FEBRUARY, 1924 25 CENTS

RADIO

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

Winners of the Cunningham $5000.00 Window Trim Contest held during Cunningham National Tube Week

September 24th to October 1, 1923

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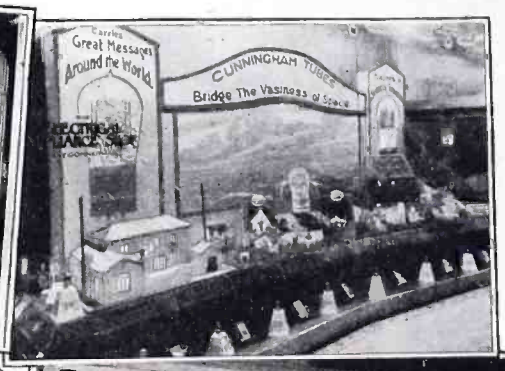

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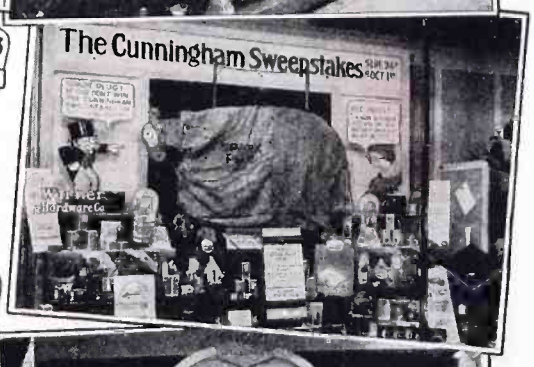

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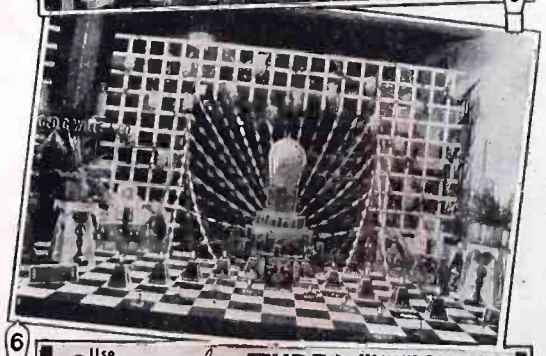

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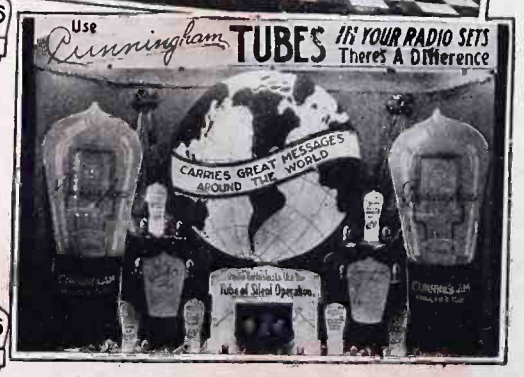

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The Judges for the Cunningham 5,000 Window Trim Contest held during Cunningham National Radio Tube Week, September 24th to October 1st, 1923, have after due deliberation, from a disinterested and unbiased viewpoint, allotted the fifty-one prizes as stipulated in the rules of the contest, declaring a tie for sixth place. Following are the names and addresses of the Radio Dealers who shared in the awards and the manner in which the prizes were awarded:

Lester's Radio Shoppe, Los Angeles, Calif.	$1000—First Prize
Hennepin Hardware Company, Minneapolis, Minn.	750—Second Prize
Electrical Appliance Shop, Los Angeles, Calif.	500—Third Prize
Warner Hardware Company, Minneapolis, Minn.	250—Fourth Prize
Pincus & Murphey, Alexandria, La	150—Fifth Prize

There being a tie for sixth place, the same prize has been allotted to the two dealers participating in the tie, increasing the total amount of the prizes from $5,000 to $5,100.

Geo. C. Wille & Company, Canton, Ohio	$100—Sixth	Tie
Hook Drug Company, Indianapolis, Ind.	100—Sixth	

$50 HONORABLE MENTION

The forty-five prizes as stipulated in the rules of the Contest are awarded to the following Cunningham Radio Tube Dealers for windows of Honorable Mention:

Banister & Pollard Co., Newark, N. J.
W. E. Berry—Radio, Waco, Tex.
Jesse C. Cutler, Brookings, So. Dakota.
Ehrler Radio Co., Chicago, Ills.
Equipment Sales Co., San Diego, Calif.
Ervin's Electrical Co., Parsons, Kans.
Evers Hardware Co., Denton, Tex.
Fortner Camera Supply Co., Sterling, Colo.
C. H. Gilliam's Radio Store, Brownwood, Texas.
Robert A. Goodall, Ogallala, Nebr.
Thos. J. Green, Winona, Minn.
Haskell Electric Co., Holyoke, Mass.
Lazar & Son Music Center, Chicago, Ills.
Long Beach Radio Shop, Long Beach, Calif.
H. Lesser & Company, Cleveland, Ohio.
Lindemann Auto & Machine Co., Enderlin, No. Dak.
Louis D. Rubin Elec'l. Co., Inc., Charleston, S. C.
Mason, Pyle & Parkhurst Radio Co., Webster City, Ia.
Mid-Continent Radio Corpn., Ft. Worth, Tex.
Midwest Radio Co., Kansas City, Mo.
Murphy Maclay Hardware Co., Great Falls, Mont.
Newark Radio Supply Co., Newark, N. J.
Oscar A. Huelsman, Fond du Lac, Wis.
Paramount Radio & Elec. Co., Atlantic City, N. J.
H. Y. Parrott, Dennison, Tex.
Pfahl Electric Co., Cleveland, Ohio.
Prest Electric Co., San Bernardino, Calif.
P. S. Radio Service Co., Cleveland, Ohio.
QST Radio Shop, Tacoma, Wash.
Radio Sales & Repair Co., Cleveland, Ohio.
E. M. Sargent Co., Oakland, Calif.
Selby & Reed, Martins Ferry, Ohio.
Harry H. Smith, Decatur, Ills.
Southern Pbg. & Elec. Co., Taylor, Tex.
Stoehrer's Electric Shop, Oxnard, Calif.
H. C. Tafel Co., Louisville, Ky.
The Broadcast Shop, Washington, D. C.
The Brown Pharmacy, Chanute, Kans.
The Motor Supply Co., Seattle, Wash.
The Radio Distributors, Long Beach, Calif.
The Salzer Electric Co., Cleveland, Ohio.
Thibaut & Mautz Bros., Marion, Ohio.
Weed's Radio Shop, Portland, Ore.
Willapa Electric Co., Raymond, Wash.
Wolf Electric Co., Beaver Falls, Penn.

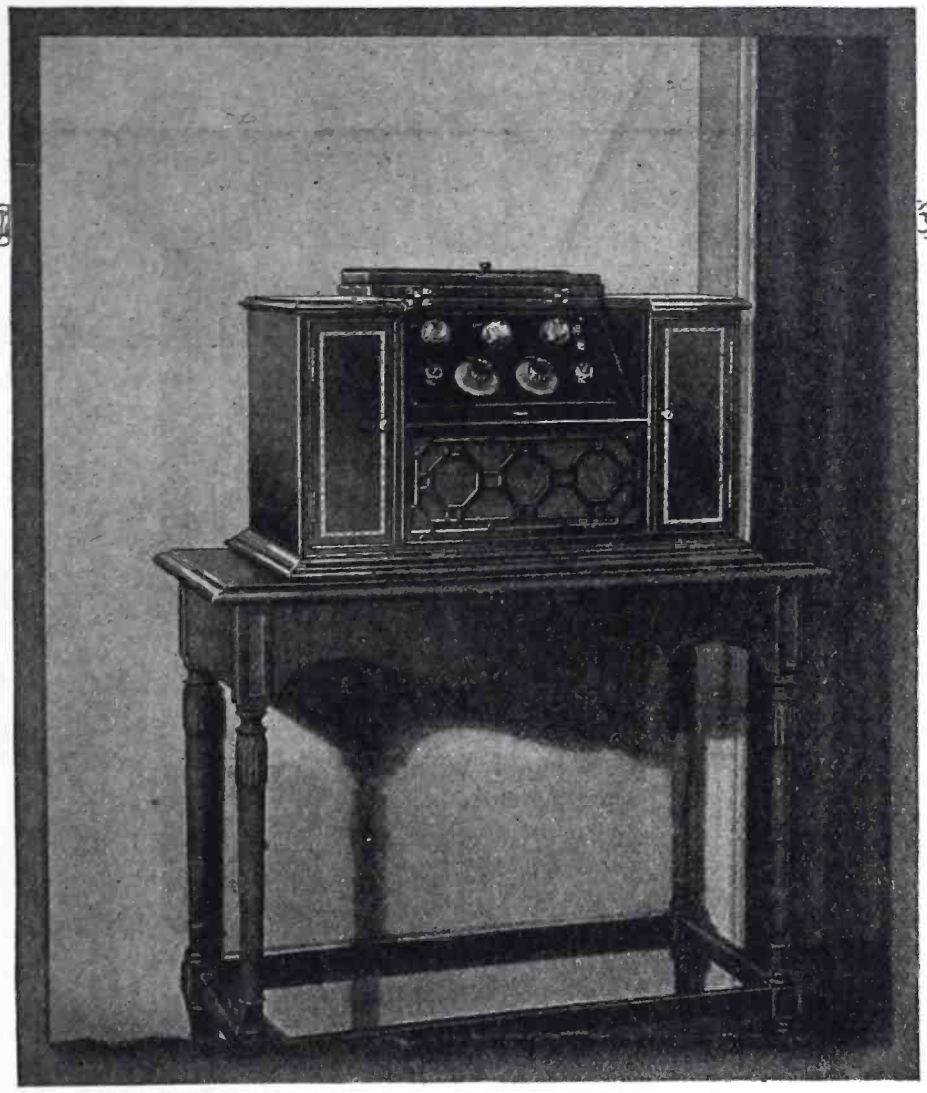
We take this occasion to extend our deep appreciation to the thousands of Radio Dealers located all over the country who so whole-heartedly entered into the contest and while many of them did not carry off one of the prizes they nevertheless have placed themselves in the front ranks of live Radio Dealers in their respective localities and have the hearty co-operation and earnest support of this organization.

R. J. Cunningham Inc.

Home Office: 182 Second St. San Francisco, Calif.

154 West Lake Street Chicago, Illinois

30 Church Street New York City, N. Y.



Model X

$285, Fully Equipped With Built-in Loud Speaker

This radio receiving unit is a newly perfected development of the Kennedy Engineering Staff. It is unusual in that it combines extreme simplicity of operation with the same scientific accuracy and selectivity that characterized the earlier Kennedy models. After an initial setting is made only one dial is required for all tuning. And, when a dial setting of a station is once determined, that station will always "come in" at its own setting regardless of where the receiver is used.

It is stable in operation, reproduces music and voice with remarkable faithfulness and has established some unusual distance records. Responds to all broadcast wave-lengths—operates on any antennae, outside type preferred. "Re-radiation" has been practically eliminated.

Beautiful Radio Furniture— *the* New Kennedy Receiver, Model X

As a graceful piece of furniture, the Kennedy Radio Receiver, Model X, makes a charming addition to any home. The cabinet is of mahogany, hand rubbed to a beautiful finish—with its delicate inlay of satinwood and ebony and the grill at the front, it is truly typical of the Sheraton design. A loud speaker of superior quality is built into the cabinet—by this means faithful reproduction of music and voice is available to an entire family or assembly of guests.

The control panel is symmetrically balanced and immediately indicates the remarkable ease with which the receiver may be operated—the angle at which it is set is the result of much study to provide greater comfort while tuning.

The receiving unit in Model X is everywhere recognized as one of the most noteworthy achievements in radio development—particularly since it sets a new standard of operating simplicity in combination with the precision and selectivity that have always been a feature of Kennedy radio receivers.

The price of Model X, completely equipped with all tubes, dry batteries, built-in loud speaker and individual Kennedy 3,000-ohm phones, with plug, is $285.00. Other models range from $125.00 to $825.00, completely equipped.

Ask your dealer to show you the new Kennedy Radio, Model X, or write us direct for fully illustrated literature.

THE COLIN B. KENNEDY COMPANY
St. Louis San Francisco

All Kennedy receiving sets are regenerative.
Licensed under Armstrong U. S. Patent No. 1,113,149.

KENNEDY

The Royalty K *of Radio*

Tell them that you saw it in RADIO

RADIO

Established 1917 as Pacific Radio News

Volume VI *for February, 1924* *Number 2*

CONTENTS *for* FEBRUARY, 1924

RADIO is Published Monthly by the Pacific Radio Publishing Co., Inc., Pacific Building, San Francisco, Calif.

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Entered as second-class matter at the Post Office at San Francisco, Calif., under the Act of March 3, 1879.

Forecast of Contributions for March Issue

D. B. McGown has two fine articles. One gives the constructional details of "An Ideal Short Wave Regenerative Receiver" which he has just built. The other tells how nickel plating is done.

Paul Oard continues his Radio Construction Pointers with some good ideas on condensers, switch points and knobs, panels, and soldering. He also tells how to make a single tube reflex receiver.

Don Lippincott has some good advice on "Sensitive Receivers."

Maurice Buchbinder presents a handy chart of inductance and capacity values corresponding to any wavelength from 100 to 1000 meters.

John F. Rider describes the construction of a selective receiver designed for 80 to 220-meter reception with a minimum of tuning controls. This should be of especial value to the amateur operator.

The fiction feature is a real radio story, "To Sea or Not to Sea", by Preston D. Allen, an old-time operator.

S. G. McMeen tells how to make a winder for honeycomb coils.

Florian J. Fox discusses "Modulation".

Edward T. Jones treats of "Misconceptions of Radio".

Alexander Maxwell gives some interesting facts on the condenser loop.

W. S. Thompson, Jr., has written some helpful "Notes on Distortionless Amplification".

Charles F. Filstead has an article on "A Reflex Receiver for Beginners".

P. J. Townsend gives the details of the "super-autodyne" circuit.

F. L. Allrich describes a motor buzzer transmitter.

M. Wolf has an article on "Tone Transmission for Amateurs".

Advertising Contests Award

The judges of the advertising contest announced in the February issue have selected the letters written by the following as the winners: $15.00 first prize, S. R. Winters, Washington, D. C.; $10.00 second prize, P. B. Stapp, Muncie, Ind.; $5.00 third prize, E. J. Nicholson, Syracuse, N. Y.; $1.00 4th to 20th prizes—R. P. Anderson, Berkeley, Calif.; W. D. Budge, Chicago, Ill.; E. O. Knoch, Los Angeles, Calif.; K. A. Cantin, Honolulu; H. N. Bowman, New York City; Albert E. Lemay, Manchester, N. H.; E. C. Mann, New York City; J. J. O'Malley, Chicago, Ill.; W. L. Snyder, Clarksville, Va.; F. D. Vercellino, Dickinson, No. Dak.; J. N. Howell, Jr., San Jose, Calif.; G. T. Foster, Dayton, Ohio; James Wallace, Mt. Vernon, Wash.; K. Kelsey, Schenectady, N. Y.; Don F. Towns, Ft. Worth, Texas; H. H. Bein, Los Angeles, Calif.; E. Kampf, Washington, D. C.

Form 1204

CLASS OF SERVICE	SYMBOL
Telegram	
Day Letter	Blue
Night Message	Nite
Night Letter	N L

If none of these three symbols appears after the check (number of words) this is a telegram. Otherwise its character is indicated by the symbol appearing after the check.

WESTERN UNION TELEGRAM

NEWCOMB CARLTON, PRESIDENT GEORGE W. E. ATKINS, FIRST VICE-PRESIDENT

CLASS OF SERVICE	SYMBOL
Telegram	
Day Letter	Blue
Night Message	Nite
Night Letter	N L

If none of these three symbols appears after the check (number of words) this is a telegram. Otherwise its character is indicated by the symbol appearing after the check.

RECEIVED AT 21 NORTH WASHINGTON ST.
JAMAICA, N.Y.

49N CO 41 COLLECT BLUE

AVALON CALIF 925A NOV 27 1923

DOUGLAS RIGNEY

A. H. GREBE AND CO. VANWYCK BLVD RICHMOND HILL NY

USING GREBE THIRTEEN BROKE ALL SPEED RECORDS EARLY TODAY STOP RECEIVED MESSAGE FOR MIX FROM BOYD PHELPS STATION ONE HAVE XRAY HARTFORD CONNECTICUT DIRECT STOP TRANSMITTED DIRECT TO MIX AND RETURNED ANSWER TO HARTFORD IN FIVE MINUTES AND SIX SECONDS

MAJOR LAWRENCE MOTT

220P

California to the Arctic

Again it is our privilege to congratulate Major Lawrence Mott, 6XAD-6ZW, upon a splendid achievement.

Effecting direct communication with both Hartford and the "Bowdoin" and relaying a message and its answer between them is a feat of which anyone might well be proud.

That so able an operator as Major Mott should use a Grebe "13" for such work is significant.

Ask your dealer or write us.

A. H. GREBE & CO., Inc.

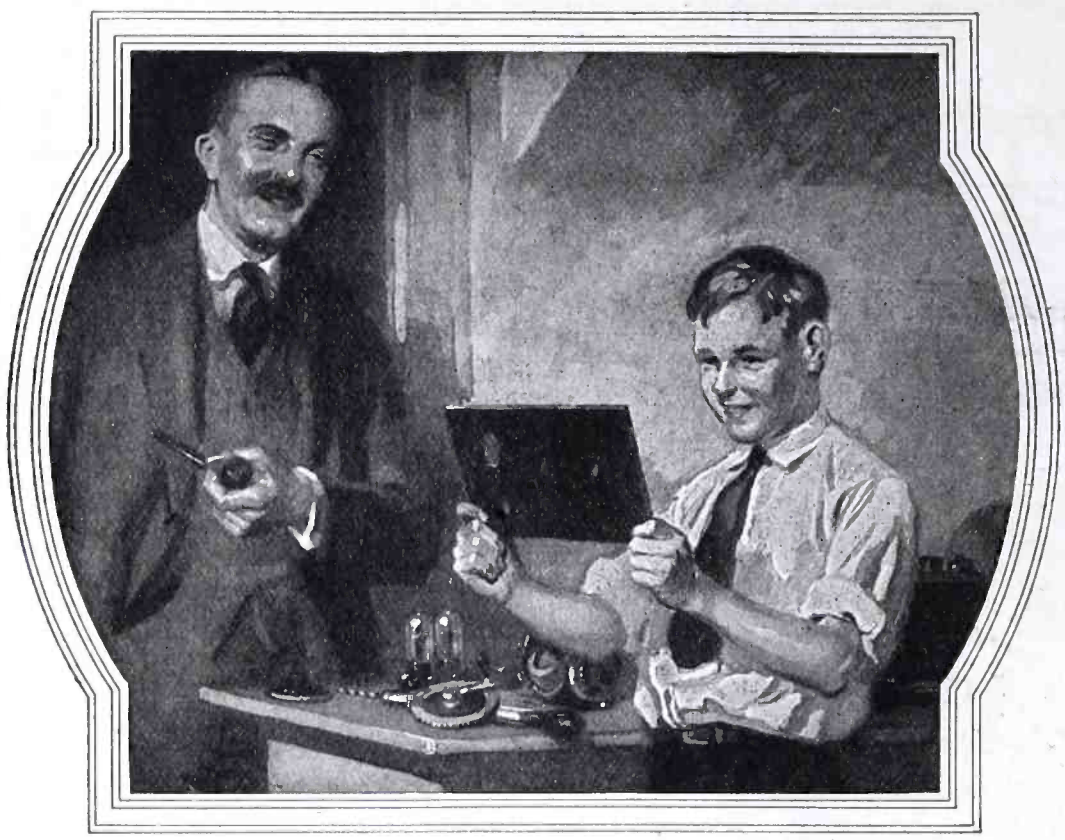
79 Van Wyck Blvd. Richmond Hill, N. Y.
Western Branch: 451 East 3rd Street, Los Angeles, Calif.

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

In the real test of DX performance the Grebe "13" establishes its true merit.

Doctor Mu

Licensed under Armstrong
U. S. Pat. No. 1,113,149



Now for the hook-up

THE radio set builder's eyes shine with pride as he inspects his drilled Celoron panel. He has done a good job. The finely finished Celoron panel reflects his good workmanship. He is ready to mount his instruments and make the final connections.

A Celoron panel insures good looks to the radio set. Celoron panels are finished in black, oak and mahogany. Each Celoron panel is wrapped in a dust-proof glassine envelope to protect its lustrous surface. Grit cannot scratch it. Hands cannot fingerprint it. You are the *first* to unwrap it.

Celoron has high dielectric strength. It is approved by the U. S. Navy Department Bureau of Engineering and the U. S. Signal Corps.

Special-sized Celoron panels are cut to order from sheet Celoron. Standard Celoron panels come cut and trimmed, ready to use, in these sizes:

1—6 x 7 x ⅛	5— 7 x 18 x 3/16
2—7 x 9 x ⅛	6— 7 x 21 x 3/16
3—7 x 12 x ⅛	7— 7 x 24 x 3/16
4—7 x 14 x 3/16	8—12 x 18 x 3/16
9—7 x 26 x 3/16	

Write for our interesting booklet—"*Getting the Right Hook-Up.*" Sent *free* upon request.

To radio dealers: Send for special dealer price list showing standard assortments

Diamond State Fibre Company

BRIDGEPORT (near Philadelphia) PENNSYLVANIA

Branches in Principal Cities

Toronto, Canada - - - London, England

CONDENSITE CELORON

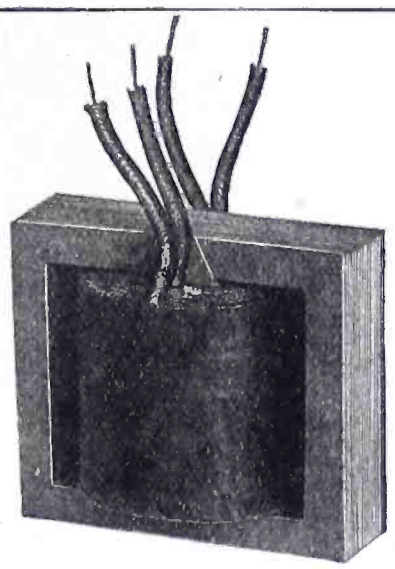
STANDARD RADIO PANEL

Tell them that you saw it in RADIO

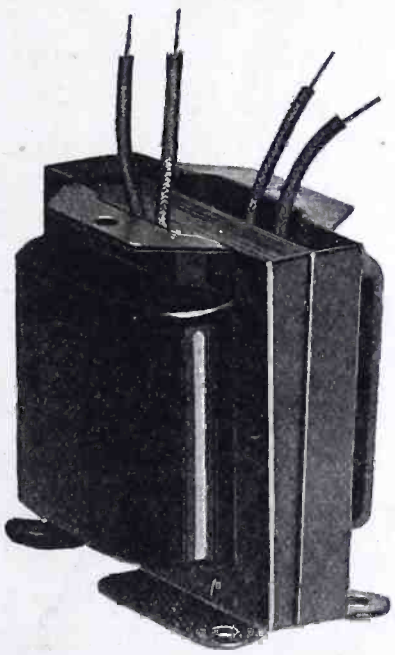
A Transformer of Real Merit

Amplification of Entire Musical Range Free from Distortion

The winding that Kellogg developed, was found to be most efficient for audio frequency transformers. Its problems involved the finding of the proper thickness of paper, the proper kind of insulated wire to provide the proper number of ampere turns, and impedence.

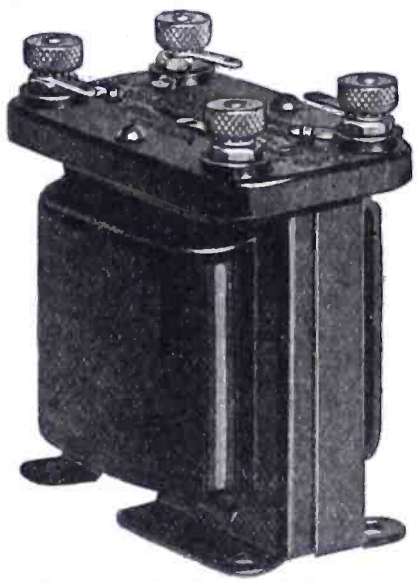


The one-piece laminations of silicon contain no punched holes, which in many other transformers causes eddy currents and losses. The one-piece lamination is exclusively a feature of the Kellogg transformer. It provides an exceptionally true electro-magnetic core.



To correctly shield these transformers that they may be mounted in any position desired without losses, this brass shield was designed. It is so arranged that both sides are interchangeable, locking together at the base. They are finished in a handsome maroon enamel.

The wires extend through the Bakelite top, which affords perfect insulation, and are soldered to the terminals in plain sight, where they may be inspected. This also eliminates any possibility of breakage of transformer leads.



The finished job, of which we are mighty proud. The leads are soldered to tinned terminals, which are under nickel plated nuts over which are placed knurled nuts. Each binding post is plainly marked so that it is impossible to make incorrect connections.

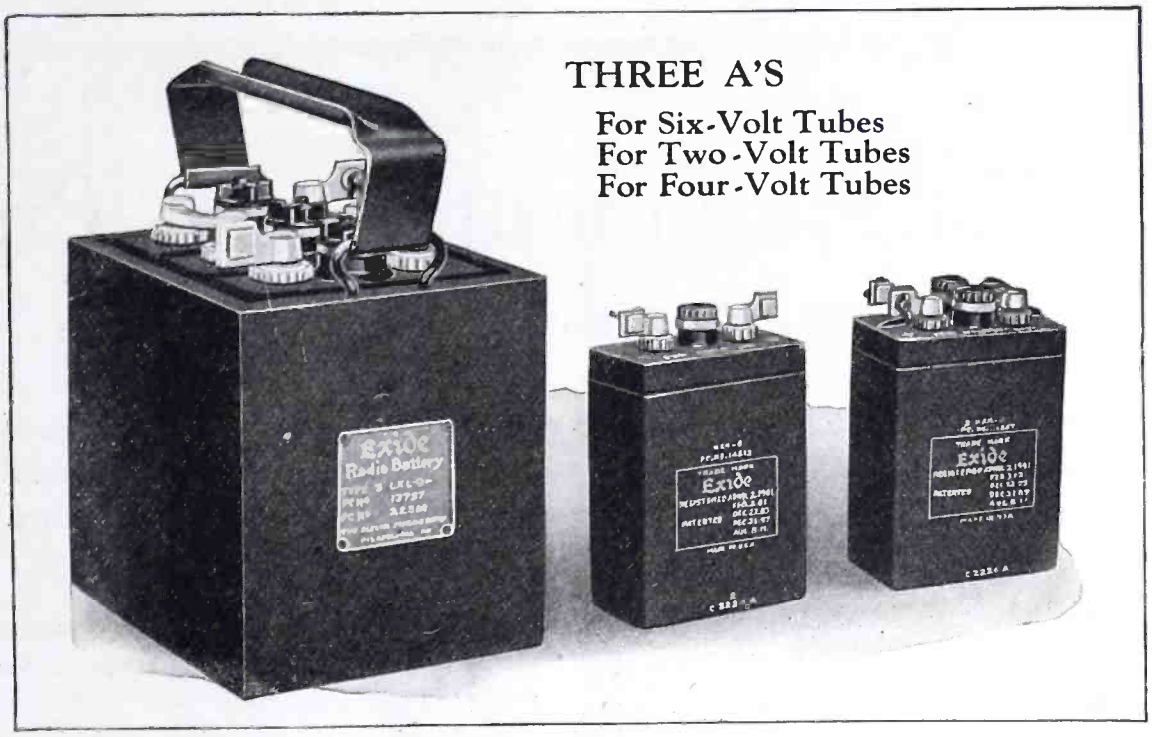
Amplify the pleasure of your radio set by installing Kellogg audio frequency transformers. Second to none in volume, clarity and freedom from distortion.

No. 501—Ratio 4½ to 1. No. 502—Ratio 3 to 1. Only $4.50 each

Built and Guaranteed by

Kellogg Switchboard & Supply Company

1066 West Adams Street, Chicago



If you take radio seriously

YOU want to tune in distant stations, but there is another thing you want just as keenly—to get what you get *clearly*.

No matter how far or how near the station is, for greatest clearness and for all-round satisfaction, you must use storage batteries. Once you hook up to Exide Radio Batteries you will never be satisfied with anything less. They give uniform current, smoothly, quietly, over a long period of discharge. Like good little boys, they are seen and not heard.

For low-voltage tubes

The two newest members of the Exide family are midgets in size but giants in power. These sturdy little A batteries weigh only five and six pounds each. They furnish in full measure that uniform and unfailing power so essential to clarity and distant reception.

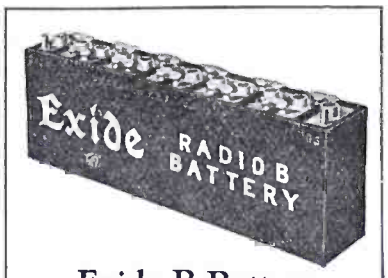
They were specially designed for WD-11 and UV-199 vacuum tubes, but can be used with any low-voltage tube. The two-volt Exide A Battery consists of a single cell. It will heat the filament of a WD-11 or other quarter-ampere tube for approximately 96 hours. The four-volt A battery, having two cells, will light the filament of a UV-199 tube for 200 hours.

For six-volt tubes

Like all Exide Storage Batteries, the Exide A Battery for six-volt tubes is dependable and long-lasting. It is made in four sizes—of 25, 50, 100, and 150 ampere-hour capacities.

On land, at sea, in the air

It is the experience back of Exide Batteries that makes the Exide give such exceptional service in radio. There is an Exide Battery for every purpose. Exides run trucks, start and light automobiles, operate drawbridges, propel under the sea a majority of the world's submarines, send your voice over the wire every time you use the telephone.



Exide B Battery

A majority of all government and commercial radio plants both on land and at sea are equipped with Exide Batteries. The Leviathan is Exide-equipped. The giant dirigible Shenandoah carries Exide Batteries for ignition, lights, and radio.

It does not pay to get any but a known-to-be-reliable storage battery for radio. Exide Radio Batteries are sold by radio dealers and Exide Service Stations everywhere. Ask your dealer for booklets describing in detail the Exide Radio Batteries, or write us direct.

Exide
RADIO BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, PHILADELPHIA

Manufactured in Canada by Exide Batteries of Canada, Limited, 133-157 Dufferin Street, Toronto

Tell them that you saw it in RADIO

A Radio Statement to the Public

The Meaning of Coordinated Scientific Research

KEEPING its pledge to the public, the Radio Corporation of America has concentrated its vast research and engineering forces upon the solution of certain fundamental problems facing the art—problems which have become more apparent as broadcasting stations and radio receivers multiply.

The phenomenal expansion of the radio industry, and the universal and ever-increasing appeal of radio, represent an outstanding development of the present century—for this industry has grown from infancy to maturity in a space of but two years.

◆ ◆ ◆

Briefly stated, there is today a necessity for

—*A radio receiver providing super-selectivity* —the ability to select the station you want—whether or not local stations operate. A selectivity which goes to the theoretical limits of the science.

—*Super-sensitiveness* — meaning volume from distant stations—along with selectivity.

—*Improved acoustics*—more faithful reproduction of broadcasted voice and music than has ever been possible before.

—*"Non-radiating" receivers*—a new development, a type of receiver which, no matter how handled, will not interfere with your neighbor's enjoyment.

—*More simplified operation*—a super-receiver requiring no technical skill, thus making the greatest achievements of entertainment immediately available to all members of the family.

—*A receiver for the apartment house* and populated districts, requiring neither aerial nor ground connection.

—*Another type of improved receiver for the suburban districts,* equally capable to that above, for use where the erection of an aerial presents no problem.

◆ ◆ ◆

Painstaking search in quest of these ideals has led to new discoveries, setting new standards of excellence and performance—discoveries, which have established:

First—that improved acoustics are possible—a matter of scientific research and not of haphazard design—for truly melodious reception.

Second—that dry battery operated sets can be so designed as to give both *volume* and distance.

Third—that the regenerative receiver is susceptible to marked improvement providing selectivity, sensitiveness and simplicity of operation hitherto deemed impossible of accomplishment.

Fourth—that the Super-Heterodyne—the hitherto complicated device requiring engineering skill to operate—could be vastly improved—improved in sensitiveness and selectivity—and simplified so that the very novice and the layman could enter new regions of entertainment and delight.

Watch For Further Announcements

Radio Corporation of America
Sales Offices: Dept. 52
233 Broadway, N. Y. C. 10 So. LaSalle St., Chicago, Ill. 433 California St., San Francisco, Cal.

Radiola
REG. U. S. PAT. OFF.

February 1924

RADIO

Established 1917

Trademark Registered U. S. Patent Office

Volume 6
No. 2

Radiotorial Comment

EVER since broadcasting was started the moot question has been "Who will pay for it eventually?" And in all the answers given there has been a manifest tendency to sidestep or mask the fact that, as always, the public will pay for it, directly or indirectly. Even so eminent an authority as David Sarnof has recently been widely quoted as stating that the public will not pay for radio programs and "that broadcasting can be made commercially practical without any means being found for collecting from the consumer."

The inference is obvious that the commercial practicability resides in the sale of radio equipment and supplies, these being so priced as to make it possible to pay for broadcasting from the proceeds. While there can be no valid objection to this so far as the big radio manufacturers are concerned it does not take care of many worthy stations not so supported, stations that are performing an appreciated public service.

All of which leads us to offer the suggestion that before making a statement there can be no harm in testing it experimentally. As far as we are aware the public has never been asked whether it would pay if asked to do so. Unless we are greatly mistaken there are a million people in the United States who would prefer to preserve their feeling of independence and fair play and to have a voice as to the kinds of programs broadcast.

This would be possible by forming an American Radio Association similar to the American Automobile Association in its de-centralized form of organization and functions. With but nominal dues from the large possible membership such an association could finance programs and secure favorable legislation to far better advantage than the present unorganized listeners-in. With the understanding that the major portion of the funds collected would be devoted to the support of broadcast programs, we believe that the majority of the listeners would voluntarily contribute their share.

This would in no way restrict the enjoyment of radio to those who pay for it. Those unwilling or unable to pay would continue to have their radio "free as the air" just as the non-member motorist benefits from the work of the automobile association.

So we propound the question to our readers: Would such an association be practical and advisable? Furthermore we will devote such space in these columns as may be necessary for a complete discussion of the pros and cons of the subject.

OFTEN has it been suggested that the broadcast listener learn the code in order that he may derive the greater pleasure that comes from listening-in on the higher wavelengths. But today, with the multitudinous interference that comes from spark and arc, the person who understands the code has an advantage in being able to determine the source. Too often the amateur is blamed where a ship or commercial station is at fault. Every station is required to sign its call letters and these are listed in the call books, so that there is no trouble in locating the offender. If enough letters of complaint are sent to the owner of the station and to the radio inspector the interference will ultimately be eliminated.

THE bane of radio is interference. Now that the much-maligned and more-abused amateur has been obliged to cease transmission during the evening broadcast hours, the objectionable interference is almost as bad as before. This fact was prophesied in these columns months ago, as it was realized that the amateur was blamed for much interference for which he was in no way responsible.

The chief offenders are the commercial stations, the Navy arcs, and re-radiating receivers. In some localities the troubles are traceable to leaky insulators on power lines, to electrostatic precipitation plants, to telephone ringing equipment, and to violet ray machines. All these can be corrected where the will to do so exists.

Many of the commercial stations have shown a fine spirit of co-operation in limiting their traffic to essential communication during the early evening. Ship position reports and the like are being given before or after the B.C.L. period. In the sixth and seventh districts the commercial wavelength was raised to 706 meters on the first of the year with a consequent marked decrease in complaints. Similar steps will probably soon be taken in the other districts preliminary to a re-allocation of wavelengths for ship-to-shore traffic.

That the same co-operation has not been extended by the Navy is most regrettable. With a wide range of upper wavelengths already at their command there is little or no excuse for Navy communication on the lower wavelengths close to the broadcast band. Nor has the Navy made sufficient effort to eliminate harmonics. Restrictive legislation seems to be the only remedy, as many appeals to reason and mercy have failed.

But the worst cause of interference today is the regenerative receiver in the hands of uninformed or careless operators. The "blooping" in congested districts is well-nigh intolerable. Although careful operation will minimize this irritation, absolute prohibition of re-radiation without a license is the only present answer to the problem. Many inventors are trying to muffle the regenerative receiver and several non-radiating circuits are available, so that, by the time such prohibition could become effective, no hardship need be worked on the radio public. Rumor hath it that the new radio bill to be presented to Congress will prohibit the use of re-radiating receivers, as has already been done in England.

Clearing the Trans-Atlantic Shipping Lanes by Radio

By S. R. Winters

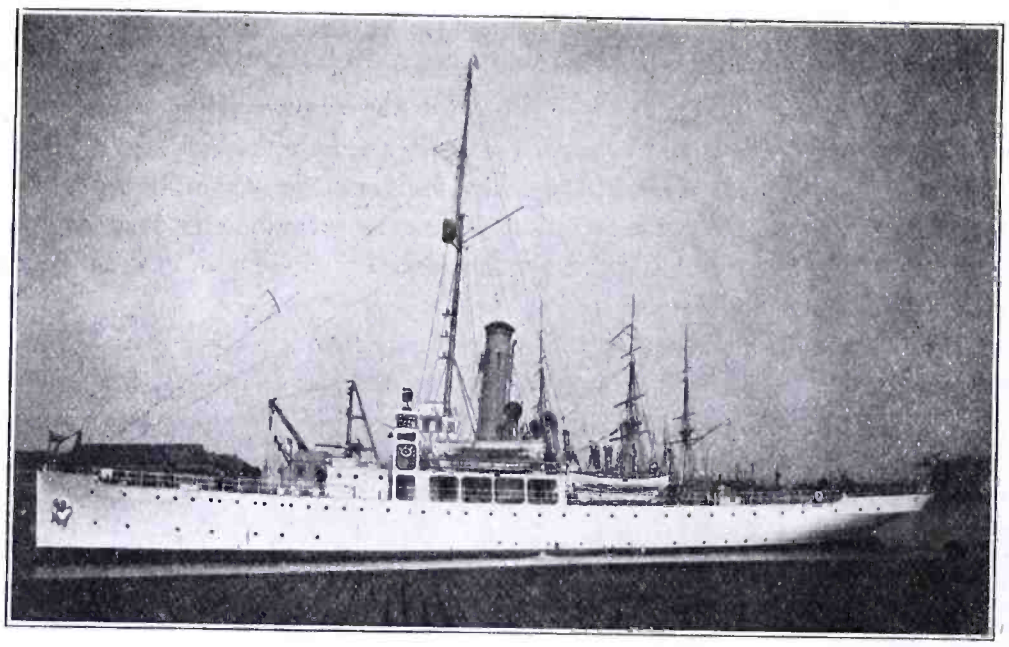
Here is another example of the service to humanity that is being rendered by radio. The author gives the interesting details of how radio warnings of icebergs are sent out to ships in the North Atlantic.

THE captain of a steamship leaving port with a cargo for European points may accept as commonplace the instructions charting his course up the St. Lawrence River. However, in the absence of an ice-patrol system in the vicinity of the Grand Banks, off Newfoundland, a floating mass of ice might cross the pathway of the ship and, not unlike the fate of the cargo of Antonio, the debtor of Shylock, in Shakespeare's "Merchant of Venice", the vessel and its contents fail of their destination. Life and property would be in constant jeopardy from icebergs and field ice but for the observations and warnings made and issued frequently by patrols assigned in a region where navigation is menaced.

A Typical Iceberg Off Newfoundland

The "International Ice Observation and Ice Patrol Service," so termed because it is a form of "league of nations" in the interest of safety of life at sea, sprang into being as an aftermath of the toll of life exacted when the *Titanic* was wrecked on an iceberg, April 14, 1912. The patrol of the ice region, in consequence of the conditions subscribed to by the International Convention for the Safety of Life at Sea, meeting in London January 20, 1914, was delegated to the Coast Guard of the U. S. Treasury Department.

Now, with each recurring spring, if you happen to be in Halifax, Nova Scotia, you may observe a cutter of the Coast Guard, either *Tampa* or *Modoc* steam out of port in a bee-line for the tail of the Grand Banks, 250 miles south of Cape Race, Newfoundland. These cutters were built in 1921 and 1922, at Oakland, California. They are electrically propelled, each having a driving force of 2,600 h.p. Each vessel is manned by a crew of 75 men, excluding 8 officers.



One of the Ice Patrol Cutters

Each cutter is equipped with a 2-kilowatt spark transmitting outfit, and a 2-kilowatt Federal arc transmitting equipment. A ½-kilowatt transmitting set is in reserve. A Navy type 1420 receiver and radio compass complete the equipment.

"The object of the patrol is to locate the icebergs and field ice nearest to the trans-Atlantic steamship lanes. It will be the duty of patrol vessels to determine the southerly, easterly, and westerly limits of the ice and to keep in touch with these fields as they move to the southward, in order that radio messages may be sent out daily, giving the whereabouts of the ice, particularly the ice that may be in the immediate vicinity of the regular steamship lanes."

The greatest menace from ice formations is during April, May and June. The continuity of the ice patrol is uninterrupted during this period of time, and for a longer duration, in the event that the danger to navigation is not naturally removed. For instance, during the last observation season the first ice-patrol ship left Boston on March 8. After 15 days of vigilance, excluding the

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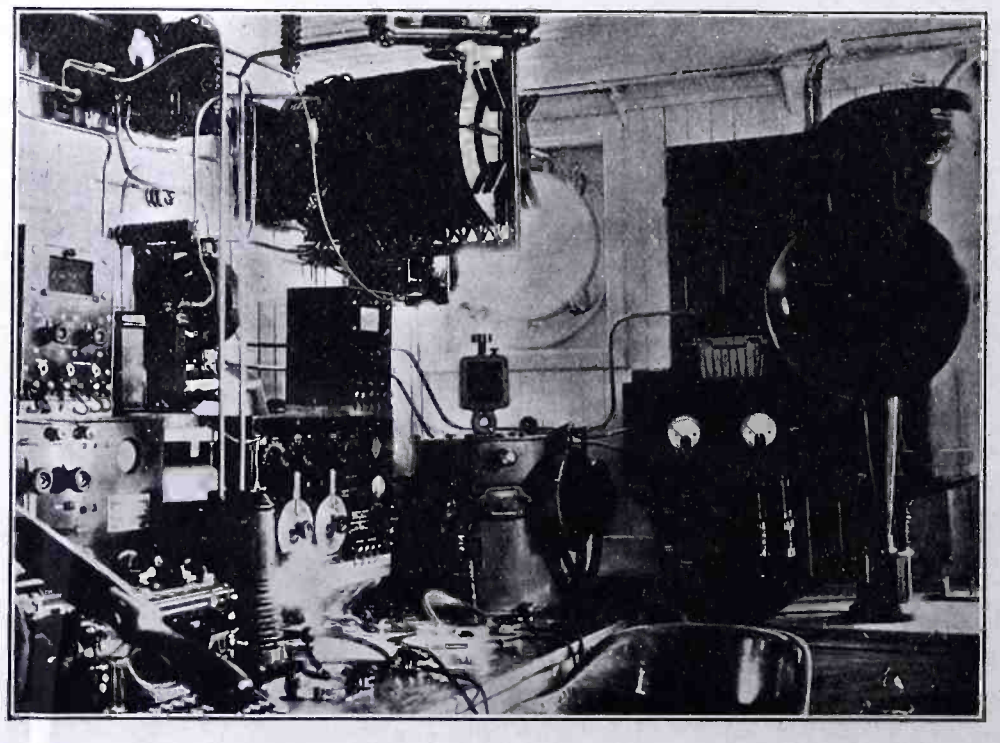


A 2-K.W. Arc Transmitter Which Was Copied 1980 Miles Away

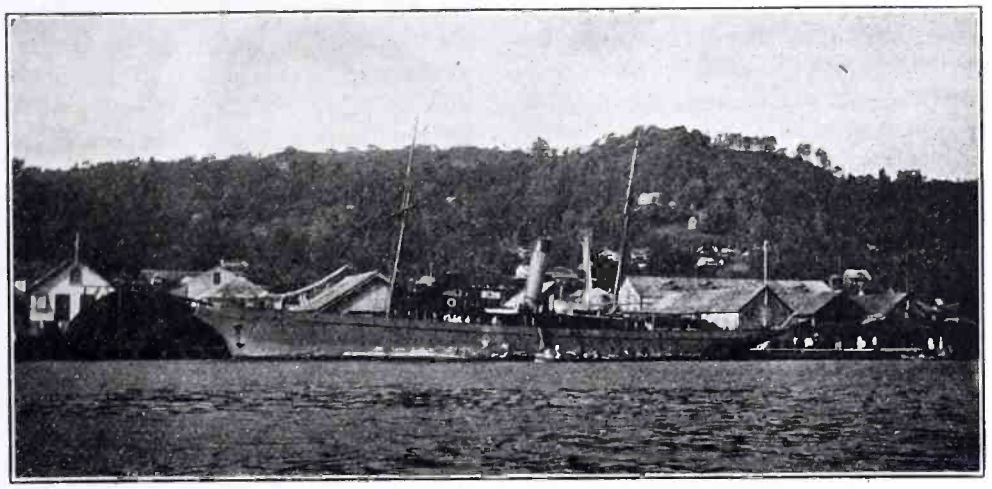
A Four-Electrode Tube Receiver

By Brooke Sawyer

Interesting not alone from its description of a novel receiver but also from its account of an ill-fated expedition, this article should have a wide appeal. The facts are here presented, we believe, for the first time in an American publication.

THE advance guard of a world-circling airplane, the British steam yacht *Frontiersman,* rests idle in Los Angeles Harbor. It is an unusual ship on an unusual mission, and the most unusual thing about her from the radio point of view is her Marconi set. We will let Capt. R. L. Spalding tell the story of the ship in his own words and then try to solve the mysteries of the modern Marconi ship receiver.

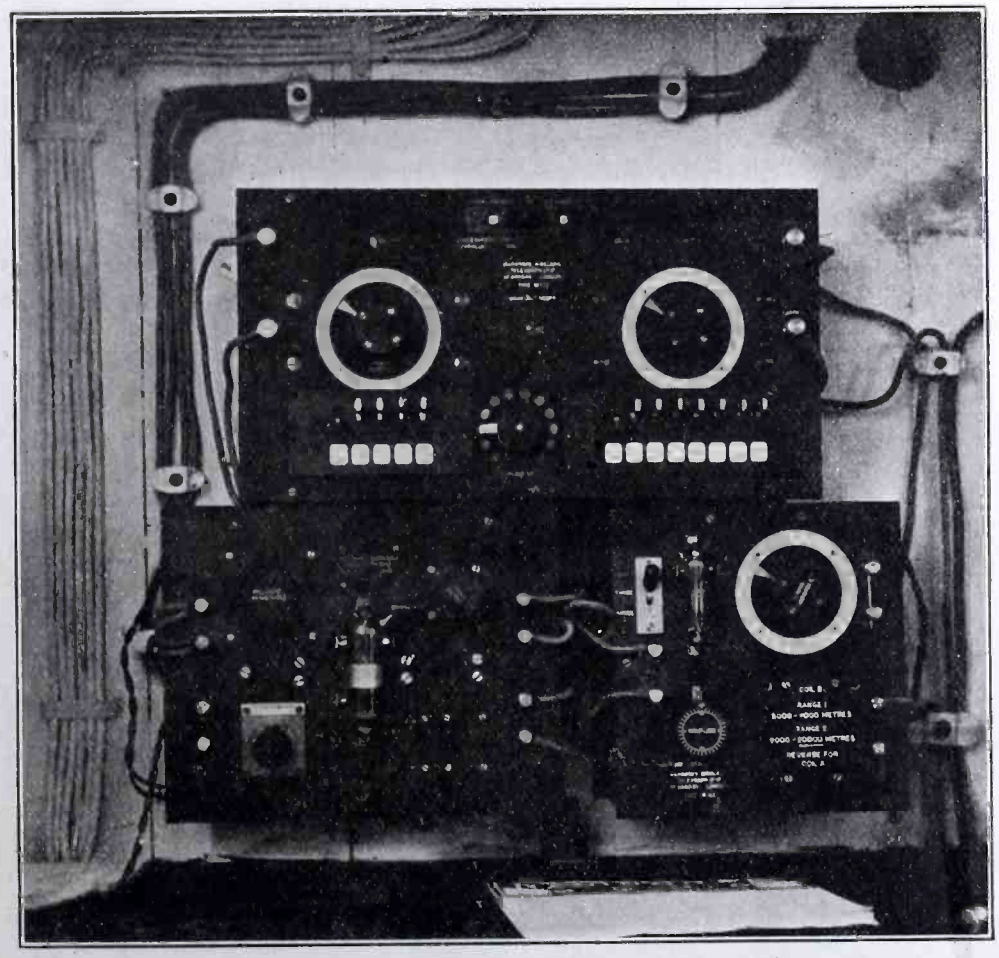
"In the summer of 1922," said Capt. Spalding, "Captains MacMillan and Malins attempted to fly around the world. They left London in a 'DH-9' and, after many difficulties, reach Calcutta. There they transferred to a Fairey seaplane in which they hoped to finish the trip. But trouble developed and they ended by spending three days on an upturned float in the Bay of Bengal, where they swore that if they were picked up, of which possibility they had almost given up hope, they would make another attempt. From the experience gained in this first flight they realized that a mother-ship would be necessary for the long flight across the Pacific. When they returned to England they started appealing for funds, started the building of a boat plane which would be suitable for the job, and also advertised for a crew of adventurers who would take a ship to the remote parts of the northern Pacific. This appeal was broadcast from 2LO, and the letters received in reply showed the great number of people that could be reached through the medium of broadcasting. From nearly 3000 applicants 38 were chosen, who set sail from London on June 28, 1923.



"The Frontiersman" Rests Idle in Los Angeles Harbor

"The ship had the moral support of the British government, especially the Air Ministry, but nothing in the financial line. No big paper was backing the show, all support coming from individuals interested in a sporting adventure. The expedition got as far as Los Angeles in safety. Here, owing to the unexpected financial upsets in Europe which stopped subscriptions, funds ran out and the ship was unable to meet her debts. Bailiffs were put in possession, and the crew took such work as they could find ashore. The majority were ex-officers in the army, navy, or air force, but, in order to keep themselves going, turned to such jobs as laborers in timber yards, package sorters in a Los Angeles department store, deck hands on other ships, and drivers of laundry vans. The wireless operator was employed for a time as bailiff on a libeled Mexican coaster.

"As things stand at the present time the ship will probably be sold to meet her debts. Meanwhile every effort is being made to raise the capital to re-start the venture next spring."



Marconi Receiver Employing Four-Element Tube

WHEN the *Frontiersman* started on her cruise she was equipped by the British Marconi with a standard ship installation, many points of which will be of great interest to our American operators and amateurs. The transmitting set will be passed over quickly, for it is in the receiving equipment that the greatest departures from American practice take place. The transmitter is of the quenched gap type of 1½ kilowatts input. It is an excellently constructed machine and equipped with a quick wave change switch which also varies the coupling of the oscillation transformer so as to take advantage of maximum quenching. Fifteen amperes are radiated on full power. The key, a monster in our eyes, is very well balanced, however, and plenty of speed is possible. For auxiliary power, instead of carrying sufficient storage battery to run the motor-generator, only a small battery is used with a magnetic interrupter in series with the transformer

primary, thus making it practically an induction coil. Ranges up to 200 miles are easily obtained in this way.

The receiving set consists of a tuner, on the top, a combined radio-frequency amplifier, detector, and one stage audio-frequency amplifier using one 4-electrode tube, at the lower left, and a local oscillator or heterodyne at the lower right, as shown in the picture. As there are rumors that we are soon to have a 4-electrode tube of American manufacture, a discussion of the operation of the Marconi "valve" will not be out of place, while the heterodyne arrangement will be of interest to those who are designing super-heterodyne sets.

The aerial side of the tuner consists of a .0016 mfd. variable condenser, eight separate inductances, and eight switches which allow any one of the inductances being cut into the circuit, and a series-parallel condenser switch. The secondary is tuned by a .0009 mfd. variable and a .0008 mfd. fixed condenser which may be shunted across the variable when desired. There are five separate inductances in the secondary, any one of which may be used. Coupling between the two circuits is varied by means of a "coupling coil" whose switch is seen between the two banks of toggle switches controlling the inductances. The range of the tuner is 200-20,000 meters. The three sets of coils, primary, secondary and coupling, are each contained in separate copper-lined compartments, minimizing electrostatic coupling to a marked degree. The amount of coupling is under almost perfect control, and this, added to the shielding which protects the coils from any outside influence, together with the complete disconnection of the coils not in use, makes the receiver very efficient as well as extremely selective.

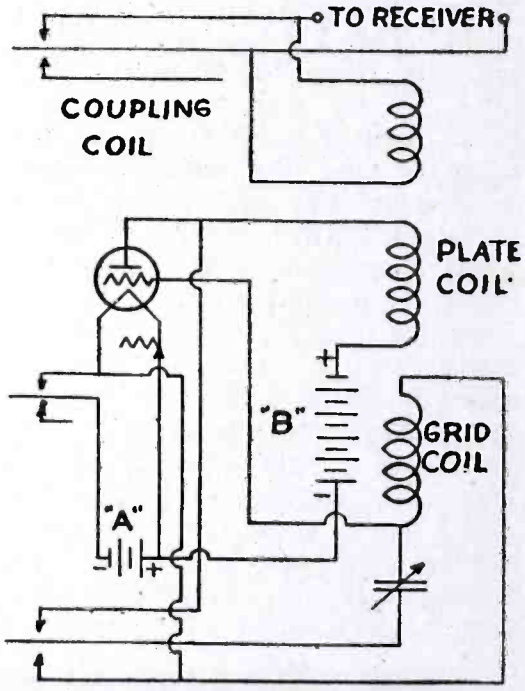
The 4-electrode tube and its arrangement are what we are most interested in and in describing it I am "cribbing" freely from the Marconi handbook. In the words of the handbook, "Amplifier type 91 embodies a single 4-electrode valve which results in great economy in valves and filament current. The amplification obtained is slightly superior to that given by amplifier type 71 (a three-tube set). The instrument requires 24 volts high tension, the limits for good working being 18 and 28." It would seem that the tube is as critical on plate voltage as our UV200 detector, if not more so. Three transformers are used, giving ranges of 200-450, 450-800, and 800-2,800 meters. On the latter good amplification is obtained up to 12,000 meters on C. W., but above this wave the amplification falls off slowly to about two to one at 20,000 meters. The selectivity, controlled to a great extent by the potentiometer, is much greater than that obtained in three-tube sets.

At first glance the tube appears to have two grids, but the outer grid really does the work of the plate of the usual 3-electrode tube, the plate being used only for detection. Three operations are carried out at the same time, viz: radio-frequency amplification, detection, and audio-frequency amplification.

Radio-frequency amplification takes place between the filament, inner grid, and outer grid, the latter being connected to the B battery or high voltage supply, in the same manner as in the ordinary 3-electrode tube. The part of the circuit which carries out this work is shown in the diagram as a heavy line. This current is of high frequency, and will flow through condensers C_2 and C_3 in preference to the windings of T_2 and T_3.

Rectification takes place between the filament and the plate in the circuit shown as a fine line. It will be observed that T_1 performs the duties of the usual radio-frequency transformer between the radio-frequency tube and the detector. In this circuit the grids play no part in the action of rectification and there is no high voltage. The potential of the plate with respect to the filament is governed by the potentiometer, and the maximum is 3 volts positive to the negative end of the filament. The audible frequency pulsations of rectified current taking place in this circuit will act upon the filament-inner grid circuit through the transformer T_2, and these audio pulsations will be again amplified between the filament and inner and outer grids, the current following the circuit shown as a thick line, except that in this case, being of low frequency, it will flow through the winding of T_3 (dotted), instead of condenser C_3. T_3 forms the primary winding of the telephone transformer, the British generally using low resistance head-sets.

The radio-frequency transformer T_1 has triple windings, all in series, each set having an equal number of turns in the primary and secondary. The first set has 220 turns each, the second 330, and the third 1625. The switch in the "short-wave" position short circuits the second and third sets, in the "600" position the third set is short circuited, and in the "long-wave" position all are in circuit. T_2 is an ordinary closed core audio-frequency transformer, each winding having 3000 turns. T_3 is the telephone step-down transformer. C_2 has a capacity of .003 mfd. and C_3 of .0004 mfd.



Marconi Heterodyne Circuit

It should be noted that the potentiometer varies the potential of the *plate* with respect to the filament, and has nothing to do with the grids. Its sole duty is to give selective effects, which are also helped by an adjustment of the filament temperature. Selective effects can only be obtained at the expense of a certain amount of amplification.

Fig. 2 shows the circuit of the local oscillator, which has four ranges. Two sets of grid and plate coils are in the box which can be seen at the lower right hand corner of the local oscillator case. This box can be turned over, providing two ranges, and the movement of the switch places the variable condenser in parallel with either the grid winding alone, or with grid and plate windings in series. The values of these windings are chosen so that the range obtainable with the condenser in parallel with the grid winding alone overlaps the range obtainable with the condenser in parallel with the two windings in series.

