panel for mounting, and is completely protected against accidental injury. Saves batteries and tubes.

Allen-Bradley Co.
Electric Controlling Apparatus

288 Greenfield Ave. — A-B — Milwaukee, Wis.

Manufacturers of graphite disc rheostats for over twenty years.

Allen-Bradley Co.
288 Greenfield Ave., Milwaukee, Wis.
Please send me a complete set of your bulletins of Allen-Bradley radio products.

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Loud Speaker is Perfected!

Human Voice and Music Now *Actually* Reproduced over Radio

The slap-stick assembled loud speaker consisting of a phone unit attached to a horn and absolutely void of any engineering principles has placed radio in contempt. Rather than tolerate its irritating noises mixed with uncanny tones, many still prefer the headsets. A faithful reproduction of the original tones—free from all noises—was necessary before radio could be changed from a braying novelty to a refined medium of entertainment. To reach this goal, it has been conceded by experts that a radical departure in the construction of loud speakers must be made.

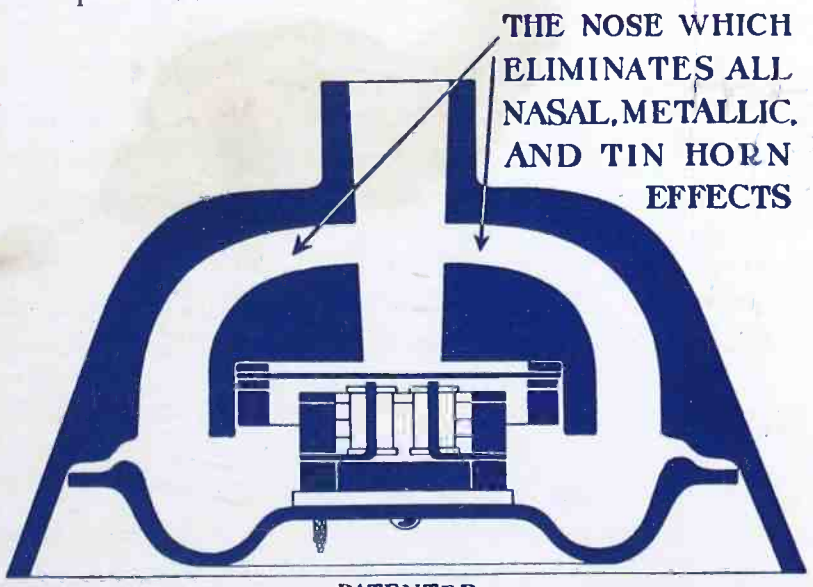
The Loud Speaker of Tomorrow Must Positively be Built

Along acoustical lines, not merely advertised as such.
Only as a reproducer, not as a reproducer and a producer.
Without a resonance that will shade the original reception into a deep down-in-the-well reproduction.

Before

A clear re-creation of the fundamental tones and their overtones—free from all internal noises—is possible.
Such only is the loud-speaker Echo-Tone.

ECHO-TONE is built upon the principles of catacoustics—the science of reflected sounds or echoes—because it was discovered that the sound waves and air back of the diaphragm needed attention. In other words, the loud speaker needed a nose, and by giving Echo-Tone a nose—the loud speaker was perfected.



PATENTED

Echo-Tone
"The loud speaker with a nose."

Equally adapted to sets using dry or wet A batteries—no extra power needed.

Dia. Horn	16 in.
Height	24 in.
Weight	5¾ lb.
Color	Silver Tone
Material	Aluminum

Durable—Fool-proof.

Price $30.00

Throw away your headset! Waiting *now* is wasted time; for that Loud Speaker of Tomorrow is here Today! Order immediately and allow the whole family to enjoy in advance the new improved 1925 model Echo-Tone.

WILLIAMS RADIO COMPANY

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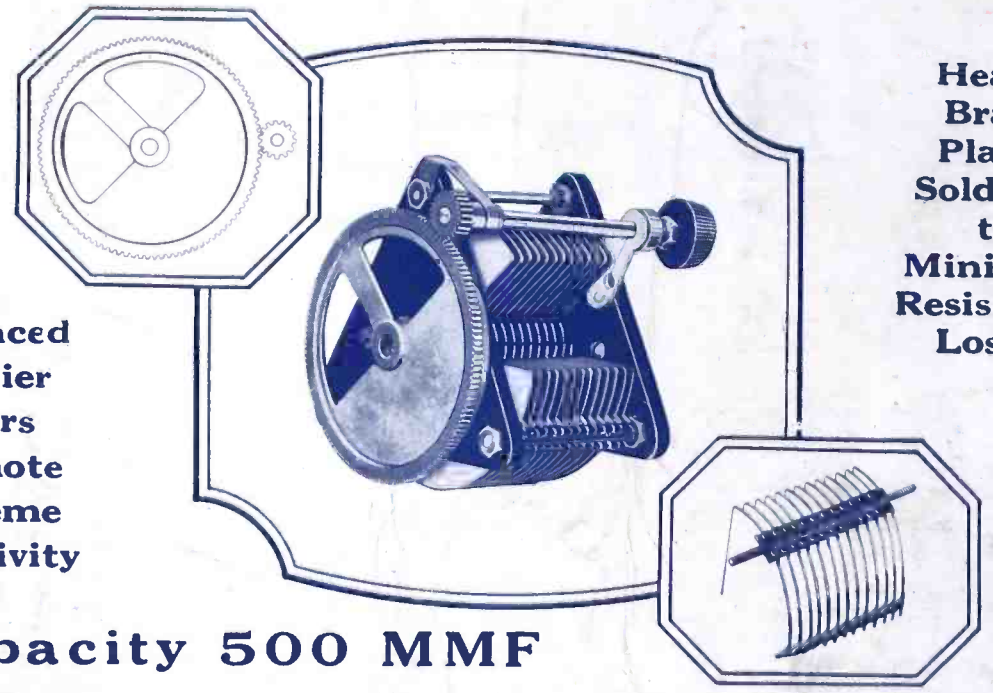
"THE CHOICE OF RADIO EXPERTS"

Designed for PRECISION



Balanced Vernier Gears Promote Extreme Selectivity

Heavy Brass Plates Soldered to Minimize Resistance Losses

Capacity 500 MMF

Price $5.00

The outstanding feature of a GENERAL RADIO condenser is PRECISION.

PRECISION in a variable condenser gives you the *sharp tuning* and *low losses* which mean *greater selectivity, signal strength and range.*

Balanced ratio gears with accurately machined teeth provide *a perfect vernier adjustment.*

Heavy brass plates of the rotor and stator groups are correctly spaced and *soldered*, thereby reducing resistance losses to a minimum.

This method of soldering makes the whole condenser assembly more rugged and assures the perfect alignment of plates which keeps capacity values constant.

Type 247-H 500 MMF with vernier $5.00

Type 247-F 500 MMF without vernier 3.25

For Sale by Good Radio Dealers Everywhere

GENERAL RADIO Co
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