There is a variable coupling coil included inside the case which is in series

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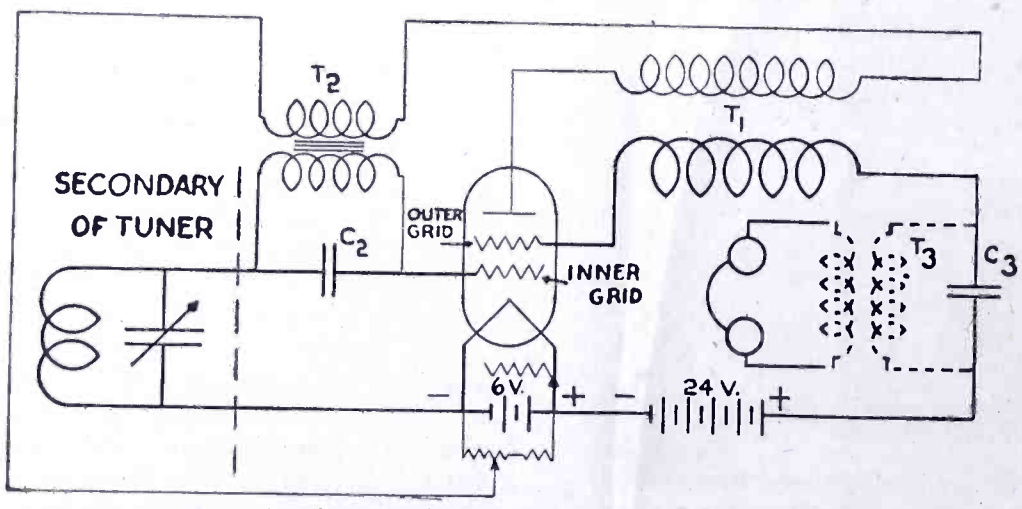

Schematic Diagram of Marconi 4-Electrode Tube Circuit

A Remarkable Receiving Set

By Samuel G. McMeen

A two-tube non-regenerative set with crystal detector that will give better quality and almost the same volume as a three-tube regenerative set is certainly worthy of the title given by the author. He employs one stage of radio and one stage of audio-frequency amplification to secure this unusual result from a crystal detector.

THE qualities of the vacuum tube as a detector are so striking and so excellent that many workers have acquired little knowledge of the virtues of the crystal. Indeed, there are those who, like the writer, have been so content with the performance of the tube that they have ignored—or at any rate overlooked—the crystal.

However, a demonstration by Mr. E. C. Nichols of California has disclosed that there is more in the subject than heretofore has been generally appreciated. That capable investigator has assembled one stage of radio-frequency amplification, one crystal detector and one stage of audio-frequency amplification into a set that operates a loud speaker most satisfactorily, and, much more to the point, does so with a really remarkable quality. Distortion of amplification is notably little. The sibilants and the *f*-sounds are faithfully rendered.

There are those who are repelled by any receiving set outline in which radio-frequency amplification appears, for the sufficient reason that those stages usually involve the use of tuned transformers with the requirement of handling extra controls, or else involve untuned, air-core radio-frequency transformers with their limited wavelength ranges. This is not to be wondered at, but all of it is avoided in the type of radio-frequency amplification used in Mr. Nichols' set. It is the type treated in the article in the March issue of RADIO, with the one inductance and no tuning thereof beyond the associated condensers. In the use of it under description, there are two of the latter, one in series with and one in parallel with the inductance. They both probably have a latitude to make a given wavelength audible throughout much of their range, so that seeking and finding is easy.

The layout of the set for broadcasting ranges is shown in Fig. 1, and the tapping necessary for reaching the amateur wavelengths in addition to broadcasting is shown in Fig. 2, the total number of turns being the same in each of the tuner windings in both cases. The object of building the set without the taps is to eliminate the two tap-switches, a desirable thing when the user can guarantee that he never will become interested in the amateur band of wavelengths. If the untapped form be chosen and the desire to participate in amateur reception should come upon the maker later on, he will then be fortunate in that he will have something new to make to provide for the new need.

Observing the details of Fig. 1, it will be seen that the 43-plate condenser and the inductance are in series to form the antenna circuit, and that the 11-plate condenser is in parallel with that inductance. In the original description of the radio-frequency plan the coil was specified as 35 turns of No. 18 wire on a 4-in. tube. Mr. Nichols uses fifty turns, in the form of a honeycomb coil, a testimony to the latitude allowed in the radio-frequency unit. The reason for the larger number of turns in the honeycomb coil, as compared with the use of the 4-in. type, is in the diameters of the windings. The inductance of the 50-turn honeycomb coil is 150 microhenries, and the calculated inductance of the 4-in. 35-turn coil is 143 microhenries, a rather close agreement. Therefore it is correct to use either.

The potentiometer has a resistance of 300 ohms shunted across the *A* battery. During all the time it is in use it is drawing approximately 20 milamperes from that battery, therefore the caution to insert the means of breaking the *A* battery circuit in a proper place to open the potentiometer circuit when the set is not in use. All that is required is that this opening be at some point in the battery circuit that is common to both filament and potentiometer.

A fixed condenser of .002 microfarad, connected between the negative side of the filament and the ground, serves as a by-pass for the high-frequency energy to prevent its passing through a part of the potentiometer. The difference between using this condenser and not using it probably is slight, but it is also probable that the set owes its success in part to just these refinements.

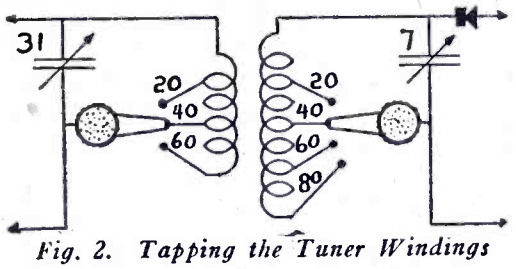

Fig. 2. Tapping the Tuner Windings

The *B* battery for the first step is of 66 volts, and is the same battery as that used for the second tube. The only reason for showing two *A* and two *B* batteries in the sketch is the hope of added clearness in the figure. There is actually but one of each. In addition to this simplification it is possible and advisable to use but one filament rheostat for both of the tubes. There being no detector tube there is no need of striving for the ability to make critical adjustments of filament temperature.

The tuner portion of the rig consists of two coils only, there being no provision for coil regeneration. These coils are wound on one 4-in. insulating tube with a separation of 2 in. between coils. If the untapped form of tuner is used it makes no difference which end of either winding goes to the destinations shown. But in the tapped form, in which at times part of the winding is not in use, the terminations shall be as follows: The radio-frequency amplifier plate shall be connected to the primary end that is nearest to the secondary coil; the crystal shall be connected to the secondary end that is nearest to the primary coil.

The turns in the primary coil shall be 60, and in the secondary 80. A useful

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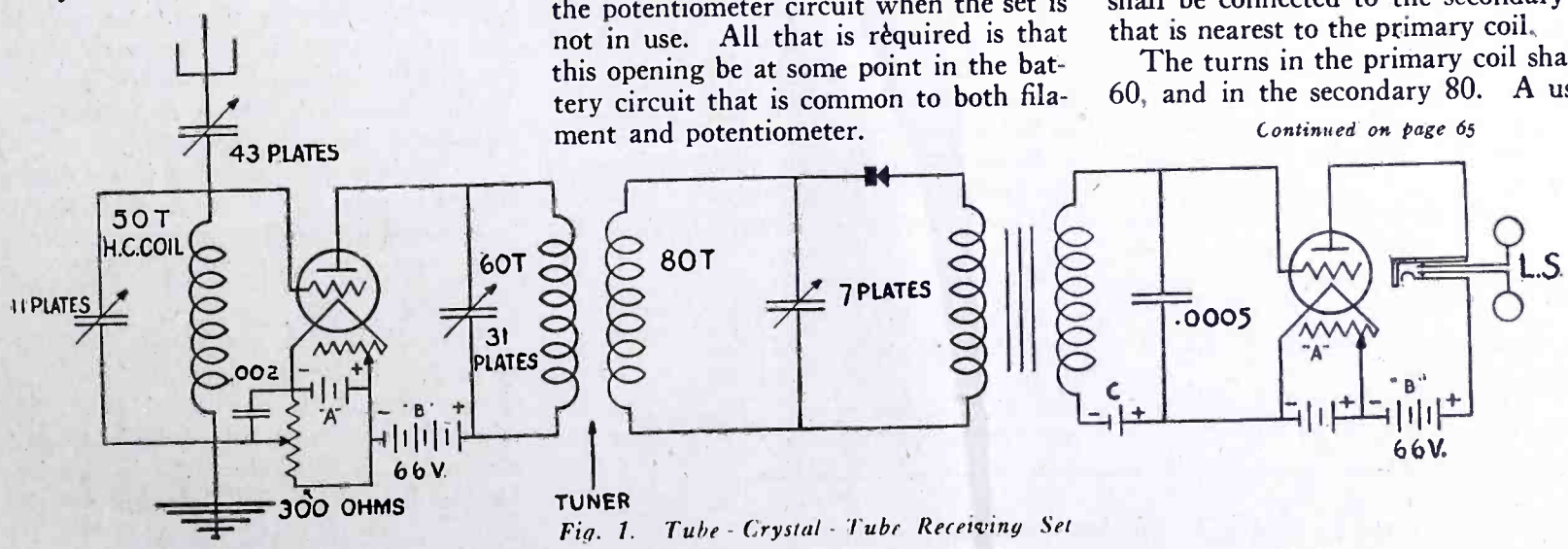


Fig. 1. Tube - Crystal - Tube Receiving Set

Filter Functions and Construction

By Florian J. Fox

After explaining the need for its use the author describes the design of a filter for eliminating the hum in a rectified alternating current supply to the plate of a vacuum tube. This article is part of a series on the design of a radiophone transmitter, though complete in itself.

DIRECT current obtained from rectified alternating current or from a motor-generator usually contains an alternating component. In the case of the rectified a.c. this is quite pronounced. Such a "ripple" or "hum" is usually reflected in the radio-frequency antenna current. The ripple, if it is quite pronounced, is objectionable in a radiophone transmitter because the frequency is in the audible range. It will not only partly drown out the voice, but will also produce "beats" with the voice frequencies, thus spoiling what might otherwise be perfect modulation.

If full wave rectification is used on 60-cycle supply the ripple frequency will be 120 cycles. If a direct current generator is used, the frequency is proportional to the number of commutator bars, and the speed in revolutions per second. The a.c. ripple is generally called an "a.c. hum", while the d.c. variation is usually spoken of as a "commutator ripple." The frequency of the commutator ripple, then, is the product of the number of commutator bars by the speed of the armature in revolutions per second. $f=NS$. Generators are designed with a large number of commutator bars and with the armature rotating at high speeds, thus producing a ripple above audibility. Such a generator requires no filter.

A FILTER is a device or circuit which can be designed to offer an extremely high impedance to a given frequency, or band of frequencies, and practically no impedance to all other frequencies. There are two fundamental types, the high-pass and the low-pass. As their names imply, the high-pass filter passes high frequencies and suppresses low ones, while the low-pass filter does the reverse.

The limits of either type can be fixed, but this is a matter that does not concern us. We shall use the low-pass filter. Our stopping frequency will be the frequency of the ripple, and our passing frequency will be zero for direct current.

The low-pass filter usually consists of one or two inductances in series, in one of the plate supply leads. Large condensers are connected across the line as shown in Fig. 1. In some systems a wave trap is also used as in Fig. 2.

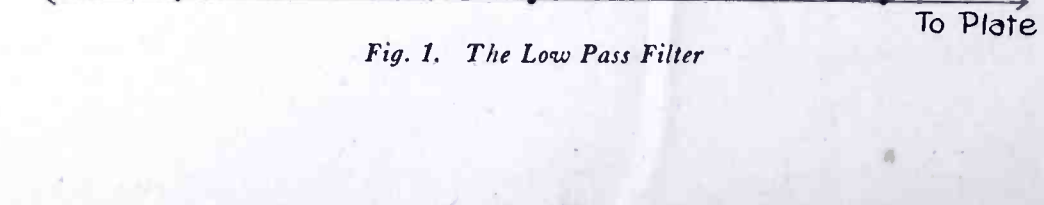


Fig. 1. The Low Pass Filter

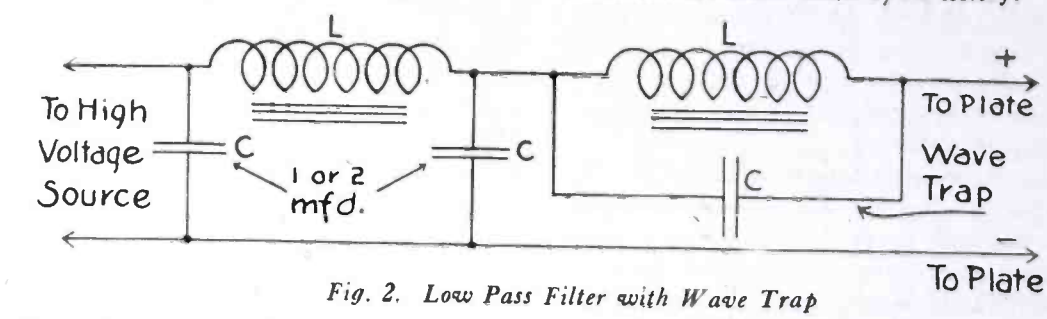


Fig. 2. Low Pass Filter with Wave Trap

For the wave trap the formula for resonance is used:

$$f = 1/2\,\pi\,\sqrt{L\,C}$$

where f=stopping frequency, L=inductance in henries, C=capacity in farads.

Since in the filter, theoretically, only half of each condenser is used with each inductance, and since there are two half condensers in series, the capacity C becomes $C/4$ and the formula for the filter is

$$f = 1/2\,\pi\,\sqrt{L\,C/4}$$

where L is the inductance of each coil in henries and C the capacity of each condenser in farads. See Fig. 3.

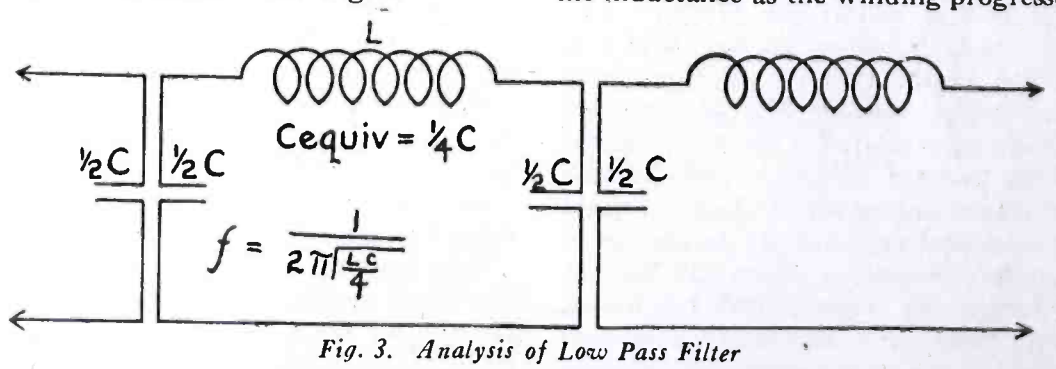


Fig. 3. Analysis of Low Pass Filter

Most writers leave the reader at this point. This is a mistake. The majority of readers have no way of making a coil, especially if it has an iron core, whose inductance is to be so many henries. This requires a knowledge of the properties of the core iron, and the use of inductance formulae; etc.

We offer a relatively simple solution; the method of cut and try.

The formulas can be used in order to obtain some idea as to the size of inductance required. It is a great help to know that a coil must have 10 henries inductance rather than 1/10 henry.

The writer made a core of transformer iron, similar to that of the C. W. transformer described in January RADIO, only somewhat smaller. About 1000 turns of No. 28 D.C.C. wire were wound, a tap taken, and then taps taken every 500 turns until 3000 turns were wound. Another similar inductance was made. These were then connected in the proper manner and tried.

Different taps were tried until the station was reported to have little or no hum. In the writer's case, best results were obtained with all the turns in on each inductance.

Some readers might prefer to check the inductance as the winding progresses. Some measuring instruments will be required.

Place the inductance across an a.c. supply (this may have to be as high as 500 volts), measure the current I flowing and the voltage E across the coil.

Then $E=IZ$ where Z is the impedance of the coil. $Z=E/I$.

Next place the coil across a *low* direct voltage supply. Measure E and I again. $E=IR$ where $R=$ resistance. $R=E/I$. Also $Z=\sqrt{R^2+X^2}$ and hence $X=\sqrt{Z^2-R^2}$.

Since Z and R are known, we can solve for X, the reactance of the coil in ohms. But X is also equal to $2\pi fL$, where f is the frequency of the impressed a.c. and L is the inductance in henries. Hence $L=X/2\pi f$. Substituting the

Continued on page 67

Some Sidelights on the Reasons for Interference

By Jesse Marsten

This article clearly explains what is meant by a "side-band" and its effect in causing interference between broadcast, spark and C. W. stations. It greatly clarifies what is usually considered a complex subject.

THE problem of interference between radio stations is only too well known by the broadcast listener who tries nightly to separate local broadcasting stations from each other and from other spark or even C. W. sets, though the mechanism by which this interference is created is not so well understood. The reader has probably also observed the tendency to abandon the designation of stations by means of their wave lengths, and to substitute instead their frequencies in kilocycles. In allocating wave lenghts for broadcasting stations wave lengths for different stations were chosen so that their frequencies were at least 10,000 cycles, or 10 kilocycles apart. The reasons for all this are intimately tied up with the problem of interference, and this article is intended to shed some light on the subject for broadcast listeners.

Before proceeding with the details of the present discussion it might be well to point out the gist of the whole matter. Broadcasting stations are assigned definite wave lengths and frequencies. Thus WJZ sends on a wave length of 455 meters, or at a frequency of 653 kilocycles, WEAF sends on the wave length of 492 meters, or at the frequency of 609 kilocycles, WRC broadcasts on 469 meters, or at the frequency of 640 kilocycles. Ship spark transmitters send on 600 meters, or at the frequency of 500 kilocycles. If each of these stations actually transmitted signals only on the wave length or frequency assigned to it the problem of interference would be considerably simplified. But the fact is that none of these stations, broadcasting, spark or even C. W., actually transmit on only the wave length or frequency assigned to them. They all transmit on a number of wave lengths and frequencies. As a result it frequently happens that interference is created because these different frequencies at which one station transmits overlap the other frequencies sent out by another station.

Let us see first what is sent out from a broadcasting station. In the first place we start with the carrier wave. This is the wave length or frequency which has been assigned to the station. Thus in the case of WJZ the carrier wave is 455 meters, frequency 653 kilocycles. Every station transmits its carrier wave. When tuned to this wave length with a regenerative receiver with very tight tickler coupling, the squeal which is heard is frequently due to this carrier wave. Many people tune in their sets by this squeal, and when they hear it they know they are on the carrier wave of a station. Now suppose that a violin solo is being broadcasted, and that one of the notes is a thousand cycle note. Then a different state of affairs is produced.

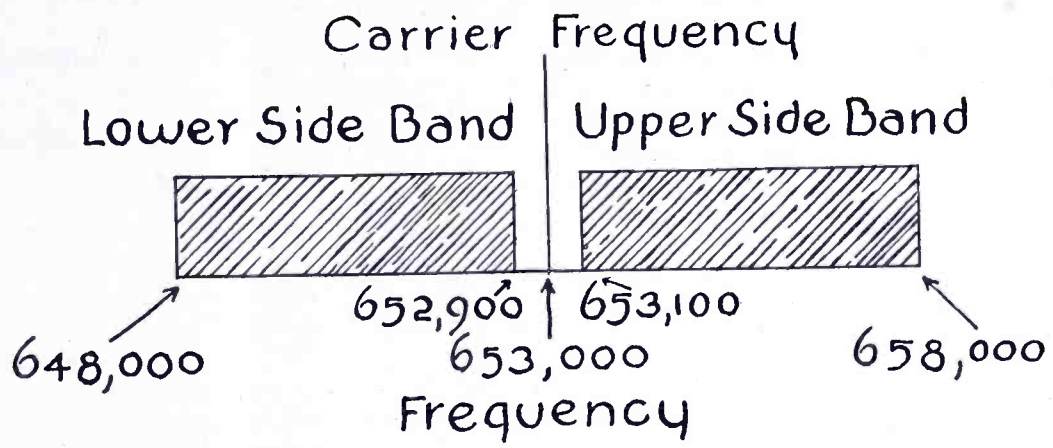


Fig. 1. Range of Frequencies Radiated with A Carrier Frequency of 653 Kilocycles and Speech Waves between 100 and 5000 Cycles

First, the carrier wave is transmitted. Secondly, a wave is transmitted whose frequency is the frequency of the carrier minus the 1000 cycles. Thirdly, another wave is transmitted whose frequency is the frequency of the carrier plus the 1000 cycles. More concretely if we go back to the case of station WJZ we have the following three waves transmitted from the station when a 1000 cycle musical note is played into the microphone: first, the carrier whose frequency is the station's assigned frequency, namely 653 kilocycles, or 653,000 cycles; secondly, 653,000 cycles minus 1000 cycles or 652,000 cycles; and thirdly, 653,000 cycles plus 1000 cycles, or 654,000 cycles.

Thus for any single audio frequency which is transmitted via radio there will be three radio frequencies transmitted. Now it is well known that speech consists of numerous frequencies ranging from about 100 cycles to, say, 5000 cycles. Thus when speech is transmitted via radio a large number of radio frequencies will be transmitted on each side of the carrier frequency. In the above case we will have the carrier, namely 653,000 cycles, and a band of frequencies between 653,000 minus 100, or 652,900 cycles, and 653,000 minus 5000, or 648,000 cycles, and also a band of frequencies between 653,000 plus 100 or 653,100 cycles, and 653,000 plus 5000, or 658,000 cycles. The lower band of frequencies is known by the name of "lower side band," while the higher band of frequencies is known by the name "upper side band." The lowest frequency transmitted is in the case of WJZ 648,000 cycles, while the highest is 658,000 cycles, and the frequencies actually transmitted beside the carrier frequency are shown by Fig. 1. It is therefore seen that a radiophone station sends out many more frequencies than its own assigned frequency, or carrier. Therefore, while station WJZ has an assigned carrier wave of 653,000 cycles, if the ordinary set is tuned to 648,000 cycles or 658,000 cycles, or any other frequency in between, this receiver will be interfered with by WJZ, because as shown above WJZ sends at these other frequencies besides. The same remarks hold true, of course, for all other broadcasting stations, hence, if all broadcasting stations are near each other in their assigned frequencies, their side bands will interfere to such an extent that interference will be be intolerable.

For this reason broadcasting stations have been assigned wave lengths by the government so that their carrier frequencies always are separated by at least 10,000 cycles. Thus suppose one station is assigned a carrier frequency of 643,000 cycles, which is 10,000 cycles lower than that of WJZ, which is 653,000 cycles. Then let us assume again that average speech contains all the frequencies from 100 to 5000 cycles. Therefore the former station will send out besides its carrier frequency of 643 kilocycles, the frequencies of 643,000 minus 100, or 642,900 cycles, 643,000 minus 5000, or 638,000 cycles; 643,000 plus 100, or 643,100 cycles, and 643,000 plus 5000 or 648,000 cycles. Its highest frequency of transmission is thus 648,000 cycles which just equals WJZ's lowest frequency of transmission which is also 648,000 cycles. Thus if broadcasting stations are assigned carrier frequencies which are 10,000 cycles apart their transmitted side bands will not overlap, hence interference will be reduced.

The above is true when the frequen-

cies of speech or music which are transmitted only go as high as 5000 cycles. Let us see what happens if an audible frequency of 10,000 cycles is transmitted. The station whose carrier frequency is 643,000 cycles will now transmit a greater band of frequencies, which in the upper side band includes the frequencies between 643,000 plus 5000, or 648,000 cycles, and 643,000 plus 10,000 or 653,000 cycles, while station WJZ will now also be transmitting more frequencies also, and in its lower band it will transmit the additional frequencies between 653,000 minus 5000, or 648,000 cycles, and 653,000 minus 10,000 or 643,000 cycles. Thus the transmitted frequencies will be found to range as follows:

Station carrier 643,000 cycles; from 633,000 to 653,000 cycles. Station carrier 653,000 cycles; from 643,000 to 663,000 cycles.

It is seen that these frequencies of transmission from these two stations overlap and hence interference will be created. Now the fact is that both speech and music contain frequencies as low as 30 cycles and as high as 10,000 cycles and perhaps more. Hence interference is almost inevitable when there are two stations operating near each other whose carrier frequencies differ by only 10,000 cycles. This condition has been avoided to a considerable extent by assigning stations in the same locality carrier frequencies which differ by much more than 10,000 cycles, and giving more distant stations which are separated by large distances frequencies which differ by 10,000 cycles, since distant stations are less apt to create interference in the average receiver. Thus WJZ and WEAF have carrier frequencies of 653,000 cycles and 609,000 cycles, a difference of 44,000 cycles, more than required because they are in the same locality. On the other hand WJZ and WRC have carrier frequencies of 653,000 and 640,000 cycles respectively, a difference of 13,000 cycles, which is just on the borderline, but since they are separated in distance by about 200 miles interference is less likely. Incidentally it is seen that the subject of interference is more easily considered when we speak of frequencies than of wave lengths, and it is primarily for this reason that the tendency is growing to speak of stations in terms of their assigned frequencies in cycles or kilocycles rather than in terms of wave lengths.

The above discussion of interference between broadcasting stations shows that the interference, from the transmitter point of view, is due to the transmitting stations sending out waves having a great number of frequencies rather than only one definite frequency. This condition exists not only with broadcasting stations but also with any telegraph station, be it spark or C. W. Let us first consider the case of the spark telegraph transmitter which sends out what is called a damped wave, which is one whose strength falls throughout an audio cycle. The radio frequency waves which such a station send out during one audio cycle are shown in Fig. 2, and the

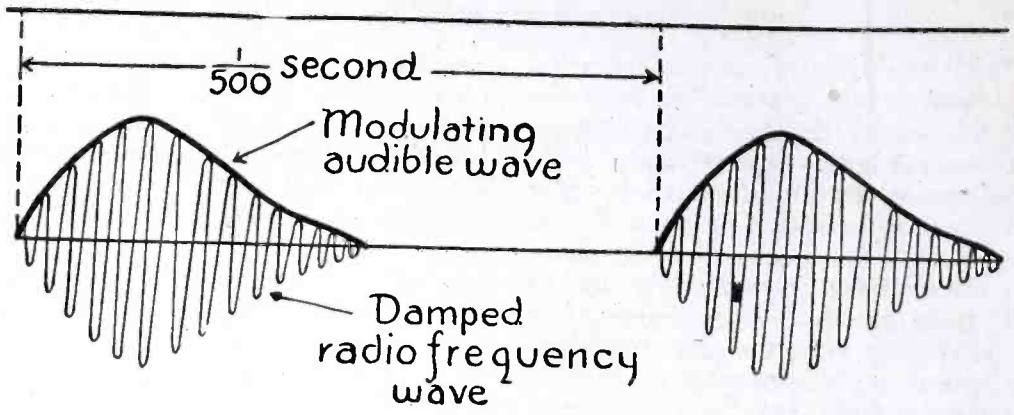


Fig. 2. Wave From A Spark Station

heavy line represents the audio wave whose frequency is heard in the telephones. The spark station may be assigned a frequency of 500,000 cycles. Every time the key is pressed a group of waves are sent out which are enveloped by the heavy line curve of Fig. 2, which may represent a dot. Now this spark station does not send out waves having only a frequency of 500,000 cycles per second. The radio waves which it sends out may be considered to be modulated by the audio frequency wave shown by the heavy line curve of Fig. 2, in exactly the same way as the radio frequency waves of a broadcast station are modulated by the speech waves. As a result if we were to analyze the problem mathematically we would find that the heavy line curve of Fig. 2, which represents an audio wave similar to a speech wave, may be resolved into a number of waves having different frequencies; one having the same fundamental frequency as the wave itself, say 500 times per second, the other having a frequency two times as great, or 1000 cycles, the third having one three times as great or 1500 cycles and so on along the line. Of course the strength of each of these component frequencies is not the same for all, but vary as in speech. Hence what the spark station sends out is far from being a wave of one definite frequency, 500,000 cycles, but like the radio telephone wave, must consist of a number of waves, one being the fundamental carrier wave of 500,000 cycles, a lower side band of frequencies, 500,000 minus 500, or 499,500 cycles, 500,000 cycles minus 1000, or 499,000 cycles, 500,000 minus 1,500 or 498,500 and so on down the scale to the lowest, and also an upper side band of frequencies including 500,000 plus 500, or 500,500 cycles, 500,000 plus 1000 or 501,000 cycles, 500,000 plus 1500, or 501,500 cycles and so on up the scale. The strength of the different frequencies in a spark set, as stated above, is not the same. In fact the strength of the fundamental carrier frequency is almost always less than two of its side frequencies. This together with the fact that a large number of side frequencies are also transmitted results in considerable interference, since it is not unlikely that some of these spark side frequencies overlap some of the broadcasting frequencies.

The same considerations apply to the case of continuous wave transmitters. In the case of continuous waves, unlike damped waves, the strength of the wave is constant while its lasts, which is shown by Fig. 3. Suppose a dot is sent. The transmitter key is closed and the wave comes up to full value at once. While the key is depressed the wave is sent out. When the key is released the wave drops to zero instantly. This state of affairs may be represented by Fig. 3, where the heavy rectangular curve is the "dot" curve. This is the curve which may be again considered to modulate the radio frequency, in the same manner in which we consider the speech wave curves to modulate the radio frequency in a radio telephone system. Now this rectangular dot curve when analyzed also turns out to be equivalent to a series of periodic sine curves having different frequencies. It has a frequency equal to the fundamental frequency of the rectangular curve,

Continued on page 66

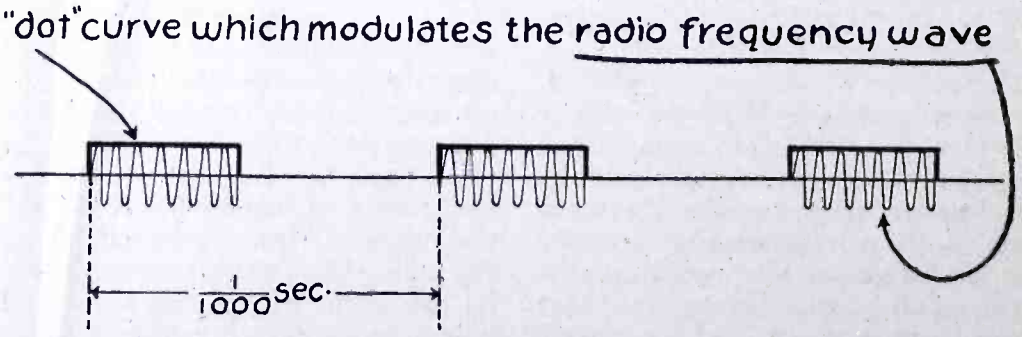


Fig. 3. Wave From A C. W. Transmitter

Causes of Interference and Its Remedy

By Alfred E. Banks, 6XN—6ZB

This is a comprehensive discussion of the entire subject of interference to radio reception. It gives practical suggestions for determining the cause and at least partial elimination of the trouble.

WITH millions of receiving sets in use, interference with good reception is a subject of intense interest. Every passenger ship afloat depends upon the absence of interference when in case of accident it becomes necessary to put out an S O S. That it is possible to regulate and control certain types of interference may be seen when one glances at the law of 1912 in which malicious interference by any transmitting station is prohibited under heavy penalties. The "courtesies of the air," so called, have been instituted for the purpose of maintaining a maximum privilege for all receiving and transmitting stations under all circumstances.

Let us look into some of the causes of interference (which by the way in the International Morse code is called QRM. The letters QRM mean "I am being interfered with.") Interference causes may be divided into two kinds, natural and artificial. Natural interference is due to "static," "dead areas," and "fading," all of which are caused by atmospheric changes beyond ordinary control.

Artificial interference is due, first to nearby sources of electric energy such as street cars, arc lamps, high power lines, defective house wiring or high frequency apparatus at some nearby point; second, to radio transmitters other than the station it is desired to hear; third, to defective tuning devices such as deteriorated *B* batteries, corroded terminals, etc., and fourth, to inexpertness on the part of the operator at the receiving station whereby a good tuning device is not made to function properly. A 60-cycle hum from nearby electrical apparatus is unpleasant to hear, and if due to high power lines in the neighborhood will have to be remedied at the receiving station. We also find that clicks due to nearby electric machinery, noises produced by small sewing machine motors and a host of others come to disturb the peace and harmony of the listener. In dealing with this sort of interference a thorough search must be made for the actual source of the noise. The proof of the cause of this kind of trouble can always be obtained by experiment.

Perhaps the bitterest complaints are those based upon interference by some station other than the one desired. Of the causes for this interference the worst is contiguity. If close to a high power spark or arc station the tremendous amount of energy radiated sets up undesirable currents in the receiving antenna in spite of one's best efforts.

Others are troubled by harmonics from high power arcs, sparks, and tube sets. The Navy has spent much effort in trying to eliminate these troubles and in the case of the arc has been relatively successful in the last year, although there is still much in excess of the amount tolerated by the Federal Telegraph Co. who designed the apparatus. Unfortunately the NPL arc station has no natural ground. Why radio engineers should have tolerated such a site for a high power transmitter when the ocean ground was so near is hard to understand. Particularly during the concert hours, Government correspondence, except in emergencies, may be suspended and this courtesy to the listening public has to a great extent been arranged by the responsible Naval officials. It is regrettable that the type of operator at times on duty at the station makes interference worse than it should be.

The amateur transmitting station has been blamed for much interference for which it is not responsible. True, an occasional breach occurs, but as a rule all amateur transmitters remain silent during the period assigned to concerts. Amateur interference during concert hours is easily remedied by reporting the station in question to the Radio Inspector.

An oscillating tube in a receiving set is probably one of the most frequent causes of interference. The British law prohibits the use of single circuits or systems for receiving which will permit of tubes' radiating energy. The faint high pitched squeal which is heard so frequently when listening on the concert wave is, in the great majority of cases, due to someone who is "feeling around" for a particular wave and has his tickler coil, variometer, or condenser governing regeneration, advanced too far so that his detector tube oscillates, producing radio frequency energy in the antenna which, while infinitesimal in power, is capable of being heard for miles. I have a letter from Radio Inspector D. B. McGown, who reports having heard a single receiving tube being oscillated in Phoenix, Arizona while he was listening in San Francisco. This shows you the amount of energy which a modern receiver will pick up. Amateurs on the low waves use oscillating tubes for the reception of C W and I have personally observed communication between the Pacific and Atlantic coasts ruined for a station in Los Angeles because of the hundreds of receiving sets which tried to listen in with oscillating tubes while 6EN was attempting to receive. The heterodyning entirely obliterated the eastern signals. When this periodic whistling is extremely loud and is noted to see-saw back and forth over a concert wave night after night it is sometimes wise to look up one's neighbors and give some help in the matter of tuning.

As to the defective tuning devices. The market has been flooded with the most imperfectly designed contraptions for concert receiving and thousands have purchased receivers of this type in good faith only to find that while they would tune in a concert, at the same time they apparently "sucked in" an inferno of extraneous noises which made listening anything but a pleasure. Of course there is only one thing to be said about this sort of thing. Interference can never be eliminated without a proper receptor.

Often a receiving station functions perfectly for a long period of time and suddenly noises of all kinds cause tremendous interference which no tuning seems to eliminate. We find that defective rheostats, broken down *B* batteries, corroded wires, leaky condensers, dirty tube sockets, broken head sets, cracked diaphragms and a thousand other things are responsible. Sometimes an intermittency of good signals with poor noisy ones is due to the burning out of a winding on an amplifying transformer. The plugs and jacks in common use may cause trouble. Careful thought and investigation will soon disclose this type of interference and its remedies.

The last class of interference is that due to the inability of the person operating the receiving set to make it do its proper duty. For example, I have seen three stages of radio frequency using a tuned antenna circuit, with coupling adjusted in such a manner that signals between the extreme waveband limitations of the transformers in use, were audible with equal intensity, and this due to the fact that the operator would persist in using tight instead of loose coupling. It behooves us to make a little study of the art of tuning, and it is a healthy thing to compare notes with other amateurs in order to get the benefit of their experience. You cannot learn to tune from a book, nor a talk, you have to "turn the knobs"; but you should know the reason for the existence of the knobs, and something of

the theory of the assembly of the set in use.

Now as to the remedies. Static cannot be stopped today. The keener the tuning of the set the narrower the band of static absorbed, yet with amplification, static becomes unbearable, oftentimes drowning out the desired signals. One remedy for static, therefore, is to use but one tube and the head phones.

In dealing with pockets or dead spaces, so far we have only one remedy and that is the selection of a new station site. Fading (when not due to a dying *A* battery or *B* battery) cannot be remedied at the receiving end. If a transmitter persistently fades, notwithstanding the fact that other similar transmitters in the same section do not fade, letters should be sent to the transmitting station advising them of the facts in order that they may investigate tubes which are overheating, and a hundred other possibilities in a transmitting set imperfectly adjusted.

When the trouble from interference is due to power lines and a 60-cycle hum, probably the best method of handling it is by use of a filter designed to absorb this frequency. Directions for filters of proper types for various purposes will be found in the current literature. Look up recent numbers of RADIO and *QST*.

When noises are produced by machinery, locate the apparatus and see if the owner cannot introduce resistance brushes or whether it will be possible to discontinue the use of the apparatus at certain hours.

In dealing with interference caused by spark and arc stations the careful adjustment of multiple filters promises most, and it is surprising how much can be eliminated in this way without hurting the reception of desired signals. If it is found that a harmonic exists on the exact wave of some desired station a letter to the owners of the station, and the Radio Inspector will be productive of results. This is particularly the case where a large number of similar reports are made. A wave trap however should be in the possession of everyone annoyed with interference. The literature shows exactly how these can be built and where they can be purchased.

Broken down radio apparatus should be carefully repaired. We have already noted that it requires training and experience with any type of receiving apparatus to get the best results. Why not invite some other amateur to experiment with your receiver and see which of you can make it function the best and then compare notes.

Since undesirable interference is most frequently in code, you should learn the code in order to get the signature of the interfering station. There is no need to guess at this. Each station signs its call whether in code or by voice.

Heterodyning by two broadcast stations causes trouble. The new regulations have apparently made it less frequent although there is still an occasional heterodyning with high squealing note between the arc or some other broadcast station and the one being listened to. If after careful tuning effort this persists night after night a report should be made to the Radio Inspector. Perhaps a slight change of transmitter wave length will remedy the trouble. Finally when interference of some nature not understood causes continuous trouble which no effort relieves, bring the trouble before the local club for discussion and surely many heads may prove better than one.

A cause of interference which has not been named will be taken up as a separate problem. I refer to interference due to the inadequate present Law and Regulations as provided by the Act of 1912. When it is considered that this law was enacted with a view to dealing with spark transmitters and that no thought was given to public service of the nature of broadcast, it can readily be understood how inadequate conditions are without a new enactment. The last Congress failed to pass the bill which had been recommended by the radio committee, and it remains to be seen what the next session will accomplish on this important matter. If each person interested in "better radio" would but use his or her influence to have competent laws passed, it would not be long before a much better state of affairs would exist on the air than is the case today.

True the Department of Commerce has done everything within reason to so adjust the present regulations as to give broadcast extended privileges. In fact many of the older amateurs feel a good deal "peeved" at the seeming unfairness of the late ruling of the Department which prohibits amateur transmission at certain hours. It may be that the future will see this ruling done away with, but for the present it has seemed best to leave it in effect and all right minded amateurs throughout the country have done their part in assisting in this particular. The greatest need today in radio is new legislation and we should bend our efforts to drawing some strong resolutions for presentation to our local representatives, the Radio Inspector, the Department of Commerce, and National Headquarters of the A. R. R. L. in order that it may be known in Washington how strongly we feel the need in this particular. We must not let the commercial interests in the field of radio do injustice to anyone nor must we allow any big faction or the Government service greater privileges than we, the citizenry, are accorded.

BROADCASTING ALLOWED IN JAPAN

The Japanese government has issued regulations permitting radio broadcasting on two wavelength bands upon payment of certain fees. For the 365-385 meter band with 1.5 kw. input the fee is 500 yen per year. For the 215-235 meter band with 250 watts input the fee is 200 yen per year. An annual fee of 2 yen is made for receivers.

Applications for broadcasting should be made to the Minister of Communications, giving complete specifications as to proposed construction and cost thereof. No discrimination is to be made against foreign enterprises or materials. The U. S. Bureau of Foreign and Domestic Commerce suggests the American manufacturers protect their patents in Japan. There will probably be a 20 per cent import duty.

One Pushee, One Pullee, She Workee Like Hellee!

By E. W. Kersten

This account of a push-pull radio-frequency amplifier is based upon results secured by Mr. Clinton H. Hulbert of Menominee, Mich. The transformer referred to is the Type D Transinductor of which he is the inventor. The reception recorded is the actual experience of the author.

"SHIVER my timbers, but that's clear music for a three-stage power amplifier, Queue!"

"This no three stage, Sea, this only two-stage amplifier."

"G'wan, what d'ya mean, only two stages—? There are three bulbs in it."

"Allee samee only two stage! Second and third bulbs in second stage."

"Oh, I see, two bulbs in parallel to handle the output of the second stage."

"No, not in parallel. Here what you call 'em—chart:" (Fig. 1.)

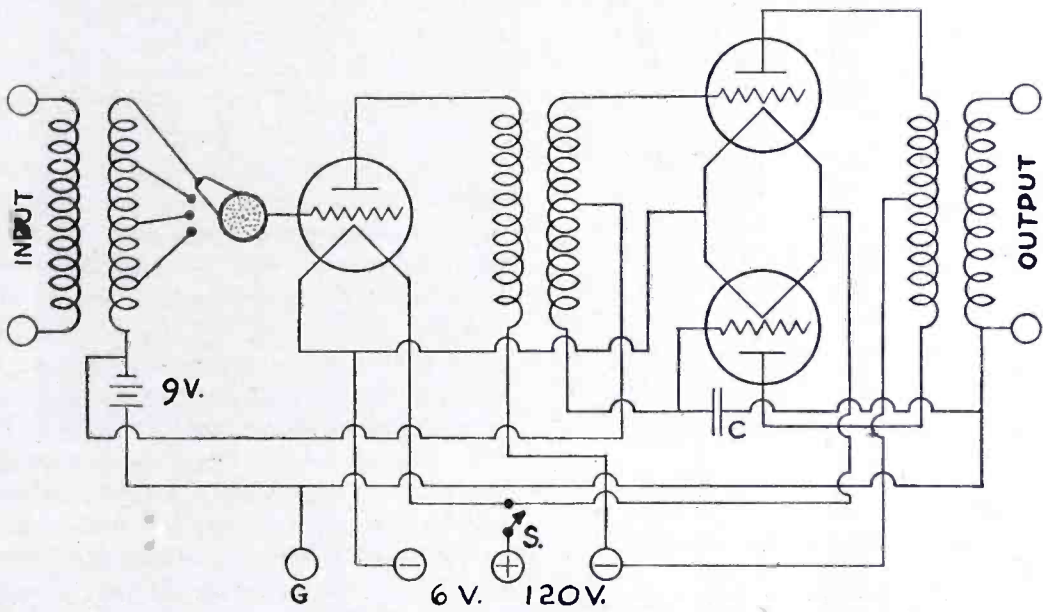


Fig. 1. W. E. 2-Stage Power Amplifier Circuit

"You see," explained Queue, "this map he balanced, when the current go down in one bulb, he go up in other and—"

"Oh-ho-o-o-o, so that's why the modulation is so strong and clear! I see now. Say, is the amplification increased any with the extra tube?"

"Listen:" And with that Queue proudly took out the second tube and the amplification fell off to where it sounded like an ordinary two-stage amplifier.

"Try it with the other tube out." No sooner said than done. Queue replaced the second tube and took out the third, with the same result as before.

"Say, by golly, that's good! Wish I could get hold of a little theory on that circuit."

"You can, Sea. McMeen he write article in October RADIO on 'Improving Amplification.' He say one thing I like to see worked out."

"What's that?" "Here, read it."

" 'We have not yet heard of the use of middle-tapped transformers and the push-pull arrangement in connection with radio-frequency stages, but there would seem to be no reason why the method should not succeed.' I wish we could get hold of a radio-frequency transformer that really amplifies over all the wavelengths we want and that has a center tap."

"Let's make one, Sea!"

"Gosh, but you've got a lot of ambition!"

"Oh, I don't know—let's see now what we need. In the first place, in order to get amplification we must have air core transformer and in order to tune from 150 to 750 or 800 meters we must have iron core. Now, how can we have an air core and an iron core at the same time?"

"Oh, Sea, you old Tar! I got it! We split the primary and secondary so half of each is on stator and other half on rotor. That give us control of the inductance and capacity and—"

"Good boy, Queue, and then we'll put some iron into the rotor, and then, by turning the rotor, we'll have control of the inductance, capacity AND IRON! Then we can adjust it to get the peak of amplification over all wavelengths. Queue, we've got it! Gimme a pencil! We'll make it like this:" (See Fig. 2.)

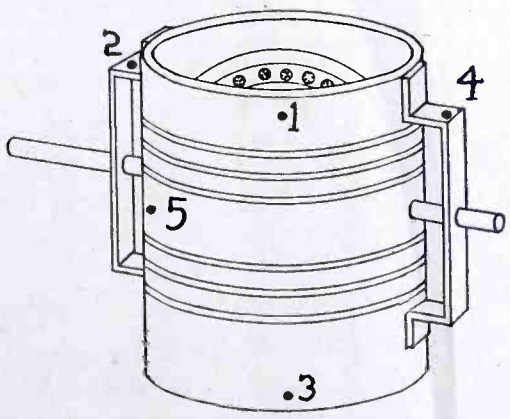


Fig. 2. Mid-Tapped Radio-Frequency Transformer

"No. *1* and *2* are the low winding and *3* and *4* will be the high winding or secondary. We'll get our center tap right here where the winding goes from rotor to stator and we'll call that *5*.

"Here the way McMeen show he work on audio-frequency:" (Fig. 3.)

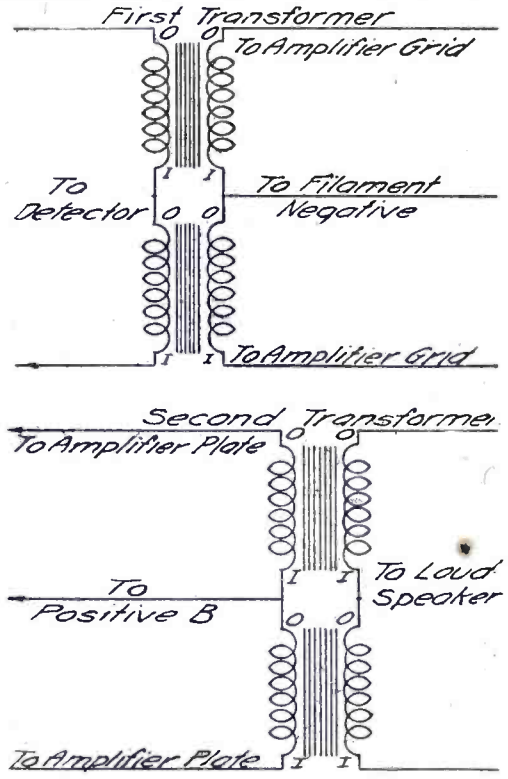


Fig. 3. Push-Pull Arrangement with Two Transformers

"Now we hook it up just that way with our new transformer, but we have natural center tap, so we need only one instead of using two like in drawing before." (Fig 4.)

"Winding *1-2* on one transformer is primary, while *3-4-5* is secondary. Now, Queue, we will need a tapped transformer to carry the output of the two tubes to the detector so we will make a two-stage amplifier and then if that works we can put on another."

Sea was just battening down the hatches of an audio-frequency transformer when Queue burst in with: "We got to have another stage of audio on there or we won't be able to hear it. I get another transformer."

"SEE, Queue, WJAZ on 448, WDAP on 347 and WMAQ on 448 are at Chicago. That's only 265 miles away. Here's KDKA on 326 meters and that's 700 miles. That's better distance. Say, take off that second stage audio! I can't hear myself think!"

"Allee samee just as loud on one audio! Must work to limit of tube. How much *B* battery you got on, Sea?"

"70 volts."

"Cut it down to 45—there, that bet-

ter. So nice and clear! Loud speaker sound just like 'PSC Orchestra' right out in next room. They on high wavelength—517 meters."

"If we turn in this condenser a little then we ought to get WOAW on 525. Sure enuf—'WOAW at Omaha'!"

"If we only get KSD on 546 and KYW we have all the broadcasting wavelengths." "No we won't, Queue, KDKA is broadcasting on 100 meters, too. Wouldn't it be great if we could hear them there? Let's try it anyway. Just listen to the hams! There's 9AAW, and 8ZZ. Here comes 5EK, 4GL and there's 3ZO, too."

"There's a 2 and a 1 but I can't get their calls because they so mussed up with sloppy sending. Well, let's try to get KDKA. Listen to that C. W. on those low wavelengths! Turn out that condenser a little more. My, but it's quiet down there. Wait! There it is, Sea! 'KDKA signing off at 1:06 Eastern Standard Time. Good night!' Hooray! This is a red letter day for us. We'll have to mark it on the calendar."

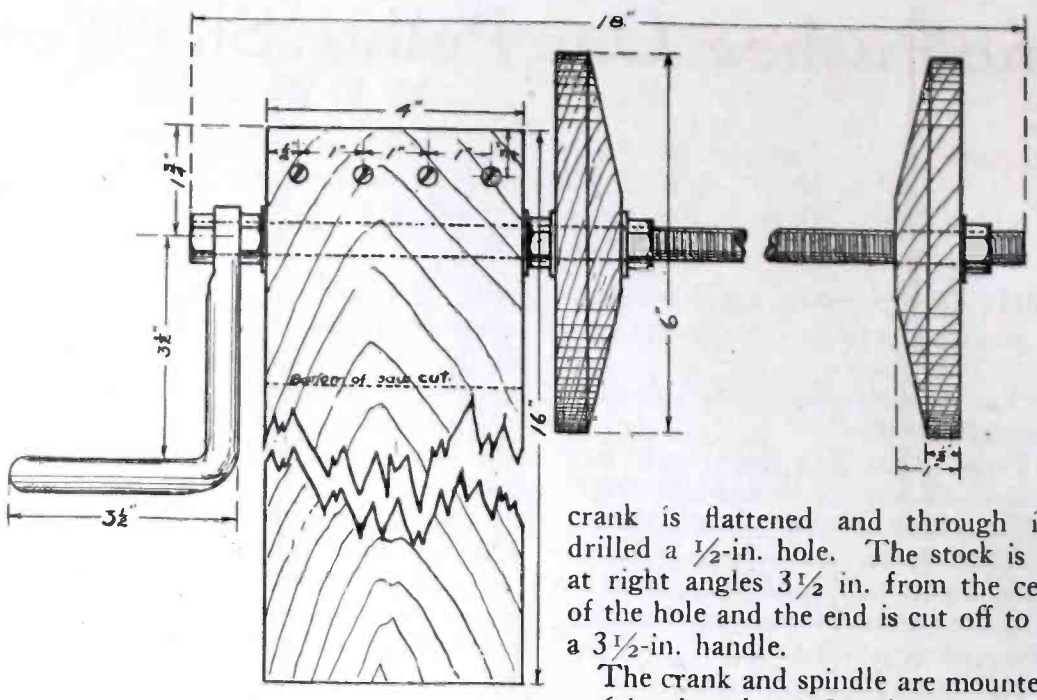
"Let's see if we can hear the west coast. We'll try the hams first. There's 5ZA. Wonder who he's working? 6XAD! Now we're beginning to reach out, Queue."

"If we only get a 7 now, we have every ham district. They surely on now: it's time for them to start. 10:30 their time."

"Look here, Queue, we have some wavelength control in our transformers, too: over here we get 5ZA and right here we get 6XAD. Say, that's great! What are ya doin'?" "C. W. faint, I tune in. Oh my, so loud! We listen till he signs—de 7ZO! At last we hear every district. Now let's try west coast broadcasting. 'KHJ'." "That's *'The Times'* at Los Angeles."

"I hear other one, Sea, not so loud. Sounds like WGAD. Now sending music again. Never hear WGAD before, wonder who he is? Yeah, it's WGAD allight. Let's look it up and see who it is."

"Where's your call book, Queue?"



Coil Winder

"Under the battery charger."

"What in thunder have you got it down there for?"

"He pretty noisy so to make him call not so loud I stand him on call book. Who is WGAD? He just sign again."

"Are you sure of that call?"

"Uh-huh. I don't understand what he say except 'WGAD'."

"No wonder! This good book says it's: 'Escuela Hispano Americana de Radio Telegrafia, Inc., Ensenada, Porto Rico!' "

"Porto Rico! Oh, I feel seasick. We better stop for tonight. One tube pushee, one pullee; she workee like hellee."

AN EFFICIENT COIL WINDER

By E. B. WHIGAN

TO make a winder that will handle almost all types of coils first secure a piece of ½-in. cold rolled steel for the spindle. Thread its entire length to within 5¼ in. of one end, leaving a 4-in. space unthreaded where it is to be supported, and then threading 1¼ in. at the end. A crank is bolted on this end, being made from another piece of ½-in. steel about 8 in. long. One end of the crank is flattened and through it is drilled a ½-in. hole. The stock is bent at right angles 3½ in. from the center of the hole and the end is cut off to give a 3½-in. handle.

The crank and spindle are mounted in a 6-in. length of 2x4 by means of a ½-in. hole bored through its width 1½ in. from one end. The axis of the hole should be split by a saw cut 4 in. deep. This split may be slightly opened or closed by means of four wood screws in 3/16-in. holes bored as shown in the sketch. Five ½-in. hexagon nuts and washers complete the materials needed.

Fasten the crank to the spindle by loosening a nut on each side. Place a washer on the spindle and push it through the supporting piece. Another washer and nut will prevent the spindle from having end play. Add another washer, a wooden disc, and the whole will be held tight by another nut.

The four wood screws control the tension on the spindle. These should be tight enough to prevent the wire from slipping when the handle is released.

For coils such as tuning and bank wound the tube is placed over the spindle, and the other disc and nut run up against it and tightened.

This winder will be found to be very fast and produce a very fine job.

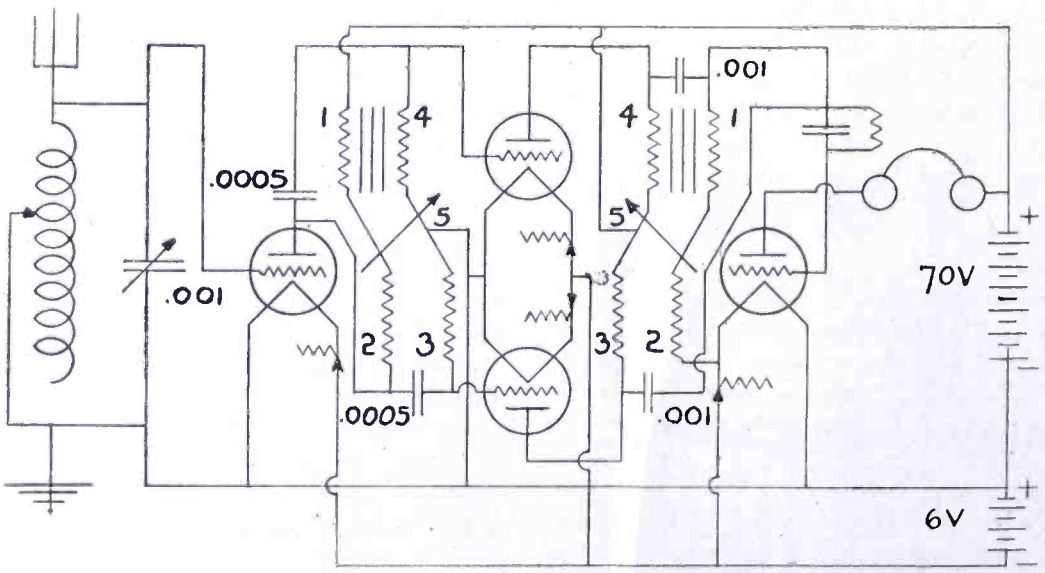


Fig. 4. Radio-Frequency Push-Pull Circuit

When making a radio set it is often difficult to hold the screws so that they may be put in some nearly inaccessible place and one always thinks that his fingers are all thumbs. An efficient device may be made by slitting a piece of quarter-inch brass rod about six inches long with a hacksaw for about a half inch. In this slit is inserted two pieces of phosphor bronze or spring brass an inch and a quarter long and a quarter of an inch wide. These strips are sweated in and then the tips filed so that they will be thin enough to hold small screws. The tips are sprung so that their natural position is with the ends about an eighth of an inch apart. When these tips are pressed together and placed in the slot in the screw and then released they will hold the screw securely until it has been started and then they can be released by simply pulling.

"He sits down in my chair and sticks on my phones."

The Jinx of the Bobolink

By Volney G. Mathison

"Q-S-T-! Q-S-T! To all ships and stations! The largest landslide that has taken place since the opening of the Panama Canal occurred at two o'clock yesterday morning, when the side of Culebra Cut caved in for a distance of one and one-half miles, filling the Canal completely with debris. The slide is attributed to earth eruptions in the canal bottom, which have been unprecedented. All available dredges, scoops, and sand-suckers have been dispatched to the scene, but the time that will be required to clear the cut is impossible to foresee. All vessels en route to the Canal should immediately radio their home offices for instructions to refuel and take sufficient supplies at Cristobal or Balboa to enable them to proceed to destinations via Cape Horn.

J. N. BELLOC,
Military Governor, Canal Zone."

I BELIEVE that every sea-going brasspounder in the world either copied directly or had relayed to him this mysterious forged radiogram, which was sent out from somewhere along the west coast of Central America on the morning of July 16, 1923.

Every operator, taking the signature of NBA, affixed to this broadcast, at its face value, delivered the message to his captain, and then made haste to relay it. For days thereafter there was confusion and uncertainty in many steamship offices, and pandemonium on the air. A thousand freighters, tankers, and passenger liners bound for transit through Uncle Sam's big ditch jammed the ether with radiograms to agents and home offices requesting orders; a dozen ships hove to in mid-ocean to await their answers; several turned back; others changed their courses for the Straits of Magellan, and one of these last eventually met destruction upon the rocks, in essaying that wintry blizzard-swept passage.

At length, definite word followed that the radiogram was a forgery, a malicious joke, and there was peace again, albeit an angry, revenge-thirsting peace that would hang the faker. Then fancy the stir when it was later broadcasted far and wide that the perpetrator of the ill-conceived jest had been apprehended in the person of one Samuel Jones.

Some sort of an investigation followed; but since the subsequent fate of Samuel Jones seems to be unknown to the general public, I feel that justice requires the setting forth of some of the ins and outs of this amazing matter. And now let me surrender the helm to Samuel Jones himself—and you'll find he's not the densest and dumbest.

WHEN the *Steel Bobolink*, backs slowly out of her berth at Pier 37 I stands over my suitcase an' sea-gab an' mops my face with relief.

"Thank criminy, I'm off to sea again!" I mutters to the rainbow-tinted amplifier tubes of my private three-step, as I proceed to tack up my license in the corner alongside the lightning-switch. "May a half-million-volt high tension line drop on me if I ever monkkey with a shore-job again!"

"Whassamatter with shore jobs?" inquires Ziegfield Stubbs, third assistant engineer of the *Bobolink*, who has come up topside to trim the big red-throated ventilators abaft the radio shack.

I replies, briefly, "Tried installin' a gang of wimmen brasspounders for a bughouse steamship company down in New Orleans—got five hundred dollars on my accident insurance policy and three months in th' hospital out of it. Wimmen an' me don't mix, an' that's

why I'm back on a good iron deck. This Pacific-Atlantic run is goin' to be just my speed—sunshine an' blue sea, th' propellor's thump, an' no skirt inside of five-hundred miles. Great stuff!"

Ziegfield Stubbs looks at me quizzical like, an' scratches his head.

"You'll git sunshine, all right," he replies. "You'll git sunshine that'll burn th' paint off'n your sparky coop an' melt th' bak'rylite in your lead-in gadgets; but you ain't gittin' no rest, nor five hundred miles from th' long-stockin's. This ship is jinxed, an' squattin' right up there on th' bridge, 'longside th' chart-house, is th' joner."

Alarmed like, I follows Ziegfield's stumpy finger, an' see sittin' up on the bridge a two-hundred-pound female, strong-shouldered as a battle-ship an' with a hard-square-jawed map like a block of cement.

"By th' holy red whiskers of Trotzky!" I groans, dismayed. "What's that old battle-axe doin' on this freight carrier?"

"Cap'n's wife, of course," replies Ziegfield. "She's king round here, too."

"Well, she ain't goin' t' sit on top of me!" I announces, hard-boiled like. "If she starts any czar stuff around my shack, she'll find out a bullshevik is a tomato-picker alongside of me—

Just as I am deliverin' this declaration, a young kid, about eighteen, with a wide, stupid, empty face an' a burnt-out cigarette-butt hangin' on his lip, his clothes torn an' dirty, climbs up onto the topside, jostles past me roughly, an' walks right into my wireless shack. Here he sits down in my chair, sticks on my phones, switches in the audions of my private amplifier, an' begins jerkin' the tunin' controls around, careless like.

"This is a crummy rig—I got one home worth a dozen of it," announces the kid, with a sneer, as he hoists his oil-smeared shoes onto my typewrtier an' proceeds to turn up my vacuum-tubes until they are blazin' like a bunch of mazda lamps.

"Hey, you gally rat;" I yells, enraged, dashin' in through the door after him, "you git th' h—l out'a here!"

"I won't!" snarls the kid, glarin' at me, vicious-like. "I can come in here any time I want to; I'm Captain Pirky's son." About one-tenth of a second later I have got a couple of fast-movin' fists an' a hard-shod hoof into action, and Sir Pirky scoops up a shovelful of the cinders out on the boat-deck with a well-skinned ear.

"Baww!" he blubbers, his wide, sloppy face wrinklin' up like a struck mainsail. "I'm gonna tell my maw!"

"My gorry, Sparky, you hit that ole woman's boy! You got yoreself in a mess, now, certain!" exclaims Ziegfield Stubbs, with a scared look. "That boy is a spoiled egg, he's signed on here ordinary seaman, but he ain't done a tap of work sence he come on th' ship. They got him eatin' in th' saloon with us off'cers an' sleepin' in th' owner's suite—look; he's up on th' bridge now telling th' ole hag what you done t' him. Goodnight, I'm gittin' down from here!"—an' with this Ziegfield vanishes.

Glancin' through a port-hole toward the bridge, I sees the Amazon of the *Bobolink* talkin' to her old man, a finger of one knotty-fisted mitt pointin' aft at my hangout an' her jaw workin' like a pair of plate-shears in a shipyard.

Directly Captain Pirky, a spineless-lookin' old weasel with mouse ears an' a weak curved-in nose, comes hustlin' down the boat-deck, while th' empress of the *Bokolink* stands up on th' after side of the bridge, watching him.

"Mr. Jones, what have you done to my boy, Elmer?" he demands, all steamed up like.

"I threw him out'a here!" I replies, belligerent-like. "If he comes in again, I'll do worse!"

"You'll do no such thing!" exclaims old Pirky, wobblin' his narrow bean around, angrily. "Elmer is privileged to go into any part of this ship he wants to—

"No, I'll be hung if he is!" I barks. "When th' crew can hang around in th' radio shack an' fool with my gear, I'll take my license an' wipe my auto-strop with it!" With this I turns my back an' puts on my phones.

Old Pirky hestitates kind of uncertain-like, then returns up on the bridge, where he wobbles his head some more, like he was tellin' his boss how he's bawled me out proper an' set me in the corner.

"I S'POSE ya see what kind of a joner we got on this ship, now, I reckon," Ziegfield Stubbs hollers into my ear above the heavy roar of the main reduction-gears, when a little after eight bells I climb down fifty feet of iron ladders to visit him at his post alongside the turbine-head. "I gotta hunch somepin's gonna happen 'fore we git back t' Bal'more—a woman's a joner on a freight ship, an' th' only worst one's a pricher—s'pecially a nigger."

Gettin' in on the air, half-an-hour later, I runs across a big bunch of file press on the way over the navy arc circuit from San Francisco to Manila. The first item I copies is dated from Cristobal, and reads:

"*A small slide occurred in the Panama Canal at four this morning, when thirty-thousand cubic yards of earth fell from the upper south face of Culebra Cut. Dredgers are clearing the debris, and there has been no delay to ship transits—*"

About this time, I hear a heavy, solid tread out on deck; then the door of my shack opens an' in marches the empress of the *Bobolink*.

"Mr. Jones, tune in a radio concert!" she commands, in a tone like a Chink mandarin's wife givin' an order to a pig-tailed coolie. "I wish to hear some music."

My first thought is to rise up an' do battle right there—then I gets a idea.

"Sure thing, ever so pleased," I says, chilly polite. I gets up to plug in the loud-speaker with which the ship is fitted out; whereupon the kaiserin takes possession of my chair an' sits watchin' me, hawk-eyed.

Tunin' down on phone waves, I bring in the San Jose Radio Shanty's wash-tub jazz clatter: "Yer gotter see mommer ev'ry night, tiddle de plunk, bananas and ashcans—honk, konk, bologna—

"Eliminate that!" snaps the old battle-axe, glarin' at me, murderous-like.

"Excuse me," I murmurs, hastily. "I took it fer a Rigoletti op'ra. With this I proceeds to tune in "The Flies, Loss-Enghelles, Caleeforrneea," whereupon from the loud-speaker busts out a roar of: "*Desfaceradero de mee casa! Le vee besando-le ah mee moohair! Con coocheellyo le matar-r-r-e-e-e-!*"

"What do you mean by this, sir!" flares the kaiserin of the *Bobolink*. "I want you to tune in Kale Brothers, Inc. of San Francisco, where on the pipe-organ tonight Subien Gotchowski is going to play "The Soul Kiss."

"I'm sorry, but the Kale boys ain't broadcastin'," I replies, regretful as the Reichstag explainin' to the Frenchys about the war debt. "They've gone bankrupt buyin' pipes for their organ fast as old kid Gotchowski splits 'em."

With a hostile sniff, the empress of the *Bobolink* takes her departure. Relieved, I makes up my press news and send copies down to the messrooms.

The next evening I finds the younger Pirky in my shack rootin' into the ship's library, which is kept in a bookcase in the wireless house; and just as I come in I catch him deliberately tearing a page out of a book which is titled "Days and Nights on the Isthmus."

"I'm gettin' a couple of pictures that Zokur II wants to try to copy with one of his cameras," he says, fresh-like, when I call him on it. Zukor was one of the wipers that the kid had taken for a buddy. He had a ole rattle-trap camera machine that he shot moving pictures with.

After landin' the kid roughly out on the boat-deck, I step down to the saloon pantry to get a cup of coffee, only to hear the shrill whistle of my motor-generator suddenly start up. Dashin' back up onto the boat-deck, I finds the old kaiserin in my shack again, while her kid Elmer is sittin' in my chair with the phones over his head an' his fingers on the key.

"What th' Hades!" I begins—

"Cease that cursing, sir!" snaps the old battle-axe. "I'm having Elmer call up the station at Los Angeles to find out when Hamburgers Home Friend Furniture Company is going to broadcast

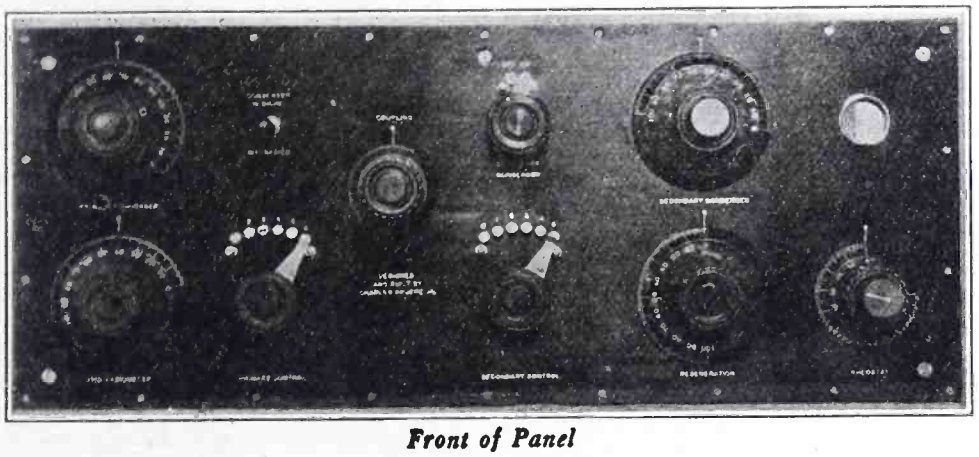
Continued on page 56

An Efficient Low Wave Regenerative Tuner

By Charles Bruere, Jr., 6GZ.

This article has been prepared for the amateur who wants not merely to assemble a set but to construct some of the parts. Detailed directions are given for winding the variometers, variocoupler and grid coupler, as well as for making the panel.

THIS tuner is modeled after the Paragon R A 10 except that it uses a variometer to tune the grid circuit for amateur wavelengths, and a condenser to tune for the higher waves. The circuit will respond to waves from as low as 130 meters, up to 230 meters without the condenser, and to above 800 meters with it. The whole set may be built by anybody with a little mechanical ability who has access to a lathe. The necessary parts are:



Front of Panel

1 pc. bakelite 8½ in. x 20½ in.
1 pc. bakelite 8 in. x 19¾ in.
1 pc. bakelite 2 in. x 19¾ in.
8 inches 3½ in. bakelite tubing.
2½ inches of 2½ in. bakelite tubing.
1 pc. aluminum 1/16 in. x 8½ in. x 20½ in.
2 wireless shop 3-in. rotor balls (moulded).
1 43-pl. variable condenser.
1 23-pl. vernier condenser.
1 6-ohm. vernier rheostat.
9 binding posts.
4 Gilfillan 3-in. dials.
1 Gilfillan 2¼-in. dial.
1 2-in. dial.
28 contact points.
6 switch stops.
2 Gilfillan large switches (1¼-in. radius).
1 .00025 mf. mica grid condenser.
2 .001 mf. stopping condensers.
6 lengths of hard rubber rod ½-in. diameter.
1 piece ⅜-in. hard rubber rod 2 feet long.
1 1-in. bezel.
2 doz. 2-56 flat head screws ½ in. long.
2 doz. 8-32 flat head screws ½ in. long.
2 doz. 6-32 flat head screws 1 in. long.
3 feet of hard wood 4 in. wide and ¾ in. thick (birch).
1 ft. ¾-in. brass rod.
3 ft. 3/16-in. brass rod.
2 ft. ⅛-in. brass rod.
2 doz. 8-32 hexagon nuts.
2 doz. 10-32 hexagon nuts.
2 doz. 6-32 hexagon nuts.
1 jack for series parallel switch (or regular series parallel switch).
1½ lbs. No. 18 S. C. C. wire.
20 ft. No. 14 hard drawn wire for connections.

Variometer Construction

ANY variometer may be used if it has a low inductance range and is wound with large wire. A small variometer makes tuning much easier, as it spreads only a small amount of wavelength range over the whole 180°. The two rotors are wound with 32 turns of No. 18 S. C. C. wire, 16 turns to a side. Fig. 1 shows rotor dimensions and Fig. 2 the plan for each side of the stator. The inside face of the stator was not turned to conform to the curvature of the rotor but cut out flat, as the variometers are so small no efficiency will be lost. Four of these forms are made, one for each half of the two variometers. The blocks are cut 4 in. square and ¾ in. thick. After they are square set them up on the face of the lathe and turn the center out to size.

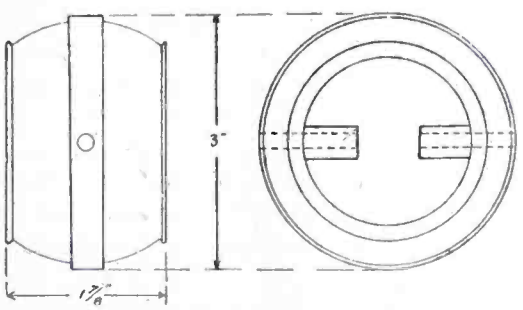


Fig. 1. Dimensions for Variometer Rotor

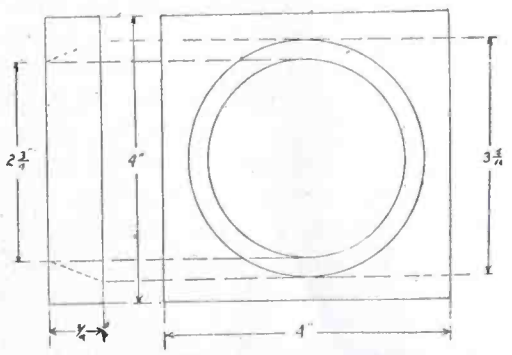


Fig. 2. Dimensions for Variometer Stator

To wind the wire a form must be turned out of 1-in. stock. It should have about 3/32-in. less diameter than the inside of the stator. The size and shape is shown in Fig. 2A. After this

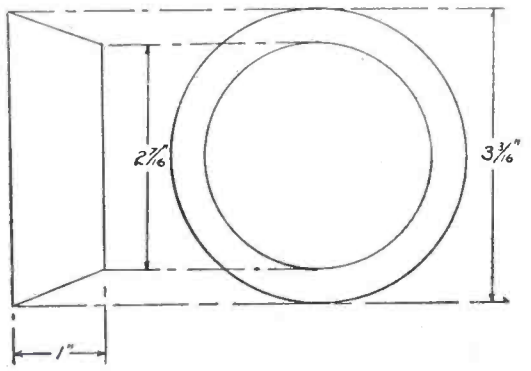


Fig. 2a. Wire-Winding Form

is completed a piece of wood is placed on the smaller face and wound with No. 18 wire. Give the wire a coat of collodion. After it is dry, which will be almost immediately, remove the coil and place it in one of the stator sections with a little glue.

Make a coil for each stator section. After they are all filled take off turns until each one has fifteen turns, thereby balancing the value of inductance of both rotor and stator. The total turns on the rotor are 32 and 30 on the stator.

The bearings for the shaft should be cut out of 1/16-in. brass ¾ in. wide and 1⅞ in. long. The hole for the shaft should be exactly in the center, otherwise there will be trouble in making the rotor turn without scraping. These are shown in Fig. 3.

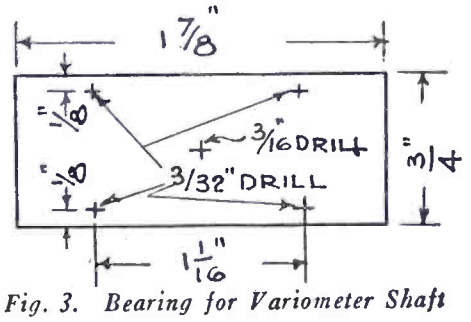
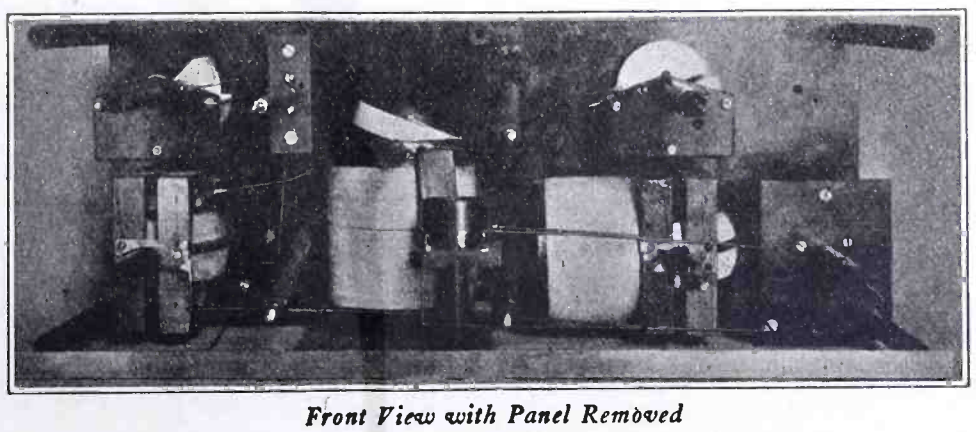


Fig. 3. Bearing for Variometer Shaft



Front View with Panel Removed

The collars for end play should be turned from ½-in. brass rod. They are ½ in. long. A groove ⅛ in. deep should be cut 1/16 in. from the end. A 6-32 screw should be placed 3/16 in. from the end for a set screw. The groove is cut in for a pigtail connection, soldered to the end bearings, thus insuring perfect contact. If the pigtail is put on the collars in opposite directions it can be used for stops and the rotor adjusted

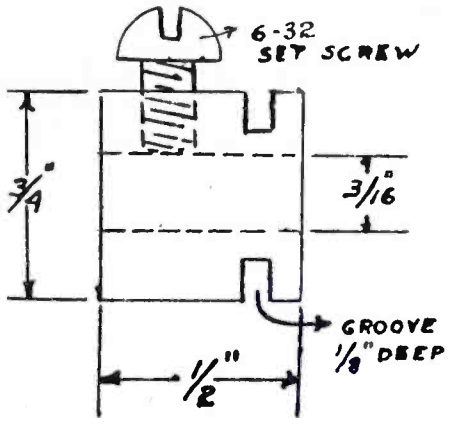


Fig. 4. Collar

to make only one revolution. Six collars should be made, as two are used on variocoupler. Shown in Fig. 4.

Fig. 5 shows the bearings used in the front panel. These are not necessary, but help by keeping the shafts running

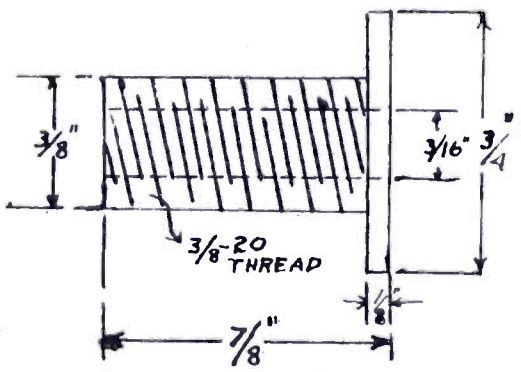


Fig. 5. Front Panel Bearings

smooth and easy. They are turned from ¾-in. brass rod. A flange 1/16 in. thick is left on one end and the other turned down to ⅜ in. diameter and threaded with a ⅜ in. x 20 thread. The rod should first be drilled, then turned down to ⅜ in., threaded, and then cut off, leaving the flange. These bearings are held to the panel by ⅜ in. x 20 hexagon nuts.

Variocoupler Construction

THE variocoupler rotor shown in Fig. 6 is a piece of bakelite tubing 2½ in. diameter and 2 in. long. This is shown as L_2 in Fig. 12. A piece of ½ in. rubber rod about 2½ in. long is drilled for a 3/16-in. shaft. The ends are filed down to conform to the curvature of the tubing. The holes for the shafts in the tubing can be accurately drilled by using a strip of paper. Wind the paper over the tube, prick it with a pin, take the paper off, fold it and then place it back and prick the tube. The holes then may be lined up evenly from the sides with a ruler. After drilling the holes place the hard rubber rod in place. Put a piece of 3/16-in. brass rod through temporarily. Place a 2-56 flathead screw in one end to keep the rubber rod from turning. Take it apart again and drill the rubber rod for clearance for a 4-36 screw. These holes are shown 90 degrees out in the drawing to make the construction clear. Place in two pieces of 3/16-in. rod for the shafts. These are split so as to be able to make the connections from the windings. The rods are tapped for 4-36 thread. The clearance hole in the rubber was made so that the screws made good connection to the rods. The windings consist of 30 turns No. 18 wire, although it may be necessary to experiment slightly to be able to get the exact amount. A small amount of collodion should be put on the edges of the wire, but not all over the coil, as this would cause too high a capacity effect.

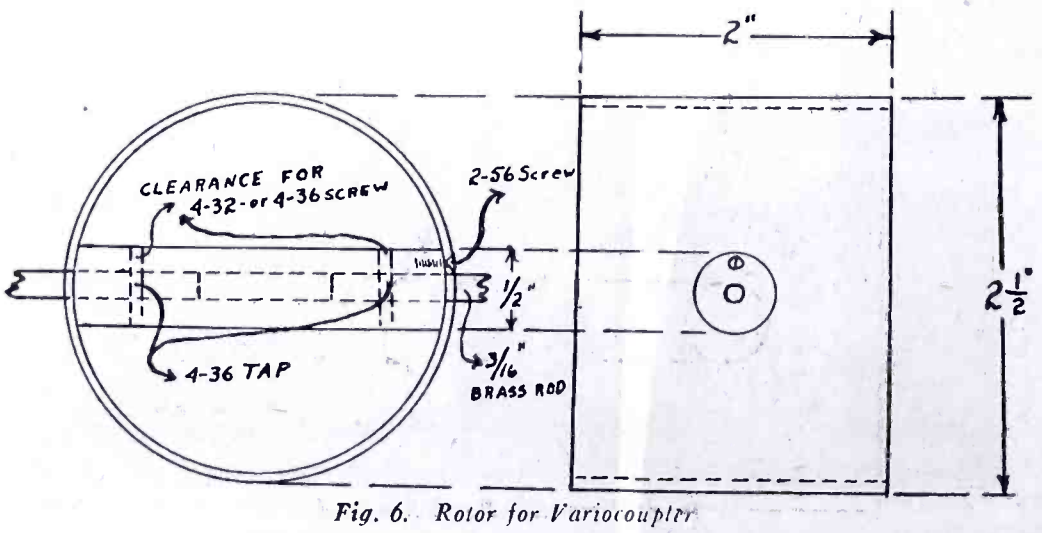


Fig. 6. Rotor for Variocoupler

The primary coil L_1 in Fig. 12 is

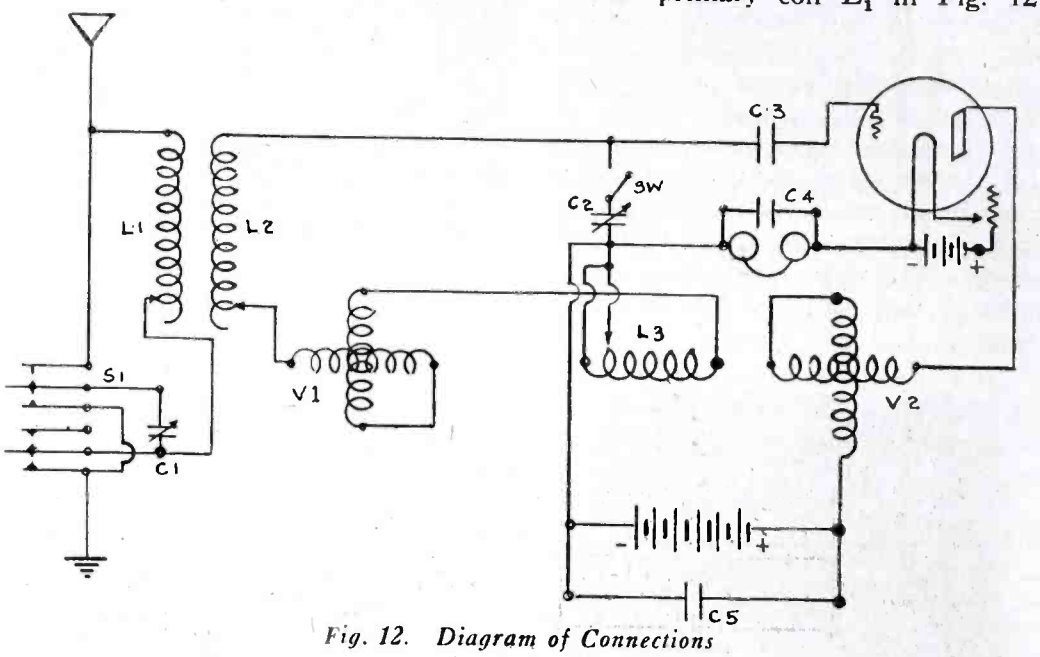


Fig. 12. Diagram of Connections

L_1—Primary coil.
L_2—Secondary coil.
L_3—Grid loading and coupling coil.
V_1—Grid variometer.
V_2—Plate variometer.
S W—Condenser switch.

C_1—.001 mfd. primary condenser.
C_2—.0005 mfd. secondary condenser.
C_3—.00025 mfd. grid condenser.
C_4—.001 mfd. stopping condenser.
C_5—.002 mfd. R. F. condenser.
S_1—Series shunt switch.

wound on a tube 4¾ in. long and 3½ in. diameter. The winding consists of 75 turns of No. 18 S. C. C. wire. The winding starts at the top ¾ in. from the edge. The taps are taken off after the windings are in place. One edge of the insulation is cut with a razor blade. The insulation is then pulled off with a pair of pliers. This leaves no unsightly lumps of insulation. The coil is tapped for six taps. The first at 8 turns, and the others at 18, 29, 41, 66 and 75 turns respectively. Short pieces of wire long enough for the connection should be soldered on the coil at the scraped places. The holes for the bearings were centered the same as for L_2. A 6-32 screw should be placed about ¾ in. away from the holes to solder the pigtail to. The two collars can now be used. The Wireless Shop makes a complete set of parts, for mounting the rotor to the primary coil, which sells for about $1.50. This saves time and worry if the parts are used. A piece of wood was turned up to fit snugly in the base of the tube. Four small wood screws were used to hold it in place. This is used to mount the coil on the sub-base put in to hold the coil. This is shown in the picture of the bottom of the set. Assemble the two coils and solder the pigtail down.

Grid Loading and Coupling Coil

COIL L_3 consists of 50 turns of No. 18 S. C. C. wire wound on a tube 3½ in. diameter and 2⅝ in. long. Taps

were taken off every ten turns. This makes five taps. The beginning is connected to the first contact point, thereby making six contacts.

A groove was turned in one side of V_2 to hold the coil. This should fit snugly. The coil is held in this groove by glue. Any other method of mounting may be used, but this method gives the closest coupling between L_3 and V_2. L_3 is a grid-loading coil and also coupling coil to V_2, the plate variometer, to give inductive regeneration.

After all the coils are completed the edges should be coated with a little collodion to keep the wires in place. The collodion may be made by dissolving some old photographic film in ether.

It would not be a bad idea to mount the instruments on a board to test them out. It may be necessary to reverse the leads of V_2 in order to get the correct field of the two coils V_2 and V_3, otherwise the set will not oscillate. Experiment with the distance of the unit V_2 and L_3 from the primary coil L_1, as there is a coefficient of coupling between these, even though they are at right angles. After everything has been tested out the rest of the work may continue.

Panel Construction and Assembly

THE panel should next be cut to exactly 8½ in. x 20½ in. If larger condensers than Wireless Shop or other standard size are used the dimensions will have to be changed. This, of course, holds true for the variometers also. Clearance holes for 2-56 screws should be drilled around the edge as shown in Fig. 7. These should be countersunk. Bakelite or hard rubber may be easily planed if an oil stone is kept handy to keep the blade sharp. After the panel is drilled a piece of 1/16-in. aluminum 9x21 in. is placed behind the panel and drilled to correspond to the holes in the panel.

The drilling is for a 2-56 tap and should not be drilled clearance. Tap the holes with 2-56 except the holes on the bottom, which should be drilled clearance in order to allow the placing of a ½-in. piece of angle brass the same length as the panel. This should be drilled and tapped. This serves to keep the panel rigid. After the aluminum is in place it may also be planed down to size. Threading aluminum is easily done if a little gasoline or kerosene is used as the lubricant instead of a heavier oil. The rest of the holes should be drilled in the panel as shown in Fig. 7.

The sub-panel shown in Fig. 8 is cut to exactly 8 in. x 19¾ in. This of course will vary if different instruments are used. For this reason only the holes for the support rods, binding posts and switches are shown. The holes for the

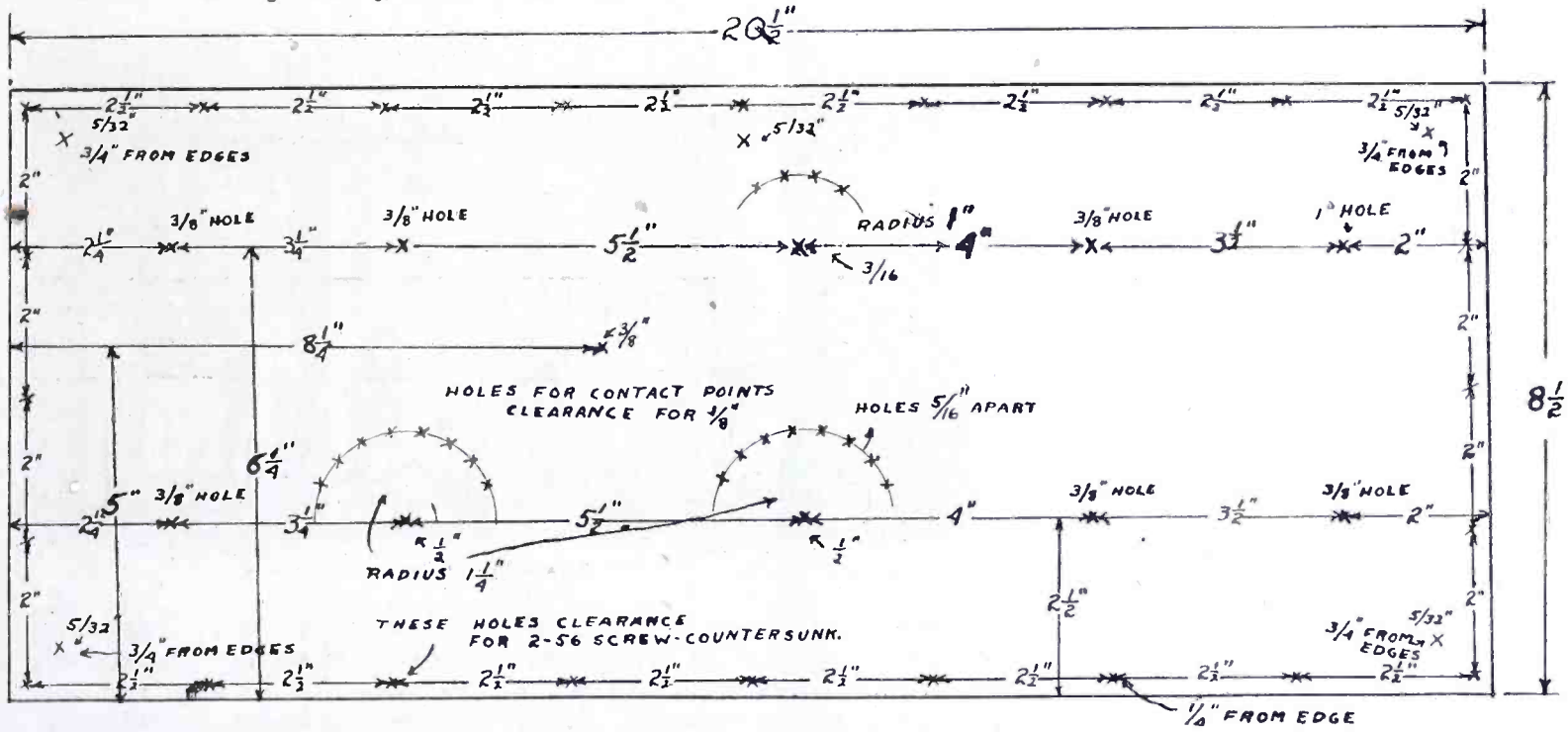


Fig. 7. Panel Layout

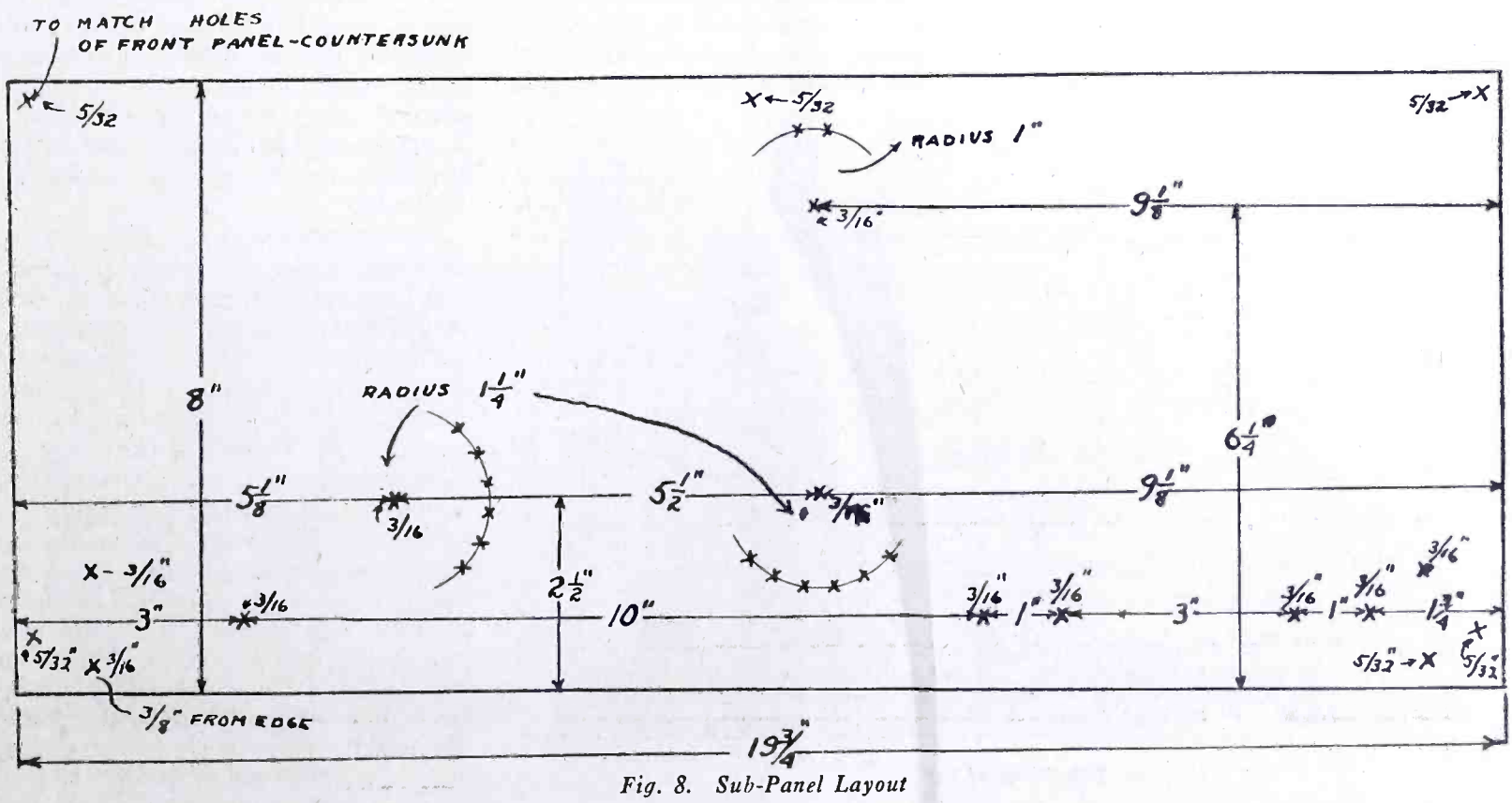


Fig. 8. Sub-Panel Layout

support rods may be drilled by clamping the two panels together. The panel should be marked in the exact spot where the holes are in the front panel so as to be able to accurately line up the instruments on the rear panel. It will be noticed, however, that the contact points are not symmetrical with those of the front panel. This is done in order to secure shorter leads and keep them from being bunched up as they come from the coil. If the two panels are lined up so every instrument is in line with the front bearing an easily-turning instrument will result.

The binding post locations are shown in Fig. 11. This is not necessary if you are satisfied to have the rear panel open in the back of the box. I used it in order to keep dust and dirt away from the switches mounted in the back. This is cut exactly 2 in. x 19¾ in. It is held ¾ in. from the rear panel by hard rubber bushings.

The back view of this panel is shown as the inside of the rear or sub-panel. The hard rubber bushing fits over the shank of the binding posts.

The series parallel switch was mounted on two hard rubber supports. This is shown in the picture of the top view of the set. It is a double-pole, double-throw telephone jack switch. The Colin P. Kennedy Co. puts out one a trifle larger, but of the same order. This push-pull type is much handier than the double-bladed panel switch type.

All the instruments are controlled by knobs and dials on the front panel. They are insulated from the aluminum shield by hard rubber rods drilled to fit the shaft and fastened by two ⅛ in. x 3/16-in. set screws, which have a ⅛-in.-40 thread, which is a special size, although any small screws may be used. These hold much tighter though. The construction is shown in Fig. 10.

The idea of mounting the instruments so far back is to reduce capacity. Every one knows that tuning in C. W. signals or the carrier wave from some broadcasting is greatly interfered with by the body capacity of the operator. As he moves his hands around the signals vary, so the aluminum shield is put on the front panel. This keeps the body capacity from interfering with the tuning, as both the shield (if it is grounded) and the body of the operator are at ground potential.

The instruments are mounted 9 in. back because if they were next to the shield there would be a capacity effect between the instruments, raising the wave and changing the tuning of the set, thereby spoiling the effect of using this particular circuit and reducing therefore the distance it is capable of receiving.

Five pieces of hard rubber rod 9 in. long and ½ in. diameter are cut out on the lathe to be used as supports for the two panels. They are used on all corners and the middle of the top of the panels. The center of the bottom is held rigid by the board or sub base used to mount the variocoupler.

The board measures ⅜ in. x 4½ in. x 8⅞ in. The extra ⅛ in. is taken care of by the ½-in. angle brass on the front panel and on the rear panel. A short piece of the angle brass 4½ in. long is used for this purpose. The thickness of this board will of course depend upon the height of the variocoupler if it is to be in line with the hole in the front of the panel.

Continued on page 68

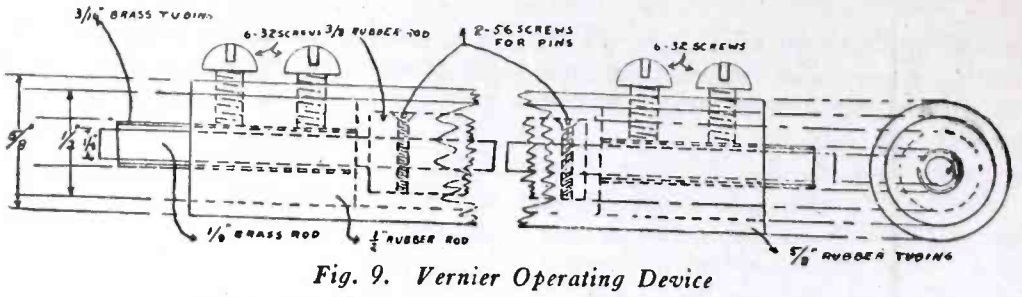


Fig. 9. Vernier Operating Device

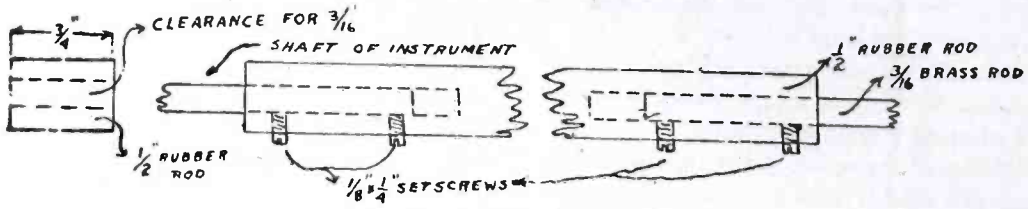


Fig. 10. Insulated Control Rod

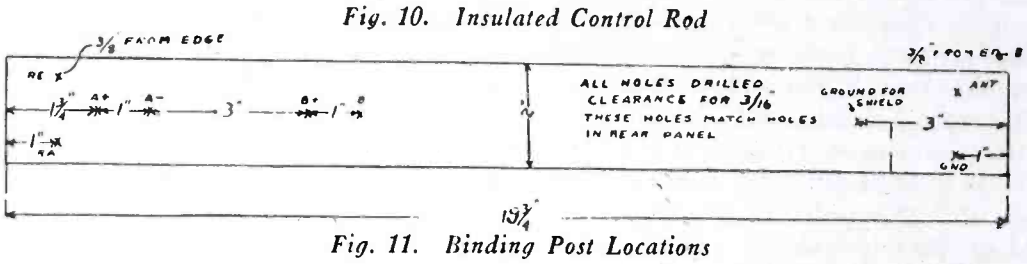
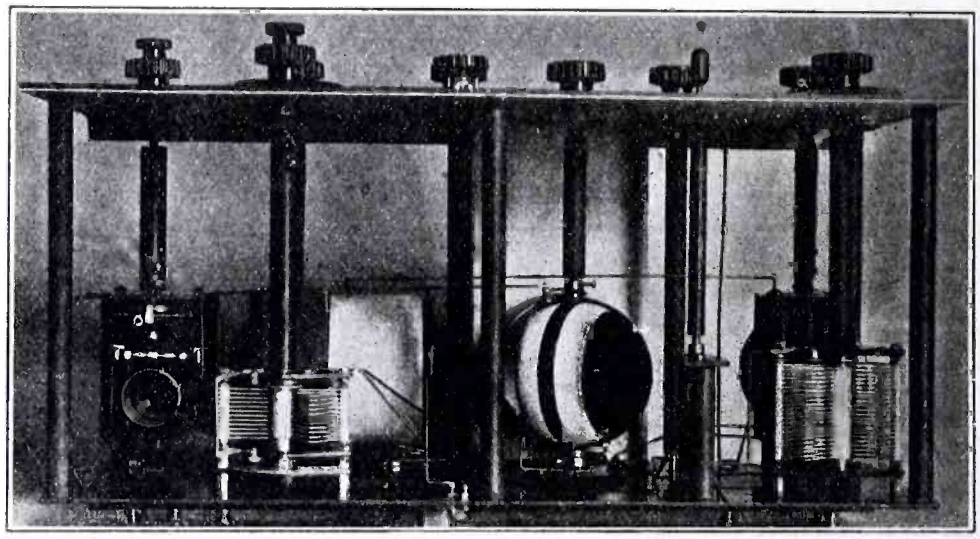
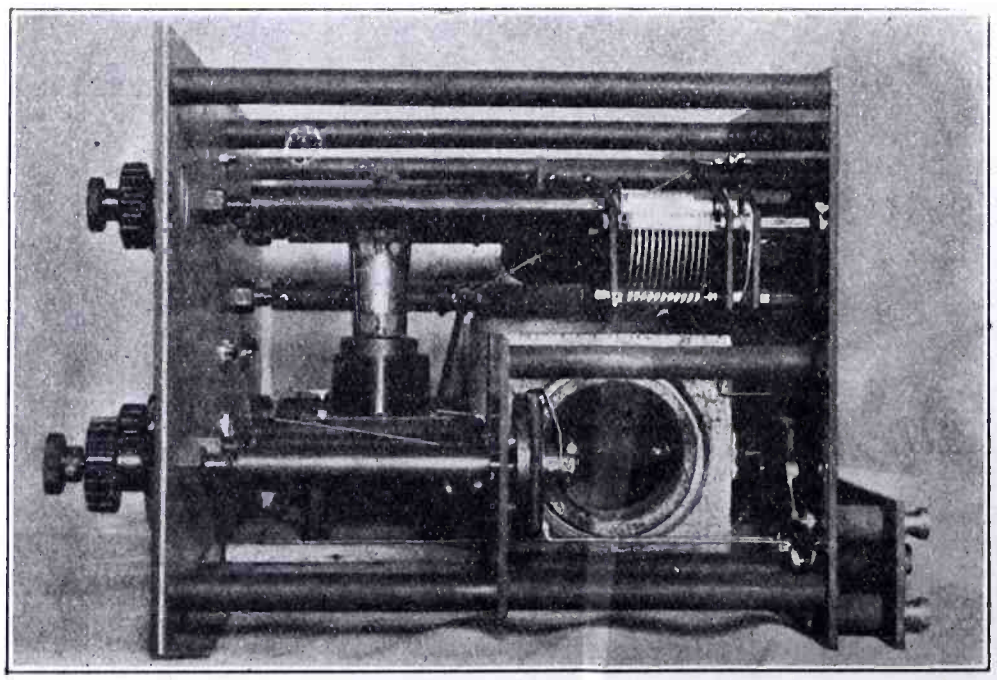


Fig. 11. Binding Post Locations



Top View of Set



Side View of Set

How to Tune a Honeycomb Coil Set

By Paul Oard

After a brief statement of the reasons for the unwarranted relative unpopularity of the honeycomb coil, the author presents some oft-forgotten directions for securing the excellent results possible with this type of tuner. He believes that its merits will soon make it a universal favorite.

THAT the honeycomb coil, with its manifold advantages, is not more widely used today is probably due to the fact that when regeneration first became popular with the amateurs sufficient stress was not laid on the necessity of current flow in the same direction in the secondary and tickler coils. Many amateurs became discouraged if the set refused to regenerate when the coil was connected backwards, and discarded their coils, also passing their experience on to others. Another reason was that some of the early tubes would not regenerate even when the coils were properly connected and the coil was blamed for no fault of its own. The third was a prevalent belief that a set so equipped is hard to tune, especially for distant stations.

Nothing could be further from the fact, once the simple principles of tuning are understood. A station may be tuned in with honeycombs just as quickly as with a single-circuit receiver and unwanted stations may be eliminated to a far greater degree. Furthermore, with the inevitable upward movement of broadcast wavelengths, any change can be met with a minimum of expense by merely substituting a new coil.

In studying the problem of tuning a honeycomb coil set we understand that the wavelength of each coil is varied by means of a variable condenser, rather than through an inductance switch. If the tickler, or third coil, is not shunted by a variable condenser, it should be. A 23-plate size is proper. On the shorter waves such a condenser is ofttimes invaluable in the securing of regeneration, particularly when the tickler coil is of small inductive value—say a 35-turn coil.

The primary coil, as a rule, has a 43-plate condenser in series with the antenna. Some instruments are provided with a series-parallel switch that permits either series or shunt connections to be used. For short waves, as in broadcasting reception, series connection is to be preferred. The secondary is preferably shunted with a 23-plate condenser. In short wave reception the use of a 43-plate type is not advisable, as the location of a given wave is rendered more difficult on account of the sharper adjustment necessary. A vernier condenser is to be preferred, on the secondary coil.

The first consideration in tuning any regenerative receiver, regardless of the circuit involved, is to be certain that your tube is in a regenerative condition. The three coils are coupled closely together, the filament of the detector tube is turned up until the familiar boiling point is reached. The primary condenser is set at any point between half to full of the dial, the secondary condenser at zero, and the tickler condenser at any point between zero upward that insures regeneration.

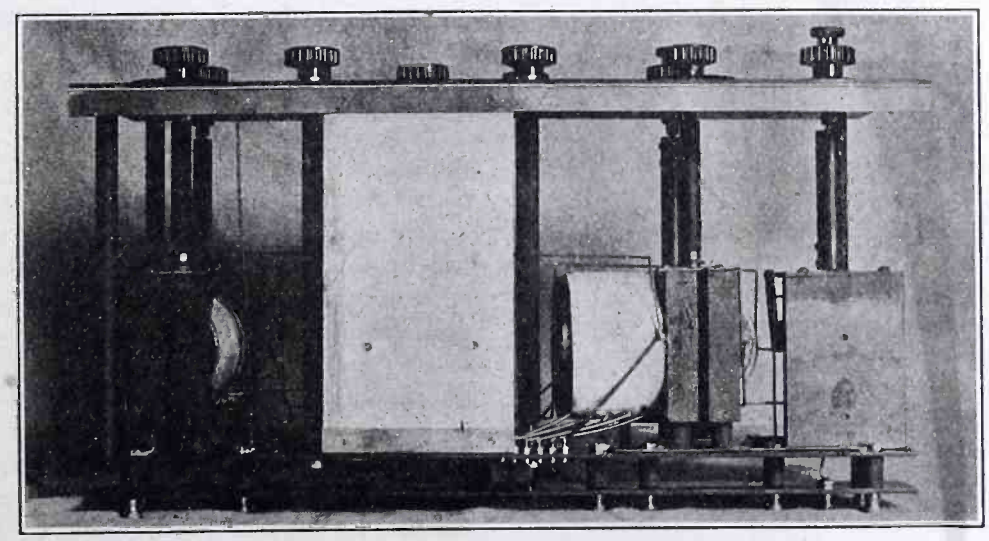
Under such adjustment, with a 25-turn honeycomb coil in the primary mounting, 50-turn in the secondary and 35-turn in the tickler, we are ready for broadcasting reception. With adjustments set as stated, we are ready to locate a given station. *Preliminary tuning is done on the secondary condenser alone.* As long as the three coils are close coupled, the position of the primary condenser is not of great importance, as the primary coil functions through a form of shock excitation in this instance. The secondary condenser is turned slowly from zero to full. If the receiving station desired is within range, this simple adjustment of the secondary condenser will bring in its carrier wave if it is possible to get it on any regenerative set.

This fundamental rule for tuning a honeycomb coil unit lays the foundation for the fine work of eliminating undesired signals. One must be his own teacher from this point on. The charm of the honeycomb coil receiver lies in the endless variety of tuning combinations possible. The further out your primary coil is moved from the secondary, the sharper your general tuning becomes, with consequent attention necessary to adjustment of the primary condenser. The further out your tickler coil is moved, the greater capacity becomes necessary to hold regeneration.

The current flow in all three coils should be in the same direction. Use a small compass as a current indicator, placing it inside the coil and shorting the coil with a weak current. Watch out for occasional coils with reversed terminals. Be certain that coil plugs make positive contact with coil mounting terminals. Grounding the filament battery will help reduce capacity effects. For broadcast stations over 500 meters use 35, 75 and 50-turn coils in order named.

Whenever it becomes necessary to move your secondary and tickler variable condensers more than half way through their capacity, to secure a station, you will secure better results if you substitute the next larger size of coil, and drop back on your condenser dial. If your primary series condenser must be brought close to the zero mark to get your station, substitute a next size *smaller* coil, and *advance* your condenser dial. This ruling applies to signal strength. Where sharp tuning is essential, the reverse of the above ofttimes helps eliminate a station that is not wanted. As I have said before, one must be his own teacher in getting the very best from the instrument.

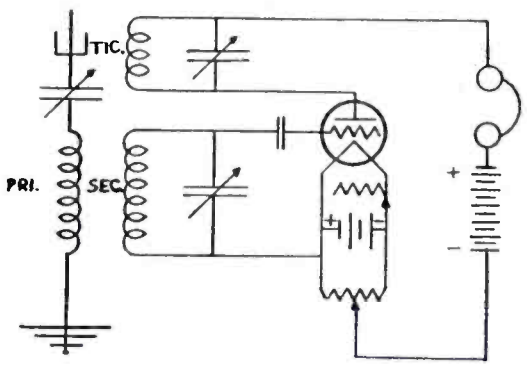
As a practical example of what it is possible to do in the way of tuning out a close-in station and bringing in one further away, consider this. The writer is one mile from a 50-watt station. This station can be cut out, and KPO, 75 miles away, can be brought in without a trace of interference. This is on an antenna 150 ft. long and 60 ft. high. A shorter lower antenna of course allows even greater selectivity, for weaker distant stations.



Bottom View of Set Described in Preceding Pages

In so far as signal strength is concerned, between a single circuit and a three-circuit honeycomb coil receiver, local stations will have greater signal strength on the first named, but distant stations will be about equal, set for set. This takes into consideration a certain amount of familiarity with the last-named outfit.

The writer looks forward to seeing the honeycomb coil receiver soon move up to the front ranks of radio receiving systems. This is not a reflection upon the many useful and efficient forms of receivers now in use. The honeycomb



Fundamental Honeycomb Coil Wiring Diagram

coil regenerative receiver has a definite place, and it will yet occupy this place with credit. Referring back to the pointers on rough tuning, we find it possible, after once making an adjustment, to do all of our tuning on one control, the secondary condenser, for the entire range of present-day broadcasting wavelengths. To simplify tuning below this point, that of one control, would be a difficult matter indeed. But when desired, one may take advantage of a range of adjustments that are limitless, and thus obtain a degree of satisfaction impossible to obtain in the simpler types of receiving instruments.

WINDOW DIALS FOR RADIO SETS

By E. H. SWANSON

IN the search for new and better ways of showing instrument positions, coupling, and capacity readings, etc., many experimenters overlook the "window-dial" system of scale recording. The window dial is best exemplified in automobile speedometers. A variation of this form of displaying an indicating scale, which adapts itself very well to popular radio apparatus, is shown in Figs. 1 and 2.

The drawings are almost self-explanatory. A cardboard disc, bearing the desired reading (after proper calibration) is mounted on the shaft of the instruments used. In fact, the effect is the same as with the hard rubber dials at present used for showing scale readings on the exterior of the instrument panel.

The advantages of window dials are obvious: Only the reading desired is in view, and if the control knob is accidentally moved, even but a fraction of an inch, the change in reading is instantly detected. Thus the window dial makes for more accurate tuning. In addition, the celluloid window protects the scale, so that the markings are always distinct. This protective feature and the fact that the size of the cardboard disc, within certain limits, can be almost anything desired, admits of a finer graduation of the scale.

The neatness and business-like appearance of the window dial will lend distinction to any radio set, and the work of adapting it to various instruments is practically nil.

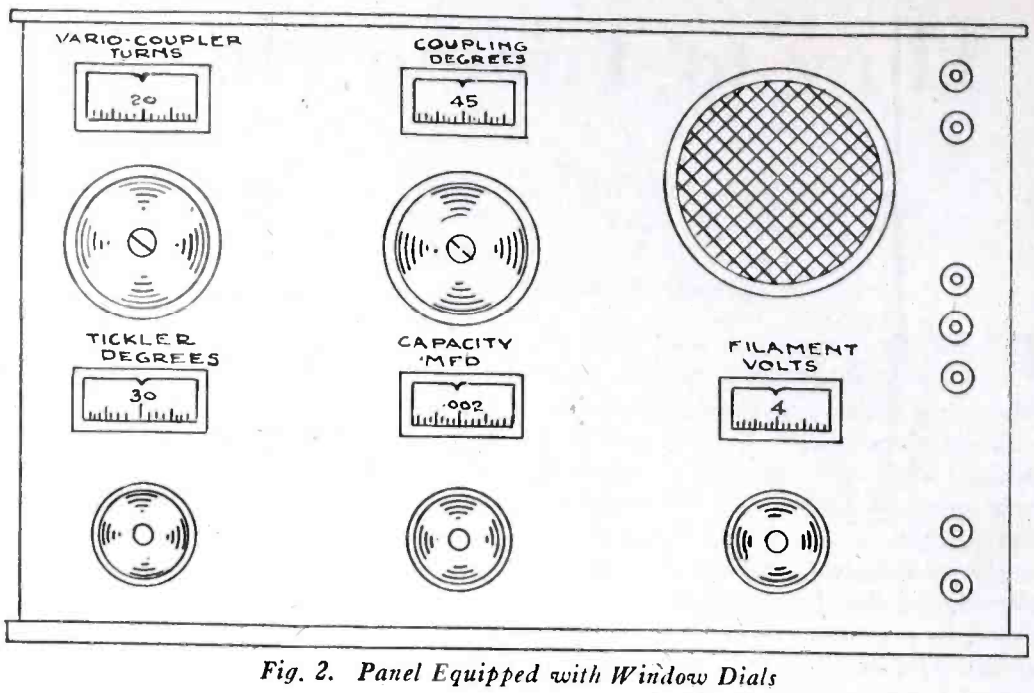


Fig. 2. Panel Equipped with Window Dials

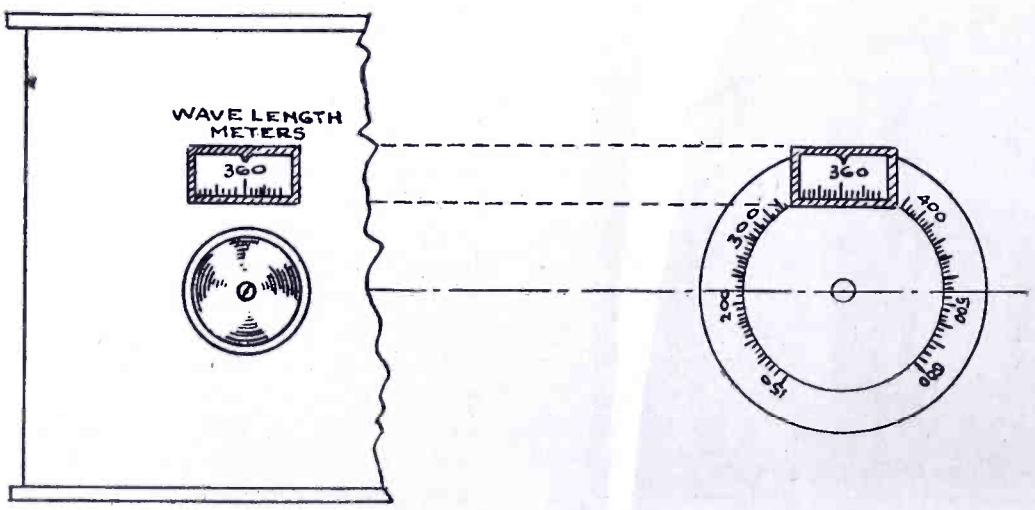


Fig. 1. Details of Window Dial

URUGUAY TAKES UP RADIO

Keen interest in radio is developing in Uruguay, according to Trade Commissioner George S. Brady of Buenos Aires. An increasing demand for apparatus is expected after the end of the hot weather. Amateur radio enthusiasm got a retarded start in Uruguay, as in Argentina, and even up to the present time very little has been done. There are only five houses, Mr. Brady states, dealing in radio apparatus in Montevideo, two of whom have only just begun to handle radio goods to any extent. One of these concerns intends to erect a small broadcasting station, since the only station now broadcasting in Montevideo gives concerts very irregularly, making it necessary for the Uruguayan radio fan to depend very largely upon Buenos Aires. The other house actively dealing in radio apparatus has just hired a Belgian electrical engineer, who has been trained in radio in the United States, to take charge of a new radio department, and the manager feels that his house is going to make a big success of radio apparatus. Both of these concerns intend to sell American sets only.

A common wood plane may be used to square up the edges of bakelite if it is set rather fine. An excellent and rather unusual finish may be given bakelite by inserting in the chuck of drill a piece of wood about ¼-in. in diameter and bringing this down on the surface of the bakelite so that the circles produced will overlap slightly. The finish is similar that given the armor plate of safes, and when done evenly gives a very pretty effect. It is best to practice on the wrong side of the piece or on a scrap piece until the knack is acquired.

Radio Construction Pointers

By Paul Oard

These suggestions deal with the making of inductance coils for various purposes. They will be followed in a subsequent issue with hints on condenser construction. They are thoroughly dependable, as the author has had a wide experience in radio construction.

Inductance Coil Binders

ALL radio construction jobs call for coil winding in some form, and the appearance and performance of an instrument is made or marred by the work done. Most constructors find that a coil, unless held by some kind of binding material, will loosen on its form. Most constructors blame the *contraction* of the tube for this condition, whereas in reality this is only half the reason. The other half of the blame is traceable to the *expansion* of the winding.

Copper magnet wire, whether silk, cotton or enamel insulated, is soft drawn. This means that a hundred foot length can be stretched several feet longer. The experimenter who takes the simple precaution of *pre-stretching* the magnet wire before winding it on the form will find that there will be no further trouble in retaining a tight winding, providing that the form itself is proof against contraction. The wire should be laid out in convenient lengths, and drawn out carefully. Very little practice will serve to tell the constructor when he has reached the safety limit. Particular care should be taken that there are no kinks in the wire—also that the wire be fastened so that it does not bear against a sharp corner at the end where it is secured. In pre-stretching the heavier gauges, it is advisable to stretch the entire length in one operation if possible, as the necessity of fastening the wire at several places along its length introduces kinks that may be troublesome to eliminate. The finer gauges will not give trouble in this respect. After the pre-stretched wire has been wound, further security may be had by using a binding of shellac or collodion.

Winding the Coil

WHILE a coil winder is a highly desirable piece of apparatus, not every experimenter possesses one, as the work to be done does not warrant its construction. If the coil to be wound is not too large, lay out the wire to its entire length, securing it at the opposite end firmly. The pre-stretching may be done at this time also if desired. Secure the free end of the wire to the form, grasp the form firmly at the ends, and turning it toward you, walk up on the wire. The wire should be wound over, not under, thus allowing the constructor to guide it evenly. The form should be held as tightly against the wire as its mechanical strength and that of the wire will permit. A little practice will enable the constructor to make surprising speed, and a first-class job. Where wire of finer gauge is being wound, as for secondary and tickler use, it may be fastened and unfastened a number of times along its length without damaging it, the pre-stretching process taking out any kinks or ripples caused through so doing.

Binding Fluids

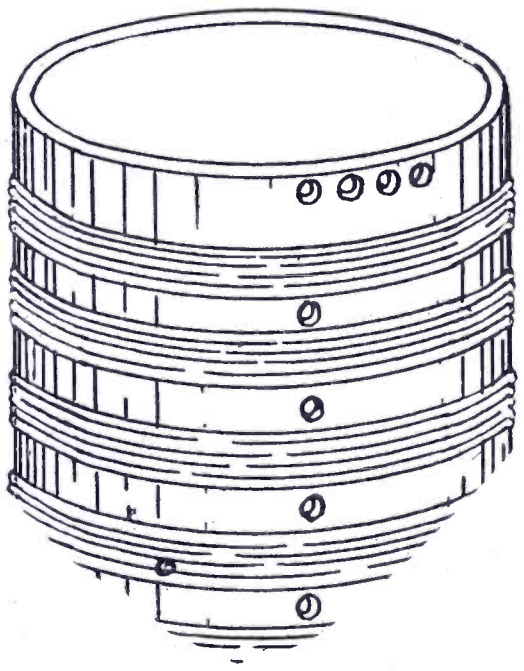
SHELLAC as a medium for binding the coil to the form has fallen into disrepute under the heavy hammering that text books and technical articles have dealt it, yet shellac properly applied is highly satisfactory, and losses occasioned through its use are to all *practical* purposes negligible. Most constructors apply shellac as it comes in the bottle and herein lies most of the trouble. In most cases it is too thick, and when smeared over a coil, a formidable coating is built up that is detrimental to best results, as well as making a poor appearance. The average bottle of shellac should be thinned with alcohol to about half its volume again, a very thin mixture being preferable. But one coating should be used, and no surplus should be allowed to remain. Where the wire has been pre-stretched, and this thin coating applied, there is no danger that a winding will "walk" off the form. Properly thinned and applied, shellac will enhance the appearance of a green silk winding, whereas the ordinary job spoils the effect. White shellac is preferable to orange for silk jobs, while either will do on cotton. The same thinned-out shellac makes an excellent treatment for cardboard tubing forms. They should of course be thoroughly baked out in an oven first, then *dipped* bodily in the shellac, providing that the constructor's purse will allow of such procedure. This may be accomplished by placing enough in a pie tin or shallow pan to allow the tube to be partly immersed, and then turning the tube over until it is saturated.

In using collodion as a binding medium, it should also be thinned with commercial ether, which may be purchased in one pound cans at drug stores. In doing a satisfactory job with collodion, one must work quickly, as the ether evaporates rapidly, especially in warm climates. The thinner fluid again permits a much neater job, and one that will bind the winding firmly as if a thick mixture had been used.

In some of the extremely advanced circuits now coming into use, it is advisable to use no binder, but in the majority of circuits, it is preferable to do so, it being better to suffer a slight theoretical loss in working efficiency than to have the winding fall off its form in time.

Tapping the Coil

ABOUT one constructor out of six can tap a coil so that it presents a first-class appearance. A method which the writer has dubbed "section tapping" presents a finished job that a novice can do. The coil is wound with pre-stretched wire, and finished off with a binder, and allowed to thoroughly dry. At one end of the tube, spaced about ¼ inch, bore as many holes as taps are desired, using drills but slightly larger than the wire.



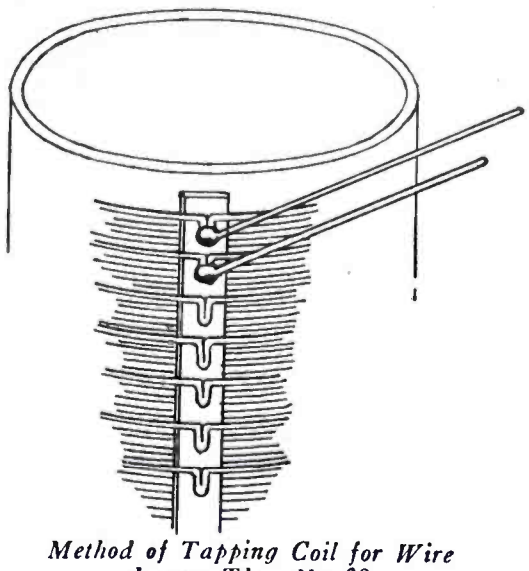
Method of Tapping Coil for No. 20 Wire or Smaller

Wherever a tap is desired, the wire is lifted from the form with a needle, and broken. Each end is then unwound one turn. The binder will prevent the winding from unwinding further. At each spot so broken, a small hole is drilled through the tube. The two ends of the winding are then run through the hole, and brought up to the corresponding hole at the end of the form. When desirable, either 4-56 or 4-36 machine screws may be placed in these holes, with a nut to fasten them to the form, and the tapped off ends soldered to the head. An exceptionally neat coil results, the evenly spaced off sections enhancing the appearance greatly. Where it is not wished to use binding fluid to hold the winding, the same job may be accom-

plished with a little care, by holding the winding down with the fingers while breaking the wire and making the tap.

This method is suitable for all gauges from 20 to 36. Where a coarser gauge than 20 is used, proceed as follows:

Raise the wire at the point to be tapped with a knife blade. Even when pre-stretched, the wire will give enough for the purpose. When all points have been raised, slip a thin strip of bakelite or dry wood through the raised places. With a pair of flat-



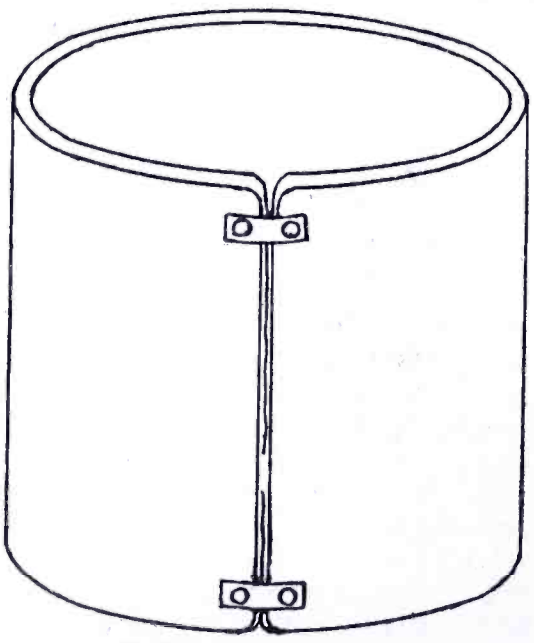
Method of Tapping Coil for Wire Larger Than No. 20

nosed pliers, crimp the wire against the strip. Use a manicure or spark plug file to remove the insulation on the raised points. Solder lengths of wire long enough to reach the switch assembly to these points, using rosin core solder preferably.

Where the first method of tapping is used, it is good radio practice to solder the two wires together at the point where they leave the coil. However, where the coil is a small one and the leads to the end of the coil are short, this is not absolutely necessary. The second method renders this procedure unnecessary.

Rolling Your Own Tubes

NOW that hard rubber is beginning to find favor and can be readily obtained in sheets of different lengths,



Rolling Your Own Tubes

it is possible to make tubes of the sheet material quite readily. Placed in hot water, hard rubber can be bent readily, and may be rolled into winding forms without much trouble. After allowing to harden, the two edges may be fastened together with two small strips of metal at the ends, drilling them to receive machine screws of 4-56 or 4-36 thread. Tin cans of varying diameter may be used to form the hard rubber with several turns of stout cord over the hard rubber to hold it in place while hardening. After hardening it may be slipped off the tin, and the rims fastened together as outlined.

METAL LACQUERING

By D. B. McGOWN

Lacquering is employed to preserve the original metallic surface of many radio parts from tarnish. The process is particularly applicable to brass, which is first burnished and then covered with a protective coating of transparent lacquer. Metal lacquer is usually made of guncotton dissolved in ether, acetone or other liquids to give it the proper body and color. Water-white brush lacquer is usually used for finishing radio parts. It is generally advisable to use equal parts of lacquer and "thinner" in order to get a good job, as the commercial lacquer is too thick for ready application.

Before applying the lacquer the metal surface must be thoroughly cleaned with gasoline and fine sandpaper and then rubbed with a soft cloth, care being taken that the object is not touched with the fingers. Do not use water, as the lacquer will not stick, or, at best, a cloudy finish will result. With small articles the most effective way is to dip the entire article, dirt and all, into "precipitating thinner" which will clean the surface.

The lacquer should be applied as soon as the thinner has dried off, in order that no moisture may be absorbed. The temperature of the room where the work is done should be about 70 degrees F., which will cause the lacquer to dry in about 10 minutes.

The simplest way to apply the lacquer is with a small camel's-hair brush. The lacquer should be thinned so that it will flow freely from a brush and "set" within a minute after it is applied. If it tends to gather in drops at the bottom of the work it is too thin. If it sets too rapidly and cannot be brushed well it is too thick. Never go over the work with a brush after the lacquer sets.

As brush lacquering is slow and requires considerable skill, recourse is usually had to dipping or spraying such work as will allow it. Because of the extreme care necessary to get the lacquer of just the right consistency for dipping and just the right conditions for drying, this method should be tried only after experimenting with a number of samples.

The ideal method is by means of an air-brush or atomizer which sprays the lacquer onto the object. The lacquer should flow over the object very slightly after it has been sprayed so as to give a smooth surface. After a little experimenting the amateur should be able to turn out a good looking job. The air-brush ought to be held 10 or 12 inches from the work and two thin coats will be generally found to give better results than one thick coat. The brush should be played back and forth across the piece being coated so as to give a series of slightly overlapping bands from edge to edge. An even coating results only if the brush is moved slowly and uniformly. It is essential to practice on some old stuff before trying a finished job. Old tin cans or doorknobs serve admirably as trial pieces.

Although an air-brush requires quite an outlay for equipment, it is useful for many other kinds of painting. Lacquer is obtainable in many colors and finishes. As it is a good insulator, it is useful in many ways. It is superior to shellac or collodion as a binder for inductance coils.

NEW FRENCH REGULATIONS TO ENCOURAGE RADIO

French authorities have issued a set of regulations intended to encourage broadcasting and the use of radio equipment by amateurs throughout the country, according to advices received at the Department of Commerce from the American Commercial Attaché at Paris. It is provided that receiving sets may be possessed by any citizen of France who will sign a formal declaration, receivable at any post office, stating the kind of equipment used and agreeing that no part shall be taken in the transmission of private correspondence. Sets in the possession of foreigners, or used to receive private correspondence, require individual authorization.

The right to operate transmitting sets will be regulated by the Under-Secretary of the French Postal Services, on the recommendation of a permanent commission upon which public service groups, manufacturers, and amateurs, will have representation. Transmitting sets are to be classified as, those intended for establishing private communication; public broadcasting sets; portable sets; sets used for technical experiments; and amateurs' sets.

Wavelength standards and other technical regulations will be set up for each class by public authority. The use of amateur and experimental sets will not involve the payment of any fees. Public broadcasting is made the subject of individual contract.

The Ultra Reinartz Receiver

By Jack Ward, 6CKC

Here is an answer to the problem of simplicity of control for an efficient tuner at a minimum cost. After trying it out on a test board many amateurs will want to incorporate it in a finished panel and cabinet.

THE Ultra Reinartz is based on the straight Reinartz, but modified to eliminate several controls. This set includes all the advantages of the original Reinartz and is more practical in some ways. The control units consist of a .001 mfd. variable condenser, a vario-coupler, and one pair of spiderweb coils. This cuts down the actual adjusting to two knobs, one switch, and a slight adjustment of the spiderwebs. After the operator becomes accustomed to the set this may be cut to one dial, one switch, and the spiderwebs, leaving the entire adjustment to these three controls.

The spiderweb coils and the vario-coupler may be constructed by the assembler, but I find it advisable to buy the other parts ready to mount. Those wishing to make their own spiderwebs and vario-coupler, will find the following price list about right.

2 dials	$1.50	1 socket	.75
1 switch	.45	1 coupler rotor.	.50
9 switch contacts	.20	1 variable cond.	3.00
1 panel 3/8in.x 6 in. x 15 in.	1.75	6 binding posts.	.70
1 rheostat	.75	wire	.75
		Total	$10.35

Those wishing to buy the vario-coupler and spiderweb coils should figure about $7 extra.

Fig. 1 shows the general layout of the units. Special care should be taken in selecting the variable condenser. If possible, obtain one with bakelite ends and with the rotary plates cut sharp at both ends, leaving no rounded edges. Also it is always best to use bakelite dials on both the condenser and the vario-coupler, as some fans grip the edges of the dial in tuning in a weak station, and, as the metal dials are usually only enameled, the fingers will eventually come in contact with the metal and a serious loss in signal strength will occur.

Each spiderweb coil is wound with 30 turns of No. 24 d.c.c. wire. Its inside diameter is 1½ in., there being 9 legs on each coil. The vario-coupler consists of the ordinary ball rotor, wound with 40 turns of No. 22 d.c.c. wire, 20 turns to a side. In this case a bakelite stator was used, wound with 70 turns of No. 20 d.c.c. wire, and tapped every 7 turns. This vario-coupler will be found to cover all the new broadcast and amateur wavelengths. But if the owner should wish to reach higher ones he may do so by shorting the rotor of the coupler with a 23-plate variable condenser. The other units may be of any make, but standard makes are the best.

The hook-up in Fig. 2 is not complicated. It gives equally good results on all makes of tubes, but care must be taken in selecting a rheostat to fit the tube used, and it in all cases should be a vernier. For the 200 and 300 tubes a 6-ohm rheostat will do, a 20 to 30-ohm rheostat for the 201A and the 301A tubes, and a 30 or more ohm rheostat will be best for the 1½ and 3-volt tubes. A 22½-volt battery should be used for the plate supply of the 200 and the 300 tubes, but a voltage of 40 is considered best for the plates of the others. For the 201A and 301A tubes a sponge socket is necessary.

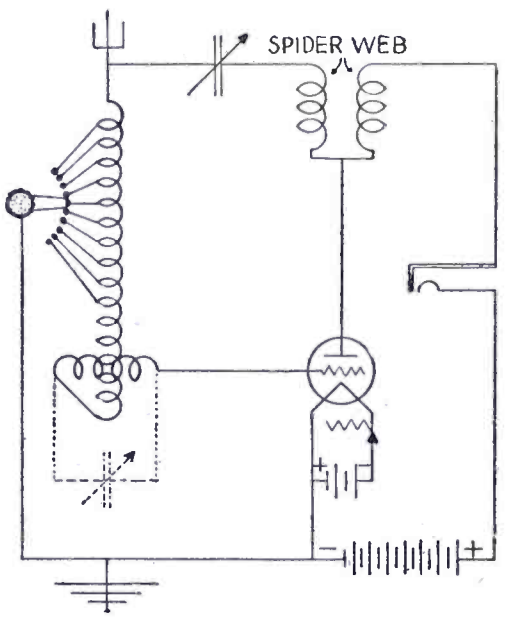


Fig. 2. Ultra Reinartz Hook-up

The operation of this set is exceedingly simple from the first, and no difficulty should be experienced if all the connections are firmly soldered. Turn the rheostat half way on and place the condenser dial at the half-way mark, then, with the spiderweb coils nearly touching each other, give the vario-coupler rotor one complete turn, to find where the set oscillates best. When you find the desired place, leave the rotor in that position, and adjust the tap switch and condenser until the desired station is picked up and tuned in. To eliminate the squeal caused by over-regeneration, instead of turning down the rheostat, slowly spread the spiderweb coils until the squeal fades out, and there you will find the maximum volume of the set on that particular wavelength.

I find that the use of a grid leak does not help the clarity or the volume in the least, but that a 23-plate condenser across the vario-coupler will sometimes help the volume of distant stations. The cost of the condenser and the extra control, however, does not pay for the extra volume obtained. The builder of this set will be surprised at the quiet operation. There is no loud "sh" or crackling in the phones, even when the set is oscillating to its full capacity.

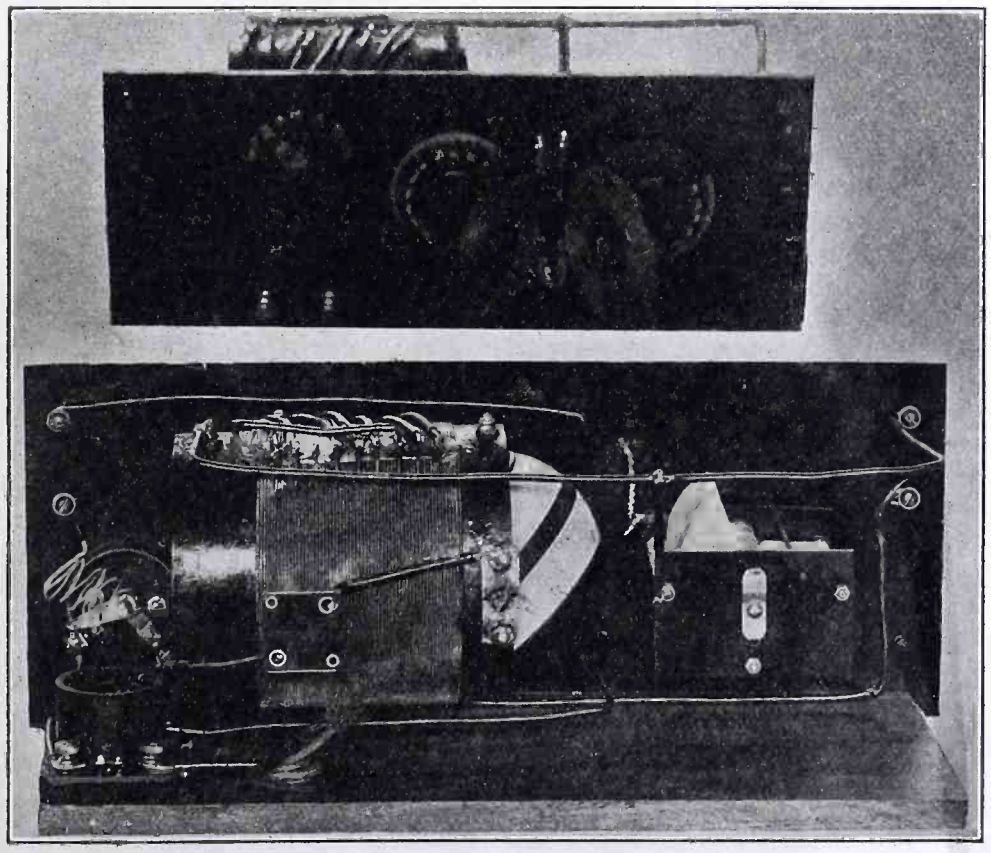


Fig. 1. General Layout of Ultra-Reinartz Receiver

An Adjustable Fixed Condenser

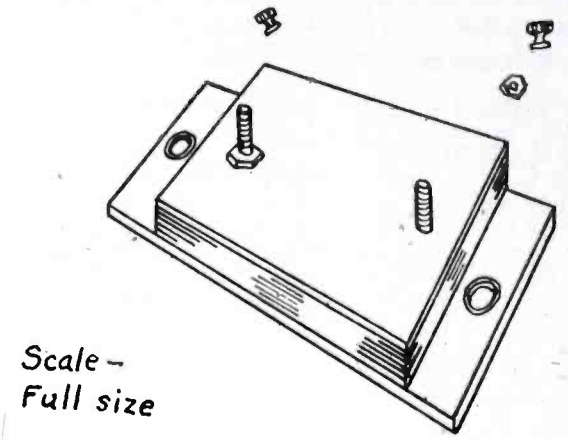
By Charles F. Filstead, 6CU

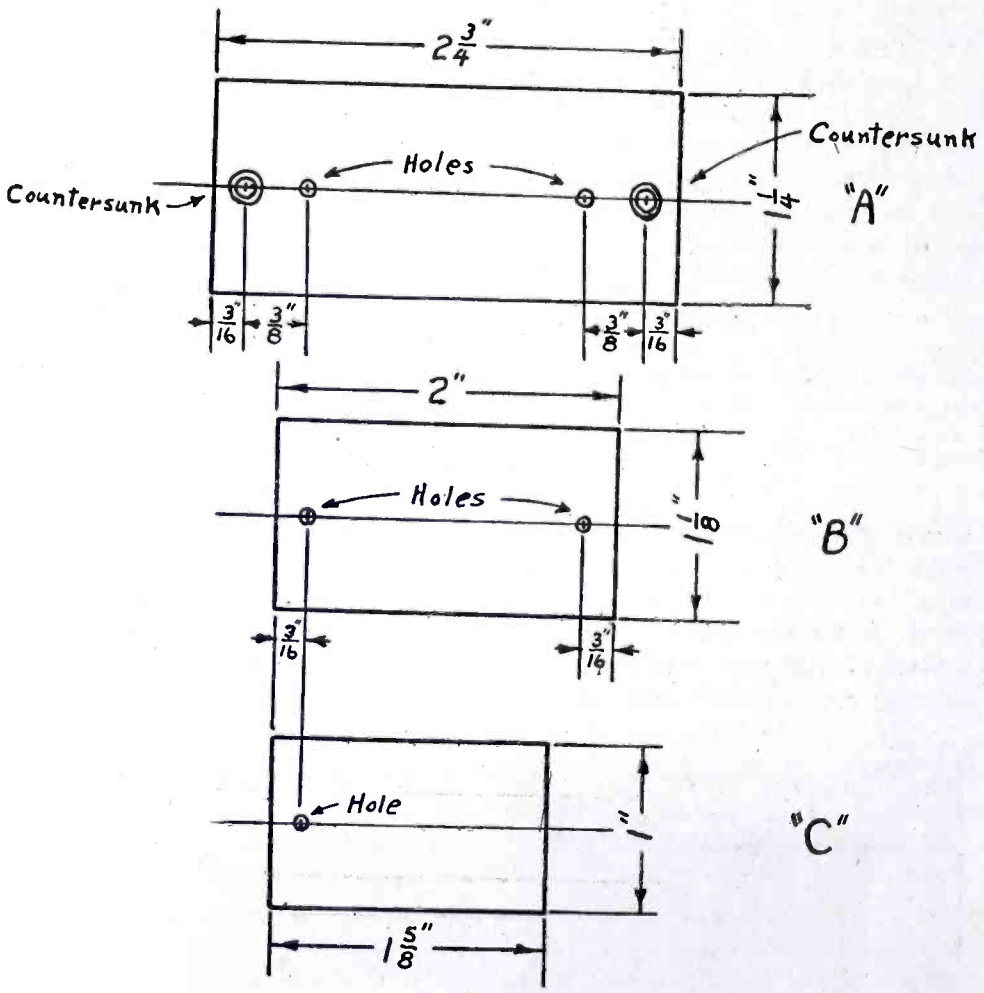
A FIXED, mica receiving condenser may be a very cheap thing to buy, but when an amateur is constantly experimenting and building new sets, the cost of even such a small item as fixed condensers begins to count up. Also, many amateurs like to build all the parts of their outfits just for the fun of the work. It is for them that this description is meant. The capacity of this condenser can be changed to any desired value by merely adding or taking away copper-foil plates from each side of the condenser.

First, two pieces of 1/8-in. bakelite are cut to make the top and bottom of the condenser. The bottom piece of bakelite is cut to the dimensions shown at *A*, and the top piece is cut to the dimensions shown at *B*. The holes in the bakelite are drilled with a No. 28 drill. The two holes nearest the center of the bottom piece of bakelite are countersunk on the under side, and two 3/4-in., 6-32, flat-head machine screws are put through these countersunk holes from the under side. The other two holes in this bottom piece are for the wood screws which are to hold the condenser down, and they are countersunk on the upper side of the bakelite. The sheets of mica insulation are 5 mils thick (that is: 0.005-inch thick) and they are cut and drilled to the dimensions given in *B*. The metal plates are now cut out of thin copper-foil to the dimensions given in *C*. A larger than necessary number of both mica and copper plates should be cut, so that the capacity of the condenser may be changed.

To assemble the condenser: the two machine screws are put through the bottom piece of bakelite, over them is put a piece of mica, then a copper plate making contact with one of the screws, then another piece of mica, then another copper plate which makes contact with the other machine screw, then another piece of mica—and so on. Care must be taken in assembling the condenser to see that the metal plates are staggered: that every other plate makes contact with the same machine screw. After the right number of copper plates have been put on, a last mica plate is put over the screws, and then the top piece of bakelite is put on, and the whole condenser clamped tightly together by putting nuts on the two machine screws. Two nuts are put on each screw; besides holding the condenser together, they also act as binding posts for attaching the wires to the condenser.

Twenty-two mica and twenty-one copper-foil plates will give a capacity of about 0.005 microfarad; although the capacity will vary with the kind of mica used. Two plates of copper and three of mica will give a capacity of about 0.00025 microfarad, which is just the right capacity for a grid condenser. The capacity of the condenser can be figured by means of the following formula:





$$C = 0.0885\ N\ K\ \frac{S}{t}$$

Where C = capacity in micro-micro-farads;
N = number of metal plates used minus one;
K = dielectric constant (6.0 for India ruby mica, and 3.0 for Canadian amber mica);
S = active surface of one side of one copper plate in square centimeters;
t = thickness of dielectric in centimeters.

The capacity in microfarads =

$$\frac{C}{1{,}000{,}000} = C\text{mfd.}$$

Using the dimensions given in this article, and taking 4.5 (the mean of 3.0 and 6.0) for K, the formula can be simplified to:

$$C\text{mfd.} = 0.000249\ N$$

whereby the capacity in microfarads may easily be found if the number of metal plates used in the condenser is known.

NOTE:—1 inch is equal to 2.54 centimeters.

Some Principles of Amplifier Tube Operation

By Maurice Buchbinder

Here is told in simple terms the how and why of amplifier tube action. Especially clear is the explanation of the reason for the grid bias.

IN an article in December RADIO we considered those principles of the detector tube upon which its use in radio circuits depends. It was pointed out that the detector, in contradistinction to the amplifier, is one of comparatively low vacuum and is spoken of as "soft." The amplifier tube has an exceedingly high vacuum and is spoken of as "hard." Some tubes may be used either as amplifiers or detectors. But in their case it is generally granted that they are not nearly as good amplifiers as those tubes intended solely for this purpose. It is the object of the present article to present in a simple way those principles of the amplifier tube which enable it to function efficiently.

The amplifier tube used in radio is merely a repeater; that is, it builds up small electromotive forces and currents. It must introduce no distortion and must amplify as many times as possible without making the circuit unstable. How it functions as a repeater is probably as easy to understand as any phenomenon connected with the vacuum tube.

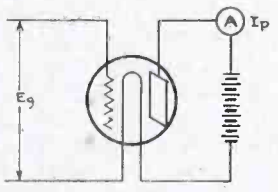


Fig. 1. Vacuum Tube Circuit

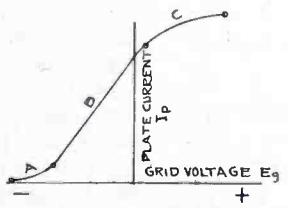


Fig. 2. Characteristic of Tube

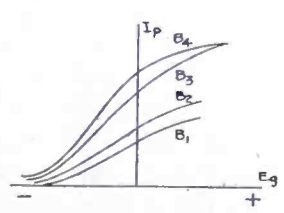


Fig. 3. Characteristics at Various Plate Voltages

Let us consider a simple circuit such as shown in Fig. 1, which represents a vacuum tube to which a source of direct grid voltage is connected. If the grid voltage be fixed at any value E_g, then the plate current will be a certain value I_p. If now the grid voltage be changed to a new value E'_g then the plate current automatically switches to a new value I'_p. Such is the nature of the device. Furthermore, for every value of E_g, whether plus or minus, there is a definite plate current I_p.

Consequently we can plot the "characteristic curve" of the tube as given in Fig. 2. It consists of an initial flat part *A* for extremely negative grid voltages, then of a straight part *B*, and finally of a long flat part *C* for very positive grid voltages. The "steepness" of the straight portion *B* can but slightly be controlled by the operator. It is a feature of the particular kind of tube and depends upon its physical constants; upon the size and closeness of the electrodes—the grid plate, upon the size of the filament and its temperature and material, and upon the shapes of the various parts. This steepness is a direct measure of the value of the device as an amplifier because obviously it tells how small a change in grid voltage will cause a certain change in plate current. That is, the steeper the curve, the more change in plate current will a definite change in grid voltage produce—or the louder the signal will be amplified.

The next feature of the curve is the location of the zero line for grid voltage values E_g. It is seen upon inspection of Fig. 2 that to the right of this zero line the curve soon loses its straightness and becomes flat, while most of the straight portion is to the left. This explains the use of a negative "bias" on amplifier tubes, or why it is that when we reverse the *A* battery leads to an amplifier we get such a marked effect upon the loudness of tone. Later the reason will be more fully discussed.

The third feature of the characteristic curve is the width of the straight line portion *B;* that is, the extent of variation in grid voltage E_g between the time the curve flattens in a negative direction *A* and the time it begins to flatten in a positive direction *B*. This third feature is important because it tells us the value of the device as a handler of large amounts of current e.g. in the power circuit of a loud speaker. The more extreme this range the better will be the tube as a power amplifier and the less the distortion it will introduce.

These three features of a characteristic curve tell us practically all that we need to know in order to understand and adjust an amplifier tube and amplifier circuits. So far, however, we have obtained a characteristic curve at a certain fixed plate voltage. We may, of course, raise or lower this plate voltage at will. Then it is possible to draw a series of similar curves, one curve for each plate voltage. Fig. 3 gives such a group of curves. Inspection will show that B_1 corresponds to the lowest plate voltage used, while B_4 corresponds to the highest. It is seen that increasing the plate voltage has the effect of lengthening the straight line part of the curve and also to some extent its steepness. The most marked effect, however, is to push the entire curve more and more to the negative side of grid potential.

Several pratical conclusions in amplifier tube operation may be reached from Fig. 3. The first is in the importance of employing a plate voltage high enough to cause the maximum steepness. These data are furnished by the manufacturer. The second is that any increase of plate voltage beyond this is useless in increasing loudness because the maximum steepness has already been reached. Only by a simultaneous increase of the electronic emission, or the filament temperature and current, can the steepness be greatly affected by excess plate voltage. Unduly high filament temperature is, of course, detrimental to tube life. Finally, since the curves are shifting negatively all the time as we increase plate voltage, it follows that to prevent distortion and obtain best amplification at higher plate voltages we must bias the grid more and more negatively. A practical example of the amount of biasing necessary for power tubes lies in the Western Electric power tube Type F. This operates at 350-volt plate and requires a negative grid bias of from 7 to 15 volts in order to function efficiently.

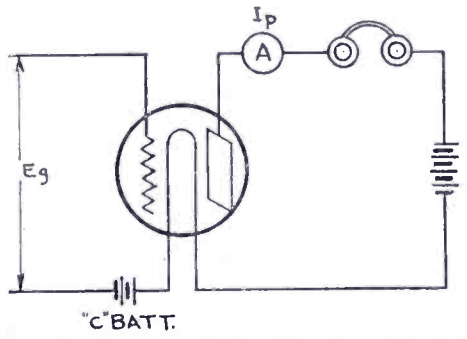


Fig. 4. Vacuum Tube Circuit with Grid Biasing Battery

Fig. 4 E_g represents an alternating electromotive force such as would be produced by a clear note from a musical instrument in a broadcast concert. This electromotive force is impressed between grid and filament of the amplifier tube, after, of course, the signal has been rectified by the detecting device, smoothed out by condensers, and enlarged by the step-up transformer. When no music is coming in, the plate current I_p reaches such a value as is dictated by the biasing grid battery *C*. Hence, referring to Fig. 5, we are normally at a grid voltage *C* and a definite point *a* on the characteristic curve. As soon as the signal starts coming in it alternately raises and lowers the grid voltage *about this point "a" as a center*. Hence the plate current will rise from *a* to *b*, then fall down to *C*, rise again and keep on oscillating about *a* as a center, reproducing by the change

in plate current a musical sound in the telephones exactly the same as the broadcast sound. Suppose, however, that we had not used a biasing resistance. Then

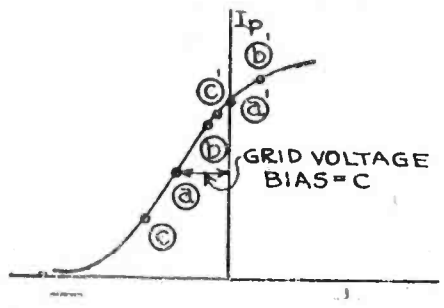


Fig. 5. Characteristic Showing Effect of Grid Bias

the normal grid voltage would be zero (indicated by a point *a'* on the curve). As the same signal started coming in it would first cause a rise in grid voltage. But, because of the presence of the flattened portion of the curve at this point, this rise in grid voltage may cause only a slight rise in plate current to correspond. Hence any resulting sound in the telephones will be distorted and blurred as if the note had been choked in some way.

We can show graphically just what happens. Referring to Fig. 6, curve *A* is that of the impressed electromotive force E_g on the grid, due to a continuous note in the broadcasted music. If the ampli-

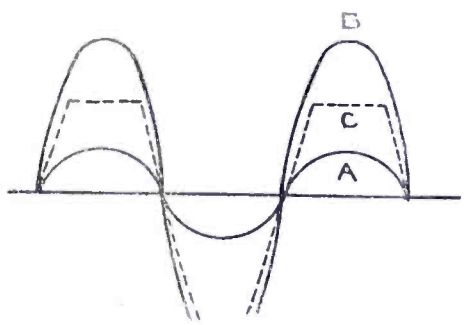


Fig. 6. Graphic Representation of Grid Bias Effects

fier be operated about point *a*, as mentioned, then the plate current would be like this curve *A* and would follow it faithfully—giving curve *B*. They are both simple harmonic curves corresponding to pure tones. Thus, if the grid voltage $C=E \sin \omega t$, then the plate current $i = I \sin \omega t$. If, however, the amplifier tube be operated wrongly about *a'* as a center, then the current in the telephone will not be simple harmonic—but flattened off at the positive halves, namely at or near point *b'*. Such a tone is impure and sounds choked and distorted. Also because the positive halves are chopped off, so to speak, the sound is not nearly as loud as the pure tone would have been. Expressed mathematically, the plate currents will now consist of a diminished pure tone plus several undesired harmonics (curve *C*).

Another reason for the negative grid bias in an amplifier tube is of some importance. If the grid were at any time in the cycle of impressed voltages to become positive, then it, as an electrostatic conductor, would attract electrons to it, for the simple reason that a negative charge will always tend to flow to a positive one wherever it exists. This flow of electrons to the grid constitutes an electric current, which is a *short circuit* to some extent on the source of alternating potential. Hence for positive halves of the cycle the grid is in effect short-circuited by the grid current flow. If, therefore we normally keep the grid so negative that it always stays negative no matter what size of alternating voltages we impress upon it, then we avoid the short-circuiting effect with its consequent inefficiency and distortion.

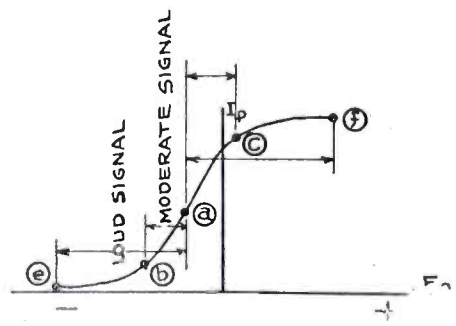


Fig. 7. Result of Working on Flat Portion of Curve

Our analysis thus far has revealed the fact that to prevent distortion we must bias the amplifier tube so that it normally operates at or about the center of the straight line portion. This biasing is always negative; the grid must in some way be rendered negative at all times. The negative bias is accomplished practically in several ways: by introducing a grid or *C* battery as we have indicated in the diagram, or by use of biasing resistances in the filament circuit such that the resistance drop in the filament circuit is utilized. If no biasing resistance is used, then the grid lead in an amplifier circuit must always terminate electrically at the negative of the *A* battery. In this way the internal drop in the filament wire and the drop in the filament rheostat are utilized.

With an idea of the distortion possible if we work on the flat portion of the curve, we can understand why some tubes will handle small and moderate powers perfectly but high powers very poorly. Fig. 7 is the characteristic curve of such a tube. Suppose the tube be operated about *a* as a center. If moderate signal voltages be impressed then the grid will vary from *c* to *b* or entirely on the straight line portion. If, however, large powers and high voltages be impressed, then the grid will vary from *d* to *e* or it will encroach upon the flattened portions both positively and negatively. This, as we already have shown, means blurring and choking, with impurity and very much diminished tone.

Theoretically, gas particles in the tube have no function whatsoever. All the equations derived, which agree very well with practice, are based upon perfect vacua. The sole effect of gas particles is to cause at high voltages the familiar blue glow in a vacuum tube when the gas ionizes and temporarily or permanently suspends its action. Vacuum tubes, as they are used, tend to gradually rise in their gas pressure, due doubtless to evaporation from the occluded filament. In time they are therefore rendered useless. In broadcasting stations, with so many tubes in constant use, the replacement of one each day due to "arcing" is not uncommon.

SPECTRUM ANALYSIS OF RADIO SIGNALS

When a radio sending station emits a signal consisting of successive trains of waves, the manner in which the vibrations are interrupted or die down has an important bearing on the amount of interference which this radiation will produce in receiving circuits tuned to frequencies other than the one on which this station is supposed to be operating. In other words, the very suddenness or other peculiarity of the interruptions causes the station to send out unintentionally frequencies other than those it is supposed to be sending. A somewhat analogous case is that of the arc light, which in addition to the light it gives out emits also certain invisible radiations. By examining its light with a spectroscope these invisible radiations have been found, and filters have been devised to screen them out. Similarly, a "spectroscopic" study of radio-frequencies emitted by a station might help to find those frequencies which cause interference. Such a study could be made if it were possible to devise a series of receiving circuits, each of which would respond to one wavelength only and turn a deaf ear to all others; or if the signal were repeated indefinitely a single circuit could be used and tuned successively to different frequencies. But, as a matter of fact, all circuits will respond to a considerable range of frequencies, and the result of such a study gives a record which is apt to be confused by this overlapping of the effects of a number of frequencies. A mathematical study has therefore been made by the Bureau of Standards of the theory by which the actual frequency distribution in the radiation may be reduced from observations of the mean current induced in the receiving circuit when it is tuned to various frequencies. This theory affords a basis for spectroscopic study by which the interference producing quality of a station may be measured.

The theory is given in Scientific Paper No. 477 of the Bureau of Standards entitled "Spectroradiometric Analysis of Radio Signals." Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 10 cents, cash.

LOS ANGELES RADIO SHOW

A great radio and electrical exposition is to be held in the ballrooms of the Biltmore Hotel, Los Angeles, Calif., February 4-10, under the auspices of the American Radio Exposition Co. of New York. This exposition is national in scope and is being participated in by the leading radio manufacturers, jobbers and dealers throughout the country. It will surpass in interest and artistic setting any exposition yet given in the West. An attractive program of prominent speakers will be heard not only by those in attendance but also by thousands of radio listeners-in.

Naming the Receiver Circuits

By C. W. Radoslovich

MANY people find difficulty in telling whether receiving sets are single, double or three circuit. The purpose of this article is to clear up the uncertainty. The main idea is to see if the radio circuit is tuned. In Fig. 1a the capacity is variable while in Fig. 1b the inductance is variable, but both give practically the same results. This type of

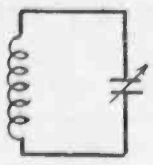


Fig. 1a. Variable Capacity

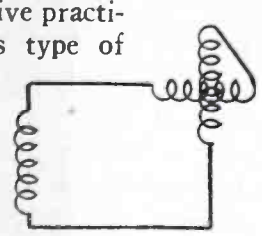


Fig. 1b. Variable Inductance

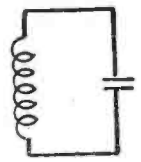


Fig. 2. Fixed Inductance and Capacity

circuit will tune to all wavelengths within its range. If both the inductance and capacity are fixed, as in Fig. 2, the circuit is tuned to one wavelength only.

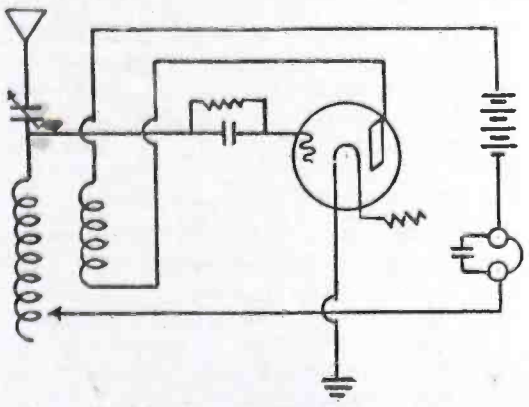


Fig. 3. Single-Circuit Receiver

The receiver in Fig. 3 is a single-circuit receiver because only the antenna circuit is tuned. The inductance and capacity in the plate circuit are fixed. But if we tap the tickler (Fig. 4) or

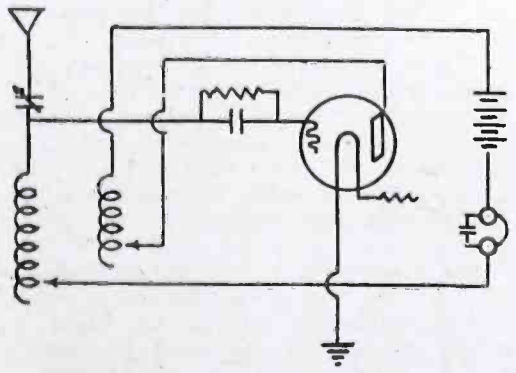


Fig. 4. Double-Circuit Receiver

shunt it with a "variable" as in Fig. 5, or substitute for it a variometer, we have a double-circuit receiver (Fig. 6). Many people make the mistake of calling this a single-circuit receiver because they see only one coil to couple the primary and secondary.

Another double-circuit receiver is shown in Fig. 7. This is a three-coil tuner but not a three-circuit unless either the capacity or inductance in the plate circuit is variable. When properly handled this circuit and those in Fig. 9a and 9b are the most selective circuits possible to use.

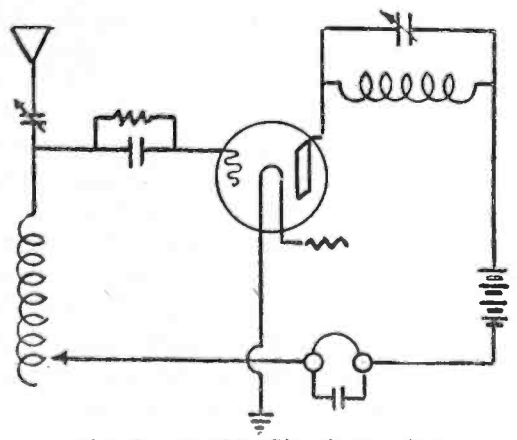


Fig. 5. Double-Circuit Receiver

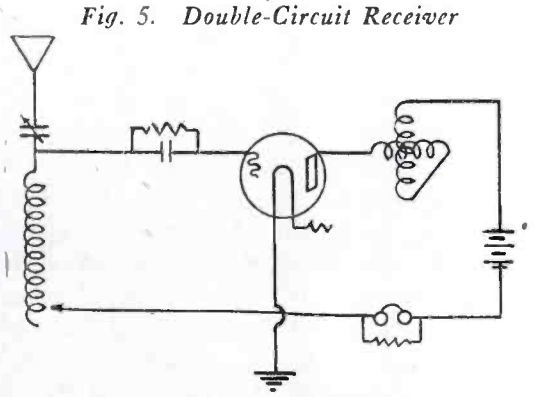


Fig. 6. Double-Circuit Receiver

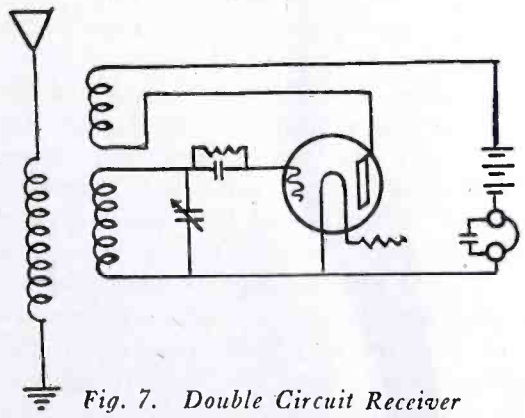


Fig. 7. Double Circuit Receiver

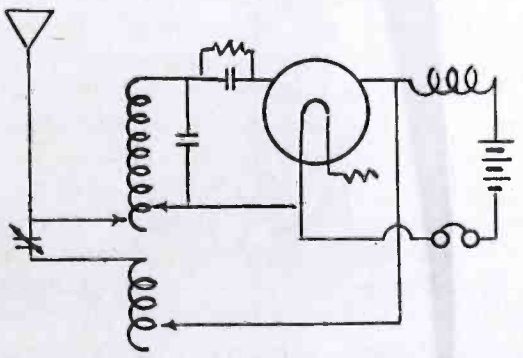


Fig. 8. Reinartz Circuit

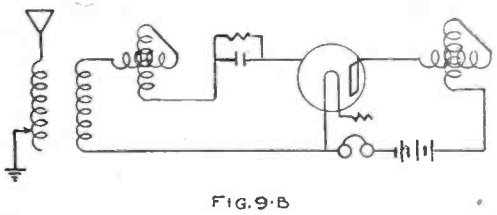


Fig. 9. Three-Circuit Tuners

The Reinartz circuit (Fig. 8) has three circuits, but the antenna functions aperiodically and so does not have to be tuned very often. This makes it practically a double-circuit receiver. This receiver is more selective than all others except Figs. 7 and 9.

Figs. 9a and 9b are three-circuit tuners and give same results whether secondary is tuned with a condenser or variometer.

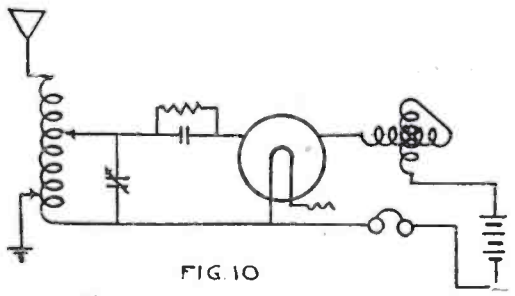


Fig. 10. Three-Circuit Tuner

Fig. 10 is also a three-circuit, but not as selective as circuits using separate coils for primary and secondary.

The "best circuit"? There is no best circuit. Each circuit has certain advantages and disadvantages. I use the circuit of Fig. 7 with fixed coupling, thus eliminating one control. On a 3-in. diameter tube wind 50 turns No. 24 d.c.c. tapped every ten turns. This is the primary. On the same tube 3 in. away wind 50 more turns tapped every 10 turns for the secondary. With a .005 m.f. condenser across the secondary this will tune from 150-700 meters. A 50-turn tickler is used.

For circuits 3-6 a wave filter may be added to eliminate unwanted stations. Wind 40 turns No. 24 d.c.c. on a 3-in. form and connect it in series with a .005 variable condenser. Connect as shown

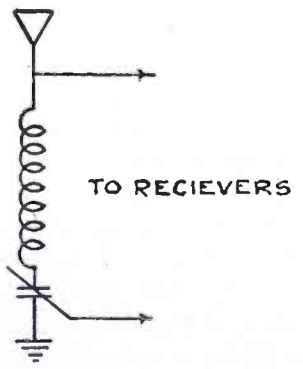


Fig. 11

in Fig. 11. This is a tuned circuit and if added to a three-circuit tune makes it a four-circuit tuner.

BEWARE THE RADYONATIC

By RAY DIO

You know the fellow who, with a one-tube receiving set, heard Kalamazoo the other night 50 ft. from the telephone receivers while everyone else complained severely of exceptionally bad weather conditions. That guy has a bad case of radyonitis. He is an exceptional specimen for the radio diagnostician.

With alarming velocity he spludders the radio dealer with that 200 or less radio vocab—of his and makes everyone in the place feel like rushing out to the nearest hardware store to purchase an axe with which they might easily put their three, four, five and even six-tube sets out of misery.

He goes on to tell how, with a new fandangled variable grid leak he tuned in first one station and then another without moving the dials on his tuner. How, with an old umbrella connected to his antenna lead he increased the strength of KMHJ signals two-hundred fold—

Then he took both the aerial and ground off, and Behold! There was KGPHY as loud as you would care to hear him.

There are numerous radyonatics at large and you will find them gathering at the local dealers every day at practically the same time, to tell of the remarkable hook-ups they discovered the night before. Sometimes, they even get into print with their new???? circuits.

The radyonatic is the guy who was actually engaged in the building of radio sets before Marconi had his first vision of radio. That all-knowing, irresistible, ever-convincing radio expert who was probably selling hardware before the advent of broadcasting . . . . . just two and one-half years ago.

The BCL is his meat—and he is the parasite of the species. In his eagerness to tell how much he does not know about radio he picks out all the BCLs he can get in touch with in order to unload his depraved mind. He represents one of the worst evils in radio today and those selling radio have to undo all of the nonsensical things the radyonatic has brought home to the BCL before he can effect the sale of any piece of apparatus.

The BCL will be amazingly surprised when he learns how few men there are in the radio business today that are capable of imparting reliable information of value to him. He is no judge of what is told him—but he can at least ascertain the name of one or more men in his vicinity who are capable of giving correct information about the building of a set or the operation of a newly-purchased set and just what he can expect in the way of performance.

Don't seek information from every Tom, Dick and Harry who has delved in radio—first interview one who is known to be reliable—then go ahead.

The sooner the radyonatic is corralled —the more peaceful a life will the BCL enjoy . . . . . .

KGO, NEW G. E. STATION

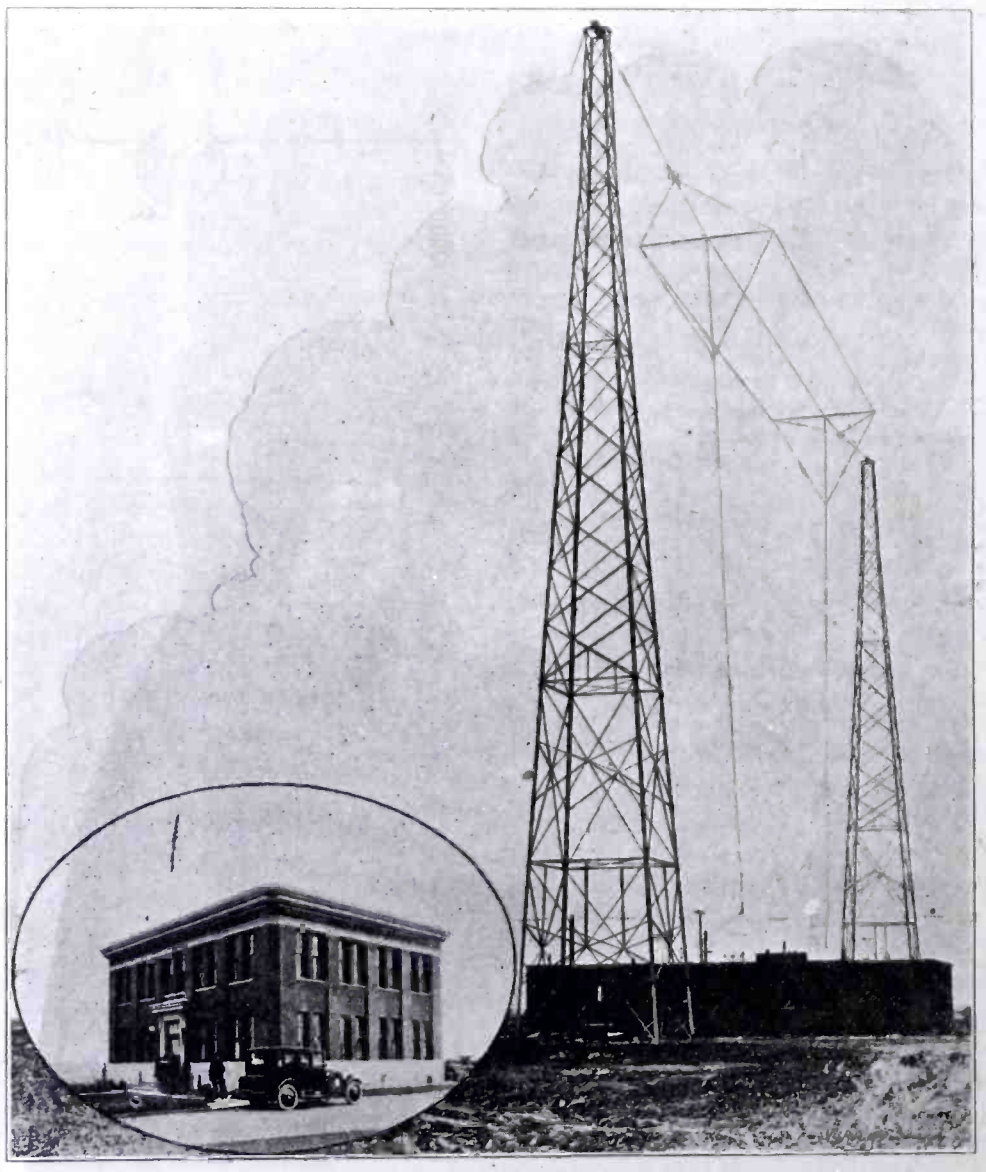
KGO, the new Pacific Coast broadcasting station of the General Electric Co., has been on the air since January 8th on 312 meters. The station and studio at East Oakland, Calif., is connected by wire with neighboring cities so that programs can be broadcast from them. It is operating at 1000 watts, with greater power in reserve for testing and experiment. While testing at 6XB it was heard with remarkable clearness and strength in New York and New Jersey.

The antenna and power house are 1000 ft. from the studio building. The 260-ft. aerial is supported by two 150-ft. steel towers. The counterpoise, 14 ft. above ground, covers an area of 150 by 300 ft. Six motor generators in the power house supply filament and plate current for the 10 kw. tubes employed. The entire equipment is in duplicate.

This station, like the General Electric station at Schenectady, is under the general direction of Martin P. Rice, who was at the station for several weeks prior to the opening.

Martin P. Rice, Director of Broadcasting of the General Electric Company

For the first few weeks it will be on the air on Tuesday, Thursday and Saturday nights between 8 and 10 with a high-grade program. Its time of operation will be extended in the future as its service is perfected. Elaborate plans are being made for a most comprehensive series of programs, including radio plays.



Studio Building, Antenna and Power House of KGO, the Pacific Coast Broadcasting Station of the General Electric Company at Oakland, California

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.

Kindly publish the circuit of the Grebe CR-13 amateur receiver. Please describe the method of engraving bakelite panels.
—H. D. W., Bowerston, Ohio.

The circuit for the Grebe CR-13 receiver is shown in Fig. 1. The variometer used in this tuned circuit is not of the standard type, the total number of turns being 76; 19 turns in each half of the stator and rotor, of No. 14 D. C. C. wire. The small coil marked R. F. C. consists of 15 turns of No. 26 silk-covered wire on a 4¾-in. tube, mounted on the stator of the grid variometer. The latter consists of 92 turns of No. 16 D. C. C. wire, 23 turns per half of the stator and rotor.

A bakelite engraving machine is a rather complicated device resembling somewhat a large drill press. The material to be engraved is placed on a metal table, and a special drill is moved through various positions by means of a pantagraph, which reduces the pattern or words to be engraved from letters several inches high to as small a size as desired. The drill cuts a slot in the panel a few thousandths of an inch deep, and the slots are afterwards filled in with white lead or other white paint.

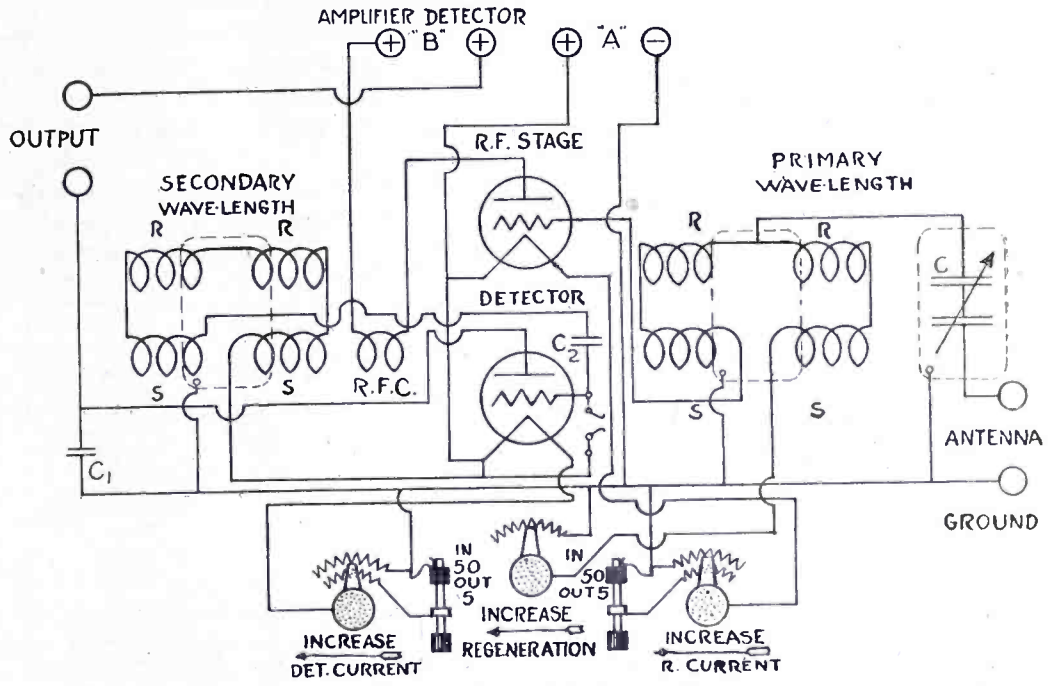


Fig. 1. Grebe CR-13 Circuit

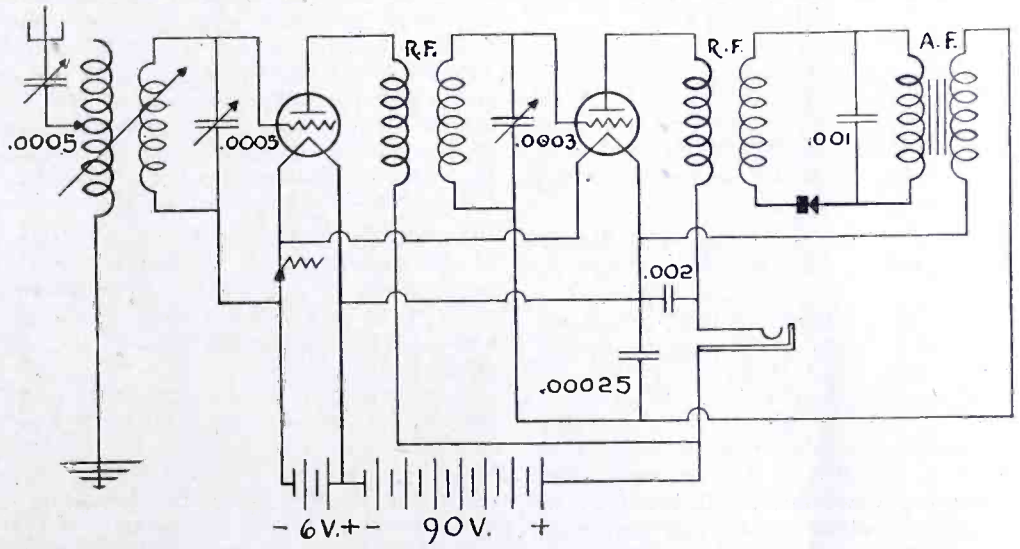


Fig. 2

Please publish a diagram showing the proper manner in which to add one step of amplification to a one-tube Erla Reflex circuit.—G. H., San Francisco, Calif.

The circuit you wish is shown in Fig. 2. In this case the second tube is reflexed, and the first tube acts only as a radio-frequency amplifier.

Can you give me a table of comparison between spiderweb inductance coils wound on a 2-in. center, and standard honeycomb coils of 25, 35 and 50 turns each?—S. DeV., Huntington Park, Calif.

You may expect a difference of about 25 per cent between the spiderweb coils and the honeycomb type, the latter having more turns for a given inductance than the former, due to the larger average diameter of the turns. Spiderweb coils of 20, 30 and 40 turns should give about the same results as the honeycomb combination.

Can burned-out 50-watt tubes be repaired? If so, where and at what cost?
—L. H., Charlotte, N. C.

A repaired tube will not have the same characteristics as it originally had, but I do not doubt that the tubes can be repaired. I would suggest that you write to one of the advertisers in RADIO who do such work, and ask if they can accommodate you.

Please publish a circuit for a three-tube neutrodyne set.—R. C. H., Natchez, Miss., R. C., Wallowa, Ore.

The circuit for two stages of radio-frequency amplification, and detector, using the neutrodyne system, is shown in Fig. 3.

Please publish data on building a one-henry choke, and explain the difference between conductively and non-conductively ohm resistances and their use.—F. C., Cincinnati, Ohio.

A small laminated core made up of silicon steel, approximately ½ in. by ½ in. cross section, on which is wound 1250 turns of No.

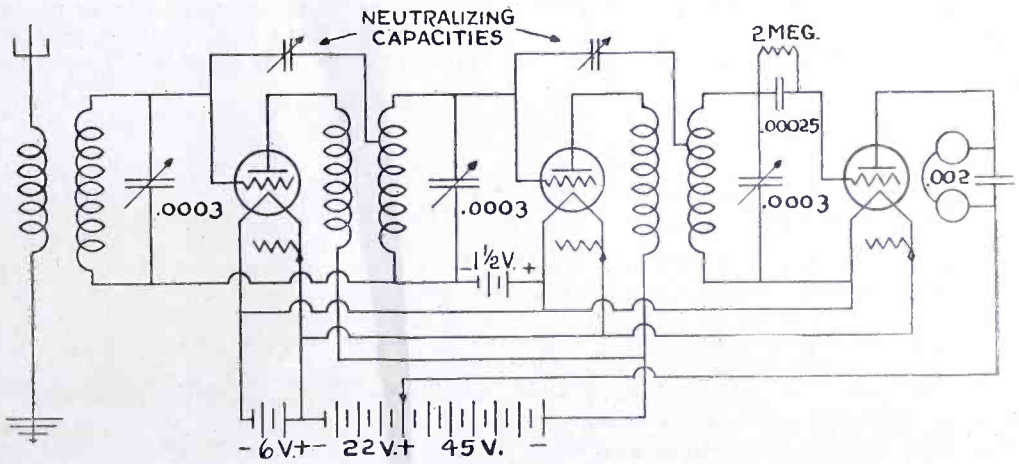


Fig. 3

28 silk or cotton-covered wire will give you about the right value of inductance. The core should be butt-jointed and taped before the coil is set in place. The inductance should be 1 henry if a good grade of silicon steel is used, but of course will vary depending upon the manner in which the core is assembled. Apparently you wish to know the difference between inductive and non-inductively wound resistances. An ordinary resistance coil, the turns of which are wound in a continuous spiral, and have a value of inductance as well as resistance, is called an inductive resistance. If, however, the center point of the resistance wire is found, and the wire doubled back on itself when wound on the spool, the coil will have no appreciable inductance, and is known as a non-inductive resistance. The latter type is useful in high frequency work where a pure resistance is desired and where inductance in the circuit would be detrimental to the efficiency of the apparatus.

Please publish the simplest possible receiving circuit using the external heterodyne. Is this better than the ordinary regenerative receiver?—G. B. McC., Portland, Ore.

The circuit is indicated in Fig. 4. While the circuit shown would not give a very great range, there is much in favor of the external

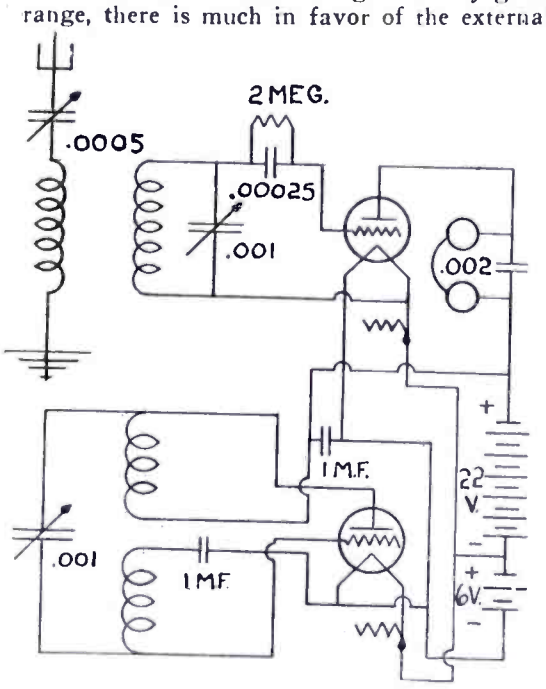


Fig. 4

heterodyne for receiving continuous wave-telegraph signals. It is of course no good for receiving speech or music, but in telegraph work permits the primary and secondary tuned circuits to be in exact resonance, a condition which is not possible in a regenerative circuit where the detector tube is oscillating.

I have an old Army crystal radio receiver, adapted for a single vacuum tube. I would like to add one stage of radio-frequency amplification to this combination. Kindly publish the circuit diagram of such an arrangement. — R. H., San Mateo, Calif.

The circuit you wish is shown in Fig. 5.

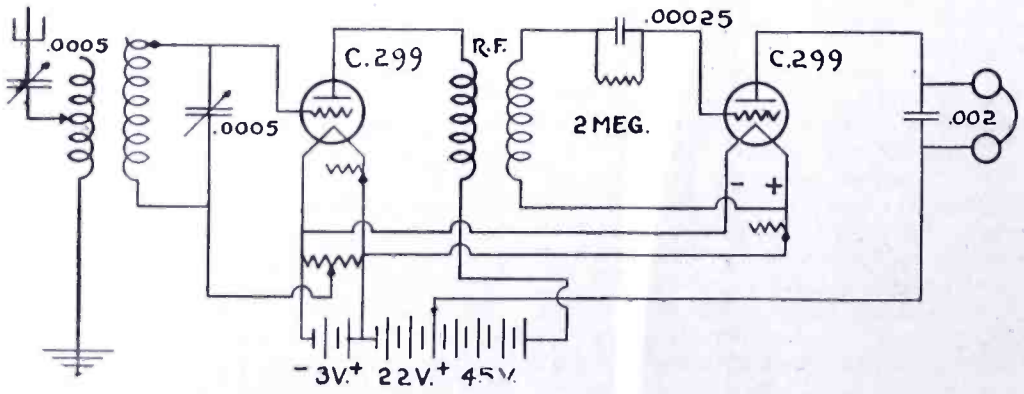


Fig. 5

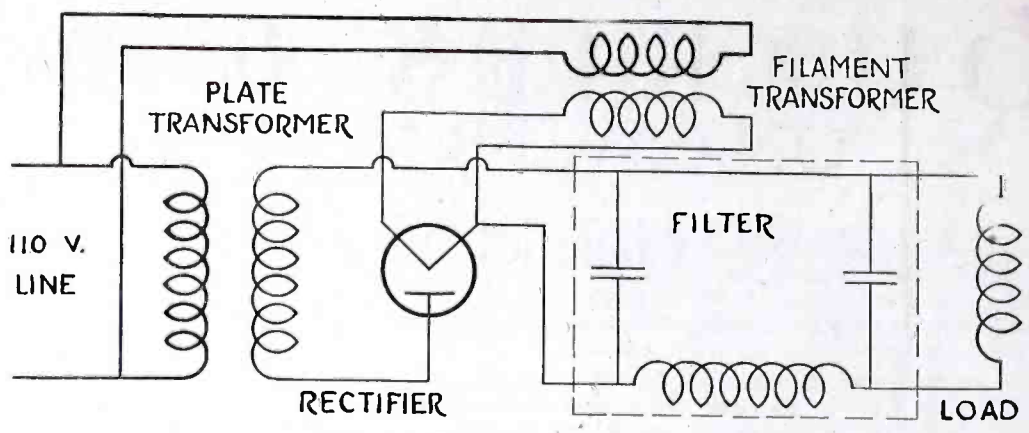


Fig. 6. Half Wave Rectification

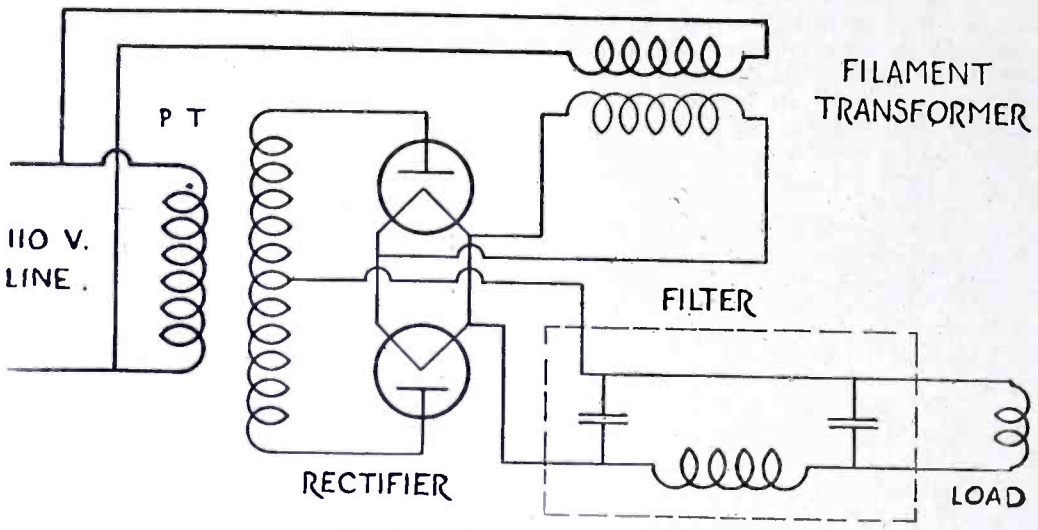


Fig. 6. Full Wave Rectification

Please publish circuit diagrams for a one and two-tube rectifier, for 500 volts, 60 cycle a.c. Will regular 6-volt amplifier tubes do for this purpose? What is the correct plate voltage for 5-watt tubes?—D. L. B., Silverton, Ore.

The diagrams are shown in Fig. 6. Six-volt amplifier tubes will not operate on plate voltages in excess of 150 volts. On 500 volts they would surely be destroyed. The correct plate voltage for standard types of 5-watt tubes is 350 volts, although most of them will stand a considerable overload.

Kindly tell how to make a .1 henry choke coil. — W. C. W., Los Angeles, Calif.

A honeycomb or other compact wound inductance coil of 1250 turns has approximately 100 millihenries, or .1 henry inductance. If the distributed capacity in the coil is of no account, 450 turns of No. 28 D. C. C. wire wound on a 1-in. spool with a ½-in. hub, and with a ¼-in. hole for an open core, will give you approximately .1 henry. The core should be made up of fine iron wire tied in a bundle and packed tightly in the hole through the center of the spool.

Please give the dimensions of a coil that could be used as a primary loading inductance in series with the primary of an Atwater Kent variocoupler to receive the Arlington time signals. Would there have to be three loading inductances in each circuit, in the case of a three-circuit tuner?—J. H. L., Minneapolis, Minn.

A coil made up of 200 turns of No. 24 D. C. C. wire wound on a 3-in. tube, with taps every 25 turns, will give you sufficient loading inductance to reach 2500 meters. The secondary should be loaded in the same way, and the plate variometer used as a tickler. In other words, the plate variometer should be placed adjacent to the secondary load coil, so that there will be an inductive feedback from the plate to the grid.

I recently bought a small microphone of the carbon type. Should a battery be used with it? I desire to experiment with it in connection with a two-stage audio-frequency amplifier.—N. P., Concord, Calif.

Any carbon type microphone requires a battery. If you are going to use it with an amplifier, you will require a transformer, commonly called a modulation transformer, to step up the impedance, or alternating current resistance, of the microphone, so that it will be equal to the input impedance of the vacuum tube. A dry cell or storage battery of six volts should furnish sufficient current to satisfactorily operate the microphone.

With reference to the article by Florian Fox in December RADIO. Can I use the same battery for filament and plate supply without flickering? Does the plate circuit use all the power or what does it do with it? Does the tube radiate all the power it receives? If I rectify the plate supply will telegraph distance increase? Would a full wave rectifier using Ford spark coils give satisfactory results?—A. D., Irwin, Pa.

Your questions are too numerous to answer fully in these columns. Providing the battery is of fairly large capacity, the filament should not flicker when the additional load of the plate supply is applied. A vacuum tube is not by any means 100 per cent efficient. Some of the power is lost in heat within the tube, some consumed by the associated appa-

Continued on page 74

LETTERS TO THE EDITOR

Transformer Ratings

Sir: In reply to the letter by Mr. Philip N. Emigh, Indian Creek, Pa., in the January issue of RADIO, I judge that he objects to the proposal to rate all transformers according to impedance ratios, because he is unfamiliar with the value of this method. If the impedance of transformers were stated, it would be exactly the same, in operation, as the present practice of giving the number of ohms in a filament rheostat. Everyone is familiar with the resistance needed for the old type UV200, or UV201 tubes, and now that the low current tubes have come on the market, we hear no objections to the use of resistance in the description of the filament rheostat to be used. If rheostats were rated, as "fifty-turn rheostats" for the old tubes, and "five hundred-turn rheostats" for the new tubes, the same general type of nomenclature would stand, as the turns-ratio method of rating transformers.

The turns ratio of transformers is not neglected, if the impedance is stated, instead of the former. If we know the impedance of a transformer, anyone who has the information can determine the exact tube which just fits that transformer, both as to the primary and secondary. As the present turns-ratio is given, we do not know that a particular "one-to-three" transformer will work better with a voltage amplifier tube, or with a pure current amplifier. If the impedance is stated we can get the *voltage* ratio between the primary, and secondary, which is all that we really want. If a transformer has an input impedance of 20,000 ohms, and an output impedance of 200,000 ohms, we will have a ten-to-one impedance, and therefore *voltage* ratio, between primary and secondary, but we do not know, nor care about the turns-ratio, except in so far as they affect the input and output voltages.

I pass over Mr. Emigh's statement regarding the use of different ratio transformers on different stages. He is simply showing his ignorance of amplifier design when he makes this statement, unless it is to be presupposed that he uses a voltage amplifier tube on his first stage, and current amplifiers on the later ones. It is not known that such tubes are available on the market.

I am in perfect agreement with his statement that the user is not interested in knowing the exact details of the design in each instrument he buys. The reason why the impedance, if stated by a salesman, would not interest the buyer, is that the latter does not know what it means. He has, through experience, found that certain "turns ratios" work pretty well, and is trying to use this elusive, unsatisfactory way to describe his wants. If the buyer had been shown what the impedance means (which is the true value he wants) he would ask for it, instead of turns.

His analogy between a phonograph salesman's talk, and the turns-ratio argument is not valid. If a person is buying a complete radio set, already built, certainly he does not have to worry about the turns or impedance ratio of the transformers, any more than the phonograph purchaser has to worry about the motor spring details. If, on the other hand, the prospective purchaser is building his own phonograph, instead of buying it already made, he most certainly does want to know all about the "innards" of the spring-motor, including the driving spring, the governor and all. The writer knows the latter, very well, too, as he has done this very thing—and he got stung, too, on an unsatisfactory motor. He would feel like almost asking for the chemical analysis, and strength of materials test on a section of the spring, as well, as the less technical details of the apparatus; this holds when *building* a radio set as well.

The article, as written, was not intended for the novice. It was presumed that those reading it would be of sufficient technical training to grasp the meaning of at least the more common electrical terms. When one system is right, and the other hopelessly wrong, it seems foolish for anyone to try to oppose it.

San Francisco, Calif. D. B. McGOWN

Phone Code

Sir: Listening to amateurs using voice many times their call letters are misleading due to phonetic similarity. Many times the amateur tries to give a name for which his call letter sounds like, but is generally very poor.

Below is a phone code used by telegraph companies, which, if adopted by amateurs using voice, would help everyone to understand them better.

CODE

A for Anna	N for Newark
B for Boston	O for Ocean
C for Charlie	P for Peter
D for Denver	Q for Queen
E for Ethel	R for Robert
F for Frank	S for Sugar
G for George	T for Tom
H for Henry	U for Union
I for Ida	V for Violet
J for John	W for Western
K for King	X for Xray
L for Lincoln	Y for Yale
M for Mary	Z for Zero

Example: If the call 6BAP is to be transmitted—6B for Boston A for Anna P for Peter.

I am sure that amateurs not acquainted with this code would be glad to know it.

Oakland, Calif. W. F. FREDERICK, 6BAP

AUSTRALIA'S 1,000 K.W. TUBE TRANSMITTER

By L. S. LANE

Australia has been a "back number" in connection with her foreign telegraphic business, depending solely upon cables for this traffic. But now that the cables are overloaded she has turned to radio for a solution of her problem, two schemes being put forward, one to erect a number of medium-powered stations, 2000 miles apart, to cover the 12,000-mile stretch from Australia to Europe, and the other to erect a station capable of maintaining a satisfactory schedule over this distance. After much consultation with radio engineers, the direct scheme was recommended for adoption.

Having decided upon direct communication, the next question was the type of transmitter to be employed: arc, high frequency generator, or vacuum tube. In copying the various high-powered European and American stations, the high frequency generator transmitters were more satisfactory than the arcs, but the difficulties to be encountered in running a number of these machines in parallel had to be considered, the largest in operation being only 200 kilowatts, about one-fifth of the required power. Vacuum tubes were then suggested and Carnarvon (MUU) was fitted with an experimental tube transmitter of 200 kw. Despite the comparatively low power, and the great distance, this station was copied on a commercial schedule covering a period of eighteen months, in Australia. This, when compared with the results of the French high-powered arc stations, also copied under similar conditions, caused the designing engineers to decide upon a 1000-watt tube transmitter to be erected in duplicate. The aerial system will be carried by 20 lattice steel masts each 800 ft. high.

The receiving equipment will consist of five sets coupled to five directional aerials of the Bellini-Tosi type, through a system of "wave traps", so that five different stations can be received simultaneously, or, in the event of heavy atmospherics, five copies of the one message, thus reducing interruption from this source to a minimum.

Remote control will be installed and the actual handling of the traffic will be entirely automatic. It is expected to maintain a speed of 120 words per minute. This is higher than any actually being maintained at the present day.

In order to avoid additional handling of the received traffic, several receiving stations will be erected in the various centers of population so that they can deliver their messages without them having to pass through the main station. All the messages for transmission will have to be handled by the big station. Part of the scheme provides for the erection of a number of feeder stations, so that the erection of long telegraph lines will be avoided. These feeder stations being located near and controlled from the various receiving stations.

RADIO TELEPHONY IN THE TIENTSIN CONSULAR DISTRICT

It is apparent that increasing interest is being taken by foreigners in the Tientsin Consular District in the use of radio telephony for both amateur and commercial purposes. The Chinese government telephone administration last year contracted with an American company to install at one of the local telephone exchanges a powerful up-to-date plant for transmitting and receiving wireless telephone messages. This station was designed to supplement the land lines in between Tientsin and Peking, a similar plant being in process in Peking to work in conjunction with it. Experiments are now going on with a view to perfecting the operation of these stations. The design is such that an ordinary telephone subscriber who wishes a long distance connection with Peking may be connected either by the land lines or by means of radio. These installations have not yet been taken over by Chinese government telephone administration, but it is understood that this may be done in the future.

A number of general import firms have become interested in developing the market for radio telephone apparatus and have inquired regarding the importation of both receiving and sending sets, together with the Chinese regulations governing their use.

The regulations of the Chinese government now in effect do not permit individuals or companies either in the interior or at the treaty ports to install and operate radio telegraph or telephone stations, either for amateur or commercial purposes. These regulations, however, govern the use of wireless apparatus and do not apply to the importation or sale of such articles. There is no ruling of the Chinese government which would prevent importation without permit of wireless telephone sets not intended for military uses.

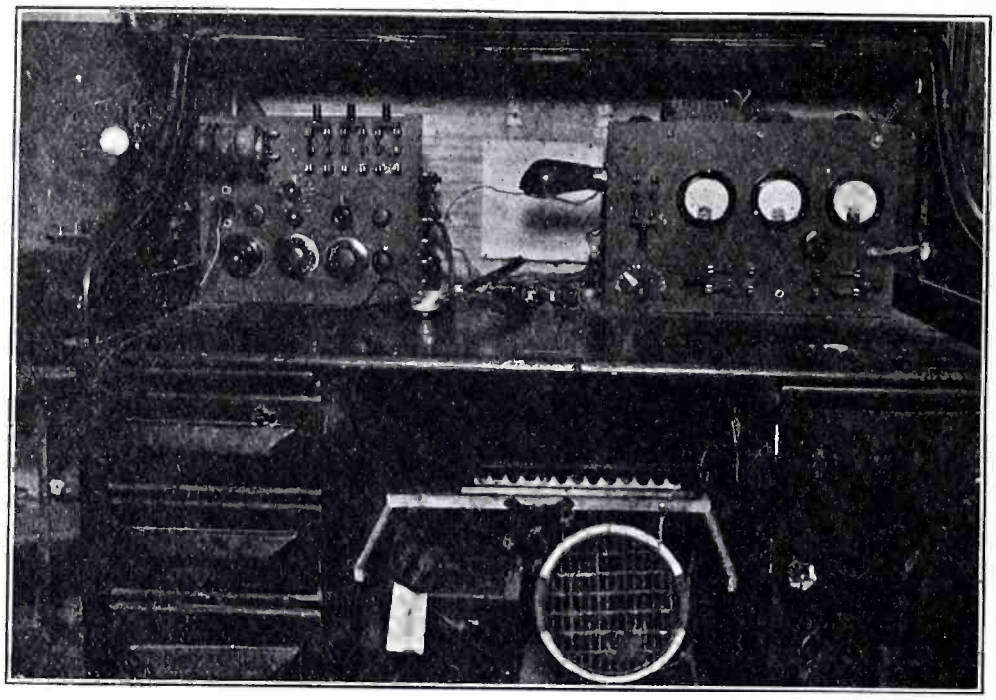
Under the above regulations wireless telephone sets for amateur uses were imported into China last fall. In another instance, the superintendent of customs permitted the entry of two wireless telephone transmitting sets that were not intended for sale but merely as samples.

WITH THE AMATEUR OPERATORS

RADIO STATION 5AHD

Radio Station 5AHD, at Altus, Oklahoma, is owned by B. H. Huff and Hardin White and operated by B. H. Huff. At the left will be seen the receiver, which is a honeycomb set or a single circuit, change-over being accomplished by the three double-pole, double-throw switches at top of panel. This set works well on waves from 150 meters up.

At the right will be seen the transmitter which consists of four 5-watt tubes in the reverse feed back circuit. At the lower right, if the cabinet door were open, you would see the power transformer and filter, transformer being wound by hand. The chemical rectifier is about 15 ft. from set, consisting of 44 quart jars. In the lower center will be seen a 100-volt Edison *B* battery and 6-volt *A* battery. Connections for transmitter and receiver are all brought out at the end or center of desk, which adds greatly to its appearance.



Radio Station 5AHD

The vertical antenna is a 6-wire cage 110 ft. high, tapering from 1 in. to 10 ft. at top. The 12-wire counterpoise is 70 ft. long fan shape, and 10 ft. high. With plate voltage of 500, the antenna current is 2 amps. Signals have been reported in every district, 39 states, Canada, Mexico, Canal Zone, Cuba and Hawaii. This DX record will prove the efficiency of set.

AUSTRALIAN 2CM TO CONDUCT AMATEUR TESTS DURING TRANS-PACIFIC RUN

Charles Maclurcan, Australian 2CM, will conduct a remarkable series of tests with a 10-watt amateur transmitter to be installed on the *Tahiti* on its trip from Sydney to San Francisco and return during March. Mr. Maclurcan has had so much success in receiving American stations and in transmitting to Australian amateurs on low power that he has persuaded Amalgamated Wireless, Ltd. to put a duplicate of his set at 2CM on the *Tahiti* and will maintain two-way communication from the ship to various amateurs in Australia and America. He will be assisted by Jack Davis and will sail from Sydney about the end of February. All signal strengths will be measured with an audibility meter and day and night ranges will be logged. A separate cage aerial and tuned counterpoise will be used.

DX LIST AT 6XAD-6ZW

The following lists are from November 27th to December 27th, both inclusive:

Stations Worked

1cmp, 1boq, 1bbo, 1hx, 1rv, 1ii, 1er, 2cbf, 2el, 2wa, 2cqz, 2byg, 2adm, 3iw, 3aqr, 3hg, 3ajd, 3tr, 3te, 3bva, 4io, 4ft, 4ku, 5xac, 5ahd, 5amh, 5aiu, 5kp, 6zh, 7eb, 7adf, 7zu, 7ze, 7yl, 8apn, 8adg, 8coi, 8zy, 8cgu, 8ame, 8dhq, 8bxt, 8bxx, 8apv, 8dgo, 8abl, 8ago, 8dlh, 8coj, 8axc, 8gz, 8bau, 8oa, 8bcp, 8cwp, 8bnh, 8hj, 8cgu, 8bfm, 8afn, 8rm, 8cei, 8brm, 8bch, 8aa, 9zt, 9dgn, 9dzs, 9dhg, 9doe, 9ayl, 9aht, 9yb, 9bly, 9ahj, 9aps, 9djb, 9dyy, 9elv, 9caj, 9ccs, 9mc, 9dis, 9dhr, 9azg, 9and, 9ato, 9ash, 9bij, 9cp.

The station's work with WNP has been fairly consistent, many messages having been transmitted to, and received direct, from the polar vessel. For several nights his signals disappeared entirely, to be again found at the same receiver markings, as QSA as ever. On January 8th 250 words were delivered to Mr. Mix, chiefly from Eugene McDonald.

Stations Reporting 6XAD-6ZW

1aaf, 1py, 1cpn, 1kc, 1ow, W. R. Gilbert, Worcester, Mass., 1cak, 1hz, 1bzp, 1mo, 1ban, 1gz, 1aoe, 1ccr, Wm. Polleys, Jr., East Greenwich, Conn., 1csw, 1ajx, 1aw, 2kx, 2abt, 2za, 2box (N. Y. City, heard 6XAD on detector with no antenna), 2bqb, 2bkj, 2bl, 2cuw, 2adi, 2bbn, 2cpq, 2ceg, 2cka, 2bun, 2wb, 3aek, 3tl, A. Cochrane, Crisfield, Md., J. Lacey, Washington Grove, Md., 3cbz, 3pz, 3yo, 3yp, 3ckc, 3bau, 3bsb, 3baa, J. Sutherland, Washington, Pa., 4sd, 5mi, 5mb, 6cis, 6wp, 8anb, 8zab, 8boe, 8cci, 8bag, 8qb, A. L. McCauly, Syracuse, N. Y., 8bge, 8bom, 8zor, 8bcz, 8yx, 8cpy,C. Murphy, Jr., Crafton, Pa., 8ajw, 8awp, L. Howitt, Endicott, N. Y., 8bgs, L. Cooke, Watertown N. Y., 8aun, 8abx, 8dgp, 8bum, 8bjn, 8wx, E. Robinson, Sandusky, O., W. Gardner, Sandusky, O., 8sz, 8akj, 8rn, 8cqh, 8uf, 8cck, 8afl, 8adk, 8aqy, 8cpd, 8bqi, 8ajw, 9ajb, 9jo, 9aoj, 9ake, J. Leach, Minneapolis, Minn., 9adn, 9eas, 9ckf, 9ddu, 9dcp, 9ea, 9dxl, 9cnb, 9edg, 9cdy, 9cej, 9azp, 9cfd, 9boo, 9cpo, 9bds, 9dfc, 9em (Logansport, Ind., 6xad audible without aerial or ground), 9bpd, 9bwo, 9ayp, 9aim, 9cew, W. Shord, Chicago, Ill.

A rather complete "performance" was achieved on Christmas morning, between 12:01 and 4:00 a.m., Pacific Standard time; all stations worked:

1cmp, 2bsc, 3zl (Can.), 3qv, 4ku, 4hh (Can.), 5zp, 6cet, 7eb, 8brm, 9zt; thus covering all districts, from an island 30 miles on the Pacific from the coast of Southern California. A good many other stations were also worked; I have merely listed a "set" from 1 to 9.

Canadian Stations: (2cg, Montreal), (4hh, Moose Jaw, Saskatchewan), (3si, Toronto), 3fc, 3bg, 3oe, 3jl.

RADIO PIONEERS

The Radio Pioneers is a new organization which has been formed at San Francisco. Its membership is made up of men who were actively engaged in radio prior to 1913. Col. J. F. Dillon and Dr. F. A. Kolster have been elected as honorary members. The Presiding Pioneer is W. E. Lufkin, radio inspector and former president of the S. F. Radio Club; the Vice Presiding Pioneer is C. M. Heaney; the secretary, H. W. Dickow, and the treasurer, Wm. Henry. Meetings are held at 8:00 p.m. Tuesday in the Assembly Hall, Pacific Bldg., where the club rooms are also located. About 50 men have already joined.

A REAL ACCOUNT OF A REAL STATION

By 6JX-6BVW-6ZU

Following is a description of the ether disturbing bottle container, known upon the air as 6JX-6BVW-6ZU, and disturbance catchers as pictured. Starting at left is seen a well known instrument, the station land phone, which usually reposes out of the way on a hook, but which the photographer thought looked better on the table. This phone has proved very handy for BCL's who are forever calling when voice is used on the air and requesting selections to be played, etc.

Next in order are the receivers, Kennedy Universal and two-step to match, and the Grebe CR8, and two-step. Since this picture was taken, the Grebe CR8 has been replaced with a new Grebe CR6, with a CR13 coming up. An antenna separate from the transmitting antenna is used for receiving, giving the advantage of "break in" reception. The output of the receivers is controlled by a plug and jack system on panel under the edge of the operating table. By system of Magnavox loud speakers, broadcasting or other radio matter may be enjoyed from any part of the house. The results by comparison of the two receivers are as follows: The Kennedy receiver is an extremely sensitive instrument with one curse; it will "sneak" right up on DX C. W. signals, but, on removing the hands from the dials, the signals are lost. On waves above 500 meters, this body capacity effect is not noticeable. As for the Grebe, for amateur use, not enough can be said in its praise. It is unbeatable on 200 meters, and, on 600 meters, can copy commercial traffic from ships at sea that local commercial stations have to ask for repeats on. Nuff sed.

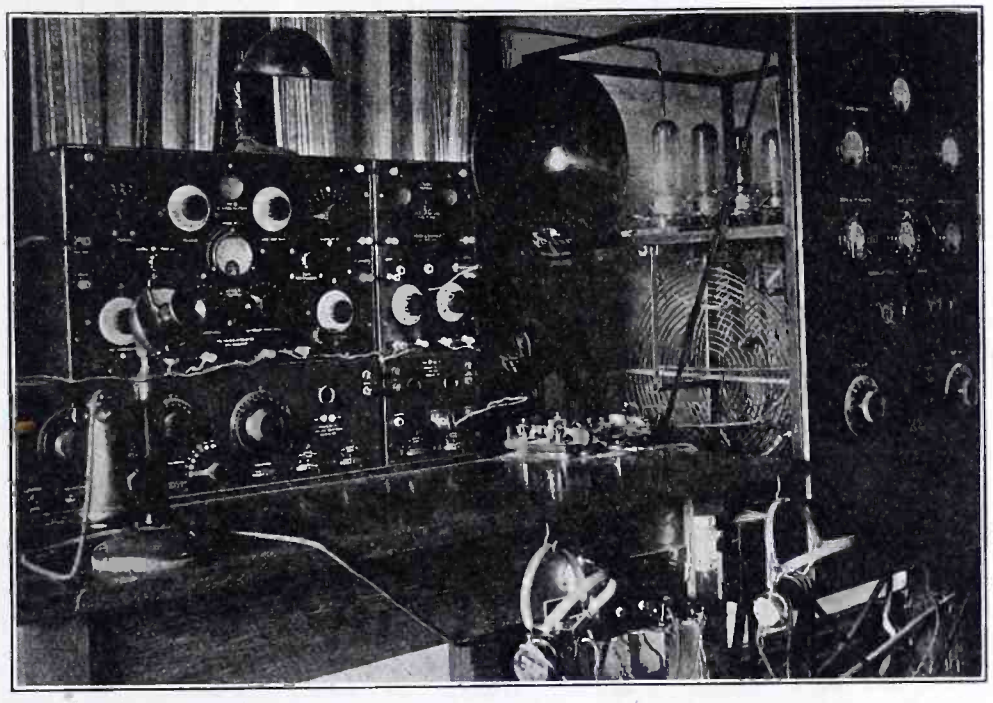
Next on the right are seen the telegraph transmitting keys. First the vibroplex bug, then the light ICW buzzer and chopper key, and mounted upon ½-in. bakelite is the C. W. key, breaking the negative high voltage to the center tap of the specially-built Westinghouse filament transformer.

On the front of the transmitting panel may be seen antenna current meter, milliameters for both oscillator and modulator tubes, and filament volt meters also for both oscillator

and modulator tubes, and between voltmeters, the 0 to 2000-volt meter for the plate supply. Next below are the two filament rheostats and below the dials controlling the two double spaced condensers shunted across the plate and grid coils, in the series feed Meissner circuit.

All internal wiring of the transmitter is with 3-16 copper tubing. All socket leads are also centered. The set is mounted on ½-in. bakelite and a frame of inch-and-a-half angle iron. Three 15-turn pancake coils form the plate, grid and antenna inductances. The power supply is an Electric Specialty 1500-volt 600-watt motor generator unit. 15 henry, 10-mfd. filter insures pure direct current. Antenna current with 100 watts, 1200 volts plate voltage, 400 mills, is 6.2 amps.

The antenna system consists of a 4-wire T antenna, 70 ft. from the ground and 60 ft.



Radio Station 6JX-6BVW-6ZU

in length. An 18-wire fan counterpoise under the antenna is used for the transmitter, no ground connection being used. Will have pair of 100-ft. sticks up for the winter.

To date signals have been heard in all districts, 41 states, 4 Canadian provinces, New Zealand, Australia, above the Arctic Circle in Alaska, Hawaii "every night", Mexico, Panama, and copied by WNP 11 degrees from the North Pole. Have worked east to edge of 8th district, but have more cards from 8th than 5th district. Hope to do much good work this winter with new antenna system. "JX-BVW-ZU" will always QSR Pacific Coast traffic, also answer all cards, reports, schedule arrangements, etc. Give us a call.

6JX-6BVW-6ZU is owned and operated by Wilford Deming, Jr., 1404 Magnolia Ave., Los Angeles, California.

WLAG, TWIN CITY RADIO CENTRAL

Programs are broadcast alternately from St. Paul and Minneapolis over WLAG, the Twin City Radio Central, operated by the Cutting & Washington Radio Corp, in Minneapolis. Eleanor Poehler, the only woman in complete charge of a radio broadcasting station, has executive control of both studios. The new St. Paul studio will be conducted under WLAG's "community broadcasting plan" with St. Paul commercial and civic associations and business concerns subscribing to programs. These include the St. Paul Retailers' Association and the St. Paul Jobbers' Association.

NEWS OF THE AMATEUR OPERATORS

Call 2BP has been assigned to S. Bruno, 10215 97th Ave., Woodhaven, New York. Pse. QSL on his 10-watt C. W.

Call 1AHU has been reissued to Joseph Chereski, 19 West St., Florence, Mass.

Call 9AHI has been reassigned to Arthur W. Joyce, 614 K St., Aurora, Neb. Pse. QSL on 50-watt fone and ¾ k.w. spark.

4PY at 233 Brickell Ave., Fort Lauderdale, Florida, is operated by Merel Bivans and B. C. Fidler, Jr.

F. C. Jones, 1822 Hearst Ave., Berkeley, Calif., recently worked 6CFZ, Los Angeles; 7ZE, Oregon, and 6CEU, Hawaii, with an amplifying tube.

Call 9ATT, formerly call of Stanley E. Fey, 402 Armory St., Champaign, Ill., has been reassigned to Claude B. Vail, 607 No. Diamond St., Jacksonville, Illinois.

6AWT, B. Molinari, 653 Union St., San Francisco, has been successfully working WNP.

The QRA of 4PV is L. H. Leathers, 148 Avant St., Spartanburg, S. C. Reports on the sigs of 4PV will be greatly appreciated and promptly QSL'D.

Anyone knowing the whereabouts of Warren D. Cheney, ex-Radio 6BDL and 7NG, last known address 625 Bushnell Ave., Alhambra, Calif., is requested to write A. C. Gordon, 964 N. E. 28 St., Portland, Ore., Radio 7FX, Tnx, O. M.

7ABB, Mr. Everett Kick of Everett, Wash., is probably the most consistent station in the whole Northwest. His signals have been reported QSA in every district. 7ABB is heard on the air every night with the regularity of a clock. Besides being one of the important links in a chain of stations which forms a relay route to WNP, 7ABB is one of the most reliable message-handling stations west of the Rockies. 7ABB has worked WNP direct but reports the 500-cycle signals from the *Bowdoin* very QRZ. Many of the messages received by Canadian 9BP from WNP have been relayed to 7ABB, who in turn relays them east to 7ZU or 9ZT.

7AHB, of Talkeetan, Alaska, has been heard by a number of amateurs in the Northwest. 7ABB relayed several messages to WNP via 7AHB. Another Alaskan station, 7IT, has been heard by different stations in Washington and Montana.

The famous 7ZN of Boise, Idaho, is now signing 7OT. We knew he couldn't stay off the air for long.

Continued on page 74

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

By 7GI, Carlos S. Yerian, 509 W. Augusta Ave., Spokane, Wash.
(Reinartz and det.)

Spk: 9bof.

C. W.: 1ef, 1yb, 2by, 2cxl, 2el, 2iu, 3adf, 8pz, 4cn, 4fa, 4ne, 5aat, 5abt, 5agj, 5ahr, 5aiu, 5akn, 5alj, 5kc, 5kg, 5lr, 5qq, 5zav, sixes and sevens too numerous; 8atc, 8awj, 8bcb, 8bda, 8bfh, 8bzk, 8cci, 8cdd, 8cki, 8cnb, 8cpy, 8ctp, 8daa, 8do, 8dgr, 8fx, 8gp, 8jy, 8pl, 8qn, 8tr, 8ur, 8xe, 8zz, 9aau, 9adf, 9aed, 9ahz, 9aiy, 9ajv, 9aon, 9aou, 9ape, 9apf, 9aps, 9apv, 9asf, 9avm, 9avv, (9avu), 9avz, 9awv, 9bav, 9bdz, 9bed, 9bgb, 9bhh, 9bis, 9biz, 9bkh, 9blm, 9bly, 9bof, 9bsz, 9btt, 9bvo, 9bvv, 9bze, 9bzi, 9caa, (9ccv), 9ccz, 9cdo, 9cdv, 9ceh, 9cga, 9cgw, 9cjv, 9ckh, 9ckp, 9cld, 9cly, 9cnb, 9coc, 9cvv, 9czg, 9dfr, 9dfw, 9dkb, 9dcp, 9dfx, 9dgk, 9dnx, 9dro, 9dsw, 9dxn, 9dxy, 9dzy, 9edb, 9efj, 9egg, 9ehj, 9elv, 9zg, 9zy.

Can.: 3co, 3ni, 3oh, 4cj, 4cl, 4dy, 4er, 4hf, 4hh, 9bp, 9bx.

By 8AGO, 3046 Centre Ave., Pittsburgh, Pa.

(1af), (1afa), (1afp), 1agk, 1ajt, 1ajx, 1ap, 1aqi, 1aqm, 1arp, 1aur, (1aww), 1awy, 1ayi, (1bav), 1bep, (1bfq), 1bgc, 1bgq, 1blx, 1bm, 1bom, 1boq, (1bqd), 1bql, 1caz, 1cmp, 1cpv, 1cws, 1eg, 1er, 1gl, 1gs, 1gv, 1ij, 1kc, 1uj, (1uo), 1vq, 1wo, 1xam, (1yb), 1yk, 2adm, 2aim, 2apo, 2ats, 2awf, 2awl, (2ayv), 2bbn, 2bdg, 2beo, 2bgc, (2blx), 2blm, 2bqb, (2bum), 2by, 2cge, 2cka, 2cqi, 2cqz, 2csl, (2cwj), 2wr, 3ab, 3abe, 3abs, 3acy, 3adb, (3aen), 3aln, 3arn, (3as), 3atb, 3ava, 3bdo, 3bei, (3bgg), (3bit), 3bjg, 3bkt, 3bnu, (3bqp), (3bqz), (3ca), 3cah, (3can), 3cej, 3cfv, 3chg, 3cjn, (3ckd), (3ckj), (3ckl), (3fb), (3gk), 3hh, 3hs, (3lg), 3me, (3mo), 3ox, 3tr, (3ur), 3vo, (3xn), (3zo), 4af, (4ai), 4bq, 4cs, 4db, 4eb, 4eq, 4ft, 4gw, (4gx), 4jk, 4jr, 4kc, 4ku, (4mb), 4me, (4mi), 4oa, 4pd, 4qw, 4rr, 4sh, 4uu, 5abb, 5abh, 5abn, 5agj, 5ago, 5air, 5ajp, 5aki, 5akn, 5amh, 5au, 5bw, 5ek, 5er, 5fx, 5gn, 5gp, 5hl, 5if, 5ka, 5kh, (5lr), 5nj, 5pv, 5sd, 5uk, 5up, 5vv, (5wo), 5xab, 5yg, 5yw, 5za, 5zas, 5zav, 5zg, 6adh, 6age, 6arb, 6avv, 6awt, 6bih, 6bua, 6cbu, 6cc, 6cga, 6cgw, 6chu, 6cmr, 6cu, 6fp, (6xad), 6zh, 6zw, 7adb, 7aez, 7bw, 7cbu, 7ve, 7yl, (8's too many), 9aa, 9aaj, 9aaq, 9aau, (9ady), 9aem, 9afp, 9afw, 9agl, 9ahe, (9ahz), 9aim, 9ajv, (9ali), 9alb, 9aog, 9aon, 9ape, 9apf, (9apv), 9arc, 9arh, 9arp, 9asx, 9aus, 9avu, (9awv), 9bak, 9bas, 9bdu, 9bei, 9bez, 9bff, (9bgc), 9bhd, 9bhi, 9bij, 9biz, 9bji, 9bkh, 9bmc, (9bop), 9bpd, 9bpy, 9bqj, (9brx), (9btl), 9btt, 9bun, 9bwj, 9byn. 9byx, 9byy, 9bzi, 9caa, 9ccf, (9ccn), 9ccs, 9ccz, 9cdj, 9cfo, 9cfy, (9chc), 9cho, 9cjc, 9cji, 9ckp, 9clq, 9cmc, 9cnb, 9cnv, 9cnw, 9cr, (9ctr), (9ctt), 9cwv, 9cxw, (9cyf), 9cyw, 9czn, 9czs, 9day, 9dca, (9dcw), 9ddn, 9deq, 9dhu, (9dis), 9djb, 9djn, 9dk, 9dky, 9dlr, 9dlw, 9doe, 9dpc, 9dpx, 9dqu, (9dso), 9dvk, 9dwk, 9dxa, 9dyl, 9eak, 9eea, 9efj, 9efu, 9ehj, 9eky, 9ell, 9elw, 9ep, 9eq, 9es, 9ig, 9ir, 9it, 9us, 9vc, 9xj, 9yy, 9zg, 9zl, (9zt).

Canadians: 1ar, 2am, 2az, 2be, (2bg), 2bn, 2by, 2cg, 2hv, 2ic, 3ab, 3ada, 3adn, 3afp, 3bg, 3bq, 3ep, 3ir, 3iv, 3ji, 3jt, 3kg, 3kp, 3ld, 3mv, 3ni, 3oh, 3pg, 3si, 3tb, 3tf, 3xi, 3xx, 3zl, (3zs), 4dy, 4ru.

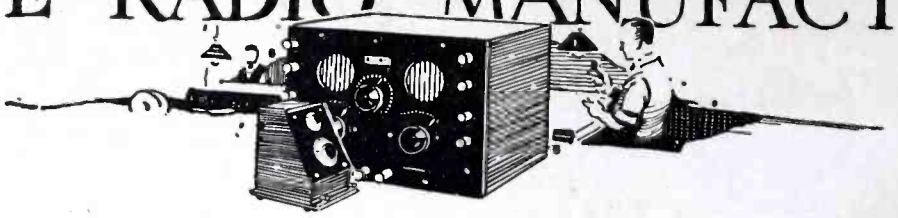
Anyone hearing my 20 or 250 watts pse. qsl.

At 6ZAD, 2043 Berryman St., Berkeley, Calif.

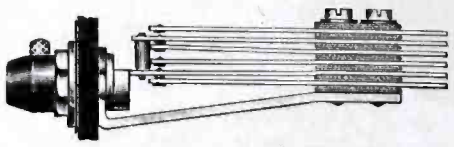
1ki, 1cma, 1cmp, 2on, 3dh, 3nl, 3ty, 5ek, 5bh, 5fx, 5gr, 5hv, 5ht, 5la, 5nh, 5yn, 5za, 5ada, 5akh, 5ama, 5aup, 5zav, 6dd, 6om, 6pl, 6mh, 6hv, 6en, 6ka, 6od spk., 6ua, (6vd), 6fy, (6fh), (6iq), 6ec, (6tu), (6tv), (6uw), (6adm), (6age), (6ahu), 6ahw, (6acz), (6ajd), 6aqd, 6asa, 6tq, 6bbg, 6bks, 6bkx, (6mn), (6bmx), 6bpz, 6bqs, 6bqk, 6bra, 6brf, 6bri, 6brk, 6bru, 6buo, 6bvg, 6bua, 6cbi, 6cbu, (6ceu), (6cfz), 6cga, (6cgd), (6cgq), 6cgw, 6cnh, 6cnl, (6zar), 7ac, 7ak, 7bz, 7em, 7io, 7kx, (7kj-spk.), 7lh, 7ln, 7lo, 7lr, 7ly, 7oh, 7go, 7pe, 7px, 7ob, 7qd, 7ra, 7sy, 7so, 7to, 7tq, 7un, 7ve, 7vn, 7ws, 7yl, 7zl, 7zn, 7zt, 7zu, 7aby, 7aci, 7adp, 7adq, 7adr, 7ads, 7afe, 7age, 7ago, 7agr, 7adg, 7ajv, 7ajy, 7akv, 8er, 8qz, 8uo, 8tt, 8zb, 8adt, 8bda, 8bez, 8ced, 8dgo, 9fs, 9vm, 9vn, 9mc, 9aau, 9aio, 9aon, 9ape, 9amb, 9ami, 9asl, 9bak, 9bud, 9bvo, 9bwa, 9bzi, 9bun, 9bxq, 9cbj, 9cjy, 9dfh, 9dkg, 9dkb, 9dkq, 9dmb, 9dpx, 9dxn, 9ebu, 9eky, 9elf.

Continued on page 44

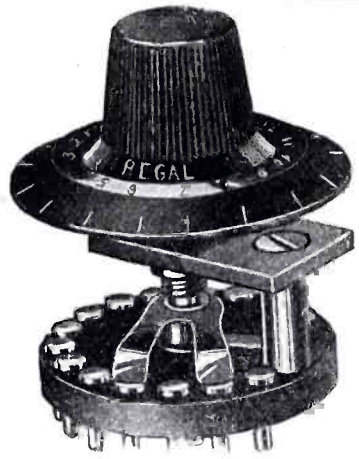
FROM THE RADIO MANUFACTURERS



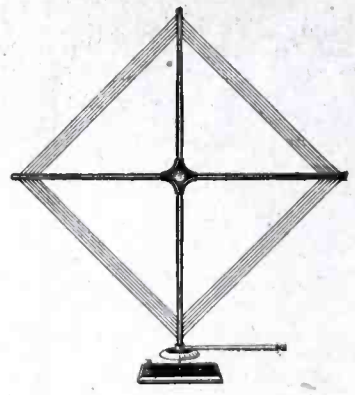
The Grebe CR-14 receiver has been especially designed for broadcast reception. It employs the Armstrong regenerative circuit with but two simple tuning adjustments and a two-adjustment wavelength switch to cover all broadcast wavelengths. It uses three dry-battery tubes, space for the batteries being provided in the cabinet.



The Carter jack switch, which is made with two, three, four or six springs according to the number of contacts to be closed, employs the same principle as used in an ordinary jack, except that the contact is made by turning the knob. The switch is easily mounted on a panel and will safely carry 10 amperes.



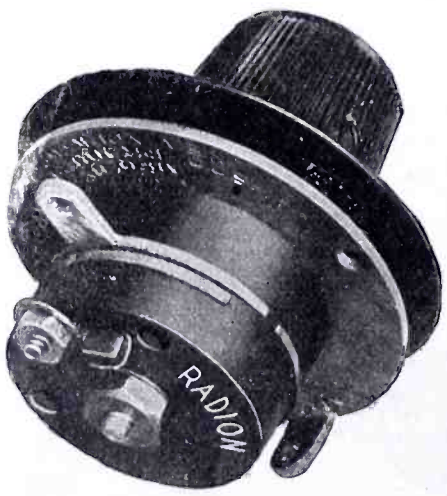
The Regal inductance switch combines in one unit 15 individual switch points. It does away with multiple drilling of the panel and with the need for soldering back of the panel, as it can be mounted through one hole in the panel after the contacts have been soldered. Positive contact is made by smooth wiping arm over accurate headed points.



The Duo-Spiral loop aerial is a compact, self-contained radio antenna especially designed for broadcast reception. It measures 2 ft. square and contains 90 ft. of wire, which is kept taut by springs in the two arms. It is mounted on a base with a removable plug and jack connection. It is also provided with a dial graduated in degrees and a long handle.

The Proudfoot one-knob vernier condenser has been especially designed to give accurate log readings. The first approximate adjustment is made by turning the knob to the right and the final fine adjustment by turning the knob to the left, which allows only the vernier plate and inner dial to move. By reading the outer and inner dials an accurate log reading can be obtained.

The Kellogg audio-frequency transformer is carefully designed to function equally as well on high and low notes. This result is attained by careful attention to coil materials, the use of one-piece silicon steel core laminations, the use of an enamelled brass housing that shields the transformer in any position, and the soldering of leads to terminals. Each binding post is plainly marked.



The Amsco Compensating Condenser takes the place of a potentiometer in a radio-frequency amplifier. With it in circuit full negative bias may be used on the amplifier grids, as the feed-back takes place not only through the tube capacity, but also through the compensator with its polarity reversed. Thus the charges arrive at the grid with equal force but with opposite voltage, and are nullified. Radion discs are used in its construction to obviate leakage and moisture absorption.

The Fansteel Balkite battery charger employs tantalum and lead electrodes and sulphuric acid electrolyte covered with an oil film. A transformer steps down 110-115 volt a.c. and the rectifier delivers 6 volt d.c. at a 3-ampere rate. It is economical in current consumption, does not deteriorate through use or disuse, requires no replacement except distilled water, has no moving or fragile parts to wear out and is noiseless in operation.

Get more Mileage out of your Radio Receiver

With THE FILAMENT KONTROL OF INFINITE ADJUSTMENT FIL-KO-STAT

The Scientifically Correct Radio Rheostat

Fil-KO-Stat is standard equipment of Radio Guild's "Radolian" Receivers.

From RICHARD J DAVIS
700 East Erie St., Painsville, Ohio.

"FIL-KO-STAT cannot be beat for fine adjustment and noiseless operation. The first night after installing it I got KDZA, Tuscon, Arizona (1500 miles), KYY, San Francisco (2500 miles) and WHA, Madison, Wis., (1000 miles)—all came in clear and loud * * * without FIL-KO-STAT never have picked up these stations."

From LESLIE C. BILES
Maple and Burlington Aves., Delanco, N J

"After experiments with various filament controls, I have adopted FIL-KO-STAT as the finest instrument for ***controlling detector** In my humble opinion it is the greatest Radio Achievement of the year.****stations never heard before**(include) WOAO, WDAF, WCX, WOC, WSB, and WLAG on loud speaker On Oct. 28th, at 8 P M with powerful Philadelphia statioins operating I tuned in with FIL-KO-STAT WKAQ, San Juan, Porto Rico **do not feel that I can say enough in praise of this little instrument** Many sets that are inclined to tune broadly can be improved with FIL-KO-STAT. It will positively separate stations on close wave lengths."

From H. R. HASLAM
249 W 126th St., New York, N Y

"**Three tube standard set**wire wound rheostats gave satisfaction on local stations, but on distant reception could not get point between owing to coarseness of adjustment. With FIL-KO-STAT change was wonderful, getting distant stations never received before, even Oklahoma City quite strong despite local interference."

From JACK WALSH
Independence, Colorado

"FIL-KO-STAT certainly a wonder Following stations received in nine days on one bulb WOAW, WDAF, WFAA, WJAZ, WOC, WBAP, WHB, KFI, KHJ, KFEL, KFIX, WSB, WMC, KLZ, KFFO, WWAC, KZN, WDA, WLAG, WDAP, WGY, (2000 miles) CKCK, WOS, KOP, CFCN, WDAE, KSD, WJAD, WCBD, KDYL, WHAS, KDKA, KGW, WAAW, KFKB, KGW, WEAY, WOI, KOB. I believe the FIL-KO-STAT is the secret of my success.

You, too, will be writing letters like these when you have tried a Fil-KO-Stat in your set

Radio News Laboratories say:

This filament rheostat (Fil-KO-Stat) is designed to control the filament current of practically all types of receiving tubes now on the market. It is noted for its exceptionally infinitesimal and uniform control of the current.

For instance, the critical adjustment of a one-ampere tube is spread out over a range of four turns of the knob, thus enabling a micrometer adjustment to be obtained.

APPROVED RADIO NEWS LABORATORIES 1922

RADIO STORES CORPORATION
Sole International Distributors
NEW YORK—CHICAGO—MINNEAPOLIS—LOS ANGELES
CLEVELAND — ST. LOUIS — OMAHA — SAN FRANCISCO
HOME OFFICE, Dept. R2. 220 W. 34th St., NEW YORK, N. Y.

YOU want more mileage out of your Radio Receiver. You can't properly tune in distant stations. You want to clear up those tube noises so exasperating when a DX announcer is telling you who he is and all you get is, "This is station brbrweeizgrump". Yes, you get many distant stations *but you never hear them.* They're on your antenna, weak little brothers waiting to be magnified into audibility. They're there with song and story, concert and dance. How you do wish you could hear them! Condensers and couplers are all on the job, properly adjusted, but all you get are whistles and disappointments, BECAUSE:

Unless your RHEOSTAT is a FIL-KO-STAT you can't adjust the most delicate, most critical tuning unit on your set—and that's your *vacuum tube.*

Wave length isn't everything. There's a finer control needed. You must be able to make most minute adjustment of your filament heat and so control the electronic flow in the tube. When you do this you will have perfect reception free of all tube noises and YOU WILL HEAR DX STATIONS YOU NEVER HEARD BEFORE!!!

Regardless of what set you have, it will *pay you* in added pleasure and satisfaction to replace your present rheostat with a FIL-KO-STAT. It's so easy to make the change. Or have your dealer do it. And if you are building a new set, Neutrodyne, Super Hetrodyne, Radio Frequency, Phusiform, Reflex, Regenerative, *any* type with *any* kind of tube—make sure of complete reception by using FIL-KO-STAT.

IMPORTANT!

FIL-KO-STAT is not a carbon powder rheostat. Nor has it discs (which break and chip). Its resistance element is over 70 per cent metallic substances. Its full resistance is 30 ohms. And it is

UNCONDITIONALLY GUARANTEED TO GIVE SATISFACTION

BY THE DX INSTRUMENT CO. HARRISBURG PA.

The Fil-KO-Stat is suitable for any panel mounting. Rigid, nickel plated, drilled and tapped mountings for setting up Fil-KO-Stat on table, 15 cents additional.

Price $2

In Canada $2 75

CALLS HEARD

Continued from page 41

By 5FU, 8696 Oak St., Vancouver, B. C.

Can.: 3ni, 4bq, 4bv, 4cl, 4cr, 4cw, 4dg, 4dq, 4fc, 4fv, 4hf, 4hh.

U. S.: 1fp, 1adv, 1bgq, 2oh, 2bnv, 2bqt, 3bej, 3brl, 5agj, 5akn, 5be, 5fv, 5gm, 5hl, 5ht, 5hz, 5kn, 5mo, 5ql, 5tj, 5za, 5zav, 5zv, 8aib, 8agy, 8bda, 8fu, 8fv, 8lu, 8wd, 8xe, 9aaf, 9aav, 9alv, 9amb, 9akc, 9ack, 9afm, 9aim, 9apw, 9awm, 9arz, 9avn, 9avs, 9bxq, 9blq, 9dhq, 9bri, 9byx, 9bms, 9biz, 9bak, 9bud, 9bji, 9caa, 9cl, 9cr, 9clq, 9cdj, 9doe, 9diw, 9dzy, 9dkq, 9dgi, 9ekq, 9elv, 9edb, 9eep, 9edx, 9ig, 9jj, 9mc, 9rh, 9zt. Sixes and sevens too many to log.

By 6CHX, Robert E. Geddes, 1820 4th St., San Diego, Calif.

Can.: 5go, 5cn.

Amer.: 5ahd, 5ado, 5adb, 5ed, 5go, 5ht, 5lr, 5uo, 5za, 5zav, 6aim, 6aqu (spk.), 6aty, 6ajf, 6auu, 6adm, 6boi, 6cdg, 6cej, 6cdl, 6cc, 6ca, 6cid, 6cek, 6chl, 6cij, 6cqe, 6cgg, 6ckc, 6cee, 6cie, 6cmi, 6dd, 6dac, 6fh, 6ii, 6ti, 6qk (spk.), 6ik, 6nx, 6rm, 7afn, 7bj, 7em, 7to, 7zn, 7zu, 7zo, 7qj, 7ks, 7uw, 7ago, 7ads, 7tq, 7sc, 7aez, 8jj, 8clo, 9amb, 9aob, 9bjk, 9bhz, 9cns, 9dxy, 9apf, 9bly, 9bji.

Anyone who hrd. my 110-volt C. W. during Oct., Nov. or Dec. pse. qsl, acct. important tests.

By V. W. Gilmore, Mile Seven, Alaska

1ana, 1bgc, 2kv, 2ts, 2xq, 3aln, 3co, 3pb, 4ay, 4bq, 4cn, 4cr, 4dq, 4eq, 4jk, 5acf, 5aiu, 5akn, 5aky, 5ama, 5amn, 5ct, 5eb, 5ek, 5ga, 5gj, 5gn, 5in, 5kc, 5lg, 5lr, 5mo, 5oo, 5qi, 5qw, 5uk, 5up, 5wx, 5zav, 5zb, 6abx, 6age, 6ajh, 6ak, 6anb, 6aoi, 6aos, 6asx, 6avv, 6bbw, 6bic, 6bih, 6biq, 6bjj, 6bm, 6bnc, 6bql, 6brk, 6buo, 6bvs, 6cc, 6ceu, 6cgd, 6cgm, 6cgw, 6ckp, 6ckr, 6cmu, 6cnh, 6cnw, 6fp, 6gr, 6jx, 6km, 6kw, 6lv, 6mh, 6nx, 6pl, 6ts, 6vf, 6xaj (fone), 6zar, 6zav, 7aea, 7ael, 7abb, 7abf, 7adr, 7agn, 7agf, 7ah, 7ahj, 7aim, 7bj, 7fd, 7ge, 7jn, 7lh, 7no, 7nn, 7px, 7ob, 7qj, 7qt, 7rc, 7sc, 7sf, 7sn, 7zea, 7zu, 8afc, 8ago, 8bda, 8bzc, 8bqc, 8ddq, 8cz, 8gz, 8kg, 8rj, 9adw, 9ahz, 9aim, 9amb, 9ape, 9apf, 9aon, 9aos, 9asf, 9auu, 9awv, 9bak, 9bau, 9bey, 9bji, 9bly, 9bof, 9bri, 9bto, 9cbj, 9cgu, 9cgw, 9cvg, 9djb, 9dnu, 9dsw, 9dxn, 9dzy, 9eae, 9eky, 9elv, 9lz, 9tv, 9xi, 9yy, 9zt.

Canadian: 4cr, 4dy, 5cn, 9ce, 9bx and wnp.

At 5ZAV, Oklahoma City, Okla.

1ajp, 1ary, 1ajg, (1adn), 1bbk, 1boq, 1bom, 1bwj, (1cmp), 1cpn, 1crw, 1cab, (1er), 1il, (1jv), 1kc, (1rv), (1sk), (1vv), 1sn, (1xz), (1yb), 1yc, 1yk, 2aay, (2ayv), 2ajf, (2brb), 2coa, 2bwx, (2cqz), (2cxd), 2cxl, 2csr, 2cpa, 2cqi, 2le, (2ts), (2rk), 2ue, (2xq), (2za), 3ab, 3aao, 3abw, (3aav), (3ba), 3bez, 3bq, (3bnu), (3bsb), 3bsv, (3bva), 3bhv, 3bna, 3bgg, 3bdo, 3bti, 3bb, 3cej, 3ckd, 3cfv, 3fl, 3fs, 3me, 3oe, (3pz), 3qs, 3su, 3te, 3vo, 3yp, (3yo), 3zs, 4af, 4ay, 4ag, 4by, 4cb, 4eb, (4fg), 4hs, 4hr, 4iu, 4jk, 4jl, 4js, 4kc, 4ku, 4lj, (4mb), 4nr, 4oa, 4om, 4pd, 4ik, 4sc, 6ak, (6aak), 6acm, 6age, 6alp, 6ane, 6ame, 6akz, 6ajp, 6aol, (6awt), (6aoi), (6bgy), (6bvg), (6bly), 6bbw, 6bdw, 6buh, 6bnt, 6bna, 6chl, 6bve, 6cei, 6cbb, (6cmr), 6ckr, 6cgw, 6ea, 6eb, 6gr, 6rm, 6mh, 6xad, 6zh, 6zah, (7abb), 7awz, (7fl), 7ly, 7lu, 7pf, 7qc, 7qj, 7sc, 7ki, 7te, (7uu), 7wm, 7wp, 7we, 7zf, 7zo, 7zt, (7zu), 7zx, (8afd), (8amb), (8aeg), (8bf), (8bvr), (8bxt), (8brm), (8byn), (8bhf), (8cqj), (8cyt), (8czz), (8cwa), (8dcy), (8dbo), (8dhq), (8hk), (8tr), (8xe), (9zy).

Canadian: 2cg, 2ic, 3bj, 3bq, 3jl, (3ko and fone), 3kg, 3om, (3qs), 3si, (3ni), 3gh, 3oh, 3xi, (4er), 4hh, 4cn, 4cl, (4dy), 4co, (5cn), (5go), 9bp, 9bx.

Mex.: (bx) fone, 4ft, 5ma, 5agt, 8kg, 5ek, 9xn.

By 1ER, Stearns Road, Wellesley, Mass.

(4ag), 4ai, 4eb, 4ft, 4hr, (4jk), (4oa), (4pm), (4qf), 4qw, 4sh, (5ga), (5hm), 5in, 5kg, (5kc), (5gj), 5bw, (5ku), (5nn), 5ht, 5qw, 5qq, 5qy, (5ql), 5qr, 5ku, 5ph, 5uk, (5up), 5sd, 5sk, 5sl, 5abt, 5agj, 5amh, (5zav), 6age, 6acm, 6ahu, 6ajh, 6alv, 6amp, 6aos, 6aoi, 6aol, 6aos, 6pp, 6aup, 6auy, 6awb, 6awt, 6app, 6arb, 6asy, 6avv, 6xad, 6zar, 6zau, 6baa, 6bad, 6baw, 6bcc, 6bcl, 6bcj, 6bcs, 6bbp, 6bbw, 6bek, 6beo, 6bic, 6bif, 6bhg, 6big, 6blm, 6bly, 6bpf, 6bpz, 6bmd, 6brf, 6btt, 6bua, 6buh, 6bun, 6buo, 6bur, 6cbl, 6cbm, 6cbu, 6cdg, 6cgd, 6cfy, 6cfz, 6chu, 6chv, 6ckp, 6ckr, 6cmr, 6cnh, 6cwz, 6cu, 6dd, 6fp, 6fr, 6fy, 6gr, 6gx, 6jx, 6kp, 6lv, 6mh, 6nh, 6nx, 6pf, 6pl, 6su, 6ti, 6ts, 6vf, 6xl, 6zh, 6zz, 7abb, 7aci, 7adr, 7ads, 7afr, 7age, 7ahn, 7ag, 7af, 7ak, 7cq, 7cs, 7fl, 7gi, 7hg, 7it, 7ks, 7lg, 7ln, 7lu, 7ly, 7nn, 7nt, 7qc, 7qj, 7sc, 7sf, 7to, 7ve, 7wp, 7ws, 7wx, 7yl, 7zd, 7zu, (9aic), (9apf), (9aps), (9arf), (9bis), (9blg), (9bly), (9buj), (9bvn), (9caa), (9ceh), (9cfz), (9chf), (9col), (9cte), (9cvs), (9ddu), (9dxu), (9eky), (9eht), (9mc), (9xi), (9yb), (9yy), (9zt).

Can.: 4cr, (4hh), 5cn, 5go.

Continued on page 46

After Painting by John Trumbull

The Golden Rule Tube

The Sodion does not oscillate.

No declaration as to sensitivity, signal strength, or quality of tone, can mean half so much to every broad-minded radio enthusiast as this simple statement of fact.

For there—in five words—you have the key to the solution of the problem of eliminating the whistles, the squeals and the howls that interfere so seriously with your enjoyment of radio today.

Don't misunderstand—

The Sodion does not protect YOUR reception against these noises from other sets.

But, because it does not oscillate—because it cannot reradiate—because it cannot whistle and howl—the Sodion DOES prevent your reception from interferring in any way with the reception of others.

This, we believe, is the practical way of eliminating one of the greatest faults in broadcast Radio reception.

In point of efficiency the Sodion Tube is far more sensitive and produces stronger signals than any detector now on the market. Its tone is fully equal to that of the finest crystal with the added advantage of great volume.

Descriptive Bulletin upon request.

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
MERIDEN Radio Division **CONNECTICUT**

CALLS HEARD

Continued from page 44

At 7GE-7ZX, Loren C. Maybee, 110 So. 7th St., Pasco, Washington

U. S. 3hg, 5ado, 5akn, 5ama, 5lr, (5zax), 6abx, (6aoi), 6aos, (6aru), (6beo), (6bds), (6bnc), (6bni), 6brf, 6bur, 6cax, (6cbu), 6cdg, 6cek, 6ceu, (6chu), 6cid, 6cnh, 6km, (6lv), 6nx, 6zah, 6zau, 6zh, (7zd), 7zo, 7zu, 8aih, 8aim, 9aar, (9amb), 9apf, 9aou, 9avs, 9avz, 9awv, 9bhz, 9bly, 9bri, 9btl, 9bxq, 9cea, 9cch, 9cns, 9dct, 9dfh, 9dkx, 9dsm, 9lz, 9vm, 9zt, 9xi.
Canadians: 4dq, 4dy, 4hf, (5bq).
QSL crd gladly sent if requested by mail.

By 8ADA, Cleveland, Ohio

(4db), (4hr), (4jl), (4lj), (4me), (4mi), (4oa), (4rm), (4qf), (5abb), 5abh, 5air, (5aiu), 5akr, (5amb), 5eh, 5gi, 5gj, (5ht), 5kn, 5kr, (5nn), (5ov), (5qf), 5sr, 5sk, 5vm, (5ws), 5xv, 5yw, 5xac, 6aak, 6afq, (6alk), 6alv, 6aoi, 6aos, 6arb, 6asx, 6atc, 6auy, 6avv, 6awt, 6bcl, 6bcs, 6bjc, 6bnt, 6bqb, 6bqe, (6bsg), 6bua, 6but, 6bwe, 6cfs, 6chc, 6chl, 6chu, 6ckp, 6ckr, 6cmr, 6cc, 6ff, 6fp, 6nx, 6pl, 6qj, 6tv, 6xl, 6xad, 6zah, 6zar, 6zat, 6zw, (7abb), 7ads, 7aea, (7afn), 7acg, 7age, 7amr, 7co, 7ds, 7fd, 7hg, 7it, 7ln, 7lu, 7ot, 7qj, 7sc icw,, 7sf, 7sh, 7to, 7uu, 7wp, 7zd, 7zo, 7zu, 7dc, 9aab, (9ack), 9agl, 9afm, 9aki, 9amb, (9apf), 9avu, (9azg), 9bji, 9bto, 9bvo, 9bxq, 9cfy, (9ccz), (9dlf), 9dte, (9efu), (9ehj), (9eak), 9gy, (9yam).
Fones—2el, 2rb, 3dd, 9aic, (9jc).
Dalite—(1yb), (3ahp), (3hs), (4db), (4jl), 7abb, (9ahq), (9apf), (9dlf), (9egw), (9ehy), (9dhk), (9ayh), (9aus), (9yam).

By "FO" of 9CTT at 9CZV

1agh dalite, 1aqi, 1bes, 1bwj, 1cmp, 1my, 1xm, 1xz, 2by, 2cpk, 2cqn, 2rb, 3uu, 3yp, 4ai, 4el, 4gx, 4pb, 4qf, 5abg, 5abh, 5adi, 5aeu, 5afq, 5agj, 5hq, 5ht, 5up, 5za, 6aoi, 6arb, 6avv, 6bic, 6bih, 6biq, 6bql, 6cfz, 6cgw, 6cmr, 6cnh, 6cqe, 6fp, 6gr, 6xad, 6zah, 6zh, 6zr, 7age, 7zu, 8's es 9's too numerous.
Can.: 1ar, 2bn, 2cg, 2ic, 4cw, 4cl, 5go. Wud appreciate reports on 9ctt, 5-watt C. W. sigs.

By 6AFT, 7526½ Figueroa St., Los Angeles, Calif. (November)

2by, 4ft, 5adb, 5ado, 5ahd, 5akf, 5ama, 5be, 5de, 5hl, 5ht, 5hz, 5if, 5jc, 5kg, 5lg, 5lr, 5ph, 5uo, 5xa, 5za, 5zav, 5zax, 7aaj, 7abb, 7aci, 7adr, 7bcx, 7bj, 7eo, 7go, 7gy, 7io, 7it, 7ly, 7ot, 7qj, 7rd, 7sc, 7to, 7wp, 7zd, 7zo, 7zu, 8ab, 8aim, 8bda, 8dat, 8er, 8kz, 8wy, 8zz, 9aau, 9ahz, 9aim, 9aon, 9apf, 9avu, 9bjk, 9bly, 9bri, 9bun, 9caa, 9ccv, 9cjy, 9cte, 9cvc, 9dfh, 9dkb, 9dzy, 9eea, 9ekf, 9fv, 9mc, 9qr, 9zt.
Can.: 3cp, 5cn, 5go. Hrd on detector es Reinartz.

By 8BUM, ex 6CIU, 228 W. 2nd Ave., Columbus, Ohio

1alz, 1awe, 1bdi, 1bgd, 1bsk, 1bsp, 1bsq, 1bhk, 1bkg, 1cpu, 1cre, 1ol, 1pa, 1yb, 4aj, 4jg, 4jn, 5aie, 5ain, 5aot, 5cu, 5gi, 5ht, 5jf, 5lr, 5ni, 5un, 5uu, 5qq, 5qy, 5qa, 5vy, 5xv, 5xar, 5xa, 5za , 9aun, 9avn, 9apl, 9ayl, 9aji, 9avu, 9ahd, 9bqq, 9bxn, 9bov, 9bhn, 9bpu, 9bed, 9cll, 9ccv, 9ceh, 9cfi, 9cgu, 9cjc, 9cly, 9cpw, 9ctr, 9dsw, 9dhu, 9dqn, 9dhb, 9bxy, 9dge, 9djb, 9ehj, 9el, 9eq. All stns. over 500 miles, hrd on one tube. Pse qsl any 5 watts.

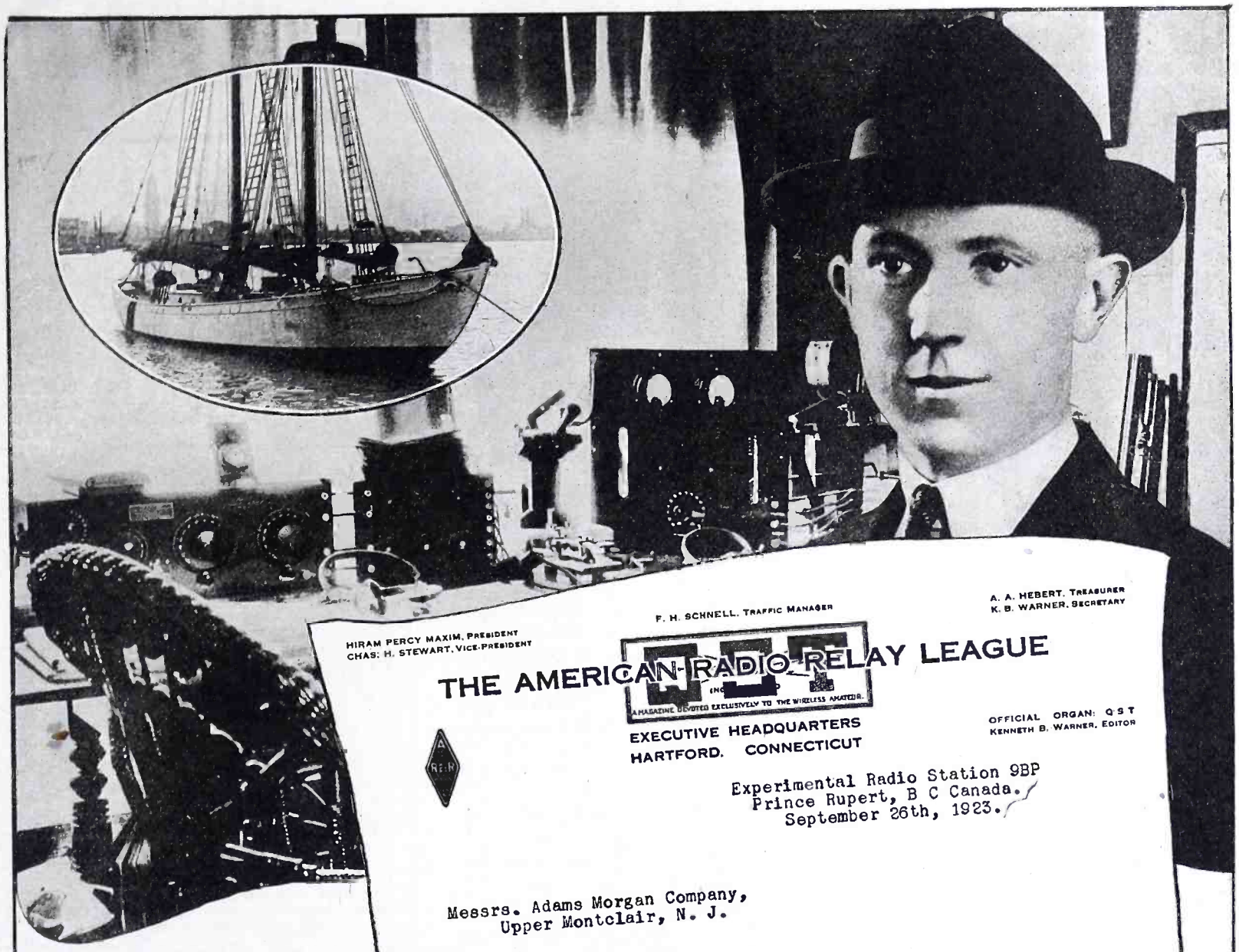
By 6ADH, H. D. Wilson, Box 8, Phoenix, Ariz.

1aaa, 1aud, 2ht (vy), 2adh, 3bgb, 4cd, 4za, 5cm, 5cr, 5fq, 5kg, 5lk, 5lm, 5xy, 5ow, 5adb, 5aia, 5agt, 5anl, 5anr, 5bcl, 5zav, 5kl, 5dn, 5akm (vy), 5lr, 5ma, 5kn, 5akn, 6acm, 6agh, 6ahp, 6ajd, 6ald, 6anb, 6aos, 6apq, 6aup, 6atc, 6azg, 6bci, 6bcs, 6brk, 6bmn, 6bpz, 6brr, 6bsy, 6buy, 6bvg, 6bvr, 6cax, 6ccr, 6cgg, 6cgw, 6cgd, 6crc, 6cjl (vy), 6ka (yy vy), 6lv, 6lm, 6pe, 6pi, 6pl, 6vd, 6ze, 6zh, 6zx, 6zy, 6zz, 7em, 7qc, 7sc, 7zd, 7zu, 7lw, 7wx, 7aeb, 8alp (vy vy qsa), 8anp, 8bsa, 8ced, 8cpq, 8zi (qsa), 8xan, 8zo, 9ap, 9cz, 9ig, 9sx, 9amh, 9apf, 9ahv, 9avu, 9ayj, 9bex, 9bbz, 9cbe, 9ccl, 9clr, 9daw, 9deg, 9dun, 9dxy, 9eeu, 9azg, 9cgm, 9eed, 9zt.
Can.: 1ar, 3bp, 3gk, 3xn, 3xx.

By 8CXI, Roy Wise, 258 East 8th St., Holland, Mich.

(1awe), (1bhk), 1bkq, 1bom, 1bsb, 1clk, 1cpn, (1crw fone), (1csx), 1er, 1fd, 1kc, 1oj, 1my, 1cb, 1yk, 1vo, 2acc, 2apy, (2bqh), 2bum, 2bxw, (2ccd), 2cee, 2cpa, 2crp, (2cxl), (2cuv), 2bt, 2cp, 2bg, 2bt, (2bm), 2by, 2el, 2gk, (2rk-icw), 2ts, 2wk, Can. (3bm), 3ph, 3pg, (3zt), 4hh, 9bx, 3ahp, (3auv), 3bei, 3bji, 3bnu, 3brf, 3ccu, (3as), 3bg, 3hg, 3lg, 3ml, 3pg, (3qw-spk), 3zm, 3zt, 4af, (4db), (4ft), (4jk), 4kw, 4mv, 4rh, 5bm, (5fa), (5fc), 5gj, 5hl, (5if), (5kp), 5kn, 5lf, 5lr, 5lu, (5nk), 5ph, 5pw, (5tj), (5uk), 5uw, (5zb), 5zm, (5abb), (5abt), 5ahr, 5akn, (5aic), 5amn, (5aiu), 5bnu, 6acm, 6age, 6alv, 6aos, 6avv, 6awt, 6beo, 6bnc, 6bvg, 6ceu, (6cfz), 6cgd, 6cgw, 6bh, 6ea, 6gv, 6nx, 7abb, 7agv, 7ahq, 7aci, 7co, 7ge, 7hg, 7sf, 7wp, 7zu.

Continued on page 48



HIRAM PERCY MAXIM, PRESIDENT
CHAS. H. STEWART, VICE-PRESIDENT

F. H. SCHNELL, TRAFFIC MANAGER

A. A. HEBERT, TREASURER
K. B. WARNER, SECRETARY

THE AMERICAN RADIO RELAY LEAGUE
(INC.)
A MAGAZINE DEVOTED EXCLUSIVELY TO THE WIRELESS AMATEUR.

EXECUTIVE HEADQUARTERS
HARTFORD, CONNECTICUT

OFFICIAL ORGAN: Q S T
KENNETH B. WARNER, EDITOR

Experimental Radio Station 9BP
Prince Rupert, B C Canada.
September 26th, 1923.

Messrs. Adams Morgan Company,
Upper Montclair, N. J.

Dear Sirs:-

I have advised you before that I am very pleased with the results of my "PARAGON APPARATUS" but here is another victory for "PARAGON APPARATUS" which I feel you will be interested to know.

The MacMillan Arctic Expedition which left Wiscassett, Maine on June 23rd. on board the radio equipped Schooner "Bowdoin" planned to keep in touch with the outside world by amateur radio. This they were able to do until they got North of Disco Island, Greenland. After going North of that point nothing was heard of the expedition. And all interested became worried at the ship's apparent silence. The Chicago Radio Laboratory on this account offered a duplicate of the receiving apparatus aboard the "Bowdoin" as a prize to the first amateur to get into communication with the Arctic Expedition. This prize I have had the honor to win with the aid of my PARAGON Type RA-10 Regenerative Receiver and PARAGON Type DA-2 Detector-Amplifier.

Since first getting into communication with the "Bowdoin" expedition(who are in winter quarters frozen in at Refuge Harbour, which is ten miles North of Greenland Latitude 78.30 North, Longitude 72.30 West) on September 7th. I have had a working schedule with the operator and have copied one 600 word and one 181 word press message from them addressed to the New York World, together with dozens of private messages from the expedition and a complete list of amateur calls heard (a total of 546 calls) by the "Bowdoin" from July 28th to September 20th. and have forwarded all of these messages to their destinations.

When you consider that the expedition has heard hundreds of amateur stations in the Arctic but that my station has been the only one with whom they have been able to communicate, I consider this quite a record for "PARAGON APPARATUS" and am glad to be able to advise you how proud I am of my receiving apparatus.

Yours very truly,
Jack L. Barnsley.

MacMillan's Link with Civilization

A Paragon Radio Receiver is the most dependable link between MacMillan's courageous explorers and a civilization eager to hear of their doings.

Read this letter from Jack Barnsley whose Paragon Receiver has been picking up these vitally important messages, picking up every one, and getting every word clearly.

A Radio Receiver could have no higher recommendation.

Illustrated Bulletins on Paragon Radio Products are yours for the asking.

ADAMS-MORGAN CO.,
2 Alvin Avenue,
Upper Montclair, N. J.

Tell them that you saw it in RADIO

CALLS HEARD

Continued from page 46

By 6WD, 3012 Modesto Ave.

1yb, 3co, 3tr, 4jk, 5ck, 5fk, 5nk, 5ps, 6pe, 6aed, 6ane, 6ceu, 6cjb, 8atp (qst de 9ac), 9bg, 9bp, 9cr, 9hc, 9ka, 9aim, 9azg, 9bsg, 9cfy, 9ctg, 9cvc, 9dge, 9dsw, 9edb, 9eky, wnp.

At 9CA, Dwight, Ill.

1af, 1ajx, 1aqm, 1arp, 1ary, 1boi, 1boq, 1bqq, 1ckp, 1cmp, 1er, 1gs, 1is, 1lt, 1si, 1yb, 6aos, 6bfg, 6bkx, 6ea, 6cnh, 6et, 6fh, 6fp, 6ua, 6xad-6zw, 7aif, 7gi, 7bf (?), 7sf. I keep the most detailed log in U. S. Details if you qsl.

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

1ajx, 1aol, 1rr, 2bqh, 2by, 2crp, 2rk, 2wr, 3ajd, 3bgg, 3btl, 3cc, 3iw, 3tj, 3mb, 4jk, 5abb, 5aew, 5agf, 5ahd, 5aic, 5aiu, 5alr, 5amb, 5ca, 5ch, 5fx, 5gj, 5lr, 5ph, 5qy, 5uk, 5xv, 5zav, 5zb, 6aak, 6aaq, 6adm, 6afz, 6age, 6ahf, 6ahp, 6ahq, 6aja, 6ajh, 6ajp, 6alg, 6alk, 6alv, 6amg, 6aoc, 6aoi, 6aos, 6avv, 6bbh, 6bcl, 6bcu, 6beg, 6beh, 6beo, 6bhk, 6bic, 6bih, 6bkx, 6blg, 6blh, 6blm, 6bnt, 6bnu, 6bon, 6bqb, 6brf, 6bsj, 6buf, 6buh, 6bui, 6bum, 6bur, 6buy, 6buz, 6bve, 6by, 6cab, 6cai, 6cbi, 6ccg, 6ccy, 6cdg, 6cgd, 6cgg, 6cgl, 6cgw, 6chc, 6che, 6chl, 6chu, 6cid, 6cix, 6cjj, 6cju, 6ckh, 6ckr, 6cls, 6cmm, 6dd, 6dk, 6et, 6fc, 6fy, 6gx, 6ii, 6ka, 6lt, 6lu, 6oh, 6pl, 6tc, 6ua, 6ux, 6zh, 6zah, 8aa 8abm, 8ada, 8adg, 8ahq, 8aib, 8aih, 8aje, 8ajv, 8alx, 8amg, 8apn, 8ard, 8atc, 8azh, 8bci, 8bda, 8bfm, 8bhn, 8bjy, 8bmm, 8brm, 8byn, 8cdz, 8ced, 8cei, 8cgx, 8chb, 8cmu, 8coj, 8com, 8cpd, 8crn, 8crw, 8cxi, 8dat, 8dbl, 8djf, 8dk, 8do, 8fm, 8hn, 8ii, 8oe, 8rn, 8tr, 8uf, 8xav, 8xe, 8yn, 8yx, 9aal, 9aaq, 9aau, 9aav, 9ac, 9aci, 9ack, 9ady, 9aen, 9afm, 9ahj, 9aim, 9ajv, 9akd, 9amb, 9amg, 9ami, 9amp, 9amu, 9and, 9any, 9aog, 9aon, 9ape, 9apf, 9aua, 9aui, 9avm, 9avn, 9avu, 9awi, 9awv, 9ayj, 9azg, 9baf, 9bav, 9bcf, 9bdh, 9bez, 9bf, 9bfi, 9bgi, 9bhd, 8bhn, 9bji, 9bjk, 9bly, 9bof, 9bpn, 9bqq, 9btt, 9buk, 9bxq, 9byc, 9bzi, 9cao, 9cbd, 9ccv, 9cfz, 9chc, 9chk, 9chn, 9clq, 9cly, 9ctb, 9cvv, 9cyf, 9dah, 9dcp, 9dct, 9des, 9dgk, 9dgv, 9djq, 9dky, 9dlf, 9doe, 9dpx, 9dro, 9dsw, 9dvw, 9dwn, 9dxn, 9dxy, 9eae, 9edb, 9eep, 9eer, 9efh, 9egu, 9ehg, 9ehn, 9ejz, 9elb, 9elv, 9fm, 9hg, 9ma, 9mc, 9mm, 9mn, 9nu, 9oy, 9uh, 9vc, 9vm, 9xaq, 9yam, 9yb, 9zg.

Can.: 2bn, 3cr, 3ni, 4cl, 4cr, 4dq, 4er, 4gh, 4hh, 9bp. 5 watts hr if it perks. Crds rec'd as ensd wi pleasure.

At 9DLF, Aneta, No. Dak.

(1cmp), (1boq), 1yb, 1adj, 1ary, 1ayt, (1bcf), (2ts), 2bqb, 2rk, 2bmr, 3ade, (3hs), (3ab), (3cah), (3aen), (4eb), (4hs), 4kc, 4db, 4aj, 4rm, (5uo), 5ql, 5xaq, 5nw, 5zav, (6arb), 6akz, 6beg, 6bnt, 6ol, 6ckp, (6bh), 6awx, 6cie, (6alv), 6cuz, (6aak), 6pl, (6bbc), 6cae, (6bui), (7cs), 7sf, 7aby, 7wa, 7ge, 7li, 7sz, 7la, 7gx, 7ae, (7aci), (7hg), 7aey, (8dlm), 8yae, 8bnw, 8sf, 8aqm, 8chj, (8bvu), (8bnh), (8ada), (8anm), (8gu), wnp, quite number times.

Can.: 1dj, 2bn, (2cg), 2be, 3aao, 3ni, 3nf, 3ia, 3adn, (3pg), 3yb, 3xi, (4er), (4co spk), 4dy, 4hh, 5ah, (5go), 5cn, 9bp.

By 6BCD, Oakdale, Calif.

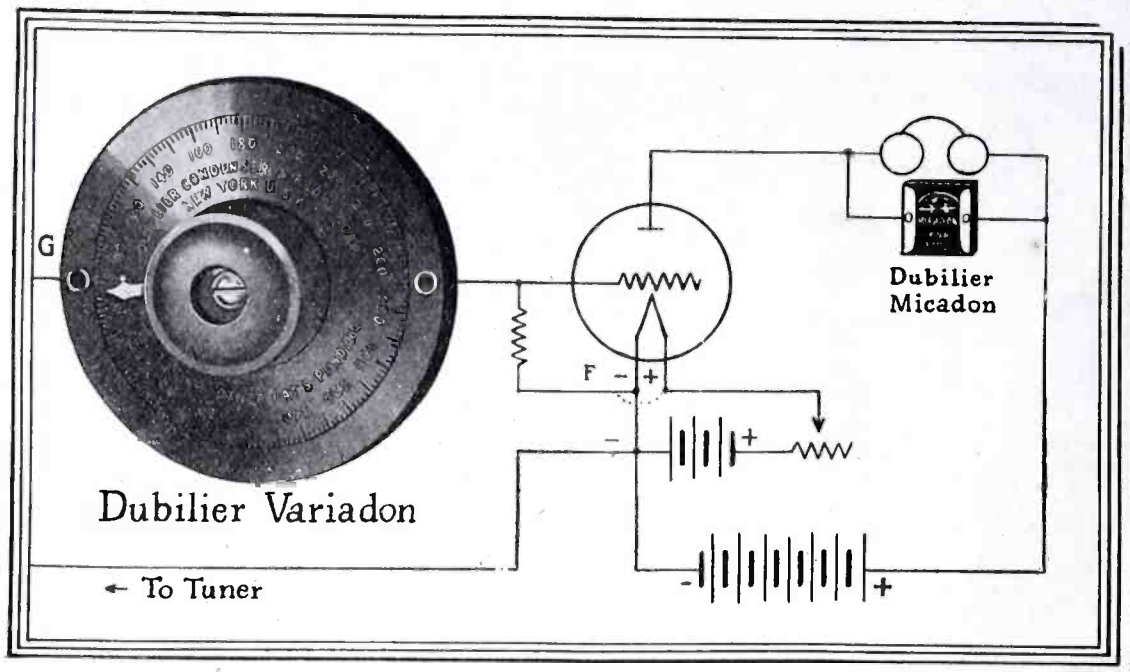
2hp, 3ajg, 3hc, 3hk, 3wg, 4ft, 4ku, 5abn, 5ahr, 5aic, 5air, 5aky, 5amh, 5ay, 5bm, 5ams, 5ek, 5fv, 5fx, 5hk, 5in, 5kc, 5nk, 5nn, 5oo, 5ov, 5px, 5ti, 5tj, 5zav, 5zb, 6ceu, 7aee, 7afo, 7aiy, 7ca, 7hc, 7it, 7ku, 7no, 7qt, 7qx, 7rb, 7sh, 7sz, 7we, 7ya, 7yl, 8afi, 8agp, 8aib, 8aih, 8alx, 8ame, 8amf, 8apt, 8aus, 8bcp, 8bda 8bfm, 8blm, 8bmb, 8bnk, 8br, 8bwz, 8bxx, 8bzz, 8cae, 8clo, 8coj, 8csy, 8cwu, 8cxw, 8czz, 8dac, 8daw, 8dg, 8dge, 8djb, 8fm, 8ij, 8jy, 8kg, 8kv, 8on, 8pl, 8pv, 8nb, 8qn, 8uf, 8vy, 8yn, 8yv, 8zz, 8zc, 8yf, 9aau, 9aav, 9aaw, 9afm, 9agl, 9ahq, 9aih, 9aim, 9alj, 9amb, 9ana, 9anf, 9ani, 9any, 9aou, 9ape, 9apf, 9aps, 9aqk, 9aua, 9avz, 9awa, 9awv, 9ayb, 9azx, 9bab, 9bav, 9bbw, 9bed, 9bez, 9bfm, 9bhz, 9bkf, 9bly, 9bmb, 9bnu, 9bol, 9bnp, 9bpv, 9bqf, 9bqk, 9bri, 9brk, 9bsj, 9bto, 9bu, 9bun, 9bwv, 9cbe, 9ccz, 9cfq, 9cfy, 9cjc, 9cmu, 9cgw, 9cns, 9co, 9col, 9cpp, 9cpu, 9cte, 9ctq, 9ctr, 9cwc, 9czu, 9czv, 9day, 9dew, 9dg, 9dge, 9dgn, 9dgv, 9djb, 9djp, 9dkb, 9dkq, 9dky, 9dlm, 9dqm, 9dr, 9dre, 9dwk, 9dx, 9dyz, 9eak, 9ee, 9eea, 9ejz, 9eky, 9elb, 9hn, 9erd, 9lz, 9mc, 9ox, 9tv, 9uh, 9ui, 9vc, 9vm, 9xg, 9yb, 9zt, 9yu, 9zg.

Can.: 3bp, 3ni, 3oh, 3tb, 4hs, 5cn,. All C. W. Any one hring mi 100-watt C. W. pse qsl.

By 6ASB, Melvin A. Russell, Box 653, La Habra, Calif.

3nf, 3xn, Can. 4cl, 5ql, 5xv, 5ek, 5zav, 5ado, 5zh, 5ul, 5jf, 5kc, 5lg, 5adb, 5kg, 5zax, 5akn, 5sk, 5ht, 5lr, 5zp, 5za, 5xap, 5abb, 6bpf, 6bnu, 6blm, 6bbh, 6zh, 6amg, (6bve), 6bh, 6cc, 6zx, 6nx, 6ccg, 6cid, 6it, 6bmy, 6aoi, 6afh, 6bua, 6ua, 6lu, 6bql, 6vf, 6buy, 6bon, 6bih, 6ajh, and many more, 7sy, 7zt, 7oh, 7zf, 7ln, 7zu, 7je, 7agr, 7aci, 7ot, 7qc, 7ks, 7aif, 7iy, 7ob, 7qd, 7akh, 7qj, 7fl, 8hv, 8zz, 8bci, 8tt, 8pu, 8wp, 9caa, 9cfy, 9eae, 9dte, 9zt, 9bjk, 9awn, 9bri, 9bg, 9vm, 9uh, 9ccz, 9amb, 9bu, 9bzi, 9bak, 9cui, 9cym, 9bwa, 9eea, 9dfh, 9bun, 9elv.

Continued on page 76



AT F, the filament terminal of the grid leak is shown connected to the negative side of the tube. Occasionally better results are obtained by connecting the grid leak terminal to the positive side of the tube.

CLEARING BY RADIO

Continued from page 10

time consumed in going to and from Nova Scotia, the *Tampa* was relieved by the *Modoc,* the latter sleuthing for large chunks of ice for a like duration of time. These alternate 15-day cruises continued during the ice patrol season. Last season also distress signals were answered and assistance was rendered the crew of the *Puritan,* wrecked at Sable Island. Furthermore, succor was extended to the crew of the schooner *Cluette,* off the coast of Newfoundland, this vessel and crew being 61 days voyage removed from their home port in Spain. Likewise this patrol ship destroyed several floating derelicts that were a menace to navigation and safety of ships in those waters.

Heretofore, the Canadian government has operated an ice-information service independent of the International Ice Observation and Ice Patrol Service. The Canadian authorities now furnish the United States Coast Guard cutter daily ice and weather reports from the government stations at Battle Harbor, Fogo and Bonavista. The Cape Race Radio Station likewise forwards ice reports received from trans-Atlantic traffic to the patrol vessel of the Coast Guard. Also the wireless station does all the broadcasting of ice warnings to steamers on the St. Lawrence River tracks.

The patrol vessel broadcasts ice information three times daily on a wavelength of 600 and 2,300 meters. Each message is sent three times, with an interval of two minutes between each transmission. The hours of this daily radio communication are 6:00 o'clock a.m. and 6:00 p.m. seventy-fifth meridian time. At 8:30 o'clock p.m. a radio message is also broadcast on 2,300 meters wavelength. This broadcast is sent at the request of the British Board of Trade for the benefit of vessels carrying only one radio operator. At 7:00 p.m. a radio message is sent to the Hydrographic Office in Washington defining the ice danger zone, its southern limits, or other definite ice news. Moreover, information on ice condition will be given to any vessel at any time when the patrol vessel is able to establish communication. Commandant W. E. Reynolds of the Coast Guard suggests that communication probably can be carried on throughout the patrol via the naval radio stations at Bar Harbor, Maine. It is suggested that vessels on patrol should, when feasible, send all reports by the Bar Harbor Radio Station, using 2,400 meters wavelength. The station at Glace Bay, Cape Benton Island, is used when Bar Harbor Station is not operative. The information thus disseminated outlines all ice spotted, its position, and probable drift of icebergs. Also this ves-

Continued on page 52

Continued from page 50

sel defines the limit of the ice territory and determines the most southerly iceberg. The data furnished the Hydrographic Office are broadcast by radio telegraphy from Arlington, Boston, New York, Norfolk and Charleston.

The information dispatched to the Hydrographic Office in Washington is usually sent to the naval radio station at Bar Harbor, Maine, first. The latter transmits the message by multiple addresses to the other radio stations, mentioned in the preceding paragraph, on a wavelength of 2,400 meters. The Bar Harbor radio-telegraph station "picks up" the message from the ice-patrol vessel, operating in the vicinity of Grand Banks, on a wavelength of 2,400 meters. The special radio call letters of ice-patrol vessels are KFOG. These call letters are not to be confused with the regular call letters of the *Modoc* and *Tampa,* the ice-patrol vessels. During the 1913 ice-patrol season, the *Modoc* and *Tampa* were on patrol duty approximately 2,688 hours or about 112 days. The radio-transmitting equipment of these vessels was in operation approximately 80 per cent of the time, sending a total of 121,915 words. This traffic does not take into account service messages which were in response to special requests from ships for information on ice conditions. Approximately 234,809 words were received by the radio-telegraph receiving instruments installed on these vessels during the 112 days. This computation does not include service messages and press notices. The greatest distance over which a radio communication was transmitted was 1,400 miles, from the cruise off the Grand Banks to Bar Harbor, Maine, using a 2-kilowatt arc transmitting outfit. On May 18, 1923, the wireless operator on the *Nieuw Amsterdam* copied the signals transmitted from the *Tampa* while the former was cruising in the English Channel, a distance of 1,980 miles. This particular message was broadcast at 8:00 p.m. on a wavelength of 600 meters, using a 2-kilowatt spark transmitter.

RADIO KFXX REPEATING STATION

Radio KFXX has been established at Hastings, Neb., by the Westinghouse Electric and Manufacturing Co. to re-broadcast programs transmitted from KDKA at Pittsburgh, Pa. The programs are received at KFXX on a 94-meter wavelength and then re-broadcast on a higher wavelength, approximately that of the regular KDKA broadcast. The programs are simultaneous from the two stations.

Short wave broadcasting will travel a longer distance than will a broadcast of a higher wavelength, provided the output of the transmitter be the same. One of the most astonishing facts discovered about the short wave was that it traveled farther in the daytime than in the night.

4-ELECTRODE TUBE

Continued from page 12

with the receiving aerial, and by means of this variable coupling the strength of the local oscillations in the receivers can be adjusted to its best values under any conditions. This coupling coil is short circuited when the switch is at "off" so as to allow short wave reception of spark signals. It should be noted that with any tube circuit generating oscillations that it is necessary to vary the reaction between the grid and the plate circuits for every considerable change in wavelength in order to produce oscillations of maximum strength. In designing a local oscillator, one of the chief points to be

C. B. Lax, Radio Operator of the "Frontiersman"

aimed at is to arrange it in such a way that the tube will generate stable oscillations throughout the whole range of the instrument without any alteration in the reaction between grid and plate. Although any well designed local oscillator will do so, yet the strength of the oscillations will vary considerably on different wavelengths, hence the advantages of the variable coupling between the aerial and the local oscillator, which allows the strength of the local oscillations in the aerial to be controlled.

As the Marconi handbook says, "Thus it will be seen that the complete Marine Receiver is a somewhat complex and costly piece of apparatus." This equipment is in charge of C. B. Lax, an expert operator formerly an instructor in the Marconi school.

THE JINX OF THE BOBOLINK

Continued from page 22

the Reverend Sarah Hotstetter's sermon "Woman the Goddess; Man the Beast."

"By th' holy whiskers of Trotzky! You git out'a here, both a' you!" I yells; then grabbin' the mutt Elmer by the scruff of his neck, I slams him with a teeth-jarrin' bump against the opposite bulkhead.

"You wretch!" snarls the old she-wolf of the *Bobolink*. Snatchin' up a heavy insulator, she lands me a crack over my *dumbell obligata* that makes me see a shower of shootin' stars, followed by nothin' at all.

TWO days out from the Canal, when on Ziegfield Stubbs' morning watch he and I are sittin' under a ventilator alongside the singing turbine havin' a checker battle on a greasy old home-made board which is kept hid behind the feed-pump when not in use.

Ziegfield, glancin' up at the gauge-board overhead, lets out a yell:

"My gorry, lookit that steam—down twelve pounds!" Fumin' an' sputterin' he dashes out into the fireroom, and I, like a fool goat, follows. Steppin' out of the alleyway between the boilers, we see the fireman has one fire out, probably to change a burner tip, an' is tryin' to start it again by squirtin' the hot crude oil from the burner nozzle onto the red glowing fire-brick in the furnace.

"Hi there, ya idjit—shut that off!" yells Ziegfield, furious-like. "Git a torch! Git a torch! Do ya want a blow-back—

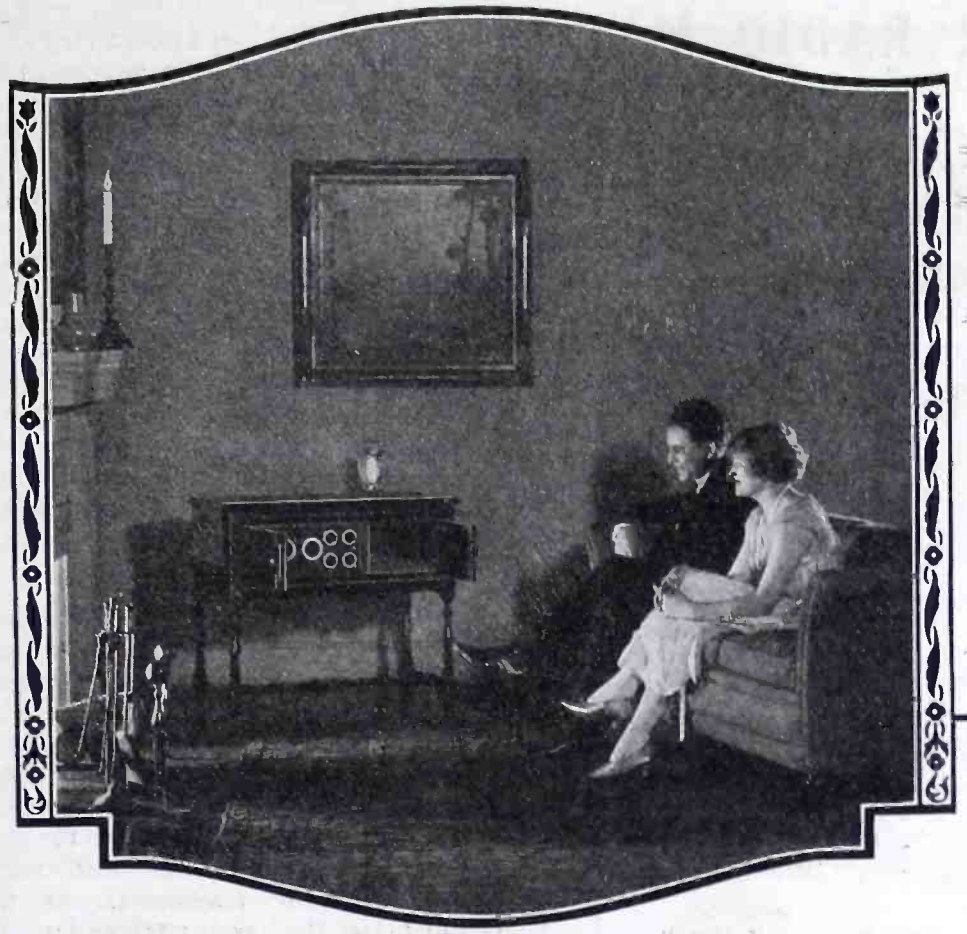
At this instant, the furnace full of hot crude oil takes off with a terrific *w-h-o-o-m*! that kicks out the doors of the boiler-front an' sends us all skiddin' across the floor-plates in a blindin' swirl of flame an' fire-brick, while from overhead comes the roar of a steam-line blow-out.

"Goodnight!" howls Ziegfield — a dancin' Tasmanian devil painted with crude oil an' ashes, he grabs his monkey-wrench an' vanishes into the smoke, while I spit out a couple chunks of hot brick an' crawl up topside through the steam an' smut.

Arriving on the boat-deck, I observes Adolph Zokur II up on top of a pile of life-rafts forward my shack excitedly grindin' a picture of the big four-masted ex-German square-rigger *Scharmbeck*, which is standin' close abeam; and as we lunge and roll broadside to in the heavy sea with our engine stopped, our grimy young Greek cameraman gradually swings his machine around aft, following the big windjammer and at the same time sweeping the decks and topwork of the *Bobolink*.

Shortly after gettin' into my coop an' rubbin' off some of the oil an' soot

Continued on page 58



And now, every home can have an Aladdin's lamp. A turn of the dial, and these fireside listeners find themselves instantly at the very footlights of a symphony stage—cheering a presidential candidate in a far-off city—thrilling with the vast throng at a Varsity game!

Choose the Right Receiver And You Can Choose Your Program—

C & W Receivers have proved by actual test to be more highly selective than any other instruments in their class. Owners state they get distant stations without interference from powerful local stations---enjoy the broadcasting programs of their choice.

The C & W Console illustrated is a highly selective 4-tube receiver, a beautiful furnishing for your home as well as a wonderful means of pleasure and entertainment.

Completely self-contained in a handsome Walnut Finish Early English Period Console, with tubes, batteries and Magnavox loud speaker all in cabinet. Finest materials, simple sturdy construction---an efficient moderate-priced instrument - - - - - - - - - - - - 325.00

CUTTING and WASHINGTON RADIO CORPORATION, Minneapolis, Minn.

Pacific Coast Distributors:
Western Radio, Inc., Los Angeles
Alexander & Lavenson, San Francisco
E. W. Murray Lighting Co., Spokane
Pacific Coast Representative—J. I. Hermans, 585 Mission St., San Francisco

ASK YOUR DEALER TO DEMONSTRATE

Cutting and Washington

Standard of Excellence in Radio Since 1914

Tell them that you saw it in RADIO

Continued from page 56

plastered all over me, I gets a ring from the bridge to warn any nearby ships that we are lying hove to.

Upon lighting up my tubes, however, I discover a dead stillness on the ether, such as follows an SOS call. I waits a few minutes; then beginnin' to wonder if some ship *is* in distress, I steps in with a cautious CQ an' asks what all the earthquake is about.

"Where ya been—asleep!" crashes in a high-pitched oil-tank Hertz. "Didn't ya copy that QST a while ago?"

"No, what was it?" I replies.

"Here, copy!" comes back the tanker brasspounder; and he hands me the "largest landslide" that everybody has already heard about.

OLD Pirky turned in a message to New York asking for orders; but since a couple hundred other skippers have done the same thing there is now such a deadlock on the air that it looks like I'll have to wait a week to slip a dash in edgewise. Finally I resolves to come on wide open an' try to bust through to somewhare; but while screwin' up my transmitter to full power I does the hammy trick of gettin' a turn of my phone-cord around a clip on the quenched gap—an' when I shove on the key there is a crash like all of Ziegfield Stubbs' boilers have exploded in my ears, followed by a sensation that I am a' aviator full of bootleg writin' my name in th' sky over New York.

When Ziegfield with a bucket of ice-water brings me to some time later lyin' under my desk with my head back of the motor-generator, I finds nothin' remainin' of my phone-cord but a streak of charcoal, while my four vacuum-tubes have that glassy six-fifty-gonetohell look that we all know too well.

That settles the communication department of the *Bobolink* the rest of the way to Panama. Two nights later we creep into the bay at Balboa, expecting to find it choked up with a swelling fleet of delayed ships. We fail to see more than two or three anchor lights, however, and at daybreak we discover the harbor is empty save for a deep-loaded Tide-Flat oil-tanker, a dirty Jap tramp with a list, an' a rust-streaked freighter of the Dollar-Squeezer Line. By this time, like old kid Marcellus, I am gettin' a strong hunch that somethin' is rotten in Denmark.

As the sun comes up glowing and hot from beyond the distant Colombian hills, the port doctor and canal pilots come out to us in their speedy white launches.

"How is the slide?" are our first words, as the pilot puts his white ducks over the rail.

"There is no slide," he replies, wearily, as if his tongue was sore from repeating this thing.

Continued on page 60

Continued from page 58

"There is no slide!" echoes old Pirky an' a dozen others, astounded; then everybody turns loose a barrage of black looks in my direction.

"Have some strawberries, Sparks!" sneers old Pirky's kid Elmer, sarcastic-like.

"This is an outrageous sort of joke!" fumes the old she-wolf of the *Bobolink*, angrily. "Fred, you will remove that man from the radio room and let Elmer do his work the rest of the way to New York."

"How about that broadcast from Balboa?" I demands, coolly.

"It is a forgery," replies the pilot. "Balboa has been shut down five days for the installation of new equipment. That message was sent out from some ship; and eventually it will be known from what ship. The Canal army officials and the naval radio are investigating every vessel passing through the locks—here comes their boat, now."

Glancin' over the rail, I see a fast gray motor-boat full of army an' navy gold stripers, and one civilian gink, comin' alongside. Directly they are aboard, a couple of them carrying bundles of charts an' papers. Callin' old Pirky aside, they all go up topside to the chart-room, while I return to my shack with a kind of ominous feelin' that somethin's goin' to happen.

And directly it does. Thirty minutes later I am called up into the chart-room, where I am confronted by five hard faces an' a pair of handcuffs.

"Mr. Jones, you are under arrest," announces the king-pin of the gold-stripers, steely-like. "You are charged with originating and broadcasting this false radiogram of the Culebra slide, and with forging the call letters NBA as a signature."

"Say, look here, how do ya git this way!" I demands, backin' off. "Show me how you do your stuff!"

The gold-striper pauses a moment.

"Yes, I'll show you," he snaps. "When you began to transmit that message the naval listeners here on Ancon Hill realized at once that it was forgery and they applied their radio compass to your signals, while by quick action on the wire to Cape Mala we obtained another bearing on you from that station. It fortunately happens that the destroyer *Zane* and the scout-cruiser *Omaha*, which are lying off the coast of Costa Rica carrying on some static experiments, became suspicious because your signals seemed too strong to be from NBA and also took bearings on you. From Balboa your signals bore 265 degrees true, from Cape Mala 283, from the *Zane* coming out of the Gulf of Nicoyo 190 plus, and from the *Omaha* off the Grande del Terraba River 242 plus. These bearings coincide accurately in a point in the Pacific in Latitude 8-31 North and 28-28 West. By reference to the log of the *Steel*

Bobolink and a dead-reckoning calculation, we find this ship precisely in this position at 9:02 A. M., July 16th—the time when the false broadcast was completed."

For a minute, I am too dazed to say a word.

"There's somethin' wrong with those bearin's," I sputters, finally.

"You might claim that if we had only two of them—but not when you've been caught on four compasses, and the readings agree as these do," snaps the gold-striper, pointing to the chart, where the four lines have been laid down.

"It's phony somewhere," I insists, desperately. "That message never came from this ship."

"That's for you to prove," returns the gold-striper, curtly. "Mr. James, the handcuffs."

The investigators were first going to pull me off the ship; but finding they have to take me to the States for a preliminary hearing before a radio inspector, they decide to keep me aboard the *Bobolink* with a guard, while a navy gadget is given special detail to pound the brass on the run from Cristobal to New York.

During the eight days of this passage I don't sit around an' bathe the deck carpet with tears, for by this time I have got a couple of ideas. Being allowed visitors, I call in Ziegfield Stubbs and instruct him to fetch me a certain book out of the ship's library.

"Now, Ziegfield," I tells him, when I have looked into the book and found what I wanted, "After supper this evening you swipe th' sugar bowl off the saloon table—the one up at old Pirky's end—

"My gorry, Sparky, I've jist thought of somethin'!" busts out Ziegfield, excited-like. "That German windjammer! Them navy compassers could be afoul of him, because he was close on us that mornin', an' Zokur's movin' pitchers'll prove it!"

"I ain't forgot that," I replies. "The first chance you get, go back into the crew's quarters an' gather in every foot of Adolph Zokur's picture film you can find, and bring it up here."

The next morning the steward gives the saloon googoo a black eye over the missin' sugar bowl, believin' th' flunky has broke it an' threw it overboard, while Zokur II sets up a terrific howl over his stolen celluloid treasures; but since Ziegfield has passed all these things into my stateroom through a outside porthole, neither my guard nor anybody else dreamed I had them stowed under my bunk.

Upon our arrival in New York, where the front page of the newspapers already have me nine an' nine-tenths of the way into a tiger-striped uniform playin' rock-pile billiards with safe-crackers an' counterfeiters, I am visited by a officious young law-twister lurkin'

behind a pair of Harold Floyd spectacles, who has been sent down by my old friend kid Cunningham. This bird starts in explainin' how he's goin' to pull off a lot of phony black-is-white stuff to save me from sojournin' the rest of my life behind the gray stone walls.

"Say, look here, Bone-Shells," I cuts in on him, short-like. "Here's what you have to do: First, get me a copy of the 1916 edition of Arthur Bollard's book "Days and Nights on the Isthmus," then on the morning the big show starts in the radio inspector's office, have up there without fail Ziegfield Stubbs, his oiler, fireman, old Pirky's kid Elmer, the black-gang's Adolph Zokur II, a finger-print expert, a movin' picture machine an' a operator for it, and the log of the *Steel Bobolink*. Take this strip of negative motion-picture film I got here an' have a positive printed off it; bring it up also. Then we'll see who gets th' strawberries."

TEN o'clock in the morning, two days later, we are all assembled in the radio inspector's hangout down in the Battery customhouse—Elmer Pirky being accompanied, of course, by the kaiserin. In the opening scene of the first act, the army and navy gold-stripers show their charts, compass bearings, and the *Steel Bobolink's* position.

"This seems pretty conclusive evidence," observes the radio inspector, givin' me the cold eye. "What have you to say in your defense, Mr. Jones?"

"Even so, I didn't send out that radiogram," I says cool-like; then I turns to the king-pin of the gold-stripers. "That fake broadcast was sent out at 9:02 A. M., wasn't it?"

"It was," he replies.

"All right. I can prove by Ziegfield Stubbs, his oiler, an' his fireman, that from 8:30 to 9:05 I was down in the engine-room—er—helpin' Ziegfield to analyze a test-tube of boiler feed water—

"Huh—yuh can't prove that by *me*, though!" breaks in Adolph Zokur II, after exhangin' a quick glance with Pirky's kid Elmer. "I was cleanin' oil pans under the turbine, and you were sittin' under the ventilator playin' checkers with the third assistant until the blow-back in the fireroom, which

was *before* nine o'clock. You went up then, and I never saw you after that, an' neither did anybody else in the engine-room!"

There is a tense silence, except for the grittin' of Ziegfield's teeth as he glares bloodthirsty-like at Zokur II.

"All right, we'll drop that a minute," I says, recovering myself; then I turn to the finger-print expert, whom Bone-Shells has brought, according to instructions.

"Will you take prints of both that snipe's thumbs, please." I points at Elmer Pirky.

"Whaddaya tryin' to do!" snarls the kid, surly-like, as all eyes turn toward him. "Ya think you're goin' t' hang this on me just because I'm a radio amateur and happened to be on board with this Jones guy!"

"Indeed, the idea!" exclaims the old-she-wolf of the *Bobolink*, ferociously. "What does my Elmer know of Governor Belloc and stories of earth eruptions?" He is too innocent and open-minded even to think of such a cunning, deceptive piece of forgery!"

"You're right, old rock jaw," I returns, coolly. "He didn't write it—he hasn't got brains enough."

"Come here and hold out your hand" breaks in the finger-printer, curtly, motioning young Pirky to a small table, where he has a couple of sheets of white paper, together with ink and roller. Reluctantly, Elmer Pirky comes forward, the finger-printer smears his left thumb with ink and rolls it over one of the pieces of paper on the table; then the same with the other.

"Now," I says, when this has been done. "I've got a book here by Arthur Bollard called "Days and Nights on the Isthmus," which it won't be hard to prove belongs to the ship library on the *Bobolink*. Page 173 has been torn out, as you can see, while here on page 175 is a thumb-print made by dirty, greasy hands. After looking at some prints on our saloon-table sugar bowl, I figure these are the same."

"They are of this Elmer Pirky," replies the finger-printer, who has taken the book. "They are unmistakably identical."

"Sweeto!" I replies. "Here's another copy of the same book, bought by Bone-Shells yesterday morning. This book is a story of the Isthmus of Panama and of the Canal, and on page 173, which has been torn out of the other one, is a copy of a telegram that was sent from the governor of the Canal Zone to Washington, D. C. on the morning of September 18, 1915, the date of the big slide that actually did close the Canal for seven months. And, except for the name of the governor, that telegram is word for word the forged message that was sent out on the morning of July 16. It was copied out of that book!"

"Baww! I never done it!" blubbers Elmer Pirky, runnin' to his mother. "Make him stop! He's a liar and a crook!"

"Indeed, I shall!" snarls the old hag, advancin' on me, menacin'-like. "You have gone far enough, you atrocious wretch! What reason on earth could my darling Elmer have"—

"Little enough reason—simply his and your grudge against me," I cuts in, grimly. "As for the idea of the fake message, I figure it came from the press report I copied and put out in the ship's newspaper a few days before about a small slide in Culebra Cut—then the finding of that telegram reproduced in Arthur Bollard's book"—

"This seems a tangle of circumstantial evidence," interrupts the radio inspector, irritatedly. "I don't see that you have much of a case here, Mr. Jones."

"I'm not quite through yet," I replies; then turning to my motion-picture operator, who has already plugged his projecting machine to a lamp socket, I pick up a strip of film.

"Come here, Zokur," I says to the wiper, showing it to him. "Do you know this?"

"It's mine—you stole it!" yells Zokur II, holding the end of the film up to the light. "It's the picture I took of the big sailing ship we met on the way to Panama!"

"Correct!" I snaps. "Now, as the log here of the *Steel Bobolink* proves, we had this square-rigger abeam at exactly 9:00 A. M. on July 16th. It's funny you could be below cleanin' drip pans under th' turbine and at the same time up here on the boat-deck taking this picture of the *Scharmbeck*. But that doesn't matter. Pull down the shades."

The room is darkened, while the operator threads the film, lights his arc lamp, and focuses his objective lens on the opposite white plaster wall. Then there is a click and a whirr and the picture begins.

It isn't much of a film classic, but we can see the big ex-German windjammer standing down on us under a cloud of white canvas, and as she passes by close on our starboard beam, the picture gradually shifts, following her, until most of the boat-deck and the upper part of the wireless shack on the *Steel Bobolink* become visible in the foreground.

Except for the whirring of the projector and the hiss of the arc lamp, there is no sound in the inspector's office; then a flock of astonished gasps arise, as in the picture Elmer Pirky is seen to slink out of the port door of the *Bobolink's* wireless house and go shufflin' off guilty-like down the deck, while I come up the ladder on the starboard side and go into the shack.

"Waww!" bellers the kid, as the end of the film flicks through the machine and the plaster-wall screen flashes up in the white light. "My ma told me to do it—she had read the telegram in the book! It was only fooling!"

"Ahem, harrumph! Have some strawberries," I says to Pirky & Co.

And so that was that.

REMARKABLE RECEIVING SET

Continued from page 13

size of wire is No. 26. With this size the windings and the necessary separation between them will occupy about 5½ in. of the tube, making a 6½-in. tube a useful length.

The condensers related to the tuner are both in parallel with their respective windings, that for the primary being of 31 plates and that for the secondary of 7 plates. The latter gives ample latitude in tuning, and needs no vernier. It is this condenser that is the principal tuning element of the set. One finds the station with it and then refines the reception with the other controls.

The crystal used in the set observed was of galena. Argentite had been used with good results. The arrangement of the crystal was in no particular special.

The amplifying transformer secondary is shunted by a fixed condenser of .0005 microfarad. If such a size is not at hand, two .00025 grid condensers in parallel will serve equally well. Like the fixed condenser associated with the potentiometer, this element contributes its part to the general success of the scheme.

With a proper antenna, the set is a good one at bringing in the distant stations. As heard by the writer, the antenna was 100 ft. long by 46 ft. high, and it was reported that with that equipment Salt Lake City, San Francisco and Portland, Oregon, had been heard at Pasadena, California. Mountain ranges intervene in all these receptions, so that the record is a good one. I have no knowledge whether that is the limit of the set's ability, but fancy not.

In the foregoing circuit description, the facts are as actually seen, for example as to the *B* battery potential. There is no reason, however, why a higher voltage can not be used to advantage if it is available. If the tubes are amplifiers, up to 100 volts may be used. If they be power tubes, say VT2's, up to 350 volts may be used. It must be said, in justice to Mr. Nichols' accomplishment, that the use of 66 volts gave all the volume needed for the usual size of room, and in the demonstration the final output of sound came from a phonograph with a pair of receivers clamped to the tone arm. One might expect a slightly larger volume from a regulation loud speaker.

A *C* battery associated with the audio-frequency tube is composed of either one or two dry cells and is for the purpose of biasing the grid of that tube. It is poled with its negative or zinc terminal toward the grid. One cell is used when the *B* battery voltage is 66 and two when it is 100 volts.

It is interesting to pass the eye through the circuit of Fig. 1, in search of any relation that can accomplish regeneration. None seems to appear; cer-

tainly no regeneration that is accomplished by means of inductance variation. The three places in the circuit where inductive coupling exists at all are places where the coupling is fixed. Nor does there seem to be any relation that will bring about capacitive regeneration, so that it seems a fair presumption that none occurs. If it does not, the set is more remarkable than it appears at first sight, for then we have to compare its performance with that of any other non-regenerative receiver, with the result of greater credit to this.

But though there is no provision for regeneration by the actual inclusion of a tertiary or tickler coil, there is the possibility of a sort of inductive reaction that it is well to guard against. It is in the relation of the honeycomb coil to the primary and secondary windings that actuate the crystal. Therefore it will be well to place the turns of the honeycomb coil at right angles to the windings in the crystal portion of the hookup, thus preventing any inductive action between these turns.

INTERFERENCE

Continued from page 16

namely, 1000 cycles per second, it has a frequency equal to three times the fundamental frequency, also one five times, seven times and so on. In this case most of the energy is in the fundamental frequency, but there is a considerable amount in the component of three and five times the frequency. As we go up in the scale of frequencies of the components the energy content of the components decreases. However, this simply shows that even in a C. W. transmitter there are a large number of frequencies transmitted with the added possibility of more interference.

There are, of course, other reasons for interference. This discussion takes the matter up from the transmitter point of view and points out the interesting and not often mentioned point that a radio transmitter of any description, which sends signals, sends them at a number of different frequencies which include the fundamental assigned carrier frequency of the station, and a number of side frequencies. Interference then is often caused by the side frequencies of different stations overlapping.

FILTER FUNCTIONS

Continued from page 14

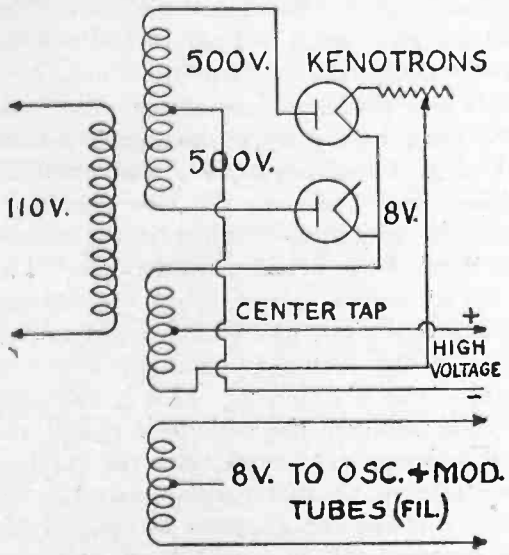
value of X in this last expression, we get a value for the inductance of the coil in henries.

The condensers were 1mfd. capacity each and rated at 1750 volts. Such a filter will practically eliminate the hum from the rectified a.c. supply.

Generator ripples are usually of a higher frequency, enabling the use of much smaller inductances.

We think that with this short discussion the experimenter should be able to "iron out" the ripple in his d.c. with success.

Our d.c. supply is now practically pure, a requisite for a good radiophone. We shall next take up briefly the subject of modulation.



Winding for Transformer Feeding Kenetron Rectifier

In connection with the author's article in the January number, it should have been stated that when kenetron rectifiers are used it will be necessary to employ a separate filament heating winding on the transformer. This winding should be similar to that used to supply filament voltage to the oscillators and modulators. The separate winding is required because the positive high voltage is taken from here. The connections are shown in the accompanying diagram.

LOW WAVE TUNER

Continued from page 26

Mount all the instruments on the rear panel. The bushings shown in Fig 10A were used to mount the variometers. See that they are exactly in line with the front panel. If they are not in line the holes may be enlarged sufficiently and by the use of some washers they may be gotten in line. If any changes are made in the parts be sure that L_3 is no closer to L_1 than L_2 is. If they are much closer there will be too great a coupling between the coils L_2 and L_3, which will have a detrimental effect. There is some coupling between these coils which seems to have a beneficial effect which I found by mounting the coils on a board and sliding them around. I found that if they were too close there was a bad effect and too far away there was no benefit.

The primary condenser C_1 was mounted in the upper left-hand corner. The grid variometer, V_1 was mounted below it. Next to C_1 was the series parallel switch and below it the switch to control the primary inductance. The coupler was in the middle. On the top opposite the ser. par. switch is the switch to cut the secondary condenser C_2 in and out of the circuit. This is necessary for as soon as the switch is closed the wave jumps 60 meters with the condenser at zero (actual measurement). Below this are the contacts to control the inductance of the grid load coil, L_3. Next to this is the plate variometer V_2. This controls the regeneration. Above this is the vernier condenser used for tuning the higher waves from 230 meters to 800. Across from this is the Bezel or window for the tube, which is merely ornamental, as the tube is mounted in front of the variocoupler. Below this is the vernier rheostat.

In order to operate the vernier attachments on the rheostat and condenser it was necessary to utilize a piece of 5/8-in. rubber tubing with a piece of 3/8-in. rubber rod turning inside of it for operating the vernier. The construction is shown in Fig. 9. Pieces of 3/16-in. brass tubing were used for the shaft with a piece of 1/8-in. brass rod for controlling the vernier. Two pieces of 1/2-in. hard rubber rod 3/4-in long were drilled; one to fit the 3/16-in. tubing and the other to fit the shaft of the condenser. 6-32 screws were used for set screws in this case. The pieces of rod were placed in the tubing and then drilled and tapped. The 3/8-in. rubber rod was drilled clearance for 1/8 in. on one end and the other end to fit the shaft of the vernier. 2-56 screws were used for pinning the rod in place, as locknuts and threads were found to slip. One of the pieces of 1/2-in. rubber rod should be placed on the condenser shaft, then the 3/8-in. rod placed on the ver-

nier shaft and pinned. The other end may be placed on easily now. The same procedure should be carried on for the rheostat control.

A Remler-moulded socket was mounted on two pieces of hard rubber rod 1⅞ in. high near the variocoupler. Originally it was mounted behind the rheostat, but this was found inefficient, as the long grid lead raised the capacity of the circuit and thereby the wave. It even caused a bad hand effect, just what was sought to eliminate. It is mounted in this way to keep away from the rubber rods, as the space is rather close. This height was chosen as the grid condenser fitted exactly from the binding post on the variocoupler to the binding post on the socket. The socket springs were soldered to the screws. I had one socket which became noisy because of loose connections at this point. I discarded it because of the trouble of removing it to tighten the nuts. The soldering remedies this.

The necessity of using pigtail connections all over is important, especially in an oscillating set, as any loose sliding connections cause a scraping noise, especially on a variometer. The switches, variometers and condensers were all pigtailed.

The picture of the front of the panel gives an idea of the neat appearance of the set. This is an important factor in the sale of any set. The use of the different dials and switches is clearly shown in this view. The view with the panel removed shows the position of each unit and the method of mounting the socket. The piece of ½-in. angle brass on the bottom of the picture serves to keep the panel rigid and to hold the board to mount the variocoupler.

The rheostat had to be mounted on a small sub-panel. This was necessary as it was a vernier type and could not be reversed or placed on the back of the rear panel, as it would stick out too far. The lower rubber rod was cut in half and threaded to hold one edge of the panel. Two other rods were used to hold this panel rigid. The method used is shown in the illustrations. A Bradleystat or a Filkostat may be used if desired.

The rubber rods for support should be cut 9 in. long. If a stop is placed in the lathe they may all be cut accurately. When the rod for the rheostat is cut in half and drilled a small piece of ⅛-in. bakelite is placed in it so the exact length of the other rods may be obtained.

The side view shows the bearings for the shafts (Fig. 5) and their use. The rubber rods for the controls show up clearly here too. The method of mounting the binding posts may be seen to an advantage here. The aluminum shield and method of fastening the two panels together is also shown.

The top and bottom views of the set were taken before the tube socket was moved, but they give a general idea of the construction. During construction these illustrations should be thoroughly looked over along with the drawings and instructions.

The set should be all assembled be-

fore wiring. If something is out of line or the shaft doesn't turn true it may be moved about by drilling the mounting holes larger and using a washer on each side of the panel. The unit may then be slid around until it is in line. After everything is O.K. the front panel should be removed to wire the set.

Wiring

BUS-BAR wiring should be used throughout. This is not only better mechanically but electrically also and looks neater. The grid and plate wires should be as short as possible and away from the other wires. The diagram in Fig. 12 should be studied. It will be noted that the fones are in the filament lead. This was found the best place after experimenting. A .001 mfd. micadon was shunted across the fones and a .002 mfd. micadon shunted across the *B* battery. It is impossible to use the same *B* battery for the amplifier. It is well worth while to use separate batteries for this purpose. No grid leak was used, as it was found detrimental to an audiotron. However, if hard tubes are used it is necessary to use one. It may either be connected across the grid condenser or from the grid down to the filament lead.

Operation

AFTER the set is wired the windings should be gone over to see if everything is right. The set is then ready to try. Be sure the rheostat is off before putting the tube in. If the set does not oscillate when the plate variometer is increased reverse the two leads. The set should readily oscillate over the whole scale.

To use the set for waves up to 230 meters use about twenty turns of grid-loading coil L_3. Throw the secondary condenser out of the circuit. Use about the second or third tap on the primary coil with the condenser in series and the coupling rather close. Cause the circuit to oscillate. Use the grid variometer and the primary condenser. Tune by the zero beat method. That is, a click will be heard when the primary and secondary circuits are in resonance. The click is caused by the aerial circuit absorbing energy faster than the tube can supply it. There is no need to change the adjustment of the plate variometer if it is placed so that the set will oscillate over the whole range. This is unnecessary because this adjustment is taken care of by the primary condenser when it approaches the resonance point. Tune the grid variometer until a signal is heard, keeping the primary condenser above the resonance point. Decrease the primary condenser, and, as it gets near the resonance point, great amplification results.

For tuning from 230 to 900 meters set the grid variometer at maximum.

Continued on page 72

The WANDERING MINSTREL of TODAY

HOW far have we progressed from the days when the minstrels, singing their self-composed ballads to the accompaniment of harp or lute, or telling their stories illustrated with crude mimicry, wandered from castle to castle in old England furnishing to the nobility, practically the only entertainment available.

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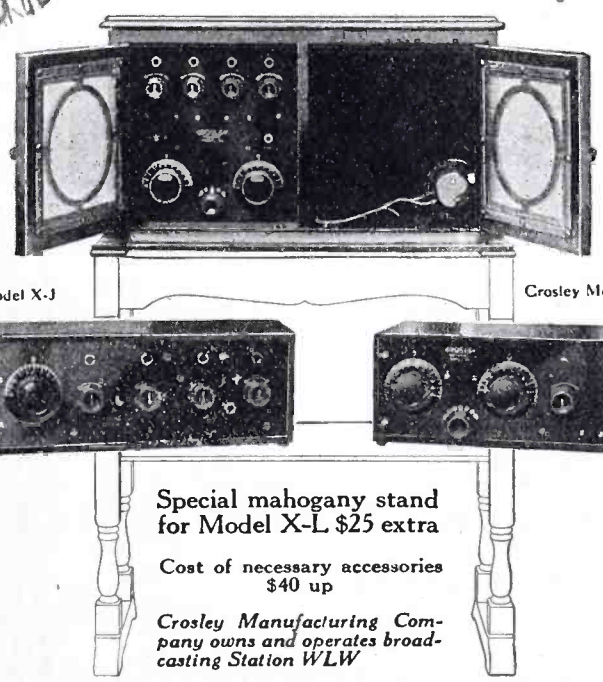

Crosley Model X-J

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Model VI—$30. A wonderfully efficient two-tube set, one stage of Tuned Radio Frequency Amplification and Detector.

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Continued from page 70

Connect the secondary condenser in the circuit and adjust the primary condenser in the same manner, using all the grid-loading coil, tuning the primary condenser and the secondary condenser this time. A little skill is necessary in operating, but this comes by practice.

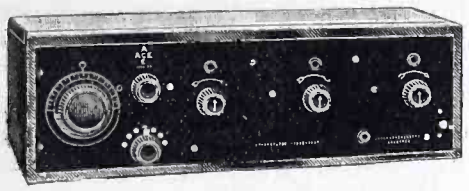
A point of coupling will be found for the low waves and another point will be found that works best for higher waves. I found these two points were about 90° apart. This is caused by the coupling between the variocoupler and the loading coil. A point of minimum coupling will be found. This is very important, as the set tunes broad if this point is not found. All the circuits are neutralized when this is found.

There are three types of feed-back, resonance feed-back, capacity feed-back, and the tickler feed-back. Capacity feed-back is not desirable, as capacity in a short-wave set is very inefficient and capacity should be kept away from, so I discarded this in designing this set. The tuned plate circuit or resonance feed-back is efficient and is used on most sets. But there is no coupling between the grid and the plate circuit other than the capacity between the grid and the plate variometers. The combination of tuned plate circuit and feed-back, therefore, is most efficient and desirable, so it was used.

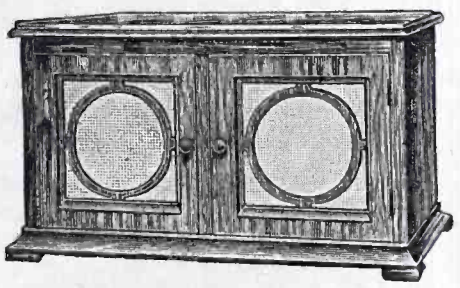
The purpose of putting the grid variometer down in the filament circuit is to keep capacity out of the grid. The voltage of the grid is raised if the variometer is on the grid lead, but this advantage is offset by the increased capacity and the resistance of the long grid wire made necessary by this circuit.

It will be noted that the far end of the grid-loading coil, L_3 in Fig. 12, is connected to the switch arm. This is done to stop the dead end loss in the coil. This way should be tried first and if there is interference from higher wave stations the double-bladed switch, such as used in Grebe or Kennedy apparatus, should be used. The last method is preferable because it shorts out a section of the coil, thereby separating the inductance of the coil and, by merely shorting out the unused turns, leaves the coil intact. This causes the set to tune broader. The first method was successful in this set, as it is much better than leaving the end open.

The set will tune very broad if the primary and secondary are not in resonance, so care must be taken to get the two circuits in resonance and get the coupling correct.



This new Ace Type 3B Armstrong Regenerative Radio Receiver is the height of perfection. It is equal to a combination of the Ace Type V and the Ace two-stage amplifier. For volume and distant reception it out-performs most sets costing a great deal more. The new Ace Type 3B has a filament switch which eliminates necessity of turning out rheostats when set is not in use. Sells for $50.00 but worth much more. Has genuine mahogany cabinet with engraved panel.



ACE TYPE 3C CONSOLETTE

This is the last addition to the Ace Family. Has beautiful solid mahogany, wax finished cabinet. Set consists of a regenerative tuner, detector and two stages of amplification with built-in loud speaker. Due to the particular method of winding Crosley coils it is exceptionally selective. Has sufficient room inside Cabinet for dry batteries, making a complete self-contained long range receiving outfit. Phone jack for tuning with head phones; Crosley multistat; filament switch, engraved Formica panel. Uses all kinds of tubes. An efficient set at a remarkable price, $125.00—without tubes or batteries.

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QUERIES AND REPLIES

Continued from page 38

ratus, and perhaps 25 or 50 per cent of the energy is radiated into the ether, in a circuit such as described in Mr. Ford's article. If the tube is supplied with pure d.c. you would expect increased distance covered by the transmitter, as the note would be much easier to read. I doubt very much if a Ford spark coil combination would deliver a pulsating d.c. supply free enough from noise to give really satisfactory results.

Erratum Notice: Fig. 1, p. 13, January RADIO should show connection between set antenna and filter.

NEWS OF AMATEUR OPERATORS

Continued from page 41

7ZU, Glenn E. West, Polytechnic, Mont., reports having worked WNP on the morning of Nov. 25th. WNP's signals have been heard at 7ZU nearly every night for a month but always too weak for consistent work.

7DC, the first 7th district station to work WNP, has combined his station with 7AIF.

7NE, at Leavenworth, Wash., is one of the few spark stations heard on the air. 7LN, of Nampa, Idaho, is heard working east coast stations almost every night. A number of the amateurs around Boise, Idaho, have been using loop modulation for fone work and distances up to 1000 miles have been covered by some.

Call 8BMP has been reassigned to Albert A. Arnold, 268 James St., Akron, Ohio.

Call 8ZE has been re-assigned to E. W. Thatcher, Oberlin, Ohio.

Call 6CJN has been issued to Frank La Barba, 623 N. Hill St., Los Angeles, Calif.

Call 9AYR has been re-issued to Cyril E. Cornwall, Osage, Iowa, who will be glad to answer all reports on his signals.

9BCJ has ceased operation at Webster Groves, Mo., and will probably join the ranks of the sixes in a short time. All communications may be sent to Chas. C. Messman, General Delivery, Prescott, Ariz.

CALLS HEARD

Continued from page 48

By 6BUR, L. E. Smith, Whittier, Calif.

1aw, 1adn, 1bvb, 1er, 1yb, 2ana, 2brb, 2byg, 2cee, (2rk), 2zm, 3adb, 3bva, 3cc, 3co, 4ay, 4cw, 4el, 4fc, 4fn, 4ft, 4gx, 4ku, 5adb, 5ado, (5ahd), 5aht, (5aij), 5air, 5ajt, 5akn, 5amu, 5anc, 5ef, 5ei, 5fa, 5ft, (5hq), 5jg, 5jj, (5lr), 5mi, 5nk, 5nn, 5ph, (5ql), 5qt, 5qy, 5vf, 5xd, 5za, (6acv), (6acz), (6aja), (6ani), (6atz), (6avv), (6bgl), (6biq dalite), (6blg), (6blm dalite), (6bni), (6buf dalite), (6bui), (6buy), (6cbw), (6ccy), (6cde), (6cek), (6egc), (6che), (6js), (6zau), (6zh), 7abb, 7acg, 7aci, 7adg, 7adu, 7aea, 7afn, 7ahi, 7af, 7ak, 7bj, 7co, 7fl, 7hc, (7hg), 7io, 7ip, 7iw, (7lh dalite), 7lr, 7ny, 7ob, 7ot, 7qc, 7qj, (7rd), 7sc, 7td, (7to), 7vs, (7vn), 7wm, 7wj, 7zt, 7zu, (8aa), 8ab, 8ada, 8adg, 8afd, 8aib, 8ajh, 8anh, 8apv, 8ard, 8atp, (8bda), 8bdu, 8bfm, 8brn, 8bxx, 8byn, 8bho, 8cci, 8cei, 8ceo, 8ces, 8cgx, 8cko, 8com, 8cpp, (8cpx), 8cxi, 8do, 8er, 8fc, 8fu, 8gz, 8hn, 8jj, 8jq, 8oa, 8pl, 8qr, 8rv, 8ue, 8ut, 8vy, 8yy, 8zy, 9aau, 9aaq, 9aaw 9ahv, 9afy, 9aic, 9aim, 9amb, 9amm, 9aog, 9aou, 9ape, 9apf, 9aps, 9aqk, 9avn, (9avu), 9awv, 9azg, 9azk, (9bak), 9bbw, 9bef, 9bez, 9bjk, 9blt, 9bly, 9bmx, 9bof, 9bri, 9brk, 9bsg, 9bsi, 9bsw, 9btt, 9bzi, (9caa), 9cgu, 9cic, 9cjc, 9clq, 9ckp, 9crr, 9csy, 9cvc, 9cyd, 9cyf, 9daw, 9dfh, 9dim, 9dkb, 9dkp, (9dkq), 9dky, 9dpx, 9dte, 9dug, 9dyr, 9edb, (9eky), 9elv, 9bp, 9bg, 9co, 9eq, 9hg, 9mc, 9ve, 9wi, 9xaq, 9zt.

Can.: 3co, 5cn, 5go, 9bp, 9cr.

Mex.: Bx, na.

6BUR answers all reports on his 5-watter.

Continued on page 81

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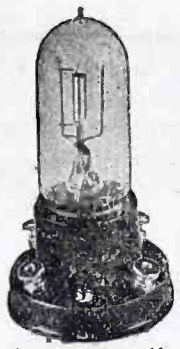

NA-ALD W. D. 11
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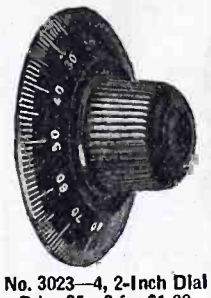
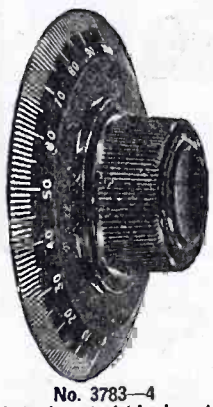


No. 3023—4, 2-Inch Dial
Price 35c, 3 for $1.00



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It's the contact that counts

Weak reception due to inferior contacts is banished when Na-ald sockets are placed in a set. Na-ald contacts exert a strong, wiping pressure on tube prongs over a broad surface, regardless of frequent removal of bulbs or variation in the length of prongs.

You can count on Na-ald Sockets under all conditions. They are moulded of genuine Bakelite, with uniform cross-section and cure. These features prevent plate to grid losses and insure full efficiency from tubes.

Insist on Na-ald Sockets, and put an end to weak reception. All good dealers carry them.

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Making a socket for U. V. 199 and C 299 tubes would seem comparatively simple. When we came to design the No. 499 socket, we did not find the task so easy. Compactness and neatness were requisites; and to be true to Na-ald standards this socket required a dependable contact. Owing to the shortness of the tube prongs, the dual-wipe contact of our De Luxe socket was impossible. In the No. 499 we avoided capacity effect and secured positive contact over the full surface of the end of the tube prongs. This again justified the phrase "It's the contact that counts."

In constructing this socket we have provided a real resilient base that actually absorbs all vibration. The socket floats in air, and all rubber with its corroding effect is kept away from the contact clips and screws. Again this forethought in design adds efficiency in service.

Send for "Why a Bakelite Socket" for further facts.

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NA-ALD

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No. 499
Price 50c for U.V. 199 tubes

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De Luxe No. 400. Price 75c

Adapter No. 429 for U. V. 199 Tubes. Price 75c

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The FERBEND "Wave Trap"
Makes Every Night Silent Night

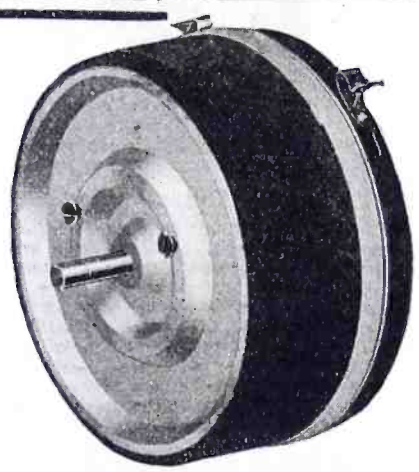
Get the station you want quickly. Listen in on the distant stations without annoying squawk-k-k-s or irritating whistles. Listen like this St. Louis user: "Heard Havana clearly with three St. Louis stations broadcasting. My receiver works like a new set. The 'Ferbend' is certainly a wonder."

YOU Can Obtain These Remarkable Results

You can obtain results as satisfactory as this St. Louis user. If you don't, it doesn't cost you a penny, for the "Wave Trap" is sold with a positive guarantee that it will tune out your powerful local stations. Don't wait. Order now at our risk.

SEND NO MONEY. You need not send a penny. Pay Postman $6.00 (plus postage). If you prefer, send $6.00 with order and Wave Trap is mailed postpaid. Money-back guarantee either way. You see, you take no risk, so order TODAY.

FERBEND
TRADE MARK
Wave Trap
PATENT APPLIED FOR



Ferbend Wave Trap ready for mounting, $6.00.

Wave Trap mounted on formica panel in mahogany finished cabinet 6x5x6 at $8.50 complete. Circular on request.

FERBEND ELECTRIC CO., 17 E. S. Water St., Chicago.
Send me a Ferbend Wave Trap. I will pay Postman $6.00, plus postage. I understand you guarantee Wave Trap to tune out our local stations or refund money.

Name .....

Address .....

RADIO WALL MAP 10c

Up to date, just off the press. Shows call letters, location, wave length, and kilocydes of all radio broadcasting stations also American Relay divisions and radio districts. Complete with scale for measuring distances. Size 28 x 34 inches printed in three colors. Postpaid for a dime.

OZARKA, INC.
862 Washington Blvd., Chicago

FREE

Complete Price List

AITKEN RADIO CO.
504 Superior St., Toledo, O.

Continued from page 78

By 3BWJ, 120 Frazer Ave., Collingswood, N. J.

5xt, 5za, 6bic, 6cgw, 6dn, 6fp, 6pl, 6zb, 6zh, 6zz, 7adh, 7af, 7co, 9ahq, 9ahy, 9ake, 9amb, 9and, 9apf, 9awg, 9axx, 9bed, 9bgc, 9bhk, 9hx, 9bkf, 9bkp, 9blg, 9blt, 9bry, 9bsp, 9btt, 9bxq, 9caa, 9ccs, 9ceb, 9egn, 9cja, 9cmk, 9day, 9dcw, 9ddu, 9dhk, 9dlg, 9dmn, 9dqu, 9dro, 9dzx, 9ell, 9er, 9kd, 9ln, 9ss, 9yb. Hrd in 13 nites; all over 500 miles. Wud appreciate crds on my sigs.

By 6ALV, Alameda, Calif.

1ajx, 1bkq, 1boq, (1cmp), 1yb, 2rk, 2cee, 2cgb, (2cpa), 3hg, 3hs, 8vp, 8bgg, 4af, 4ay, 4cs, 4el, 4ft, 4fg, 4jk, 4ku, 4oa, 4qd, 5eb, 5ek, 5fx, 5gn, 5ht, 5kc, 5lr, 5nk, 5pd, 5ql, 5qy, 5tj, 5uo, 5xd, (5xt), 5za, 5zav, 5adb, 5ado, 5aiu, 5akf, 6cea, 7mn, 8aa, 8ab, 8bf, 8er, 8fu, (8gz), 8oa, 8pl. 8tt, 8yn, (8zy), 8zz, (8abm), 8adg, 8aih, 8aim, 8ajh, 8ame, 8bda, 8bfm, 8bnh. 8cjp?, 8cmm, 8coj, 8com, 9bp, 9ce, 9cp, 9ei, 9fm, 9gy, 9lz, 9mc, 9qr, 9vc, (9yu), 9yy, (9zt), 9aag, 9aaw, 9aap, 9adf, 9ahg, (9ahz), 9aim, 9and, 9amb, 9aon, 9aoq, 9ape, 9apf, (9aps), 9auu, 9avu, 9avz, 9awv, 9azq, 9aua, 9bab, 9bch, 9bly, 9bof, 9bqy, 9brk, 9bmh, 9bsp, 9bso, (9btt), 9buh, 9bpv, 9bxc, (9bzi), 9bzx, 9caa, 9cca, 9cck, 9ccr, 9ccv, (9ccz), 9cjc, 9cjy, 9clq, 9coc, 9cpb, 9cpi, 9csy, 9cxp, 9daw, 9dcw, (9dch), 9dhd, 9dhg, 9dik, (9dlf), 9dqu, 9dxn, 9dyr, 9dyy, 9eea, 9ehj, 9ebn, 9eky, 9elv, 9xaq.

Can.: 3co, 4ea, 4cl.

By Melbourne Renken, Cole Camp, Mo.

C. W.: 1xam, 1yk, 1iv, 1cmp, 1bwu, 1cre, 2ale, 2aek, 2bof, 2atu, 2cei, 2cua, 2wr, 2bic, 2ark, 2awf, 2bsc, 2xn, 2clx, 2ccx. 3uo, 3tb, 3hs, 3gc, 3ft, 3jy, 3iu, 3qv, 3de, 3ab, 3bbv, 4ay, 4sb, 4eb, 4ai, 4na, 4db, 4mb, 4bmn, 5xv, 5aiu, 5uk. 5gz, 5uv, 5lr, 5no, 5gj, 5uo, 5fa, 5ahd, 5iu, 5ql, 5aiy, 5oj, 5mv, 5lc, 5ni, 5ri, 5hl, 5nz, 5dw, 5ama, 5nw, 5xab, 5akn, 5ahj, 5qw, 5rw, 5aec, 5iv, 5hw, 5aof, 6ohv, 6alv, 6pe, 6aun, 6gs, 6zah, 6bwc, 6ckr, 6tv, 6pl, 6abx, 6cgd, 6cu, 6km, 7bb, 7it, 8bnh, 8cld, 8bjv, 8dcn, 8bnd, 8cki, 8ctf, 8fm, 8qw, 8bhf,8att, 8cxm, 8dae, 8czz, 8nf, 8dcy, 8bxh, 8bju, 8ccu, 8jj, 8aa, 8chn, 8cxn, 8bsj, 8alw, 8ddq, 8ame, 8vl, 8ctz, 8ctc, 8eno, 8ddc, 8ij, 8cng, 8dac, 8anb, 8cuk, 8ut, 8vt, 8wm, 8aih, 8arh, 8bbi, 8bjf, 8bdm, 8bop, 8jt, 8ahj, 8fh, 8bdu, 8bus, 8anl, 8dhq, 9's too numerous.

Can. C. W.: 4aw, 3he, 3anm.

Spark: 3acy, 5ud, 5bw, 8eb, 9dgzm, 9brx, 9abv, 9oci, 9ejg, 9bof, 9dwk, 9lw, 9dsq, 9biw, 9oic, 9gt, 9lb.

Fone: 8kg, 5ame, 9bxu, 5ma.

Daylite: 8bhf, 8fu, 5akn, 5ahj, 5gj, 4en, 4sc. 9xt.

Above received on detector alone.

Continued on page 84

14-inch horn (mahogany or spruce) for the Home $30
21-inch horn (mahogany only) for Concerts $35
Comes complete, ready to attach in place of headphones. No batteries required for its operation.

Music at its Best!

FULL, clear, rich, beautiful—MUSIC MASTER brings into your home the majestic tones of the pipe organ, the incomparable master instrument of the musical world.

It will enable you to hear and **feel** the grandeur of the master instrument of the musical world as though you were in its very presence.

MUSIC MASTER gives you the **truth** of each soft strain, every arpeggio, the inspiring, kingly chords and the rich, rolling bass tones.

Why not let **everyone** hear the organ? Flood the whole room with its majestic music—simply by connecting MUSIC MASTER to your radio set.

MUSIC MASTER is equipped with a wood amplifying bell; and wood, properly shaped as a horn—furnished only with MUSIC MASTER—is the one material that makes possible the perfect reproduction of the actual, living tones themselves.

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MUSIC MASTER CORPORATION
FORMERLY GENERAL RADIO CORPORATION
Makers and Distributors of High Grade Radio Apparatus
CHICAGO *PHILADELPHIA* *PITTSBURGH*
S. W. cor. 10th and Cherry Streets

Music Master
RADIO REPRODUCER

Tell them that you saw it in RADIO

Continued from page 81

By 9ABK, Jas. H. Leach, 3345 6th St. N., Minneapolis, Minn.

1xam, 1aw?, 1ary, 1bep, 1zi, 1aol, 1mc, 1fd, 1er, 2by, 2ts, 2rk, 2bic?, 2sg, 2bxw, 2bru, 2ic, 3can, 3th, 3nf, 3brf, 3jy, 3aec, 3jy, 3wd, 3adn, 3ba, 3om, 3tf, 3jw, 3aqr, 3bss, 3ava, 3zm, 4cn, 4gw, 4af, 4el, 4er, 4mb, 4jk, 5lr, 5gg, 5aji, 5zg, 5aig, 5kh, 5bm, 5ek, 5fx, 5rg, 5ajp, 5ij, 5zax, 5zt, 5abg, 5ali, 5aiu, 5tt, 5uo, 5mj, 5on, 5qw, 5zw, 5ahj, 5za dalite, 5ef, 5zav, 5xap, 5qd, 5dr, 6buh, 6cgw, 6ya, 6fp, 6zh, 6mg, 6aoi, 6bnk, 6fy, 6abx, 6arb, 6zo, 6ak, 6bkx, 6cc, 6ahq, 6bih, 6brf, 6zw, 6auu, 6ajh, 6zu, 6ckp, 6cmr, 6blg, 6bbn, 6aos, 6bic, 6gr, 6bum, 6mh, 6zb, 6alv, 6zi, 6awt, 6bqb, 6bnc, 6lv, 6bsj, 6akz, 6auu, 6bua, 7pu, 7af, 7ob, 7du, 7aks, 7ve, 7zd, 7zt, 7zu, 7zv, 7cq, 7adh, 7ain, 7ge, 7yl, 7hw, 1dc, 7ya, 7qj, 7za, 7zx.

Spark: 4co, 8eh, 9gc, 9bef, 9cye, 9bof?

Can.: 2bg, 3cf, 3fc, 3ni, 4cl. 5 watts spark coil C. W. All qsl's answered.

By 9AQK, 5022 Underwood Ave., Omaha, Nebr.

1yb, 1alw, 1cga, 1aol, 1ajx, 1wo, 1cri, 1bep, 1atj, 1ary, 1cpn. 1cmp, 2by, 2rb, (2bqb), 2dx, 2bum, 2el, 2pz, 2cnb, 2cpk, 2cjr, 2cqo, 2byb, 2cei, 2wp, 2fz, 2bji, 2crp, 2wr, (2bdg), 2aay, 2cpa, 2bsc, 3cer, 3hg, 3afp, 3wf, 3co, 3pz, 3tr, 3cc, 3ath, 3btl, 3iu, 3jj, 3bgg, 3cjn, 3zm, 3bei, 3buv, 3dg, 3yp, 3bdu, 3cfi, 3me, 3yj, 3te, 3ckp, 3rd, 4gx, 4gw, 4hr, 4qw, 4gl, 4mi, 4jk, 4af, 4fz, 4ay, 4bx, 4dx, 4aa, 4ag, 4bp, 6aru, 6auu, 6biq, 6bsj, 6auy, 6bug, 6ckr, 6zar, 6ztc, 6bve, 6mh, 6nx, 6ahz, 6bnc, 6zbl, 6acm, 6pl, 6bbc, 6cgw, 6bua, 6chv, 6bic, 6bah, 6hkl, 6lv, 6cfz, 6bwp, 6bni, 6gr, 6pm, 6zah, 6bq, 6bih, 6zh, 6zar, 6bnh, 6bhk, 6arb, 6bve, 6aoi, 6blg, 6age, 6aos, 6ahd, 6bkx, 6cnh, 6alo, 6eo, 6bnc, 6zbs, 6adt, (7abb), 7sc, 7ael, 7ey, 7zu, 7afn, 7rd, 7alk, 7agv, 7eb, 7aos, 7du, 7alb, 7co, 7ot, 7wp, 7gi, 7mp, 7yl, 7ln, 7ob.

Can.: 2cg, 3ms, 3ij, 3ws, 3ni, 3adn, 3zl, 3om, (3oe), 3tb, 4fv, 4cl, 4ea, 5cn, 5go, 9al.

By 8BUM ex 6CIW, 228 West 2nd Ave., Columbus, Ohio

1ajx, (1bqm), 1cmp, 1ee, 1fd, 1xm, 1xaq, 1xz, 1yb, (2awl), 2cka, (2cgj), (8aek), 3acs, 3aqr, 3ahp, 3ba, 3ca, 3jj, 3jy, 3rs, 3ub, 3vo, 3xd, 3yo, 4ay, 4eq, (4ft), (4jk), 4pb, 4rh, 5aat, 5auv, 5akn, 5agn, 5ek, (5lr), 5pv, 5za, 6bic, 6cfz, 6zh, 6cfz, 6cgw, fb, 6lr, 7's too many, 8rv, (8sr), 9apf, 9aec, 9aau, (9aav), (9adf), 9ady, 9amz, 9ato, 9atn, (9bmx), 9bsg, (9byc), 9ccs, 9cmc, 9cpc, 9cra, 9ceh, 9cdo, 9dlr, 9dsr, 9doe, 9es, 9ell fb!, 9ekf, 9efj, 9edb, (9gr).

Can.: C. W.—(2bn), 2cg, 3vs. Mex.: ru. Pse. qsl my 5-watts C. W.

At 4PY, Fort Lauderdale, Florida

1acz, 1alj, 1aol, 1aqi, 1aqm, 1bgc, 1eab, 1cmp, 1ee, 1fd, (1fm), 1hx, 1oa, 1sk, 1sn, (1yb), 2agd, 2bpf, 2bsc, 2cee, 2cpa, 2cqi, 2be, 2by, 2gk, 2rk, 2xna, 3ab, 3jj, 3lg, 3ov, 3aek, 3anv, 3bdo, 3bnu, 3bta, 3bva, 3cdn, 3cjt, (4bh), (4ft), (4fs), (4sb), (4ih), (4ob), 5ac, 5ad, 5ft, 5gn, 5hr, 5ht, 5kg, 5kn, 5lr, 5nk, 5nw, 5ot, 5ov, 5qi, 5ql, 5qy, (5rh), 5sd, 5vm, 5vv, 5xap, 5za, 5zu, (5zg), 5adh, 5afs, 5akn, 5amf, 5axn, 6lv, 6zh, 6zi, 6alk, 6aoi, 6cgw, 6xad, 7ko, 7se, 7acm, 8aa, 8pl, 8px, 8rj, 8xe, 8zc, 8abm, 8ago, 8apt, 8aqv, 8axc, 8bdu, 8bfm, 8bqi, 8brm, 8com, 8opp, 8cvx, 8dhn, 8dkj, 9eq, 9jc, 9qr, 9vc, 9vm, 9wu, 9zt, 9aar, 9ack, 9ady, 9aec, 9aim, 9amb, 9apf, 9apa, 9asc, 9bak, 9bcb, 9bez, 9bhx, 9bji, 9bly, 9boz, 9brk, 9bry, 9bxq, 9cfy, 9ckp, 9cpk, 9cte, 9ctu, 9day, 9daw, 9der, 9dis, 9dkb, 9dqu, 9dtt, 9eer, 9eek, 9egw, 9elb.

Can.: 1dd, 2bn. Qsl to B. C. Fidler, Jr., ex 8abe, 233 Brickell Ave.

By 6CIX-6ABO, 317 N. Friends Ave., Whittier, Calif.

1fj, 2aay, 2ana, 2bq, 2kf, 2rk, 3bav, 3bw, 3cc, 5ahd, 5aiu, 5aiw, 5ad, 5ck, 5dn, 5ht, 5ij, 5ad, 6aja, 6buh, (6bui), 6ceu, 6rm, 7abb, 7aci, 7aea, 7afn, 7agi, 7af, 7ak, 7co, 7dc, 7ez, 7fd, 7gq, 7io, 7ks, 7lu, 7ob, 7ot, 7oy, 7px, 7qc, 7qd, 7qj, 7rp, 7rt, 7sh, 7st, (7vn), 7wp, 7yl, 7zu, 8ame, 8apt, 8ard, 8bbw, 8bcs, 8byn, 8ceo, 8com, 8eu, 9aff, 9ahv, 9aia, 9amg, (9amb), 9aou, 9apf, 9atc, 9atn, 9aua, 9ayx, 9azg, (9bez), 9bhi, 9brk, 9bun, 9bxq, 9bto, 9day, 9dhs, 9dkb, 9dlf, 9doe, 9dqa, 9dte, 9dun, 9ocs, (9caa), 9cdo, 9cld, 9clq, 9ozg, 9eku, 9elv, 9hg, 9jm, 9mc, 9ot, 9uh, 9vm. Can.: 5on.

At 6BCS and 6ACW

1bok, 1bga, 1awx, 1yb, 2bgg, 2bnu, 2ts, 3dn, 3yh, 3yo, 4ac, 4cs, 4gw, 4ku, 5adb, 5adc, 5ado, 5afo, 5ahd, 5ahr, (5aij), 5akf, 5akn, 5alr, 5ama, 5dn, 5dw, 5fx, 5ga, 5gj, 5gn, 5hq, 5ht, 5kc, 5kg, 5lr, 5mo, 5nn, 5tj, (5za), 5zak, 5zav, 5zn, 5tc, 6's too nnmerous, 7abb, 7aci, 7adf, 7ads, 7afn, 7age, 7agn, 7agr, 7agv, 7aiy, 7akh, 7aoc, 7ak, 7ap, 7bj, 7em, 7fd, 7gs, 7io, 7ks, 7it, 7lr, 7ly, 7nn, ob, 7lu, 7oh, 7om, 7ot, 7qd, 7qt, 7ri, 7sf, 7sh, 7to, 7wa, 7wm, 7ws, 7ya, 7zd, 7ze, 7zk, 7zo, 7zu, 7zz, 8ab, 8aaj, 8aio, 8ajd, 8anh, 8apa, 8apn, 8axc, 8bci, 8bcu, 8bda, 8bfh, 8bfm, 8bjv, 8byw, 8chv, 8crn, 8ctq, 8czz, 8dat, 8dgo, 8wx, 8xe, 8zz, 9aau, 9abc, 9acs, 9adr, 9aec, 9afm, 8ahz, 9aim, 9ajy, 9amb, 9aou, 9apf, 9anu, 9av, 9avn, 9avs, (9avu), 9bak, 9bcf, 9beh, 9bez, 9bhd, (9bji), 9bjk, 9bkf, 9bly, 9bri, 9brk, 9btl, 9bun, 9bwa, 9bxq, 9bzi, 9caa, 9cas, 9caq, 9ccv, 9ccz, 9cqd, 9cte, 9cvc, 9cvs, 9cxs, 9cyw, 9czg, 9dfh, 9dhq, 9dky, 9dpy, 9dro, 9dte, 9dyw, 9dzy, 9edb, 9eea, 9eil, 9eky, 9elv, 9an, 9hy, 9mc, 9ss, 9zt.

Can.: 3bp, 3co, 3ir, 3tb, 4dy, 5cn, (5go).

Wnp working 5zav. Some Australian station calling 1lk Nov. 18-19. Would appreciate a qsl fm anyone and wl qsl hr. New qra 6acw Yukio Ito, Moneta, Calif. New qra 6bcs, Kenneth Windley, Route 1, Box 113, Gardena, Calif.

By Kenneth C. Kinney, 2040 Berryman St., Berkeley, Calif.

5ado, 5akf, 5akn, 5au, 5gk, 5gn, 5kt, 5lg, 5lr, 5pw, 5xd, 5za, 5zav, 6's too numerous, 6aln, 6cbj, 6cbu, 6ceu Hawaii vy qsa, 6pe, 6rm, 6yb, 7abf, 7aby, 7acg, 7adp, 7co, 7fl, 7gi, 7gs, 7io, 7ks, 7ln, 7ot, 7oy, 7qd, 7qj, 7qx, 7ra, 7sf, 7sh, 7td, 7wb, 7we, 7xae, 7xaf, 7xi, 7ya, 7yl, 7zo, 7zu, 7zz, 8abm, 8bda, 9aaq, 9aim, 9amb, 9bik, 9bjk, 9bly, 9brk, 9bri, 9bsg, 9buj, 9bun, 9bzi, 9cho, 9ck, 9ckz, 9clq, 9czw, 9dfh, 9dky, 9dvw, 9mc, 9xaq, 9zt.

Can.: 4cl, 4cw, 4dq, 5ct, 5ef (qra)?. Will qsl all cards for check on these sigs.

By 6CIX-6ABO, 317 N. Friends Ave., Whittier, Calif.

2el, 4ag, 4ey, 5akn, 5aky, 5agj, 5anc, 5be, 5zav, 6ajp qra? 7adf, 7adr, 7ads, 7aea, 7afk, 7akh, 7af, 7cf, 7em, 7hc, 7hw, 7io, 7lh, 7ln, 7ob, 7ot, 7pf, 7qd, 7qj, 7qt, 7ra, 7sh, 7st, 7to, 7ve, 7xa, 7ya, 7zu, 7zz, 8aih, 8az, 8er, 8fu, 8jj, 8jy, 9amb, 8apf, 8aps, 8auw, 9avs, 9bez, 9bly, 9bxl, 9bji, 9bzi, 9cjy, 9cns, 9day, 9dfh, 9ekf, 9ct, 9dt, 9dx, 9wo, 9zt.

Mex.: Na qra?

Can.: 5cn.

Anyone hearing 6cix pse qsl. All cards ansd.

By 6BSG, Carl Dillman, 133 W. Lime St., Inglewood, Calif.

1boq, 1er, 4ay, 4cl, 4eq, 4ft, 4jr, 4ku, 4my, 5abn, 5adb, 5adh, 5ado, 5ahr, 5aij, 5akf, 5akn, 5be, 5bm, 5bq, 5ei, 5gi, 5gj, 5hz, 5if, 5la, 5lg, 5lr, 5pb, 5ph, 5qy, 5sd, 5ui, 5uj, 5uo, 5vv, 5za, 5zak, 5zap, 5zh, 5zo, 6ceu, 7acg, 7aci, 7acq, 7adi, 7adp, 5zak, 5zap, 5zh, 7acg, 7aci, 7acq, 7adi, 7adp, 7aea, 7afe, 7afn, 7afo, 7aft, 7agt, 7ahc, 7ch, 7dc, 7du, 7gi, 7hg, 7hp, 7hw, 7it, 7iw, 7jw, 7ks, 7ly, 7mh, 7pj, 7qd, 7ql, 7sc, 7sf, 7to, 7uu, 7ws, 8aa, 8abn, 8ack, 8ada, 8agm, 8avt, 8axc, 8bam, 8bda, 8bfm, 8bf, 8cku, 8cno, 8com, 8cs, 8cvg, 8ctp, 8cvv, 8cwu, 8dat, 8dcb, 8dgo, 8do, 8gv, 8hn, 8qn, 8qt, 8tb, 8vg, 8wx, 8xe, 8yr, 8yv, 9ack, 9aec, 9aep, 9afm, 9aim, 9ajb, 9amb, 9amc, 9ami, 9any, 9aou, 9ap, 9apa, 9apf, 9ask, 9aua, 9auv, 9auw, 9avn, 9avu, 9ayx, 9bck, 9bdu, 9bey, 9bez, 9bhz, 9bjk, 9bk, 9bly, 9boz, 9bqf, 9bri, 9brk, 9bsp, 9btt, 9bui, 9bum, 9bzi, 9caw, 9cbf, 9ccs, 9ccu, 9ccv, 9cea, 9ceh, 9ceu, 9cfy, 9ckv, 9clq, 9cns, 9ctg, 9cvc, 9cvs, 9czg, 9czw, 9daw, 9day, 9dcw, 9ddf, 9dfh, 9dhg, 9dhh, 9dhm, 9diw, 9djb, 9dkb, 9dkx, 9dky, 9dpb, 9dpx, 9dte, 9dx, 9dxe, 9dxn, 9dxy, 9dzy, 9eae, 9eea, 9eer, 9ei, 9eky, 9ih, 9mc, 9nr, 9ox, 9vm, 9vz. Pse qsl if my sigs are heard; 5 watts.

By 9CTB, 303 N. Martin St., Munice, Ind.

C. W.: 1ax, 1er, 1ez, 1gv, 1il, 1ii, 1kk, 1pa, 1sk, 1yb, 1acu, (1adn), (1alz), 1ary, 1asi, 1bes, 1bcm, 1bcu, 1bgc, (1bhk), 1bkq, 1bqc, (1bwj), 1cbj, (1cdm), 1cmc, 1cmp, 1cmx, 1cpn, (2by), (2gk), 2ts, (2aay), 2afp, 2agb, (2awl), 2bqh, 2bsc, 2bzv, 2cxd, 3bj, 3iw, 3jj, 3jy, 3mo, (3te), 3tj, 3tr, (3vo), 3auo, 3bei, (3ber), 3bmn, 3bsb, 3bvb, 3ccu, 3ccx, 3cdk, 3cjw, (4ai), 4bo, 4bx, 4by, 4cs, 4cx, 4db, 4dn, 4dt, 4dv, (4eb), 4el, 4en, 4ep, 4ft, 4hs, 4jk, 4ku, 4mb, 4me, 4nx, (4qf), 4rh, 5az, 5be, 5ef, 5ek, 5er, 5fc, 5ga, 5gi, 5gm, (5hl), 5ht, 5ik, (5je), 5ku, 5lr, (5mi), 5mo, 5nj, (5nn), 5nv, 5oi, (5ov), 5ph, 5qi, (5ql), 5vf, 5wo, 5wx, 5xv, 5ye, 5abd, 5abg, 5abt, 5aby, 5act, 5acy, 5aeo, 5agj, 5ahc, 5aiu, 5ajb, 5ajp, 5asd, 6cu, 6dd, 6et, 6ka, 6mh, 6su, 6ua, 6wx, 6abx, 6aoi, 6aos, 6auy, 6awt, 6bcl, 6beo, 6bih, 6bik, 6bjc, 6bim, 6bpz, 6bts, 6bua, 6bva, 6bve, 6bwe, 6cbi, 6cbu, 6cfz, 6cgw, 6che, 6chl, 6chu, 6chv, 6xad, 7bj, 7it, 7ob, (8al), (8bf), (8gd), (8gz), (8hj), (8pl), (8qw), (8uf), (8wg), (8abd), (8apv), (8avn), (8azh), (8bcf), (8bkb), (8bqi), (8bux), (8chb), (8cjd), (8cyz), (8dcb), (8dil), (9aau), (9aci), (9arc), (9atn), (9bgt), (9cga), (9col), (9ctg), (9ctr), (9daw), (9dvl), (9dvw), (9dxl), (9dxn), (9dxy), (9dzy), (9ekf), (9eky), (9ehj), Spk.: (9dwk).

Can.: 2bn, 3tb, (3zs).

Please qsl; 5 watter here with 2.5 T. C. A. in a 75-ft. high aerial.

Continued on page 88

Continued from page 86

By 6ARB, G. E. Duncan, 3029 Acton St., Berkeley, Calif.

(1ary), (4ft), (5ht), (5lg), (5lr), (5mn), (5ql), 5aec), (5aij), (6hv), (6rm), (6aru), (6asa), (6ceu), (6bpr), (7ba), (7bb), (7ca), (7cf), (7ac), (7hi), (7hg), (7hs), (7io), (7it), (7iw), (7ln), (7ly), (7mn), (7nn), (7qj), (7qy), (7rn), (7sa), (7we), (7ws), (7wx), (7zb), (7zl), (7zu), (7aao), (7adc), (7adp), (7ads), (7agv), (7aip), (7ajn), (7akk), (7akt), (7akv), (8aa), (8fu), (8zc), (8agp), (8bda), (8bxx), (9mf), (9vm), (9xi), (9zt), (9ack), (9aim), (9apf), (9bak), (9bji), (9bxq), (9bqq), (9bri), (9bun), (9bzi), (9bzo), (9caa), (9cjc), (9cos), (9cpu), (9cvs), (9czw), (9daw), (9ddp), (9dky), (9dlf), (9dqe), (9ejz), (9ekf), (9eky). Can.: (3bp), (5ct), (5cn), (5go), (5hg).

1er, 1fb, 1yb, 1apt, 1ary, 1cmp, 2cj, 2fp, 2rk, 2xn, 3vo, 4ca, 4dx, 4ft, 4gz, 4ku, 4my, 5ch, 5gj, 5ht, 5in, 5je, 5jf, 5kc, 5kr, 5mn, 5nn, 5rm, 5uo, 5xd, 5adb, 5afg, 5ahr, 5aiv, 5akn, 5ama, 5amh, 5ahd, 5ajj, 5zak, 5zav, 7ei, 7el, 7iy, 7lu, 7qj, 7sj, 7tk, 7we, 7ws, 7adf, 7ahi, 7aje, 8ab, 8hn, 8mz, 8vq, 8vy, 8yn, 8yo, 8yv, 8zz, 8abm, 8aih, 8anb, 8ayc, 8bdu, 8bfm, 8bnh, 8bvt, 8bwx, 8bxs, 8bxt, 8byn, 8cpx, 8cqz, 8cvg, 8cwp, 9eq, 9gb, 9ox, 9yi, 9zy, 9aau, 9aav, 9abu, 9aep, 9aeu, 9ajv, 9amb, 9aoj, 9ape, 9apf, 9aps, 9aua, 9aws, 9aye, 9azg, 9bhe, 9bhz, 9bjk, 9bly, 9bof, 9btl, 9bxm, 9bji, 9bzi, 9caa, 9caj, 9ccs, 9ccz, 9ceu, 9cfi, 9cfy, 9ctr, 9cvc, 9czd, 9dva, 9dfa, 9dhr, 9diw, 9dge, 9dkb, 9dli, 9doe, 9dsw, 9dvj, 9dxy, 9dyz, 9edb, 9eea, 9eht, 9ekf, 9yaj.

Can.: 3ko, 3co, 4cl, 4dq, 4hh, 5eb, 9bp. Wnp. Mex.: Bx.

By 6CJD, P. O. Box 33, Merced, Calif.

3dv, 3gk, 3ni, 3zo, 4it, 4ft, 4gw, 5zav, 5ado, 5agi, 5dw, 5ov, 5xv, 6acv, 6aan, 6aem, 6aos, 6ami, 6aos, 6bsx, 6beg, 6bwe, 6bsj, 6bjj, 6blm, 6bdt, 6buy, 6bqb, 6bwu, 6blm, 6buz, 6bes, 6beh, 6cef, 6cdg, 6cce, 6beq, 6ceb, 6cen, 6cei, 6cej, 6cgg, 6cia, 6cgw, 6cmi, 6cag, 6cbb, 6cbi, 6cbr, 6cbw, 6ecu, 6clx, 6ciz, 6ckh, 6ckp, 6cii, 6cmr, 6cmu, 6cng, 6et, 6nx, 6oh, 6ok, 6pl, 6zh, 6zi, 6zo, 6rm, 6su, 6mh, 6fy, 6bl, 6ik, 6ci, 7zd, 7va, 7de, 7em, 7fq, 7zu, 7ks, 7zf, 7co, 7ho, 7hd, 7to, 9hw, 7it, 7iw, 7ln, 7ob, 7oh, 7qj, 7wm, 7zf, 7zu, 7yl, 8cjd, 8aia, 8ago, 8apt, 8atp, 8bda, 8bwk, 9aby, 9bbl, 9bwi, 9bjk, 9cme, 9cea, 9dn, 9dtu, 9gd, 9hk, 9jk, 9lz, 9na, 9pm, 9rc, 9uh.

Can.: 2ab, 2cg, 2ic, 3dti, 3ge, 3ni, 3zl, 4cw, 4ci, 4hf, 4dq, 9bb. Wud appreciate reports on my 10-watt C. W. sigs. All cards answered.

Continued on page 90

Continued from page 88

By 1ary, University of Vermont, Burlington, Vt.

C. W.: 4ag, 4ai, 4bq, 4db, 4eb, 4ep, 4eq, 4ft, 4hr, 4hs, 4jh, 4ku, 4lj, 4mb, 4me, 4na, 4oa, 4sc, 4sh, 4zf, 5abb, 5abc, 5abh, 5abt, 5ahr, 5aij, 5air, 5aiu, 5aki, 5akn, 5amf, 5amh, 5asf, 5xac, 5zav, 5bw, 5cn, 5da, 5dt, 5ek, 5fv, 5ga, 5gj, 5hl, 5ht, 5in, 5kg, 5kh, 5kr, 5lr, 5nr, 5ov, 5pa, 5pw, 5uk, 5up, 5wo, 5yg, 5za, 6acm, 6aja, 6ajj, 6aos, 6arb, 6asx, 6aup, 6auy, 6avv, 6awt, 6bbu, 6bbw, 6bic, 6cgw, 6ckr, 6xad, 6zah, 6zar, 6zau, 6fp, 6gr, 6su, 6zh, 6zv, 6zz, 7abb, 7aiy, 7avj, 7af, 7ln, 7ot, 7qc, 7sc, 7sf, 7zb, 7zd, 7zt, 7zu, 9aad, 9aaf, 9aal, 9aap, 9aar, 9aau, 9aaw, 9add, 9aec, 9aek, 9aem, (9aen), 9ahw, 9ahy, 9ahz, 9aic, 9aim, 9ajv, 9ajw, 9ali, 9amb, 9amf, 9and, 9aon, 9aou, 9aoy, 9apb, 9ape, 9apf, 9aps, 9apv, 9arb, 9arc, 9arh, 9arw, 9ash, 9aus, 9avf, 9awa, 9awe, 9awf, 9aws, 9awv, 9axh, 9ayh, 9azj, 9azp, 9bac, 9baf, 9bak, 9baz, 9bbi, 9bbp, 9bcf, 9bde, 9bds, 9beh, 9bez, 9bff, 9bfg, (9bfi), 9bgc, 9bgi, 9bhl, 9bhq, 9bis, 9bji, 9bjr, (9bly), 9bof, 9bop, 9bpd, 9bpl, 9bpw, 9bqj, 9bre, 9bri, (9brk), 9brx, 9bry, 9bsh, 9btd, 9buh, (9buj), 9bun, 9bvn, 9bwj, 9bwv, 9bxq, 9bzd, 9bzi, 9cah, 9ccm, 9ccs, 9ccz, 9cdb, 9ced, (9cgy), 9cha, 9chd, 9cho, 9cja, 9cjc, 9ckd, 9ckp, 9clq, 9clx, 9cly, 9cmm, 9cmn, 9cnf, 9cou, 9cte, 9ctr, 9ctu, 9cui, 9cvc, 9cvv, (9cvs), 9cva, 9cyf, 9czs, 9czw, 9day, 9dch, (9dcp), 9dcw, 9ddg, 9ddu, 9ddy, 9dfc, 9dfh, 9dge, 9dgn, 9dgv, 9dgx, 9dgy, 9dhg, 9dhr, 9dhz, 9dks, (9dky), 9dlf, 9dlg, 9dlw, 9dmo, 9dnn, 9doe, 9don, 9dpc, 9dpx, 9dqu, 9dro, 9dsm, 9dso, 9dtt, 9duj, 9dwk, 9dxl, 9dxy, 9dyy, 9dyz, 9dzs, 9dzx, 9dzy, 9eak, 9ear, 9ecv, 9eeg, 9efz, 9ehh, 9ehi, 9ehq, 9eja, 9ejz, 9ekf, 9eky, 9elb, 9eld, 9ell, 9elv, 9elr, 9xaq, 9aa, 9an, 9ao, 9ba, 9bp, 9bt, 9cr, 9db, 9dd, 9ei, 9ep, 9eq, 9er, 9fp, 9gs, (9hk), 9ig, 9ir, 9it, 9jm, 9ln, 9mc, 9mf, 9mm, 9ok, 9on, (9ox), 9pb, 9pf, 9qi, 9qr, 9rc, 9si, 9sk, 9tv, 9tz, 9ub, 9ur, 9us, 9uz, 9vc, 9vg, 9vk, 9vm, 9wc, 9we, 9xi, 9yy, 9zg, 9zt, 9zy.

Can.: (1ar), 1dd, 1dq, 4bv, 4cb, 4cl, 4cw, 4dy, 4fn, 4hh, 5go. Mex.: DX.

By 7OY, 1304 E. 62nd St., Seattle, Wash.

1yb, 2kf, 2ro, 3ajd, 3hk, 4cr, 4cs, 5ama, 5au, 5be, 5kv, 5lr, 5rm, 5zav, 5zb, 6afd, 6afq, 6ahu, 6aja, 6ajf, 6aol, 6aqu, 6aru, 6bak, 6bcl, 6bih, (6blm), 6bnc, 6bou, 6buy, 6cdg, 6cgw, 6che, 6chl, 6cjl, 6ckc, 6ckp, 6cwu, (6et), 6fp, 6kw, 6nx, 6xa, 6xad, 6xh, 6zah, (7aby), 7ads, 7afk, 7agf, 7agr, 7ahj, 7ahn, 7ahq, 7ahz, 7aih, (7ak), 7bj, 7ea, 7eb, 7en, 7ez, 7ge, 7io, 7it, 7je, (7sy), 7kn, (7ob), 7ot, 7sz, 7so, 7lh, 7qj, 7px, 7oh, 7rp, 7qc, 7yl, 7qd, 7zd, 7zx, 8zz, 8xe, 8cwu, 8da, 8kr, 8vt, 8cea, 8wx, 8bzd, 8bda, 8aih, 8ckg, 8kj, 8ue, 8cod, 8zx, 8asv, 8bxu, 8cno, 9uh, 9dro, 9bji, 9cgu, 9fn, 9ig, 9kb, 9dzy, 9ajv, 9bik, 9cjc, 9vm, 9awb, 9bak, 9mc, 9aau, 9bjk, 9eky, 9apr, 9apf, 9bri, 9caa, 9egu, 9bxq, 9bek, 9aim, 9dsm, 9dch, 9aje, 9bed, 9dkb, 9zt, 9bqq, 9bak, 9aon, 9aus, 9bcb, 9dxm, 9uz, 9ct, 9pk, 9doe, 9amk, 9hk.

Can.: 1ar, 3he, 3ni, 3oh, 3bp, 4aw, 4cn, (4cw), 4ak, 4dq, 4er, 4fn, 4hf, 4hh, 4io, (5ah) 5ct, (5cn), 5eb, 5go, 9bp, 9bx. Wud appreciate rpts on my sigs. All crds answered.

Continued on page 93

Bristol One Stage Power Amplifier

No C Battery Required

A unit that can be used as a third stage without howling. The usual objections against a third stage of audio-frequency amplification are entirely eliminated by the use of the new Patented circuit.

The Bristol One Stage Power Amplifier does not require separate "A" or "B" battery. It uses common tubes such as U.V. 201A, 216A and U.T.2.

A remarkable achievement—a third stage audio that works RIGHT—install one today and give that distant station a chance to come in like the locals.

Ask your dealer or send for bulletin 3011-W.

Give your loud speaker a treat.

THE BRISTOL COMPANY

Waterbury, Conn.

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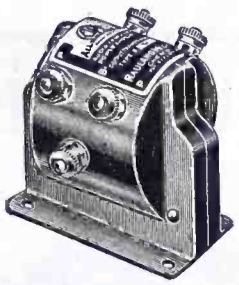
POWER AMPLIFICATION!

—for utmost volume and pure, rich tone

"Push-Pull" power amplification—added to your audio frequency amplifier by means of "All-American" Power Amplifying Transformers—develops in any good loud speaker, the maximum volume with a roundness, richness, depth and purity of tone positively amazing! All-American "Push-pull" transformers lead them all. Send 4c stamps for Power Amplification diagram-circular and book of hook-ups.



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Power Amplifying Transformers (input and output) for "push-pull" circuits. Each $6.

Audio Frequency Transformers in three ratios: $4.50 to $4.75. Pay no more!

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AMPLIFYING TRANSFORMERS

Largest Selling Transformers in the World

For all-around efficiency in actual performance we back our "Hegehog" to the very limit. Put it in comparative tests with any transformer made. Install it in any of the latest hook-ups—Neutrodyne, Autodyne, Superdyne, Miloplex, Autoplex. Judge it for volume, tone quality and consistent performance. Give it every possible test. Then consider its size and price. If you do not find the "Hegehog" unsurpassed in every way, your money will be gladly refunded. We guarantee it unconditionally. There is nothing superior to the "Hegehog" in efficiency and for compactness. Make this test. Send for FREE Bulletin No. 92. Ratios 1 to 3, 1 to 4, 1 to 5—$3.50; 1 to 10—$4.50. **Ask Your Dealer**

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$3.50

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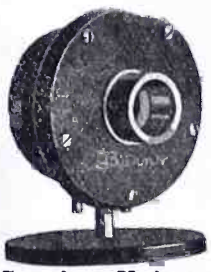
Burns Loud Speaker

for Phonograph or Horn

Excellent volume, pleasing tone. Used with any set having amplification.



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2. Cockaday Four Circuit tuner showing how to add 1 or 2 stages of A. F. amplification. Great selectivity.
3. Armstrong Super Heterodyne using only 7 dry battery tubes. Has but 2 controls. A Rolls Royce set.
4. Improved Ultra Reinartz with 2 stages of A. F. amplification. The best Reinartz.
5. Grimes Inverse Monotrol Duplex with 3 tubes, reflexed inversely on 2. The best Reflex.

Each blue print is informative, naming manufactured parts to buy, giving exact assembly directions, and telling how to wind special coils where fan likes to make everything possible. Price, 50 cents each or all five for $1.75. Send money orders only to:

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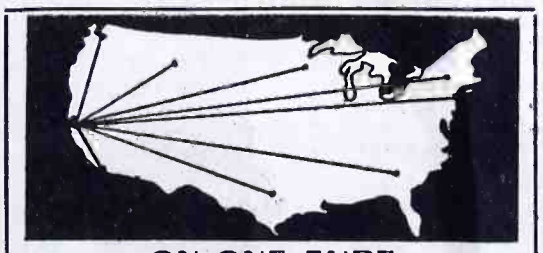
P. O. Box 1062A, Chicago, Ill.



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Broadcasting from Atlantic Coast, Mexico, Hawaii, Canada and Cuba heard in California by users of CROSS COUNTRY CIRCUIT. Range due to simplicity of set and only one tuning control. Easily and cheaply built by any novice. Dry cell tubes may be used. All instructions, blueprint panel layout, assembly photo, etc. Postpaid 25c. Stamps accepted.

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A NEW NAME TO REPLACE---

"Acmedyne"

A complete knock-down set for the present "Acmedyne" circuit will be given FREE to the person sending in the best suggestion.

Write for the rules of the contest.

All suggestions must be in before the closing date — February 15th — to be considered.

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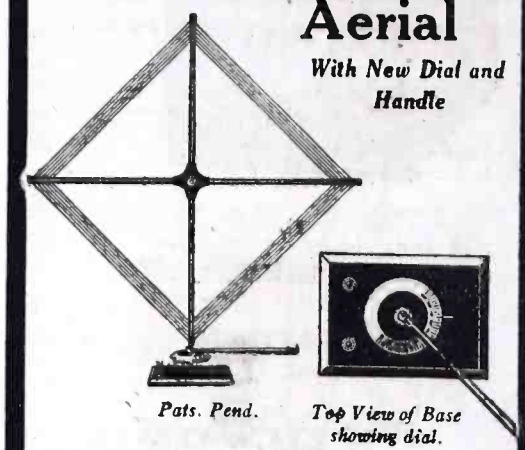
DUO-SPIRAL

The Leading Loop Aerial

With New Dial and Handle



Pats. Pend. *Top View of Base showing dial.*

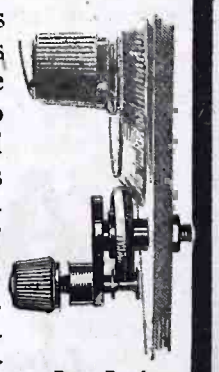
The DUO-SPIRAL Loop spans the continent on a loud speaker with many types of radio-frequency sets. Careful tests by leading manufacturers and radio engineers have proved its superiority. Used exclusively by the largest manufacturers of radio frequency sets. It is trim and neat in appearance and handsomely finished. It rotates freely on its base. Adjustment is made easy by handsome dial and a long handle which eliminates all body capacity effects. The green double silk covered wire is kept always taut by hidden springs. The DUO-SPIRAL loop completely replaces roof antenna and ground and practically eliminates static.

24-inch size $8.50 12-inch size $7.50

(These prices include new dial and handle)

TINY-TURN

A New and Superior Vernier Control



Pats. Pend. Side View showing friction drive against dial.

TINY TURN makes possible an exactness in tuning never before attained. It has a 30 to 1 gear ratio instead of only 4 or 5 to 1 as in the ordinary vernier. No lost motion! The vernier turns in the same direction as dial. It can be instantly disengaged, leaving dial free. INSTALLED ON ANY SET IN 3 MINUTES. Price 75c. Handsome nickel and black finish. Packed in individual containers. We furnish counter display demonstrating boards.

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Coast Distributors for
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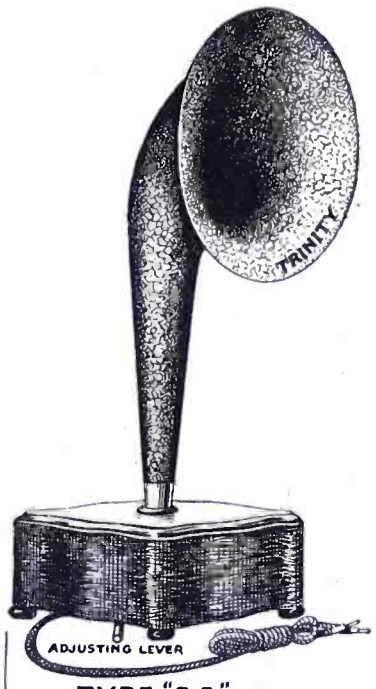
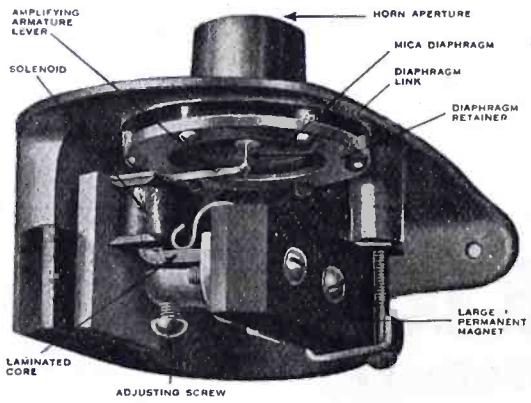
THE TRINITY LOUD SPEAKERS



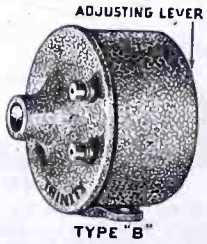
TYPE "C 2"
21" Fiber Horn **$30**



Interior Construction of all Trinity Speakers

AN ear phone is an ear phone no matter how fancy the horn that covers it may be, and, due to the delicate construction of an ear phone, it is utterly incapable of giving true tone reproduction, especially when relatively large currents are passed thru its coils, such as the output of a two-stage or power amplifier.

The Trinity Loud Speaker element embodies the well-proven principles of the phonograph reproducer with the soundest principles of electro-magnetic design best adapted for loud speaker operation. It is not an ear phone when placed on a head band and a loud speaker when covered with a horn. It is a sturdy loud speaking element always. Send for literature.



TYPE "B"
Phonograph Unit **$12.50**

TRINITY RADIO CORPORATION

446 TREMONT ST., BOSTON, MASS.

Continued from page 90

By 9CD, Fred Marco, 5723 Winthrop Ave., Chicago, Ill.

150 to 220 meters:

5za, 6acm, 6adm, 6ahu, 6ajd, 6akz, 6al, 6ani, 6aos, 6auu, 6auy, 6ava, 6awt, 6bbc, 6bcg, 6beh, 6beq, 6bfg, 6bic, 6bih, 6biq, 6blm, 6blw, 6bnc, 6bpm, 6bqb, 6brf, 6bsj, 6bua, 6buh, 6caq, 6cbw, 6cfm, 6cfz, 6cgd, 6cgw, 6chl, 6cie, 6ckp, 6cmr, 6cnc, 6cnf, 6cnh, 6cqe, 6fm, 6fp, 6fy, 6ja, 6li, 6lv, 6mh, 6nb, 6nx, 6pl, 6qj, 6xad, 6zah, 6zar, 6zh, 7abb, 7adh, 7adr, 7arq, 7aea, 7afn, 7ahq, 7aid, 7alk, 7ge, 7ks, 7mp, 7ps, 7qc, 7qd, 7qk, 7qj, 7sc, 7wp, 7yl, 7zo, 7zt.

Can.: 4er, 4fn, 4fv, 4hh, 5cn, 9bx, 9co.

90 to 120 meters:

U. S.: 1ii, 1mo, 1xam, 1xaq, 1xw, 2agb, 9zt. Can.: 1bg, 1bq, 3bp. Foreign: British—2kf, 2sh. French—8ab.

By 9DCJ, 2015 Clinton Ave., Minneapolis, Minn.

1aol, 1bgc, 1cki, 1cmp, 1fm, 1uj, 1jv, 1xam, 1zn, 2bm, 2by, 2bxd, 2cpk, 3at, 3aa, 3atb, 3aaj, 3aln, 3bdo, 3bgg, 3bng, 3bnu, 3co, 8brc, 3iw, 3lg, 8ri, 3xa, 3zl, 3zo, 4ea, 4eq, 4cs, 4ft, 4jk, 5ajj?, 5abt, 5abx, 5aby, 5afq, 5ahd, 5aiu, 5amh, 5dn, 5be, 5ek, 5kc, 5lr, 5ml, 5ph, 5ql, 5qq, 5za, 5zav, 5zb, 5zh, 5zu, 6aja, 6alk, 6bbc, 6bcl, 6blg, 6bih, 6buh, 6cbb, 6cbu, 6cgw, 6fp, 6mh, 7abh, 7co, 7hw, 7io, 7qj, 7sh, 7zu, 8aaj, 8afi, 8ajh, 8ame, 8apn, 8apt, 8azg, 8ave, 8azu, 8bbe, 8bda, 8bci, 8bfa, 8bfm, 8bhn, 8bq, 8brj, 8brk, 8bt, 8bxx, 8caw, 8cdd, 8cdi, 8cko, 8cog, 8coi, 8crw, 8cxu, 8dbl, 8dcy, 8ddt, 8dfa?, 8djf, 8dka, 8dla, 8dlg, 8ef, 8ii, 8kn, 8oe, 8qn, 8rv, 8wy, 8vt, 8xe, 8yn, 9's as thick as the call book.

Can.: 2bt, 3at, 3nf, 3tb, 3zl, 4cl, 4dk, 4fn, 4hh, 9al. Wl qsl ck on sigs to the above upon request. Anyone ever hear mi 5-watter?

By 7SY, 345 Mill St., Eugene, Oregon

2rk, 3ec, 3xm, 4bi, 4io, 5acf, 5amb, 5di, 5gj, 5ht, (5in), 5kc, 5lr, 5px, 5uk, 5xb, (5xd), (5za), 5zb, 5zh, (6zh), 7lr, 8aaf, 8ail, 8aqd, 8azf, 8bk, 8bam, 8bch, 8bef, 8bfm, 8bnh, 8cf, 8cdd, 8cgp, 8er, 8ow, 8st, 8vq, 9an, 9aap, 9abu, 9acq, 9aey, 9aip, 9aly, 9ajh, 9amb, 9ami, 9ape, 9apf, 9ase, 9aua, 9avz, 9awv, (9azg), 9bx, 9bcf, 9bex, 9bjh, (9bji), 9bjv, 9bly, 9brk, 9bri, 9brs, 9bun, 9bvo, 9bvy, 9bxm, 9bxq, 9bzz, 9caa, 9ccs, 9ccv, 9cde, 9cdv, 9cfy, 9ckm, 9cns, 9cpu, 9dfb, 9drk, 9dtm, 9dvj, 9dqu, 9drw, 9dsd, 9et, 9ebb, 9edb, 9eky, 9lq, 9ox, 9pi, 9ss, 9zt, 9zy, wnp. Anyone hearing my C. W. sigs pse qsl crd. All cards answered. Have heard "FR" and "PPDE" qra?

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QUALIFICATIONS NECESSARY:

WE PREFER YOUNG MEN;

MUST HAVE HAD SOME EXPERIENCE ASSEMBLING RADIO SETS, OR HAVE YOUNG MAN AS ASSOCIATE WHO HAS HAD SUCH EXPERIENCE;

MUST BE ABLE TO GIVE REFERENCE.

IF YOU THINK YOU MIGHT WANT THIS PLACE DON'T WAIT, WRITE AT ONCE, SOME ONE ELSE MAY BEAT YOU TO IT.

NATIONAL RADIO SERVICE CO.,
858 PACIFIC BLDG., SAN FRANCISCO, CAL.

RADIO WORLD, THE GREAT NATIONAL WEEKLY—published every seven days with all the latest news, developments and pictures of the radio field. 15c a copy. $6.00 a year (52 numbers), $3.00 six months, $1.50 three months. Special to radio readers. Send $1.00 and we will send you the next eight issues of RADIO WORLD. Pub. Office, 1493 Broadway, New York. (tc)

WE CAN USE MORE SALESMEN.

OUR NEW BUSINESS METHOD IS HELPING NEW RADIO SALESMEN TO MAKE QUICK SALES AND BIG PROFITS. WE FURNISH LIVE LEADS AND ASSIST YOU IN CLOSING SALES. EASY TERMS, LONG TIME TO PAY IS MAKING SALES EVERYWHERE. IF NO MANAGER APPOINTED IN YOUR TERRITORY, SEE OUR "MANAGER ADV." ABOVE.

NATIONAL RADIO SERVICE CO.,
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Vacuum Tube Hospital
We repair and guarantee them,
Agents, Dealers, and Customers Wanted.
George H. Porell Co., Inc.
West Somerville, Mass. (tc)

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NATIONAL RADIO SERVICE ASSOCIATION WANTS RADIO MECHANIC IN EVERY TOWN TO ASSEMBLE A NEW SUPER-RADIO FREQUENCY RECEIVER AND TO GIVE SERVICE ON OTHER KINDS OF SETS. WELL ADVERTISED REGULAR INFORMATION FROM THE ENGINEERING DEPARTMENT IS VERY VALUABLE, BEST OF CHANCES TO GROW UP WITH THE RADIO INDUSTRY. BIG PERCENTAGE PROFIT.

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A good pair of phones free. The new Navy Type $8.00 Atlas adjustable diaphragm head sets will be sent free of charge to anybody sending us five subscriptions to "RADIO" for one year each. Send $12.50 to cover full payment and the phones are yours. "RADIO," San Francisco.

RADIO GENERATORS—500 Volt 100 Watt $28.50 each. Battery Charger $12.50—High Speed Motors. Motor-Generator Sets, all sizes. MOTOR SPECIALTIES Co., Crafton, Penna. (tc)

FOR SALE—Riggs Rectifier $8.00; 2 stage Amplifier Atwater Kent $10.00; 1 Dumore Motor $5.00; 1 Rotary Gap Dumore Motor $7.00; 2 Remler Moulded Variometers $4.00 each; 1 H. C. Mounting (De Forest) $4.00; ½ KW. Packard Transformer $6.00. All the above are in first-class condition. Write for particulars. John A. Kindle, 230 Sam St., Monroe, Wash.

FOR SALE: 1 Rectigon Charger, almost new, $14.00; 2 Westingnouse Storage "B" Batteries $10.00; 1 Tungar, large, $6.50. Beverley Mason, Dunsmuir, Calif.

Wanted: Used Omnigraph in first-class condition. Other Boyce, Casa Grande, Arizona.

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5 TUBE NEUTRODYNE

Complete Fada parts, including instruction book, drilled and engraved panel, Neutroformers, Neutrodons, Sockets, Rheostats, Micadons, Amertrans and all other necessary material, $58.50; 201-A's, 199's, WD-12's, $5.45; Baldwin phones, $8.95.

Everything sent prepaid. Write for our complete price lists. Knowlton Radio Co., 414 W. 118th St., New York City.

Grebe 4-inch Dials, tapered grip, make the best sets look better. S. A. Hendrick, 85 West 181st St., New York City.

FOR SALE: Ten Watt Transmitter, Tungar Rectifier, A and B Batteries, other receiving apparatus. Martyn, 475 30th St., San Francisco.

SAVE MONEY! New Three Terminal Bradleystats, $1.60 prepaid! Edmund Unger, Oxford, Mich.

"RADIO MARVEL" Crystal receiving set—"truly a marvel." A practical, durable, and scientifically constructed instrument, guaranteed to bring stations in clear, natural and distinct, or money refunded. $2.00 postpaid. Radio Marvel Co., 1428 Washington Blvd., Chicago, Ill.

Make your own crystals for fraction of cent each from cheap materials for sale in every town. Supersensitive, immense profits, get in quick. Guaranteed instructions $1. Home Radio Shop, 736 N. St. Francis, Wichita, Kansas.

LIGHTNING STRANGE BATTERY COMPOUND. Charges discharged batteries instantly. Eliminates old method entirely. Gallon free to agents. Lightning Co., St. Paul Minn.

TELEGRAPHY—Morse and Wireless—taught at home in half usual time and at trifling cost. Omnigraph Automatic Transmitter will send, on Sounder or Buzzer, unlimited messages, any speed, just as expert operator would. Adopted by U. S. Government and used by leading Universities, Colleges, Technical and Telegraph Schools throughout U. S. Catalog free. Omnigraph Mfg. Co., 16 J. Hudson St., New York.

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Long distance Broadcasting Stations also come in loud and clear. Most of the parts you already have. Full instructions with Blue Print and Foreign Transmitting schedules, wavelengths, etc. mailed promptly on receipt of sixty cents in coin or money order. C. H. Stoup, Box 6, Valencia, Pa.

A HOWL LIKE A DOG BAYING AT THE MOON or a rattle like a set of false teeth in your radio set is easy to cure. DON'T CUSS. Get the "Trouble Shooter," a new system locating trouble on any type receiver, trouble list, trouble key, test system, remedies, explanations, preventions included. Not a dry treatise stale with age. Something new. You must have it. Send 50c to Radio Information, 909 21st St., Galveston, Texas.

WANTED—Representative in every town to sell RAY-DEE-ARTCRAFT Tuned RF Reflex Transformers. . . ld Tuned Reflex Receivers for your friends with out instructions. Large Profits. Small investment. Write for particulars to RAY-DEE-ART-CRAFT INSTRUMENT CO., Redlands, Calif.

Super Crystal Receiver—With our famous Interlock coil crystal circuit, hundreds are enjoying concerts from stations three hundred to one thousand miles distant. Cheap, simple to make, no tubes. Guaranteed instructions $1.00. Home Radio Shop, 736 N. St. Francis, Wichita, Kansas.

1-0 to 3½ amp. GR hot wire ammeter, $4.00.
0 to 15 AC ammeter $6.00, cost $8.75.
0 to 500 Jewell DC voltmeter $10.00, cost $15.00.
2 Wireless Snop CW condensers $5.00 each, cost $8.00.
Acme modulation transformer $3.00.
3 Murad ER transformers $2.00, cost $6.00 each.
0 to 15 Jewell DC ammeter $5.00, cost $7.75.
Filter $8.00, cost $15.00.
Tungar 5 amp. battery charger $22.00, cost $29.00.
Set honeycomb coils $10.00, cost $35.00.
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6-5 watt tubes slightly used, $4.00 each.
2 Baldwin type C units new $5.00 each, cost $6.50.
2 110 to 1100 and 2200 volt potential transformers, suitable for CW, 400 watts, $10.00 each.
110 volt 3400 RPM ½ HP AC motor $15.00, cost $36.00.

C. C. Brown, Redding, Calif.

VACUUM TUBE SPECIAL

Guaranteed 1½ Volt Tubes Like W. D. 12.....$4.25
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USED RADIO PARTS—We buy and sell standard material only. Send us list of parts that you wish to sell, as well as list of those that you wish to buy. All material sold is absolutely guaranteed. KEY BROS, Charleston, Wash.

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Old, established, reliable Company, with ample Warehouse and Store facilities, high-class Experienced Employees and Salesmen. Now handling Electrical and Auto-Motive Equipment; desires to act as Agent for Disbursement or Distribution of complete Radio Equipment for Kansas, Western Missouri and such other surrounding territory as required. Representing only one first-class line of goods. Can furnish agents, if desired, on salary or commission covering City and Country Districts. Investigation Solicited.

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YOU CAN GET A NEEDLE OPERATING FONOGRAPH ATTACHMENT FOR EIGHT DOLLARS. AND BOY, THEY SURE WORK. GET THE BENEFIT OF THAT EXPENSIVE FONOGRAPH AND SAVE ON A LOUD TALKER. NO FOOLING AND NO CONDITIONS. IF IT DON'T SUIT SEND IT BACK AND GET YOUR MONEY BACK. SENT C. O. D. FOR ONE DOLLAR WITH ORDER.

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FOURTH AVE., TUCSON, ARIZONA

TUBES AND OTHER SPECIALTIES

UV201-A, UV199, WD11, WD12, C301-A, C299, C11, C12	$ 5.50
Coast to Coast 1 tube receiver	10.00
With tube	14.00
Two-stage Amplifier for above	17.50
With tubes	25.00
Wave trap	6.00
Loud Speakers	5.00
Freed Eisemann Neutrodyne 5 tube receiver	125.00
Bradleystats	1.60
Radiola "RC" and "V" complete	125.00

Join our mailing list. Dealers wanted.

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RADIO CALL CARDS printed TO ORDER. Red call, black printing. 100, $1.75; 200, $2.75, prepaid. Color changes 35c extra. Government postals 1c extra each card. LETTERHEADS 8½X5½ AND ENVELOPES, 100 each $2.25; 200 each $3.25. ARRL emblem used on cards or stationery if requested. Send TODAY. Department 52C. Radio Printers, Mendota, Illinois.

Transmitter, panel mounted, commercial set, 10 watt, with Kenetron tubes, compact and transportable, for voice, C. W. or I. C. W. An A-1 set in perfect working condition. Used very little. Also two first class Receiving Sets. All bargains. Clayton R. Gerst, 2974 West 25th St., Cleveland, Ohio.

RADIO FANS—Send for samples of our Broadcasting post cards. Pocket edition of Broadcasting Stations 15c. Stamp for catalog which tells how to make your own "B" storage battery and charger. Pacific Screw Company, Dept. W., 645 N. E. 53rd St. Portland, Ore.

Use Graphite Disc Rheostat
Says prominent radio expert

RADIO FACTS FOR EVERYBODY;
NEWS AND THEORY OF WIRELESS

While Nearly All Standard Tubes Will Give Good Results, Low Vacuum Type Is Best, Says Calcaterra.

LOW VACUUM TUBE IS BEST.

All Standard Tubes, However, Will Give Good Results.

BY JOSEPH CALCATERRA.

(Radio engineer.)

Another important consideration in getting maximum efficiency from a single tube is choice of the tube to use. While practically all the standard tubes now on the market will give good results, there is one tube which gives best results. That tube is the soft or low vacuum tube especially designed for detector use. UV-200 and C-300 tubes are of this type.

In tool making and high class instrument making best results are obtained only when the best tools and most painstaking methods are used. So also in radio receiving, exceptional results are obtained only when corresponding care is taken. The hard or high vacuum amplifier tubes can be used as detectors and their characteristics are such that a critical adjustment of grid, filament and plate currents are not required. With the soft tubes, however, best results are obtained only when

Use Vernier Rheostat.

For adjustment of filament temperature, to obtain the best operating point of the tube, a Vernier rheostat, preferably of the carbon pile resistance type, should be used. Care must be exer-

tions are firmly made and the grid re-
turn from the secondary circuit to the
filament should be made to the posi-
tive lead of the "A" battery.
The rheostat should be placed in the
negative lead of the "A" battery, that
is between the negative of the "A" bat-
tery and one of the filament terminals
of the socket.

While a considerable change in the plate voltage applied in the plate circuit of a hard or amplifier tube when used as a detector will make very little difference in the operation of the tube, the soft detector tube is very responsive to slight changes in the plate voltage. The characteristics of different tubes of the same type vary to some extent, so that a fine variable adjustment must be provided to take care of the individual requirements of the tube used.

Can Vary Adjustment.

Usually the best point will vary from 18 volts to 22½ volts. The adjustment can be varied to a certain extent by trying the lead from the plate circuit to the positive end of the battery on the different taps provided on practically all "B" batteries. In most cases, however, a finer adjustment than the 1½ volt steps provided by the taps is required and this can be obtained by the use of a potentiometer.

One end (either end, may be used) of the resistance element of the potentiometer is connected with the positive end of the "A" battery and the other end of the resistance element is connected with the negative lead of the "A" battery.

The negative of the [illegible] connected direct with the filament circuit, as is done in most cases, is connected with the movable arm or contact of the potentiometer. The big variations in the plate voltage are obtained by moving the positive "B" battery lead to different taps of

Clipping from Chicago Daily News October 24, 1923

Good for ALL tubes

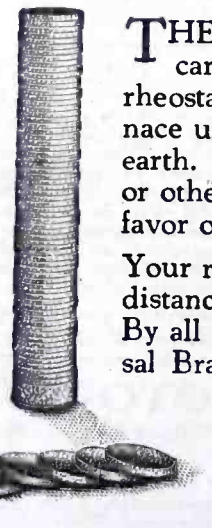
Retail Price $1.85

IN CANADA $2.50
POSTAGE 10¢ EXTRA

What Is Meant by a "Carbon Pile" Rheostat?

MORE than 20 years ago, the Allen-Bradley Co. developed a successful compression rheostat for big power circuits. It was made of flat carbon discs and the electric current flowing through the column was regulated by applying or removing pressure on the discs. The idea of the carbon pile was not new, even then, but successful commercial rheostats were unknown.

Graphite discs, however, soon replaced the carbon discs and to this day all Allen-Bradley rheostats are *graphite disc* rheostats, although many prominent engineers still speak of them as carbon piles.



THE Universal Bradleystat is sometimes called a carbon-pile rheostat. It is, however, a *graphite disc* rheostat. The discs are produced in an electric furnace under the most terrific temperatures known on earth. Carbon discs, carbon powder, metallic powder or other materials have long since been abandoned in favor of the reliable and noiseless *graphite discs.*

Your radio set needs a Universal Bradleystat for long-distance range, loud reception and noiseless control. By all means, avoid substitutes. Insist on the Universal Bradleystat.

The *Bradleystat* Won First Place

in the Radio Broadcast long distance contest. The first prize winner used a Bradleystat and the greatest mileage record was made with a Bradleystat.

More Bradleystats were used in this contest than the next four types combined. Bradleystat supremacy has become an actual fact through sheer force of superior performance.

Allen-Bradley Co.
Electric Controlling Apparatus
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Just Mail This Coupon!

Allen-Bradley Co.,
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Please send me your latest bulletin on the Universal Bradleystat and why it improves radio reception.

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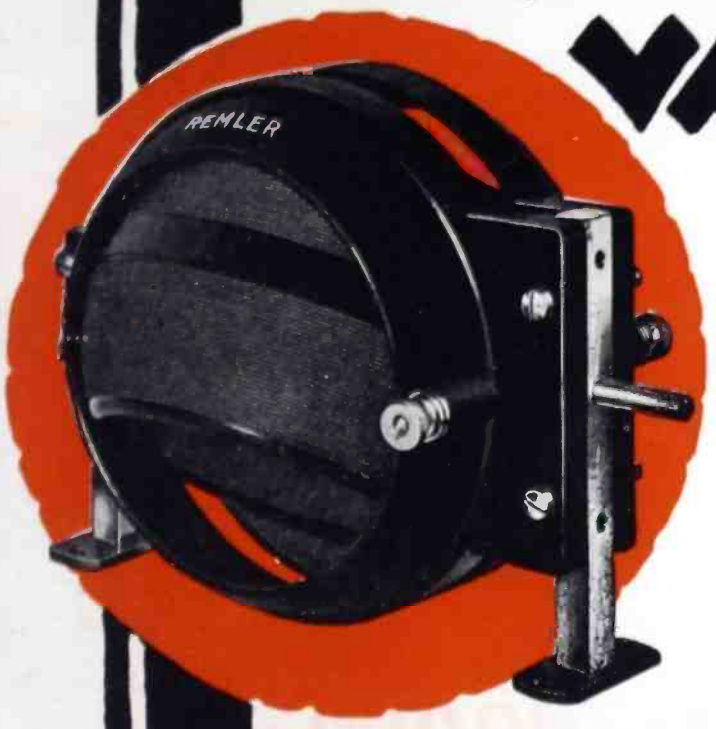

TYPE 500

WITH CLOSED ROTOR

$7.50

Low Minimum and High Maximum wave length —covering the entire amateur and broadcast range—180 to at least 570 meters—the greatest ever obtained in a variometer.

QUALITY

—the best ever built into a Radio item

THE new style Remler Variometer has many advantages over all previous designs. Greater wave length, a lower high frequency resistance and pigtail connections are a few of the outstanding features. The front shaft is entirely insulated from the windings and can be grounded to prevent body capacity effects. The rotor connections are made thru concealed pigtail leads insuring quiet operation.

The perfect contact and quiet operation obtained by reason of the pigtail connection between stator and rotor is a big feature in itself, but the low minimum and high maximum wave length—*the greatest ever obtained in a Variometer* is a Remler accomplishment. The wave length variation is exactly proportional to the reading of the dial scale. It will cover the entire range of amateur and broadcast wave lengths when used with any vario-coupler.

All metal parts are buffed and nickeled; green silk wire is used on both stator and rotor. The general appearance and quality of the bakelite molding is the best ever built into a radio item.

Remler Radio Mfg. Co.,
182 Second St.,
San Francisco, Calif.

Gentlemen:

As my dealer is unable to supply me with your new Remler Variometer I wish to place my order direct with you and am enclosing certified check or money order for $7.50.

It is understood that if after a 10 day free trial I find that this Variometer does not conform to your statements, my money will be refunded upon return of the instrument to you in the condition it was received.

Name.....

Address.....

If your dealer cannot supply you, send the attached coupon direct to us with certified check or postal money order. Write for complete descriptive circular.

Remler Radio Mfg. Co.

Home Office

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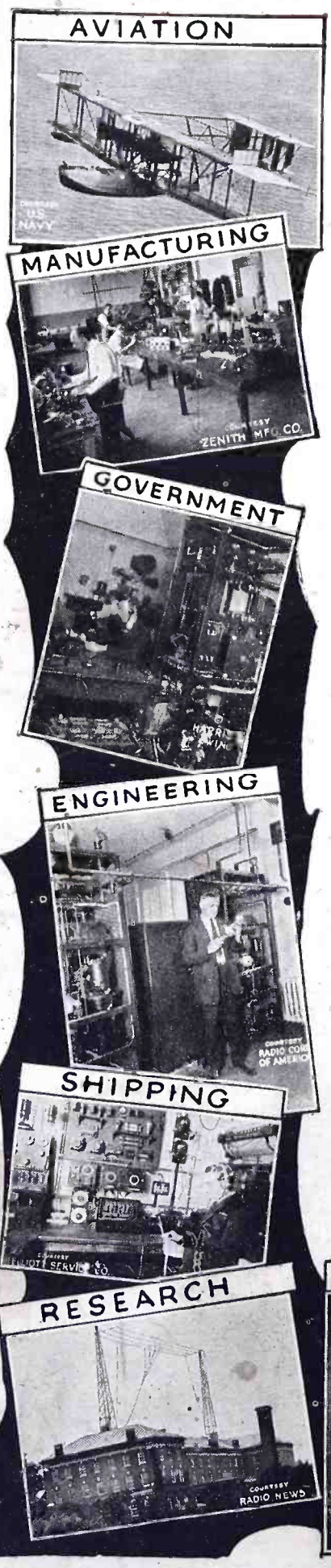
National Radio Institute Graduates Are "Cashing In" On These Wonderful Opportunities!



Austin Riu, one of our graduates, is now an operator of broadcasting station PWX of Havana, Cuba, and earns $250 a month. Merle Wetzel, of Chicago Heights, Ill., another graduate, advanced from lineman to Radio Engineer, increasing his salary about 100% *even while taking his training!* Emmett Welch of Peculiar, Mo., right after graduating started in Radio, earning $300 a month and expenses.

Every day some new use for Radio is being discovered. Every day new opportunities for earning big money are being created in this new, romantic field. Never in the history of industry has any field offered such astounding opportunities for live wires. *Hundreds, earning small salaries now, will soon make fortunes in Radio!*

More Money for YOU in Radio

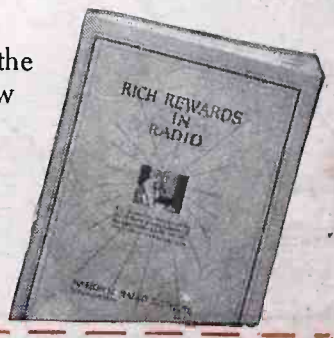
Are you "cashing in" on your Radio Knowledge? If you're not, you are passing up the best bet that has ever come your way. It's entirely up to you. There's nothing impossible in Radio for the man who has the ambition to try. In a few months at home you can easily become a *recognized radio expert*, and to these radio specialists, Radio offers remarkable salaries, easy, fascinating work, short hours—and a wonderful future!

Earn $2400 to $10,000 a Year

You can earn bigger pay than you probably ever dreamed possible. Only don't let yourself stay in a rut. Sit up—look up—make up your mind that if others can make big money and big successes in Radio, so can you. The National Radio Institute has a sound, practical radio course that defies comparison. It has a record of successful graduates that is unquestionable evidence of its ability to qualify you quickly for a big money position in Radio.

This Free Book Points the Way To Your Success

Our Free Book, "Rich Rewards in Radio", tells all about the amazing opportunities Radio offers *you*, and describes how you can become a recognized radio expert at home in an astonishingly short time. Now — while your ambition is warm — mail the coupon for this big-money Free Book!



National Radio Institute, Dept. 10BA, Washington, D. C.

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Washington, D. C.

Without obligation send me your book, "Rich Rewards in Radio", which tells all about the opportunities in Radio, how spare time study at home will qualify me quickly as a Certified Radiotrician so I can get one of these splendid positions, and how your Employment Service helps me to secure a big pay job.

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